

# **Toward a Climate Resilience Financial System for US Cities**

Innovation Network for Communities

Cadmus Group LLC

Ramboll

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<sup>1</sup> Report coauthors: Peter Plastrik, vice president of the Innovation Network for Communities; Farrah Andersen, senior analyst, the Cadmus Group LLC; John Cleveland, executive director of the Boston Green Ribbon Commission and president of the Innovation Network for Communities; Jon Crowe, principal, the Cadmus Group LLC; Trine Stausgaard Munk, project manager in Ramboll's Liveable Cities Lab.

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## EXECUTIVE SUMMARY

This research project's purpose is to identify ways to accelerate the development and growth of public and private financial resources that US cities can use to implement climate resilience plans and projects. Cities often cite access to capital as a major barrier to the implementation of their climate resilience plans.

### **Findings**

1. ***Climate risks disrupt city financing.*** Cities use multiple, well-established public and private systems to pay for their public responsibilities, but these systems do not have the ability to meet the challenges of financing the mounting climate resilience needs of cities. Barriers include:
  - Insufficient *public* revenue for climate resilience projects.
  - New and uncertain financial risks posed by climate changes.
  - Inherent imbalances between the burdens and benefits of climate resilience projects.
  - Misaligned public policies and markets.
  - Resilience projects that fall outside of traditional municipal jurisdictions.
2. ***Emerging innovations in climate resilience finance do not sum to a system-building approach.*** A growing number of developments seek to address barriers and opportunities in climate resilience financing. We identified 30 of these [Table 1], but they are mostly "one-off" innovations and changes made by an individual city or financial institution or insurer for a specific project or financial mechanism. Most of these efforts are largely disconnected from each other. The public and private sector players engaged in climate resilience finance efforts do not have a shared vision, framework, or strategies for developing, as quickly as possible, a comprehensive, large-scale urban climate resilience financial system. The set of innovations does provide a great deal of the research-and-development that could evolve into a more systemic and impactful stage of change.
3. ***A system for city climate resilience finance would contain three key elements:***
  1. City transaction capabilities, including adaptation planning, adaptation investment planning, governance arrangements at metro-region and city district scales; and public revenue sources and funding mechanisms.
  2. State and federal government policies, including: adaptation planning requirements and support; climate resilience standards; flexible governance structure frameworks; insurance market regulations and public "last resort" insurance policy; and grants and loans for city adaptation projects.

3. Financial, insurance, and real estate market capacities, including products and services; risk assessment and disclosure; risk pricing; and lending and investment standards.

### **Recommendation**

Development of an urban climate resilience financial system can be accelerated and expanded through collaborations of cities, state and federal governments, and real estate, insurance, and financial markets, as well as community-based sectors such as health care and utilities, that prioritize, design, and implement system-building solutions.

Given the highly distributed nature of the system that exists and needs to be developed, ***cities—as the entities directly facing the financing challenge—are the only players with an overriding interest in developing all of the elements of a climate resilience financial system***. But they would need support and resources from their partner organizations, other sectors and levels of government, as well as philanthropy, to help lead and sustain such an effort.

A starting point for developing a system-building collaborative approach would be to organize cities to link, learn, and align with each other, and act in concert with relevant private sectors and other levels of government to develop and implement projects that build a climate resilience financial system.

## ABOUT THIS REPORT

This report summarizes research intended to identify ways to accelerate the development and growth of public and private financial resources that US cities can use to implement climate resilience plans and projects. It was initiated in response to a critical challenge that US cities—municipal governments—face in strengthening their resilience to climate change: Many US cities report that a key barrier to implementing climate-resilience plans and projects is the availability of financial resources to cover the significant up-front and ongoing costs. Even large, affluent cities do not currently have the financial capacity in place to fund all planned actions. Some cities in weaker financial condition may hesitate to even start planning for resilience out of fear they will not be able to afford to implement plans. (See, for instance, [“Essential Capacities for Urban Adaptation: A Framework for Cities.”](#))

Our research identified 30 distinct innovative responses to these challenges with which cities and other players are experimenting. This includes individual cities developing comprehensive financial plans for their resilience; financial institutions and insurance companies designing and piloting revised financial mechanisms; consultants developing new analytic tools; governments, academics, and private sector institutions producing studies and reports, holding conferences, and assembling task forces; and philanthropists providing funding for many of these developments.

The audience for this report is urban climate resilience leaders across public, private, and non-profit sectors, including city government staff and city-based organizations/networks; philanthropic funders; private financial and insurance sector entities; nonprofit organizations focused on climate change; and state and federal government agencies.

To gain insight, our research process combined a literature review; interviews with finance, insurance, and urban climate experts; workshop and conference participation; and a process of mapping existing financial mechanisms. This research covered a broad landscape of climate resilience finance sectors—including private financing, public funding, and private and public insurance—and analytic tools, market-scale standards and institutions, and project-scale financing mechanisms.

This research benefitted greatly from the experiences and knowledge of project partner Ramboll, a worldwide consulting engineering firm with experience in developing city-scale resilience plans and projects and understanding the European resilience finance market.

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## INTRODUCTION: CITIES HUNT FOR CLIMATE RESILIENCE MONEY

In April 2018, the Sustainable Solutions Lab of the University of Massachusetts-Boston released a 60-page study, "[Financing Climate Resilience](#)," with recommendations for how the city might pay for the \$2-4 billion of climate resilience strategies contained in the comprehensive "Climate Ready Boston" report issued in December 2016. The financing report, resulting from a nearly year-long effort costing \$75,000, addressed financial needs of a mix of projects to be implemented during the next 15 years.

Investment at this scale would require a set of creative solutions outside the bounds of traditional city financing strategies and reliable state and federal funding sources. The U-Mass team's scan of existing finance mechanisms for the city concluded that even if Boston could obtain 50-60 percent of what it might require from federal and state governments, the city would still need to borrow private capital, backed by local property taxes and/or fees on water and sewer users, to cover the gap. It would also likely need to enable at-risk districts in the city to charge local property owners to cover the cost of resilience projects that would directly benefit them. In addition, the city would need new standardized measures for the performance of resilience actions; strong justifications for private and public investment; new or revised financing mechanisms that address risks due to climate change; ways to make sure that financing burdens and benefits are fair and equitable; new governance arrangements; and revisions in state and city policies.

Similar conclusions have been reached in other cities where the initial need for climate resilience investments, both public and private, cannot be met by the current financial system. The Boston report was the latest in a series of "one-off" studies and workshops by some individual US cities and metropolitan regions—Miami Beach, Minot, North Dakota, New York City, and San Francisco Bay area among them—to figure out how to pay for their climate-resilience plans. At the same time, C40 Cities, the Environmental Defense Fund, 100 Resilient Cities, and other organizations have produced white papers and case studies showing how specific types of climate-resilience projects can be financed through particular mechanisms, such as green bonds.

Solving Boston's climate-finance problems, or those of any US city, is a complex task. But the difficulties at the local level are indicators of an even bigger challenge: how to revise the US system of urban financing so that cities throughout the nation can obtain the financial resources—easily amounting to hundreds of billions of dollars—they will need to increase resilience to climate change and prevent disasters. As the Boston study put it: "A systematic approach to fund or incentivize pre-disaster resilience at these various scales does not exist."<sup>2</sup>

This report shows how the growing number of studies and emerging innovations in climate resilience financing are setting the stage for developing a comprehensive, large-scale financial system that overcomes key barriers to investment posed by climate change. It

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<sup>2</sup> David Levy, "Financing Climate Resilience: Mobilizing Resources and Incentives to Protect Boston from Climate Risks," Sustainable Solutions Lab, UMass Boston, April 2018, 3, <https://www.greenribboncommission.org/document/financing-climate-resilience-report/>.

argues that cities have the greatest stake in such an outcome and should act collectively and in collaboration with the private sector and other levels of government to help bring it about.

## CLIMATE RESILIENCE: A NEW PRACTICE FOR CITIES

Across the US, hundreds of cities are taking steps to strengthen their climate resilience. Many of these activities focus on the development of adaptation or resilience plans, either as stand-alone action agendas or integrated as a section of broader climate or sustainability planning documents. In general, cities' climate resilience plans contain a large number of projects and programs to be implemented over different time scales. These actions typically fall into three broad categories:

- Built infrastructure—the improvement, construction, relocation, or removal of built infrastructure.
- Services—the provision of services and resources that reduce social vulnerability to climate hazards.
- Risk management—the stand-by capacity, including property insurance, for emergency response and financial recovery.

Plans and projects may cover any/all of a city's spatial scales, including:

- Parcels and sites, such as a building or a block.
- Districts and neighborhoods, including a campus such as a university or hospital complex, an airport or seaport.
- Citywide systems, such as a mobility system's roads, streets, bicycle and public transit networks, or an emergency-service system's assets, or natural systems, such as a river or wetland.
- Regional scale, such as a sea coast or watershed that extends beyond a city's boundaries.

A city's climate resilience projects and programs, at various scales, require different amounts of money and may tap different sources of revenue that cities have historically used to finance investments. For example, infrastructure projects for citywide systems or districts may use borrowed private funds that are repaid from taxes or user fees. Services—usually citywide or district-scale programs—may draw on city general fund appropriation or new user fees. Risk management generally involves private or public sector payments to insurers to cover potential future property losses at the parcel, site, or campus scale.

Infrastructure is often the most prominent area of investment identified in city climate resilience plans, so it is unsurprising that many past analyses of cities' climate resilience financial needs focus on this category of investment. Infrastructure tends to have higher costs than other adaptation actions and is typically financed by borrowing money from private capital sources, for example by using the city's bonding authority.

A city's climate resilience projects may create benefits beyond increased climate resilience, including reduction of GHG emissions, improved public and mental health, increased recreational space and neighborhood livability, improved ecosystem services, and



increased property values. Some of these benefits may generate cost savings or may be monetized to provide new revenue streams to pay for climate resilience projects and programs. For example, green infrastructure projects may lessen the need for expensive stormwater system renovation; resilient open space projects may enhance land value, generating increased property tax revenue.

Conversely, a city's climate resilience projects may exacerbate or improve historical disparities in a city due to discrimination and marginalization of particular demographic groups and areas in the city. In particular, the distribution of resources and benefits inevitably raises concerns about fairness and equity: for example, who incurs the costs for needed improvements, who realizes the benefits, who has been historically harmed, who could be harmed if the needed investment is not made, and how investments can be prioritized and distributed equitably across communities of color and low-income communities.

In summary, climate resilience investments are multi-faceted and challenging for cities to implement: they are often implemented at different geographic scales and in different jurisdictional boundaries, and often demand a daunting scale of investment for large infrastructure investments. While the investments may create intangible and occasionally monetizable co-benefits, cities must also carefully weigh the potential for disproportionate and inequitable distribution of risks, costs, and benefits. Developing the internal capacity to implement successful resilience projects and programs in light of these challenges requires a sophisticated approach to resilience planning in cities. These challenges are further compounded by the unique implications climate risks introduce, which disrupt traditional financial mechanisms and city decision-making processes, as discussed in the next section.

## FINDING 1: CLIMATE RISKS DISRUPT CITY FINANCING

Cities have historically paid for infrastructure, services, and risk management by tapping into a complex array of local, state, and federal government funding sources (taxes, user fees, grants, tax expenditures, etc.) and private financing mechanisms (municipal bonds, public-private partnerships, insurance, philanthropic grants, and social investments), each with its own legal and administrative requirements, capital-managing institutions, and amounts of capital. But climate change has introduced new factors that complicate and hinder once-reliable public funding and private financing:

***There is insufficient public revenue for climate resilience projects.*** Cities already face an infrastructure investment deficit, their general fund budgets are constantly under pressure, and they have intense competition for the use of their financial resources. They will need much more money for climate resilience projects and most of it will have to come from public sources—taxpayers and public-service users. For many cities, though, raising new public revenue may be constrained by state laws and local political, financial, and economic conditions.

***Climate change poses new and uncertain financial risks.*** Climate change increases the risk of destructive, acute, chronic, and catastrophic weather hazards, but the timing and severity of these impacts—their future pattern—is uncertain. This disrupts traditional methods of calculating and pricing risk, a crucial factor for long-term investments, such as private lending for city infrastructure, for property and other insurance, and for real-estate financing. In addition, current risk-assessment methods tend to underestimate the potential damage from some climate events.

Extreme weather events are already disrupting traditional city revenue streams: for example, post-Sandy communities lost revenue from falling property values as well as abandoned properties. California communities impacted by wildfires also faced falling property values and abandonment. Meanwhile, there are uncertainties about the performance and effective life span of some types of climate resilience projects, such as green infrastructure and sea barriers, which make it difficult to estimate the value of the climate protection they provide. Few design thresholds for physical infrastructure have been adapted to projected changes in weather and climate to ensure safe and efficient operation. Consistent and comparable performance metrics are only beginning to emerge.

***There are inherent imbalances between the burdens and benefits of climate resilience projects.*** Many resilience efforts involve short-term costs, but only produce value in the long term. Some reduce future climate damage and produce future co-benefits, but do not generate financial returns for private capital. For example, existing utility business models struggle to capture the long-term value of resilience investments whose value typically represents an avoided cost rather than a positive cash flow. In addition, resilience projects typically entail investments by public agencies, but the benefits largely accrue to private property owners. The siloed structure of government agencies, budgets, and revenue sources also gets in the way of investing in resilience projects with multiple benefits, such as green infrastructure, because it fragments government's interest and resources.

Increasing public revenue to invest in resilience inevitably raises concerns about fairness and equity: who pays, how much they pay, and what benefits they obtain. Fairness, Boston's report explained, "means that the cost burden broadly reflects benefits provided. Equity means that the cost burden reflects ability to pay, and that resilience projects do not exacerbate inequalities. These two goals are often in tension."<sup>3</sup>

**Public policies and markets are misaligned.** Some crucial government programs have been designed in such a way that they incentivize the wrong kind of behaviors relative to climate resilience. Government "last resort" insurance tends to incentivize development in places at risk of climate damage while "post-disaster" funding focuses mostly on rebuilding-as-was rather than on increasing resilience to climate change. The federal government's flood insurance programs underestimate potential climate hazards and often underprice or overprice risk relative to projected future conditions. State insurance commissions prohibit risk-adjusted insurance premiums to shield risky properties from high premiums. The insurance sector has had little reason to signal increased climate risk or incentivize risk reduction. It sets rates based on historical data and focuses on providing widespread or affordable coverage. Competition among insurers limits their interest in offering incentives or issuing new coverage requirements. The insurance industry is further discouraged from offering incentives because of uncertainties about the effectiveness of risk-reduction measures and the difficulties of monitoring their implementation or effectiveness. Moreover, real estate markets do not provide climate risk information and in some cases have resisted the potential adoption of public policies to require such disclosure. Climate risks are also not factored into mortgage interest rates.

**Many resilience projects don't fall within traditional municipal jurisdictions.** Climate impacts regularly cross municipal boundaries and affect multiple municipalities and interdependent built infrastructure and natural systems that are managed and regulated by separate government agencies. Responding effectively requires a level of collaboration for planning, budgeting, funding, and operations that is rare among siloed local government entities and may not be legal in some cases. Boston's report found that "Financial and governance mechanisms don't yet exist for transfers across municipalities, for example, to enable fees from Boston buildings to pay for upstream investments, or for developers to offset stormwater impacts in Boston with mitigation measures in other communities."<sup>4</sup> At the same time, some climate impacts are experienced at the district, rather than citywide, scale. Although states and cities provide for various district financing mechanisms (e.g., tax increment financing, business improvement districts), they have not been designed for and may not permit investment in climate resilience, and the capacity for district governance/operations for climate resilience projects is underdeveloped.

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<sup>3</sup> Levy, "Financing Climate Resilience," 5.

<sup>4</sup> Levy, "Financing Climate Resilience," 23.

## FINDING 2: EMERGING INNOVATIONS IN CLIMATE RESILIENCE FINANCE DO NOT SUM TO A SYSTEM-BUILDING APPROACH

In response to these challenges, some cities, markets, and non-local governments are in an early stage of reengineering their existing financing systems to meet the challenges and opportunities of climate resilience. Some of these efforts, such as disclosure of climate risks (by cities and corporations) and the use of green bonds are moving toward becoming widespread practice, while others are still in conceptual development.

We identified 30 emerging resilience finance developments. Most of the efforts are “one-off” innovations and changes made by an individual city, nonprofit organization, financial institution, or insurer for a specific project or financial mechanism. Table 1 categorizes these efforts by the type of barrier they address, grouped into six areas:

- A. Generating public revenues
- B. Managing financial risk
- C. Balancing burdens and benefits
- D. Aligning public policies
- E. Leveraging/catalyzing private investment
- F. Revising governance jurisdictions

Table 1 also provides examples where the new developments have been considered, are currently in development, or have been implemented.

**Table 1.**  
**Innovations in Climate Resilience Finance, with Examples**

<b>A. Generating Public Revenues</b>		
A1	Improving cost-benefit analysis (CBA) to make the case for public return on resilience-project and plan investments, including valuation of ecosystem services. In addition, CBA could be modified to include other value for a city: GHG emissions reduction, improved social and economic equity, safety, and others.	<ul style="list-style-type: none"> <li>• Ramboll, <a href="#">“Economic Benefits of Blue Green Infrastructure,”</a></li> <li>• Earth Economics, <a href="#">“Benefit-Cost Analysis”</a></li> <li>• New York City, <a href="#">CBA guidance, “Climate Resiliency Design Guidelines,”</a> intended to help projects qualify for FEMA funding</li> </ul>
A2	Requiring that city infrastructure projects and capital budgets incorporate climate risk and vulnerability analysis and adaptation plans—a way to ensure that future spending contributes to resilience.	<ul style="list-style-type: none"> <li>• OneSF, <a href="#">“Sea Level Rise Guidance”</a></li> <li>• California Climate-Safe Infrastructure Working Group, <a href="#">“Paying It Forward”</a></li> </ul>
A3	Using targeted federal Disaster Recovery funds (already in state government hands) for pre-disaster planning in eligible communities. These	<ul style="list-style-type: none"> <li>• US Housing &amp; Urban Development, <a href="#">“Climate Change Resilience”</a></li> </ul>

	may include FEMA programs and HUD's Community Development Block Grant Disaster Recovery Program (CDBG-DR).	<ul style="list-style-type: none"> <li>• Harriet Tregoning, <a href="#">"Let's Talk Resilient, High-Performance Infrastructure"</a></li> </ul>
A4	Developing ways to monetize some of the long-term value that resilience creates: environmental and social benefits, future loss avoidance (insurance); and future cost avoidance (public and mental health).	<ul style="list-style-type: none"> <li>• Ramboll, <a href="#">"Economic Benefits of Blue Green Infrastructure,"</a></li> <li>• Ramboll, <a href="#">"NYC cloudburst resiliency planning study"</a></li> <li>• Earth Economics, <a href="#">"Benefit-Cost Analysis"</a></li> <li>• National Institute of Building Sciences, <a href="#">"Value of Mitigation" report</a></li> </ul>
A5	Using district-level financing mechanisms (property tax or user fee surcharges or incremental property tax value capture) to fund district-specific resilience projects.	<ul style="list-style-type: none"> <li>• Multnomah County and City of Portland, <a href="#">"Stormwater Charges in Drainage Districts"</a></li> <li>• City of Chicago, <a href="#">"Tax Increment Financing and Green Roof Improvement Fund"</a>,</li> </ul>
A6	Issuing "resilience bonds" that generate risk-reduction rebates from a city's catastrophe insurance premiums to pay for resilience projects.	<ul style="list-style-type: none"> <li>• re:focus partners, <a href="#">"A Guide for Public-Sector Resilience Bond Sponsorship"</a></li> <li>• re:focus partners, <a href="#">"Leveraging Catastrophe Bonds"</a></li> <li>• Rockefeller Foundation, <a href="#">"Innovative Finance: Zero Gap"</a></li> </ul>
A7	Creating local stormwater markets and credit trading that incentivize private property owners to invest in reducing stormwater runoff	<ul style="list-style-type: none"> <li>• IISD, <a href="#">"Stormwater Markets: Concepts and applications"</a></li> <li>• NRDC, <a href="#">"Creating Clean Water Cash Flows"</a></li> <li>• DC Department of Energy and Environment, <a href="#">"Stormwater Retention Credit Trading Program"</a></li> </ul>
A8	Levying state government surcharges on property insurance premiums to fund risk-reduction interventions.	<ul style="list-style-type: none"> <li>• The Fourth Regional Plan, <a href="#">"Institute climate adaptation trust funds in all three states"</a></li> <li>• <a href="#">"Regional Resilience Trust Funds"</a></li> </ul>
A9	Providing specialist financial advice and support to develop and finance climate-resilience infrastructure projects	<ul style="list-style-type: none"> <li>• <a href="#">C40 Cities Finance Facility</a></li> </ul>

<b>B. Managing Financial Risk</b>		
B1	Developing metrics and disclosures that enable financial markets to incorporate risk more accurately into asset values and interest rates.	<ul style="list-style-type: none"> <li>• Ceres, <a href="#">"Climate Risk Disclosure Analysis"</a></li> <li>• <a href="#">Task Force on Climate-related Financial Disclosures</a></li> <li>• Lexology, <a href="#">"Mandatory climate risk disclosure for UK companies and pension funds?"</a></li> </ul>

B2	Packaging bonds for city adaptation projects with climate-risk insurance to strengthen debt repayment likelihood.	<ul style="list-style-type: none"> <li>World Bank, <a href="#">“Climate Insurance”</a></li> <li>Science, <a href="#">“Insurance in a Climate of Change”</a></li> </ul>
B3	Using “pay for performance” or “impact” design in Environmental Impact Bonds, which make the amount of payments to lenders contingent on performance of the adaptation measures, such as green infrastructure.	<ul style="list-style-type: none"> <li>EDF, DC Water case study in <a href="#">“Unlocking Private Capital to Finance Sustainable Infrastructure”</a> report (47-50)</li> <li><a href="#">Climate Bonds Initiative</a></li> <li>Bloomberg, <a href="#">“Climate Bonds Pioneered by Goldman Lure Storm-Plagued Cities”</a></li> </ul>
B4	Preparing accurate flood maps for cities and making them available to the public	<ul style="list-style-type: none"> <li><a href="#">Boston Planning &amp; Development Agency’s flooding tool</a></li> <li>NRDC, <a href="#">“FEMA’s Outdated and Backward-Looking Flood Maps”</a></li> <li>The National Academies, <a href="#">“Mapping the Zone: Improving Flood Map Accuracy”</a></li> <li><a href="#">Boston’s “Climate Ready Boston Map Explorer”</a></li> </ul>
B5	Preparing city resilience plans and flood-risk maps based on insurance loss data from the insurance sector, which enables insurers to show reinsurers the city had reduced risks by taking due to adaptation strategies. This resulted in less costly reinsurance contracts	<ul style="list-style-type: none"> <li>Ramboll, example from Copenhagen, Denmark</li> </ul>
B6	Supporting bond-rating agencies to build the technical capacity to assess cities’ climate risks and adaptation plans.	<ul style="list-style-type: none"> <li>Moody’s Investors Service, <a href="#">“Climate change is forecast to heighten US exposure to economic loss placing short- and long-term credit pressure on US states and local governments”</a></li> </ul>

<b>C. Balancing Burdens and Benefits</b>		
C1	Designing city adaptation investment plans to combine citywide revenues, district-scale revenues, and incentives for private investment in ways that are fair and equitable	<ul style="list-style-type: none"> <li>Sustainable Solutions Lab, <a href="#">“Financing Climate Resilience: Mobilizing Resources and Incentives to Protect Boston from Climate Risks ”</a></li> <li>Jesse Kennan, <a href="#">Climate Adaptation Finance and Investment in California</a></li> </ul>
C2	Using community-based organizations and financial institutions to develop and finance projects that advance economic and social equity in the city.	<ul style="list-style-type: none"> <li>Center for Community Investment, <a href="#">“Connect Capital”</a></li> <li>Living Cities, <a href="#">“Resilience, Equity, and Innovation: The City Accelerator Guide to Urban Infrastructure Finance”</a></li> </ul>

		<ul style="list-style-type: none"> <li>Cleveland Climate Action Fund, <a href="#">“Announcing the 2017 Crowdfunding Challenge!”</a></li> </ul>
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<b>D. Aligning Public Policies</b>		
D1	Replacing National Flood Insurance Program with lower-cost state programs.	<ul style="list-style-type: none"> <li>Discussions in SF Bay Area</li> </ul>
D2	Increasing participation in FEMA Community Rating System in which municipalities earn credits (discounted NFIP premiums up to 45%) for different flood-reduction activities. All buildings receive same discount. Only 5% of 22,000 eligible NFIP communities participate; FEMA looking to expand and use structure-based pricing system.	<ul style="list-style-type: none"> <li>FEMA, <a href="#">“Community Rating System”</a></li> <li>EDF, <a href="#">“Improving FEMA’s Community Rating System to encourage investment in coastal natural infrastructure to reduce storm damages”</a></li> </ul>
D3	Use of risk-adjusted insurance premiums and longer-term property insurance policies, which typically run for only a year.	<ul style="list-style-type: none"> <li>FM Global, <a href="#">“Sustainability Select”</a></li> </ul>
D4	Requiring climate-risk disclosure for properties for sale.	<ul style="list-style-type: none"> <li>Four Twenty Seven, <a href="#">“Climate Risk, Real Estate and the Bottom Line”</a></li> </ul>

<b>E. Leveraging/Catalyzing Private Capital</b>		
E1	Issuing municipal “green bonds” to attract capital to bundles of resilience projects.	<ul style="list-style-type: none"> <li>GreenBiz, <a href="#">“Here are promising strategies for addressing climate adaptation with green bonds”</a></li> <li><a href="#">DC Water’s Green Bond</a></li> </ul>
E2	Establishing public-private partnerships to bring private expertise and capital to the design, financing, construction, operation and/or maintenance of a publicly owned asset, with contracted payments based on project revenues.	<ul style="list-style-type: none"> <li>International Finance Corporation, <a href="#">“Creating Markets for Climate Business”</a></li> <li>EDF, <a href="#">“Unlocking Private Capital to Finance Sustainable Infrastructure”</a></li> </ul>
E3	Providing government credit enhancement for private investment—e.g., loan reserves and guarantees, first-loss position.	<ul style="list-style-type: none"> <li>Earth Economics, “From Projects to Portfolios: Mainstreaming Large-Scale Investment in Integrated Infrastructure” for green infrastructure</li> </ul>
E4	Using Green Bank loan programs to property owners to increase resilience.	<ul style="list-style-type: none"> <li><i>Sea Grant Law &amp; Policy Journal</i>, <a href="#">“Financing Resilience in Connecticut: Current Programs, National Models and New Opportunities”</a></li> <li>Hillrag.com, <a href="#">“DC Eyes Becoming the First ‘Green Bank’ City”</a></li> </ul>
E5	Using density bonuses and other development incentives to induce investment in resilience strengthening.	<ul style="list-style-type: none"> <li>Boston Planning and Development Authority, <a href="#">“Request for Proposals” Boston Flood Resiliency Zoning Overlay District and Resiliency Design”</a></li> </ul>

		<ul style="list-style-type: none"> <li>• City of Toronto, <a href="#">“Eco-Roof Incentive Program”</a></li> <li>• <a href="#">“Denver Green Roof Initiative”</a></li> <li>• <a href="#">“Green Roof Legislation, Policies, and Tax Incentives”</a></li> </ul>
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<b>F. Revising Government Jurisdictions</b>		
F1	Jointly planning and financing infrastructure investments across municipal and utility jurisdictions, including the creation of single entities, such as flood and resilience districts to conduct this integrated work.	<ul style="list-style-type: none"> <li>• Mentioned in many interviews</li> <li>• Ceres, <a href="#">“Building Resilient Cities: From Risk to...”</a></li> </ul>
F2	Creating special-purpose resilience and/or flood districts.	<ul style="list-style-type: none"> <li>• <a href="#">Delta Programme</a> (Netherlands)</li> <li>• Ceres’ concept of <a href="#">Resilience Zones</a></li> </ul>
F3	Developing coastal climate adaptation plans that cover numerous communities.	<ul style="list-style-type: none"> <li>• California Coastal Commission, <a href="#">“Climate Change”</a></li> <li>• RAND, <a href="#">“Helping Coastal Communities Plan for Climate Change”</a> (focuses on Louisiana Coastal Protection and Restoration Authority)</li> <li>• Southeast Florida Regional Compact, <a href="#">“Climate Change”</a></li> </ul>
F4	Strengthening the capacity for district-scale planning, financing, and operations in a city, including the ability to align and coordinate with the city and negotiate with property owners and residents in the district.	<ul style="list-style-type: none"> <li>• Sustainable Solutions Lab, <a href="#">“Financing Climate Resilience: Mobilizing Resources and Incentives to Protect Boston from Climate Risks”</a></li> </ul>

Most of these efforts are largely disconnected from each other and, as important as each may be, are focused on a relatively narrowly defined set of challenges, actors, or sectors. They indicate a growing recognition of city financing challenges and the importance some cities, financial institutions, insurers, governments, philanthropies, and others place on addressing the problem.

However, the many public and private sector players engaged in climate resilience finance efforts do not have a shared vision, framework, or strategies for developing, as quickly as possible, a comprehensive, large-scale urban climate resilience financial system that is comparable to the financing systems cities have in place for their other important investments. In short, the activities identified above do not sum to a new system for meeting cities’ vast and complex climate resilience financial needs. Nevertheless, the innovations do provide a strong “research and development” foundation that could evolve into a more systemic and impactful stage of change.



## FINDING 3: AN EFFECTIVE SYSTEM FOR CITY CLIMATE RESILIENCE FINANCE WOULD INTEGRATE THREE KEY ELEMENTS

Cities have multiple systems in place to finance different components of their public responsibilities, including in the areas of transportation, economic development, housing, and public education. These systems obtain or leverage funding from a mix of public and private sources,<sup>5</sup> using a variety of financial mechanisms for which legal authority and regulatory frameworks, financing and accounting standards, analytic tools and data, decision-making processes, and professional capabilities and institutional structures have been established. However, a system of known mechanisms and established best-practices specifically to fund climate resilience efforts has not yet been established.

We believe that to develop and scale the needed financial investment, cities need to move beyond reliance on “one-off” projects and adapt a systemic approach to climate resilience finance. We envision this taking the process will produce a standardized climate-resilience financial system for cities, with known rules for making financial transactions involving climate-resilience projects. Such a city climate resilience financial system would not be a single, centralized system or a one-stop shopping model for cities. Instead, it would be a system of systems—a distributed set of technical capacities, public policies, and standardized mechanisms for public funding and private financing that provides cities with pathways to capital. It would be built on the existing distributed urban financing systems, modified to address climate resilience, and on innovations underway or still to be developed.

This system would contain three main elements that must be designed and operated in conjunction for each to be effective. In each of these three areas what is needed is standardized processes that can support a high volume of transactions without having to “invent” the system for each transaction.

- **City transaction capabilities.** There need to be more standardized processes for cities to produce high-quality and equitable climate resilience plans and projects with comprehensive financial strategies. These must be backed by the necessary metro-regional and district-scale governance arrangements, community support, and municipal technical capacity to implement transactions through a variety of public revenue sources and financial mechanisms. Few cities currently have these capabilities in place for climate adaptation.
- **State and federal government policies.** Cities need state and federal governments to create comprehensive and aligned policies, regulations, and standards. These should support increases in public revenue (including loan and grant funds) and private capital for climate resilience, enable flexible local

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<sup>5</sup> In 2014, local governments in the US collected \$1.5 trillion in general revenue, 30 percent of it from local property taxes, the largest single source of revenue: <http://www.taxpolicycenter.org/briefing-book/what-are-sources-revenue-local-governments>. The median budget for the largest 100 cities in the US was \$800 million in 2015: [https://ballotpedia.org/Analysis\\_of\\_spending\\_in\\_America%27s\\_largest\\_cities](https://ballotpedia.org/Analysis_of_spending_in_America%27s_largest_cities).

governance structures, and eliminate distortions in insurance and financial market behaviors. Only a few states are moving in such a direction, as are some federal agencies such as FEMA, but the efforts are often piecemeal and slow and rarely aligned with each other or informed through engagement of cities and market players.

- **Financial, insurance, and real estate markets.** Cities need key markets to accurately price climate risk and develop and rapidly deploy risk management solutions for private capital, (including revised and new products and services), and put in place standards for climate risk disclosure and resilience financing. “Making these market mechanisms work effectively requires a widely accepted set of standards and disclosures for buildings that signals the degree of resilience to the various actors and helps them assess risks more accurately,” as the Sustainable Solutions Lab of the University of Massachusetts-Boston reported in April 2018.<sup>6</sup>

The system would incorporate numerous financial mechanisms including taxation, user fees, grants (from state and federal governments and philanthropies), loans and bonds (from capital markets and financial institutions), mortgages, insurance, public-private partnerships, land sales, and insurance surcharges.<sup>7</sup>

### **Turning City Climate Resilience Plans into Financial Investments**

It is likely that financing of city climate resilience plans would engage multiple sectors and financial mechanisms for different purposes. City-scale projects, such as large physical infrastructure, would be paid for by property taxes and utility fees, which spread the cost among many payers, can raise substantial sums, and can be pledged to repay long-term loans from capital markets and financial institutions. District-scale projects, geographically targeted, would draw funding primarily through taxes/fees on direct beneficiaries of the investments. Parcel- and site-scale projects, such as increasing the resilience of buildings, would rely mostly on private investment that may be supported by government and utility lending programs, reductions in insurance premiums, and government financial incentives, including tax breaks. A site may include an airport or seaport that is an independent governmental entity and may have its own bonding capacity.

Different financial mechanisms would have different requirements or standards that cities have to meet. Those that tap public sources—local taxes and user fees, for instance—involve making the “civic case” for city investment to stakeholders, voters, rate payers, and the public. This is quite different from making the “business case” to private investors who want their loans repaid or their investments to generate the desired financial returns.

<sup>6</sup> Levy, “[Financing Climate Resilience](#),” 30.

<sup>7</sup> The San Francisco Seawall Finance Working Group identified 48 revenue and finance options: Jennifer Mayer, “[Resilience, Equity and Innovation](#),” Living Cities, November 2017, 48.

The type of financial mechanism used would determine what will be paid for, who will bear the costs, and who will benefit—so fairness and equity would be persistent concerns.

Citywide funding mechanisms, such as property taxes, spread the cost burden over a large population and may avoid imposing a heavy burden on low-income families, but do not account for the fact that some people may benefit disproportionately from the projects. In addition, many properties—including churches, universities, nonprofits, schools, and libraries—are exempt from local property taxes.

Utility service fees (water, electricity) are spread across a wide population base and the cost can be designed to reflect the degree of reduced risk (benefit). But increases in these fees can raise issues about affordability of city services, unless a solution is designed into the rate structure.

District-scale mechanisms impose costs more narrowly on direct beneficiaries in a targeted area, but this may lead to higher costs for property owners in the district and burden low-income populations. In addition, the benefits of the district resilience will extend to people outside of the district.

# RECOMMENDATION: HOW TO ACCELERATE AND EXPAND THE EMERGENCE OF AN URBAN CLIMATE-RESILIENCE FINANCIAL SYSTEM

The task ahead is to transition from a stage in which a profusion of individual experiments has been launched to a stage in which cross-sector collaborative efforts link cities with real estate, insurance, and financial sector players, community-based sectors such as health care and utilities, and other levels of government to organize, prioritize, and coordinate strategies and actions for building key elements of a climate resilience financial system for cities. This would be an *emergent* approach to system building: rather than working on a detailed grand design and implementation plan, collaborators would study, act, learn, and adapt their next actions based on what is working and how the situation is changing. Over time this would lead to a more standardized set of practices that can enable high volume transactions at scale.

A great deal of the burden for initiating a comprehensive effort along these lines would fall on cities acting collectively to build a system, not merely acting individually to solve immediate, local problems. Given the highly distributed nature of the nascent system that exists and needs modification and innovation, ***cities—as the entities directly facing the financing challenge—are the only players with an overriding interest in developing all of the elements of a climate resilience financial system.***

Cities and other collaborators could mobilize their collective cross-sector expertise, resources, and influence to:

- Develop a ***shared framework for the system*** that is to be created.
- Produce a ***comprehensive map of the emerging climate resilience financial system*** and a digital database of information about climate resilience finance innovations underway. These would be updated regularly, based on feedback and news from cities and other sources.
- Produce a ***roadmap for prioritizing key system-building strategies and projects***. Their focus could be on developing the system’s main elements by
  - Enhancing city capacities to conduct resilience-financing transactions.
  - Aligning state and federal government policies for climate resilience.
  - Scaling up promising innovations in the financial, insurance, and real estate sectors.

An examination of the innovations underway suggests that many of them fit into these three system elements (see Table 2). However, none operate at the level of a systemic, cross-sector approach that we believe is required to create a broadly applicable system that standardizes and scales city resilience finance.

**Table 2.**  
**Climate Resilience Financial Innovations Matched to System’s Major Elements**

		<b>Enhancing City-Level Transaction Capabilities</b>	<b>Aligning Government Policies</b>	<b>Scaling Market Changes</b>
<b>A. Generating Public Revenues</b>				
A1	Improving cost-benefit analysis (CBA)	X		
A2	Requiring that city infrastructure projects and capital budgets to incorporate climate risk	X	X	
A3	Using targeted federal Disaster Recovery funds for pre-disaster planning in eligible communities.		X	
A4	Developing ways to monetize some of the long-term value that resilience creates	X	X	X
A5	Using district-level financing mechanisms to fund district-specific resilience projects.	X	X	
A6	Issuing “resilience bonds” that generate risk-reduction rebates from a city’s catastrophe insurance premiums to pay for resilience projects.	X		X
A7	Creating local stormwater markets and credit trading.	X	X	
A8	Levying state government surcharges on property insurance premiums to fund risk-reduction interventions.		X	
A9	Providing specialist financial advice and support to develop and finance climate-resilience infrastructure projects	X		
<b>B. Managing Financial Risk</b>				
B1	Developing metrics and disclosures that enable financial markets to incorporate risk more accurately		X	X
B2	Packaging bonds for city adaptation projects with climate-risk insurance	X		X
B3	Using “pay for performance” design in Environmental Impact Bonds	X		X
B4	Preparing accurate flood maps for cities and making them available to the public	X	X	X
B5	Preparing city resilience plans and flood-risk maps based on insurance loss data	X		X
B6	Supporting bond-rating agencies to build the technical capacity to assess cities’ climate risks and adaptation plans	X		X
<b>C. Balancing Burdens and Benefits</b>				
C1	Designing city adaptation investment plans to combine citywide revenues, district-scale	X	X	

	revenues, and incentives for private investment in ways that are fair and equitable			
C2	Using community-based organizations and financial institutions to develop and finance projects that advance economic and social equity	X		X
<b>D. Aligning Public Policies</b>				
D1	Replacing National Flood Insurance Program with lower-cost state program		X	
D2	Expand FEMA Community Rating System	X	X	
D3	Use of risk-adjusted insurance premiums and longer-term property insurance policies, which typically run for only a year	X	X	X
D4	Requiring climate-risk disclosure for properties for sale	X	X	X
<b>E. Leveraging/Catalyzing Private Capital</b>				
E1	Issuing municipal “green bonds” to attract capital to bundles of resilience projects.	X		X
E2	Establishing public-private partnerships to bring private expertise and capital to projects	X	X	X
E3	Providing government credit enhancement for private investment—e.g., loan reserves and guarantees, first-loss position	X	X	X
E4	Using Green Bank loan programs to property owners to increase resilience	X	X	X
E5	Using density bonuses and other development incentives to induce investment in resilience strengthening	X	X	X
<b>F. Revising Government Jurisdictions</b>				
F1	Jointly planning and financing infrastructure investments across municipal and utility jurisdictions, including the creation of single entities, such as flood and resilience districts to conduct this integrated work	X	X	
F2	Creating special-purpose resilience and/or flood districts	X	X	
F3	Developing coastal master plans that cover numerous communities	X	X	
F4	Strengthening capacity for district-scale planning, financing, and operations in a city	X	X	

Cities can enact very few of these innovations on their own. They are extremely dependent, for instance, on policy-aligning actions by other governments, especially state governments. And they need the private sector to scale up private market innovations. In collaboration with other sectors, cities could identify high-priority system-building projects to undertake. Some examples include the following:

- Development of **standard tools for climate resilience investment plans** by cities, including Cost Benefit Analysis with methodologies for valuing and monetizing co-benefits produced by adaptation actions, such as reduced health risks and environmental improvements.
- Development of an actionable framework for addressing issues of **equity and fairness in financing** climate resilience projects.
- Development of an online **city climate resilience financing guide** that matches types of city adaptation actions (physical infrastructure, resilience services, and risk hedging) with financial mechanisms that cities can use—a tool that would support resilience investment planning and setting priorities for system-development strategies.
- Greater application of emerging **resilience standards for urban infrastructure** (transportation systems, utilities, etc.) to public and private investment and public policy.
- Development and refinement of **district-scale resilience models of governance and financing** of adaptation projects.
- Identification of best practices in **state government fund structures and revenue sources** for urban adaptation—and how they can be improved.
- Development of national initiatives to coordinate the expansion of financing for adaptation needs that cities identify as especially needed and compelling, such as the **design, financing, and implementation of green infrastructure** which offer cost savings and co-benefits for cities.
- Identification of **gaps in the innovation pipeline** and design of research-and-development projects to fill the gaps. For instance, it could be useful to identify potential synergies between investments in climate resilience and investments in reduction of GHG emissions.

A starting point for developing a system-building collaborative approach would be to **organize cities to link, learn, and align with each other, and act in concert with relevant private sectors and other levels of government to develop and implement projects that build a climate resilience financial system.**

Cities would need support and resources from their partner organizations, other sectors and levels of government, as well as philanthropy, to help lead and sustain such an effort to evolve the field of practice from one-off implementation of innovations to a systemic, strategic, and scalable approach to meeting the significant climate resilience finance challenges that lie ahead.

Philanthropic funding and convening power could play a crucial role in advancing the development of the needed system for climate-resilience finance. Foundations have already backed many of the innovations underway, and they have contributed to the development of urban climate-resilience planning processes and capacities. Their relationships with cities and innovators in other relevant sectors as well as their ability to provide financial support

position foundations to catalyze productive new collaborations to solve the pressing problem of finance for climate resilience.



## RESOURCES

Acclimatise, Four Twenty Seven, and Climate Finance Advisors, [“Lender’s Guide for Considering Climate Risk in Infrastructure Investments.”](#) January 2018, an introduction for loan and credit officers assessing potential lending for infrastructure in the context of weather- and climate-related risks and opportunities.

AECOM, [“Paying for Climate Adaptation in California: A Primer for Practitioners.”](#) Resources Legacy Fund, October 2018, focusing on one state with a particular climate and legal/policy context, describes existing constraints and opportunities for funding climate-resilience projects, and offers a set of recommendations for practitioners and policymakers.

Environmental Defense Fund and Meister Consultants Group, [“Unlocking Private Capital to Finance Sustainable Infrastructure.”](#) September 2017, provides a framework for mobilizing private finance for sustainable infrastructure projects.

Jesse M. Keenan, [Climate Adaptation Finance in California](#) (Routledge: 2018), a comprehensive and deep guide for local and state governments and private enterprises.

David Levy, [“Financing Climate Resilience: Mobilizing Resources and Incentives to Protect Boston from Climate Risks.”](#) Sustainable Solutions Lab, UMass Boston, April 2018, a study for the City of Boston of the financial options for implementing climate resilience plans.

Jennifer Mayer, [“Resilience, Equity and Innovation.”](#) Living Cities, November 2017, offers tools, processes, and lessons from four cities—Pittsburgh, St. Paul, San Francisco, and Washington, DC, about innovative revenue sources and creative financing tools.

NHA Advisors, [“Finance Guide for Resilient by Design: Bay Area Challenge Design Teams.”](#) December 2017, describes the range of funding sources and financing mechanisms that can be used for infrastructure development in California, including short-term predevelopment funding and long-term construction financing.

Ramboll, [“Inventory and analysis of mechanisms to support damage prevention in the EU: final report - Study.”](#) European Commission, September 2017, study to encourage use of insurance to manage weather and climate-related disaster risk in Europe.

re:focus partners, [“A Guide for Public-Sector Resilience Bond Sponsorship.”](#) September 2017, a roadmap for aligning public sector disaster risk reduction measures with private insurance, using Resilience Bonds.

Claire Walsh et al, [“Alternative business models for flood risk management infrastructure.”](#) Centre for Earth Systems Engineering Research, School of Civil Engineering and Geosciences, Newcastle University, UK, 2016.