

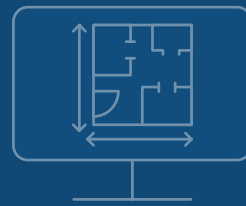
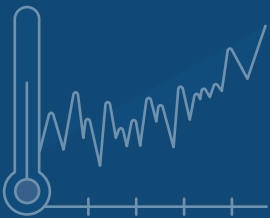


Innovation Network
for Communities

ESSENTIAL CAPACITIES

FOR URBAN CLIMATE ADAPTATION

A Framework for Cities



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Foreword

As a philanthropic investor in the amazing potential of North American communities, the Summit Foundation sees climate change not as an existential threat, but as an opportunity to detour from a path of dark outcomes to a future in which communities become places where all people thrive and nature flourishes.

Many cities have already seized this opportunity by acting boldly, learning and exchanging with each other, aligning to influence public policies and markets, and developing and implementing new solutions to our most persistent challenges. We have worked closely with other city-oriented and climate-change funders to support and promote visionary urban leaders, arm them with frameworks and metrics, inspirational models and policies, and link them in effective networks.

How can more and more cities adapt more quickly and more effectively? This report by the Innovation Network for Communities provides a framework—detailing the seven capacities that are pillars for effective urban climate adaptation—that can inform future collaborations within cities, among cities, and between cities and philanthropic funders. Correctly coordinated, city climate adaptation and mitigation efforts can reinforce each other and contribute to building the communities we want. In this report we hope you will see how your work can support a greater effort to collectively forge a positive path forward.

Darryl Young
Director, Sustainable Cities
Summit Foundation



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INTRODUCTION

Purpose of the Framework

This report presents a framework for urban climate adaptation that identifies seven essential capacities that cities need to develop so they can effectively implement climate adaptation actions in the short- and long-term. This framework is based on an extensive review of current adaptation practice and is different from most available frameworks, which focus primarily on processes for adaptation planning and specific actions to take depending on which climate hazards a city faces. Identifying the new, enduring capacities that cities need builds on the current knowledge of urban adaptation.

SEVEN ESSENTIAL CAPACITIES FOR URBAN ADAPTATION

- 

1 SCIENTIFIC FOUNDATION
Capacity to assess and understand climate risks and vulnerabilities of city's built, natural, and economic assets and its populations, and use these analyses for ongoing adaptation planning
- 

2 COMMUNICATIONS
Capacity to communicate with and educate civic leaders and community members in ways that build and sustain a sense of urgency to adapt for climate changes
- 

3 EQUITABLE ADAPTATION
Capacity to make social and economic equity a central driver of the city's adaptation approach
- 

4 INCLUSIVE COMMUNITY ENGAGEMENT
Capacity to fully engage stakeholders and the public, especially vulnerable and underrepresented populations, in developing, implementing, and monitoring adaptation plans
- 

5 INTERGOVERNMENTAL ALIGNMENT
Capacity to coordinate planning and action across governments at local, regional, state, tribal, and federal levels
- 

6 TECHNICAL DESIGN
Capacity to design, test, and implement adaptation actions that require engineering, legal, and other highly specialized details, as well as performance metrics for monitoring
- 

7 FINANCIAL RESOURCES
Capacity to repurpose, leverage, and obtain public and private funds to invest in infrastructure development and other adaptation actions

This report focuses on climate adaptation—the preventive actions a city seeks to take in anticipation of climate hazards, which may also be called climate preparedness or climate resilience. Climate adaptation does not include the emergency response to actual climate hazard events or the after-event process of recovery. These are important for cities, but are not subjects of this report.

Our purpose is to present cities with a useful framework, based on their practical experiences, for understanding how to grow and prosper in the face of increasing climate disruptions. In support of this information, we provide examples from cities that have been developing versions of the essential capacities, an overview of prevailing adaptation planning frameworks, and links to useful tools and reports.

Project Research Base

The project undertook four research activities in 2016:

- ▶ **Interviews.** In-depth interviews with 35 city practitioners, climate-adaptation experts, city-supporting and conservation NGOs, and funders of urban adaptation work. For a list of the interviewees, see Appendix A.
- ▶ **Review of City Adaptation Plans.** Examination of 24 U.S. cities' adaptation plans and 6 international cities' plans. For a list of these cities, see Appendix B.
- ▶ **Literature Review.** Review of guidance and tools for and recent studies and articles about urban adaptation planning in the U.S. This included several papers reporting research on dozens of U.S. cities' adaptation plans.
- ▶ **Feedback.** Selected city practitioners, researchers, and philanthropic funders provided feedback on our draft materials. This included a webinar presentation with about 30 members of the Urban Sustainability Directors Network and a conference presentation with about 25 members of The Funders Network for Smart Growth and Livable Communities.

Acknowledgements

The project team consisted of Peter Plastrik, vice president of the [Innovation Network for Communities](#) and principal author of “[Framework for Long-Term Deep Carbon Reduction Planning](#)” produced by the Carbon Neutral Cities Alliance; Jill Simmons, then-principal of Evergreen Strategic and former director of City of Seattle Office of Sustainability & Environment, 2010-2015, who became executive director of the Washington Trails Association in February 2017; and John Cleveland, president of Innovation Network for Communities and executive director of the Boston Green Ribbon Commission.

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- ▶ **Garrett Fitzgerald**, Strategic Partnerships Advisor, Urban Sustainability Directors Network
- ▶ **Tracy Morgenstern**, Climate Protection Program Manager, Seattle Office of Sustainability and Environment
- ▶ **Susanna Sutherland**, Sutherland and Associates, who analyzed 20 city adaptation plans for the project
- ▶ **Jason Vogel**, Managing Analyst for Environmental Research at Abt Associates, who provided the project with access to Abt’s draft case studies and database of communities
- ▶ **Missy Stults**, Climate Adaptation Specialist, who provided us with the research database used for a 2016 paper about city adaptation that she coauthored with Sierra Woodruff

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**THE URBAN
CLIMATE
ADAPTATION
CHALLENGE**

Climate Change and City Vulnerability

Climate changes are already occurring and impacting U.S. cities. More and more cities have experienced extreme weather, rising seas, and other effects that are attributed to climate change.

- ▶ Cities along the Atlantic Ocean and Gulf Coasts are experiencing “sunny-day flooding,” tidal surges that swamp basements, block traffic, damage cars, kill lawns and forests, and block stormwater drainage. High tide flooding in **MIAMI BEACH** has increased 400 percent since 2006,¹ and in September 2015 a king tide raised sea levels 2.2 feet, the highest non-storm water level ever recorded there.²
- ▶ “Over the last 50 years, much of the U.S. has seen increases in prolonged periods of excessively high temperatures, heavy downpours, and in some regions, severe floods and droughts.” –National Climate Assessment

▶ News Headlines from 2016

- *Wildfires Char 80,000 Acres in South, and Some Could Burn for Weeks*³
- *Dust storm smothers Phoenix*⁴
- *Houston Submerged by Two Feet of Rain Overnight*⁵
- *Thousands Displaced in Storm-Drenched Louisiana*⁶
- *Hazier days in the high country due to drought and forest fires, scientists find*⁷
- *How California went from drought to dangerous rain and snow*⁸
- *California forests fail to regrow after intense wildfires*⁹
- *Alaskan indigenous people see culture slipping away as sea ice vanishes*¹⁰

More U.S. cities have experienced or witnessed urban system failures—stormwater management, electricity supply, telecommunications, transportation, and emergency response systems—due to extreme weather events and have seen how the impacts of climate change cascade across interdependent sectors (e.g., the energy, water, and food sectors).

Cities increasingly recognize that exposure and sensitivity to climate hazards differ considerably *within a city*, with vulnerable populations and neighborhoods especially at risk, including children, the elderly, low-income, disabled, or ill.

Some cities face greater climate risks than others, of course, and some may need to take more difficult adaptation actions than others (e.g., relocation of populations or built infrastructure; prohibition on development in certain places). But no city is likely to escape some climate impacts, if only due to future climate migrations of people from other places.

Climate changes are predicted to become much more disruptive, depending on the future degree of global warming due to GHG emissions in the atmosphere. Some forecasts include:

- ▶ Sea level rise of as much as 10 feet by 2100 is expected for some coastal regions.
- ▶ The number of tidal floods in Southeast Florida, now about 10 per year now, is likely to be around 240 floods per year by 2045.¹¹

- ▶ The Northeast is warming more rapidly than any other part of the country except Alaska — and the temperature in the region is expected to rise 3.6 degrees Fahrenheit two decades before the rest of the world gets to that point.¹²
- ▶ “Average temperatures in Oregon are expected to rise by 3 to 7 degrees Fahrenheit by 2050 and 5 to 11 degrees by 2080,” according to a 2017 report. “If [GHG] emissions level off by mid-century the warming will be less drastic, but would still be in the range of 2 to 7 degrees on average.”¹³

How Adaptation Planning Is Different

For cities, climate adaptation planning is a crucial challenge that cannot be addressed through city-planning-as-usual. Cities face a number of new problems in developing adaptation plans, including:

- ▶ **Uncertainty.** Climate changes and potential impacts are more probable than certain, depending on many factors outside of a city’s control, and will unfold over decades. A good example is sea level rise (SLR): how much of it will there be and when it will occur? “Adaptation planning is challenging for many reasons,” explains Jessica Grannis of the Georgetown Climate Center. “Climate science is technical and complex; global climate models consider a multitude of variables to project future scenarios. The projected rate of SLR varies under each scenario; and the rate and degree of SLR will depend on the rate of future greenhouse gas emissions, the rate of increases in temperature, and ice sheet melt, among other things. Additionally, some areas of the coast will be much more vulnerable to SLR impacts than others. Some areas of the coast are particularly low-lying or have highly erosive beaches. SLR will vary based upon local conditions—groundwater withdrawal, extraction of oil and gas, and other geologic factors are causing land to subside in certain regions. As a result, scientists are uncertain about the extent of SLR and the time period over which it will occur, especially at local and regional levels.”¹⁴
 - **BOSTON’s** climate assessment found that “a major reduction in global greenhouse gas emissions can have a tremendous impact on the future of Boston Harbor. While sea level rise projections for 2030 are about the same across all emission scenarios, in later years there are big differences between scenarios. With a sharp reduction in global emissions, end-of-century sea level rise could stay under two feet, but a continuation of business as usual may result in over seven feet of sea level rise.”¹⁵
- ▶ **Extended Time Horizon.** Climate change projections and impacts, such as sea level rise, play out over many decades—a time frame that is beyond the typical planning horizons of cities, except for major infrastructure projects; that is far beyond the electoral cycle for local officials, meaning successive administrations and political leaders will have to support plans; and that, because of its duration, tends to undermine a sense of urgency in the community.
- ▶ **Widespread Risk.** Climate impacts can threaten the full range of a city’s built, natural, economic, and social systems, with cascading effects across the systems. These are enormous and complex systems. Cities have little experience in planning for them in an integrated way. And the potential economic cost of various climate risks and adaptation actions can

be staggering. For instance, a 2015 study estimated that, under current climate change projections, \$69 billion of existing Florida coastal property will be below mean high tide by 2030, rising to \$152 billion by 2050.¹⁶ Some adaptation actions, such as building barriers to rising seas, can cost billions of dollars, while relocating housing and infrastructure out of high-risk areas can cost hundreds of millions of dollars.

- ▶ **Socio-Economic Inequities.** Climate impacts have significant potential to exacerbate a city's social and economic inequities. A city's most vulnerable populations may be hardest hit and a city's adaptation actions may aggravate economic inequities. Nearly every city has low-income neighborhoods facing climate risks. **WASHINGTON D.C.**'s analysis of community vulnerabilities concluded they were "not evenly distributed across the District. Wards 7 and 8 are most vulnerable given high levels of unemployment, poverty, obesity, and asthma, as well as a large elderly population." Ward 7 "is home to the largest number of vulnerable community resources, including schools, medical services, and public housing located along the flood-prone Watts Branch."¹⁷ In **MIAMI-DADE**, Shorecrest, a mostly Latino community on the city's west side, faces "freshwater flooding and the possible loss of their drinking supply, a risk that only gets worse with every inch of sea-level rise," according to a 2016 CityLab article.¹⁸
- ▶ **Beyond City Boundaries.** Adaptation strategies and actions often need to occur at a metropolitan regional scale and/or at ecosystem/landscape scale (watersheds, coastlines), not just within a city's jurisdiction. "Cities are not the only actors with authority for making investments in their jurisdictions," explains Steve Adams, Director of Urban Resilience for the Institute for Sustainable Communities. "You have to figure out how to align federal, state, regional, and local action." An example of how complex jurisdictions can get comes from **NEW YORK CITY**, where the Jamaica Bay watershed is home to 2.5 million residents and is a heavily visited recreational area. In addition to five city departments, a list of the public agencies with management responsibility for the watershed includes six federal agencies, four state agencies, two regional entities, an interstate commission, two boroughs of the city, a town, and a county.¹⁹ In other cities, tribal governments could be added to the list of entities with authority relevant to adaptation planning.

Climate impacts have significant potential to exacerbate a city's social and economic inequities.

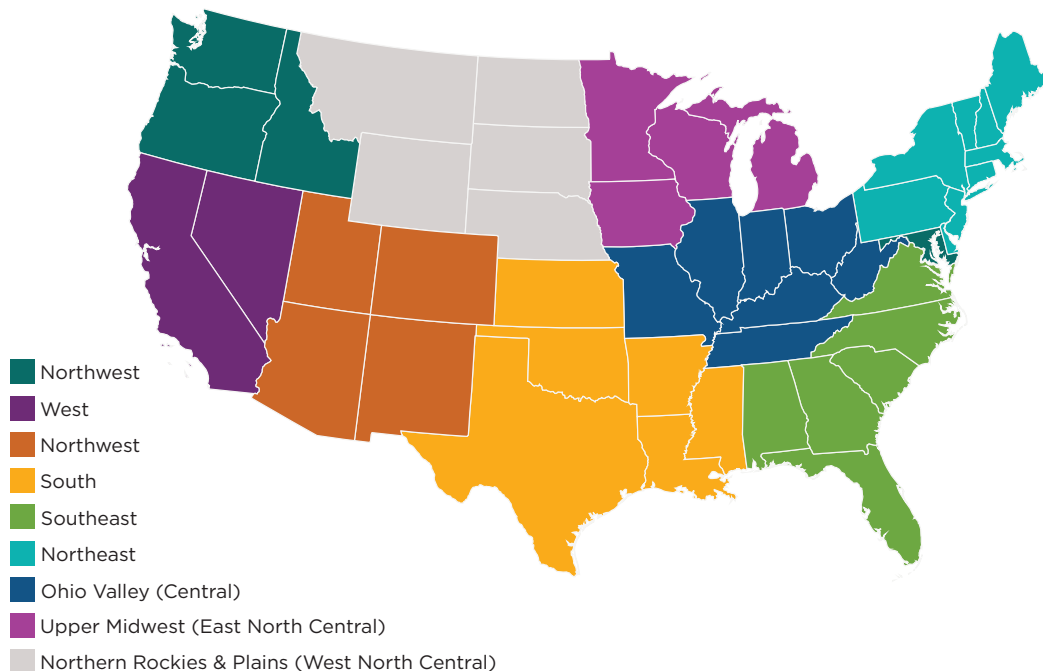
The First Wave of City Climate Adaptation

A first wave of as many as 75 U.S. cities has undertaken adaptation planning in the past decade, and a second wave of cities is starting to plan.²⁰ The first wave contained a diversity of cities—large and small cities, in each of nine climate regions in the U.S.²¹ Coastal cities driven by concerns about sea-level rise—most prominently along the eastern seaboard, Gulf Coast, and San Francisco Bay—have been especially active in adaptation planning.²²

However, most of the more than 1,000 cities in the U.S. with populations above 25,000, including 300 cities with more than 100,000 people, are not yet doing significant climate adaptation. While communities are increasingly interested in “what effective adaptation might be and how to achieve it”—notes a 2016 report by Arnott, Moser, and Goodrich—“many are only beginning to grapple with the topic.”²³ Of the first 44 cities to achieve a certification from the STAR Community Rating system by 2016, which assesses a community’s progress toward sustainability, only about a third had created adaptation plans.²⁴

A second wave of cities is starting adaptation planning. In an Urban Sustainability Directors Network survey in April 2016, about 50 member cities and urban counties in North America reported they were starting vulnerability assessments and adaptation planning.

U.S. CLIMATE REGIONS



An Emerging Infrastructure

An emerging infrastructure of information, expertise, and organizations for urban adaptation is providing a growing amount of support for city adaptation.

- ▶ **Technical Expertise.** An infrastructure of technical expertise has been developing slowly in government agencies, nonprofit organizations, universities, and the business sector, especially in engineering consulting firms.
- ▶ **Experience.** A small but growing number of people in local governments, NGOs, and consulting firms have hands-on experience with climate adaptation.
- ▶ **Organizations and Networks with Assets Useful for Cities.** A number of new organizations—the American Society of Adaptation Professionals; the Georgetown Climate Center, which curates the Climate Adaptation Clearinghouse; Ceres; 100 Resilient Cities; the University of Notre Dame’s Global Adaptation Initiative, and many others—are a growing presence in the field. Three years ago, a study by Meister Consulting Group identified 135 organizations providing five types of climate adaptation/resilience products and services: research, case studies, training/education, technical assistance and consulting, and project implementation support. Nearly half of these organizations were involved in planning and implementation activities.²⁵ Moreover, a 2013 report that reviewed the climate adaptation-relevant resources provided by 89 organizations found more than 3,400 unique resources, most of them focused on planning or assessing vulnerability.²⁶
 - February 2017 saw the launch of Zilient.org, an online publishing and knowledge-sharing platform designed for resilience practitioners.
 - In January 2017, [Resilience Dialogues](#), a public-private collaboration to help local communities address climate-related vulnerabilities through online access to scientists, practitioners, and community leaders, announced 10 communities will participate in its beta phase.
 - Networks with relevance to city adaptation are also spreading. For example, the [Green Cities Clean Water Exchange](#) focuses on research, innovation, and implementation of green stormwater infrastructure in North America, which touches on a number of critical climate adaptation issues. In 2016 [WASHINGTON D.C.](#) joined [NEW ORLEANS](#) and [NEW YORK CITY](#) as U.S. members of [Connecting Delta Cities](#), a self-described network of the “world’s front runners, sharing knowledge and experience . . . connected by a common goal: a climateproof, resilient future for their residents and businesses.”²⁷
- ▶ **State Governments.** A total of 15 states (11 of them with sea coasts) have completed adaptation planning, according to the Center for Climate and Energy Solutions, and five more states have planning underway. In seven other states, climate action plans included adaptation plans.²⁸ California supports regional collaborations of cities around adaptation, and its climate legislation (AB 535) specifically targets a higher proportion of climate benefits to disadvantaged communities.

► **Federal Government.** The federal government has taken on several relevant roles: technical assistance on climate science projections; providing grants to assess the vulnerability of infrastructure, such as highways and public transportation systems; and responsibility for the resilience of federal assets. The latter includes military bases and federal buildings scattered throughout cities around the country and heavily present in some cities (e.g., Washington, D.C., San Diego, Norfolk).

- The Federal Emergency Management Agency (FEMA), which plays an important role in natural disaster recovery, affects urban adaptation in several ways. It requires that U.S. communities and states develop hazard mitigation plans if they want to be eligible for FEMA funding, and more than 22,000 communities have complied. Recently, FEMA required state government hazard mitigation plans to consider potential climate changes. It has not extended this requirement to local government plans (although it is encouraged), but California has. In addition, FEMA produces flood hazard maps for cities that identify high-risk areas in which homes and buildings may be required to have flood insurance.
- In 2016, the U.S. Department of Housing and Urban Development’s National Disaster Resilience Competition, in partnership with the Rockefeller Foundation, hosted nine Resilience Academies for communities around the U.S., and then issued \$1 billion in grants to eight states, **NEW ORLEANS, NEW YORK CITY, MINOT** (North Dakota), **SPRINGFIELD** (Massachusetts), and **SHELBY COUNTY** (Tennessee) for housing and infrastructure projects focused mainly on coastal and watershed resilience.²⁹
- A 2013 report by Ceres documented rising taxpayer costs of federal programs that provide flood insurance, crop insurance, wildfire protection, and disaster relief. “Taxpayer costs from climate change are getting bigger and bigger. Last year’s extreme weather events alone cost every American more than \$300 apiece, or \$100 billion altogether—most of it to pay for federal crop, flood, wildfire and disaster relief,” said Ceres president Mindy Lubber. “Yet, our public disaster relief and recovery programs have been slow to recognize that worsening climate impacts will drive up future losses to unsustainable levels. Instead of encouraging behavior that reduces risks from extreme weather events, these programs are encouraging behavior that increases these risks.”³⁰

► **Insurance Industry.** In private insurance markets, more property & casualty, life & annuity, and health insurers are doing more to take climate risks into account, a 2016 Ceres study found, but “most are still giving it minimal attention.”

► **Municipal Bond Market.** Change has been slow to come to the municipal bond market. Washington, D.C. did pioneer an “environmental impact bond” for \$25 million of green infrastructure, with a provision that varies payments to investors based on how effective the installation proves to be. Ceres has been pushing for bond investors to require climate risk assessment and disclosure by water systems seeking capital.

A handful of national-scale philanthropic funders and a number of local/regional funders have been active investors in urban adaptation.

- ▶ **Urban “Anchor Institutions.”** In some cities, anchor institutions such as hospitals and universities, which have immobile assets at risk from climate change and may be essential to a city’s adaptation, have recognized the importance of developing their own adaptation approach and are collaborating with cities. For instance, the nonprofit organization Health Care Without Harm (HCWH), with hospitals and health partners throughout the U.S., is part of a consortium of health-care organizations that educates medical professionals and the public about climate-related health issues. HCWH notes that “clinicians will be on the front lines of all climate-related health impacts, whether those result from catastrophic disasters such as floods, heat waves or other temperature extremes, or indirect effects like increases in emergency room visits over time due to decreasing air quality.”³¹
- ▶ **Legal Liability.** The **BOSTON** Green Ribbon Commission is partnering with the Conservation Law Foundation to examine how public officials and private sector professionals could be held legally liable for failure to adapt to climate change, specifically “whether successful claims lie with those private and public actors who are turning a blind eye to the accumulating risks of climate change when they are designing, authorizing, and constructing new infrastructure.”³²

The Role of Philanthropic Investment

A handful of national-scale philanthropic funders and a number of local/regional funders have been active investors in urban adaptation. These investments have spanned a number of different concerns and strategies. National funders tend to support development of infrastructure, such as information and organizations, while local/regional funders mostly support adaptation planning processes in chosen cities and urban regions. Funders have taken a variety of approaches to urban adaptation grantmaking, including:

- ▶ Focusing on a particular strategy for climate adaptation, such as the use of green infrastructure.
- ▶ Attending to issues embedded in climate adaptation, such as the potential to exacerbate or, conversely, to alleviate social inequities through adaptation actions.
- ▶ Investing in a particular aspect of a city’s planning process, such as communicating climate science to the public or designing a set of adaptation actions.
- ▶ Investing in climate adaptation as part of a city approach to broader resilience building.
- ▶ Investing in specific capacities that a city needs for adaptation.

In addition, some funders have invested in assessments of urban adaptation practice—case studies, frameworks, and evaluations. For instance, “[Climate Adaptation: The State of Practice in U.S. Communities](#),” by Abt Associates, released in 2016, provides case studies from 17 communities. The Georgetown Climate Center produced [100 case studies](#) in 2015 focused on communities adapting transportation systems to climate risks.

The background is a solid teal color. It features several large, semi-transparent, overlapping geometric shapes in a slightly darker shade of teal. These shapes include a large circle at the bottom, a large square at the top left, and various angular, polygonal shapes that create a layered, architectural feel.

THE ADAPTATION PLANNING MODEL

A Basic Planning Process

Cities come to adaptation planning from different starting points. A climate disaster may trigger planning. Elected officials may anticipate problems and start planning. Community members may demand action and the city begins planning. But the planning process does not always follow a linear path from start to finish. For instance, in **MIAMI BEACH**, which was suffering from flooding due to sea level rise, newly elected officials first took action, implementing stormwater

projects to reduce the flooding, before beginning a more comprehensive vulnerability assessment of climate impacts and city assets.

Vulnerability is a combination of the exposure, sensitivity, and adaptive capacity of the city’s assets, populations, and neighborhoods.

As adaptation-planning efforts spread to more cities, much has already been learned about how to do this work. The basic planning process is understood as a sequence of stages, a cycle, that is like most planning processes but applied to the climate change problem. Cities tend to use a similar process model for adaptation planning, which usually proceeds through these stages:

1. **Assess Climate Risks.** There are many guides to assessing a city’s potential (and already present) climate changes and risks. The C40 Cities and Arup report, “[City Climate Hazard Taxonomy](#),” identifies in detail more than 30 climate hazards that cities face, from rainstorms, severe wind, and heat waves to drought, storm surges, and floods, land subsidence, water- and air-borne diseases, and insect infestation. The [federal climate change data center](#) houses nearly 91,000 government data sets, along with mapping services, and tools, with key resources featured to help new users get started by type of climate impact. Because most climate data is at the global or continental scale, cities use either regional climate models or “downscaled” local climate information. The latter is produced by running computerized climate models at local scales, an intensive process, and/or developing statistical relationships between local climate variables and large-scale predictors of climate and then applying these relationships to global climate models to simulate future local climate conditions.
2. **Assess City Vulnerabilities.** With an understanding of projected climate change impacts in hand, cities assess the climate vulnerability of built, natural, economic, and social assets, of populations, and of neighborhoods/districts in the city. Vulnerability is a combination of the exposure, sensitivity, and adaptive capacity of the city’s assets, populations, and neighborhoods. It’s not unusual to think primarily about the vulnerability of the city’s physical infrastructure, but other assets, particularly economic activity and ecosystem services, such as water supply and biodiversity, matter and can be at risk. Cities concerned with social and economic equity in climate adaptation analyze certain characteristics of the population—income, age, and health, for instance—and map these to where the people reside in the city to determine their climate vulnerability.
 - From **LOS ANGELES’** plan: “Studies of public health and vulnerability to disasters repeatedly indicate that minority populations tend to have lower capacity for responding to disasters and adapting to climate change than non-Hispanic whites.”
 - A [2016 report by the U.S. Environmental Protection Agency](#) identified groups of people whose health may be disproportionately affected by climate change: children, communities

with environmental justice concerns, indigenous peoples, occupational groups, older adults, people with disabilities, people with existing health conditions, pregnant women.

- A report by the U.S. Army Corps of Engineers on engaging socially vulnerable populations in its decision-making processes identified these characteristics of vulnerable populations: age (elderly and young); low-income status; language other than English spoken at home, limited access to transportation, inadequate housing, low educational attainment, ethnic minority, and physically and mentally challenged.³³
 - From **PORTLAND**'s (Oregon) plan: "...many low-income people are reliant on transit, and walking to and from and waiting at transit stops can result in exposure to extreme heat conditions."
 - From **AUSTIN**'s plan: "Although 56% of the population is under 35 years old, Austin is currently attracting more people in the 55+ age group than almost any other city. Analysts predict that the 65+ age group will make up as much as 20% of the population by 2050."
3. **Set Goals, Strategies, and Actions.** Cities set goals for climate adaptation, then identify strategies and actions to achieve the goals. For each type of climate risk—extreme precipitation, extreme heat, sea-level rise, and others—and city vulnerability there is a growing list of potential actions that cities may pursue. For example, the "U.S. Climate Resilience Toolkit," a website developed by federal agencies, covers coastal flood risk, food resilience, human health, ecosystem vulnerability, water resources, energy supply and infrastructure, and transportation. The Georgetown Climate Center's [Adaptation Clearinghouse](#) organizes this kind of information by a mix of factors: agriculture and food, business, coastal, emergency preparedness, energy, land use, transportation, and water.



4. **Set Priorities.** Cities prioritize which actions will be taken, based on urgency, resources, and other factors including political feasibility in the city.
5. **Implement.** Cities implement the actions, establishing clear responsibilities and timetables for each action.
6. **Monitor Progress.** Cities monitor progress of the plan implementation and evaluate results of adaptation actions.

A prominent variation of the typical adaptation-planning model was used in **NEW YORK CITY** for the Rebuild By Design (RBD) process after Superstorm Sandy and was replicated in 2017 in **SAN FRANCISCO**.³⁴ The RBD model uses a competitive design challenge as the driver for a planning and implementation process. It invites global design experts to collaborate with community leaders, government agencies, and the private sector to develop visionary and implementable projects to address the effects of rising sea levels on the city's neighborhoods, infrastructure, and physical environment.

City Levers, Strategies, and Actions

Each city's adaptation plan is somewhat unique, due to variations in the city's climate and climate changes and the type of assets and populations in the city and their vulnerability to climate changes. Another source of variation in plans is which of four levers the city government chooses to use in determining its adaptation strategies and actions. The four levers that cities can use to adapt are:

- ▶ **Encouraging Voluntary Action.** Encourage specific voluntary actions of residents and businesses, usually by providing information and mounting behavior-change campaigns.
- ▶ **Sending Market and Price Signals.** Send price signals and provide subsidies to incentivize or discourage particular behaviors and investments by residents and businesses.
- ▶ **Making Targeted Public Investments.** Make targeted public investments that meet standards for adaptation, especially for public infrastructure and natural systems, such as wetlands.
- ▶ **Mandating Behaviors.** Mandate actions, requiring certain behaviors and investments that meet adaptation standards.

Each lever comes with a set of different general strategies—a total of 12 strategies for the four levers—and a menu of actions that can be customized for the particular climate risk (sea level rise, extreme heat, high winds, etc.) that is being addressed. Different cities use different combinations of levers, depending on local circumstances such as whether climate disasters have already occurred locally. In many communities, elected officials are likely to want to avoid mandating behaviors through regulations and standards, at least until they have used other less controversial levers.

LEVER	ADAPTATION STRATEGY	ADAPTATION ACTION EXAMPLES
ENCOURAGE VOLUNTARY ACTION	1. Outreach/education/technical assistance for self-adaptation improvements	<ul style="list-style-type: none"> • Provide property owners with information about preparing for specific risks • Encourage businesses to assess their vulnerability
	2. Link and coordinate NGOs, community groups, private businesses, and public services relevant to adaptation	<ul style="list-style-type: none"> • Develop connections among and shared plans for health sector, public safety, and other community entities, as well as neighborhood residents, to prepare for climate impacts
SEND MARKET AND PRICE SIGNALS	3. Financially support retrofitting for increased resilience	<ul style="list-style-type: none"> • Subsidies or financing access for implementing building resilience measures • Sliding-scale or targeted subsidies to support retrofitting by low-income building residents or owners
	4. Require disclosures of climate risk	<ul style="list-style-type: none"> • Real estate disclosure statements
	5. Provide incentives for water and electricity conservation	<ul style="list-style-type: none"> • Restructure utility pricing to reward consumers that reduce demand
MAKE TARGETED PUBLIC INVESTMENTS	6. Embed adaptation requirements and/or standards into design of and investment in new public infrastructure	<ul style="list-style-type: none"> • Complete Streets, Green Infrastructure, smart technology to detect critical problems in equipment/systems • Flood protection infrastructure, such as sea walls • Hardening of communications and transportation infrastructure • Disaster alert communications systems
	7. Embed adaptation requirements and/or standards into design of and investment in restoration and management of natural systems	<ul style="list-style-type: none"> • Brush management for wildfires; invasive species control • Green infrastructure solutions for flooding • Wetlands restoration
	8. Invest in emergency preparedness response	<ul style="list-style-type: none"> • Equip community centers/shelters • Micro-grid energy supply for emergency equipment
	9. Invest in removing assets and populations from high-risk areas	<ul style="list-style-type: none"> • Acquire properties in chronic floodplain area; managed/phased retreat
MANDATE BEHAVIORS	10. Embed adaptation requirements and/or standards into requirements for new development	<ul style="list-style-type: none"> • Setbacks, on-site stormwater capture, site elevations • Intervene in utility rate cases to require adaptation plans and actions
	11. Prevent development in high-risk areas	<ul style="list-style-type: none"> • Zoning restrictions in floodplains
	12. Update regulations for preservation and restoration of natural areas to reflect adaptation	<ul style="list-style-type: none"> • Increase protection of wetland buffers

A large, stylized number '4' is the central graphic element. It is composed of several overlapping, semi-transparent teal-colored shapes. The top part of the '4' is a wide, horizontal bar that tapers to a point on the left. Below this, a vertical stem descends, and a horizontal bar crosses it, forming the base of the number. The overall effect is a modern, layered, and geometric representation of the number 4.

LEARNING FROM THE FIRST WAVE OF ADAPTATION CITIES

Positive Adaptation

Climate adaptation is not just about preparing for an undesirable future of climate risks. Although it presents cities with some difficult decisions, it also offers positive opportunities to improve cities' livability, social cohesion, and economic equity, while diminishing losses to climate-change impacts and promoting low-carbon living. In 2016, a study in **MIAMI-DADE** to understand how to engage the community in addressing sea level rise listed among the top takeaways:

“Seeing [adaptation] as an opportunity is motivating. The idea of taking this as an opportunity to embrace change and become a model ‘City of the Future’ was a popular and motivating meme. Innovation and imagination can thrive in the face of the crisis. The business community especially appreciated this call-to-action.”³⁵

Framing a set of benefits from adaptation helps enhance the “return on investment” case and build local support for a city to invest in climate adaptation.

- ▶ “Climate action will not only keep us safer in the face of higher tides, more intense storms, and more extreme heat. It will also create jobs, improve public spaces and public health, and make our energy supply more efficient and resilient.” –**BOSTON** Mayor Martin Walsh (“Climate Ready Boston,” December 2016)
- ▶ “Most adaptation actions draw upon, promote, and sustain multiple community values. Climate change was not typically the exclusive justification for community-based adaptation in the cases we studied.” –Abt Associates, “The State of Practice in U.S. Communities”

Although a city's adaptation is driven by the climate risks and vulnerabilities, many cities frame adaptation in terms of the ways that life in the city can be improved. These include:

- ▶ **Livability “Co-Benefits.”** Cities are seeking to leverage adaptation investments and actions to improve other aspects of a city's livability: increased green space, improved uses of public infrastructure, increased “green economy” jobs, and more. Emphasizing these co-benefits, they believe, makes it more likely that residents and local businesses will support government adaptation actions. Examples of adaptation co-benefits include:
 - Investments in green infrastructure to manage stormwater increases park and forest land and other green space available in the community and adds natural features to streetscapes, which can also increase the value of property.
 - Investments in public infrastructure, such as water-capturing plazas, can be designed to increase recreational opportunities even as they improve the water-management system.
 - A 2016 C40 Cities study identified additional co-benefits from adaptation actions: stable delivery of energy, water, and food services; reduced mortality and health impacts; increased number of green jobs; reduced evacuations of households, improved public health from increased physical activity, and enhanced biodiversity.³⁶

“By investing in equity,
we are investing
in resilience.”

- In 2016 in the San Francisco Bay area, 70 percent of voters approved Measure AA, the “**SAN FRANCISCO** Bay Clean Water, Pollution Prevention and Habitat Restoration Program,” a tax increase that will raise up to \$25 million a year for 20 years. The investment is needed to protect against sea level rise, but the campaign behind it focused on the Bay’s benefits for the community. For example, a leading advocacy group stated: “San Francisco Bay is a part of all of our lives—whether we live along the Bay; work there; walk, jog, or visit parks along its shores; or simply appreciate it as we drive over a bridge. The Bay also attracts tourists, supports commercial fishing and attracts quality employers to the region—all of which help keep our economy strong. But pollution and other problems have put the health of the Bay at serious risk.”³⁷

- Striking a more general co-benefits theme, the **MIAMI-DADE** communications study identified this potential adaptation message to the business community: “Immediate action on sea level rise is an investment in Miami’s future.” And this message to a Millennial audience: “We’re determined to make Miami a place to be proud of (to call home).”³⁸
- A 2017 report by the U.S. Environmental Protection Agency noted that “smart growth approaches” to adaptation “offer multiple benefits . . . including protecting air and water quality, saving people money by using energy more efficiently and offering transportation options, and creating new economic opportunities.”³⁹
- From **CLEVELAND**’s plan: “Even if climate change was not a factor, taking the actions laid out in this plan would still make sense from an economic, environmental, and equity perspective. The fact of climate change simply adds urgency to acting now.”

► **Low-Carbon Living/GHG Reduction.** Cities are integrating adaptation actions with greenhouse gas mitigation actions in ways that bolster city efforts to de-carbonize its core systems.

- Actions that increase vegetation/landscaping—green infrastructure—for water absorption and heat reduction can also reduce GHG emissions.
- Efforts to reduce energy and water consumption, which can make a city more resilient to climate disasters, also may reduce GHG emissions.
- Some cities believe that awareness of the limits of what adaptation actions can accomplish to reduce climate risks may stimulate greater public and stakeholder interest in acting to reduce GHG emissions that lead to global warming.

► **Equity.** Placing social and economic equity at the core of a city’s adaptation approach can ensure that historic patterns of discrimination are abandoned when it comes to prioritizing adaptation actions that benefit low-income and minority populations and neighborhoods. This improves a city’s overall resilience to climate changes and improves living conditions for these vulnerable populations and neighborhoods, while potentially increasing a sense of social inclusion in the community. It can also help to expand the diversity of civic leadership in the city.

- From **PORTLAND**'s (Oregon) plan: "To deal with the unequal impacts these communities (low income and communities of color) will face, this Climate Action Plan prioritizes actions that improve resilience in disproportionately affected communities."
 - From **NEW ORLEANS**' plan: "By investing in equity, we are investing in resilience."
 - From **BOSTON**'s plan: "It is critical to consistently quantify the social, environmental, and economic benefits of each alternative intervention—with particular attention to social equity and the needs of socially vulnerable populations—so that they can be weighed both against the costs of the project and against each other."
- **Loss Avoidance.** Cities' adaptation actions reduce the risk of loss of life, increases in physical injuries and diseases, damage to housing and other property, disruption of business, and increased costs of rebuilding infrastructure.
- An extreme example of climate loss came in **NEW YORK CITY** when Hurricane Sandy killed at least 186 people, damaged or destroyed more than 600,000 homes, closed 200,000 small businesses, left 8.5 million customers without power, released hundreds of millions of gallons of sewage into waterways, and caused more than \$65 billion in damages and economic loss.
 - **BOSTON**'s adaptation plan contains a scenario for coastal and river flooding that would inundate 2,100 buildings, including homes of 16,000 Bostonians, and estimated there would be \$2.3 billion in physical damages to buildings and property and other economic losses, including relocation and lost productivity, concentrated mostly in two districts of the city.
 - From **HAMPTON**'s plan: "The total value of affected parcels in vulnerable areas has been summed to provide some indication of the investments in real property that could be lost due to sea level rise."
 - A 2015 assessment found that tourism in Southeast Florida, which contributed nearly \$24 billion to the **MIAMI-DADE** economy, was one of the economic sectors most at risk from sea level rise, storms, and heat waves.⁴⁰ **FT. LAUDERDALE** Mayor Jack Seiler acknowledged the strong connection between economic interests and climate adaptation: "We live in paradise. When paradise goes under water, we're all going to feel the impact. It is now an environmental and economic discussion. What is our economy going to be like? What is our economy going to look like if we don't prepare our community for rising sea levels and climate change?"⁴¹

Summary Insights About City Climate Adaptation Planning

- ▶ **It's not just about planning.** Climate adaptation is not just about having an adaptation plan; it involves a new approach and set of competencies for cities. The need to develop ongoing, not just temporary capacities—proficiencies, partnerships, and resources—is the basis for the next section in this report.
- ▶ **It involves more than a city.** The most effective geographical scope for climate adaptation is regional—the metropolitan area and natural ecosystems—not just the city and its built environment. Adaptation also involves alignment of state and federal policies that cities must depend on to be able to develop and advance their adaptation plans.
- ▶ **It benefits from prioritizing equity.** Cities that make equity central to their climate adaptation approach can develop greater overall resilience to climate change, because they have engaged vulnerable populations in developing adaptation plans and have prioritized adaptation for people and places that historically have been marginalized in city affairs.
- ▶ **It's often about being opportunistic.** Adaptation planning often involves figuring out which actions to take long before the opportunity to implement them presents itself. City practitioners find that a city's readiness to act may take time to emerge, but in the meantime they develop plans and design actions to be ready when the opportunity arises.

Difficulties in Early-Stage Practice

Overall, the content of the plans and the experiences of the first wave of adaptation practitioners in U.S. cities provide a sufficiently large base of information that reveals substantial variation in the planning and plans. This is not an unusual pattern in an emerging and complex practice.

- ▶ **Scope.** Some cities focus on municipally-owned assets only, while others look at a broader base of assets in the community. Some concentrate almost entirely on built infrastructure, while others also attend to natural and social assets. Very few offer economic analysis of the potential local impacts of climate change. In some cases, a single city department or authority (e.g., water or transportation) has conducted the adaptation planning, and the city has not taken a comprehensive approach.
- ▶ **Depth and Completion.** Some plans are extremely thorough and backed by extensive and documented research and deliberative processes, while others rely on far less analysis and reflection. In many plans, a significant number of the proposed actions merely call for more research and assessment to figure out what to do. In some plans, goals and strategies are left quite vague, which may make them weak guides for designing actions.
- ▶ **Gaps.** The quality of plans varies greatly, an assessment of 44 cities' adaptation plans concluded. For instance, most plans did not address the uncertainty inherent in climate science and risk assessment, or identify the cost of implementing actions, or describe how plans would be evaluated.⁴²

In addition, adaptation is highly contextualized, which limits the value of many tools and frameworks already developed. Local conditions—climate, assets, vulnerabilities, priorities, financial resources, etc.—vary considerably city-to-city. As a result, the proliferation of frameworks, guidance information, and tools to help cities has limited value because the information tends to be generalized. In addition, so much information is available, cities say, that they don't have the time or means to determine what will be most useful, what can be trusted.

- “Each community is unique not only in its specific vulnerabilities, but also in how it defines successful adaptation.” –Urban Sustainability Directors Network project
- “A large percentage of the resources available are ‘generic’ in the sense that they are not specifically focused on a geographical region, sector, or phase of the adaptation planning process. [They] are not able to meet the particular needs of cities that are looking for targeted services and resources.” –Nordgren, Stults, and Meerow (2016)

Moving From Planning to Implementation

The focus of urban climate adaptation has mostly revolved around planning: understanding the science, conducting vulnerability assessments, identifying strategies, and deciding on actions. As a growing number of cities has produced adaptation plans, the edge of innovation in the adaptation practice is turning from planning to implementation. Barriers to implementing city adaptation plans loom everywhere.

This was the clear and overriding conclusion from our interviews with city adaptation practitioners, climate adaptation experts, and foundations investing in urban adaptation.

Other research reports a similar finding. Many plans do not contain basic implementation approaches, such as identifying the parties responsible for moving an action forward and what the timeline is for taking action. Woodruff and Stults concluded that most of the city plans they analyzed “fail to prioritize impacts and strategies or provide detailed implementation processes, raising concerns about whether adaptation plans will translate into on-the-ground reductions in vulnerability.”⁴³ Nordgren, Stults, and Meerow found that most resources for city adaptation supported vulnerability assessments and adaptation planning, with “minimal resources” dedicated to implementation, financing, or monitoring adaptation efforts.⁴⁴

Moving forward with implementing adaptation plans is no easy task, and cities are beginning to wrestle with formidable challenges, including:

- ▶ **Lack of Urgency.** The city and its government and civic leadership may lack a sense of urgency due to a general perception that the climate danger is uncertain and far off in time, and therefore very difficult or perhaps not necessary to address. Framed that way,

As a growing number of cities has produced adaptation plans, the edge of innovation in the adaptation practice is turning from planning to implementation.

climate adaptation has difficulty competing with the many near-term community pressures that resource-constrained local governments face every day. Many communities that have taken significant adaptation action have done so only after experiencing a disaster that clearly demonstrated community vulnerabilities to climatic events.

- ▶ **Reluctance to Diminish Development.** City officials may not want to take adaptation actions that constrain development in certain areas of the city or increase the costs of new development, as they view development as essential for the city's economic and population growth and for city government revenues. Even as some cities develop adaptation plans, they may be slow to apply changes to their processes for permitting of new development. Cities experience a similar reluctance to consider, or even discuss, the relocation of buildings, people, or entire neighborhoods—"managed retreat"—that are at high risk of climate-caused damage, because of likely political resistance to the idea.
- ▶ **Unclear Authority.** City officials may be unclear about what decision-making authority and financial responsibility they have for taking adaptation actions. Sometimes the needed actions require collaboration among multiple municipalities, which can also be uncharted territory.
- ▶ **Lack of Proven Solutions.** The city may face specific climate risks for which the potential actions to take are not fully developed or technically certain to deliver the desired results. As coastal cities contemplate sea level rise, for instance, they find they face complex analytic tasks—figuring out how different actions, such as building a sea wall, will affect the coastal environment; comparing the potential results and costs of various engineering options—and that there can be a great deal of uncertainty about what actions will work.
- ▶ **Capital Constraints.** Local public and private sectors may have limited financial capacity for investment in adaptation actions, and other city priorities compete for resources.
- ▶ **Lack of Metrics.** There are no widely accepted and used measures for cities to monitor progress in adaptation and to create accountability for implementation. Use of adaptation indicators and metrics "is still in the early days of developing practice, let alone 'best practice,'" reports one research team.⁴⁵
- ▶ **Potential for Inequities.** The potential for different populations and neighborhoods to experience disproportionate burdens and benefits due to climate changes and/or adaptation actions can impede development of community and political leadership agreement about moving forward with actions.
- ▶ **Difficulty Incorporating Climate Information.** City governments may not have effective processes for incorporating climate projections, which are uncertain and distant, into their decision-making processes.

To address implementation barriers like these, cities take steps that suggest they need a set of ongoing capacities for climate adaptation—both to develop and implement effective adaptation plans and to do so over the long-term, not just for a single planning process.

The background is a solid teal color. It features several overlapping geometric shapes: a large, semi-transparent teal circle in the lower half, a smaller semi-transparent teal circle above it, and two semi-transparent teal rectangles in the upper half. The text is centered in the lower half of the page.

SEVEN ESSENTIAL CAPACITIES FOR URBAN ADAPTATION

To support the quality and effectiveness of adaptation plans and actions, leading cities have been developing some or all of seven adaptation capacities that are sets of proficiencies, partnerships, and resources.

SEVEN ESSENTIAL CAPACITIES FOR URBAN ADAPTATION

- 

1 SCIENTIFIC FOUNDATION
Capacity to assess and understand climate risks and vulnerabilities of city's built, natural, and economic assets and its populations, and use these analyses for ongoing adaptation planning
- 

2 COMMUNICATIONS
Capacity to communicate with and educate civic leaders and community members in ways that build and sustain a sense of urgency to adapt for climate changes
- 

3 EQUITABLE ADAPTATION
Capacity to make social and economic equity a central driver of the city's adaptation approach
- 

4 INCLUSIVE COMMUNITY ENGAGEMENT
Capacity to fully engage stakeholders and the public, especially vulnerable and underrepresented populations, in developing, implementing, and monitoring adaptation plans
- 

5 INTERGOVERNMENTAL ALIGNMENT
Capacity to coordinate planning and action across governments at local, regional, state, tribal, and federal levels
- 

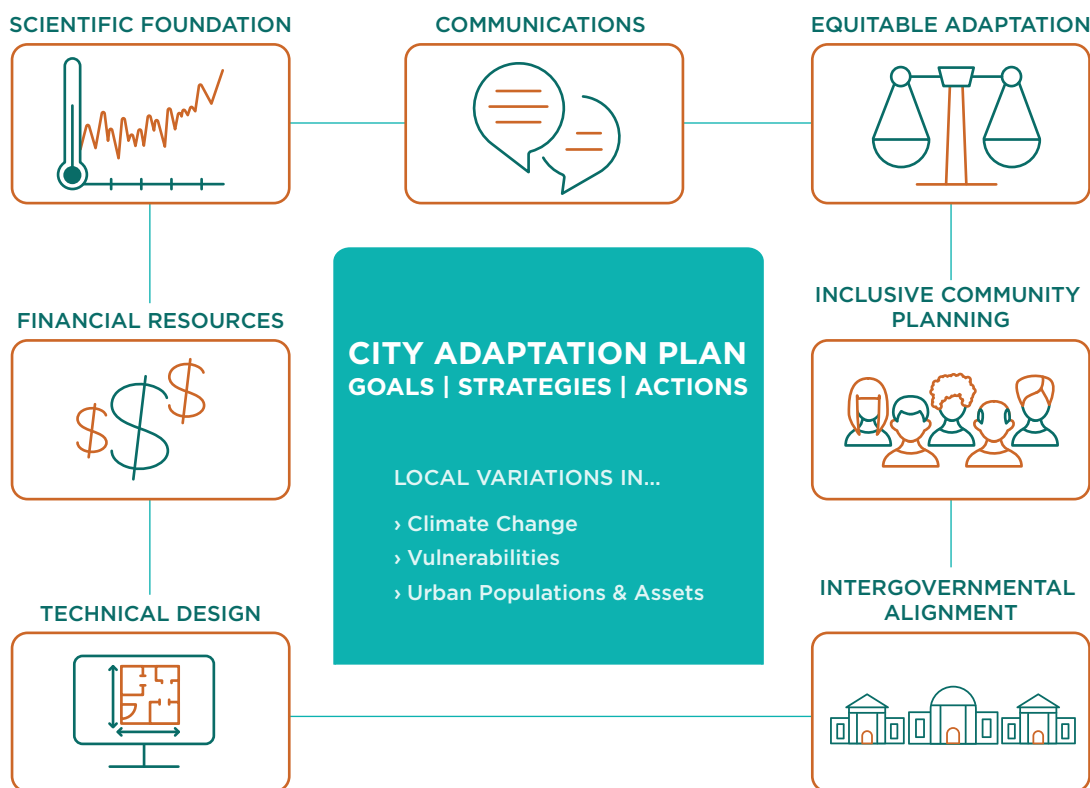
6 TECHNICAL DESIGN
Capacity to design, test, and implement adaptation actions that require engineering, legal, and other highly specialized details, as well as performance metrics for monitoring
- 

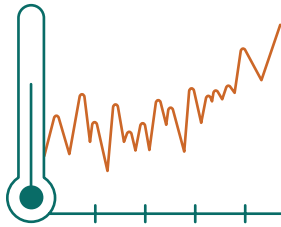
7 FINANCIAL RESOURCES
Capacity to repurpose, leverage, and obtain public and private funds to invest in infrastructure development and other adaptation actions

Each of the seven capacities is distinct, but they are also linked to each other in some ways. For instance, a city’s capacity for Equitable Adaptation may depend on its capacity for Inclusive Community Engagement, because both involve a city’s more vulnerable populations. The capacity for Intergovernmental Alignment may be related to the Financial Resources capacity, because both are likely to involve financing of major infrastructure projects, which often will need the approval of multiple local jurisdictions as well as multiple levels of government.

(See Appendix C for a summary of recommendations from two recently published studies on urban adaptation practice in the U.S. that touched on the seven capacities identified in this report.)

7 CAPACITIES FOR URBAN CLIMATE ADAPTION





CAPACITY 1: SCIENTIFIC FOUNDATION

A city's Scientific Foundation for climate adaptation is the capacity to assess and understand climate risks and vulnerabilities of the city's built, natural, and economic assets and its populations, and use these analyses for ongoing adaptation planning.

Climate risk assessment involves obtaining and analyzing scientific projections of local climate changes and their probability—and doing this continuously, because both the science and the climate are evolving and should be monitored. Ecological knowledge, an understanding of the underlying natural ecosystems of the city, is also an important element in the assessment. Essential to assessing climate risk, given the inherent uncertainty in climate projections, is the ability to build consensus among city policy makers and practitioners about which climate-change projections to use to provide enough certainty for the design of adaptation actions.

City vulnerability assessment involves obtaining and assessing data about the potential impacts to the city of projected climate changes—and doing this continuously, too, because climate projections and a city's vulnerabilities may change. Indigenous knowledge, the understanding of local residents about their place, is also an important input into vulnerability assessment. Essential to assessing vulnerability is the ability to use an analytic framework and data that comprehensively cover the diversity and complexities of a city's assets and populations.

Cities use these assessments to develop adaptation strategies and actions, and to set priorities for action. Cities vary widely in the level of rigor and localization of their climate impact assessments. Some cities, like **BOSTON**, conduct detailed localized downscaling of climate models, while others rely on regional or state projections. The extent to which the projected climate impacts need to be highly localized and assessed in-depth should be based on the level of detail that's necessary to inform planning and design of actions. For instance, in communities that are expected to be highly impacted, extensive localized understanding of potential climate impacts may be essential for planning. There is also variation in the rigor of cities' vulnerability assessments, in how cities frame their assets and populations, what data they use to assess vulnerability, and how deeply they analyze the situation.

Any city that has conducted adaptation planning will have developed one or more climate-change scenarios as part of its process to develop a version of the city's assets and populations to determine vulnerabilities. But building a continuing Scientific Foundation that will be available over the years involves more than that, including:

- ▶ **Partnering.** The city partners with a variety of organizations to obtain and analyze data and develop consensus about climate-change projections, including universities and state and federal government agencies with climate data, and nonprofit organizations with expertise, such as in the ways that climate changes may damage watersheds and other natural ecosystems.
- ▶ **Data Management.** The city gathers and manages the substantial data needed to analyze city vulnerabilities as they change over time. This includes access to databases controlled by other government entities, nonprofit organizations, community-based organizations, and businesses.

Examples of Scientific Foundation Capacity

- ▶ **CITIES IN THE HEARTLAND REGIONAL NETWORK**, covering five Midwestern states, worked with state climatologists in 2015 to evaluate historical and recent climate data and future climate change projections so the cities would be able to develop climate plans. During the process, they used several methods to address uncertainties in climate projections and to validate the climate data. They produced a report, “*Climate in the Heartland*,” that detailed the process.
- ▶ **SAN FRANCISCO** developed adaptation plans by drawing on sea-level rise information provided by state agencies using the National Research Council report, *Sea-Level Rise for the Coasts of California, Oregon, and Washington*, as the best available science.⁴⁶ The agencies encourage local jurisdictions to revisit best available science frequently and to account for uncertainty in developing sea level rise vulnerability assessments.⁴⁷ The San Francisco Bay Conservation and Development Commission’s (BCDC) Adapting to Rising Tides (ART) program is building on the state’s scientific foundation by partnering with the Metropolitan Transportation Commission to spearhead development of integrated regional shoreline mapping and analysis products that can support unified sea level rise assessments across the region.⁴⁸ Detailed shoreline mapping and analysis were produced for four of the region’s nine counties, and work continues to build out region-wide tools. Additionally, the BCDC adopted recommendations to develop a multi-sector unified vulnerability assessment for the entire region.⁴⁹

Also in San Francisco: In 2013, Mayor Ed Lee appointed a Sea Level Rise Technical Committee with representatives from key departments to look at sea level rise vulnerability with a focus on government-owned assets contained in the City’s 10 Year Capital Plan. The Technical Committee developed the “Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco” (SLR Guidance) to integrate sea level rise projections in City capital projections. The SLR Guidance was adopted by the City’s Capital Planning Committee in September 2014, and an updated version was adopted in December 2015.⁵⁰ The SLR Guidance includes an overview of current projections for sea level rise, assistance for determining the amount of sea level rise to include in design given project location and lifespan, and instructions for developing project risk assessments and sea level rise adaptation plans. The SLR Guidance also includes a project checklist, which all capital projects included in the City’s 10-year Capital Improvement Plan must complete. Development of the SLR Guidance was informed by the leading-edge work to incorporate sea level rise into their plans and policies by several San Francisco departments, including the San Francisco Public Utilities Commission, the San Francisco Planning Department, the Port of San Francisco, and the San Francisco International Airport, and has quickly become a reference for other cities in the region and nation. Following the development

Essential to assessing vulnerability is the ability to use an analytic framework and data that comprehensively cover the diversity and complexities of a city’s assets and populations.

of the SLR Guidance, Mayor Lee transitioned the Technical Committee into an ongoing Sea Level Rise Coordinating Committee, which was given responsibility for overseeing City efforts to prepare for sea level rise, and was tasked with developing a Sea Level Rise Action Plan, which was released in March 2016. The Sea Level Rise Action Plan lays out the City's sea level rise resiliency goals, as well as a two-year workplan to conduct further analysis, develop a citywide sea level rise adaptation plan, and create a workplan for implementation.⁵¹

- ▶ Creating a consensus climate risk forecast was the first deliverable for the City of **BOSTON**'s "Climate Ready Boston" initiative. To create this, the city partnered with the Boston Green Ribbon Commission to form the Boston Research Advisory Group (BRAG). The BRAG was led by the University of Massachusetts-Boston, and assembled a team of world-renowned scientists from MIT, Harvard, Boston University, Harvard, Tufts, Rutgers, Cornell, and Northeastern, as well as National Oceanic and Atmospheric Administration, to develop a climate forecast through 2100 that could be used to shape the city's climate vulnerability assessment. Published in a **peer-reviewed report**, the BRAG report includes detailed projections for expected sea level rise, extreme heat, extreme precipitation and coastal storms through 2100. These projections were used to analyze the risks to people and property citywide and within individual neighborhoods. The 2016 "Climate Ready Boston" report includes a recommendation to institutionalize the updating of Boston-specific climate recommendations by creating the Greater Boston Panel on Climate Change. The Panel would be charged with updating the projections every five years based on available scientific research.
- ▶ One of the four-county **SOUTHEAST FLORIDA** Climate Compact's first projects was to develop consensus projections for sea level rise that could be used by all members. In 2011 it created a Technical Work Group that reviewed existing projections and the scientific literature to develop unified projections for the region, looking at two time horizons: 2030 and 2060. The Work Group recognized that the unified projections would need to evolve over time to keep pace with the best available science on climate change impacts. It recommended an update of the unified sea level rise projections by 2015 to incorporate, among other research, the 2013 release of the United Nations Intergovernmental Panel on Climate Change Fifth Assessment Report. In October 2015, the Compact released its updated sea level rise projections, and expanded the time horizon to include 2100, as well as 2030 and 2060.⁵² The four counties formally adopted these projections as the baseline projections to use in their climate change vulnerability assessments. Although the consensus projections inform adaptation planning and the design of infrastructure projects, planning and design also take into account the specific context of each project, which may differ from the more general consensus. To monitor climate change over time, the Compact in 2016 partnered with the Florida Climate Institute and the South Florida Water Management District, as well as other agencies, to track a range of indicators that measure climate impacts, including sea level rise, saltwater intrusion, nuisance flooding, severe storms, and heat index, across the region.⁵³



CAPACITY 2: COMMUNICATIONS

A city's Communications for climate adaptation is the capacity to communicate with and educate civic leaders and community members in ways that build and sustain a sense of urgency to adapt for climate impacts.

A sense of urgency, a necessary condition for mobilizing the community to act and to bear the changes and costs of adaptation, can be difficult to develop if climate risks are perceived to be uncertain and far off in the future, especially since adaptation changes and costs will be certain and in the near term.

In cities that have already suffered from climate changes—whether it was a disastrous event like extreme precipitation that unleashed flooding or the ongoing small disruptions of nuisance flooding due to sea level rise—a sense of urgency may already be “naturally” present. In cities with forward-looking leadership, recognition of the risks from climate changes may be sufficient to mobilize planning and action, even if the community has no lived experience (yet) with climate disaster. But even in these cases, a Communications capacity is needed to ensure a critical mass of the community and stakeholders engages in adaptation planning and supports taking action. A city's adaptation strategies are likely to unfold over decades, not just in a one-time planning push, and there will be a need to sustain the community leadership's will to act. This is especially true if the city's plan requires long-term spending on infrastructure and/or postpones taking more controversial but necessary actions, such as limiting where new development can occur.

Education and communication campaigns to build a city's readiness, before the community has direct experience of climate impacts, often touch on a city's previous experience of disasters even if they were not attributed to climate change—an earthquake, wildfires—as a way of evoking just how bad things could be. In the **SAN DIEGO** area, for instance, a history of wildfires that had killed people, destroyed thousands of homes and forestland, and required as much as \$80 million for firefighting, raised public awareness about the potential impacts of warming temperatures. But campaigns also focus on the positive: the “return on investment” for taking action, based mostly on co-benefits that can be achieved through adaptation, or how adaptation actions fit in with a optimistic vision for the city's future. Campaigns may also stress the financial savings that can be realized by preventing climate disaster and/or by taking actions over the long term, rather than in a hurry during a crisis. In other words, as one adaptation guidance report advised: “Address issues important to the community . . . For example, adaptation in Taos works under the rubric of water conservation and affordable housing.”⁵⁴

These educational campaigns require substantial and credible analysis of climate risks and, especially, the economic case for adaptation. Like many efforts at developing public understanding and support, they involve careful design of messages and messaging, as well

A city's adaptation strategies are likely to unfold over decades, not just in a one-time planning push, and there will be a need to sustain the community leadership's will to act.

as methods for engaging the community and stakeholder groups in educational processes. Campaigns may also incorporate information about market signals that could influence an audience, such as the availability and pricing of insurance for buildings. An important aspect of the education process can be to emphasize that it's not intended to create political advantage. As Republican commissioner of Miami-Dade, Rebeca Sosa, noted: "Sea level rise has no party. Saltwater intrusion has no party. Drinking water has no party."⁵⁵

To help local leaders talk effectively with residents and businesses and build public support for adaptation action, the Miami Foundation and the John S. and James L. Knight Foundation jointly funded research in **MIAMI-DADE** County to identify best ways to motivate the community to act to address sea level rise.⁵⁶ The project produced a communications toolkit in October 2016 that identified the communications messages most likely to resonate with the diversity of Miami communities, including businesses, frontline neighborhoods, the economically vulnerable, political influencers, and Millennials. The report's top recommendations for communicating about climate adaptation are relevant in most cities:

1. **Less doom and gloom.** Tell people what's happening and what they can do about it.
2. **Have frequent, genuine conversations.** Public meetings, town halls, collaborative decision-making technologies, social media... the more transparent, open, and two-way the conversation, the better.
3. **Clear leadership and accountability.** Who is doing what? What has been done? What are other cities doing? Who can step up and take charge? People are looking for fearless leadership and trustworthy sources.
4. **Engage artists, activists, youth and elders.** Storytelling, art, and self-expression are critical to engaging the public.
5. **Need a real vision and plan of action.** Where are we headed? The clearer the long-term vision for the city, the more courage and conviction we will see in personal and professional decisions about staying, investing, building a city of the future...⁵⁷

Examples of Communications Capacity

- ▶ The **SAN DIEGO REGIONAL CLIMATE COLLABORATIVE** is 18 cities and the county that share expertise, leverage resources, and advance solutions to facilitate climate change planning, in partnership with academia, non-profits, and businesses.
- ▶ The **WESTERN ADAPTATION ALLIANCE**, a network of 14 city governments in the southwest and intermountain regions, is developing the "Climate Event Database," an online inventory of climate-related weather disasters that have occurred in the regions.
- ▶ **NORFOLK** (Virginia) developed the "Norfolk Resilience Plan," which incorporates climate adaptation in a broader vision and strategies for the city's long-term resilience, which includes economic development and neighborhood healthiness. (Norfolk is a member of the 100 Resilient Cities.)
- ▶ **BOSTON**'s adaptation plan analyzed the potential economic losses in multiple climate-change scenarios due to physical damage to buildings and property, relocation and loss of productivity, and pinpointed these losses by neighborhood.

- ▶ In 2015, the Risky Business Project released an assessment of the economic risks from Climate Change that detailed the economic risks to **FLORIDA** from climate change impacts, including sea level rise, storms, and heat waves.⁵⁸ For example, the report estimates that \$69 billion of existing Florida coastal property will be below mean high tide by 2030, rising to \$152 billion by 2050.⁵⁹



CAPACITY 3: EQUITABLE ADAPTATION

A city's capacity for Equitable Adaptation in climate adaptation is the ability to make social and economic equity a central driver of the city's adaptation approach.

The burdens and benefits of climate impacts do not spread uniformly across urban communities. In most cities, the populations and neighborhoods most vulnerable to climate impacts are also those facing significant other economic, social, and health inequities. They may face greater exposure to climate hazards due to where they are located, living in flood plains or parts of the city more subject to heat island effects. They may be more sensitive to the negative effects of climate hazards than other people and neighborhoods, because they live in housing that is less resilient to inundation and extreme heat or have chronic health problems, such as asthma, that leave them less resilient to extreme heat and other climate effects. They may have fewer resources, less adaptive capacity—sufficient wealth, technology, education, institutional services, information, social capital, and physical infrastructure—to prepare sufficiently for climate changes and to recover from climate disasters.

The comparatively greater vulnerability of certain populations is not an accident; it has historical roots, as the authors of “[Pathways to Resilience](#)” note: “Conventional approaches to adaptation and mitigation view vulnerability as a characteristic or condition of groups of people and not as a circumstance or consequence of the ways social groups have been historically and systematically marginalized and excluded from opportunity.”⁶⁰

Equitable Adaptation benefits climate adaptation efforts in several ways: It expands and deepens a city's understanding of its climate risks, because vulnerable populations provide information and insights based on their direct experiences, which are otherwise underrepresented in traditional planning processes. It produces a “whole community” assessment with the insights of vulnerable populations and a thoughtful analysis of the conditions of climate vulnerable populations and places.

- From the **LOS ANGELES** plan: “Equity in the access to economic resources, infrastructure, education, social capital among stakeholders, and technological options tend to increase adaptive capacity.”
- From the **BALTIMORE** adaptation plan: “The City and County seek to ensure that the benefits of taking actions to prepare for climate change are shared by the whole community and across multiple generations.”

Equitable Adaptation also helps to build greater social cohesion within the city and improve the distribution of civic leadership within the city. It increases the implementation viability of adaptation actions by getting vulnerable populations to participate in the actions when this is necessary and by reducing their potential political and legal resistance to actions.

Equitable adaptation involves a set of practices, each of which is at a relatively early stage of development, with few mainstream understandings of what makes for effective practice or standards against which to assess the practice. The four practices are:

- ▶ **Awareness of and commitment to equitable adaptation.** Recognizing and acknowledging inequity and its causes is an essential step for cities seeking to develop their capacity for equitable adaptation. Some cities have explicitly identified “institutional racism” as the cause of a pattern of decisions—by government and other sectors—that resulted in greater climate vulnerability for certain populations and places. An example is the design and placement of roads and highways or housing developments to physically separate and isolate neighborhoods along racial lines.
 - From the **PORTLAND** (Oregon) plan: “Achieving the City and County’s climate equity goals requires intentionally addressing disparate experiences and outcomes by understanding and undoing institutional bias and racism.”

A city that espouses equitable adaptation but does not acknowledge and examine the causes of local climate inequities is not likely to win the trust and cooperation of vulnerable populations and neighborhoods that feel marginalized or victimized by city policies. Nor is it likely to prioritize adaptation actions that reduce climate inequities. Prioritizing equity means more than saying the planning process will engage diverse communities and identify actions to address vulnerabilities. It requires placing equity as a core value in the city’s adaptation approach; equity lives as a guiding objective that influences the way the city achieves its other preparedness objectives.

- ▶ **Engagement of vulnerable populations and places in planning processes.** As described in the Inclusive Community Engagement capacity, this practice starts with a recognition that traditional community involvement processes have not done a good job of engaging vulnerable communities, and that new methods need to be used to ensure that those with the most at stake are active participants in identifying, designing, prioritizing, and helping to implement adaptation actions. Cities go beyond information seeking and consultation, and enter into a dialogue with vulnerable communities, co-develop understandings of the adaptation problem and potential solutions, and empower the communities to develop and implement solutions themselves. More than likely, city governments and community-based organizations that represent vulnerable communities must develop relationships with understanding and trust of each other, which allow them to work together effectively.

A number of city governments have recognized that they need to prepare themselves to build new relationships with minority and low-income populations and neighborhoods. Cities in the Urban Sustainability Directors Network have been developing a “Racial Equity Evaluation Tool” to help city governments assess their own readiness for engagement that empowers people of color and low-income communities, and an “Equitable Climate Resilience Planning

Model and Framework” to guide local government in designing and implementing a more equitable climate preparedness planning process. Likewise, community-based organizations and resident leaders may benefit from preparation for engagement with city government, rather than just plunging in. They may, for instance, come together to define their shared values and principles, as well as a shared analysis of and vision for climate preparedness. They may seek to engage other stakeholder groups in the city, to learn from them and to explore opportunities for alliance building on preparedness issues. They may study how other cities have dealt with climate preparedness and link with community groups in those cities. To help community members undertake these and other preparatory tasks, cities may provide financial and technical resources to community groups.

► **Analysis of vulnerable populations and places.** This gives standing to social vulnerabilities along with the physical vulnerabilities of built infrastructure, the biological vulnerabilities of the natural environment, and the economic vulnerabilities of businesses. Cities mine different databases to identify their vulnerable populations and to map them spatially. An NAACP report, “[Equity in Building Resilience in Adaptation Planning](#),” identified 13 categories of pre-existing vulnerabilities/assets, pointing out that “it is critical that these characteristics be taken into account in planning as each may be indicative of the need for a different design.” The categories are: Population Demographics, Housing Security, Food Security, Mobility, Health Status/System/Services, Environmental Hazards, Emergency Services, Businesses/ Jobs, Public/Private Utilities, Social Services, Governance/Policies, Community Knowledge/ Attitudes, and Culture. The NAACP also identified an important analytic task: cross-reference indicators to gain greater understanding: “For example, during Hurricane Katrina, low income, African American women suffered the highest rates of injury and mortality. So looking at any of those indicators in isolation would be insufficient in assessing and addressing vulnerabilities.”⁶¹

Prioritizing equity means more than saying the planning process will engage diverse communities and identify actions to address vulnerabilities.

► **Design of equitable adaptation actions, indicators of progress, and implementation processes.** This practice is mostly uncharted territory, because there is not yet much city practice to look at. It has two elements:

- **Applying an Equity Lens.** This involves applying an equity lens to any and all climate adaptation actions that are under consideration to determine whether they may inadvertently exacerbate or perpetuate, rather than repair, climate inequities.
- **Targeted Actions.** This involves designing actions, especially public investments and policies, specifically to reduce the exposure and sensitivity of vulnerable populations and places to climate hazards and to increase their adaptive capacity. From the **CLEVELAND** plan: “Continue to work with social service and health care stakeholders to increase support for vulnerable populations through actions such as providing cooling shelters during heat waves and alerting people during days of poor air quality.” From the **PORTLAND** (Oregon) plan: “To ensure that energy efficiency upgrades do not result in increased cost burden to low-income populations and communities of color that are already under financial stress, programs must be designed with this in mind.” The following table provides some examples of targeted actions.

GOAL	TARGETED ACTIONS
REDUCE EXPOSURE	<p>These actions might be used anywhere in the city, but are targeted for neighborhoods/districts of vulnerable populations, which in the past might not have received a priority. They include:</p> <ul style="list-style-type: none"> • Protecting infrastructure by raising, hardening, or moving it • Building physical barriers to flooding • Increasing the tree canopy and other green infrastructure that reduces heat and flooding <p>Given a city's limited resources and competing needs, the key to these actions is the prioritization by decision makers.</p>
REDUCE SENSITIVITY	<p>These actions target specific sensitivities of vulnerable populations, such as financial stress, health problems (e.g., asthma), inaccessibility of emergency information, and social isolation. Examples include:</p> <ul style="list-style-type: none"> • Limiting cost increases of essential services (e.g., energy, transportation, water, and wastewater) to ensure continuing affordability • Providing early warning alerts (in multiple languages) for extreme heat and other climate hazards • Ensuring continuity of and access to essential services (e.g., electricity, hospitals, fire, policing) during climate events • Building and/or requiring decentralized and on-site systems (e.g., electricity microgrids to provide backup power, building stormwater capture systems to reduce flooding) • Improving community-based health services and subsidizing the acquisition of cooling equipment.
INCREASE ADAPTIVE CAPACITY	<p>These actions improve a group or place's capacity to reduce its exposure and sensitivity by increasing its control of or access to necessary resources. They could be part of a broader city approach to improve economic and social equity and to generate "co-benefits" that improve quality of life. They include:</p> <ul style="list-style-type: none"> • Access to resources needed for participation in green economic opportunities, such as training, education, transportation, and connectivity to labor markets • Neighborhood greening provided by green infrastructure solutions for stormwater management.

A city's Equitable Adaptation capacity involves proficiency in developing robust analytic information about equity issues in adaptation, productive relationships, even long-term partnerships, with community groups and members, and allocating resources to support equity-oriented adaptation strategies and actions.

Examples of Equitable Adaptation Capacity

- ▶ **BOSTON** is a member of the 100 Resilient Cities initiative, under which member cities build a comprehensive resilience plan and implementation strategy. Boston's strategy is focused on increasing resilience by reducing economic and racial inequality. The Mayor's Office of Resilience and Racial Equity, headed by Dr. Atyia Martin, leads this effort. The office is focused on reducing racial disparities in a proactive way: "Racial equity means closing the gaps so that a person's race does not predict her or his success, while also

improving outcomes for all. It is not just the absence of racial discrimination and inequities, but the presence of deliberate systems and supports to achieve and sustain racial equity through reflective, proactive, and preventive measures.” The city’s resilience approach contains a commitment to equitable climate adaptation: “Like many cities, Boston is also facing the consequences of a changing climate, including extreme temperatures, sea level rise, heavy precipitation, and coastal storms. The impacts felt as a result of these threats will disproportionately affect communities of color and overlapping socially vulnerable communities such as older adults, children, people with limited English proficiency, people with low to no income, and people with disabilities. Preparing communities of color for the impacts of climate change and strengthening emergency responses are necessary to build resilience citywide.”⁶²

- ▶ A forthcoming USDN Equitable Climate Resilience Planning Model and Framework, to be completed and released in 2017, will contain examples of equitable planning processes and adaptation actions—from Baltimore, Boulder, Cleveland, Detroit, East Palo Alto, Los Angeles, Miami, New Orleans, New York City, Oakland, Portland (Oregon), Richmond, San Francisco, Seattle, Washington, D.C., and other cities.

CAPACITY 4: INCLUSIVE COMMUNITY ENGAGEMENT



A city’s capacity for Inclusive Community Engagement for climate adaptation is the ability to fully engage stakeholders and the public, especially vulnerable and underrepresented populations, in developing, implementing, and monitoring adaptation plans.

Most cities recognize the importance of conducting adaptation planning by involving residents, businesses, and neighborhoods, not just experts and city officials, in the process of setting goals, identifying strategies and actions, developing implementation details, and monitoring results. But many cities acknowledge that traditional community outreach models have not done a good job of fully tapping the community’s knowledge and creativity or of fully engaging vulnerable, historically marginalized populations in the city. Inclusive Community Engagement involves more than just “participation” in which residents are asked to attend public hearings to provide ideas to city officials or feedback on ideas the city has developed. It typically contains continuing processes for educating and supporting community members and stakeholder groups, by building their capacity and willingness to develop ideas about climate adaptation, collaborate with the city in identifying priorities and selecting actions that reflect their concerns and ideas, and be active in supporting implementation of adaptation actions and holding the city government accountable for its performance. The city benefits, noted the **LOS ANGELES** climate plan, when adaptation strategies are “selected in consultation and agreement with affected stakeholder communities,” because the alternative—exclusion from the process—“can lead to political resistance and lack of buy-in.” Partnerships with community groups, stated the **CLEVELAND** plan, “can be leveraged to share resources and expertise,” but it also helps to “ensure that climate resiliency becomes part of the fabric of the community, and not an effort dependent on a small handful of champions.”

A city's Inclusive Community Engagement capacity depends on the commitment of city government to use planning processes that produce a high degree of engagement in the community. This may occur when city officials discover that stakeholder groups, such as business community leaders or grassroots and neighborhood organizations, are dissatisfied with traditional involvement methods and want more effective engagement. As a result, the city enters into dialogue with stakeholders and, together, they design planning processes to engage community members effectively. But city officials must be willing to share control and implementation of the planning process with stakeholder groups. In **CHULA VISTA** (California), for instance, the city recruited 16 members from organizations that would be vulnerable to climate changes to identify and evaluate adaptation actions, host public workshops to engage residents, and encourage community members to engage in the planning effort.⁶³

City officials must be willing to share control and implementation of the planning process with stakeholder groups.

A key element in the engagement process is to develop trust between city government and stakeholder groups and community members that may be wary of each other's intentions. In addition, the city must become proficient in how to use effective engagement methods. For example, the processes are usually tailored to meet the engagement needs of specific stakeholders, as the climate plan for **PORTLAND** (Oregon) noted: "Customize communications and engagement strategies for audiences including large families, residents with

limited English proficiency, renters and landlords to ensure that they have equitable access to information and services." In addition to commitment, trust building, and proficiency, the capacity depends on developing sustained partnerships with stakeholder groups, especially community- and neighborhood-based organizations that represent and engage highly vulnerable and historically marginalized populations in the city.

Examples of Inclusive Community Engagement Capacity

- ▶ To improve its efforts at inclusive community engagement, **SEATTLE** undertook a third-party evaluation of a community-driven planning process in two neighborhoods to determine the extent to which the process advanced racially equitable adaptation policies and actions. The evaluation used frameworks for community engagement and racial equity to determine that the "project did not achieve shared decision-making (shared power and control) with communities of color," and offered lessons for identifying more effective engagement practices, including "Makeup of the Core Planning Team Must Reflect Communities of Color," "Spend the Necessary Time Building Authentic Relationships and Trust." The assessment called for redesigning the approach to engaging communities of color in which communities of color "must be the designers, not just the recipient of the design."⁶⁴

- ▶ In **OAKLAND** (California), 30 organizations in the community formed the Oakland Climate Action Coalition and partnered with the Pacific Institute to develop a city vulnerability assessment and recommendations for equitable adaptation actions. Coalition members reach a consensus on issues and then work with the city to have community concerns reflected in plans. The Coalition conducts community education and has helped the city obtain philanthropic grants. A [case study by Abt Associates](#) reported that the Coalition holds ongoing workshops on climate impacts and developed pocket guides with appropriate actions for households in climate preparedness and emergencies; helped the city promote its Adopt-a-Drain program to get residents and business owners to clear out storm drains to help minimize flooding; had a representative on the committee that helped the city select a new Chief Resiliency Officer; and encourages its member organizations to participate in city hearings on relevant topics.⁶⁵
- ▶ In **ST. PAUL**, the city, Macalester College, and the Science Museum of Minnesota partnered to host “community climate change conversations” in four districts, at which residents talked with their neighbors about concerns for local climate change impacts and to prioritize the solutions they would like to see implemented. The process hosted a follow-up meeting for participants to speak directly with city leaders and share their stories.⁶⁶
- ▶ In **CLEVELAND**, where the city tied climate change efforts to the revitalization of neighborhoods, city officials worked with community development corporations in low-income neighborhoods to develop Neighborhood Climate Action Toolkits with tools, resources, and guidance that help neighborhoods use their assets to increase adaptive capacity and prepare for climate changes. As [Abt Associates reported](#), toolkits “help neighborhoods and residents: Learn about Cleveland’s Climate Action Plan. Identify neighborhood assets and concerns and relate them to climate action. Develop neighborhood climate action project ideas. Develop a neighborhood climate action project proposal that they can use to secure funding to implement their climate action project ideas.” After a neighborhood’s residents participate in a workshop to complete the toolkit, they apply for funding from the city to implement specific projects.⁶⁷
- ▶ **BALTIMORE** initiated an extensive effort to educate and engage community members as part of its adaptation planning process, earning the American Society of Adaptation Professionals’ Prize for Progress in Adaptation.

CAPACITY 5: INTERGOVERNMENTAL ALIGNMENT



A city's capacity for Intergovernmental Alignment for climate adaptation is the ability to coordinate planning and action across governments at local, regional, state, tribal, and federal levels.

Local climate impacts don't confine themselves to a city's jurisdictional boundaries, and the strategies to prepare for them don't either. Few, if any, cities can go it alone to achieve effective climate adaptation. At the same time, it is likely that climate changes will impact the ecosystems that a city depends on—watersheds and coastal areas, for example—and these often extend beyond the city's boundaries, yet another reason that alignment with other jurisdictions is essential. The Institute for Sustainable Communities (ISC) identified three practical benefits of regional-level alignments: coordination of effective action across multiple governments; reduction and resolution of conflicts; and pooling of funding, capacities, and communications.⁶⁸

The Intergovernmental Alignment of relationships—both “horizontally” within the metropolitan area and “vertically” across different levels of government—is voluntary and may involve undertaking a number of functions: understanding climate projections, supporting planning efforts, including vulnerability studies, setting shared priorities for adaptation actions, aligning decision-making authority, and undertaking intergovernmental responsibilities for policies and accountability for implementation.

The Intergovernmental Alignment capacity involves, most fundamentally, the development of productive partnerships, often a slow process that requires trust building and the identification and exploration of potential mutual interests. Often, the aligning process begins with shared learning processes, rather than actions or formal agreements. But in places with historic rivalries or current competition among jurisdictions, it can be challenging to even initiate “low-hurdle” alignment. The Institute for Sustainable Communities described a four-part continuum for regional-scale collaboratives with differing degrees of formality and flexibility:

- ▶ **Informal Networks** in which members work together toward a shared goal
- ▶ **Chartered Networks** with agreed-upon rules that specify how members govern their interactions and make decisions
- ▶ **Legal Entities** that give privileges to members such as collecting and managing funding, hiring staff, and entering into contracts
- ▶ **Regulatory Bodies** that have the authority to act as a government, including the ability to levy taxes, set regulations, and make policies.⁶⁹

In cities where Intergovernmental Alignment is emerging, especially at the metropolitan level, some sort of formal agreement and structure, with dedicated resources, is put into place. The structures may have shared control by the participating governments. However, few such efforts have aimed to create a new form of regional government (the Legal Entities and Regulatory Bodies in the ISC continuum); they foster collaboration among jurisdictions at a regional scale, but not the redesign of local government authority.

Examples of Intergovernmental Alignment Capacity

- ▶ In the **SAN DIEGO** Regional Climate Collaborative, 10 cities, county government, and local utilities, academic, and philanthropic organizations are preparing for sea-level rise, flooding, wildfires, and other climate changes by coordinating activities, partnering to improve local understanding of climate risks, building local capacity through training and convenings, and helping to obtain funding for project implementation. The Collaborative received a \$689,500 grant from the National Oceanic and Atmospheric Administration to lead the Resilient Coastlines Project of Greater San Diego, which connects and coordinates local sea-level rise initiatives across the region.⁷⁰
- ▶ In **SALT LAKE CITY**, city government started discussions with other municipalities in the region, which after several years morphed into the Utah Climate Action Network, a forum for regional collaboration with about 30 governmental and other local organizations focused on adaptation planning, especially water systems, and coordination with relevant state and federal programs. In 2016 the network obtained funding to hire a manager.
- ▶ The **SOUTHEAST FLORIDA** Regional Climate Change Compact, established in 2010 to coordinate climate adaptation and mitigation activities across four counties' lines, is a go-to resource for 108 municipalities, providing opportunities for technical assistance, collaborative projects, information sharing, and peer learning. There is further alignment with some state agencies that provide tools to support local climate adaptation. The Compact is a voluntary collaboration, without regulatory or taxing authority, which provides a platform for Southeast Florida jurisdictions to coordinate on climate commitments, state and federal advocacy, share best practices, and collaborate on projects. One of those collaborative initiatives was the 2012 development of the Compact's Regional Climate Action Plan (RCAP), which outlines 110 recommended climate preparedness actions, some of which are actions the Compact can implement collaboratively and others of which are actions each jurisdiction needs to pursue.⁷¹ Since the RCAP's release, Compact jurisdictions have worked together to set unified sea level rise projections, hold annual regional summits to share best practices, and develop a suite of indicators to monitor climate impacts across the region. In addition to the broad umbrella of regional collaboration that the Compact provides, agencies in several sectors are working together to coordinate action. Three of the counties' Metropolitan Planning Organizations jointly developed a transportation vulnerability assessment through a grant from the Federal Highway Administration. Additionally, the region is developing an Infrastructure Coordination Council to align significant infrastructure investments, and the water and wastewater utilities have formed a regional utilities collaboration.
- ▶ In May of 2016, the seventeen members of the Metro Mayors Coalition, representing **BOSTON** and surrounding municipalities, convened to sign the **Climate Preparedness Commitment**, pledging to work together to prepare the region for climate change and to reduce greenhouse gas emissions. The Coalition launched an ongoing Taskforce to address vulnerabilities in the region's shared critical infrastructure, such as transportation, food

Few, if any, cities can go it alone to achieve effective climate adaptation.

systems, energy, clean water, telecommunications, and health and safety protections. The Taskforce will help to coordinate a regional and cross-governmental effort to protect critical infrastructure and other vital resources and systems. It will also develop best practices for local government, make policy recommendations, set regional priorities based on the goals outlined at the Summit and develop an action-based work plan to present to the Metro Mayors Coalition on an annual basis.

- In the **SAN FRANCISCO** Bay area regional alignment is realized through cooperative relationships among a number of government entities, associations, and nonprofit organizations. Securing voter approval of Measure AA in 2016, which will provide \$500 million for adaptation to sea level in the Bay, is one example of what this network coordination can achieve. A key player is the Bay Conservation and Development Commission (BCDC), created by the state in 1969, the first coastal zone management agency in the U.S., which regulates development along the Bay's shoreline. In its regulatory role, BDCD has worked to incorporate sea level rise projections into permit requirements for development in and along the Bay. But the leadership at BCDC recognized that regulation alone was insufficient to achieve BDCD's desire to catalyze a coordinated approach to addressing sea level rise around the Bay. In 2010, BCDC joined forces with the National Oceanic and Atmospheric Administration's Coastal Management Office to create the Adapting to Rising Tides (ART) program. ART brings together local, regional, state and federal agencies and organizations, as well as non-profit and private associations, for collaborative planning to identify how communities

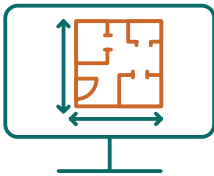
can adapt to sea level rise by restoring ecosystem health, protecting infrastructure, strengthening the economy, and enhancing equity. Over the last six years, the ART program has integrated adaptation into local and regional planning and decision-making in multiple ways, including: leading collaborative preparedness planning projects; providing technical assistance to other planning efforts; creating the ART Portfolio, which has a comprehensive set of online preparedness resources and a help desk to assist practitioners in using those resources; and advocating at state and federal levels to ensure policies, programs, and resources are responsive to the needs of the

In Salt Lake City, city government started discussions with other municipalities in the region, which after several years morphed into the Utah Climate Action Network.

Bay Area.⁷² To date, BCDC has invested \$3 million in adaptation planning in communities around the bay, and hopes to invest \$8 million more during the next five years to complete planning in all Bay Area communities. In addition to ART, BDCD joined forces with other key regional agencies—Metropolitan Transportation Commission, Association of Bay Area Governments, and Bay Area Air Quality Management District, to create the Bay Area Regional Collaborative (BARC) in 2013. BARC is a consortium of member agencies that agree to work together to address crosscutting issues of regional significance, including developing regional climate protection and climate adaptation strategies.⁷³ In October 2016, BCDC adopted a sea level rise policy, which sets the organization on a continued course of regional leadership, including: taking a leading role in developing a regional sea level rise adaptation plan; ensuring all nine counties conduct a robust vulnerability assessment; pursuing organizational agreements to foster a regional perspective and

enhanced intergovernmental collaboration; strengthening existing laws, policies and regulations to fully consider impacts of sea level rise in permitting and decision-making processes; and supporting a regional data depository to track sea level rise impacts and inform adaptation actions.

CAPACITY 6: TECHNICAL DESIGN



A city's capacity for Technical Design for climate adaptation is the ability to design, test, and implement adaptation actions that require engineering, legal, and other highly specialized details, as well as performance metrics for monitoring.

Sooner or later, a city's adaptation effort requires the design and implementation of actions—policies, regulations, investments, and projects—that are technically complex, far more so than the goal, strategy, and action statements in an adaptation plan. The complexities may involve engineering design: how much and how to protect a particular roadbed from flooding, for example, or how much green infrastructure is needed to retain a certain amount of water after a rainfall. They may involve legal issues: for instance, which city codes, ordinances, and permitting processes should contain new adaptation standards for buildings or how to make sure that city prohibitions against development in certain areas will survive legal challenges. Integrating adaptation policies into a typical city's array of plans—comprehensive plans, watershed management plans, tree and shade plans, capital improvement plans, and the like—is another technical design task. Nordgren, Stults, and Meerow noted that city practitioners they studied “placed great emphasis on the need for specific policy tools, model ordinances, and bylaws to help accelerate the transition from planning into action.”⁷⁴ Sometimes, the answers to engineering, legal, and other questions are not known and it becomes necessary to develop innovative approaches. Or the answers exist but have not been fully tested and proven, and it's necessary to test and assess them. Often there is a sufficient amount of time to address the complexities that arise in developing the detailed actions. But sometimes the technicalities of an action should be worked out in the anticipation that at some unknown future time the opportunity to implement the action will emerge and will have to occur quickly. An additional technical design concern is the development and monitoring of indicators of adaptation progress. The Woodruff and Stults analysis of 44 city adaptation plans found that far fewer than half of them detailed how progress of action-implementation would be measured or included requirements for regular reporting of progress.

BOSTON's adaptation plan identified several types of technical design issues that most cities face when they get down to the details of adaptations they are considering or have decided to pursue:

- ▶ **Adaptation plans should create “layers of protection working at multiple scales.”** The design of layers can result in mutual support between the layers and reduce the risk of catastrophic failure in a single layer. “For example, to address extreme heat, adding green infrastructure (e.g., increasing tree canopy) in combination with building-scale adaptations (e.g., using cool roofing and paving materials or increasing energy efficiency) is more effective than doing either independently. Shading from the tree canopy reduces the cooling

load on the building, and the retrofitted building radiates less heat, with a failure to either layer having less impact because of the other.” A city’s multiple physical scales—streets and buildings, neighborhoods and districts, citywide infrastructure systems—poses the additional technical challenge of ensuring that adaptation actions designed for one scale will be compatible with designs at other scales.

- ▶ **Adaptation actions should be designed for “flexibility and adaptability” because climate conditions will change over time.** “For example, the 24-hour rainfall for a ten-year storm is projected to increase through the century. To be effective, the stormwater system must be flexible enough to adapt to this increase in extreme precipitation. In practice, this often means decentralized, distributed stormwater storage across cities that can be expanded without disrupting the gray stormwater system. Similarly, the elevation of 1 percent annual chance floods is also projected to increase throughout the century. Buildings can be built today with high ground-floor ceilings so that the ground floor can be filled in as sea levels rise over time.” Another example: In the San Francisco Bay Area, flexibility will be needed in the design of wetlands restoration projects that will be initiated to reduce damage from projected sea level rise. The projects’ design will be based on current assumptions about how much change in sea levels must be addressed. But these projects will require many years to design, permit, and complete, during which the assumptions could prove to be incorrect. Flexible design of the projects would allow for adjustments that may become necessary.
- ▶ **Adaptation actions should “leverage building cycles.”** Taking adaptation actions within the natural cycle of rehabilitating or replacing buildings and infrastructure “can reduce disruption and cost, as in the case of adding green infrastructure to roads as they are being rebuilt, rather than pulling them up just to install green infrastructure.”

Buildings can be built today with high ground-floor ceilings so that the ground floor can be filled in as sea levels rise.

A city’s Technical Design capacity involves having substantial and prolonged access to a set of professional proficiencies—engineering, legal, and policy development, for example—that are relevant to the particular adaptation challenges the city faces. Cities may develop these proficiencies in-house, within their departments and agencies, and obtain them through contracting for outside expertise or in partnership with businesses, higher education institutions, and nonprofit organizations. Typically, the professionals participate in networks and associations that offer opportunities to further develop expertise, through education and training as well as peer-to-peer exchanges.

Examples of Technical Design Capacity

- ▶ In **NEW YORK CITY** the Rebuild by Design competition to design physical infrastructure solutions for sea level rise attracted the expertise of design teams—architects, engineers, landscape architects, ecologists, infrastructure experts, real estate developers, and others—from around the world, and a version of this competition process is now being introduced in **SAN FRANCISCO** by a coalition of area leaders.⁷⁵

- ▶ In 2014 **SAN FRANCISCO** developed and formally adopted a 38-page technical guidance document detailing how sea level rise should be accounted for in proposed infrastructure projects. It noted, for example, that “in many instances, it is not feasible or cost effective to design and build for long-term potential sea level rise scenarios of a highly uncertain nature,” and that projects should have adaptive capacity so they can meet such scenarios.⁷⁶ Developers of the guidance included city planning, public works, transportation, public utilities, the port, the airport, and private sector engineers.
- ▶ **GRAND RAPIDS** (Michigan), a city susceptible to river flooding, created guidelines that require all upgrades of or new road and stormwater projects to prioritize green infrastructure techniques or justify why this is not technically feasible. A case study by Abt Associates⁷⁷ notes that a 2012 report had identified green infrastructure as a community priority and when the chamber of commerce and other organizations asked for an assessment of what infrastructure improvements were needed and how they would be funded, the city hired an engineering consulting firm to develop the answers. That report confirmed the need for significant investment and that green infrastructure could be used effectively. The guidelines subsequently adopted by the city specify that projects for investment will be “accessible, attractive, environmentally responsible and safe; serving all people of our community . . . [and be based on design that] manages stormwater in place through low impact development practices, enhances urban tree canopy and quality of life in neighborhoods and economic vitality in business districts.”⁷⁸ Adoption of the guidelines, Abt reported, led the city to start developing the next level of technical detail for its long-term stormwater management. The city contracted with an engineering firm to assess how climate change could affect rainfall patterns and what areas of infrastructure are the most vulnerable to issues such as extreme weather and increased precipitation. It also created a stormwater management oversight commission to ensure the prioritization of green infrastructure is implemented.
- ▶ In 2014, the **SOUTHEAST FLORIDA** Climate Change Compact collaborated with the Dutch Consulate in Miami to work with local government staff, key regional stakeholders, and experts from the Netherlands to propose resilient design strategies that could serve as models of resilience for communities throughout the region. The collaboration resulted in the Southeast Florida Resilient Redesign initiative, which hosts intensive design charrettes to explore integration of climate preparedness design solutions into future development and redevelopment projects. The first Resilient Redesign in July 2014 focused on three areas of Southeast Florida that represent characteristic landscapes in the region—a barrier island site, suburban site, and commercial corridor. The three-day event engaged nearly 50 professionals to develop preliminary designs for the three focus areas. As a result of the collaboration, the City of Dania Beach worked with Broward County to receive an Environmental Protection Agency grant to refine initial planning scenarios and design recommendations. The Compact has hosted two other charrettes in 2015 and 2016, focusing on new areas of Southeast Florida.

The three-day event engaged nearly 50 professionals to develop preliminary designs for the three focus areas.



CAPACITY 7: FINANCIAL RESOURCES

A city's Financial Resources capacity for climate adaptation is the ability to repurpose, leverage, and obtain public and private funds to invest in infrastructure development and other adaptation actions.

Cities face a number of challenges when it comes to financing adaptation actions. Any public funding needs must compete with other priorities for the use of city government revenues. The availability of grants from state and federal governments is limited

by those governments' priorities and resources. Efforts to raise new local revenues, through increased taxes or user fees, are usually subject to political concerns about voter approval (of either the tax or fee or the elected officials raising them). And a city's access to private capital, for instance, long-term debt through municipal bond markets, may be limited by the existing indebtedness of the city as well as the lending requirements of the bond market. Moreover, cities have to develop agreement among elected officials and business, community, and other stakeholder groups on which and how much of the costs of adaptation should be borne by the public sector and which should be borne by business or residents who use public services. This also involves deciding whether and how to help low-income populations and neighborhoods or struggling businesses to access funding they need to carry out their own adaptation actions, such as increasing buildings' resilience.

Financing for adaptation actions may come from traditional financing sources or from innovations in finance. In general, there are three types of financial sources for cities, each with different drivers:

- ▶ Public financing, driven by the intended public purpose
- ▶ Private financing, driven by the ability to repay at a projected rate
- ▶ Philanthropic funding, driven by the potential to achieve changes related to the philanthropy's mission⁷⁹

Within these three categories there are many different traditional mechanisms that deliver capital, each with its own requirements: private investors in bond markets provide long-term debt but have low tolerance for financial risk; federal and state government grant and loan programs support infrastructure development, but are guided by those governments' spending priorities; businesses invest their capital in public-private partnerships for building and operating infrastructure; local taxes and fees on users of services such as water, sewage and stormwater management, transportation, and electricity, provide revenues for operating the services. Each of these sources raises capital and forms rules about accessing and using the capital; the dozens of financing mechanisms they create (e.g., revenue bonds, tax increment financing districts) differ in what they can be used for, how they are repaid, how much financial risk they tolerate, their complexity, how much capital they provide, and other characteristics.

The development of cities' financial resources for climate adaptation occurs in three ways:

- ▶ **The repurposing and leveraging of existing public funds for adaptation.** For example, a city's upcoming investments in transportation and other infrastructure improvement, repair, replacement, or expansion can be designed to meet standards for adaptation such as protection from flooding, which either forces changes in the typical design of infrastructure or consideration of alternative types of infrastructure, such as green infrastructure. In addition, note the authors of "Climate Adaptation Finance Mechanisms," public funds "can be more actively used to leverage private participation through packaging of finance strategies."⁸⁰
- ▶ **The generation of increased revenue from local taxpayers and service users.** For example, the city may decide to increase fees for, say, water supply, or increase taxes, with the additional revenue dedicated to adaptation actions. Cities have found that if the city has experienced climate disasters or if co-benefits of the adaptation investments are emphasized, the odds of adopting an increase improve. In either case, the support of users or taxpayers is essential to reduce the potential negative political consequences of these cost-increasing efforts.
- ▶ **The development of innovative financing mechanisms designed for adaptation resources.** Innovations can involve using traditional mechanisms in new ways, such as green bonds that provide long-term financing for green, rather than grey, infrastructure. Or innovations may involve developing entirely new mechanisms, such as "cap-and-trade" markets for stormwater retention.

Development of financial resources to support climate adaptation is made more challenging by the difficulty of quantifying the Return on Investment (ROI) from adaptation expenditures.

A city's Financial Resources capacity is based on several elements: its expertise with using the large menu of public and private financing mechanisms, which usually lies in the city's finance department; its intergovernmental relationships that can be used to coordinate infrastructure investment and develop cost-sharing and financing agreements; its partnerships with organizations thinking creatively about new financial mechanisms, including nonprofit organizations and private financial companies; and its proficiency in local "demand creation and deal packaging." The capacity to develop projects that meet the requirements of financial investors is often overlooked. As ICLEI reported in "Financing the Resilient City," accessing capital for adaptation is partly a match-making process for which "the right capacity must be available at the local level to leverage the right finance," and one function of local capacity is "to organize effective demand" in the form of projects ready for capital.⁸¹ A similar point is made in a 2015 working paper supported by the Kresge and MacArthur Foundations, "Community Investment: Focusing on the System": for communities to attract more capital for adaptation and other priorities, they must "develop a more coordinated, strategic approach to organizing demand for capital and ensuring it is deployed to achieve their social and environmental priorities."⁸² An essential element of preparing deals for financing, as the Rockefeller Foundation noted, is to be able to articulate the project's measurable, predictable benefits for stakeholders with the ability to invest and to "maximize private financing to conserve public and philanthropic funding."⁸³ In addition, explain Jack Karetz and Samuel Merrill in a review of adaptation financing

mechanisms, packaging and leveraging financing requires thinking about “the co-benefits that can be created,” which is not usually needed when financing traditional public works.⁸⁴

Development of financial resources to support climate adaptation is made more challenging by the difficulty of quantifying the Return on Investment (ROI) from adaptation expenditures. In GHG reduction/climate mitigation efforts, most reductions in energy use bring economic benefits in the form of reduced energy expenditures; so economic actors can calculate their returns from an investment. But for most adaptation expenditures, there is no measurable return until some form of potential risk materializes: a flood, extreme heat, collapse of an economic sector, etc. More precise vulnerability assessments help by more accurately quantifying the expected average rate of loss from future risks, but the actual economic benefit still does not materialize until the losses are experienced. Thus, building accepted risk/return calculations that cities can use to justify long-term adaptation investments is one of the large challenges for adaptation practitioners.

Examples of Financial Resources Capacity

- ▶ **WASHINGTON, D.C.**'s water utility has been especially innovative in developing new financing mechanisms. It created the nation's first Environmental Impact Bond, \$25 million to fund green infrastructure, in partnership with Goldman Sachs and the Calvert Foundation. The bond contains a unique “pay for success” provision according to which payments to investors would vary depending on how effectively the green infrastructure controls stormwater runoff.⁸⁵ The utility also created the nation's first stormwater retention credit market, winner of a 2014 award from C40 Cities.⁸⁶ The market enables developers, who are required to manage stormwater runoff on projects, to meet their mandated requirements by purchasing credits from offsite designs like rain gardens, green roofs, permeable pavement and other green infrastructure that reduce stormwater runoff elsewhere in the city.
- ▶ After an extensive \$3-million campaign, voters in the nine-county **SAN FRANCISCO BAY AREA** approved Measure AA, a \$12-a-year parcel tax that will generate about \$25 million annually for 20 years to enhance the San Francisco Bay's shoreline, restore wetlands, and protect homes, businesses and infrastructure from flooding. The campaign emphasized the condition and uses of the San Francisco Bay, rather than the necessity of adapting to sea level rise.
- ▶ Several years after catastrophic wildfires threatened water supplies, voters in **FLAGSTAFF** approved a \$10 million bond measure to fund forest thinning to reduce the risk of wildfires in the region's watersheds.
- ▶ **MIAMI BEACH**, where rising seas have already led to significant disruption of life-as-usual, raised stormwater rates 84 percent (\$7 per month per household), which through bonding against future revenue resulted in a \$90 million initial investment in infrastructure projects to address flooding from sea level rise.
- ▶ In **BERKELEY**, voters approved a \$100 million bond measure to improve Berkeley's infrastructure over 40 years—to repair, renovate, replace, or reconstruct the City's aging infrastructure and facilities, with a priority on climate adaptation.

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DEVELOPING AND INSTITUTIONALIZING THE CAPACITIES

Institutionalizing Capacities

For most cities, the seven capacities for climate adaptation need to be sustained and institutionalized into the fabric of governance, because climate adaptation is inherently a long-term, iterative, and adaptive process. Institutionalization typically involves creation of new organizational arrangements, dedicated resources, and development of professional competencies. Along these lines, as described in some of the examples earlier, some cities have found ways to start institutionalizing the capacities:

- ▶ **Scientific Foundation.** They create permanent advisory boards to engage the scientific community in periodically analyzing climate data and advising the city about adjustments in its assumptions about future climate.
- ▶ **Inclusive Engagement.** They initiate training for city staff in how to conduct inclusive community planning and how to engage vulnerable communities and develop actions with equitable outcomes. And they support the development of other technical staff capacities within city government.
- ▶ **Intergovernmental Relationships.** They develop formal relationships—compacts, collaboratives—among cities in the metropolitan region to work together on certain aspects of climate adaptation, including coordination of investments in infrastructure.
- ▶ **Technical Design.** They develop processes to integrate climate projections and adaptation strategies into *all* city plans, policies, investments and project designs, including zoning codes, building codes, development approval processes, and infrastructure investments. And they include climate adaptation outcomes and metrics in the evaluation of projects, policies, and programs' success.
- ▶ **Financing Resources.** They establish long-term revenue streams—taxes, user fees—to provide public investment for adaptation actions.

But so far this sort of institutionalization has occurred mostly in isolated, one-off developments that don't yet add up to a prevailing practice in urban climate adaptation. There are a number of ways that cities can work to change this:

- ▶ **Start at Home.** Individual cities can work locally with cross-sector civic leaders, community groups, and local philanthropies to develop approaches for building the most important adaptation capacities locally and institutionalizing them.
- ▶ **Engage in Peer Learning.** Cities can learn from each other about how to build and institutionalize the needed capacities, using peer-to-peer exchange, site visits, and other methods for sharing their useful how-to information and lessons learned.

- ▶ **Form “Institutionalization Clusters” of Cities.** Groups of cities can band together to develop shared capacities and institutionalize them, not just as peer knowledge, but operationally. Cities are already organizing some adaptation capacity-building efforts—mainly the Scientific Foundation, Communications, and Intergovernmental Alignment capacities—at metropolitan, sub-state regional, and inter-state scales
- ▶ **Develop Voluntary Best-Practice Standards.** Groups of cities can work with city-oriented NGOs, philanthropic funders, business sectors such as real estate developers, and community-based organizations, as well as state and federal governments, to develop and put into place high-quality standards for adaptation policies, regulations, and practices that cities can choose to use.

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CHECKLIST FOR CITY ADAPTATION CAPACITIES

The checklist below depicts three stages in a city's development of each essential capacity for climate adaptation. You can use the checklist to roughly assess where your city stands in this developmental progression, by marking the description for each capacity that best captures your city's status. (If your city has not begun, don't circle anything.) Your circles will form a pattern that indicates which strengths your city is building and where it might have capacity gaps worth paying attention to.

	STARTING Awareness & Instigation	BEING DEVELOPED Activities	INSTITUTIONALIZED Partners, Proficiencies & Resources
<p>SCIENTIFIC FOUNDATION</p> <p>Capacity to assess climate risks and vulnerability of the city's built, natural, and economic assets and its populations, and use these analyses for ongoing planning</p>	<p>City recognizes the need to have regional or localized climate projections as basis for planning and to have a framework for assessing city assets and populations and their climate vulnerabilities; it begins to develop both of these</p>	<p>City is using regional or localized climate projections to assess risks and develop a comprehensive assessment of asset and population vulnerabilities to guide adaptation planning</p>	<p>City has used regional or localized climate projections and vulnerability assessments for planning and has ongoing partnerships that will periodically update regional or localized climate change projections and manage data and technical analysis of vulnerabilities in future</p>
<p>COMMUNICATIONS</p> <p>Capacity to communicate with and educate civic leaders and community members to build and sustain a sense of urgency to adapt for climate changes</p>	<p>City recognizes the need to build a commitment to adaptation in the community; it begins to develop the case for adaptation action and plans for communications and education campaigns</p>	<p>City is supporting educational campaigns targeted to stakeholder groups and the community, with basic case statement about risks of inaction and benefits of adaptation action</p>	<p>City has implemented educational campaigns to build sense of urgency and has partnerships, resources, and plans and resources in place to sustain stakeholder and community understanding and support for climate action</p>
<p>EQUITABLE ADAPTATION</p> <p>Capacity to make social and economic equity a central driver and priority of the city's adaptation approach</p>	<p>City acknowledges social and economic inequities in city and the possibility that adaptation actions will exacerbate them; it begins to assess equity-in-adaptation issues</p>	<p>City is assessing local equity issues in adaptation and using "equity lens" to assess and prioritize possible adaptation actions that benefit vulnerable populations</p>	<p>City has made equity a driver of its adaptation plan, with prioritization of actions that positively affect equity, has developed partnerships with community-based groups, and has developed mechanisms to ensure accountability for implementation</p>

	STARTING Awareness & Instigation	BEING DEVELOPED Activities	INSTITUTIONALIZED Partners, Proficiencies & Resources
<p>INCLUSIVE COMMUNITY ENGAGEMENT</p> <p>Capacity to fully engage stakeholders and the public, especially vulnerable and underrepresented populations, in developing and monitoring adaptation plans</p>	<p>City recognizes that more than traditional community outreach processes are needed to fully engage all parts of the community in planning; it begins to explore how to conduct inclusive engagement process</p>	<p>City is committed to inclusive engagement and working with stakeholder groups to design and implement engagement processes that build stakeholders' capacities and influence</p>	<p>City has developed proficiency, established partnerships with stakeholder organizations, and dedicated resources for continuous inclusive engagement in monitoring adaptation plan implementation and future planning cycles</p>
<p>INTERGOVERNMENTAL ALIGNMENT</p> <p>Capacity to coordinate planning and action across governments at local, regional, state, tribal, and federal levels</p>	<p>City recognizes the need to work closely with other governments to develop effective adaptation plans; it begins to identify opportunities to build intergovernmental relationships focused on adaptation</p>	<p>City is engaging other governmental jurisdictions in jointly developing and implementing adaptation plans and actions, and exploring ways to sustain and expand alignment</p>	<p>City has formally established intergovernmental partnerships for coordination of climate adaptation planning and actions, with dedicated resources (staffing and funding), coordination plans adopted, and shared adaptation activities underway</p>
<p>TECHNICAL DESIGN</p> <p>Capacity to design, test, and implement adaptation actions that require engineering, legal, and other highly specialized details, as well as performance metrics for monitoring</p>	<p>City recognizes that it will need new or increased technical abilities to develop adaptation actions; it begins to identify specific abilities and consider ways to obtain them</p>	<p>City is obtaining and using technical support for designing adaptation actions and integrating them into relevant city policies</p>	<p>City has completed deep technical design of major adaptation actions and developed partnerships and allocated resources to ensure long-term access to necessary technical proficiencies; it has established performance metrics for monitoring implementation of adaptation actions</p>
<p>FINANCIAL RESOURCES</p> <p>Capacity to repurpose, leverage, and obtain public and private funds to invest in infrastructure development and other adaptation actions</p>	<p>City recognizes that its adaptation plans will require significant financing, but its ability to provide funds is constrained; it begins to consider ways to secure funding for actions</p>	<p>City is analyzing a range of financial mechanisms that may be used or developed to pay for adaptation actions under consideration</p>	<p>City has established in-house proficiency, intergovernmental alliances, and partnerships with financing experts and local organizations to develop funding streams for adaptation actions and to package financial deals</p>

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SUMMARY
CONCLUSION

Advancing the development of effective climate adaptation by U.S. cities depends on the decisions that cities make individually and collectively. Each city must determine its understanding of what adaptation requires and its commitment to building the adaptation capacities it needs. Cities in metropolitan regions, states, multi-state regions, and nationally must determine their interest in and commitment to working together to ensure that all cities can access and benefit from the adaptation capacities they need. As cities consider these possibilities, the following conclusions from our research may be helpful:

- ▶ **There are Wide Variations in Planning Quality.** An increasingly large number of cities are engaging in climate adaptation planning, although the number of cities with sophisticated plans is still quite low. There is little consistency in the quality of city adaptation processes and plans' content. How will best practices and standards for urban adaptation planning be developed?
- ▶ **There is An Implementation Gap.** Few cities have moved aggressively from adaptation planning to implementation, and most cities that have are motivated by some sort of experienced, not prospective, climate crisis. The barriers to implementation are quite challenging. How will cities that are not yet motivated by an experienced climate disaster be able to overcome them?
- ▶ **Cities Require Fundamentally New Capacities.** Effective climate adaptation implementation requires the development of a new set of capacities for cities—and these competencies need to be institutionalized within the fabric of city governance. Thanks to the experiences and lessons learned of the first wave of cities undertaking adaptation planning, it is possible to define these capacities and say something about what it takes to develop them. How will cities develop and institutionalize essential adaptation capacities?
- ▶ **Cities Need to be Collectively Intentional About Building Capacities.** To advance the development of urban adaptation capacities will require a critical mass of cities to come together to reach consensus on what these adaptation capacities entail—a framework—and which ones they should seek to develop with their partners in philanthropy, the nonprofit and private sectors, and other levels of government. How will cities stimulate the development of a widely shared vision and strategy for achieving effective urban adaptation?



**ONLINE RESOURCES
FOR CITIES**

ASSESSMENTS OF CITY ADAPTATION PLANNING PRACTICES

- ▶ Abt Associates, “Climate Adaptation: The State of Practice in U.S. Communities,” November 2016.
- ▶ James C. Arnott, Susanne C. Moser, and Kristen A. Goodrich, “Evaluation that counts: A review of climate change adaptation indicators & metrics using lessons from effective evaluation and science-practice interaction,” *Environmental Science & Policy* (2016).
- ▶ John Nordgren, Missy Stults, and Sara Meerow, “Supporting local climate change adaptation: Where we are and where we need to go,” *Environmental Science & Policy* (2016).
- ▶ Sierra C. Woodruff and Missy Stults, “Numerous strategies but limited implementation guidance in US local adaptation plans,” May 2, 2016, *Nature Climate Change* (MacMillan Publishers, 2016), www.nature.com/nclimate/journal/v6/n8/full/nclimate3012.html

PLANNING PROCESSES

▶ Climate Hazards

- C40 Cities & Arup, “City Climate Hazard Taxonomy.” Classifies climate hazards into five key groups: meteorological, climatological, hydrological, geophysical, and biological—to assist cities identifying other cities or tools and techniques that are appropriate for helping them to manage that hazard. At www.c40.org/researches/city-climate-hazard-taxonomy.
- United States Agency for International Development, “A Review of Downscaling Methods for Climate Change Projections,” September 2014, www.climatelinks.org/resources/review-downscaling-methods-climate-change-projections

▶ Vulnerability Assessment

- U.S. Environmental Protection Agency, “Climate Change, Health, and Environmental Justice,” December 2016. Contains climate communication materials that summarize key points for the different populations that are disproportionately affected by climate-change impacts; provides a comprehensive analysis of observed and projected health impacts from climate change, and specifies the impacts on a range of vulnerable populations. The eight assessment kits distill this information and focus on the climate impact attributes respective to each population of concern, while offering educational materials and communication strategies.
- Although produced in 2007, ICLEI’s “Preparing For Climate Change: A Guidebook For Local, Regional, And State Governments,” provides useful general guidance for developing a city’s vulnerability assessment.

▶ Adaptation Metrics

- Urban Sustainability Directors Network and Government of the District of Columbia, “Developing Urban Climate Adaptation Indicators,” <http://usdn.org/public/page/18/Climate-Change-Preparedness>.

► **Rebuild by Design (RBD) Model**

- As applied In San Francisco: http://www.resilientbayarea.org/?utm_source=Master+Contact+Sheet&utm_campaign=eed1c1c732-January+2017+Newsletter&utm_medium=email&utm_term=0_96d3bf4fc1-eed1c1c732-98292521&mc_cid=eed1c1c732&mc_eid=1de7011a45.

STRATEGIES AND ACTIONS

► **Sea Level Rise**

- Jessica Grannis, “[Adaptation Tool Kit: Sea-Level Rise and Coastal Land Use: How Governments Can Use Land Use Practices to Adapt to Sea-Level Rise](#),” Georgetown Climate Center, October 2011. Details the use of 18 local government planning, regulatory, spending, and tax and market-based tools to address sea level rise.

► **Green Infrastructure**

- Georgetown Climate Center, “[Green Infrastructure Toolkit](#).” The toolkit analyzes common trends in the approaches various cities are taking to planning, implementing, and funding green infrastructure to manage stormwater.

► **Land Use and Building Codes**

- U.S. Environmental Protection Agency, “[Smart Growth Fixes for Climate Adaptation and Resilience: Land Use and Building Codes and Policies to Prepare for Climate Change](#),” January 2017.

CAPACITIES FOR ADAPTATION

► **Scientific Foundation**

- San Francisco [Adapting to Rising Tides website](#).
- Heartland Regional Network, “Climate in the Heartland”, September 2015, at http://usdn.org/uploads/cms/documents/climate_in_the_heartland_report.pdf.

► **Communications**

- The Miami Foundation for a Greater Miami, “We’re all in this together. Suggestions for Effective Sea-Level Rise Communication in Miami-Dade,” Fall 2016, at http://www.southeastfloridaclimatecompact.org/wp-content/uploads/2016/11/SLR_TMF_TOOL_d3.pdf.
- The Risky Business Project, “[National Report: The Economic Risks of Climate Change in the U.S.](#)” Details the potential financial costs of inaction, region by region in the U.S.

► Equitable Adaptation

- Urban Sustainability Directors Network, “[Equity in Sustainability: USDN Capacity Building Program](#),” 2016. An online program—webinars, videos, and worksheets—to support local government staff in applying an equity lens to sustainability projects.
- Georgetown Climate Center, “[Workshop on Opportunities for Equitable Adaptation](#),” April 2016.
- Movement Generation, “[Redefining Resilience: Principles, Practices and Pathways](#),” in Movement Strategy Center, “[Pathways to Resilience: Transforming Cities in A Changing Climate](#),” January 2015.

► Intergovernmental Alignment

- Georgetown Climate Center, “[Lessons in Regional Resilience](#).” This 2017 report documents lessons learned from six regional climate collaboratives, which are bringing together local governments and other stakeholders to coordinate climate change initiatives at a regional level. The collaboratives help communities overcome the limited resources and technical capacity that many cities face and enables them to share resources, leverage expertise, and develop coordinated plans and policy solutions.
- Institute for Sustainable Communities, “[Regional Governance for Climate Action](#),” January 2016, at www.iscvt.org/wp.../Regional-Resilience-Report-FINAL-small.pdf. Explores strategies emerging from 12 regional collaboratives to build or expand governance structures for regional climate action.

► Technical Design

- City of San Francisco, “[Sea Level Rise Guidance](#),” September 2014. Provides an example of a technical design instruction that applies across city departments for infrastructure project development.

► Financial Resources

- Jack Kartez and Samuel Merrill, “[Climate Adaptation Finance Mechanisms: New Frontiers For Familiar Tools](#),” *Journal of Ocean and Coastal Economics*, volume 3, issue 2, November 2016, at <http://cbe.miis.edu/joce/vol3/iss2/4/>. Presents existing tools and strategies available to pay for climate adaptation, largely as it affects the local government level in the U.S. Has special focus on “resilience bonds” and “trading market schemes.”
- Georgetown Climate Center, “[DC Water Environmental Impact Bond](#).”
- Bipartisan Policy Center, “[Public-Private Partnership Model State Legislation](#),” December 2015.

APPENDICES

A: Project Interviewees

- ▶ **Steve Adams**, Director of Urban Resilience, Institute for Sustainable Communities
- ▶ **Kristin Baja**, Climate and Resilience Planner, Office of Sustainability, Baltimore, MD
- ▶ **Leah Bamberger**, Director of Sustainability, Providence, RI
- ▶ **Zach Baumer**, Chief Sustainability Director, Austin, TX
- ▶ **Vicki Bennett**, Director, Sustainability and Environment, Salt Lake City, UT
- ▶ **Dana Bourland**, Vice President, Environment, JPB Foundation
- ▶ **Timothy Burroughs**, Chief Resilience Office, Berkeley, CA
- ▶ **Sam Carter**, Managing Director, Resilience Team and Global Resilience Partnership, Rockefeller Foundation
- ▶ **Melissa Deas**, Institute Associate, Georgetown Climate Center
- ▶ **Lois DeBacker**, Managing Director, Environment Program, Kresge Foundation
- ▶ **Laura Engeman**, Manager, San Diego Regional Climate Collaborative
- ▶ **Garrett Fitzgerald**, Strategic Partnerships Advisor, Urban Sustainability Directors Network
- ▶ **Larry Goldbanz**, Executive Director, San Francisco Bay Conservation and Development Commission
- ▶ **Tonya Graham**, Executive Director, Geos Institute
- ▶ **Jessica Grannis**, Adaptation Program Manager, Georgetown Climate Center
- ▶ **Katherine Greig**, Deputy Directory, Mayor's Office of Recovery and Resiliency, New York, NY
- ▶ **Robin Hacke**, Senior Fellow, Executive Office, Kresge Foundation
- ▶ **Lara Hansen**, Board President, Chief Scientist and Executive Director, EcoAdapt
- ▶ **Nicola Hedge**, Director of Environmental Initiatives, San Diego Foundation
- ▶ **Stuart Kennedy**, Senior Programs Officer, Miami Foundation
- ▶ **Christine Morris**, Chief Resilience Officer, Norfolk, VA
- ▶ **Kelly Muellman**, Sustainability Program Coordinator, Minneapolis, MN

- ▶ **Jim Murley**, Chief Resilience Officer, Miami-Dade
- ▶ **John Nordgren**, Principal, Foresight Consulting, and Director, Climate Resilience Fund
- ▶ **Otis Rolley**, Regional Director, City & Practice Management (Africa & North America), 100 Resilient Cities
- ▶ **Mary Skelton Roberts**, Senior Program Officer for Climate, Barr Foundation
- ▶ **Sam Schuchat**, Executive Officer, California State Coastal Conservancy
- ▶ **Diana Sokolove**, Senior Planner, Citywide Planning, San Francisco Planning Department
- ▶ **Missy Stults**, Urban and Regional Planning Program and School of Natural Resources and Environment, University of Michigan
- ▶ **Suzy Torriente**, Chief Resilience Officer, Miami Beach, FL
- ▶ **Francesca Vietori**, Senior Director, Expanding Access to Opportunity, San Francisco Foundation
- ▶ **Elizabeth Wheaton**, Environment & Sustainability Director, Miami Beach, FL
- ▶ **Sarah Wu**, Deputy Director, Mayor's Office of Sustainability, Philadelphia, PA
- ▶ **Darryl Young**, Director, Sustainable Cities, Summit Foundation
- ▶ **Katie Zimmerman**, Program Director, Air, Water & Public Health, Coastal Conservation League

B: City Adaptation Plans Reviewed

- ▶ **Atlanta, GA.** Metropolitan Atlanta Rapid Transit Authority, “Transit Climate Change Adaptation Assessment/Asset Management Pilot,” August 2013
- ▶ **Austin, TX.** Austin, “Austin Community Climate Plan,” 2015 and “Toward a Resilient Austin”
- ▶ **Baltimore, MD.** Baltimore, “Baltimore Climate Action Plan” and “Baltimore Disaster Preparedness and Planning Project – Chapter 5”
- ▶ **Berkeley, CA.** “Berkeley Resiliency Strategy”
- ▶ **Boston, MA.** “Climate Ready Boston Resilience Initiatives,” August 2016
- ▶ **Chicago, IL.** “Chicago Climate Action Plan”
- ▶ **Cleveland, OH.** “Cleveland Climate Action Plan: Building Thriving and Healthy Neighborhoods,” 2013
- ▶ **Denver, CO.** City and County of Denver, “Climate Adaptation Plan,” 2014
- ▶ **Hampton Roads, VA.** “Climate Change in Hampton Roads: Phase III: Sea Level Rise in Hampton Roads, Virginia”
- ▶ **Lewes, DE.** “The City of Lewes Hazard Mitigation and Climate Adaptation Action Plan”
- ▶ **Los Angeles, CA.** “Sea Level Rise Vulnerability Study for the City of Los Angeles -- Appendix 2: Physical Vulnerability Assessment Findings for the City of Los Angeles Final Report,” January 2013, and “Appendix 4: Economic Impact of Sea-level Rise to City of Los Angeles”
- ▶ **Miami Beach, FL.** “Sustainability Plan: Energy Economic Zone Work Plan”
- ▶ **Minneapolis, MN.** “Technical Report: Minneapolis Climate Change Vulnerability Assessment”
- ▶ **New Orleans, LA.** “Resilient New Orleans: Strategic actions to shape our future city” (2015)
- ▶ **New York, NY.** “One City: Built to Last” and “OneNYC: 2016 Progress Report”
- ▶ **Norfolk, VA.** “Norfolk: Resilient City”
- ▶ **Portland, OR.** “Portland Climate Action Plan: Local Strategies to Address Climate Change,” 2015
- ▶ **Salt Lake City, UT.** “Sustainable Salt Lake Plan 2015”
- ▶ **San Diego, CA.** “City of San Diego Climate Action Plan”

- ▶ **San Francisco, CA.** “Guidance for Incorporating Sea Level Rise into Capital Planning in San Francisco: Assessing Vulnerability and Risk to Support Adaptation,” December 2015
- ▶ **Savannah, GA.** “Coastal Region Metropolitan Planning Organization - Total Mobility Plan - 2040”
- ▶ **Seattle, WA.** “Seattle City Light Climate Change Vulnerability Assessment and Adaptation Plan”
- ▶ **Southeast Florida,** “A Region Responds to a Changing Climate: Southeast Florida Regional Climate Action Plan,” October 2012
- ▶ **Washington, D.C.** “Climate Ready DC - Action Items,” and “District Department of Transportation Climate Change Adaptation Plan”

INTERNATIONAL CITIES’ PLANS REVIEWED

- ▶ **Copenhagen.** “Climate Change Adaptation and Investment Statement - Part 2,” October 2015
- ▶ **London.** “Managing London’s Exposure to Climate Change,” September 2016
- ▶ **Montréal.** “Climate Change Adaptation Plan For The Agglomeration Of Montréal,” 2015
- ▶ **Paris.** “Adaptation Strategy,” 2015
- ▶ **Rotterdam.** “Climate Change Adaptation Strategy”
- ▶ **Vancouver.** “Climate Change Adaptation Strategy”

C: Aligning Capacities with Other Reports' Recommendations

Two recently published studies produced recommendations for advancing urban adaptation practice in the U.S. Nordgren, Stults, and Meerow offered nine recommendations, while Abt Associates offered 10 recommendations.⁸⁷ Several of these focused on mechanisms for the field—a web platform, a centralized adaptation extension service, peer-to-peer learning, partnerships—or on adaptation strategies and actions, but most touched on at least one of the seven capacities identified in this report.

SCIENTIFIC FOUNDATION	Nordgren: “Also identified was technical assistance with scenario planning and statistical and dynamical downscaling of climate models. Importantly though, participants noted that there is already a bounty of scientific information available. Instead of investing in the creation of more information, participants called for a central, easily accessible clearinghouse to store existing information, supported by technical assistance to help find and translate the information for use.”
COMMUNICATIONS	Abt: “Look for co-benefits and link climate adaptation to other salient community issues.” Nordgren: “Participants identified the need for detailed information regarding the economic impacts of climate change and assistance in using that information to make a financial case for why climate action is warranted.”
EQUITABLE ADAPTATION	Abt: “Focus on the needs of the poorest, and individuals facing disenfranchisement and racism.”
INCLUSIVE COMMUNITY ENGAGEMENT	Nordgren: “Engage professional societies and their membership, including those from public health, social justice, public works, etc. in climate adaptation activities.” Abt: “Build community support through outreach and engagement.”
INTERGOVERNMENTAL ALIGNMENT	Nordgren: “Incentivize or initiate the development of regional collaboratives of local governments, nonprofits, and other stakeholders to promote multi-jurisdictional.” Nordgren: “Work with U.S. federal agencies such as FEMA, EPA, DOT, and HUD to ensure they incorporate climate considerations in their grant review and investment decisions, thereby avoiding maladaptive activities.”
TECHNICAL DESIGN	Abt: “Takes steps to mainstream adaptation into existing policy tools such as permits, bonds, utility fees, and hazard mitigation planning.” Abt: “Accept that adaptation involves experimentation and adjustments over time.”
FINANCIAL CAPACITY	Nordgren: “Develop new resources focused on filling key gaps needed to aid in the implementation of adaptation actions. Areas for initial investment should include resources for: 1) financing adaptation...”

ENDNOTES

Endnotes

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