CENTER FOR CLIMATE PREPAREDNESS AND COMMUNITY RESILIENCE

LOCAL SOLUTIONS REPORT:

Identifying and meeting the needs of local communities adapting to climate change

October 2016

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Center for Climate Preparedness and Community Resilience

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The Center for Climate Preparedness and Community Resilience is grateful to all the individuals who participated in the Local Solutions survey, and the U.S. Climate Resilience Toolkit Facilitated Community of Practice, and who applied for Local Solutions conference travel grants and provided feedback on the Weathering Change: Local Solutions for Strong Communities webinar series. We also offer sincere thanks to the Bay & Paul Foundations for grant support that enabled the Center to produce this report. Thanks as well to the Bay & Paul Foundations, the Community Foundation of NJ, High Meadows Fund, the New Hampshire Charitable Foundation, and Town Creek Foundation for providing support to participants in the Center's capacity-building programs. We also thank our partners at the U.S. Environmental Protection Agency for collaboration on the Local Solutions conferences and Weathering Change: Local Solutions for Strong Communities webinar series, from which datasets for this report were derived.

Local Solutions Report

Identifying and meeting the needs of local communities adapting to climate change

Antioch University New England Authors:

Abigail Abrash Walton, Ph.D.
Co-Director, Center for Climate Preparedness and Community Resilience
Director, Advocacy for Social Justice & Sustainability Concentration
Department of Environmental Studies

Michael Simpson
Co-Director, Center for Climate Preparedness and Community Resilience
Director, Sustainable Development and Climate Change Concentration
Department of Environmental Studies

Jason Rhoades, Ph.D.
Researcher, Center for Climate Preparedness and Community Resilience
Department of Environmental Studies

Christa Daniels, AICP
Doctoral Fellow, Center for Climate Preparedness and Community Resilience
Department of Environmental Studies

External Reviewers:

John Bolduc
Environmental Planner
City of Cambridge, Massachusetts

David Herring
Communication & Education Program Manager
NOAA Climate Program Office

Deborah L. Markowitz
Secretary
Agency of Natural Resources
State of Vermont

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Center for Climate Preparedness and Community Resilience
Antioch University New England
40 Avon Street
Keene, NH 03431

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Executive Summary

Climate change will have far-reaching and serious consequences for social, economic, and ecological systems. Communities in the United States and abroad are already feeling the impacts of climate change. Local level action is vital to ensure preparedness and build resilience to meet site-specific conditions. Leaders and other decision-makers at municipal, county, regional, and watershed scales – as well as within community-based organizations and small- and medium-sized businesses – are on the frontlines of preparing for and responding to the impacts of a changing climate. Yet those pursuing solutions at the local level face numerous challenges that could limit their effectiveness. Engagement by a range of partners is instrumental in identifying and advancing local solutions to meet these challenges. Reliable and up-to-date needs assessments, such as this report, are important to tailoring this support.

This report coalesces and analyzes data from a range of sources, including the Local Solutions Survey, participant evaluations of climate preparedness capacity-building programs, and community need statements to inform priorities for public policies, budget setting, private sector funding, investments, and action. The report contains information from 4 sources, with more than 600 respondents from 48 U.S. states and 19 other countries working on local adaptation in a range of capacities.

Results indicate that those engaging in local level adaptation have a high need for broad support covering multiple facets of the adaptation process. Results also indicate the importance of ongoing support throughout the adaptation process that is responsive to local level decision makers' changing needs. This support can be organized around six key needs:

- Introductory orientation for communities beginning the adaptation planning process that clarifies various adaptation objectives, highlights major steps involved, and identifies available and relevant resources
- Funding to support various aspects of the adaptation process
- Scale-relevant data that are responsive to local level needs and presented in a manner that informs local decision-making
- Public and stakeholder engagement throughout the adaptation process
- Facilitated opportunities for peer-to-peer interaction among those leading local adaptation
- Regionally coordinated adaptation initiatives

We offer five specific recommendations to meet these needs:

1. Nimbly innovate funding resources and encourage private sector investment to support local level adaptation
2. Develop actionable data sets for local level end users
3. Build local capacity through multiple approaches, including conferences, webinars, decision support tools and facilitated communities of practice with a focus on peer-to-peer interaction and practical guidance
4. Facilitate regional collaboration
5. Conduct ongoing needs assessment

This report suggests multiple approaches within each category and includes insights from field-tested examples. The report points to the pressing need to focus such support on the smaller and more rural, less resourced communities that make up the vast majority of local governments in the United States. We highlight forming partnerships between institutions of higher education and those working on adaptation at the local level as one effective and mutually beneficial approach to designing and delivering these resources.

Introduction

As the most recent U.S. National Climate Assessment describes, communities across the U.S. are already experiencing the impacts of climate change (Melillo, Richmond, & Yohe, 2014). These impacts include more frequent and extreme high-heat days, more frequent and intense storm events, reduced snowpack, coastal storm surge and rising sea levels. Researchers expect these impacts to have far-reaching and serious consequences for social, economic, and ecological systems. As greenhouse gases continue to accumulate in the atmosphere, the need for climate change adaptation becomes ever more important. Average temperatures in the United States have increased by 1.3°F to 1.9°F since 1895, when record keeping began. Indeed, the most recent decade was the warmest on record (Melillo et al., 2014), and 2015 was the warmest year on record (NASA, 2016a). NASA's Goddard Institute recently reported that the first six months of 2016 are the warmest ever recorded for each of those respective months (NASA, 2016b). Researchers project that temperatures will rise approximately 3°F to 5°F by the year 2100, if greenhouse gas emissions – primarily from the combustion of fossil fuels – are significantly reduced; they project a 5°F to 10°F increase, if greenhouse gas emissions continue to increase (Melillo et al, 2014).

As world leaders convened in Paris for the December 2015 United Nations climate change conference, the eyes of the world have been focused on the need for urgent and unprecedented action to cut climate-altering greenhouse gas emissions. Under the agreement, member countries commit to limiting global average temperature rise to below 2 degrees Celsius (or 3.8°F), with a more stringent goal of less than 1.5°C (or 2.7°F). As the conference closed, 188 countries representing nearly 100 percent of global greenhouse gas emissions had submitted their Intended Nationally Determined Contributions to meeting the goal (Paris Agreement under the United Nations Framework Convention on Climate Change, 2015).

There are significant and promising signs and trends of responses to meeting the challenge of reducing greenhouse gas emissions. National government commitments in Paris – combined with other initiatives, including changes in the energy market – are just some of the signs suggesting that the tide may be turning with respect to engaging effective responses to climate change. Even with these new measures, communities still need to prepare for, and respond to, the climate change impacts already documented due to past greenhouse gas loading into the atmosphere.

The Intergovernmental Panel on Climate Change (IPCC), in the Fifth Assessment Report, defines climate adaptation as "The process of adjustment to actual or expected climate and its effects" (IPCC, 2014b, p. 1758). The same report defines climate resilience as "The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation" (IPCC, 2014b. p. 1772). A recent literature review suggests significant differences in how the term climate adaptation is framed and understood, with a need for further research on whether to use the term "adaptation," "resilience," or alternative language (Moser, 2014).

Many practitioners at the local level use the terms climate adaptation and climate resilience interchangeably. However, there are important distinctions between the two that need to be reflected in local decision-making discourse. Climate adaptation is one option of achieving climate resilience. At the local level, adaptation usually refers to actions the community can adopt to reduce the severity of impacts forecasted and to recover from those impacts at the local level. Climate resilience refers to the capacity of the community to withstand the impacts and the ability to adapt successfully in the face of changes. Importantly, capacity also includes social capital that facilitates individuals' access to resources through relationships with other community members and with others outside the community. Trust, reciprocity, and collective action are key attributes of social capital and can enhance community resilience. There are a range of interpretations used by practitioners about what local climate resilience and adaptation look like when implemented. Ensuring that stakeholders involved in local climate adaptation

and resilience are aware of the various definitions will contribute to intended adaptation and resilience outcomes aligning with stakeholder objectives.

Adaptation will benefit from a coordinated effort across international, national, regional, and local scales (Van Aalst, Cannon, & Burton, 2008; Dumaru, 2010; National Research Council, 2010). At the international scale, coordinated effort can distribute resources to assist in adaptation and limit greenhouse gas emissions (Dodman & Mitlin, 2011; Measham et al., 2011). For example, financial assistance from wealthy industrialized nations will be essential to the adaptation efforts of nations with fewer resources. A similar focus on modestly and under-resourced communities in the United States is imperative and should be a top priority of public and private sector entities.

National and regional efforts are able to further distribute resources, provide guidance and expertise, and create laws, policies, and priorities that will support adaptation at the community level (Adger, 2003; Interagency, 2011; Snover et al., 2007; United States Government Accountability Office, 2009). For example, the U.S. federal government has set national priorities and developed policies to incentivize adaptation, make funding available, and allocate resources. Through White House leadership (White House, 2013), the Interagency Climate Change Adaptation Task Force and the State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience have contributed important guidance. Federal agencies have developed informational resources and decision support tools to assist adaptation efforts at local levels. Notable examples include:

- U.S. Centers for Disease Control's Building Resilience Against Climate Effects program, implemented at the local level through county-based initiatives (www.cdc.gov/climateandhealth/brace.htm)
- U.S. Climate Resilience Toolkit (toolkit.climate.gov)
- U.S. Department of Agriculture Climate Change Resource Center (www.fs.usda.gov/ccrc/category/ccrc-bibliography/cluster-analysis)
- U.S. Department of Housing and Urban Development's National Disaster Resilience Competition
- U.S. Environmental Protection Agency's Local Government Climate Adaptation Training (www.epa.gov/communityhealth/local-government-climateadaptation-training) and Adaptation Resource Center (www.epa.gov/ARC-X)
- White House Climate Data Initiative (climate.data.gov)

Flood damage in Ellicott City, MD, 2016. Photo courtesy of Preservation Maryland.

Regional branches of federal agencies as well as state governments can truly collaborate with local stakeholders to develop the most effective and efficient strategies to facilitate coordinated projects among multiple communities. Indeed, state government plays a unique and important role as a principal source of funding for infrastructure investments and capacity building in a community, as a primary source of technical assistance to communities and as regulator. Many states also have state climate adaptation and resilience plans that contemplate local partnership. The occurrence of such extreme storm events as Katrina, Sandy, and Irene, the extended California drought, and the increase in the number and size of wildfires in the west have provided impetus for states to focus on comprehensive climate adaptation planning. Concurrently, some state governments have initiated innovative funding support for adaptation. Prime examples include Vermont's use of Housing and Conservation Board funds combined with Community Development Block Grant funds to buy out properties situated in the flood hazard zone, and Delaware's Strategic Opportunity Fund for Adaptation initiative.

Municipalities are also breaking new ground in comprehensive adaptation planning. Many of these are the larger urban centers such as Denver, New York City, Seattle/King County, and Boston. However, more than

2016 Local Solutions: Eastern Regional Climate Preparedness Conference. Photo by Karen Buchsbaum

90% of U.S. municipalities are much more modestly sized and resourced, with populations less than 25,000 people. (National League of Cities, 2016) Adaptation at the local level, for smaller or more rural municipalities, counties, and water districts, is critical. These local governments play a key role in decision making about allocating limited local resources to address the complex challenge of climate change impacts that are directly experienced at this community scale (NRC, 2010). Local elected and appointed officials and professional staff are on the frontlines of decision-making about protecting vulnerable populations and built infrastructure; transportation maintenance, planning and redevelopment; energy and other public utilities; communication systems; housing; public health; emergency management; and protection of natural resources that provide the essential human systems and ecosystem services that support society, as we know it (Adger, 2003; NRC, 2010). Because local communities often have the most detailed knowledge of these systems, local level adaptation is able to tailor actions to the site-specific nature of climate threats and vulnerabilities (Few, Brown, & Tomkins, 2007; NRC, 2010; Winsvold, Stokke, Klausin, & Saglie, 2009).

Adaptation at the local level is also able to incorporate and reflect community priorities that are effective and that community members also view as equitable (Collins & Ison, 2009; Winsvold et al., 2009). Some adaptive decisions, like balancing historic preservation of a coastal town with potential retreat and redesign, are intimately bound with local cultural identity. In these cases, community engagement in the planning process will be essential to navigate the value-laden decisions that must be made. Other decisions, like allocating funding to upgrade culverts in the face of increasing stormwater run-off, may call for less explicit public consultation. Yet even in this example, community engagement and leadership at the local level is still broadly important because of the need to support budgetary allocation for such initiatives over a number of fiscal cycles.

Local level adaptation is also able to incorporate local knowledge and values to address social vulnerability to climate change. In particular, such an approach offers the potential for the meaningful and effective inclusion of vulnerable and marginalized groups into local planning processes. For example, in a project conducted by the Center for Climate Preparedness and Community Resilience in Bridgeport, Connecticut, senior citizens engaged in a participatory adaptation planning process that was shown to enhance resilience in multiple ways (Rhoades, 2016).

While local level adaptation is important, decision makers face numerous challenges that could limit effectiveness (GAO, 2009). For example, those engaging in local level adaptation may not have staff with relevant expertise or they may lack needed site-specific climate or vulnerability data on which to base decision-making. Additionally, they may not have the financial resources, access to technical assistance or necessary community support to go forward with adaptation planning or implementation.

More than 90% of U.S. municipalities are modestly sized and resourced, with populations less than 25,000 people. Adaptation at this local level is critical. These local governments play a key role in allocating limited local resources to address the complex challenge of climate change impacts (NRC, 2010).

Acting in isolation at the local scale also can reduce the effectiveness of adaptive responses or lead to maladaptation. For example, a storm surge barrier constructed by one coastal town may be ineffective unless this is combined with additional projects undertaken by neighboring towns as part of a regionally coordinated effort. If a municipality enlarges culverts to adapt to greater stormwater flows, the approach may be effective in the context of that local area, but may also exacerbate stormwater management issues in downstream communities. In both cases, a coordinated approach is required to design effective adaptation measures that address issues at the appropriate scale. Engaging in such a collaborative effort without the assistance or facilitation of a regionally focused organization can present an additional challenge for municipalities and those engaged in local level adaptation.

Acting in isolation at the local scale also can reduce the effectiveness of adaptive responses or lead to maladaptation.

The assistance of a range of partners is vital in communities' success in overcoming these challenges. Potential partners include federal and state government agencies, philanthropic institutions, private sector investment banks, non-profit organizations, private businesses, and academic institutions. For these groups to provide effective, targeted, and coordinated support, they will need a clear and detailed sense of the adaptation needs at the local level that they are working to address.

There have been few assessments, however, of the needs of those engaging in adaptation at the local level that these groups can use to tailor the financial, informational, and material support they provide. A notable exception is a survey conducted by the non-profit Clean Air-Cool Planet, which asked participants to identify their most pressing needs associated with climate change adaptation (Clean Air-Cool Planet, 2011). Fifty-one respondents completed that survey, 48 of whom worked in state, regional, and local levels of government in the northeastern U.S. The results can be grouped into three categories: technical, communication, and financial assistance. The most pressing technical assistance needs included **assessing infrastructure vulnerability**, **updating floodplain maps**, **obtaining local climate data**, and **creating adaptation plans**. The most pressing communication need was for **assistance with education efforts to increase local understanding of climate change**. Financial needs focused most significantly on **enhancing staff capacity** to more effectively engage in adaptation.

Flood damage, Walpole, NH. Photo by Duncan Watson

While providing valuable insight into local adaptation needs, this survey was conducted in 2011, and the sample was focused exclusively on the Northeast U.S. The needs associated with local level adaptation could quickly change as the risks and impacts of climate change become clearer and communities progress with adaptation planning and implementation. Adaptation needs vary by geographic location. More comprehensive and ongoing assessment is important to ensure that the priorities of support organizations are current and responsive to the needs of those working at the local level.

The Center for Climate Preparedness and Community Resilience (the Center) has drawn on multiple original data sets to synthesize and summarize the most pressing adaptation needs of local communities in order to update and advance ongoing assessment. Analysis of these data sets further contextualizes local adaptation needs and highlights potentially effective approaches for strengthening local solutions to climate adaptation.

Data Sources

This report contains information from four primary sources: the Local Solutions Survey, 2014 and 2016 Local Solutions Climate Preparedness conference travel grant applications, survey feedback on the *2014-15 Weathering Change: Local Solutions for Strong Communities* webinar series, and the Center's collaboration with the federal government to road test the U.S. Climate Resilience Toolkit (Table 1). All of these sources were derived from Center initiatives focused on building the climate preparedness and community resilience capacity of local level decision-makers. While there is overlap among the audiences across these four data sets, there is also diversity as they targeted groups in a range of contexts with varying areas of concern and focus. Taken as a whole, these sources represent a sizable data set, including respondents across the United States and 19 other countries engaging in local level adaptation in a variety of capacities. Collectively, they provide insight on a range of issues associated with adaptation and preparedness, including local level concerns about climate change, local level responses, support needs, and interest in specific adaptation issues.

Local Solutions Survey

The Local Solutions Survey was administered electronically to 1,378 individuals, during a 10-day period in April 2015. Recipients were individuals who had participated in Center capacity-building programs or who had signed up for Center outreach communication. The survey contained 10 items and was explicitly designed to assess adaptation needs at the local level. Three items asked respondents to rate the importance of assistance relative to a given topic on a scale of 1 to 5. These questions were organized into three overarching categories: facilitating the adaptation process, assistance and training relating to adaptation planning and implementation, and climate data/information needs. In an effort to assess how needs might change based on communities' varying levels of progress in the adaptation process, a filter question separated participants' responses into those who reported that they had not yet started any adaptation planning and those who had initiated or completed some degree of adaptation planning or implementation.

Three hundred and twenty nine (329) individuals responded to the survey from a total 1,378 invitations (24% response rate). Nearly all respondents were from the United States (96.6%) (Figure 1), with additional respondents from Canada (2.8%), Australia, and the United Kingdom (both with 0.3%). U.S.-based respondents comprised a diverse geographic

Table 1. Data sources, original purpose, and their report application

Source	Original purpose	Provides insight into
Local Solutions Survey	To assess adaptation needs at local level	• Current state of adaptation planning at the local level • Adaptation support needed at the local level • Opportunities for collaboration in supporting local level adaptation
Travel Grant Applications	To evaluate, award, and support participation assistance to climate preparedness conferences	• Concerns about climate change at the local level • Adaptation actions underway at the local level • Adaptation support needed at the local level
Webinar Surveys	To evaluate webinars	• Local level interest in specific adaptation issues
U.S. Climate Resilience Toolkit Facilitated Community of Practice	To evaluate an adaptation planning decision support tool	• Local level interest in specific adaptation issues

representation, including 37 states and the District of Columbia. A sizable percentage of respondents were from the Northeast U.S. (59%).

Survey respondents indicated a range of capacities in which they engaged with climate change adaptation (Figure 2). The highest number of respondents (32%) identified their role in a municipal position, including employment as professional staff or serving as elected or appointed officials. A high percentage of respondents also indicated working at other levels of government, including state (22%), regional (19%), county levels (5%), federal government (1%), and tribal government (1%). A smaller portion of respondents indicated associations outside of the public sphere, including non-profit organizations (8%) and academic/research institutions (1%). The remaining respondents (11%) indicated a range of other positions.

Travel Grants Applications

The Center has convened two climate change preparedness conferences, in partnership with the U.S. Environmental Protection Agency. The 2014 Local Solutions: Northeast Climate Change Preparedness conference (Manchester, NH) and the 2016 Local Solutions: Eastern Regional Climate Preparedness conference (Baltimore, MD). The Center mobilized private foundation resources to support the participation of local decision-makers, at both conferences, through travel grants. The Center invited travel grant applications from prospective participants seeking this support. These applications served as the basis for awarding travel assistance; applicants' responses provided insight into the self-reported climate challenges facing respondents' communities, actions respondents were taking to address those impacts, and the most important types of information and support respondents were seeking.

Seventy-four travel grant applications were submitted for the conferences, at the time of this report, and some of the applications were submitted on behalf of multiple participants, grouped as teams.

Applicants were based in 18 states, with the majority from the Northeast (65%) (Figure 3). Among the most prominent affiliations, respondents indicated working at a range of governmental levels: municipal (37.5%) and regional (18.7%), federal (7.5%), county (3.8%), and state (3.8%) levels (Figure 4). Respondents also included individuals working for non-profit organizations (12.5%) and academic/research institutions (11%). The remaining 5% indicated affiliations with a range of other positions (Figure 2).

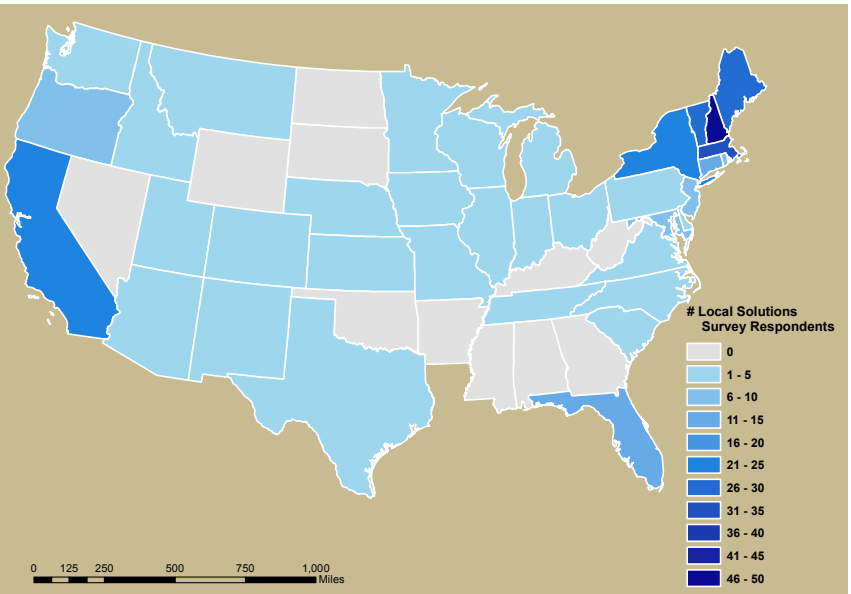

Figure 1. Location and number of Local Solutions Survey respondents, by U.S. state

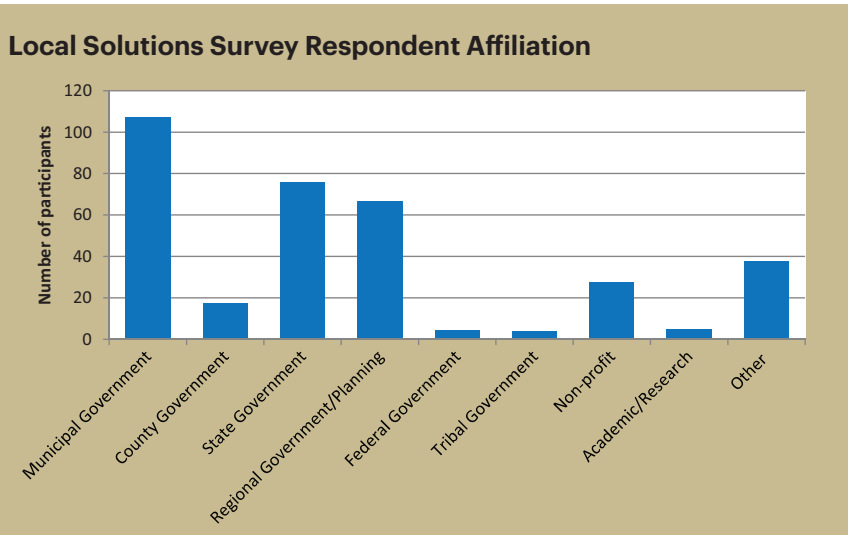

Figure 2. Primary affiliations of Local Solutions Survey respondents (n=329)

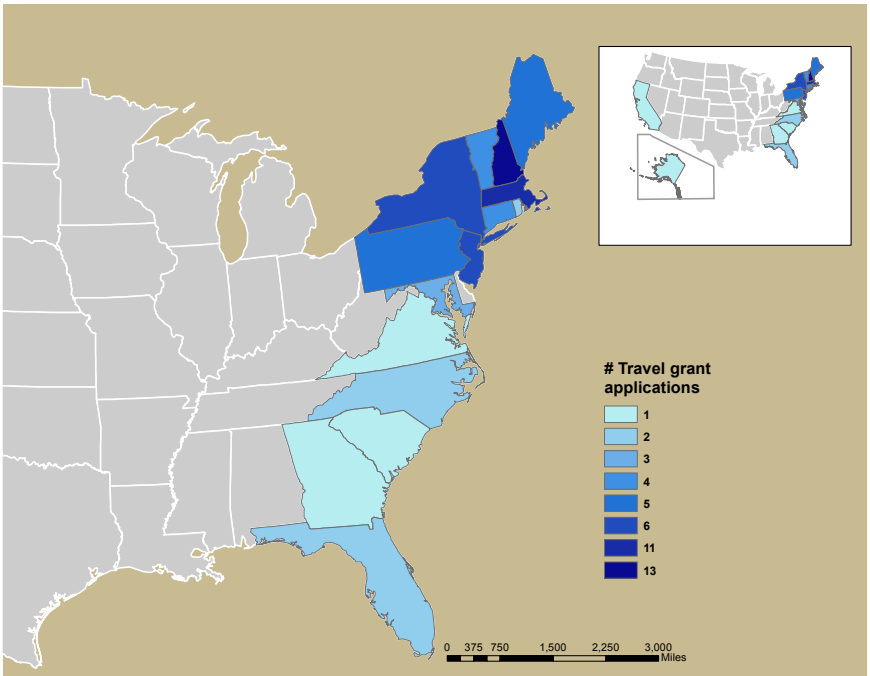

Figure 3. Location and number of travel grant applicants, by U.S. state

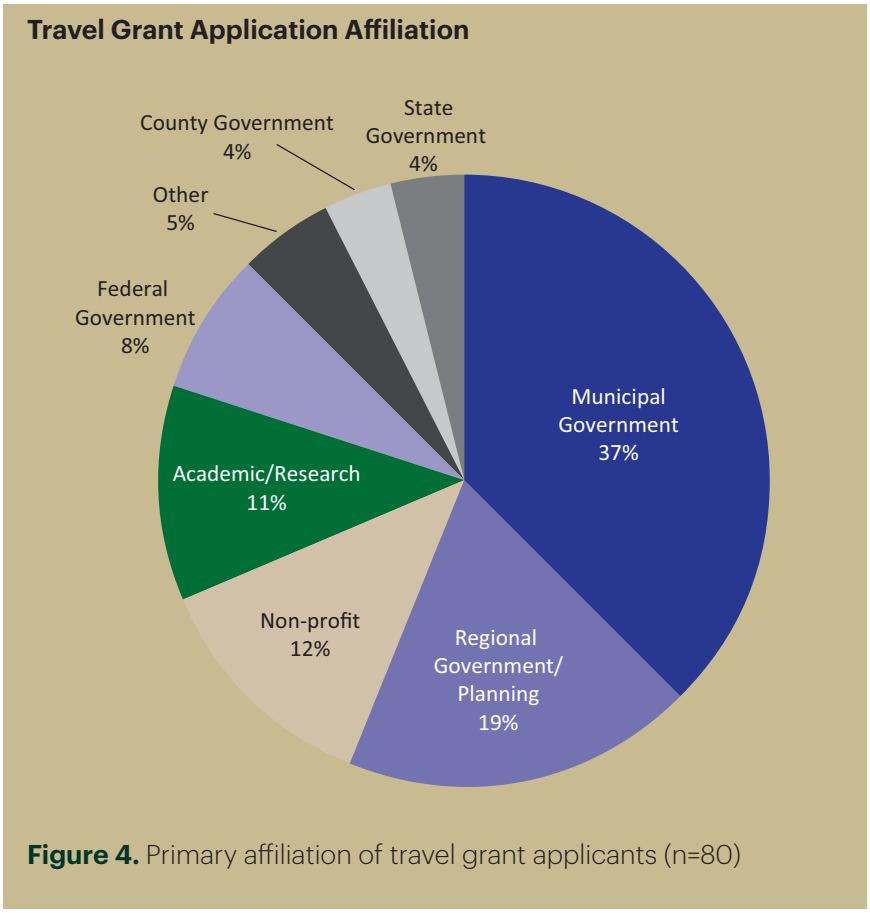

Figure 4. Primary affiliation of travel grant applicants (n=80)

Webinar Data

During 2014-2015, the Center convened, in partnership with the U.S. Environmental Protection Agency, a series of webinars on topics relevant to climate change preparedness, adaptation, and community resilience. Specific webinar topics included:

- Assessing the vulnerability of water conveyance infrastructure
- Collaborating for resilience: equitable adaptation
- Communication and community engagement strategies
- Green infrastructure, flood resiliency and land use management
- Navigating the Stafford Act
- Resilient design

The Center solicited survey feedback from participants on each webinar presentation, with the primary purpose of evaluating the effectiveness of the webinars as capacity-building vehicles. The survey instrument also invited participants to indicate what topics they were most interested in. While some individuals participated in more than one webinar, the following numbers refer to participants per webinar rather than a cumulative total of discrete individuals.

The survey data from the six webinars included in this report were based on responses from 1,896 webinar participants. The majority were from the United States (95%) (Figure 5). Nineteen other countries were also represented, including participants from Africa, the Americas, Asia, Australia, Europe, and the Middle East (Figure 6). Participants included individuals from 48 U.S. states. The highest percentages of U.S.-based participants were from the states of Massachusetts (12%), New Hampshire (7%), New York (7%) and California (6%). Respondents indicated working

in a range of private and public sector positions. The highest percentage of respondents indicated a primary affiliation with state and local government (38%), followed by consulting firms (17%), the federal government (15%) and educational institutions (12%). The remainder of respondents indicated affiliations with a range of private industries and public utilities (Figure 7).

U.S. Climate Resilience Toolkit Facilitated Community of Practice

During the first quarter of 2015, the Center convened a Facilitated Community of Practice to "road test" version 1.0 of the U.S. Climate Resilience Toolkit, an online decision support tool — offering federal science-based tools, information, and expertise — published in November 2014. The primary purpose of the Facilitated Community of Practice was to provide feedback from practitioners to the Toolkit developers regarding the effectiveness and usability of the first iteration of the Toolkit, which had a specific initial focus on building resilience in coastal regions. As part of their involvement, participants highlighted adaptation questions and needs that they were hoping the "road test" could assist them in addressing. In this way, the Facilitated Community of Practice yielded insights into specific adaptation issues that participants identified as priorities for technical assistance and financial support and investment.

The Center recruited 29 end-user decision-makers (planners, emergency preparedness and municipal administration personnel, natural resource specialists, and others) working in 25 coastal communities from 10 Eastern U.S. states to participate in the Facilitated Community of Practice (Figure 8). Participants had the following affiliations:

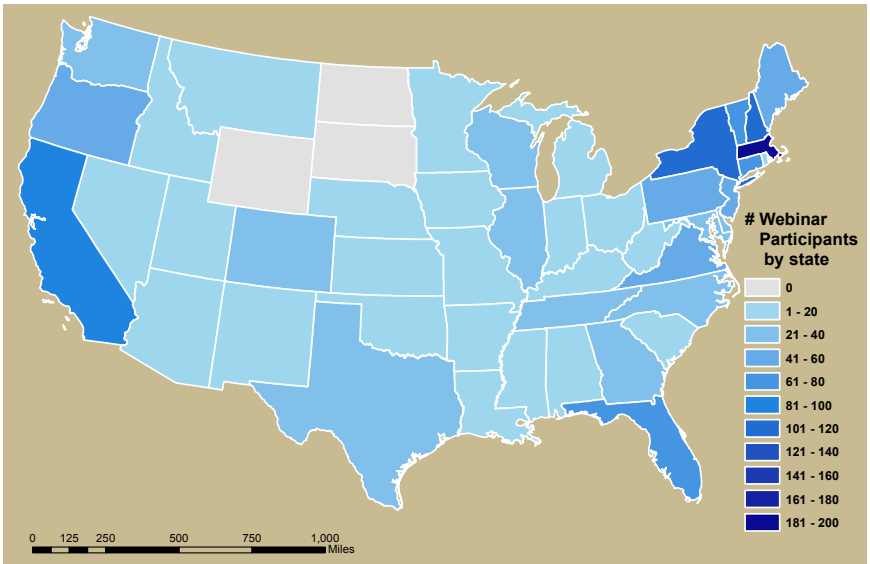

Figure 5. Location and number of webinar participants, by U.S. state

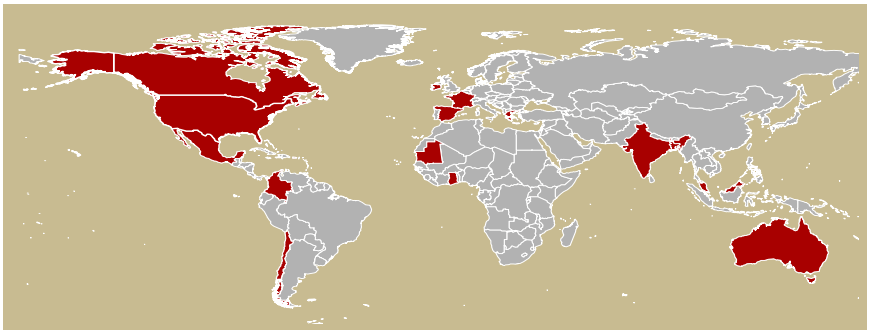

Figure 6. Location of webinar participants, by country

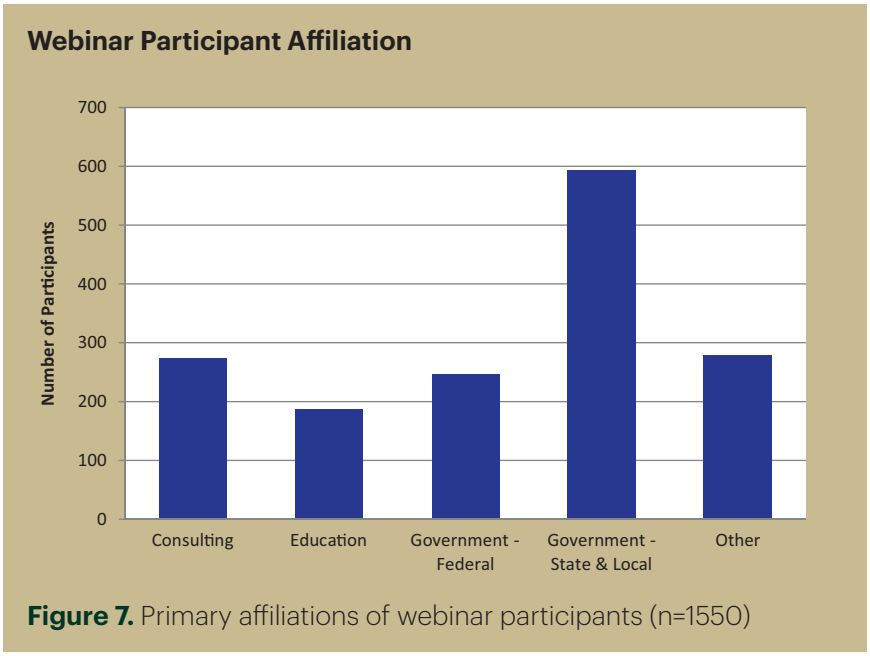

Figure 7. Primary affiliations of webinar participants (n=1550)

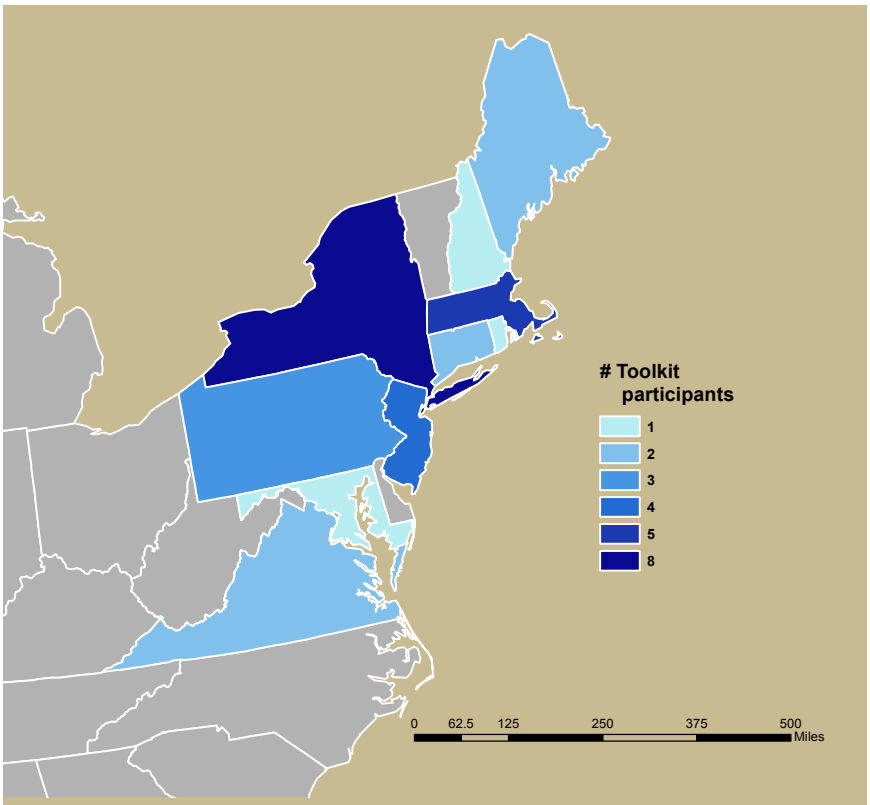

Figure 8. Location and number of Toolkit participants by State

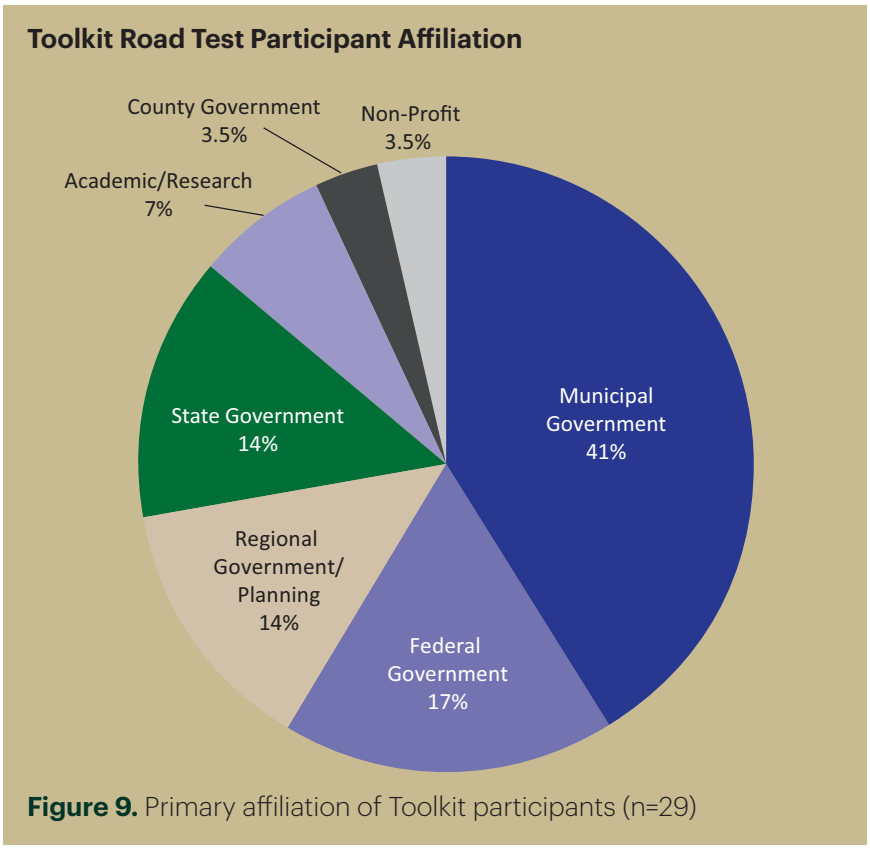

Figure 9. Primary affiliation of Toolkit participants (n=29)

municipal government (41%), federal government (17%), regional government/ planning (14%), state government (14%), academic/research institutions (7%), county government (3.5%), and nonprofit organizations (3.5%) (Figure 9).

Overall for the four data sources, the largest percentage of respondents was at the municipal level, followed by other levels of government. Supporting organizations such as educational institutions and NGOs were also represented, but vary in response rate depending on the data source.

Results

Our analysis of the data, from the sources outlined above, highlight that key decision makers in communities across the United States and other countries are concerned about climate change and its impacts. Our findings illustrate that local decision makers:

- recognize the need for adaptive responses
- are signaling that they intend to take action or already are doing so
- need support
- need easy access to locally relevant data from which they can extract actionable information, and
- guidance from scientists and subject matter experts in the use of science-based tools and data for decision making.

We discuss each of these findings, drawing on the relevant data sources. Specifically, the travel grant applications highlight the **concerns** of local decision makers, the Local Solutions Survey and the travel grant applications provide insight into **local actions**, and the Local Solutions Survey in concert with the other three data sources illustrate the **needs** of those engaging in local level adaptation.

Local Decision Makers are Concerned

Travel grant applicants identified specific climate change stressors which they were experiencing in their communities. Respondents most frequently cited concerns (Figure 10) about:

- **increasing frequency and intensity of storm events** (mentioned in 74% of applications)
- **sea level rise** (mentioned in 42% of applications)
- **increasing temperatures and extreme heat** (mentioned in 34% of applications)

Increasing probability of drought was less frequently referenced, appearing in only 8% of applications; this may be due in part to a lower representation of respondents in regions, such as the Southwest U.S., where declining precipitation and water availability is a primary climate-related concern.

Respondents also referenced a wide range of specific impacts about which they were concerned (Figure 11). The impact

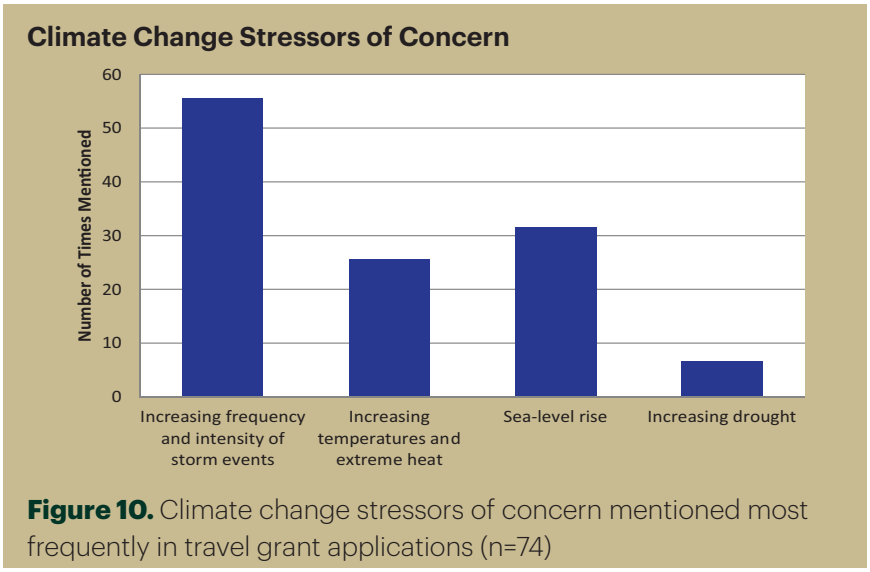

Figure 10. Climate change stressors of concern mentioned most frequently in travel grant applications (n=74)

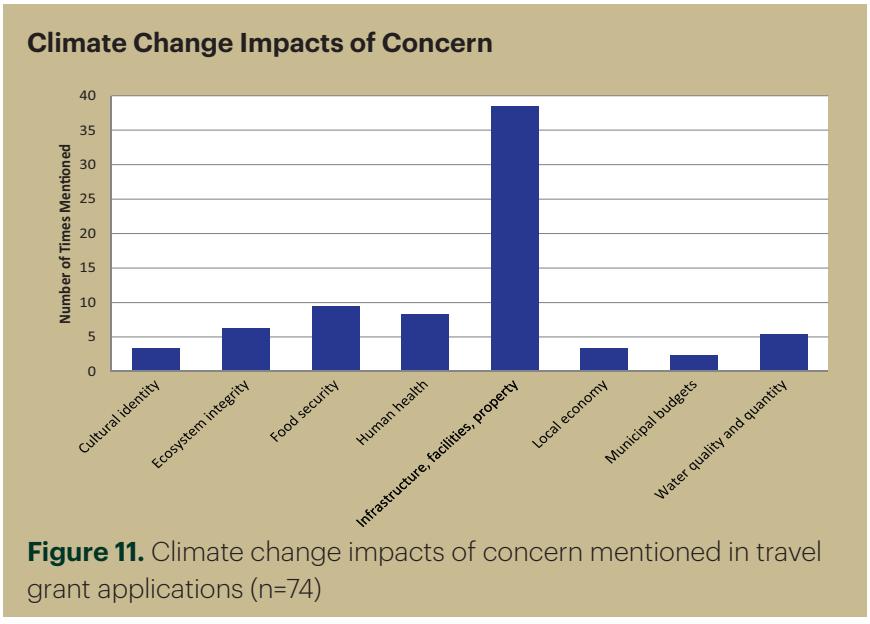

Figure 11. Climate change impacts of concern mentioned in travel grant applications (n=74)

most frequently mentioned, appearing in 51% of the applications, was potential damage to infrastructure, facilities, and property. Applicants connected these concerns to the impacts of flooding and stormwater as well as the vulnerability to electrical infrastructure from increasing summer temperatures. Highlighted concerns also included: **food security** (mentioned in 12% of applications), **human health** (mentioned in 11% of applications), **ecosystem integrity** (mentioned in 8% of applications), **water quality and quantity** (appearing in 7% of applications), **preserving cultural identity** (mentioned in 4% of applications), and **economic health and stability** (mentioned in 4% of applications).

Applicants' concerns did not focus solely on predicted future conditions, but in many cases reflected current challenges facing communities. For example, one travel grant respondent mentioned that her community "already struggles with wet weather issues such as combined sewer overflows and flooding, but is projected to receive even more rain with climate change. Climate change will also increase temperatures and worsen already contaminated air quality." Writing in 2014, another respondent highlighted that his state, Vermont, had "received five federal disaster declarations since Tropical Storm Irene in 2011" and that the "cumulative impacts of these disasters are putting a great strain on the member towns' infrastructure and ability to recover."

Needs Associated with Facilitation

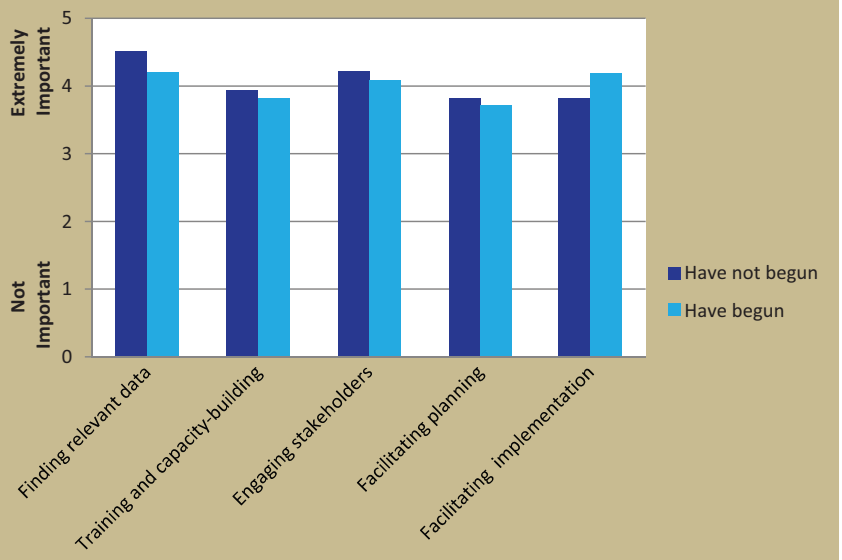

Figure 12. Needs associated with facilitating the adaptation planning and implementation process (n=329)

In the Local Solutions Survey, 58% of respondents indicated that they have already begun some adaptation planning.

Local Decision Makers are Taking Action

Local decision makers are taking action to prepare. In the Local Solutions Survey, 58% of respondents indicated that they have already begun some adaptation planning. In addition, the 2014 and 2016 travel grant applications referenced specific actions communities are already engaging in as part of the adaptation process. It is evident that communities are taking actions throughout the various stages of the adaptive process, from **assessing vulnerabilities** (mentioned in 16% of applications), to **conducting initial outreach** and **engaging stakeholders** (appearing in 14% of applications), to **implementing adaptive actions** (mentioned in 15% of applications). The value of this work is exemplified by the comment of one travel grant applicant who described his efforts in the aftermath of Superstorm Sandy to help affected communities "develop plans that would not just rebuild facilities but would be resilient to future challenges from climate change."

Communities Need Assistance

As communities undertake adaptation actions, the various data sets also make clear that those working on adaptation at the local level are in need of support. All of the data sources indicated a need for assistance in a broad range of topics and tasks. The Local Solutions Survey explored these needs most systematically.

Local Solutions Survey Results

The Local Solutions Survey was organized into three overarching sections based

on different types of climate adaptation planning and implementation support:

- Facilitating the adaptation planning and implementation process
- Assistance and training regarding specific aspects of conducting adaptation planning and implementation
- Climate data and other relevant information

The data are separated between results from respondents who reported having already started adaptation planning and those who reported not yet starting adaptation planning. This division illustrates how needs change or remain consistent as communities work through the adaptive process.

Facilitation of the Adaptation Process

The survey's first section centered on needs regarding facilitation of the adaptation process. Questions focused on:

- Finding the relevant data to support decision-making
- Finding training and other capacity-building opportunities
- Bringing stakeholders to the table
- Facilitating the planning process
- Facilitating the implementation process

The survey respondents indicated a broad and high level of need for support with facilitating the adaptation process, with each aspect scoring a four or high three on a scale of one to five (Figure 12).

For those respondents who had not yet started the adaptation planning process, initial steps such as finding the relevant data and bringing stakeholders to the table were particularly pressing. Those respondents who had begun the adaptation process also voiced these needs, but with less urgency. These findings indicate that, in addition to initial support with issues such as finding relevant data, communities also need ongoing support as they progress through the adaptation process. As communities progress through the adaptation process, these findings illustrate that their priorities shift. For example, while the importance of support with finding relevant data decreases as communities work through the process, desire for support in facilitating the implementation process increases among those who have already begun adaptation planning.

For those respondents who had not yet started the adaptation planning process, initial steps such as finding the relevant data and bringing stakeholders to the table were particularly pressing.

Looking at the distribution of each individual question reveals some additional patterns (See Appendix A). All of the questions received very few rankings of a one or two, indicating that these are high priorities for the vast majority of respondents. Additionally, while the relative uncertainty about the need for specific kinds of support as indicated by the frequency of "don't know" responses is generally low among all respondents, it is consistently higher among the group that has yet to begin adaptation planning. This indicates the value of training communities who have yet to begin adaptation planning in order to introduce them to the adaptation process, what potential resources exist to support the process, and how to effectively access and engage those resources.

In addition to the adaptation aspects surveyed in this section, respondents also identified other needs. The most frequent responses, with 18 individuals commenting, centered on **expanding capacity through funding sources**, **increased staff resources**, and **training in grant writing**. Additionally, 11 participants requested additional assistance with **outreach and engagement**, **including raising awareness**, **identifying and including additional stakeholders**, and **building support for action**. Additional requests included:

- Support for developing collaborative partnerships
- Coordinated assistance from federal and state partners
- Regionally pertinent case studies
- Sample policy language
- Downscaled climate and vulnerability data

Technical Needs

The survey's second section focused on technical needs

and particular types of adaptation assistance. Questions focused on:

- How to identify the challenge (problem statement)
- How to conduct a vulnerability assessment
- How to quantify risk
- How to communicate the challenge or issue
- How to best identify values and priorities of stakeholders in the community
- Which data are required for specific applications of assessment/decision making
- How to translate relevant science into effective policy
- How to plan for businesses to continue to operate and recover from impacts
- How to develop a shared language between decision makers and community members

Assistance and Training Associated with Planning and Implementation

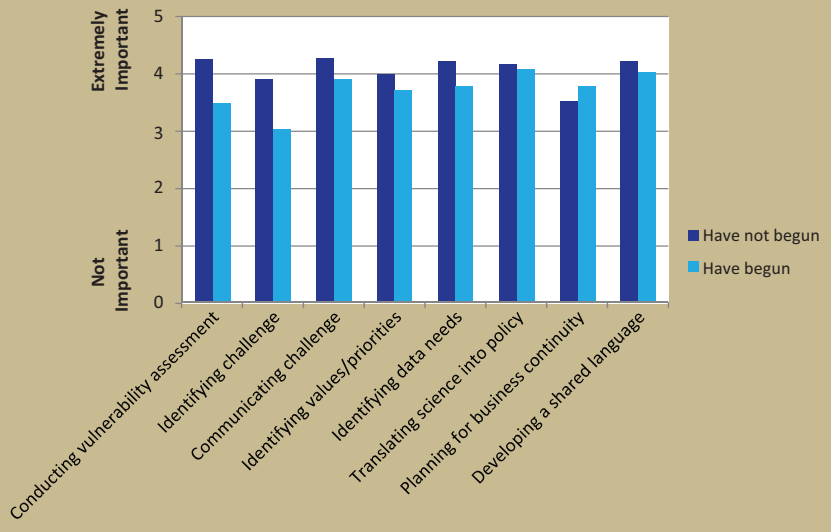

Figure 13. Assistance and training needs associated with planning and implementation (n=329)

How to Identify the Challenge (Problem Statement)

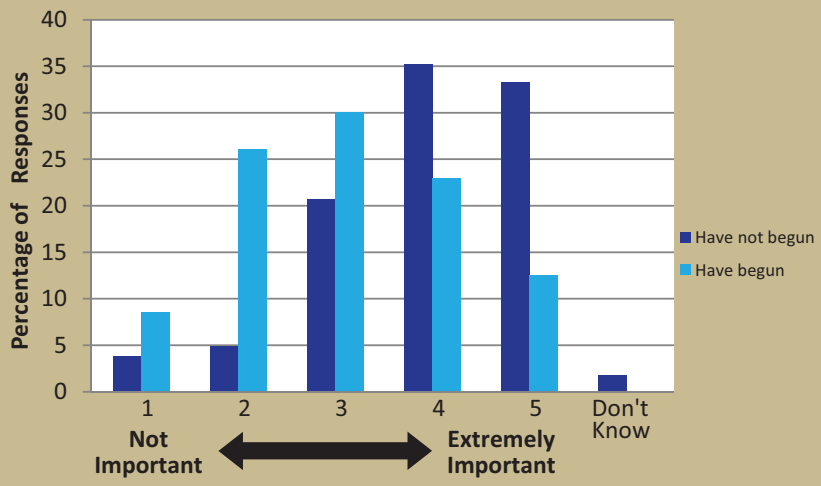

Figure 14. Needs associated with how to identify the challenge (problem statement) (n=329)

As with the first section of survey results, respondents indicated a high need for support associated with each question (Figure 13). Again, the need does decrease slightly for those who have begun adaptation, but still remains consistently high, demonstrating a desire for ongoing support.

For those yet to begin the adaptation process, **the most pressing issues were associated with the initial aspects of planning**, including **conducting a vulnerability assessment**, **communicating the challenge**, **identifying data needs**, and **developing a shared language between decision makers and community members**. For those who had already begun adaptation planning or implementation, the interest in these initial stages, including conducting the vulnerability assessment and identifying the challenge, is less pronounced. Instead, steps with a greater focus on action and implementation were more prominent, including **translating science into policy** and **planning for business continuity**. These findings show how the needs of those already engaged in adaptation planning shift away from planning skills toward a focus on translating those plans into action.

Both groups indicated a strong desire for support in effectively communicating with identified stakeholders and the general public. More specifically, there is strong interest in developing a shared language that can facilitate communication to allow decision makers to move agendas

forward with community support. This consistency in the survey analysis highlights the ongoing importance of communication and outreach throughout the adaptation planning and implementation process.

Examining the distribution of each question individually identifies a few additional trends (See Appendix B). As with the previous questions, there is more uncertainty among those who have not yet begun adaptation planning about the need for support associated with each topic. Also, some of the questions have a wider distribution, with more high and low responses indicating a greater range of need. These include identifying the challenge (Figure 14), identifying the values and priorities of stakeholders (Figure 15), and planning for business continuity (Figure 16). This greater range of responses could be a result of differences in the focus of individual practitioners or communities or could be attributable to changing needs associated with the various stages of the adaptation process. For example, assistance in identifying the problem statement could be of great importance for those still in the early stages of planning, but is expected to become less urgent once it is defined and incorporated into planning. As another example, planning for business continuity may rank as a higher priority for those with a connection to or awareness of the importance of the business community, but might rank less so for those focused on other aspects of the adaptation process.

As with the previous section, participants offered additional requests. Seven participants mentioned funding resources. Collaboration, and downscaled climate data were also mentioned again. Other topics included:

- Support monetizing potential climate impacts
- Moving from adaptation planning to implementation
- Collecting relevant socioeconomic data
- Engaging stakeholders in a community visioning process.

Information Needs

The survey's third section focused on informational needs, with questions regarding:

- Identification and location of hazards on the landscape
- Identification and location of vulnerable populations

How Best to Identify Values and Priorities of Stakeholders in the Community

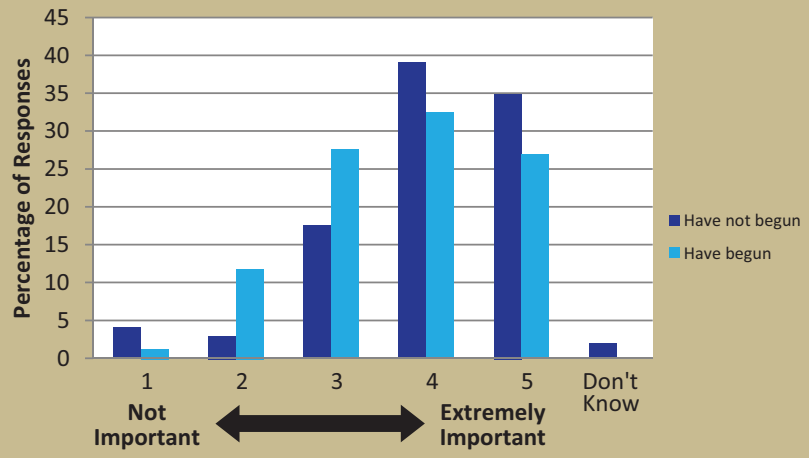

Figure 15. Needs associated with how to best identify values and priorities of stakeholders in the community (n=329)

How to Plan for Businesses to Continue to Operate and Recover from Impacts

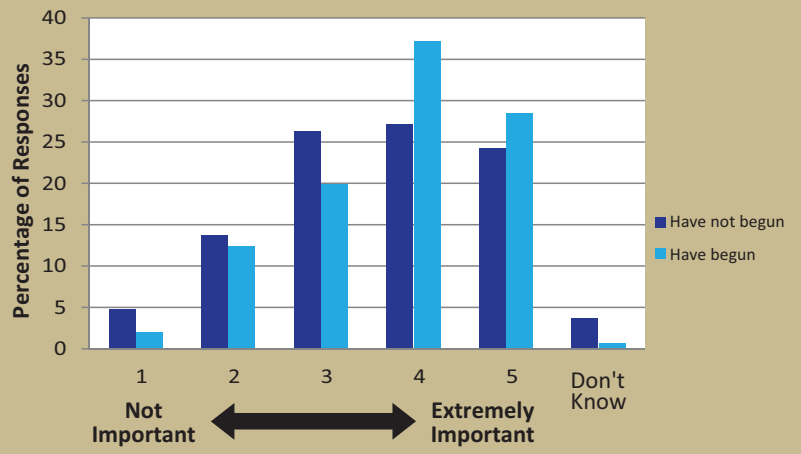

Figure 16. Needs associated with how to plan for businesses to continue to operate and recover from impacts (n=329)

- Light Detection and Ranging (LIDAR) maps
- Location of emergency services
- Location and vulnerability of built infrastructure
- Value of built infrastructure and building stock
- Location and importance of natural systems that provide ecosystem services
- Hydrological assessment of the local watershed[1]

Informational Needs Associated with Adaptive Process

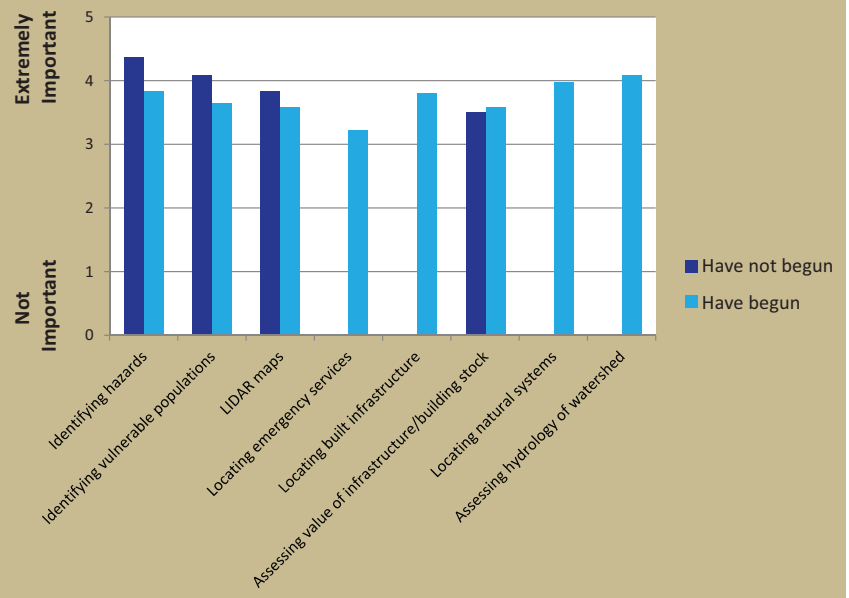

Figure 17. Informational needs associated with the adaptive process (n=329)

LIDAR Maps

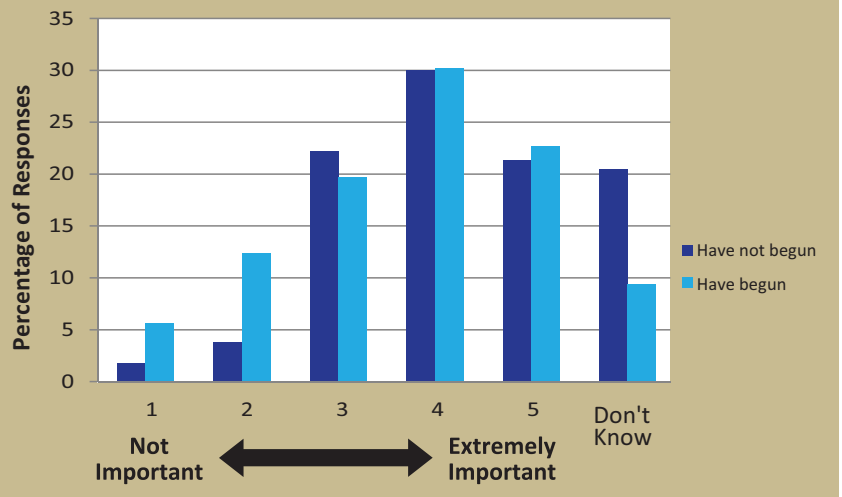

Figure 18. Needs associated with LIDAR maps (n=329)

As with the previous two sections, need is generally high across all of the questions, with each receiving an average ranking of 3 or 4 (Figure 17). Identifying hazards and vulnerable populations were the top priorities for respondents starting the adaptation process. Respondents continuing the process had varying areas of focus. Certain needs were less pressing, such as obtaining information on the location of emergency services. Respondents deemed other needs as higher priorities; for example, understanding the natural systems and hydrology of an area.

Focusing on distribution of each specific question reveals additional trends (See Appendix C). Most notably, among those who have not yet begun adaptation planning, there is high uncertainty about the importance of high definition remote sensing, known as LIDAR, with 20% responding "don't know" (Figure 18). LIDAR technology and data can be very useful in helping communities spatially assess vulnerabilities. The uncertainty about the need for LIDAR still seemed significant for those who have already begun adaptation efforts with 10% indicating "don't know." This high uncertainly highlights the need to inform decision makers about the capacity of LIDAR and its value for informing adaption planning.

Respondents again wrote in needs associated with financial support and techniques for engaging stakeholders. Associated with this, there were specific requests for assistance in:

- building a sense of urgency among local decision makers
- identifying and incorporating vulnerable groups into adaptation planning
- decision support tools to evaluate

[1] The four questions referring respectively to emergency services, built infrastructure, natural systems, and local hydrology only contain the responses of those who have begun or completed some adaptation planning or implementation

economic and social impacts
- approaches to prioritizing adaptation measures, and
- developing local level GIS maps, with climate and vulnerability data.

Travel Grant Application Results

Information from travel grant applications echoed the broad range of needs identified in the Local Solutions Survey (Figure 19). The most frequently mentioned request expressed by these respondents was for opportunities for peer-to-peer interaction. This theme appeared in 55% of the travel grants and included opportunities to:

- learn from other communities about what they have been doing and what has worked.
- network and engage in mutually supportive collaborations with colleagues working on similar issues.

This desire for peer-to-peer interaction, collaboration, and inspiration highlights the **importance of providing face-to-face and virtual spaces for these interactions to take place**. This request, and the interest in learning from other communities, also connects to a strong desire expressed by applicants to learn practical and applicable approaches to adaptation that have proven successful elsewhere.

The two other most prominent topics identified in the travel grant applications focused on **support developing specific adaptation strategies** (mentioned in 41% of the applications) and **engaging the public in climate change mitigation and adaptation** (mentioned in 35% of the applications). The latter subject included an emphasis on communicating complex climate science to lay audiences and communicating information about climate change in a way that can overcome apathy and denial.

While limited in sample size and scope, the travel grant applications also provided insight into the specific adaptation issues that respondents prioritized (Figure 20). Viewing the responses from this lens reveals a variety of issues of concern, ranging from rural to urban and encompassing environmental, human health, built environment, and cultural adaptation. **The two most pressing concerns, stormwater management and coastal adaptation** (each mentioned in 11% of applications), **focused on**

Travel Grant Applications: Needs Identified

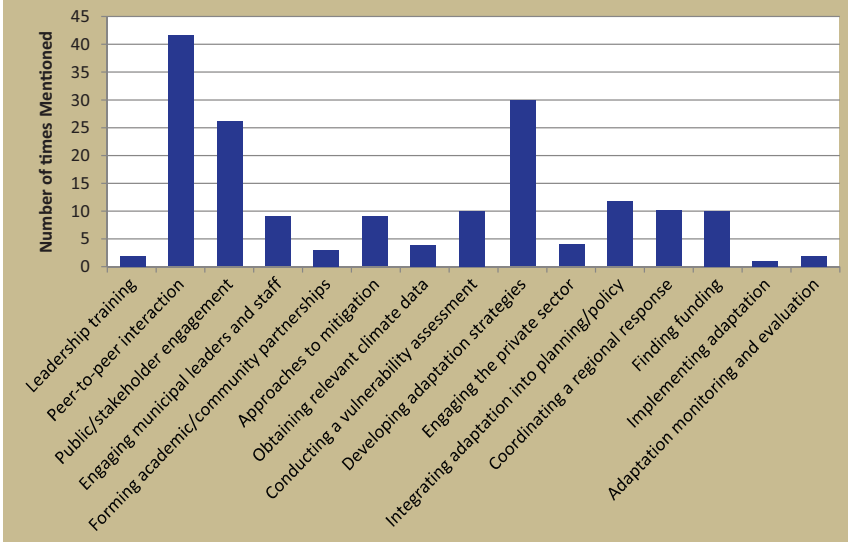

Figure 19. Needs associated with the adaptation planning and implementation process identified in the Travel Grant Applications (n=74)

Travel Grant Applications: Adaptation Issues

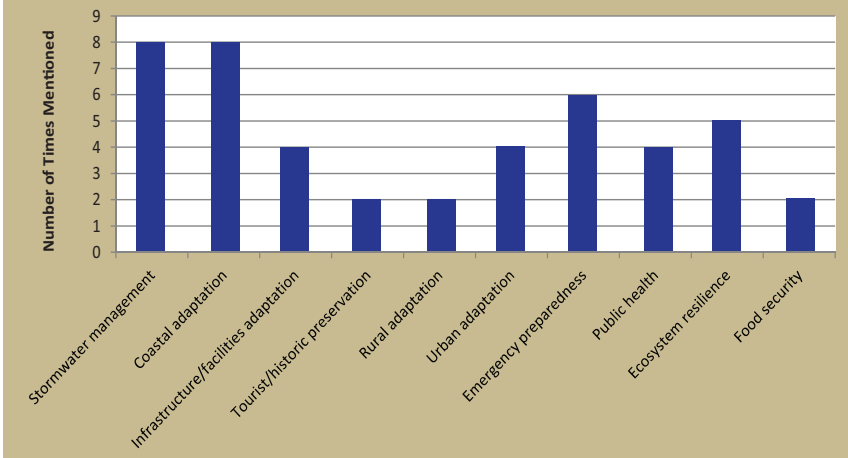

Figure 20. Needs associated with specific adaptation issues identified in the travel grant applications (n=74)

mitigating risks associated with flooding. The strong interest in these issues may be due in part to the strong representation of applicants from the Northeast where many states are already facing increasing extreme precipitation and sea level rise (Horton et al, 2014).

Webinar Results

Participation in the six webinars also demonstrates the potential interest in and need for support associated with various adaptation topics (Figure 21). The webinars averaged participation by more than 300 people. The greatest attendance, with more than 600 participants, was for the webinar on green infrastructure, flood resiliency, and land use management. Four other webinars, focusing on resilient design, water conveyance, collaboration for resilience/ equitable adaptation, and getting the message out also had strong participation, attracted more than 250 participants each. The sixth webinar, focused on navigating the Stafford Act, was structured as a training, required a registration fee, and drew a smaller number of participants.

In addition to the topics that were offered, participants also suggested additional subjects for future webinars related to climate preparedness and community resilience. With 37 requests, the greatest interest was in engagement strategies for relevant stakeholders and the public. This echoes the strong interest in supporting public engagement evidenced in both the travel grant applications and the needs survey. In addition, with each receiving 17 requests, there was strong interest in **green infrastructure** and **land use regulation and management**, as well as **resilience and emergency preparedness**. While mentioned less frequently, the additional requests highlighted the diverse subject matter that participants are interested in and spanned the spectrum from capacity building and funding to food security and sustainability. Finally, the requests for specific adaptation case studies again speaks to the need of gathering and communicating "best cases" reflecting tangible efforts that can be utilized in new contexts.

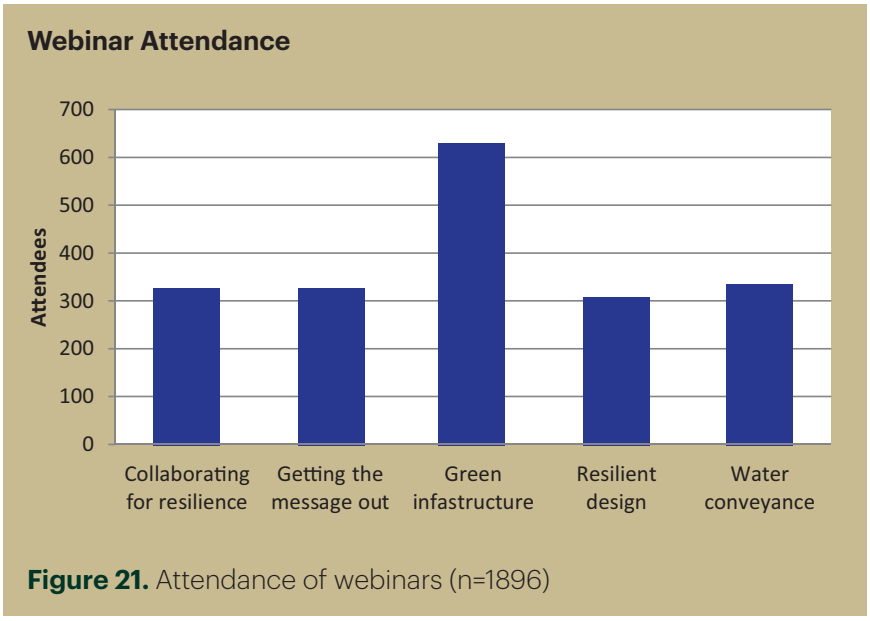

Figure 21. Attendance of webinars (n=1896)

Facilitated Community of Practice: U.S. Climate Resilience Toolkit Road Test Results

Despite the small sample size and targeted sample population with a strong interest in coastal issues, the primary questions posed by the Toolkit road test participants also reveal insight into the needs of those working on local level adaptation (Figure 22). Consistent with the other data sources, the **most frequently mentioned topic was for support with public and stakeholder engagement** (mentioned by 17% of participants). Support **securing funding for mitigation and adaptation** was also frequently referenced (mentioned by 14% of participants).

Beyond the more frequently mentioned topics, the range of needs highlight the potentially context-specific nature of adaptation. Throughout the data sources, the subject-specific support requested appear to be linked to the climate issues facing the respondents' community of focus, the professional focus of the respondents, and the community's stage in the adaptive process. For example, for a community or individual focusing on economic impacts, economic adaptation will be of primary importance, for a coastal community experiencing declining fisheries and a need to find alternative livelihoods, adaptation focused around fisheries will be of greatest urgency.

Results Summary

From these data sets, it is clear that those working on local level adaptation require broad support. It is also evident that they require ongoing support that is responsive to their evolving needs as they progress

through the adaptation process. The primary needs expressed by the respondents can be broken out into seven overarching categories:

- Introductory overview of the adaptation process
- Public and stakeholder engagement
- Funding
- Data
- Topic-specific support
- Peer-to-peer interaction
- Regional coordination

Introductory overview of the adaptation process

For communities just embarking on adaptation planning, our analysis indicates that there was greater uncertainly about the importance of various resources and aspects of the adaptation process. To help ensure that those beginning adaptation are broadly aware of the tasks involved as well as the supporting resources they can call on, respondents could benefit from an introductory overview of the adaptation process.

This introductory overview of the process should raise community awareness about the different facets and definitions of adaptation and resilience. For example, many municipal decision makers tend to think of climate change preparedness as engineering resilience (Davoudi, Brooks, & Mehmood, 2013). They strive to return to or "bounce back" to what the community looked like and how it functioned prior to a disaster (Davoudi et al., 2013). This prior state may have included social injustice, inadequate public infrastructure and housing, other hazard vulnerability, and a weak local economy (Glavovic & Smith, 2014). It is important for practitioners to understand that how they measure the success of their adaptation process will depend on how they define climate resilience. The introductory overview process should include building awareness and understanding of how the different definitions of resilience will result in different outcomes. Deliberate planning and decision-making throughout the adaptation process is a key factor in the ability to measure success (Moser and Boykoff, 2013). This will help stakeholders collaborate to build a shared community vision of local climate resilience.

Public and stakeholder engagement

Respondents emphasized their desire for help with enhancing public and stakeholder engagement in the adaptation process. The importance of support remains consistent throughout the process but the nature of the support may shift as communities progress through the process. For example, effectively communicating the challenges facing the community in a way that can overcome both denial and apathy was more pressing for those just embarking on adaptation planning than for those already underway.

Respondents highlighted assistance in building support, including reaching out to the general public as well as local leaders. There may also be needs associated with identifying key stakeholders and to find approaches to incorporate them as well as the general public into the adaptation planning process. This includes finding ways to bring these stakeholders to the table as well as to meaningfully integrate the perspectives of residents, local decision makers, and scientists with a range of expertise and understanding. These results correspond closely with other research that has found public engagement

Needs Identified by Toolkit Participants

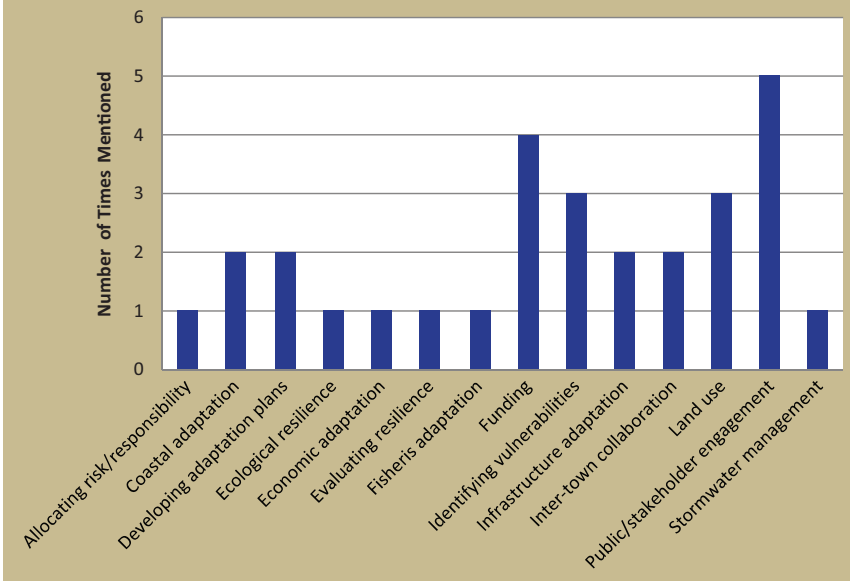

Figure 22. Primary support questions posed by Toolkit road test participants (n=29)

and communication to be essential for a community to implement adaptation goals (Nordgren and Stults, 2014).

It is also important to identify and incorporate vulnerable groups into the adaptation planning process. Such groups include children, disabled, elderly, homeless, immigrant, low-income, and other historically marginalized people (NAACP, 2015). To this end, one participant in the Local Solutions Survey requested support with the "identification of authentic leadership or representative organizations and individuals" to foster the "inclusion of impacted communities or demographic groups" that are especially vulnerable to climate change. Integrating diverse voices is vital to ensure that resulting plans:

- meet the needs of all community members, especially the most vulnerable;
- reflect locally held knowledge and values; and
- have the support of the community and local leaders

Funding

Respondents consistently highlighted assistance with funding. Such funding support was not only mentioned in the Local Solutions survey but from participants in the travel grants, the webinars, and the Facilitated Community of Practice Toolkit road test. While the general category of funding has been indicated by many, it is important to note that, to support local level adaptation, funding is needed in multiple areas that include general operating costs and finding innovative ways to finance capital projects. For example, funding may be required to hire or train staff in an effort to build capacity to effectively prepare for climate change. Funding may also be required to generate or acquire usable data as well as to engage in the planning process. For those farther along in the process, funding may be needed to implement adaptation plans. These findings suggest that **the conventional revenue sources and budgetary processes on which local level decision makers typically rely have not yet adapted themselves to supporting robust adaptation planning and implementation**.

Beyond financial assistance itself, **those engaged in local level adaptation may require technical assistance to enhance their capacity to secure adaptation funding**. This includes training in how to locate funding sources and create competitive grant proposals. Another set of skills may be how to develop future-focused strategies that are not susceptible to the political whims of annual budgeting cycles. For example, a community could establish a capital reserve fund that increases in asset value over time for likely projected needs. Or a community can utilize bonding that offers a payback term comparable to fixed capital turn-over rates so the annual rate shock to a household is minimized. Staff may also need to increase their capacity to contract with consultants, including identification of needed skillsets and how to best manage consultants.

Being able to justify the economic investment in actions responding to potential climate impacts necessarily entails an understanding of the relationship of expenditures to expected risk. This also may require benefit/cost analyses of different adaptation options compared to taking no action at all. Decision makers may require additional data to conduct these assessments. As one participant in the Local Solutions Survey noted, "I really need socio-economic information and data that will assist decision-makers to understand the benefits of planning 40-50 years out and understand the return-on-investment of their investments over the long term." As another participant mentioned, in other cases, decision makers may need assistance with analysis itself, such as "more robust economic valuation and decision making tools."

As one participant in the Local Solutions Survey noted, "I really need socio-economic information and data that will assist decision-makers to understand the benefits of planning 40-50 years out and understand the return-on-investment of their investments over the long term."

Data

Respondents mentioned a desire for various types of data to inform decision making. For example, the Local Solutions Survey considered data associated with vulnerable populations, built infrastructure, and natural systems, among other categories. While these

requests refer to specific types of information, the needs associated with data extend beyond the production of additional data sets. In many cases, the raw data may be available but other hurdles prevent those engaged in local level adaptation from being able to fully utilize the information. For example, data may not be at the appropriate scale to be relevant for local decision makers. Even if appropriately scaled, raw data may be hard for local decision makers to interpret and incorporate into their planning processes. In addition, they may not know where to access relevant data or which data or models would be most useful to inform specific decisions. As one Local Solutions Survey participant noted, "there are so many models out there - now it is hard to figure out which one is good for our area."

For data to be actionable at the local level, local decision makers may need it analyzed and summarized in a form that can actually meet adaptation objectives. Alternatively, local decision makers may need training on how to actually incorporate data into adaptation planning. A Local Solutions Survey participant noted the additional challenge of "how to help community decision-makers understand when they have enough science and data to take action." In all of these cases, issues associated with the uncertainty in the data add additional challenges. As one Local Solutions Survey participant wrote, "future weather data is not really a predictable foundation for design and planning." How best to communicate this uncertainty is a complementary set of skills associated with using the data in decision making.

Topic-specific Support

Respondents shared needs associated with a great range of specific social, economic, and environmental issues and topics related to climate change and adaptation. While some topics were fairly common among respondents across the data sets, such as stormwater management and infrastructure adaptation, the majority of needs were more specific to individual respondents and respondent groups.

One topical need mentioned less frequently by respondents, but still of great importance, is addressing the social causes of vulnerability in adaptation planning and promoting an equitable response to climate change. Addressing the vulnerability of individuals and groups within society is also an essential aspect of adaptation. As climate change presents increased economic and health related challenges for underprivileged and marginalized groups within society, ensuring that adaptation planning incorporates and addresses their needs is a critically important aspect of local level efforts. One participant in the Local Solutions Survey focused on these issues directly, requesting support with "how to integrate health equity and address social determinants of health in developing resilience and adaptive planning and strategic policy work." The respondent continued, noting the need for assistance with a "'Health in All Policies Approach' to climate adaptation" that assesses "any consequences for health equity for all proposed interventions and implementations."

Most importantly, respondents emphasized that topical information be presented in actionable terms. They requested **clear and applicable strategies for dealing with climate change that they could customize to meet the challenges facing their community**. This request is exemplified by the response of a Local Solutions Survey respondent, "Please give us solutions! More tools in the tool box to assist communities in making the tough decisions." Respondents sought case studies associated with specific adaptation challenges and requested to learn what has worked from real examples. Another Local Solutions Survey respondent highlighted the importance of actionable information, requesting to be connected to "other communities that have planned and implemented to get feedback on what works and what does not." Another respondent emphasized the importance of solutions that are locally relevant, stating, "we need adaptation strategies that are known to work in our specific area."

Peer to peer interaction

Throughout the data sets, respondents mentioned the value of peer-to-peer interactions. They emphasized **the value of being able to network with their peers and share resources, strategies, and best practices**. A travel grant respondent highlighted the importance of these interactions, stating, "I would like to hear what colleagues are doing on any of these climate change and health topics. I would love to know how they're identifying climate change adaptations and how they're prioritizing them."

Respondents also referred to the value of these interactions in leading to future collaborations. Further, they noted **the role of peer-to–peer interactions in providing moral and emotional support in part by removing the sense of working in isolation** that some of those engaged with local level climate change adaptation may feel.

Regional coordination

Some respondents requested support engaging in a coordinated regional effort to prepare for climate change. As one participant in the Local Solutions Survey commented, it is vital to be "building partnerships that can maintain themselves and foster cooperative action." Respondents also highlighted the importance of having an organization or institution, perhaps at a state or regional level, bring together the relevant parties and help guide the collaborative effort. As mentioned earlier in this report, bringing together local adaptation efforts as part of a more regional collaboration is essential to ensuring that adaptive issues are addressed at the appropriate scale and do not result in secondary impacts to nearby communities.

Opportunities for Action

The data collected and analyzed in this report span a significant segment of the population that is currently wrestling with the challenges of responding effectively to the impacts from a changing climate. We encourage readers to view the report findings as "a snapshot in time" of the needs voiced by local decision-makers on the frontlines. The findings also point to areas of focus and action by all levels of government and other societal actors in terms of allocating resources and expertise to build the capacity for local stakeholders to effectively implement initiatives that increase community resilience.

Recommendations

We offer five recommendations to meet the needs identified in this report:

- Develop a set of approaches to assist in funding adaptation planning and sustained implementation
- Develop actionable data sets for local level end users
- Build local level capacity through multiple approaches including conferences, webinars, decision support tools and communities of practice with a focus on peer-to-peer interaction and practical guidance
- Facilitate regional collaboration
- Conduct regular, ongoing assessment of needs

Develop approaches to assist in funding adaptation

It is important for both private and public sector funding institutions to allocate the necessary financial resources to support local level adaptation. There are multiple areas in which this funding is needed to:

- Support the creation of scale-relevant data sets that can support local level vulnerability assessments and associated adaptation planning
- Build capacity at the local level, either by enabling local efforts to hire additional staff or consultants, or by providing trainings, informational resources, and decision support tools for local decision makers
- Bring local level practitioners together for peer-to-peer interactions
- Support collaborative efforts at regional scales by financing staff time for dedicated facilitators and by convening the participants to engage in coordinated planning
- Conduct ongoing assessment of adaptation needs at the local level to help ensure that future support stays current with evolving needs

These efforts should be combined with educating communities about potential funding sources that exist though mission- and program-related philanthropy, private sector investment, and federal and state government grants. As a necessary corollary educational effort, interventions are needed to build local expertise for development of competitive funding requests.

We view it as a necessity to develop a series of tested approaches that can be used by local climate adaptation planners and that can be applied to local annual budgetary approval processes in order to fund longer-term adaptation implementation strategies (e. g. capital reserve funds, municipal bonding, and multi-jurisdictional collaboration).

Another imperative is to strengthen local expertise in framing sound economic arguments in order to effectively achieve (re)allocation of funds to support targeted adaptation efforts. This capacity-building should include effective presentation approaches for informing decision makers who oversee local budget allocation.

Develop actionable data sets for local level end users

There is a plethora of existing data that can be used to inform policy decisions. There are three primary challenges:

1. Understanding what type of data are required to answer a specific question arising out of the adaptation planning process
2. Where to find such data
3. How to parse the data into a form that can be useful and used by local planners and decision makers

These findings suggest that government, academic, and research institutions should develop data sets that meet the needs of local-level end users. This requires processes that

clearly frame the questions that the data will help to answer.

Data sets should include information associated with local vulnerabilities, relevant social and environmental systems, up-to-date climate predictions and projections, and the economic benefits and costs of potential actions. These data sets need to be structured to be responsive to specific local needs and be scaled finely enough to be relevant to municipal planning efforts. In short, unless data are presented in a way that reflects local analytic expertise, all the data already developed will remain unused.

Build local level capacity through multiple approaches

Capacity building at the local level is essential to developing the needed expertise to facilitate effective local level adaptation. Multiple organizations can contribute to this capacity building effort including institutions of higher education, non-profits, and state, regional, and federal governmental agencies.

Important aspects of this capacity building include:

- Increasing understanding of the different definitions and concepts of resilience to ensure responses align with objectives.
- Increasing understanding of predicted climate impacts along with possible response options
- Leading and managing the adaptation planning process
- Bridging the traditional balkanization of municipal departments to establish a unified approach to the day-to-day responses that can build community resilience
- Facilitating public and stakeholder engagement
- Securing funding
- Developing strategies to promote preparedness in response to specific climate threats.
- Addressing social and economic causes of vulnerability and fostering equitable responses to climate change

Specific subject matter should be responsive to the needs of local level partners. Using a process to surface priorities is the first step. For those just beginning the adaptation process, an introductory training detailing the main steps in the adaptation process, important approaches to adaptation planning, and potential resources to support local level efforts is essential.

We advocate a climate justice moral imperative that ensures that those least resilient to the impacts of a changing climate become a priority of any climate adaptation plan. We view a social vulnerability assessment as a necessary component of any adaptation planning process.

In addition to providing subject matter specific support, facilitators should seek to create spaces for practitioners to come together and network, form ongoing collaborations, create collegial connectivity, and share resources, information, and opportunities. These networks can be built around geographic areas, specific adaptive issues of focus, or some combination of the two. Practitioners can be brought together in person or through virtual settings. While virtual gatherings overcome some of the logistical challenges of bringing practitioners together, their ability to effectively meet all of these needs has not been directly assessed in comparison to in-person gatherings. We suggest the value of face-to-face connectivity in strengthening capacity building.

A variety of approaches can be employed to deliver this support. Conferences, workshops, webinars, decision support tools, deliberative dialogue combined with visualization approaches and facilitated communities of practice can all serve to build capacities in different aspects. Each approach has distinct advantages and challenges and it is recommended that a variety of approaches are utilized.

For example, conferences or regional meetings offer the opportunity to provide targeted and practical subject matter and training on a range of topics informed by end user input. They also create opportunities for peer-to peer interaction and networking. Conferences, however, can be logistically challenging to host and present financial challenges to would-be attendees. Webinars avoid these challenges while also providing a vehicle for providing targeted subject matter, but they do not offer the same immediate possibility to foster peer-to-peer interaction. Decision support tools can help local decision makers work through an adaptation planning process and by connecting such a tool with a facilitated community of practice can also provide some of the benefits associated with peer-to-peer interactions.

Regardless of the delivery modality employed, facilitators should keep in mind practitioners' preference for tangible examples and applicable best practices.

In particular, content should focus on what has worked in the field and how it can be tailored to meet specific circumstances so that participants can understand how they might apply approaches, data, and tools in the context of their own work.

Findings from the Local Solutions Survey point to a "booster effect" of collaboration with higher education institutions by those engaging in local level adaptation planning and implementation.

Facilitate regional collaboration

Regional coordination is vital to effective adaptation at the local level. External facilitation is an important aspect of these collaborative efforts. Among the organizations well positioned to facilitate regional collaboration are state agencies, the regional branches of federal agencies, regionally based non-profits, and higher education institutions. To aid in these efforts it is important for staff time be dedicated to the facilitation of the collaboration and that local partners also allocate resources including staff time for collaboration.

Elements of effective regional collaboration also include:

- Consideration of who should be at the table, inclusive of vulnerable populations
- How best to get input from those concerned but not central to the challenge being addressed; and
- How best to inform the general public about the importance of the endeavor and the progress being made to date.

Conduct ongoing assessment of needs

As the results of this report illustrate, the needs of those engaged in local level adaptation change over time as a result of the varying needs associated with different stages of the process. A community's needs will also change in response to the evolving science, establishment of new adaptation best practices, and shift in the understanding of how observed vulnerabilities are linked to the larger global change in climate. To inform the future support of local level efforts, it is vital to conduct ongoing assessment of local level needs. In addition, data that have been collected in this and future surveys could be further analyzed regarding the differences in capacity-building needs based on respondents' professional or public service roles. For example, professional staff, such as municipal planners and public works personnel, may need a different type of technical support than volunteer public service decision-makers such as elected officials or zoning board members, a professional stakeholder, such as a hospital director or local utility manager or volunteer stakeholders, such as members of faith-based institutions or community groups. Institutions of higher education, non-profit organizations, as well as state and regional government institutions could play vital roles in conducting this ongoing assessment.

Engaging Collaborative Partners

As mentioned above, a range of organizations and institutions are well positioned to play instrumental roles in supporting local level adaptation. These include:

- federal agencies and their regional branches and networks
- state agencies
- regional organizations
- non-profit organizations working in a variety of fields
- charitable foundations
- research-based organizations
- institutions of higher education

As each of these groups has different resources to contribute, a coordinated effort engaging multiple partners will be needed.

To focus on one example of a valued collaboration, institutions of higher education have been shown to be instrumental in successful partnerships that move the adaptation agenda forward at the local level (Gruber et al., 2015). They have expertise in a range of fields from data collection and analysis to planning, grants writing, public messaging and facilitating community engagement.

Findings from the Local Solutions Survey point to a "booster effect" of collaboration with higher education institutions by those engaging in local level adaptation

planning and implementation. When asked if they were partnering with a higher education institution, only 7% percent of those yet to begin adaptation planning indicated that they were (Figure 23). This number significantly increases to 44% for those who have begun or completed some adaptation planning or implementation. Still, more than half of respondents indicated no such partnership (Figure 24).

These findings highlight the potential for an important and as yet largely unrealized opportunity: expanded and enhanced collaboration between higher education institutions and local level decision makers. A recent paper by members of the Center highlights the benefits of this form of collaboration (Gruber et al., 2015). These benefits extend to both the communities themselves as well as their academic partners. In particular, the paper highlights how, as a result of these partnerships, communities can receive up-to-date scientific data, technical expertise, and facilitative support to aid in the planning and implementation process. Simultaneously, the institution of higher education receives locally relevant opportunities for engaged scholarship, meaningful opportunities for faculty to conduct applied research, and real world projects and internships for students.

Collaboration with a Higher Education Institution: Respondents Who Have Not Begun Adaptation Planning

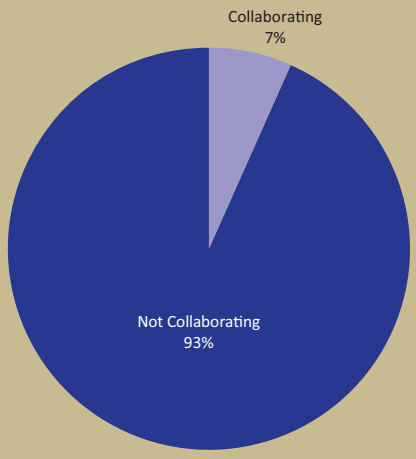

Figure 23. Collaboration with a higher education institution: Respondents who have not begun adaptation planning (n=103)

Collaboration with a Higher Education Institution: Respondents Who Have Begun Adaptation Planning/Implementation

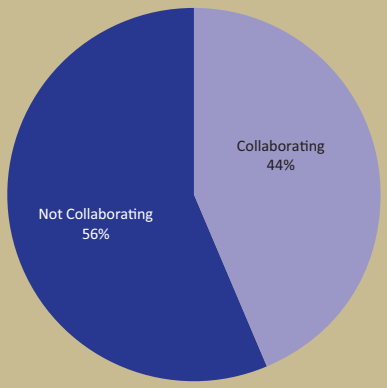

Figure 24. Collaboration with a higher education institution: Respondents who have begun or completed some adaptation planning or implementation (n=162)

As part of this collaboration, local institutions of higher education could play instrumental roles in meeting the local adaptation needs described in this report. For example, institutions of higher education have the expertise to generate actionable data, deliver a range of capacity-building initiatives, facilitate regional coordination, and conduct ongoing adaptation needs assessments.

To encourage effective partnerships, the Center has established a successful process that takes local stakeholders through a series of specific steps to develop and implement actionable adaptation strategies. This process can be enhanced by partnering with an institution of higher education, whose role is to fill key gaps in the capacity of the local partners. Such collaborative processes can serve to enhance the capacity of local stakeholders to better prepare for, and respond to, the impacts from a changing climate.

Tested Capacity-Building Modalities and Lessons Learned

As institutions of higher education and other partners seek to develop and deliver the aforementioned resources, the activities of the Center thus far in supporting local level adaptation offer practical insight into meeting local needs.

Specifically, the Center's experience with and evaluation of its conference, webinar series, and facilitated community of practice initiatives offers insights into how best to provide resources to support local level adaptation.

These findings highlight the potential for an important and as yet largely unrealized opportunity: expanded and enhanced collaboration between higher education institutions and local level decision makers.

Convenings

The Center convened its first climate preparedness conference in Manchester, New Hampshire, in May 2014 and a second conference in April 2016 in Baltimore, Maryland. More than 800 individuals participated in these convenings. These conferences delivered more than 40 interactive sessions and workshops focusing on a range of preparedness issues across four tracks: built environment, communication and community engagement, human health and ecosystem services, and planning and process. These events also provided ample opportunity for peer-to-peer engagement and learning.

The Center utilized the conferences to build capacity in multiple ways. In designing the conferences, the Center brought together a steering committee, which encouraged peer-to-peer interaction and built capacity among participants. The conference sessions were informed by input from the target audience of local decision makers and planners and were designed to build capacity through providing practical guidance. Finally, the Center used conference feedback to develop a webinar series that continues to build capacity relative to specific adaptation issues.

Maryland Eastern Shore Coastal Resilience Facilitated Community of Practice participants, April 2016.

Post conference evaluations reveal that participants found the information presented at the conferences useful for their preparedness work, and advanced their readiness to engage in pursuing next steps and available resources. Evaluations also show that attending the conferences enabled participants to make meaningful contacts with other professionals working in the field. Evaluations also highlighted that participants planned to apply what they learned in a variety of ways, including by developing and collaborating with the networks they formed at the conferences, by utilizing the tools and concepts they learned about, and by following up with conference presenters and resources. Some benefits of the conferences were summed up by one participant, who shared "I came back with many new ideas and contacts, and have already started to discuss them with my peers and staff for eventual deployment."

As part of the evaluation, participants highlighted what aspects of the sessions were of most value. These responses may be of interest to those planning future conferences and presentations. Echoing the findings of this report, participants at the conferences found the **concrete examples and tangible recommendations** offered by presenters to be very helpful. They also appreciated when a **range of perspectives or multiple options** were presented on a specific climate preparedness issue. Additionally, participants noted the value of time for **networking** as part of the conference.

Webinars

The Center delivered multiple webinars from 2014-2016. As previously discussed, the interest in these initial webinars has been very strong. Further, the initial feedback on the webinars has been very positive. Participants shared a wide variety of ways in which they

will apply what they have learned from the webinars including by integrating information into their ongoing professional and personal life, forming new collaborative efforts, sharing information with their project team or colleagues, following up with and utilizing references and resources, and advocating for change in their community.

As part of the evaluation of each webinar, participants also highlighted what they found most useful (Figure 25). These suggestions may be of use to others in planning webinars. Participants noted the adaptive strategies and best practices that were presented around specific topics as particularly useful. Participants also found the specific case study examples and additional resources useful. All of these highlight the value of tangible and actionable steps identified elsewhere in the various data sources. In addition, participants found value in the initial overviews presented on the webinar topics. They also positively commented on the breadth of material and presenters associated with the webinars. They found useful the connections that webinar presenters made between primary and associated issues, and the relevant scientific data that presenters shared.

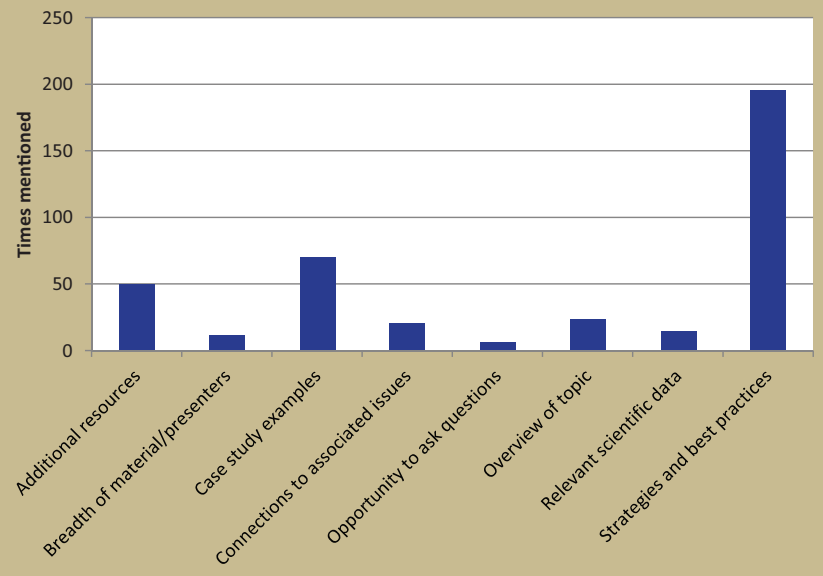

Figure 25. Aspects of the webinars which participants identified as most useful (n =1896)

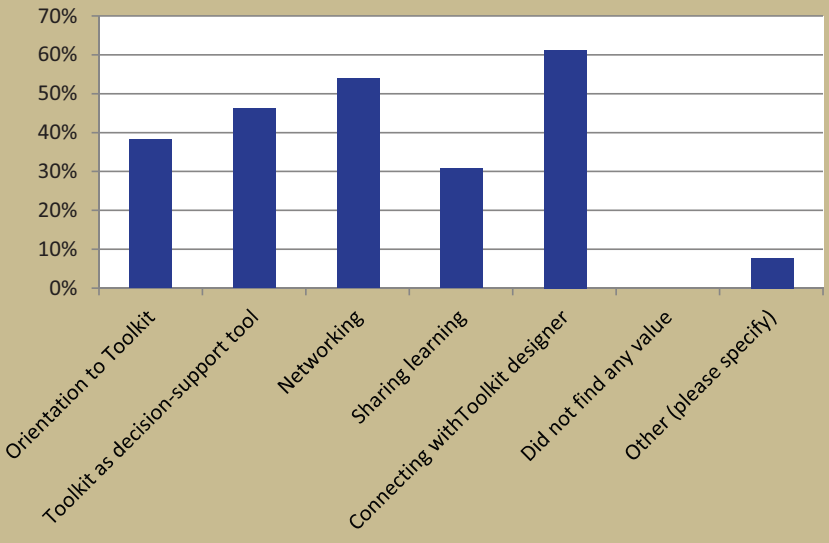

Figure 26. Aspects of the Toolkit road test participants identified as most useful (n =29)

Facilitated Community of Practice; U.S. Climate Resilience Toolkit Road Test

Building a community of practice is considered a key element for climate engagement (Moser and Pike, 2015). Antioch convened its first resilience Facilitated Community of Practice (FCoP) in order to test the the U.S. Climate Resilience Toolkit during the first quarter of 2015 and partnered in 2016 with the Eastern Shore Land Conservancy to convene an FCoP with local decision-makers on Maryland's Eastern Shore. Based on the Center's assessment, the Toolkit resource, with some additional support, is ideal for providing an introductory orientation to the adaptation process, and highlighting the major steps involved and resources available to communities who are just embarking on adaptation planning.

Responding to end-user requests for peer-to-peer interactions, the Center combined the initial road test with an

FCoP. An evaluation at the end of the test revealed that nearly 80% of the participants found the Toolkit helpful in answering their questions and more than 90% agreed that the Toolkit would be helpful in building resilience within their community. While the Toolkit itself received positive reviews for its usability, participants also viewed the interpersonal opportunities connected to the FCoP as highly valuable. For example, participants ranked the personal interactions with the designer of the Toolkit and with the other participants as even more useful than the tool itself (Figure 26). These findings suggest that there is an important need for facilitated networking and other relational aspects of building capacity among those advancing adaptation at the local level.

While the Toolkit itself received positive reviews for its usability, participants also viewed the interpersonal opportunities connected to the FCoP as highly valuable. For example, participants ranked the personal interactions with the designer of the Toolkit and with the other participants as even more useful than the tool itself (Figure 26). These findings suggest that there is an important need for facilitated networking and other relational aspects of building capacity among those advancing adaptation at the local level.

A few primary recommendations emerged as part of the evaluation that may be useful to others planning similar projects. Participants highlighted the importance of having a well-developed structure for the tool and process to help guide the users' interactions. They also noted the value in organizing resources around specific climate issues and including "live" interactive time with other participants for networking and discussion.[2] Participants also requested specific resources to aid in cost/benefit analysis associated with evaluating adaptation options and shared a preference for a highly interactive interface with the Toolkit that avoided an overreliance on text.

Based on evaluation of the first FCoP, the Center has just completed a subsequent process in partnership with the Eastern Shore Land Conservancy, working with planners, emergency managers, town/county administrators, and public health officials from Maryland's Mid and Upper Eastern Shore as well as some state partners. Through the FCoP, participants:

- Developed mastery of resilience/adaptation/mitigation concepts
- Identified clear next steps for regional resilience planning/implementation
- Received an introduction to the U.S. Climate Resilience Toolkit
- Engaged in peer-to-peer learning and networking

In addition, the FCoP achieved three specific, near-term desired outcomes:

1. Established a regional network of practitioners with a focus on pursuing adaptation and resilience strategies.
2. Developed a clear structure and programming priorities among the participants for how the community of practice can be continued beyond the pilot phase.
3. Piloted a model for regional engagement of local governments in conjunction with Antioch's regional climate preparedness conference (2016 Local Solutions: Eastern Regional Climate Preparedness conference, April 4-6, 2015; Baltimore, MD).

[2] The Center has also utilized a face-to-face interactive component contributing to the success of this FCoP process model for Maryland Eastern Shore communities in advancing coastal resilience.

Conclusions

The results of this report demonstrate that communities are concerned about climate change and that many are already taking action. The results also make clear that those engaged in local level adaptation need broad and ongoing support. This support can be organized around six key needs:

- Communities just embarking on adaptation planning need an introductory orientation to the adaptation process highlighting the major steps involved and resources available.
- Innovative strategies for funding and technical assistance are needed to support various aspects of the adaptation process and those engaged in local level adaptation need to be able to find and secure this support.
- Scale-relevant data need to be developed that is tailored to each community.
- Public and stakeholder engagement needs to be supported throughout the adaptation process.
- Specific expertise across multiple areas of vulnerability needs to be provided in response to the specific community-identified vulnerabilities. Opportunities for peer-to-peer interaction need to be created.
- External facilitation is valuable in promoting regionally coordinated adaptation efforts.

It may be obvious, but worth overtly stating, that in order to determine what would be useful resources to move local adaptation forward, clarity is needed about the questions being asked by a community. Understanding local needs is the first step in developing useful data sets, mobilizing appropriate funding, or building local expertise. This report is a contribution to identifying those needs. Based on our findings, we offer five recommendations:

- Develop actionable data sets for local level end users
- Nimbly innovate funding resources to support local level adaptation through financing site-specific data creation, capacity building, adaptation planning, and implementation
- Build local level capacity through conferences, webinars, decision support tools and facilitated communities of practice with a focus on encouraging peer-to-peer interaction and providing practical guidance that is responsive to community needs
- Facilitate regional collaboration
- Conduct ongoing assessment of needs

A range of partners including federal, regional, and state government, regional planning agencies, utilities, non-profit and research organizations, as well as charitable foundations and private sector investors will be vital in developing and delivering this support. In addition to delivering support, these partners can also serve as role models by demonstrating best practices. For example, academic institutions and local businesses can set an example by showcasing the importance of their own vulnerability assessments and climate adaptation planning.

In particular, **higher education institutions are an as yet under-utilized partner well positioned to provide a range of support**. As the last recommendation highlights, the concerted efforts of these groups to provide resources should be informed by the ongoing assessment and evaluation of adaptation needs to ensure that efforts are responsive to the evolving landscape of local level adaptation. Through a coordinated and informed effort to support local adaptation, communities can effectively work to prepare themselves for the impacts of climate change.

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Appendix A

Finding the Relevant Data to Support Decision-Making

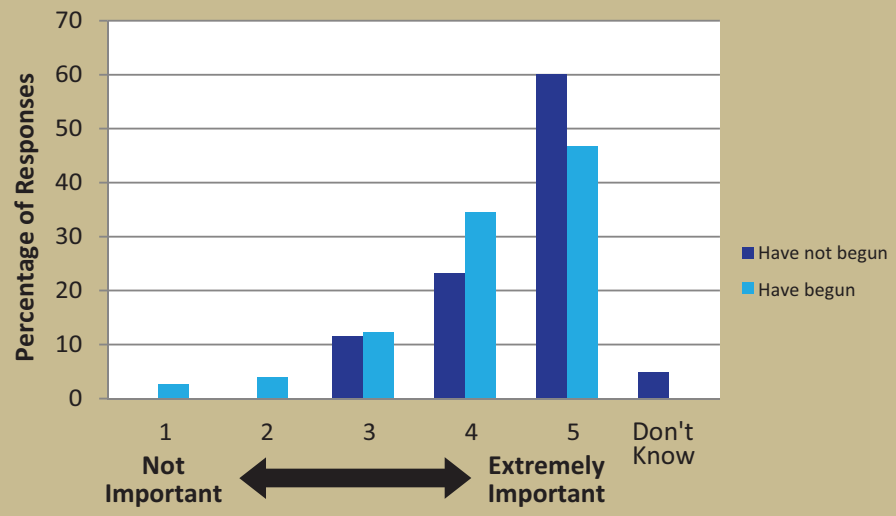

Figure 27. Needs associated with finding the relevant data to support decision-making (n=329)

Finding Training and Other Capacity-building Opportunities

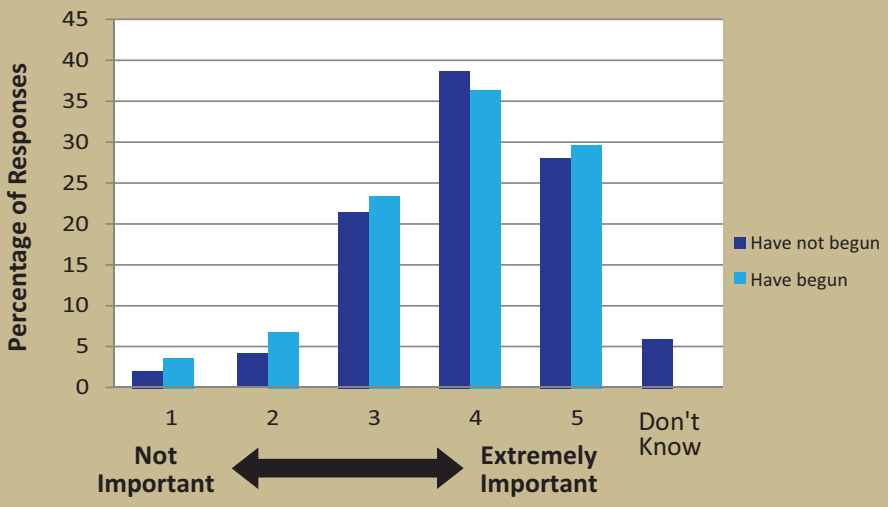

Figure 28. Needs associated with finding training and other capacity-building opportunities (n=329)

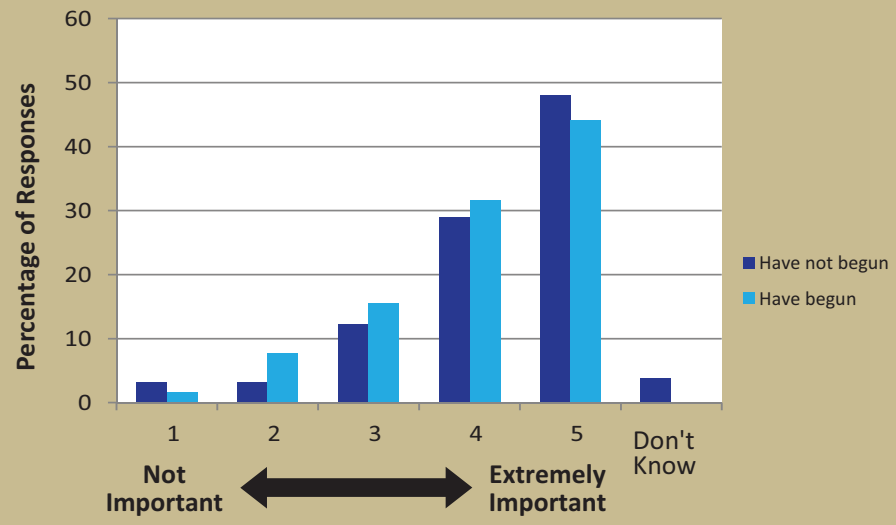

Figure 29. Needs associated with bringing stakeholder to the table (n=329)

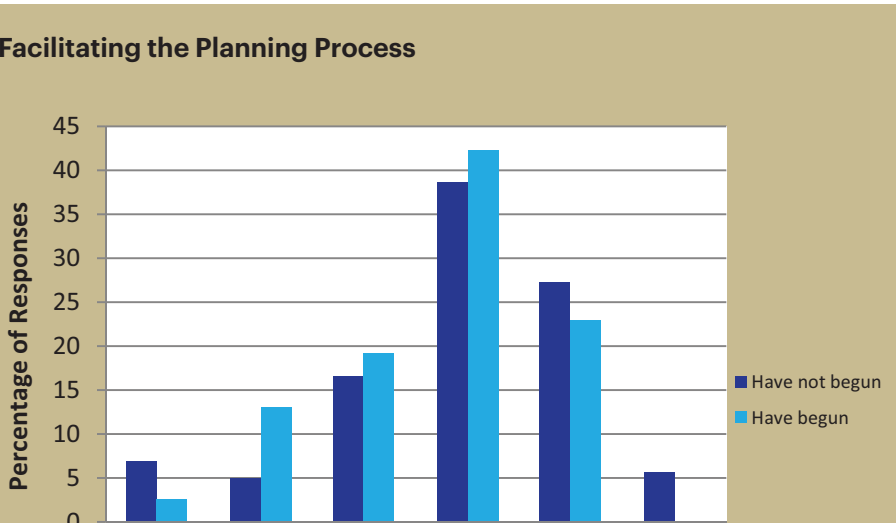

Figure 30. Needs associated with facilitating the planning process (n=329)

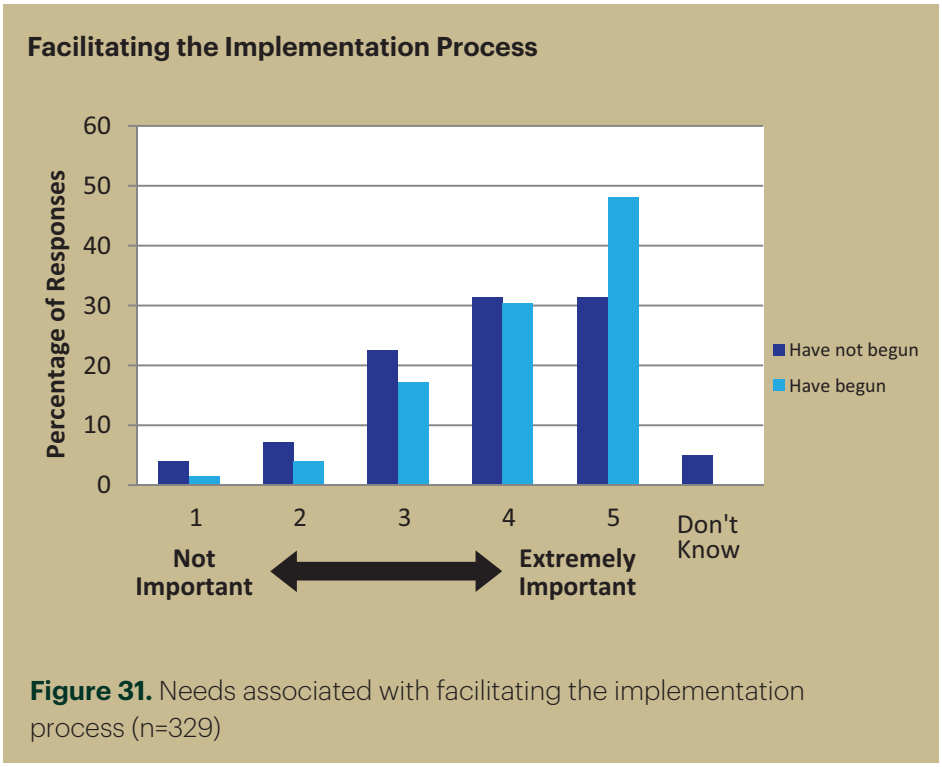

Figure 31. Needs associated with facilitating the implementation process (n=329)

Appendix B

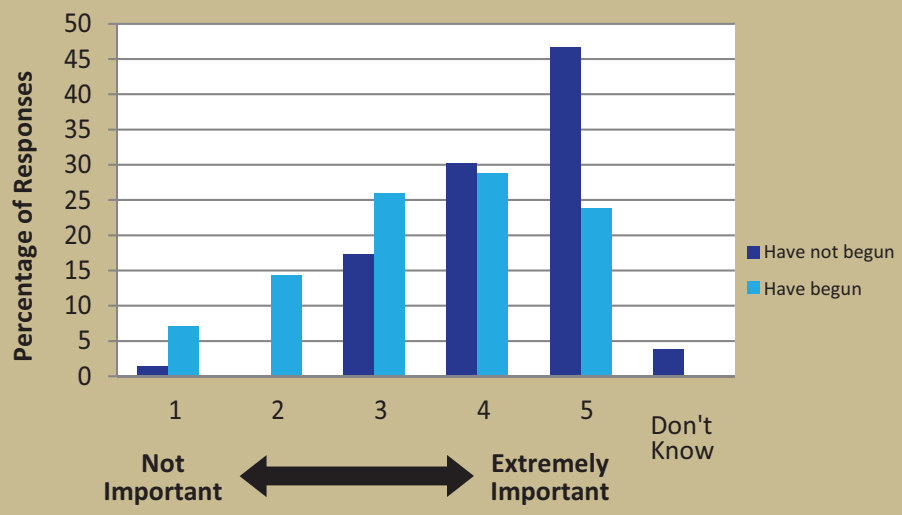

Figure 32. Needs associated with how to conduct a vulnerability assessment (n=329)

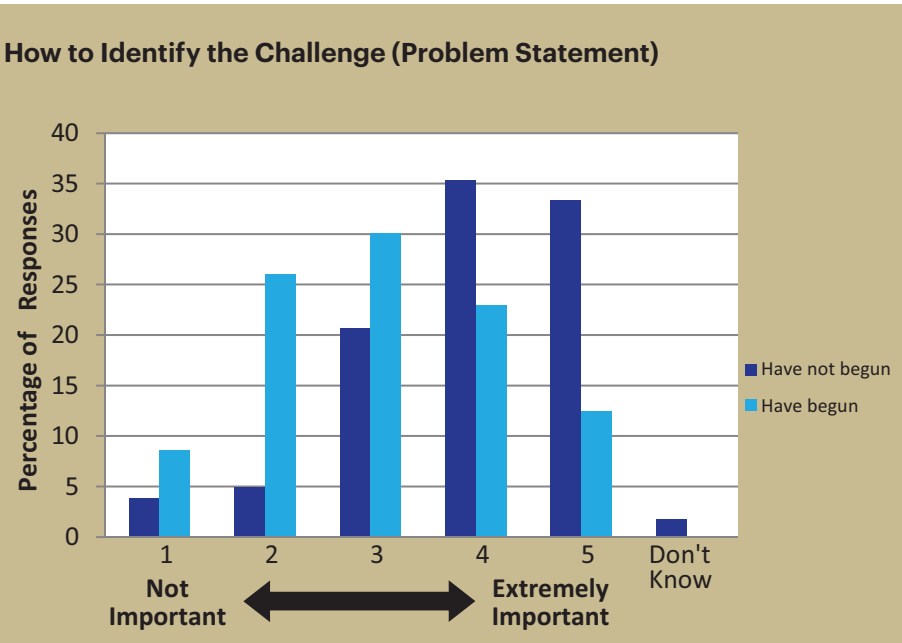

Figure 33. Needs associated with how to identify the problem statement (n=329)

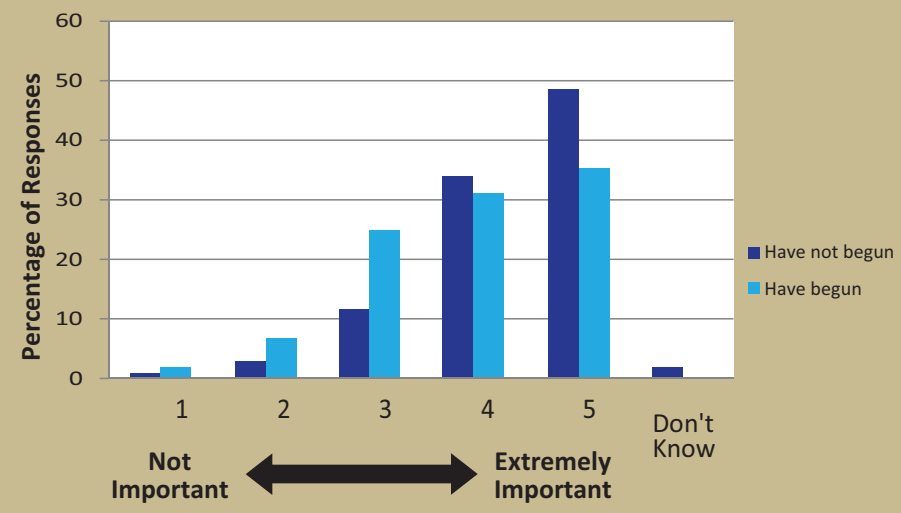

Figure 34. Needs associated with how to communicate the challenge or issue (n=329)

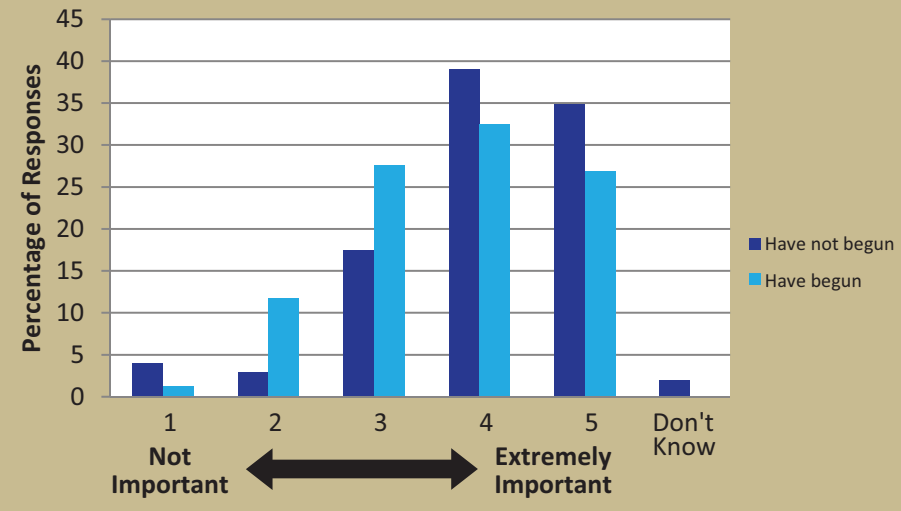

Figure 35. Needs associated with how to best identify values and priorities of stakeholders in the community (n=329)

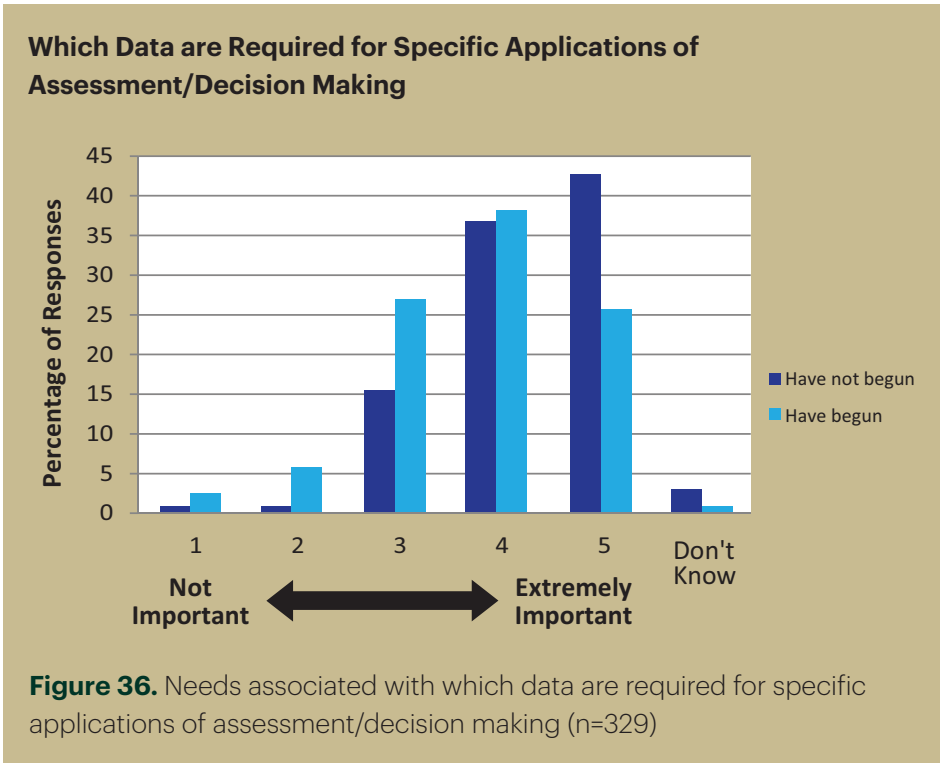

Figure 36. Needs associated with which data are required for specific applications of assessment/decision making (n=329)

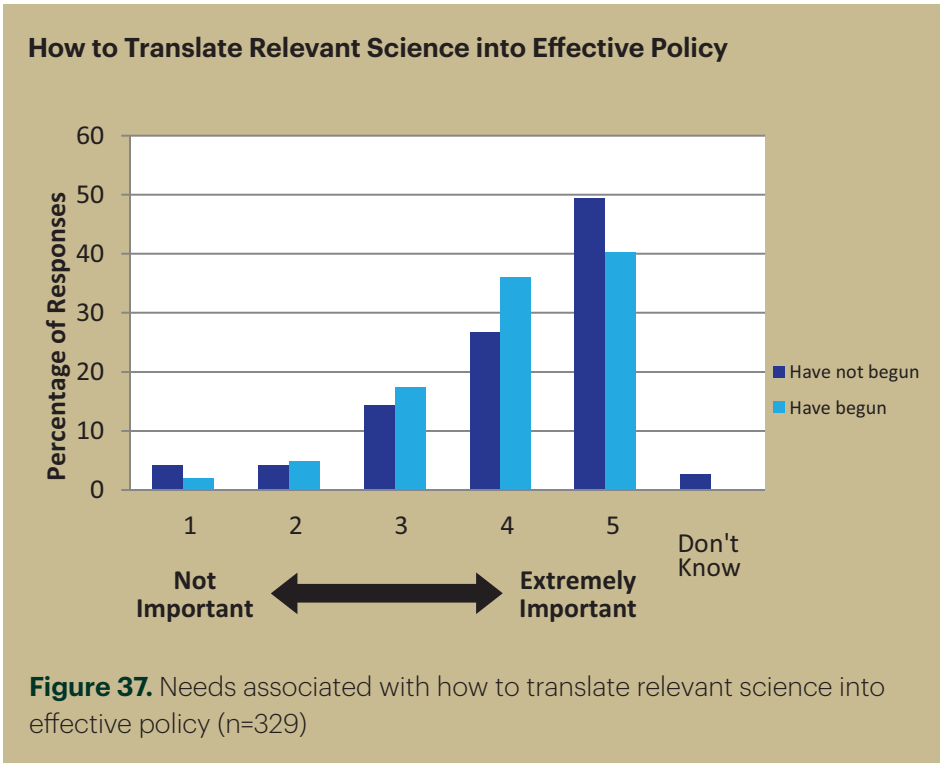

Figure 37. Needs associated with how to translate relevant science into effective policy (n=329)

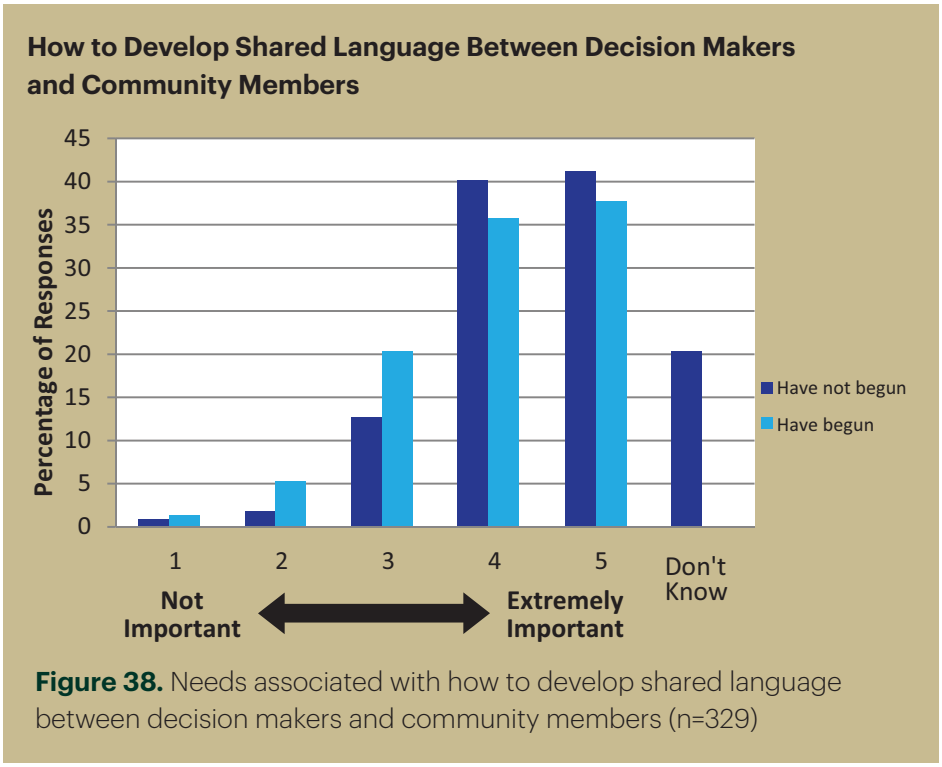

Figure 38. Needs associated with how to develop shared language between decision makers and community members (n=329)

Appendix C

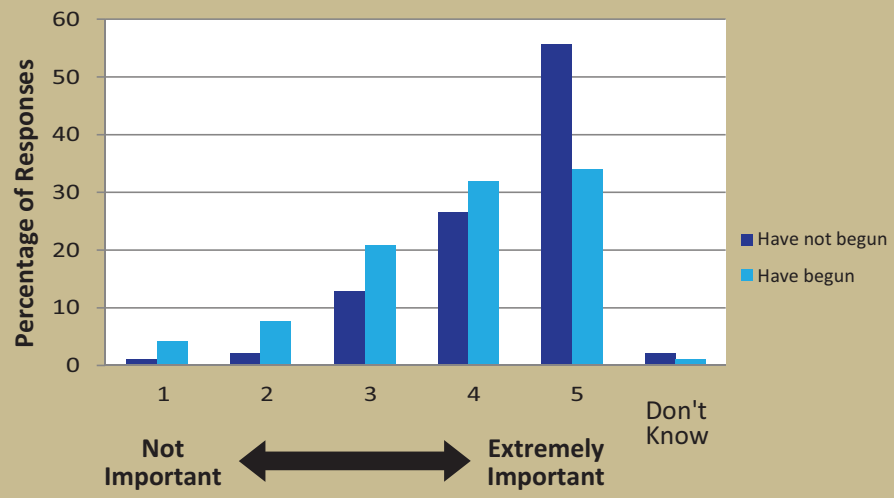

Figure 39. Needs associated with the identification and location of hazards on the landscape (n=329)

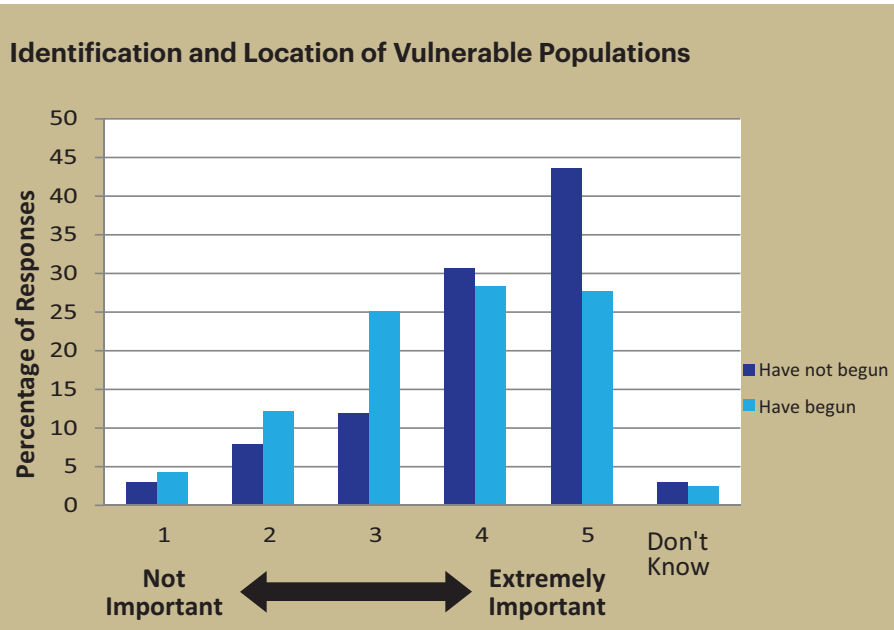

Figure 40. Needs associated with the identification and location of vulnerable populations (n=329)

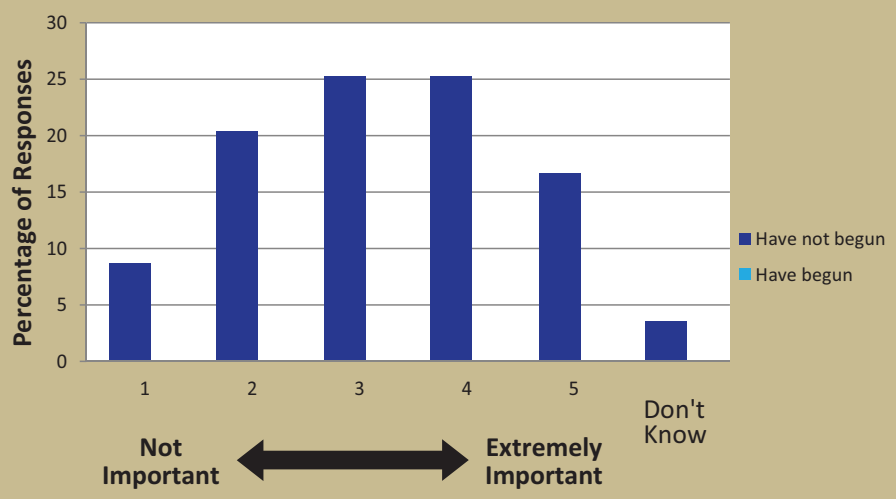

Figure 41. Needs associated with identifying the location of emergency services (n=192)

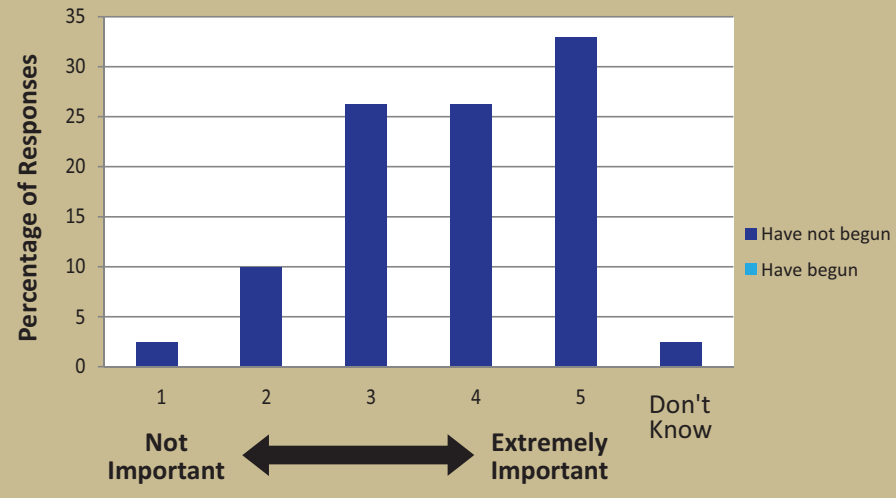

Figure 42. Needs associated with identifying the location and vulnerability of built infrastructure (n=192)

Value of Built Infrastructure and Building Stock

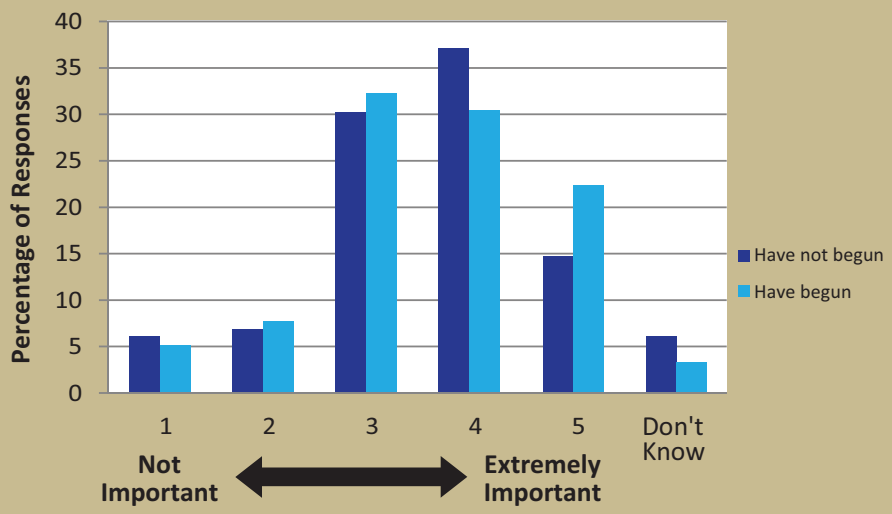

Figure 43. Needs associated with assessing the value of built infrastructure and building stock (n=329)

Location and Importance of Natural Systems that Provide Ecosystem Services (have begun only)

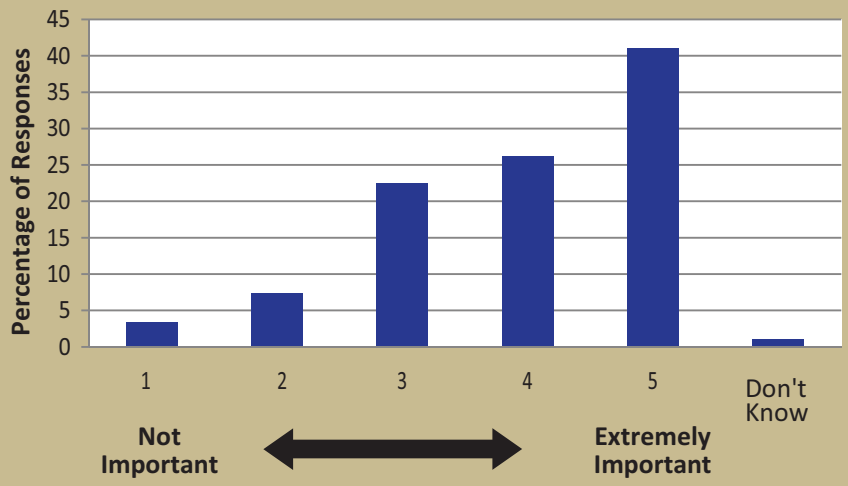

Figure 44. Needs associated with determining the location and importance of natural systems that provide ecosystem services (n=192)

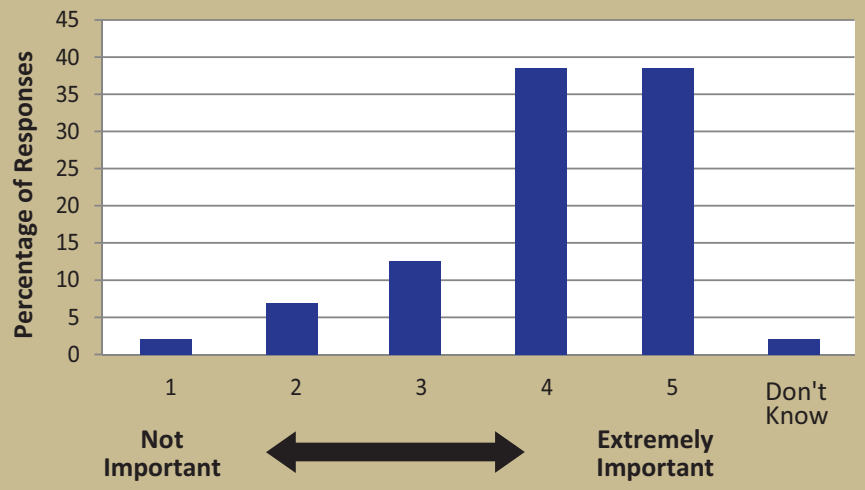

Figure 45. Needs associated with conducting a hydrological assessment of the local watershed (n=192)

Antioch University New England

Center for Climate Preparedness and Community Resilience

Local Solutions Report 2016

Center for Climate Preparedness and Community Resilience
Antioch University New England • 40 Avon Street • Keene, NH 03431

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