

A Report of the
NATIONAL ACADEMY OF PUBLIC ADMINISTRATION'S
CENTER FOR INTERGOVERNMENTAL PARTNERSHIPS

Modern Climate Adaptation Governance and Financing Strategies



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August 2024

A Report of the

NATIONAL ACADEMY OF PUBLIC ADMINISTRATION'S
CENTER FOR INTERGOVERNMENTAL PARTNERSHIPS

Modern Climate Adaptation Governance and Financing Strategies

Sponsored

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The Haynes Foundation



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About the Academy



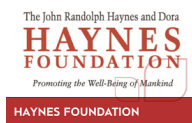
The National Academy of Public Administration (the Academy) is an independent, non-profit, and nonpartisan organization established in 1967 and chartered by Congress in 1984. It provides expert advice to government leaders in building more effective, efficient, accountable, and transparent organizations. To carry out this mission, the Academy draws on the knowledge and experience of its approximately 1,000 Fellows—including former cabinet officers, Members of Congress, governors, mayors, state legislators, as well as prominent scholars, career public administrators, and non-profit and business executives. The Academy helps public institutions address their most critical governance and management challenges through in-depth studies and analyses, advisory services and technical assistance, congressional testimony, forums and conferences, and online stakeholder engagement. Learn more about the Academy and its work at www.NAPAwash.org.

About the Center for Intergovernmental Partnerships



The Academy established the Center for Intergovernmental Partnerships (the Center) in September 2021 in recognition that no significant public problem fits entirely within one government agency or even one level of government. The Center helps identify intergovernmental gaps and serves as a forum for dialogue and problem-solving on those issues across local, state, tribal, territorial, and federal levels of government. Through convenings, collaboration, and research, the Center will be a hub for solutions to our society's biggest intergovernmental challenges. It will bring leaders from every level of government and relevant sectors together to design solutions that create new governance models for the 21st century.

About the Haynes Foundation



Established in 1926 by a prominent, reform-minded physician and his suffragist wife, the John Randolph Haynes and Dora Haynes Foundation is a leading supporter of social science research for Los Angeles. It is also the oldest private foundation in the city. Each year, the Foundation provides up to \$3 million in grants and scholarships to various public and private institutions. These funds are used to encourage study and research into the underlying causes of Los Angeles's social problems and recommend ways of addressing them. Over the years, the Foundation has funded hundreds of important urban studies in education, transportation, local government, elections, public safety, demographics, public personal services, and natural resources. In doing so, the Foundation has continued its founders' philosophy of promoting "the social betterment of mankind."

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FOREWORD

In the 21st century, no significant public problem fits entirely within one government agency or even one level of government. The federal system presupposes that all levels of government are essential in the democratic process. Yet, collaborating on important topics, such as climate change adaptation, is often challenging.

Climate change is a “wicked problem” in a complex society. It has wide-ranging impacts on infrastructure, public health, economies, and the demand for emergency services. Adapting to it requires significant financial investment, strategic planning, and collaboration among governments, communities, and other stakeholders. Failure to adequately address climate change can lead to escalating costs, increased vulnerabilities, and diminished quality of life.

The magnitude and scope of climate change response necessitate partnerships across local, state, and federal governments. This report focuses on local-level climate-change impact and options that local governments can leverage to create a wide range of possibilities for collaboratively addressing the issue.

I extend my thanks to the Academy Fellows who aided this project, all experienced professionals who offered their invaluable insight and keen analysis, the members of a University of Maryland Public Administration Capstone Assignment who investigated collaborative governance examples, and the Academy’s Study Team that combined all the critical insights and their research into this impactful product.

Teresa W. Gerton

President and Chief Executive Officer

National Academy of Public Administration

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Contents

ACRONYMS..... i

EXECUTIVE SUMMARY 1

CLIMATE CHANGE IS A LARGE, WIDESPREAD, EXPENSIVE, COMPLEX, AND DAUNTING CHALLENGE 1

 Resilience Can Be Improved through Mitigation and Adaptation 2

 Retreat Is the Preferred Option in Some Situations..... 3

 Adaptation Is a Local Challenge Needing an Area Response, but Governance Structures Have Limitations 4

THREE STRATEGIES CAN SUPPORT PARTNERSHIPS RESPONDING TO CLIMATE CHANGE 6

 Create Incentives and Eliminate Obstacles to Partnership 6

 State Facilitation 6

 Alignment and Prioritization 9

 Access Multiple Sources to Pay for Adaptation Investment..... 12

 Federal Grants Designated for Climate-Related Projects..... 12

 Federal Loans and Loan Guarantees..... 14

 Federal Revolving Loan Funds..... 14

 Public-Private Partnerships and Alternative Project Delivery Models 15

 Debt Financing..... 17

 Funding to Repay Debt 17

 Address Uncertainty..... 19

 Impact on Local Decision Making..... 20

 Financial Implications of Uncertainty 21

 Data and Information to Reduce Uncertainty..... 22

 Decision Making under Deep Uncertainty 23

 Supplementing Local Capacity to Use Data 23

CONCLUSION 24

 States Create Incentives and Eliminate Obstacles to Partnership 24

 Local Governments Should Consider Multiple Sources to Pay for Adaptation Investments 24

 The Federal Government and Other Institutions Continue to Invest in and Disseminate Climate Data and Modeling..... 25

APPENDIX A: AUTHOR INFORMATION & BIOGRAPHIES..... 26

ACRONYMS

Academy	National Academy of Public Administration
ASCE	American Society of Civil Engineers
BIL	Bipartisan Infrastructure Law
BRIC	Building Resilient Infrastructure and Communities
CDFI	Community Development Financial Institutions
Center	Center for Intergovernmental Partnerships
CRA	Climate Resilience Authority
CRD	Climate Resilience District
CWSRF	Clean Water State Revolving Fund
DB	Design-Build
DBF	Design-Build-Finance
DBFOM	Design-Build-Finance-Operate-Maintain
DBOM	Design-Build-Operate-Maintain
DMDU	Decision Making under Deep Uncertainty
DOC	Department of Commerce
DOE	Department of Energy
DOI	Department of the Interior
DOT	Department of Transportation
DTA	Direct Technical Assistance
EIFD	Enhanced Infrastructure Financing District
EMAC	Emergency Management Assistance Compacts
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
GAO	Government Accountability Office
GFOA	Government Financing Officer Association
HMGP	Hazard Mitigation Grant Program
HUD	Department of Housing and Urban Development
ICMA	International City/County Management Association
IJA	Infrastructure Investment and Jobs Act
IRA	Inflation Reduction Act

LTT	Local, Tribal, and territorial governments
NCA5	Fifth National Climate Association
NCSL	National Conference of State Legislatures
NGA	National Governors Association
NIST	National Institute of Standards and Technology
NLC	National League of Cities
NOAA	National Oceanic and Atmospheric Administration
OMB	Office of Management and Budget
RESTORE	Resources and Ecosystems Sustainability, Tourist, Opportunities, and Revived Economies of the Gulf Coast States
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TIF	Tax Increment Financing
TIFIA	Transportation Infrastructure Finance and Innovation Act
USGCRP	U.S. Global Change Research Program
WIFIA	Water Infrastructure Finance and Innovation Act

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EXECUTIVE SUMMARY

In the 21st century, no significant public problem is the sole province of one government agency or even one level of government. Effective problem-solving requires federal, state, and local governments to work together, often with partners in the private and nonprofit sectors. Building collaborative capabilities to develop and implement effective policies and programs across levels of government and sectors of society is a significant challenge to all concerned.

Climate change is a “wicked problem” in a complex society. This report focuses on the impacts of climate change at the local level and options that local governments can leverage to create a wide range of options for addressing the issue. Climate change poses a significant and costly challenge for local governments worldwide due to its wide-ranging impacts on infrastructure, public health, economies, and the demand for emergency services. Addressing these challenges requires significant financial investment, strategic planning, and collaboration among governments, communities, and other stakeholders. Failure to adequately address climate change can lead to escalating costs, increased vulnerabilities, and diminished quality of life for residents.

The certainty of continued climate change and the uncertainty of its trajectory create less-than-optimal conditions for local governments to plan and make substantial investments for the future. Federal agencies and research institutions are developing data, analytical tools, and climate models to increase the scientific evidence basis of decision making that can be useful inputs for strategy development.

The magnitude and scope of climate change response necessitate partnerships across local, state, and federal governments. Yet many partnership governance structures are underdeveloped, cumbersome to create, or non-existent. Working together is the exception rather than the rule. This report highlights examples of local government officials overcoming the obstacles to collaboration and partnership. Figure 1 summarizes the strategies and tactics suggested by these examples and presented throughout this report.

Figure 1. Checklist of Strategies to Support Partnerships Responding to Climate Change

Obstacle	Goal	Strategies
<p>A partnership to address shared adaptation challenges does not exist.</p>	<p>States Create Incentives and Eliminate Obstacles to Partnership</p>	<ul style="list-style-type: none"> ✓ Use an existing partnership as a platform or model for additional collaboration. ✓ Build durable institutions. ✓ Address obstacles proactively. ✓ Create partnership frameworks to facilitate interlocal collaboration and partnerships across jurisdictions. ✓ Take stock of internal and external conditions that can hurt or help efforts to form a partnership. ✓ Create incentives and reduce barriers for multiple departments and disciplines to work together. ✓ Practice agile government principles throughout the process. ✓ Acknowledge and address partnership governance challenges.
<p>The cost of adaptation investments exceeds the resources of any individual local government.</p>	<p>Local Governments Consider Multiple Sources to Pay for Adaptation Investments</p>	<ul style="list-style-type: none"> ✓ Explore federal grants designated for climate-related projects. ✓ Utilize federal loans and loan guarantees and Federal revolving loan funds. ✓ Consider public-private partnerships and alternative project delivery models. ✓ Employ debt financing options when appropriate. ✓ Repay debt with funding if it helps further adaptation goals.
<p>The timing and location of adaptation needs can be hard to predict.</p>	<p>The Federal Government and Other Institutions Continue to Invest in and Disseminate Climate Data and Modeling</p>	<ul style="list-style-type: none"> ✓ Understand how uncertainty impacts local decision making. ✓ Consider the financial implications of uncertainty. ✓ Make use of data and information to reduce uncertainty. ✓ Apply Decision Making under Deep Uncertainty (DMDU) and other methodologies. ✓ Supplement local capacity to collect/use data with nonprofit resources.

CLIMATE CHANGE IS A LARGE, WIDESPREAD, EXPENSIVE, COMPLEX, AND DAUNTING CHALLENGE

In the 21st century, many significant public problems are larger and more complex than any single government agency or even one level of government can effectively address. Climate change is a prime example. Its causes are longstanding, widespread, interconnected, and disputed, to some extent. The impact varies substantially across space and time, spanning political boundaries and terms of office. Climate change is a problem that cannot be “solved.” While many initiatives have been proposed to reduce or delay the problem, stakeholders do not agree on the efficacy, urgency, or obligation to participate. Scientists are attempting to develop models to predict the trajectory of climate change, but these models may not be adequate to predict site-specific conditions. In addition to these complexities, a common perception that climate change adaptation and economic growth are at odds makes it a highly charged political issue. Uncertainty abounds, and the costs of society’s actions and inactions cannot be calculated precisely.

Disaster events are becoming more significant and common. National Oceanic and Atmospheric Administration (NOAA) [analysis](#) shows that while the number of major disaster events varies yearly, incidence and total costs have been increasing since 1980. The U.S. Global Change Research Program (USGCRP) [Fifth National Climate Assessment](#) (NCA5), a comprehensive source of government-produced information and data,¹ describes growing nationwide and region-specific climate-change risks, including the increasing incidence, severity, and geographic spread of climate-related health hazards, economic losses, and natural resource degradation.

Supporting USGCRP’s research, NOAA and the Cooperative Institute for Satellite Earth System Studies produced [state-level summaries](#) in 2022.

Over the last three years (2021-23) in the U.S.:

- 66 billion-dollar disaster events occurred.
- 171 major disasters were declared.
- 58,981 wildfires took place.
- Disaster damages in 2023 reached \$92.9B.
- The world set a record for the warmest month (July 2023).



Stock Image

¹ Congress established the USGCRP in 1990 to “coordinate federal research and investments in understanding the forces shaping the global environment, both human and natural, and their impacts on society.” USGCRP produces the climate assessment once every four years, synthesizing the most recent research of 14 federal agencies. The NCA5 was released in November 2023.

Understanding U.S. Infrastructure Status – Bridges



Pittsburgh's Fern Hollow Bridge Collapse on Jan 28, 2022. [Source](#)

In 2023, the American Road & Transportation Builders Association reviewed the U.S. DOT's National Bridge Inventory, finding that "36 percent of all U.S. bridges (621,510) require major repair work or replacement." Almost 7 percent, or 42,391, of those bridges are considered structurally deficient. That number has decreased by roughly 600 since 2022, but it would take 75 years to address them all at the current repair rate.

The United States is facing climate change with outdated infrastructure. According to the American Society of Civil Engineers (ASCE) 2021 [infrastructure report card](#) (released every four years), the United States must invest [an additional \\$2.6 trillion](#) by 2029 to upgrade and maintain infrastructure, including addressing climate-related vulnerabilities. This figure includes spending on transportation, water systems, energy infrastructure, and other critical assets to enhance resilience. The ASCE produced its first Report Card for America's Infrastructure in 1998 and noted that the grades have struggled since then to "get out of the D's." Recent federal infrastructure funding packages cover some of this shortfall, but gaps are expected to remain.

Resilience Can Be Improved through Mitigation and Adaptation

Failing to respond to climate change is not a realistic option, especially when considering the needs of future generations. A community's long-term vitality and viability depend on its governing body's ability to address these existential challenges.

Government officials can take steps to reduce or prevent the impacts of climate change by enhancing resilience. Resilience is the ability to bounce back from a disaster. It involves anticipating, preparing for, adapting to, and recovering rapidly from adverse events and changing conditions. Mitigation and adaptation improve resilience. They are more effective when designed and implemented over an entire impact area rather than within jurisdictional boundaries.

"Mitigation" attempts to reduce or eliminate factors contributing to climate change. Such efforts can improve resilience by reducing the impact of a weather event or other disaster, for instance, by absorbing rainwater, reducing flooding, and improving water quality. For example, flood mitigation efforts might focus on building flood barriers, limiting construction in flood-prone areas, and developing early-warning systems.

By contrast, “adaptation” helps build resilience by preparing systems to cope with climate-related challenges, ensuring they can recover and thrive despite adversity. Adaptation can reduce vulnerability by updating existing assets and constructing new buildings, bridges, roads, and parks to better withstand more frequent and intense weather events, coastal erosion, floods, storms, fires, and heat waves.

Mitigation and adaptation are complex undertakings within complex systems that are not designed for multidisciplinary and coordinated action. Society’s scientific, economic, social, environmental, governmental, land use, legal, and health systems each have distinct purposes, policies, operating principles, decision-making frameworks, key factors, and goals. Specialists in any one of these areas may have only a passing knowledge of the others. Devising principles that span these societal systems and then applying them in a single community with its overlay of politics, history, services, facilities, culture, demographics, and geography is an onerous task. The difficulties become orders of magnitude greater when planning actions across multiple local jurisdictions, states, and nations or vertically in the intergovernmental system. Adding a time element compounds complexity even further.

Retreat Is the Preferred Option in Some Situations

In extreme circumstances, retreat may be the most viable option, if not the preferred one. “Retreat” is the deliberate process of relocating people, infrastructure, or communities from vulnerable areas to enhance safety and reduce exposure to hazards. It involves vacating places where the risks (such as sea-level rise, flooding, wildfires, or erosion) and associated costs outweigh the benefits of staying. This option has been considered for areas such as the [Outer Banks of North Carolina](#), the [U.S. Gulf Coast Region](#), the [California coast](#), coastal [Alaska](#), and [along Alaska's Kuskokwim River](#).

Managed retreats are costly and disruptive to communities and individuals. It requires extensive, time-consuming study.



Houses collapsed due to coastal erosion in Shishmaref, Alaska, US. [Source](#)

Investment in infrastructure, housing, facilities, and other aspects of the built environment would be abandoned, and property owners would be relocated and potentially compensated. People often have deep emotional connections to their homes, neighborhoods, and communities; leaving behind a familiar place can be distressing, especially for those whose families have lived in a place for generations. In short, retreat is complicated.

Adaptation Is a Local Challenge Needing an Area Response, but Governance Structures Have Limitations

Climate change effects are felt most acutely at the local level. Rising sea levels, severe weather events, and extreme temperatures directly impact communities, infrastructure, and ecosystems within specific geographic areas. Local officials are on the front lines, dealing with floods, heat waves, and other climate-related challenges that affect their constituents.

Intergovernmental partnerships are vital because they create resource-sharing, coordination, and learning opportunities. Since climate change exceeds jurisdictional boundaries, effective solutions require increased intergovernmental cooperation. States and localities can only partially address disaster resilience when acting individually.

However, collaborations and partnerships are the exception rather than the rule. Local officials might not be aware of partnership as an option. They may assume it's too complicated or resource-intensive to establish. They might not have relationships with other local officials, which is critical to developing trust. The cause may lack a champion; an influential leader with a vision to convince potential partners to come to the table and work toward consensus has yet to emerge. Pressure to maintain the status quo or focus on short-term needs may stymie efforts to address large-scale, long-term needs. Finally, local officials may not be willing to give up control of projects using taxpayer dollars.

Well-structured partnerships can address widespread challenges effectively.

Bridgebuilders: How Government Can Transcend Boundaries to Solve Big Problems, by William D. Eggers and Donald F. Kettl, provides a model for transforming the public sector and getting things done in the face of complex societal challenges. The book emphasizes collaboration across organizational boundaries, both within and outside government. Specifically, the authors advocate for a government of “bridgebuilders” who manage horizontally, connect various stakeholders, and identify assets needed to address unprecedented problems such as climate change, pandemics, and refugee resettlement.

The Academy's Center for Intergovernmental Partnerships' earlier work described principles for structuring partnerships that can substantially impact many policy areas, including climate change. These sound governance principles describe how governments should collaborate and coordinate, make decisions, and deploy resources to address society's wicked problems, such as climate change adaptation (Figure 2).

Figure 2: Principles of Modern Intergovernmental Governance

<i>Category</i>	<i>Principle</i>
Accountability and Transparency	The partnership is accountable and transparent to its members and stakeholders, with appropriate oversight and performance measures.
Community Participation	Community members and stakeholders have access to and are meaningfully engaged in deliberations.
Empowerment	The partnership helps the lower levels of government pursue their objectives.
Structural Equity	Resource-constrained SLTTs can participate on par with other partners; communities in resource-constrained jurisdictions are also represented as communities in high-capacity jurisdictions.
Partner Equity	Participants benefit in proportion to their contributions, but partners agree to calibrate contributions as needed to achieve regional equity objectives.
Independence	Arrangements provide sufficient autonomy to individual participants without compromising the collaboration.

THREE STRATEGIES CAN SUPPORT PARTNERSHIPS RESPONDING TO CLIMATE CHANGE

In the face of the challenges laid out in the prior section, all levels of government can work together to address climate change adaptation and mitigation. Strategies in three main areas address the challenges. First, states can facilitate interlocal partnerships by creating legal frameworks, supporting the creation of durable institutions, building local capacity, and incentivizing collaboration. Second, large projects usually require access to multiple funding and financing sources. State and federal programs can support a wide range of activities, while public-private partnerships can mitigate the costs and risks faced by any one local government. Finally, tools must be developed to address uncertainty on a large scale. The Study Team developed these strategies through document review and unstructured interviews with subject matter experts who provided details otherwise unavailable.

Create Incentives and Eliminate Obstacles to Partnership

In many functional and policy areas, local governments operate independently by default. Establishing a multi-jurisdictional, multi-sectoral, and multidisciplinary partnership is complex. Institutional inertia—pressure to preserve the status quo, avoid taking proactive steps, and resist giving up control—can undermine exploring and establishing partnerships. The pressure arising from political and value-based differences can be formidable.

State Facilitation

States can create incentives, offer financial support, provide technical assistance, and create platforms for dialogue. Other entities, such as large jurisdictions, regional coordinating groups, or non-profit organizations, can support state efforts or take the lead. The Inflation Reduction Act (IRA) is one example of a federal program that incentivizes states, localities, and tribal governments to collaborate rather than compete for funding. Some states have programs like [Minnesota's State Aid for Local Transportation](#), which aims “to provide world-class customer service to local governments as they deliver a safe, accessible, and efficient transportation system for all users.” These programs and their priorities differ from state to state. Still, they help localities access funding, utilize state resources, and build partnerships to address multijurisdictional challenges like transportation and climate change. Some nonprofit, philanthropic, and private organizations and collaborations offer similar assistance. For example, the [Local Infrastructure Hub](#) provides an online search tool, reference guides, training, and boot camps to help local officials access federal infrastructure funds.

Use an existing partnership as a platform or model for additional collaboration.

Local governments may have working relationships through regional councils, local government associations, special districts, authorities, compacts, or other organizations. Adaptation and resilience planning may be a logical extension of their activities, or the organizational structure may serve as a model for a new set of arrangements.

Federal initiatives can serve as models for state efforts. [Emergency Management Assistance Compacts](#) (EMACs) are preexisting arrangements that allow states to provide mutual assistance, collaborate, and share resources when responding to state-declared disasters. All fifty states, the District of Columbia, and four territories are members. Although EMAC is a state-to-state arrangement, EMAC legislation passed by Congress in 1996 addressed the complexities of liability, responsibility for costs, and the recognition of credentials, licenses, and certifications to be honored across state lines. Furthermore, mobilization through EMAC triggers access to federal support.

Another example is Congress' passing of the [Resources and Ecosystems Sustainability, Tourist, Opportunities, and Revived Economies of the Gulf Coast States \(RESTORE\)](#) Act in 2012 to support ongoing recovery from the 2010 Deepwater Horizon oil spill. The Act created the Gulf Coast Ecosystem Restoration Council, comprised of five Gulf Coast state governors and cabinet-level officials from six federal agencies. Funding recovered from sanctions and insurance helps Gulf Coast states and communities recover from the broad economic impacts. This model could be used to address regional vulnerabilities.²

Build durable institutions.

Depending on the setting, various methods can achieve durability critical to long-term projects. Interstate compacts are jointly ratified by two or more state legislatures, such as the [Chesapeake Bay Compact](#); dissolving or changing the terms of a compact would be difficult and time-consuming, making it a less likely target. State legislatures can also formalize support for local governments in statute, which can be equally challenging to dissolve. Similarly, a non-profit association, joint powers authority, quasi-governmental agency, or special district with multi-jurisdictional governing boards enjoys some stability as each participant has limited power. Examples illustrate the variation in institutional structure.

- [Charles County \(Maryland\) Resilience Authority - Non-profit](#)
- [The San Joaquin Joint Powers Authority](#)
- [San Francisco Bay Conservation & Development Commission](#) – Quasi-Governmental
- [Urban Flood Safety & Water Quality Special District \(Oregon\)](#)

² Both of these examples originally appeared in the 2024 Academy report, [Disaster Resilience: Addressing Modern Housing and Infrastructure Resiliency Challenges](#)

Address obstacles proactively.

Local governments operate within state law, creating opportunities and obstacles to partnerships. States can encourage local collaboration through several methods:

- Ensure the appropriate authority exists.
- Ease the administrative burden by developing governance frameworks, creating model documents, developing checklists, streamlining processes, providing technical assistance, and establishing collaborative purchasing options equally applicable to large and small localities.
- Support local investment in efficiency-increasing tools such as information and communication technology, performance measurement systems, data-driven decision making, analytical frameworks, and streamlined regulatory frameworks.
- Lay the groundwork for effective collaboration with local officials and pursue joint funding opportunities to address multi-jurisdictional issues.
- Develop relationships and lines of communication with potential and established partners long before disasters occur. Include non-profit and private organizations, which are critical in addressing large-scale challenges.
- Build local capacity through communication, training, relationship-building, and information sharing about mutual issues.

Achieving data-driven decision making can be challenging. The [Bloomberg Center for Government Excellence](#) offers training, technical assistance, resources, and other supports to help public sector officials incorporate data, research, and analytics into their decision making.

Create partnership frameworks to facilitate interlocal collaboration and partnerships across jurisdictions.



The Annapolis City Dock, located in the historic downtown, often floods during storm events. [Source](#)

“Horizontal” partnerships may be managed by a non-profit organization or a special-purpose government entity, such as a special district, joint-powers authority, or quasi-governmental entity. At least two states (Maryland and California) have authorized such partnerships to address climate change.

For example, Maryland local governments can create [Climate Resilience Authorities](#) (CRAs) to enhance community resilience against climate change impacts

such as sea-level rise, flooding, and extreme weather. CRAs create a mechanism for neighboring jurisdictions to pool resources and coordinate efforts. CRAs are not authorized to collect taxes but can pursue state and federal grants, issue bonds, and attract private investment. Representatives from participating localities govern the CRA, ensuring that decision making reflects the diverse needs and priorities of the region. [Charles County](#) created the first CRA in the state in 2020. The University of Maryland Center for Environmental Science (UMCES) is working with the county to develop an adaptation and resilience report card modeled after the UMCES Coastal Adaptation Report Card. The City of Annapolis and Anne Arundel County created a [joint CRA](#) in 2022. It is currently pursuing a slate of nine projects to be funded primarily by grants. Baltimore County has begun to develop a framework for the state's third CRA.

Similarly, California has authorized Climate Resilience Districts (CRDs), the most recent of several collaborative governance forms in the state that use tax increment financing (TIF) and other revenue sources. CRDs are designed to serve multiple jurisdictions in a region. In 2022, the [legislature](#) designated the [Sonoma County Regional Climate Protection Authority](#) (formed in 2009) as the first CRD in the state. Per the enabling legislation, a minimum of 95 percent of all taxes and fees collected must be spent on projects related to the risk of sea level rise, extreme heat, extreme cold, wildfire, drought, and flooding. The lack of resources to fund administrative support, capped at 5 percent of revenues, may be a barrier to establishing a CRD.

Alignment and Prioritization

Many administrative, legal, and political conditions must align to create and maintain a partnership. Fragmented and siloed agencies, departments, and jurisdictions create barriers, disincentivize collaboration, and lead to less effective, piecemeal solutions.

Take stock of internal and external conditions that can hurt or help efforts to form a partnership.

A SWOT (strengths, weaknesses, opportunities, and threats) analysis, scenario planning, maturity models, and other analytical tools can help an organization identify paths to change. Local governments may face information and capacity issues that limit the expertise and experience available for decision making and problem-solving related to partnerships and regional issues. Training, seminars, professional associations, and knowledge networks can help officials and their jurisdictions fill the gaps.

Create incentives and reduce barriers for multiple departments and disciplines to work together.

Agencies, departments, and disciplines are separate by design—fragmented and siloed, each with its own objectives, knowledge, and expertise. Yet climate adaptation projects often must address several siloed systems at once, such as water utilities, stormwater, and transportation. One way to counter this fragmentation is through an instrumental

leader, a “bridge builder” with a vision that can bring agencies together and work toward consensus.

Without such a leader, levels of government can review policies, procedures, and requirements to determine what elements are necessary and identify critical issues and challenges—especially for smaller capacity jurisdictions. Adjusting these procedures to incentivize collaboration across jurisdictions by reducing barriers will increase the ability and likelihood that multiple jurisdictions can cooperate effectively to address climate change adaptation and other challenges.

Use agile government principles throughout the process.

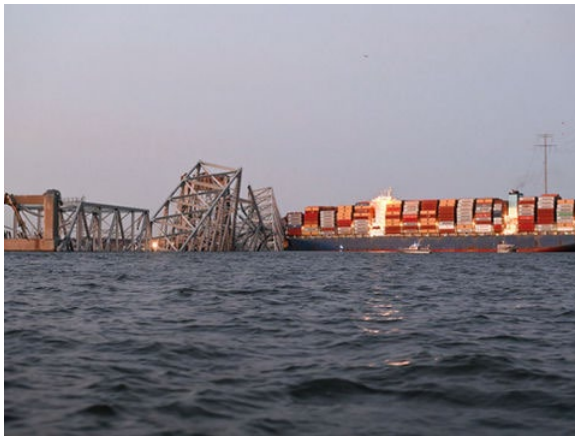
Resistance to change can undermine any new initiative. Intentionally managing change can ease all parties away from the status quo. That process is challenging in an individual organization, let alone across jurisdictions. [Agile government principles](#) can smooth the transition and orient the organization to improve the outcomes of its policies, regulations, and programs. The National Academy of Public Administration Agile Government Center defines summary principles for agile government as follows:

- Mission is at the heart of Agile Government. It should be crystal clear, laser-focused, and easy to communicate and understand.
- Metrics should reflect the mission and be outcome-focused, widely agreed upon, evidence-based, and easily tracked.
- Stakeholders should be intimately involved in program design and redesign. Their journey should be ingrained in the culture of the organization.
- Speed should be encouraged and enabled by establishing clear deadlines that create a sense of urgency.
- Team members should be experts in their roles and diverse in their thinking. They should engage in continual face-to-face communication and make well-supported decisions that address the immediate challenge and advance the project.
- Developing and sustaining networks is integral to leveraging stakeholder support for the organization’s mission.
- Repeated experimentation, evaluation, and improvement promote learning and support the achievement of successful outcomes.
- Innovation should be rewarded. Preference for new approaches that test rules, regulations, and past practices will deliver better results and higher levels of stakeholder satisfaction.
- Solid evidence should form the basis for designing and implementing policy, regulatory, and program options.
- Organizational leaders should eliminate roadblocks, aggregate and assume risks, empower teams to make decisions, hold them accountable and reward them.

Acknowledge and address partnership governance challenges.

Establishing a multi-jurisdictional, multi-sectoral, and multidisciplinary partnership contradicts local government's standard operations. Local officials make decisions for the communities they represent. Within limits set by the state, they manage revenue, spending, and investments. Their actions reflect their commitment to accountability, transparency, community participation, equity, and other good government principles. Working with one or more other governments requires them to relinquish some control.

Context shapes the effectiveness of various strategies to address governance challenges. The Academy's 2023 [Modern Intergovernmental Governance Toolkit](#) proposes options to address various obstacles that may arise. For example, a lack of trust can prevent the formation of a partnership or undermine its effectiveness. Officials may lack confidence or faith in other officials' intentions, actions, or reliability, undermining the basis of negotiation and willingness to sustain the partnership. Several strategies can address this situation. Officials can invest in relationships across governments by creating formal and informal communication channels. Starting with small-scale, relatively low-stakes collaboration to pursue shared goals can build working relationships. As the collaboration grows, developing procedures for conflict management and decision making create safeguards for handling areas of disagreement.



A container ship struck the Key Bridge in Baltimore, Maryland, in March 2024, temporarily blocking the Fort McHenry Channel. [Source](#)

The response to Baltimore's Key Bridge collapse in March 2024 demonstrates the effectiveness of communication and coordination to address significant, urgent issues. A multidisciplinary [Unified Command](#) has been coordinating the response and disseminating information. It includes representatives of the U.S. Coast Guard, the U.S. Army Corps of Engineers, the Maryland Department of the Environment, the Maryland Transportation Authority, the Maryland State Police, and a private emergency management firm that worked with 56 federal, state, and local agencies to restore normal channel operations by early June 2024.

Access Multiple Sources to Pay for Adaptation Investment

Tackling institutional challenges to facilitate climate change adaptation projects is one piece, but even the best collaborative governance structure must find a way to pay the bills. Numerous strategies can help individual or collaborative efforts pay for climate adaptation investment, facilitating more effective responses to climate change impacts. However, these mechanisms may be inadequate for climate improvements, especially for initiatives that cross jurisdictions. Large projects may require multiple sources of funding or financing that become too administratively complex due to conflicting or unreasonable requirements of the different funding streams.

Several factors must be evaluated when deciding how to pay to solve a problem. States, localities, and other stakeholders must consider these elements when devising plans for substantial infrastructure investments, especially for climate change adaptation.

Federal grant and funding programs were often designed for a single purpose that does not work with complex and multi-disciplinary climate adaptation projects. Some programs allow the blending or braiding of funds or permit applicants to seek waivers to achieve the same result. But dealing with these multiple grants—finding, applying for, managing, ensuring compliance, and reporting on them—creates a crushing administrative burden that many jurisdictions cannot handle, even collaboratively. The [Government Accountability Office](#) (GAO) has reported on this phenomenon. Burden reduction is one of the objectives of the Office of Management and Budget (OMB) [2024 revisions to the Uniform Grants Guidance](#), and federal agencies must comply by implementing improvements by October 2024. Also, in 2024, the [Disaster Assistance Simplification Act](#) directs the Federal Emergency Management Agency (FEMA) to align the deadlines for two of its major programs, Disaster Unemployment Assistance and Individuals and Households Program.

Professional associations such as the Government Finance Officers Association (GFOA) offer resources, training, and contacts to help officials understand whether a financing initiative is within reach. Alternatively, many private financial institutions have specialists who work with the public sector.

Federal Grants Designated for Climate-Related Projects

One such strategy is leveraging federal funding opportunities and grants designated explicitly for climate resilience and adaptation projects. Local governments can access additional financial resources to fund adaptation projects, infrastructure upgrades, and community resilience initiatives by actively seeking and applying for these grants. Federal agencies like FEMA, the Environmental Protection Agency (EPA), the Department of Transportation, and the Department of Housing and Urban Development (HUD) offer various grant programs to support local efforts to prepare for and mitigate climate-related risks. These programs help state and local governments plan, prepare for, and recover from climate-related and other disasters.

As described in a [2024 Academy report](#), FEMA is the primary provider of this assistance. The [Building Resilient Infrastructure and Communities](#) (BRIC, a competitive grant) program and the [Hazard Mitigation Grant Program](#) (HMGP, a formula grant) generally cover 75 percent of project costs, with states and local governments responsible for the remaining 25 percent. States can spend funds directly or pass funds through to local governments, private companies, and non-profit organizations. Beyond those two grant programs, additional funds are available from the Infrastructure Investment and Jobs Act (IIJA, also known as the Bipartisan Infrastructure Law or BIL) and the Inflation Reduction Act (IRA) funded during the Biden Administration. According to the [National Conference of State Legislatures](#) (NCSL), the IIJA makes \$50 billion available to address floods, wildfires, heat, and droughts, among other adaptation and resilience-focused funding. The IRA provides an additional \$112 billion for climate-related projects.

Federal agencies have also created programs to help state and local governments overcome the hurdles of applying for federal grants. FEMA's [BRIC Direct Technical Assistance](#) (DTA) program helps lower-capacity communities and tribal nations begin climate resilience planning and project solution design. Participants can receive assistance with climate risk assessments, community engagement, partnership building, and mitigation and climate adaptation planning. Disadvantaged communities and those facing hardship receive priority. Several programs—including BRIC, the [Disaster Resilience Grants Program](#) administered by the National Institute of Standards and Technology (NIST), and the Environmental Protection Agency's (EPA) [Climate Pollution Reduction Grant](#)—have a two-phase application process. The initial-phase submission is less involved and less costly than a full proposal to develop and provides some awards. The EPA program provides \$250 million for noncompetitive planning grants for projects successfully passing the first phase.

Finding an appropriate federal funding opportunity can be challenging, especially for jurisdictions with capacity issues. A 2023 National League of Cities (NLC) resource allows users to [search for climate-related federal funding options](#) by agency, type of infrastructure, and environmental focus. The tool lists several additional multi-purpose grants, including:

- Department of Housing and Urban Development (HUD): [Community Development Block Grant Disaster Recovery](#) and [Community Development Block Grant Mitigation](#)
- EPA: [Environmental Justice Collaborative Problem-Solving Cooperative Agreement Program](#) and [Environmental Justice Government-to-Government Program](#)
- Department of Energy (DOE): [Funding for DOE Loan Programs Office – Clean Energy Financing](#)
- FEMA: [Hazard Mitigation Safeguarding Tomorrow Revolving Loan Fund Program](#) and [Pre-Disaster Mitigation Grant](#)

Additional programs beyond those explicitly tied to climate resilience and adaptation help local governments pay for projects related to ecosystem restoration, the electric grid, public transit, water management, and other infrastructure concerns.

Federal Loans and Loan Guarantees

Many federal loan and loan guarantee programs are available for local climate-related projects. For instance, the Department of Transportation (DOT) [Transportation Infrastructure Finance and Innovation Act \(TIFIA\)](#) program provides credit assistance through direct loans, loan guarantees, and standby lines of credit to finance surface transportation projects that improve transportation efficiency and resilience to climate impacts. Direct loans offer (typically) below-market interest rates and provide flexible repayment terms, combining construction and permanent financing of capital costs. Similarly, the EPA [Water Infrastructure and Innovation Act \(WIFIA\)](#) offers loans and loan guarantees to eligible entities, including state and local governments.

Other agencies offer loans and loan guarantees. For example, the [Section 108 Loan Guarantee Program](#) allows the use of CDBG funds to access low-cost, flexible financing for infrastructure and other projects. The [Energy Infrastructure Reinvestment Financing Program](#) allows the DOE Loan Programs Office to provide loan guarantees for projects supporting clean energy deployment and energy infrastructure reinvestment. Although Community Development Financial Institutions (CDFIs) are not federal entities, some are certified to receive federal support through the [CDFI Fund](#) (Department of the Treasury). CDFIs make a wide range of investments in underserved communities, including infrastructure.

Federal Revolving Loan Funds

Federally funded revolving loan funds are financial mechanisms established by several agencies to provide low-interest loans to support adaptation. These funds operate on the principle of revolving capital, where repayments from previous loans are reinvested to finance new projects, thus ensuring a continuous funding source over time.

State-level agencies—such as environmental protection departments, water resource management authorities, energy offices, and housing and community development agencies—are commonly tasked with administering federal revolving loan funds within their respective states. The federal government establishes guidelines for these programs, while state agencies manage the day-to-day operations, including loan application processing, project oversight, and financial management. States may establish additional eligibility criteria, prioritize certain projects or geographic areas, and develop specific guidelines and procedures to streamline the application and funding process. Repayment terms for loans from revolving funds are typically structured to be flexible and favorable to borrowers, with low interest rates, extended repayment periods, and deferred payment options to accommodate the financial constraints of local governments and other borrowers.

As borrowers repay their loans, the principal and interest payments are returned to the revolving fund, replenishing its capital base and making funds available for future loans. This revolving structure allows the fund to recycle its resources continuously, maximizing the impact of the initial investment and supporting a steady stream of climate-related projects in communities across the country.



Aerial view of Boston Harbor, where water and wastewater improvements are underway. [Source](#)

For example, the Massachusetts Clean Water Trust operates the Clean Water State Revolving Fund (CWSRF). This EPA-capitalized program provides low-interest loans and grants to finance water quality protection and wastewater infrastructure projects in the state. The CWSRF supports many projects, including those addressing climate change impacts, such as stormwater management, coastal resilience, and green infrastructure

improvements to reduce flooding and pollution. A notable project is the "[Resilient Boston Harbor](#)" project, designed to protect against sea-level rise and storm surge events. The project is installing tide gates and pump stations at critical locations along the Boston Harbor shoreline to prevent seawater from backing up into the wastewater system during high tide events and storm surges. These mechanisms help protect infrastructure from saltwater intrusion and flooding, reducing the risk of system failures and environmental contamination. The project also incorporates rain gardens, permeable pavement, and restored wetlands to absorb stormwater, reduce runoff, and mitigate flooding in urban areas. These nature-based approaches are less intrusive and provide co-benefits such as habitat restoration and recreational opportunities.

Public-Private Partnerships and Alternative Project Delivery Models

State and local governments use various market mechanisms to cover some of their climate-related project costs, such as public-private partnerships (P3s). P3s are sometimes controversial but can work well when implemented properly. They typically involve public goods, which do not have a market price, leaving the government and private sector to negotiate terms. The drive to profitability could lead private sector partners to underinvest in the project's most important aspects for public welfare; the private sector seeks returns on investment, but public goods' value extends to societal well-being, environmental quality, and public health. The Congressional Budget Office estimates that since 1990, no more than 3 percent of spending for highway, transit, and water infrastructure has used a public-private partnership.

The Center for Innovative Finance Support at the Federal Highway Administration [identifies the following forms of P3s](#):

- *Design Build Finance (DBF)*: A single contract is awarded for a facility's design, construction, and full or partial financing. Responsibility for the long-term maintenance and operation of the facility remains with the project sponsor but could be included in a separate agreement. This approach takes advantage of the design-build (DB) approach's efficiencies and allows the project sponsor to defer financing either completely or partially during the construction period.
- *Design Build Finance Operate Maintain (DBFOM) Toll Concessions*: In return for the right to collect tolls [or other user-generated revenue] during the concession period, the P3 developer bears the risk that the revenues may be inadequate to repay the underlying project loans and equity investments. In the event of greater-than-expected revenues, some concession agreements include a revenue-sharing provision between the private partner and the public owner.
- *DBFOM Availability Payment Concessions*: The public agency pays the P3 developer throughout the concession period to make the facility available to users. Payments may be reduced if the private partner does not meet operational performance standards such as lane closures, incident management, or snow removal. These transactions often include construction “milestone” payments to defray the amount of the ongoing availability payment.



Palm Beach and Broward counties are constructing the C-51 Reservoir on 2,200 acres in South Florida. [Source](#)

Local public utilities and private sector entities are working to construct a \$161 million stormwater and water supply reservoir, expected to meet Palm Beach and Broward County water demand for 50 years. Phase I was [completed in March 2024](#). The [Southeast Florida Regional Climate Change Compact](#) served as a platform for creating the public-private partnership. The compact was [created in 2009](#) in recognition of heightened risks due to low land elevations, rising sea level projections, and anticipated increases in tropical storm events. The region includes 6.2 million people, 109 municipalities, and two Tribal governments.

Alternative project delivery models shift some decisions to private-sector partners. Rather than specifying how a project should be carried out, the government agency might describe how the project should perform upon completion. Performance typically relates to the design (DB or design-build) but could also involve operations and maintenance (DBOM or design-build-operate-maintain). In either of these models, cost overrun, delay, and other risks are shared with the private sector.

Debt Financing

State and local governments shoulder most of the capital costs of infrastructure, which are covered by issuing debt. In a 2017 study, the [Congressional Budget Office](#) found that in the preceding 40 years, state and local governments had covered three-quarters of all infrastructure capital spending. According to the [International City/County Management Association \(ICMA\)](#), 90 percent of that spending is financed with municipal bonds.

State and local borrowing falls into two main categories:

- *General Obligation (GO) bonds* are backed by the full faith and credit of the government body issuing them. Some states require voter approval to issue a GO bond, and several states limit the amount of GO debt a local government can issue.
- *Revenue bonds* are debt securities backed by revenues from a specific project, such as a water or wastewater utility.

Both types of bonds are most suitable for long-term borrowing associated with major projects, such as roads, bridges, schools, and mass transportation. Investors' rate of return reflects the estimated risk; credit rating companies grade risk based on the issuer's creditworthiness and default rates. Defaults are rare, making municipal bonds a relatively safe investment.³ Interest income is typically exempt from federal income tax and may also be exempt from state and local taxes within the issuing state. The Minneapolis Fed's Center for Indian Country Development has reported that Tribal governments issue tax-exempt bonds at a lower rate per capita than states and localities, largely due to legal and debt service barriers.

Funding to Repay Debt

The ability to borrow hinges on the ability to repay. Debt issuance comes with a legal obligation to make regular payments on interest and principal. A robust and diversified revenue base, economic vitality, and effective financial practices bolster creditworthiness. One important consideration is whether taxpayers in a community are willing to pay for investments. A [2018 nationwide survey by the Energy Policy Institute at the University of Chicago](#) found that among the 70 percent of respondents who think climate change is a reality, most want the federal (83 percent), state (80 percent), and

³ The [Municipal Securities Rulemaking Board \(MSRB\)](#), based on [Moody's Investors Service](#) data, reported the municipal securities default rate is 0.09 percent. Among corporate securities, the rate is 2.23 percent.

local (76 percent) government to address it. The survey also found that more than half of respondents would be willing to pay at least an additional \$1 per month on their electricity bill to combat climate change. Less than one-third would be willing to pay up to \$20 per month.

General Revenue: State and local governments use many sources of revenue to make interest and capital payments against bond issuances. The primary sources are revenues from income, property, sales, excise, and other taxes. Non-tax sources of revenue can include *licensing fees, alcohol sales, lottery and gambling revenues, settlements, fees, fines, and penalties associated with various violations*. Even when these sources are earmarked to offset the cost of providing related services, they free up revenue to cover other activities.

Value Capture Revenue Streams: Value capture is a broad category of many different types of revenue generated by recovering funds from land value increases resulting from government investment, often related to infrastructure. As part of the development process, local governments may require developers to pay *impact fees* to offset the public cost of providing infrastructure to a site. They may also require the developer to build facilities or infrastructure to serve a site, sometimes called an *exaction*. On a larger scale, *special assessments* are additional payments made (typically) by property owners to pay for specific projects that benefit their properties. *Tax increment financing* (TIF) captures the growth in property tax revenue after an investment is made. Both forms of revenue can be used to pay directly for improvements in the designated area or to service debt issued to finance those improvements.

Capital Optimization: Several mechanisms allow state and local governments to convert existing assets into a funding source for infrastructure or other projects or free up capital to pay down debt. *Asset recycling* and *infrastructure leases* involve leasing an existing asset to raise funds for new infrastructure development. *Privatization* is a similar arrangement, except that the government transfers ownership. An important consideration for the government is how much control to retain. Privatization allows the private sector partner to operate, maintain, and earn revenue from the asset. The private sector partner might attempt to cut costs to increase the return on investment, which could degrade services. A *sale-leaseback* arrangement also involves the sale of a government asset, and then the government leases it back from the buyer. The government can use proceeds to fund other projects while retaining the use of the asset.

Local governments and transportation authorities have used infrastructure leases to raise funds and bring private-sector investment into core operations. The examples below demonstrate the range of applications.



[Source](#)



[Source](#)



[Source](#)



[Source](#)



[Source](#)

[Chicago Skyway Lease](#): In 2005, Chicago leased the Chicago Skyway toll road to a private consortium for 99 years. Analysis conducted by [The Civic Federation](#) showed that by 2013, the City would use almost three-quarters of the proceeds for operating expenses and debt retirement, leaving \$500 million in long-term reserve.

[San Juan International Airport Lease](#): Puerto Rico leased its main airport to a private operator in 2012. The lease agreement provided an upfront payment, annual payments, and revenue sharing. The funds were expected to help pay down the Ports Authority's long-term debt.

[Bayonne, New Jersey Water/Wastewater System Lease](#): In 2012, the city of Bayonne signed a 40-year lease for its water and wastewater system. The private operator agreed to an upfront concession payment and annual concession fees, which Bayonne used to pay down existing debt and supplement general fund revenue. The agreement also specified capital investments to be made over many years.

[Maryland's Seagirt Marine Terminal Lease](#): In 2009, the Maryland Port Administration leased its marine terminal to a private operator for 50 years. The state used the upfront payment to support highway, bridge, and tunnel projects serving the Port of Baltimore area.

[Milwaukee leased an eight-acre former landfill](#) to We Energies for 20 years to develop a 2.25-megawatt solar energy facility. The utility firm will pay the city an annual lease payment and feed electricity generated into the grid. The city retains the [Renewable Energy Certificates](#).

Address Uncertainty

The scientific consensus points to continued climate change, but some uncertainty remains. While risk is the measurable probability of an outcome, uncertainty occurs

when not enough information is available to calculate the likelihood of an outcome. Uncertainty may occur due to a lack of data on an event or condition's time, location, or magnitude. Often, uncertainty indicates too many indeterminate moving parts, as in the case of climate change.

The climate models used to simulate future climate conditions are based on mathematical representations of the climate system. Different models may produce different results due to variations in how they represent physical processes such as cloud formation, ocean currents, and land-atmosphere interactions. Future climate projections depend on various scenarios of greenhouse gas emissions, which are uncertain because they rely on assumptions about future economic growth, technological advancements, energy consumption, mitigation activities, and policy decisions. The climate system also has inherent natural variability, such as El Niño and La Niña events, volcanic eruptions, and solar radiation fluctuations, which can cause short-term deviations from long-term trends.

Research, analysis, and data collection may reduce the uncertainty associated with these factors. But human behavior, societal responses, and policy decisions are wildcards. For example, economic growth will shape future emissions. The global economy will almost certainly continue to grow, but the rate, location, nature, and timing of that growth are challenging to predict. Growth is a function of human and physical capital, access to technology, financial and political stability, policy decisions, and many other factors and systems. Other interconnected systems, such as education, research, societal trends, and conditions in different areas, also shape those systems. The resulting web is nearly incomprehensible, especially over the 50 to 100-year timeframes associated with climate change.

Academy Series: Solving the Data Problem for the Climate Crisis

In August and September 2023, the Technology Leadership Standing Panel hosted a two-part series on reducing uncertainty related to climate change.

The [second session](#) focused on the need for better local data to plan and implement programs for climate change mitigation, adaptation, and resilience. Speakers talked about global climate data issues, many of which are equally relevant in the United States. The main takeaway is that various kinds of data from multiple sources must be brought together to understand the current context and its impact.

Impact on Local Decision Making

Local decision making must occur in the context of this climate change uncertainty. It requires navigating a complex landscape of regional variability, resource constraints, evolving scientific understanding, and diverse views among their community members. Climate impacts vary significantly by region, necessitating tailored responses addressing

specific local vulnerabilities, such as rising sea levels in coastal areas or increased wildfire risks in forested regions.

Resource limitations further complicate decision making, requiring local authorities to prioritize actions that balance immediate needs with long-term resilience. Engaging with community stakeholders is essential for understanding their diverse concerns and ensuring equity, as climate change often exacerbates existing inequalities. This process adds layers of complexity but is crucial for informed and inclusive policy development.

The evolving national and state-level policy landscape creates additional uncertainty, necessitating local strategies that can adapt to regulatory changes. Technological and scientific advancements also play a critical role, as local governments must evaluate the potential and applicability of emerging technologies for climate mitigation and adaptation. Small communities may not have the capacity to incorporate scientific data into established projects and future decision making.

Financial Implications of Uncertainty

Climate change introduces variability in weather patterns and the frequency of extreme events, making it difficult for local governments to predict and plan for future expenditures. For example, local governments must build or retrofit infrastructure to withstand climate impacts, such as rising sea levels, increased storm intensity, and extreme temperatures. These investments are capital-intensive and require careful planning to ensure that infrastructure remains resilient over its intended lifespan. Local officials must decide between designing infrastructure to withstand expected conditions during the structure's lifetime or designing for worst-case scenarios, including the possibility of extreme events.

Another implication for budgeting and expenditures is the growing chance of unexpected natural disasters such as floods, hurricanes, or wildfires. These disasters can strain municipal budgets, leading to emergency expenditures that disrupt planned projects and services. Local governments must allocate funds for disaster response and recovery, often drawing from general reserves or seeking state and federal assistance, which may not always be timely or sufficient. There is the possibility of a future where officials must choose between disaster declarations and their state's solvency.

Uncertainty also impacts decision making outside of government. Property insurance companies make daily decisions regarding which properties to cover and how much to charge. Because they can cancel a policy almost anytime, insurance companies need only consider the immediate future.

The increasing unpredictability of climate events affects local governments' insurance costs and risk management strategies. Premiums for municipal insurance, including property and liability coverage, will likely rise as insurers account for higher risks. Additionally, some insurers may limit coverage in high-risk areas, forcing local governments to self-insure or create contingency funds to cover potential losses. The

retreat of insurance providers is already occurring in the southeastern U.S. due to violent storms and in the western U.S. due to forest fires. The [availability of insurance may shape some communities' viability](#).

Developing comprehensive risk management plans that include risk assessments, emergency response strategies, and financial reserves is crucial to dealing with uncertainty. However, these measures entail significant upfront and ongoing financial commitments. Securing funding for climate adaptation and mitigation projects is a considerable challenge. Local governments must identify and prioritize projects that reduce vulnerability to climate impacts, such as flood defenses, green infrastructure, and renewable energy initiatives. Competing for grants and subsidies from higher levels of government, as well as leveraging public-private partnerships, is essential but can be competitive and time-consuming. Moreover, local governments may need to increase taxes or reallocate funds from other services to finance these projects, potentially facing public resistance.

Data and Information to Reduce Uncertainty

Federal agencies have developed numerous datasets associated with climate change, environmental disasters, and other factors critical to climate adaptation or infrastructure project decisions. The data helps local governments improve planning, make decisions, and execute climate change adaptation and infrastructure improvements. NOAA is among the agencies that provide data and information to enhance the scientific basis of decision making. Some of their resources are described below.

- [Climate.gov](#) is an online portal that provides a wide range of information and resources related to climate science, data, education, and decision making tools. The website is designed to serve various audiences, including scientists, educators, policy makers, and the general public. A dashboard lets users keep visualizations and access data related to several key indicators. The Climate Resilience Toolkit offers resources and case studies of data-driven climate adaptation steps nationwide.
- Through the [Weather-Ready Nation](#) initiative, the National Weather Service provides forecast information to support state and local decision making to prepare for extreme weather, water, and climate events.
- The 2022 [Sea Level Rise Technical Report](#) projects flooding risk throughout the United States. Decision makers can use this information to plan for adaptation and bolster resilience.
- [State Climate Summaries](#) provide current, local climate perspectives in each state, Puerto Rico, and the U.S. Virgin Islands. The summaries describe each state's historical temperature and precipitation conditions and use several visual aids to show past observations and plausible future projections.
- Easy-to-access climate data is available through [Climate Mapping for Resilience and Adaptation](#). In addition to providing an evidence basis for decision making, grant

applicants can use the portal to demonstrate proposed actions to address known current and future hazards equitably and inclusively

Decision Making under Deep Uncertainty

When the data is insufficient to support decision making, leaders can deploy modern decision making approaches that account for as much uncertainty as possible. [Decision Making Under Deep Uncertainty](#) (DMDU) methods provide resources and techniques to inform and improve deeply uncertain decisions. According to RAND, deep uncertainty exists when experts or stakeholders do not know or cannot agree on appropriate conceptual models that describe relationships among key driving forces in a system, the probability distributions used to represent uncertainty about critical variables and parameters, and/or how to weigh and value desirable alternative outcomes. DMDU allows decision makers and experts to “work together to build a common understanding of challenges and to find creative compromise strategies,” ultimately making the best decision possible.

Supplementing Local Capacity to Use Data

Data and decision-making tools will only help if communities have the capacity and know-how to utilize them effectively. Given the various resource limitations facing many local governments and some states, more support is necessary. Jurisdictions can seek resources available from federal agencies, nonprofits, and other parties working to grow capacity around data-driven decision making.

Federal funding, such as the IIJA, offers climate and resilience-related funding opportunities, and some states are using those funds to pursue data-focused projects. For example, the [Qawalangin Tribe of Unalaska in Alaska plans to use \\$2.9 million to conduct a vulnerability assessment, develop data and tools, and evaluate methods for nature-based infrastructure enhancement](#). Other IIJA projects are similarly focused on assessments and developing data for decision making and public awareness.

Capacity problems like these may be great opportunities for the strategic deployment of artificial intelligence (AI). The World Bank promotes the incorporation of AI into decision making. A recent blog post discusses how the strategic use of AI can [enhance the public sector’s ability to leverage available climate data, lowering the barriers to climate-smart public investment and asset management strategies](#).

Organizations like the [Municipal Research and Services Center \(MRSC\)](#) help Washington state local governments access data resources and learn from each other’s experiences. Similarly, but on a global scale, the [International Council for Local Environmental Initiatives](#) (Local Governments for Sustainability) offers a vast network of local and regional governments, case studies, and activities to facilitate integrated sustainable urban development, of which climate adaptation is a critical factor.

CONCLUSION

States and the federal government can help local governments navigate adaptation by facilitating interlocal collaboration, providing access to multiple funding sources, and addressing uncertainty.

Local government adaptation to the multifaceted challenges posed by climate change is a critical and urgent endeavor. Climate change is a larger, more widespread, expensive, and complex problem than local governments can address alone. Adaptation demands a concerted and proactive response from local governments. This response, however, is inherently complex and expensive, requiring innovative strategies and substantial resources. The three strategies discussed—facilitating interlocal partnerships, securing diverse funding sources, and addressing scientific uncertainties—offer a pragmatic framework to enhance local governments' resilience and adaptive capacity.

States Create Incentives and Eliminate Obstacles to Partnership

First, the role of states in fostering interlocal partnerships is paramount. Climate change does not adhere to political boundaries, and its impacts are felt across regions. By enabling local governments to collaborate, states can help create synergies that leverage each municipality's unique strengths and resources. Interlocal partnerships allow for sharing best practices, pooling resources, and developing regional strategies that are more comprehensive and effective than isolated efforts. States can provide the necessary legislative and financial support to initiate and sustain these partnerships, ensuring local governments work together towards common adaptation goals.

Local Governments Should Consider Multiple Sources to Pay for Adaptation Investments

Second, accessing a diverse array of public and private funding is essential to meet the financial demands of climate adaptation. Traditional funding sources, such as federal and state grants, are often insufficient to cover the extensive costs associated with adaptation projects. Local governments must explore alternative funding mechanisms, including public-private partnerships, green bonds, and philanthropic contributions. These varied funding sources can provide the financial flexibility needed to implement large-scale adaptation initiatives. Additionally, innovative financing models, such as resilience bonds, can be tailored to specific local contexts, aligning financial incentives with long-term climate resilience goals.

The Federal Government and Other Institutions Continue to Invest in and Disseminate Climate Data and Modeling

Third, addressing the scientific uncertainty surrounding climate change impacts is crucial for effective local adaptation. Climate change's inherent variability and unpredictability pose significant challenges to local, state, regional, and national planning and decision making. Local governments need access to robust scientific data and predictive models that can inform their adaptation strategies. Engaging with academic institutions, research organizations, and climate experts can help local governments interpret and apply scientific findings to their specific contexts. Furthermore, developing adaptive management practices that can evolve in response to new information and changing conditions is vital. This iterative approach ensures local governments remain flexible and responsive to emerging climate risks.

In summary, the daunting challenge of climate change requires local governments to adopt a multifaceted and dynamic approach to adaptation. By leveraging state support for interlocal partnerships, diversifying funding sources, and addressing scientific uncertainties, local governments can enhance their resilience and capacity to adapt. These strategies not only provide practical solutions but also foster a culture of collaboration, innovation, and proactive planning. As climate change continues to unfold, the adaptability and preparedness of local governments will be instrumental in safeguarding communities and ensuring sustainable development. The path forward demands collective effort, continuous learning, and unwavering commitment to building a resilient future.

APPENDIX A: AUTHOR INFORMATION & BIOGRAPHIES

Nancy Y. Augustine, Ph.D.: Nancy joined the Academy in January 2019 and was named Director of the Center for Intergovernmental Partnerships in July 2021. She has led projects for the Legislative Branch, the Department of Commerce Office of Inspector General, and the US Merchant Marine Academy (DOT). She specializes in intergovernmental relations, public management, policy assessment, comprehensive and strategic planning, state and local fiscal issues, and planning for facilities and infrastructure investments. Nancy has previously researched housing and social support programs for the Department of Housing and Urban Development, the Department of Labor, the District of Columbia Auditor, and the Pew Charitable Trusts. She also worked in local government for ten years in long-range planning and policy development. Nancy has a Ph.D. in Public Policy and Public Administration from the George Washington University and has taught at the Trachtenberg School (George Washington University). She also has an M.A. in Economics from Georgetown University and a Master of Urban and Environmental Planning from the University of Virginia.

Miles Murphy: Miles is a Senior Research Analyst with the Center for Intergovernmental Partnerships, overseeing the coordination, planning, and facilitation of meetings, research, and analysis related to all aspects of the Academy's intergovernmental activities. He is developing subject matter expertise for various CIP projects and organizes the creation/development of social media and web content for the Academy/CIP. Miles graduated from Wake Forest University in 2011 and later earned his M.S. in Coastal and Ocean Policy, a degree focused on the overlapping interests of environmental science and public policy, from UNC Wilmington in 2015. He has experience working in the private and public sectors, most recently as the Senior Planner for the Town of Carolina Beach.

Coleman Stallworth: Coleman is a Senior Research Associate with the Center for Intergovernmental Partnerships. He helps plan and organize CIP events and activities. Coleman also runs the Center's social media and develops online intergovernmental content. He graduated from the University of Miami with a B.A. in Political Science and a minor in Public Administration. Previously, Coleman helped on city council campaigns and helped organize the University's first black-led student government campaign.

Lauren Boczkowski: Lauren Boczkowski is a Senior Research Associate working with the Center for Intergovernmental Partnerships as part of her studies for a master's in public health through Brown University's School of Public Health. She has spent the past 20 years working in various capacities with government entities, from a public policy administrator to a banker serving the federal government to a strategist for local, state, and federal government at a large financial institution. In addition to her work at the Center, she runs business operations for a small architectural engineering firm.