Be Prepared!

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Communities across the United States are coping with more frequent and intense storms, droughts, heat waves, coastal storm surges, wildfires, and sea-level rise. These events are having costly impacts on public health, the environment, and local economies. City, state, and federal budgets are being over-stressed, as resources are increasingly being spent on emergency response and, then, rebuilding activities. Since 1980, the United States has incurred over $1.5 trillion in damages from weather and climate disasters, each of which cost at least $1 billion. 2017 was the most expensive year on record, with $306 billion in total damages. The economic impacts have become so severe that the vulnerability of local communities to future impacts is now influencing credit ratings for municipal bonds.

Mayors, county executives, and other local government officials are becoming increasingly aware of the need to anticipate and prepare for these events, particularly since they are expected to occur more frequently, and in some cases with increased intensity, as the Earth's climate continues to change. Also, local government officials whose communities are rebuilding following major disasters (a major hurricane; a wildfire) increasingly recognize the benefits of "rebuilding smarter" so their communities are more resilient to future impacts. They understand that adaptation is smart government and helps ensure investments made with scarce taxpayer dollars are effective even as the climate changes. The National Institute of Building Sciences estimates investments in climate resilience and adaptation can save the nation six dollars in future disaster costs for every dollar spent on hazard mitigation.

Anticipating, preparing for, and adapting to a changing climate is also critically important for environmental protection. Many of the outcomes EPA, in partnership with states, tribes, and local communities, is trying to attain — clean air, safe drinking water, Superfund remediation — are sensitive to weather extremes and future changes in climate. For example, more frequent and intense storms can cause combined sewer systems to overflow, spilling raw effluent into rivers and streams. Sea-level rise and storm surges can inundate Superfund sites, increasing the risk that toxic material will be released into the environment and local neighborhoods. More intense and prolonged heat waves can increase tropospheric ozone pollution in certain regions and make it more difficult to attain health-based air quality standards.

Some communities are already acting. The Massachusetts Water Resources Authority anticipated the impacts of

climate change when it redesigned and upgraded the Deer Island Wastewater Treatment Plant in Boston Harbor between 1989 and 1998. It recognized that sea levels would rise over the lifetime of the facility (through 2050), and thus it would be prudent to adapt the design to protect the $3.8 billion investment. The MWRA raised key portions of the facility by 1.9 feet in anticipation of future increases in sea levels.

Investments like these are already yielding significant benefits. Washington, D.C., has a combined sewer system that dumps raw waste into the Anacostia River when the capacity of the system is exceeded during severe storms. New controls that will be completed by 2023 are being put in place that will reduce the risk of overflows. As part of this effort, a new seven-mile-long, 23-foot-wide tunnel was completed last March. During its first two months in operation, it prevented overflows that would have poured about a billion gallons of raw sewage into the Anacostia, leading into the Potomac River near the national capital's key monuments and then into endangered Chesapeake Bay.

Despite these proactive efforts, many communities across the country are still struggling to adapt. Coping with climate risks can be particularly challenging for middle- to smaller-sized communities, which often lack the technical expertise and experience with anticipating and preparing for the future impacts of climate change. They also often have limited resources to devote to climate adaptation.

In 2016, the Environmental Protection Agency launched an innovative web-based Climate Change Adaptation Resource Center to help all 40,000 communities across the nation anticipate, prepare for, and adapt to the impacts of climate change. Located at epa.gov/arc-x, what we call ARC-X is designed to support local government officials throughout the country, from those with extensive experience and expertise dealing with the impacts of climate change, to those working in communities just beginning to meet those challenges. The goal, consistent with EPA's mission and statutes, is to help ensure localities continue to protect public health and the environment even as the climate changes.

There is, in fact, already a huge volume of information available to help decisionmakers understand the risks climate change poses to the things they care about, and to develop and implement adaptation strategies. Websites such as the U.S. Climate Resilience Toolkit, Georgetown Climate Center, Climate Adaptation Knowledge Exchange, Kresge Foundation "Climate Adaptation: The State of Practice in U.S. Communities," ICLEI Local Government Climate Adaptation Toolkit, and others are rich with information. The problem is that these websites often contain a wide array of disparate information which can be overwhelming for a decisionmaker with limited or no experience dealing with climate adaptation. It can be challenging for officials to integrate the different types of information available in any of these sites into a single package that will provide them with a complete recipe for how to evaluate and prepare for the risks posed by climate change.

In meeting this challenge, the ARC-X is unlike any other resource currently available to the public. The ARC-X provides users with an integrated package of information tailored specifically to their needs, based on where they live and the issues of concern to them. Users are given an opportunity to self-identify by indicating the region of the country in which they live and the specific issues of concern to them. The system then provides them with a complete package of information that includes insights about the implications of climate change for the things they've indicated they care about in their region and their community; adaptation strategies to address the risks posed by climate change; case studies that illustrate how other localities with similar concerns have already successfully adapted, along with instructions on how to replicate their successful efforts; tools available from EPA to help implement the adaptation strategies; and sources of funding from EPA and other federal agencies. Users can follow a thread through the package, eliminating the need to figure out how all the relevant information fits together. The ARC-X does that for the user.

To help ensure the effectiveness and usefulness of the ARC-X, the agency sought input from potential users as soon as it began designing the system. EPA engaged its Local Government Advisory Committee, whose members include mayors, county executives, and other administrators. The agency also benefitted from comments received in other

forums. Several key insights emerged from these discussions.

For instance, we learned that local government officials are overwhelmed by the multitude of websites containing huge volumes of information, much of which is irrelevant to the issues of concern to them. In too many cases, policymakers must search for and piece together the specific information of interest to them. This is a particularly serious problem for the thousands of officials with limited or no expertise with climate adaptation.

The tendency of websites to overwhelm users with information not relevant to their needs was starkly illustrated by a county executive trying to sift through the wide array of adaptation tools that have been developed. The official stated at a climate leadership conference, "We don't need any more stinkin' tools. What we need is the technical assistance to understand which tools are the right ones for us to use given the issues of concern to us, and the technical assistance to understand how to use the tools." For this reason, the ARC-X system was designed to first elicit the specific issues of concern to the user, and then provide relevant information in a manner that meets this official's needs.

Policymakers also wanted a system that is non-prescriptive. Local government officials need a resource that will inform their decisions, not tell what the decisions should be. It is the prerogative of the communities to decide what, if any, adaptive measures they want to take.

In that vein, there is no question that adaptation is smart government and helps local agencies deliver critical services to their communities even as the climate changes. For example, it helps ensure investments made with scarce taxpayer dollars to clean up Superfund and brownfield sites are resilient to future extreme weather events. But the future is uncertain and decisions about the margins of safety communities want to build into their systems are value-laden choices that must be made by local government officials given available resources. Do they want to ensure Superfund remediation is effective if a 100-year storm hits, or do they want to be more risk averse and spend to prepare for the possibility of a 500-year storm? These are social choices. The challenge is to empower community leaders to make more informed decisions.

"Thank you so much for developing a program . . . from the bottom up, instead of the top down," Mayor Bob Dixson of Greensburg, Kansas, told us upon reviewing the completed ARC-X system. "It is more receptive to all areas of the United States than . . . just what the Beltway says is going to happen."

The functionality of the ARC-X system can be illustrated with a real-world problem confronting many coastal communities: the potential impacts of sea-level rise and storm surge on wastewater treatment plants located along the coast. For our illustration, let's assume the user is a mayor in a small coastal community in the Northeast who is new to thinking about climate change adaptation. The community's wastewater treatment facility is already protected from flooding by a seawall, but the mayor is concerned the level of protection it provides may prove inadequate in the future. Unfortunately, the community lacks the necessary expertise to assess the risks posed by sea-level rise and worsening storms to develop adaptation strategies.

Let's follow the thread that leads the mayor through the ARC-X system. When the mayor enters the portal, she is immediately presented with a "Tailor Your Search" option to have the system deliver a complete package of information designed specifically to her needs. She is then asked to self-identify by indicating the geographic region in which her community is located (since impacts vary by region) and citizens' specific issues of concern. The areas of interest from which she can choose are those related to EPA's statutory authorities and mission of protecting public health and the environment — air quality, water management, waste management and emergency response, public health, and adaptation planning. Multiple areas of interest can be chosen. In this example, the mayor indicates her community is concerned with the implications of "Sea-level Rise" for "Water Management."

The ARC-X immediately provides information designed for her locale and specific concerns under the heading "Results Tailored to Your Interests." The first item in the package addresses the foremost questions the mayor is likely to ask:

Why should I care? Why does climate change matter for the things my community cares about? The system explains that climate change is causing sea levels to rise more rapidly across the country, amplifying the magnitude of storm surges in coastal areas. The storm surges could flood or damage water infrastructure that is located along the coast or tidally influenced water bodies. These threats will worsen over time as sea levels increase and the magnitude of storm surges increase.

One can imagine the mayor then asking, What can I do about it? What adaptation options exist that I might consider implementing? In response, the system provides a list of adaptation strategies from which she can choose. The mayor is introduced, for example, to the possibility of building flood barriers like levees, dikes, and seawalls; relocating the utility infrastructure to a higher elevation; developing coastal wetlands as buffers to storm surge; and retrofitting the facility with stronger pumps to prevent wastewater outlets from backflowing.

Since the ARC-X is non-prescriptive, the mayor must decide which, if any, adaptation strategies she is interested in implementing. Since her community's wastewater treatment facility is already protected from flooding by a seawall, she would like to consider an adaptation option that would raise the wall (the ARC-X adaptation category she might choose is labeled "Plan for climate change: Integrate climate-related risks into capital improvement plans").

At this point, the mayor is likely to ask the practical question, How can I do it? The ARC-X answers with case studies to demonstrate how other communities concerned with protecting coastal water infrastructure from sea-level rise have successfully implemented the adaptation option she has chosen.

One of the case studies might be the Blue Plains Wastewater Facility in Washington, D.C. The facility is vulnerable to flooding because it is located adjacent to the tidal Potomac River. The mayor learns that Blue Plains has also historically been protected from flooding by a seawall built to withstand a 1-in-100-year flood. She then discovers the local water and sewer authority has assessed the risks posed by sea-level rise and decided to raise the height of the wall. It is investing $13 million in the construction of a 17.2-foot-high sea wall that will surpass the recommended 1-in-500-year storm level. The construction project is due to be completed in 2021.

If the case study stopped here, it wouldn't help the mayor understand how to replicate the steps taken by the wastewater authority to assess the vulnerability of the Blue Plains facility to sea-level rise and to determine an appropriate height for the sea wall. But the case studies in the ARC-X are different than case studies on other websites. The mayor discovers the ARC-X case study includes a "How did they do it?" section containing the key steps her community would have to take to replicate the actions being taken at the Blue Plains facility. The ARC-X then identifies specific tools available to implement each of the key steps, training materials to help the mayor's staff understand how to use the tools, contact information for people at EPA who can answer any questions, and financial support available from EPA and other federal agencies to help defray costs.

Recall the ARC-X planning insights gained from the county executive who stated, "We don't need any more stinkin' tools." In our example, the mayor in the Northeast along the coast who is facing flooding of her wastewater plant has been led by the portal to tools her community can use, along with technical support to understand how to use them, meeting the concern of the exasperated county executive. Indeed, all the material provided to the mayor is in non-technical terms. The website then provides links to more technical documentation that can be used by staff to whom the job of implementing the adaptation strategies will be delegated.

Looking ahead, EPA is expanding the number of case studies. A major source of new information will be the communities themselves as they increasingly adapt to the risks posed by climate change. A mechanism therefore exists within the ARC-X for communities to share their experiences and work with EPA to develop new case studies.

The agency recognizes the ARC-X is a nationwide system that lacks a lot of detailed case studies for any one state. EPA is therefore actively looking for opportunities to work with states to develop their own state-level versions of the

portal that would contain more detailed content relevant to their communities. EPA is prepared to share the entire system (content and computer code) with states at no cost so they can use it as a platform for building their own state-level versions of the ARC-X. The first state-level version was launched by Indiana University last year. The school's system, the Environmental Resilience Institute Toolkit, is tailored to the specific needs of communities in Indiana and the surrounding midwestern states.

EPA continues to enhance the ARC-X to make it useful to a wider base. A new component is being developed that focuses on the information needs of businesses. Climate change poses risks to the assets and operations of many businesses across the country, and can have adverse environmental and public health outcomes. Since businesses are important partners in state and local efforts to protect public health and the environment, empowering them to make more informed investments in climate adaptation is warranted.

The initial success of the ARC-X suggests its unique user interface and system for producing integrated packages of tailored information can be a model the designers of other adaptation websites may wish to adopt and adapt. Replication of the ARC-X approach could help enhance the usefulness of the huge volume of information about climate impacts and adaptation that is already available to the public. TEF