



# Opportunities to Enhance the Nation's Resilience to Climate Change

Council on Climate Preparedness and Resilience

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# Table of Contents

Introduction .....	1
Objective .....	1
Foundations for Climate Resilience .....	1
Understanding Current and Future Climate Change Impacts.....	1
Executive Action.....	2
Federal Efforts to Build Climate Resilience .....	3
Supporting Community-Driven Resilience .....	5
Opportunities for Action .....	6
Advancing and Applying Science-Based Information, Technology, and Tools to Address Climate Risk.....	8
Improve awareness and dissemination of climate information .....	8
Enhance usability of climate tools for decision making.....	9
Facilitate co-production of knowledge and tools .....	9
Improve understanding of the economics of climate change .....	12
Evaluate progress and performance of resilience investments .....	13
Support cross-sector collaboration to advance research and development.....	13
Integrating Climate Resilience into Federal Agency Missions, Operations, and Culture .....	17
Strengthen resilience coordination across Federal agencies .....	17
Strengthen Federal workforce capacity through leadership direction and training .....	18
Expand incentives and requirements to increase the resilience of infrastructure and buildings .....	19
Address national security risks from climate change .....	20
Conserve, restore, and manage ecosystems to enhance resilience .....	21
Apply climate-resilient approaches to international development.....	22
Supporting Community Efforts to Enhance Climate Resilience.....	23
Build capacity, meaningfully engage the community, and invest in local leaders .....	23
Strengthen place-based approaches to climate resilience .....	26
Integrate resilience into health and social service delivery.....	28
Improve navigability of Federal resources.....	29
Encourage comprehensive preparedness.....	30
Conclusion.....	34





# Executive Summary

Climate change affects every community and economic sector in the United States. Increasing temperatures, rising sea levels, increases in the intensity and frequency of certain extreme weather events, changing precipitation patterns, and other impacts are affecting people throughout the Nation. Higher temperatures and more frequent and intense heat waves drive up energy costs; raise the risk of heat-related illness; and threaten crops, fisheries, recreation, and the reliability of water and food supplies. Sea level rise threatens coastlines and ports and can fuel higher storm surge.

The Obama Administration's work to build climate resilience forms the foundation for future opportunities. The interagency Council on Climate Preparedness and Resilience (Resilience Council) coordinates this work across Federal agencies. The Resilience Council has worked with state, local, and tribal leaders, community organizations, academic institutions, philanthropic organizations, and the private sector to advance climate science and support on-the-ground decisions. To build upon and sustain this work, the Resilience Council identified a set of key opportunities using the expertise and experience within Federal agencies and the perspectives of numerous stakeholders. These opportunities will guide sustained and coordinated action among Federal agencies and empower stakeholders to work with them on a shared resilience agenda.

The Resilience Council developed these opportunities using the following principles, which should continue to guide actions for climate resilience:

- ❖ Climate resilience should incorporate meaningful community engagement, fair and equitable outcomes, and targeted investments for communities that are often overlooked;
- ❖ Climate resilience should be coordinated among multiple stakeholders—including all levels of government, academic institutions, companies, and nonprofits—through partnerships, shared knowledge and resources, and coordinated strategies;
- ❖ Climate resilience should be mainstreamed into everyday decision making; and
- ❖ Climate resilience should be a factor in fiscally responsible investments.

The 17 opportunities are grouped into three themes. They are complementary to one another and, collectively, will help build climate resilience throughout the Nation.

**Theme 1: Advancing and applying science-based information, technology, and tools to address climate risk.** The Obama Administration has worked to connect the best-available climate science, data, and tools to communities and organizations throughout the Nation. The Federal Government can continue its critical role in this work through advancing observations, research, modeling, and innovative technology development, and communicating and translating information to support decision making. Opportunities within this theme are the following:

- Improve awareness and dissemination of climate information
- Enhance usability of climate tools for decision making
- Facilitate co-production of knowledge and tools
- Improve understanding of the economics of climate change
- Evaluate progress and performance of resilience investments

- Support cross-sector collaboration to advance research and development

**Theme 2: Integrating climate resilience into Federal agency missions, operations, and culture.** The President has used executive action to build the foundation for climate resilience in the Federal Government. Continuing this work would ensure that the Federal Government fulfills its responsibility to the American people to continue its statutory missions, operations, and programs in the face of climate change. Opportunities within this theme are the following:

- Strengthen resilience coordination across Federal agencies
- Strengthen Federal workforce capacity through leadership direction and training
- Expand incentives and requirements to increase the resilience of infrastructure and buildings
- Address national security risks from climate change
- Conserve, restore, and manage ecosystems to enhance resilience
- Apply climate-resilient approaches to international development

**Theme 3: Supporting community efforts to enhance climate resilience.** The Obama Administration has demonstrated its commitment to support communities as they develop strategies and partnerships for building climate resilience. The Federal Government can continue to support communities through stakeholder engagement to understand on-the-ground needs and build capacity. Opportunities within this theme are the following:

- Build capacity, meaningfully engage communities, and invest in local leaders
- Strengthen place-based approaches to climate resilience
- Integrate resilience into health and social-service delivery
- Improve navigability of Federal resources
- Encourage comprehensive preparedness

The United States has come a long way in understanding the effects of climate change, organizing communities, strengthening infrastructure, protecting natural and cultural resources, developing technology, and planning for the future. Federal leadership remains important to understand climate change; improve the resilience of Federal Government missions, operations, and programs that serve communities; and support community efforts to enhance resilience.

The Nation's resilience depends upon many decisions and actions that strengthen the ability to respond and adapt to the changing climate. Fortifying homes and buildings against storms and flooding, conserving and restoring vulnerable ecosystems, and helping communities plan for weather-related hazards are just a few ways in which Americans are already working to build climate resilience. Though many of these efforts are underway, more work remains to build climate resilience throughout the Nation.

The opportunities described here, which are based on the experience of the Resilience Council to date, are intended to guide action within Federal agencies and collaboration with stakeholders in building resilient communities. The Resilience Council invites stakeholders to continue working with Federal agencies on these opportunities over the next several years to enhance the Nation's resilience to climate change.



# Introduction

## Objective

The impacts of climate change—including an increase in prolonged periods of excessively high temperatures, more heavy downpours, an increase in wildfires, more severe droughts, thawing permafrost, ocean acidification, and sea level rise—are already affecting communities, natural and cultural resources, ecosystems, economies, and public health across the United States. These impacts come with significant costs. Across the country, governments, businesses, and communities are taking important steps to prepare themselves, and the Obama Administration has been working with stakeholders to strengthen the Nation’s climate resilience. The Administration’s accomplishments provide the foundation for building resilience<sup>1</sup> to these impacts now and in the future.

This document describes opportunities developed by the Council on Climate Preparedness and Resilience (Resilience Council) to: support science and research for building resilience to climate change impacts, ensure the resilience of Federal operations and facilities in a changing climate, protect critical infrastructure and public resources, and establish and implement policies that promote resilience and support community-based resilience planning and implementation.

To identify the highest-priority opportunities, the Resilience Council sought the expertise of the many career professionals whose experience and commitment will drive future action on climate resilience. Through listening sessions with state, local, and tribal leaders, community advocates, and representatives from academia, philanthropic organizations, non-governmental organizations, and the private sector, the Resilience Council heard directly from stakeholders about ways that the Federal Government can best support their efforts to build resilient communities.

**This document has two objectives:**

- 1. Guide sustained and coordinated action among Federal agencies to further climate resilience efforts; and**
- 2. Empower stakeholders to continue to work with Federal agencies on shared resilience priorities.**

## Foundations for Climate Resilience

The Federal Government has built a strong foundation for the Nation’s climate resilience, but climate change impacts will continue to grow for decades to come, and the need to prepare for, adapt, and respond to these impacts remains urgent and costly. Managing these impacts requires continued leadership, leveraged resources, and coordinated, strategic action from communities, businesses, and government at all levels.

## Understanding Current and Future Climate Change Impacts

In May 2014, the U.S Global Change Research Program (USGCRP) issued the [Third National Climate Assessment](#)<sup>2</sup> (NCA3), a quadrennial report required by the Global Change Research Act of 1990. NCA3 is the most comprehensive assessment ever conducted on the impacts of climate change in the United States. It translates scientific insights into practical knowledge that can help decision makers anticipate and prepare for the impacts of a changing climate. Over 300 experts and thousands of stakeholders engaged in the development of the NCA3 through more than 100 listening sessions, workshops, and public meetings across the country. The report is available in a user-friendly, online format to enable a

broad reach and enhanced accessibility. Within the first year of publication, users downloaded the report over 850,000 times.

NCA3 projected that average temperatures in most regions of the United States will rise another 2°F to 4°F over the next few decades. Sea levels have already risen eight inches over the past century and are expected to rise by another one to four feet—possibly more—by the end of this century. Rising sea levels intensify coastal flooding and storm surges, exacerbating threats to public safety and infrastructure. In the future, the United States can expect to see still more heavy downpours and associated flooding, increases in the power of the strongest hurricanes, and continuing acidification of the oceans driven by carbon-dioxide absorption. The polar regions are warming at twice the rate of the global average, leading to rapidly melting glaciers and sea ice and thawing permafrost. Dry spells are projected to increase in duration in most of the United States, and long-term droughts are expected to intensify in large areas of the Southwest, southern Great Plains, and Southeast, areas with major agricultural production and forested lands. In the western United States, the droughts over the last decade resulted in the driest conditions in that area in 800 years. Rising temperatures and increasing dry spells in the West exacerbate conditions conducive to wildfires, causing wildfires to start earlier in the season, last later into the fall, and burn more acreage.

These impacts translate into significant costs to the economy and the environment. The American Climate Prospectus estimated hundreds of billions in annual economic losses through the end of the century due to agricultural impacts, lost labor productivity, elevated rates of property crime and violent crime, premature mortality, and damages due to coastal storms. The Congressional Budget Office recently estimated that expected annual economic damages from coastal hurricanes would increase from \$30 billion today to \$150 billion in 2075, in large part due to climate change. Climate change is also expected to fundamentally alter ecosystems in ways that impact the services that these systems provide in support of human well-being. These risks will affect not only American families and businesses, but also American taxpayers. The Federal Government faces significant and growing fiscal risk in the coming decades due to climate change—after incurring at least \$357 billion in direct costs over the last decade due to extreme weather and wildfires alone.<sup>3</sup> This number represents a small fraction of the true economic cost of climate change. It does not include costs absorbed by the private sector, state, tribal, and local governments, international disaster response and relief, military spending, healthcare expenses, and loss or damage to ecosystem services, among other costs.<sup>4</sup> Thus, these conservative estimates significantly underestimate actual financial exposure to changes in extreme events such as droughts, floods, and storms.

## Executive Action

Through executive action, President Obama laid the foundation for the Federal Government to build and support climate resilience in American communities. Key executive actions described in this section catalyzed significant changes in the way Federal agencies approach their work, and together, they form the basis for many of the subsequent Federal actions to build resilience.

This work began in 2009, when President Obama issued [Executive Order 13514, Federal Leadership in Environmental, Energy, and Economic Performance](#),<sup>5</sup> which established the **Interagency Climate Change Adaptation Task Force** and directed Federal agencies to develop **Climate Change Adaptation Plans** to protect their operations, missions, and programs from the effects of climate change. Federal agencies released the first Climate Change Adaptation Plans in February 2013.<sup>6</sup>

In response to the devastating impacts of Hurricane Sandy in October 2012, the President convened the **Hurricane Sandy Rebuilding Task Force** to help homeowners stay in and repair their homes, strengthen small businesses, revitalize local economies, and help communities withstand and recover from future

storms. In August 2013, that group – led by Federal officials, with input from an advisory group of State, local, and tribal leaders – released the [Hurricane Sandy Rebuilding Strategy](#).<sup>7</sup>

The Strategy includes recommendations and best practices to inform resilient rebuilding and resilience planning in the Sandy-affected region. In October 2014, the Administration released a [Progress Report](#)<sup>8</sup> describing the Federal Government’s progress in implementing these recommendations.

In June 2013, the President issued his [Climate Action Plan](#),<sup>9</sup> which set forth Federal actions to build stronger and safer communities and infrastructure, protect the economy and natural resources, and use sound science to manage climate change impacts.

In November 2013, [Executive Order 13653, Preparing the United States for the Impacts of Climate Change](#),<sup>10</sup> established the interagency **Council on Climate Preparedness and Resilience (the “Resilience Council”)** to coordinate Federal resilience efforts. It also created the **State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience** – a group of 26 governors, mayors, county officials, and tribal leaders – to inform Federal efforts to support climate preparedness and resilience. In November 2014, this group released its [Recommendations to the President](#),<sup>11</sup> which have been an important guide for prioritizing Federal action on climate resilience. In July 2015, the Resilience Council issued a [Progress Report](#) on how Federal agencies have addressed the Recommendations. This report provides information on many Federal resilience programs then underway and can serve as a useful resource for stakeholders interested in learning more about these programs. See the Executive Orders and Memoranda box on the following page for more information on executive actions.

## Federal Efforts to Build Climate Resilience

While many efforts to address climate change occur at the state, tribal, and local levels, the Federal Government has a critical role in developing best practices, stimulating action, and coordinating with stakeholders to build climate resilience across the United States. The Federal Government has made significant progress in building climate resilience by improving understanding of climate change-related risks, promoting resilience to climate change impacts in Federal missions, operations, and programs, and supporting community efforts to enhance resilience.

In 2013, Federal agencies released the first [agency adaptation plans](#), which evaluated their most significant short- and long-term climate change-related risks and vulnerabilities. The plans outline the actions that agencies will take to manage these risks and vulnerabilities. The development of the agency adaptation plans—which agencies made available for public comment—was an important step in mainstreaming climate change considerations within agencies. Since 2014, agencies have reported on their progress on an annual basis. To strengthen the agency adaptation plans, in 2016, agencies participated in a self-assessment and the first annual in-person progress reviews with the Office of Management and Budget and the Council on Environmental Quality.<sup>12</sup>

The Federal Government is also taking action to address specific hazards, including wildfires, droughts, and floods, through designing, building, and planning with resilience in mind. Floods are the most common—and costliest—natural disaster in the Nation and the leading cause of fatalities related to natural disasters. A flood occurs somewhere in the United States or its territories nearly every day of the year, and many, such as the recent Louisiana floods, can cause significant damage. In 2015 alone, the National Oceanic and Atmospheric Administration (NOAA) reported 176 flood-related deaths—a dramatic increase from the 38 flood-related deaths in 2014, and well above the 10-year average of 82 flood-related deaths per year.<sup>13</sup> As of the end of September, 25 of the 35 Major Disaster Declarations in 2016 have included flooding.

## Executive Orders and Memoranda

President Obama has issued Executive Orders and Presidential Memoranda to drive and coordinate Federal action in key focus areas related to climate change, including national security, drought, wildfire, floods, Arctic concerns, international development, and sustainability.

**October 2009:** Executive Order 13514, [Federal Leadership in Environmental, Energy, and Economic Performance](#), sets sustainability goals for Federal agencies and seeks to improve their environmental, energy, and economic performance.

**November 2013:** Executive Order 13653, [Preparing the United States for the Impacts of Climate Change](#), directs Federal agencies to take actions to increase resilience, including modernizing Federal programs, managing land and waters, providing information, data, and tools, and updating agency adaptation plans.

**September 2014:** Executive Order 13677, [Climate-Resilient International Development](#), requires that Federal agencies with international development programs incorporate climate resilience into strategies, planning, programming, investments, and management of overseas facilities.

**January 2015:** Executive Order 13689, [Enhancing Coordination of National Efforts in the Arctic](#), created the Arctic Executive Steering Committee to coordinate national efforts in the Arctic region to protect the following national interests: national defense, sovereign rights and responsibilities, maritime safety, energy and economic benefits, environmental stewardship, promotion of science and research, and preservation of the rights, freedoms, and uses of the sea as reflected in international law.

**January 2015:** Executive Order 13690, [Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input](#), reduces the risk and cost of future flood disasters by requiring that Federal investments in and affecting floodplains meet higher flood risk standards.

**March 2015:** Executive Order 13693, [Planning for Federal Sustainability in the Next Decade](#), directs Federal agencies to increase energy efficiency, improve environmental performance, and incorporate climate resilience into these efforts. This order supersedes Executive Order 13514.

**March 2016:** Presidential Memorandum: [Building National Capabilities for Long-Term Drought Resilience](#) addresses the Nation's need to sustain and expand efforts to reduce the vulnerability of communities to the impacts of drought.

**May 2016:** Executive Order 13728, [Wildland-Urban Interface Federal Risk Mitigation](#), directs Federal agencies to enhance the resilience of Federal buildings and lands to wildfire in order to promote public safety, economic strength, and national security.

**September 2016:** Presidential Memorandum: [Climate Change and National Security](#) establishes a framework for coordination and directs Federal agencies to take actions to ensure that climate change-related impacts are fully considered in the development of national security doctrine, policies, and plans.

Executive Order 13690 requires that Federally funded buildings, roads, and other infrastructure are constructed to better withstand the impacts of flooding. It established the [Federal Flood Risk Management Standard \(FFRMS\)](#)<sup>14</sup>—an example of how the Federal Government is making taxpayer investments more resilient to climate change impacts.<sup>15</sup> The FFRMS imposes a higher resilience standard for future Federal investments in buildings and infrastructure to reduce the increased threat of flooding associated with climate change. The new standard also requires agencies to consider current and future risk for any Federally funded project to build or rebuild in areas of flood risk. In doing so, the FFRMS will support the thousands of communities that have strengthened their local floodplain management codes and standards and will help ensure that Federal projects last as long as intended.

Agencies have begun the process of implementing the FFRMS, including the modernization of agency floodplain management procedures to prepare for increased risk of flooding.<sup>16</sup> The new standard gives agencies flexibility in establishing the flood elevation and hazard area they use in siting, design, and construction.<sup>17</sup> Along with the standard, the Federal Government developed guidance for Federal agencies with input from stakeholders through a robust public engagement process.<sup>18</sup> Federal agency implementation of the FFRMS will help to protect the people who live and work in those buildings, reduce damage to Federal investments, and decrease the burden on communities of cleaning up and rebuilding after a flood. In August 2016, FEMA was the first agency to publish its Notice of Proposed Rulemaking to implement the FFRMS.

### Supporting Community-Driven Resilience

Coordinated action among all stakeholders is critical to tackling shared climate change impacts. The Federal Government plays an important role in this process by enabling stakeholders to advance their resilience priorities.

In response to one of the recommendations made by the State, Local, and Tribal Leaders Task Force, the Corporation for National and Community Service (CNCS), with the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), the Department of Energy (DOE) and non-Federal partners launched [Resilience AmeriCorps](#),<sup>19</sup> a program that builds capacity for climate resilience planning and implementation in low-income communities. Resilience AmeriCorps members utilize the Federal Government's climate data, information, tools, and training to provide technical assistance directly to local communities. The program also serves as a mechanism to gain feedback, thereby improving the effectiveness and accessibility of Federal resources. In Phoenix, Arizona, AmeriCorps members are engaging low-income communities in climate resilience planning and implementation to address recent flash floods, record-breaking heat, and water shortages.<sup>20</sup> Members are engaging with community residents to understand how they view their vulnerabilities, needs, and capacity to build resilience.

USGCRP, with Federal agencies and non-Federal partners, is launching Resilience Dialogues to address the need for training and technical assistance for communities. Resilience Dialogues is a public-private collaboration that will allow communities to consult directly with climate science experts and resilience practitioners. Through this collaboration, communities will be connected to science-based, location-specific information, programs, and tools to support resilience planning.

The White House and DOE launched the Climate Action Champions initiative in 2014. This effort highlighted the leadership of sixteen communities and helped them demonstrate examples of successful climate action that could benefit other communities. Under the initiative, agencies provided \$1.4 million in targeted Federal support and worked with the Climate Action Champions to understand how the Federal Government could more effectively support their climate resilience activities. These include improving the navigability of Federal resources, creating training and capacity-building opportunities for

local leaders, creating opportunities for public-private partnership coordination, and enhancing understanding of the capacity of Federal resources.

In addition to these capacity-building efforts, Federal agencies can create incentives for communities to invest in resilience by modernizing existing Federal programs. This is a key directive of Executive Order 13653 and a focus of the State, Local, and Tribal Leaders Task Force Recommendations. For example, the Department of Housing and Urban Development (HUD) launched the National Disaster Resilience Competition (NDRC) to allocate funds for disaster recovery and invest in long-term resilience. In January 2016, HUD awarded thirteen states, counties, and cities a combined \$1 billion to support low- and moderate-income communities with resilience activities including coastal protection, stormwater management, relocation assistance for the most distressed communities, and job creation through adaptation.

Through a companion effort, the Rockefeller Foundation provided technical assistance to more than fifty eligible NDRC communities and supported a stakeholder-driven process to identify recovery needs and innovative solutions. The 16-month competition engaged more than 25 Federal agencies and over 100 industry experts. The Rockefeller Foundation has also supported training for Resilience AmeriCorps members and leaders in the communities they serve. These examples show how the Federal Government can work hand-in-hand with communities, philanthropic organizations, and the private sector to build capacity and stimulate investment in climate resilience.

## Opportunities for Action

Climate resilience is still an emerging field, and strategies for future action should leverage the shared experience, progress, and momentum of governments, communities, and businesses as they build climate resilience.

The Federal Government has an important role in building climate resilience across the Nation. To build on the foundation that the Obama Administration has laid for climate resilience, this document uses the following three themes to organize the opportunities identified for future Federal action:

- **Advancing and applying science-based information, technology, and tools to address climate risk;**
- **Integrating climate resilience into Federal agency missions, operations, and culture; and**
- **Supporting community efforts to enhance climate resilience.**

Each of the following sections presents background information and opportunities relevant to each theme and incorporates the following principles:

- **Climate resilience should incorporate meaningful community engagement, fair and equitable outcomes, and targeted investments for communities that are often overlooked.** Resilience planning should be accessible to all communities, include diverse community members, and promote social cohesion, economic growth, stability of communities, and continuity of public services to ensure that all types of communities are considered in and have access to short- and long-term responses to climate change impacts. Challenges such as poverty, language barriers, or physical and mental health make it difficult to respond to and recover from climate change impacts and should be considered in the resilience planning process.
- **Climate resilience should be coordinated among multiple stakeholders—including all levels of government, academic institutions, companies and nonprofits—through partnerships, shared knowledge and resources, and coordinated strategies.** Collaboration improves efficiency,

expands capacity, and produces outcomes that could not be achieved individually, especially where individual organizations have limited resources. Collaboration builds on existing successes, experiences, and expertise of diverse stakeholders, leverages shared resources, and improves communication for a coordinated response.

- **Climate resilience should be mainstreamed into everyday decision making.** Climate change will continue to impact public and private sector operations in a diversity of ways, from transportation planning to capital asset acquisition to procurement and budgeting. Climate resilience should be mainstreamed throughout governmental and organizational decision-making processes to ensure continuity of service and protection of assets.
- **Climate resilience should be a factor in fiscally responsible investments.** Climate change is increasing costs for maintenance of infrastructure, response to natural disasters, disruptions to supply chains, energy and agricultural production, healthcare and natural resource management. Increasingly, organizations are seeing that investment in resilience today reduce future costs of climate change impacts and save money over time.

# Advancing and Applying Science-Based Information, Technology, and Tools to Address Climate Risk

Decision makers need access to actionable, science-based information, data, and tools to understand and manage climate risks to their communities, businesses, and households. Preparing for climate change requires integrated information on current and future impacts to physical, natural, social, and economic systems. The Federal Government plays a critical role in advancing understanding of, and response to, climate change through observations, research, modeling, and innovative technology development, and in communication and translation of information to support decision making.

The Administration launched the [Climate Data Initiative \(CDI\)](#)<sup>21</sup> and [U.S. Climate Resilience Toolkit \(CRT\)](#)<sup>22</sup> to help address these needs. The CDI was a call to America's top private-sector innovators to leverage open-government data resources. Through the CDI, over 600 high-value climate-related datasets, from human health to ecosystem vulnerability and energy infrastructure, are now open and accessible on data.gov. Innovators and entrepreneurs are using these resources to build data products, tools, and applications, and a new community of climate data users is rapidly growing. This competition is contributing to the emergence of a robust private-sector marketplace around climate information services.

The CRT is an online resource designed to help people find and use information, tools, and subject matter expertise to build climate resilience. It includes a step-by-step guide for issues to consider in resilience planning, case studies, science-based tools, topical narratives, authoritative reports, regional experts, and training courses. It also includes the recently updated Climate Explorer,<sup>23</sup> a visualization tool that provides county-level climate projections, enabling users to see how climate change will affect their own backyards. The following pages describe case studies where the CRT has helped communities prepare for sea level rise, drought, and wildfire.

Federal agencies continue to advance critical data, information, and tools to understand climate changes and their impacts on economies and built and natural systems. These agencies are producing research, modeling innovative technology development, and working together in areas where they have a common mission, such as water, energy, health, and agriculture. This section describes opportunities in this important work to facilitate climate resilience across the country.

## Improve awareness and dissemination of climate information

Communities and businesses look to the Federal Government for authoritative sources of current and future climate change-related information. For example, the CRT's [Climate Explorer](#)<sup>24</sup> enables users to visualize county-level climate projections for the continental United States. USGCRP's Sea Level Rise Scenarios Task Force is currently developing sea level rise estimates for the entire U.S. coastline as part of the Fourth National Climate Assessment process. This information can help coastal communities make decisions about how to protect existing infrastructure from storms and flooding, where to build, how to restore and conserve natural resources, and even whether to relocate to higher ground. The

Federal Government can support and enhance efforts like these to improve understanding among communities and businesses regarding a range of climate-related threats.

## Enhance usability of climate tools for decision making

Community-level data collected by communities themselves can support decision making to plan for climate change impacts. Data on age, health conditions, socioeconomic status, employment, housing, access to transportation, electricity cost, and availability of public services can be combined with data on climate change impacts to understand a community's vulnerabilities. This information can be critical to meet the needs of people who experience a natural hazard.

States, local governments, tribes, and territories are on the front lines of natural disasters and make important community planning and land-use decisions in response to climate change. Some cities and community groups are already collecting these data by surveying neighborhoods and developing representative community maps. The Federal Government can work with communities to improve these data, integrate them with climate science information and tools, and spread awareness to inform the actions of planners, natural resource managers, local leaders, emergency responders, and local businesses. For example, the CRT's [Sea-Level Rise Viewer](#)<sup>25</sup> overlays community data from the Center for Disease Control's [Social Vulnerability Index](#)<sup>26</sup> in its coastal-inundation and sea-level-rise impacts maps. FEMA has also developed a draft concept for community resilience indicators that includes a [web-based viewer with state- and county-specific information](#).<sup>27</sup>

## Facilitate co-production of knowledge and tools

Federal agencies and the academic community are advancing data, information, tools, and technologies to support state, local, and tribal planners, community advocates, and businesses in their efforts to build resilience in their communities. These resources are often difficult to navigate. Intermediary experts can help communities understand and apply climate science information to meet their unique needs. They can work with decision makers to understand how climate is affecting communities on the ground and what information they need to support their resilience efforts.

The Federal Government currently supports a number of successful science-to-user "boundary organizations" that translate both ways between the science and decision-making communities. Similarly, extension services provide climate information to ranchers, farmers, fishers, local community planners in rural areas, and others whose livelihoods are vulnerable to the impacts of a changing climate. These organizations provide climate science to communities, help communities find the tools and resources they need to manage climate change impacts, learn from them what information is needed to manage shared challenges, and co-produce knowledge and tools.

### Boundary Organizations

DOI: [Climate Science Centers](#)  
DOI: [Landscape Conservation Cooperatives](#)  
NOAA: [National Integrated Drought Information System](#)  
NOAA: [Regional Climate Services Partners](#)  
NOAA: [Regional Integrated Sciences and Assessments \(RISA\) programs](#)  
USDA: [Regional Climate Hubs](#)  
USAID and NASA: [SERVIR network of regional hubs](#)

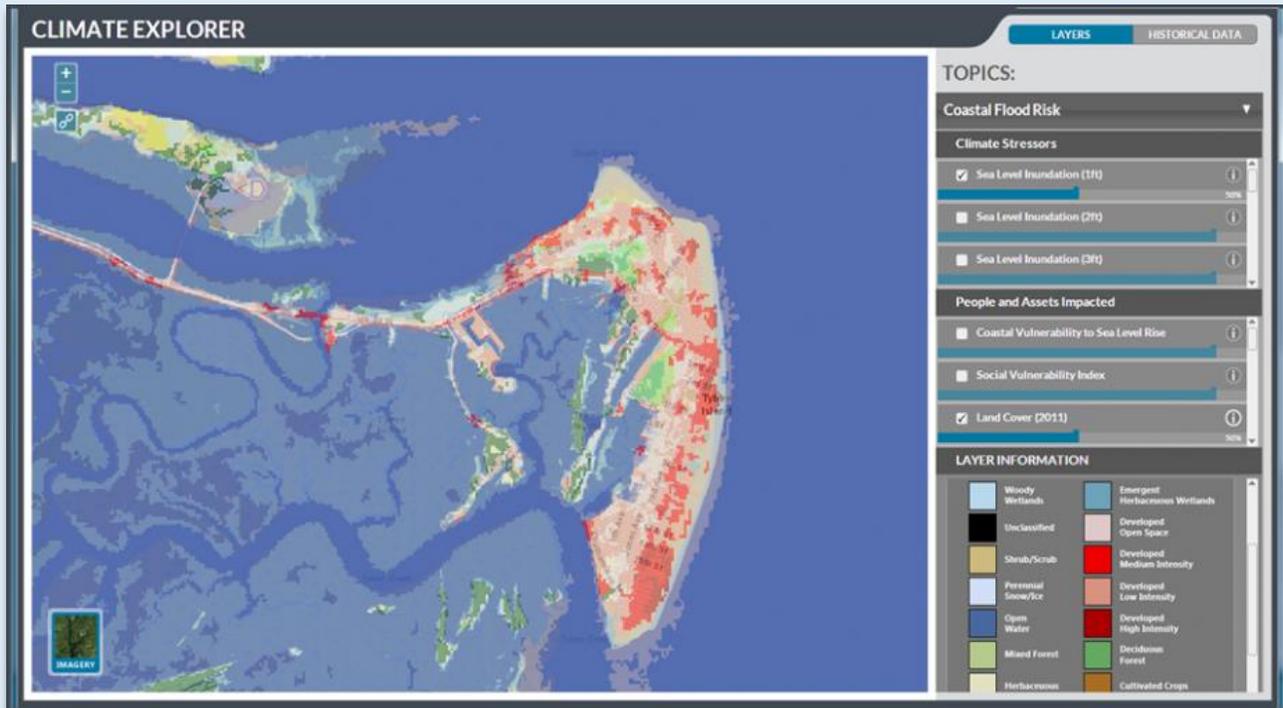
### Extension Services

USDA: [Cooperative Extension](#)  
NOAA: [NOAA Sea Grant Extension](#)

## Case Study: U.S. Climate Resilience Toolkit

For people across the country, the Climate Resilience Toolkit has made data and tools for climate-informed decision making easily accessible. From wildfire risk to sea level rise projections, the right information can facilitate successful planning, reduce costs, and save lives.

### Tools to manage sea level rise and flooding in coastal towns



Tybee Island Georgia in the Climate Explorer tool, shown with just 1 foot of sea level rise. US 80 connects the island to the mainland. Photo credit: Climate Resilience Toolkit, available at: <http://toolkit.climate.gov/>.

With rising waters threatening homes and businesses, people from coast to coast have turned to the Sea Level Rise and Coastal Flooding Impacts Viewer to assess their vulnerability and plan to strengthen their communities. Tybee Island, Georgia—an historic barrier island town with 3000 permanent residents and tens of thousands of summer visitors—has experienced 10 inches of sea level rise since 1935. Scientists expect this trend to accelerate, with consequences for the community’s economy, infrastructure, and the surrounding environment.<sup>28</sup> Concerned city officials reached out to the University of Georgia and Georgia Sea Grant for help. By using the Sea Level Rise and Coastal Flooding Impacts Viewer, they demonstrated the likelihood of severe impacts due to higher water levels. With funding from the National Sea Grant Community Climate Adaptation Initiative, experts and city officials assessed their risk and made a plan for action, utilizing NOAA’s sea level rise projections through 2100 and outreach to members of the community.<sup>29</sup> The recommendations include elevating well houses that provide drinking water, retrofitting stormwater systems, elevating the U.S. 80 highway (the only road connecting the island to the mainland), and strengthening shoreline defenses. In April 2016, the City Council voted unanimously to accept the report and is now implementing its recommendations. Thanks to these investments, FEMA has raised Tybee’s Community Rating System score, which measures the effectiveness of flood-loss-reduction techniques. As a result, Tybee flood insurance policyholders in the Special Flood Hazard Area receive a 25% discount on their flood insurance premium.

## Tools for managing drought and rising temperatures on farms

Actionable data and tools empower the Nation’s hardworking farmers to anticipate change, respond to drought, and thrive in a variable and changing climate. Changing conditions and droughts are driving farmers across the country to use more climate data and tools—such as USDA’s Soil Climate Analysis Network (SCAN)—in their decision making. Dee Waldron, a dairy and feed-grain farmer in Morgan County, Utah, needs accurate information about weather and climate to make decisions for his farm. Waldron was an early adopter of SCAN, agreeing in 2007 to establish a data-collection site on his farm to measure soil moisture, temperature, solar radiation, humidity, wind speed and direction, and precipitation.<sup>30</sup> The SCAN tool has been highly useful for Waldron, who explained, “the SCAN data has helped me determine the optimum time to water, and as a result, last year I had the best corn crop I’ve ever had on this farm... I can sleep better at night knowing I can get up early, check the dew point on the computer, and decide if it’s the right time to bale my hay.” SCAN has installed 38 sites in Utah and 400 across the nation, providing farmers with useful real-time information and contributing to a nationwide database of soil moisture data available through the Climate Resilience Toolkit.



Utah farmer Dee Waldron in front of the SCAN installation on his Morgan County farm, which gives him real-time information on weather, soil moisture, and solar radiation. Photo credit: <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ut/newsroom/stories/?cid=stelprdb1269085>



Satellite images show the extent of smoke plumes in Southern California. Red dots identify active fires. Photo credit: <http://www.berkeley.edu/news/media/releases/2007/10/images/wildfire.jpg>.

## Tools for managing wildfire risks in the desert

In Southern California, a series of deadly wildfires led utility companies to develop the Santa Ana Wildfire Threat Index, which combines historical wildfire data, weather forecasts, and climatology to give resource managers the information they need to anticipate fire risk and make necessary preparations. The 2007 wildfires in San Diego County burned nearly 200,000 acres, destroyed more than 1,300 homes, and killed two people.<sup>31</sup>

Investigators determined that power-lines were largely responsible for sparking the flames during strong, dry Santa Ana winds. With a lack of early warnings about the fire-prone conditions, the flames quickly burned out of control and it took months for firefighting agencies to put out the flames. In response to the costly devastation, San Diego Gas & Electric (SDG&E) invested in research and partnerships to provide real-time data on wildfire hazards in the region, leading to the development of the Santa Ana Wildfire Threat Index. SDG&E has used the Index, available through the Climate Resilience Toolkit, to identify at-risk electric trunk lines and replace 3400 wooden poles with steel.<sup>32</sup> By using the best-available climate science, the utility has done its part to prevent deadly fires in the future.

For example, USDA’s Regional Climate Hubs deliver science-based information and program support to farmers, ranchers, forest landowners, and resource managers through trusted advisors. The Hubs inform research agendas, provide regional vulnerability assessments, and share region- and sector-specific tools to inform decision making at the farm and forest scales. NOAA’s Regional Integrated Sciences and Assessments (RISA) Program leverages a trusted network of research teams around the country to advance the knowledge base, provide expertise to support responses to extreme events such as severe flooding or drought, and build capacity of decision makers and communities to prepare for climate change impacts. The teams work hand-in-hand with managers and planners to advance climate adaptation approaches at local and regional scales. DOI’s Landscape Conservation Cooperatives (LCC) join communities across political boundaries to address shared challenges such as wildland fire, invasive species, and scarcity of water resources. The Bureau of Reclamation’s Basin Studies Program is an LCC that works with communities to help address water supply sustainability by assessing the effects of climate change on water supply, understanding present and future community demand for water, and implementing adaptation strategies.

In addition to regional collaborative approaches, the Federal Government can make climate science available by providing direct and sustained technical assistance to healthcare professionals, transportation managers, energy providers, emergency responders, and other state, local, and tribal government entities. Through two-way communication, users can inform the future development of tools and resources with on-the-ground information to ensure that community resilience needs are met. For example, traditional ecological knowledge can help researchers understand climate impacts and inform policy decisions to support the livelihood of tribes that rely on hunting, fishing, agriculture, and forestry.

## Improve understanding of the economics of climate change

One of the most important drivers of efforts to improve national climate resilience is understanding the potential economic impacts of climate change. This includes understanding how, without action, climate change will increase costs, including those associated with disaster recovery, energy usage, agriculture, and healthcare. It also includes the benefits of investments to prepare for and adapt to climate change. While there is a wealth of information on the economics of greenhouse gas mitigation, the literature on the costs and benefits of building resilience is relatively scarce. Some studies describe the increase in costs to key economic sectors due to climate change impacts,<sup>33</sup> but few identify the costs avoided over the long term by investments in resilience.

Federal agencies, in coordination with non-Federal leaders in climate resilience, should advance and communicate the economic risks of climate change impacts and the potential costs avoided through resilience investments. The Environmental Protection Agency (EPA) identified some of these avoided costs through adaptation in its paper [Climate Change in the United States: Benefits of Global Action](#).<sup>34</sup> EPA found that from the present through the year 2100, adaptation measures could reduce estimated damages to coastal property from sea level rise and storm surge from \$5 trillion to \$810 billion. NOAA also developed a framework for performing a holistic assessment of costs and benefits of different adaptation approaches in its paper, [What Will Adaptation Cost? An Economic Framework for Coastal Community Infrastructure](#).<sup>35</sup>

The Federal Government—and partners in the private sector, trade associations, think tanks, academia and local, state, and tribal governments—can conduct additional studies to characterize avoided costs from climate preparedness and valuation of resilience investments. For example, the National Institute

of Building Sciences, a nongovernmental organization, is currently updating a 2005 study that analyzed data on FEMA-funded mitigation activities to reflect not only the return on investment for emergency preparedness, but also climate preparedness measures, which occur over a much longer timeframe.

## Evaluate progress and performance of resilience investments

There is strong demand from the private sector, state, tribal, and local decision-makers, and non-governmental partners for information and tools that can help them evaluate the value of resilience investments. Information on the costs, benefits, and co-benefits of investments in resilience can help decision makers weigh projects based on their expected returns. The Federal Government has an important role in the development of metrics to help monitor and evaluate diverse investments in climate adaptation and resilience.

Many Federal agencies are already developing metrics, analytical frameworks, data, and tools to test innovative resilience strategies and methods. The [DOE Grid Modernization Laboratory Consortium](#)<sup>36</sup> is investing in research to develop metrics for resilience and tools for improving evaluation of system performance. DOI convened experts from agencies and academia to develop ecological<sup>37</sup> and socio-economic<sup>38</sup> performance metrics for natural infrastructure that can help natural resource managers develop best practices and guide future resilience investments.

Leaders from diverse private-sector entities are working with the Federal Government to develop data, metrics, and tools needed to evaluate the resilience of supply chains, infrastructure, and investments, and this work can be expanded. For example, EPA works with water, wastewater, and stormwater utilities to increase the resilience of their infrastructure by using the Climate Resilience Evaluation & Awareness Tool (CREAT). The CREAT software tool empowers utilities to assess the potential impacts of climate change on their infrastructure and operations and to evaluate the costs and benefits of different risk reduction strategies.

Some investors have asked the Federal Government to strengthen its climate-risk disclosure requirements to better characterize and evaluate the material financial risk of companies. Disclosure of material climate-related risks could help investors understand changes in risk to investment portfolios, including municipal bonds, security pricing, and benchmarking of mortgage pools susceptible to risks of extreme weather events.

## Support cross-sector collaboration to advance research and development

The Federal Government can work with businesses, think tanks, and communities to support research and development (R&D) of technologies to manage climate-related risks. Alongside these efforts, the Federal Government can assess the costs and benefits of these technologies, as well as policy incentives (*e.g.*, grants, loans, tax credits, and other financial instruments), and challenges to deployment of resilience technologies at the national, regional, and local levels.

The Federal Government has already committed significant resources to R&D for innovative water sustainability and energy efficiency initiatives. Increasing droughts can affect many sectors of society, including human health, tourism, transportation, energy, fisheries, agriculture, and food security. To increase the resilience of water supplies, the Federal Government is developing approaches to conserve water, reuse water, and reduce the cost of water technology. For example, the Bureau of Reclamation and DOE are developing technology solutions for desalination and water purification. NOAA is developing tools to help predict water availability. USGS is developing tools to track real-time water use during droughts. USDA is developing methods to improve water retention of soil.

## Case Study: Financing Community Resilience

To support resilience efforts, government, communities, and private-sector organizations are developing financing mechanisms that reduce consumer costs and incentivize pre-disaster mitigation and other climate resilience actions. These mechanisms leverage tax credits, green and resilient bonds, permit rebates, insurance premium reductions, and other financial tools to help communities, businesses, and families invest in resilience and reduce the costs of post-disaster recovery.

According to the 2005 National Institute of Building Sciences study mentioned above, a dollar spent on disaster mitigation saves four dollars in future costs associated with recovery and allows the Federal Treasury to redirect an average of \$3.65 from disaster relief costs and tax losses to communities and other outcomes.<sup>39</sup> Developing strategies to finance resilience is critical to incentivizing and supporting community climate resilience.

### Establishing Municipal Bonds for Wildfires

In 2010, the Schultz Fire in the Coconino National Forest and subsequent flooding down bare mountain slopes into Flagstaff, Arizona caused over \$130 million in damages and killed one resident of Flagstaff.<sup>40</sup>

In response to these impacts on Flagstaff homes and businesses, the Greater Flagstaff Forests Partnership—a coalition of scientists, environmental nonprofits, and Federal and local representatives—crafted solutions to minimize the impacts and likelihood of future wildfires. In 2012, Flagstaff residents approved a \$10 million bond for forest treatments in Flagstaff watersheds to reduce unnaturally high fuel loads in forests and decrease wildfire risks. This is an example of how community engagement and innovative use of financial strategies can create powerful opportunities to fund risk reduction and resilience.



The Schultz Fire in Coconino National Forest on June 24, 2010.

Photo credit: [http://www.azgs.az.gov/arizona\\_geology/winter10/article\\_feature.html](http://www.azgs.az.gov/arizona_geology/winter10/article_feature.html).

### Creating Public-Private Partnerships to Fund Solutions to Wildfire Effects on Watershed Quality

The Rio Grande watershed in New Mexico supplies water to more than half of New Mexico's population, including Albuquerque, Santa Fe, Pueblos, and many rural communities. Debris from flooding after wildfires can render the water untreatable, an increasing threat to the Rio Grande watershed as wildfires in the area become more frequent and more severe.<sup>41</sup> State and Federal agencies spend hundreds of millions of dollars a year responding to wildfires, and businesses and communities struggle with water scarcity. Through a partnership of water managers, the business sector, foresters, conservation organizations, and local, state, Federal, and tribal government representatives, the Rio Grande Water Fund has set out to invest in the restoration of forested lands upstream of affected watersheds to reduce



Debris floating in Lake Cochiti from post-fire debris flows and flooding.  
Photo credit: <http://nmconservation.org/rgwf/plan.html>.

wildfire risks and ensure clean water for communities downstream. While the economic impact of one acre affected by damaging wildfire can be up to \$2,150, thinning an acre of dense forest costs an average of only \$700. The fund's goal is to generate sustainable funding over 20 years to increase the rate and reach of forest restoration in New Mexico. The Rio Grande Water Fund leverages investment from individuals, businesses, and foundations, state funding appropriated by the New Mexico state legislature,

voluntary contributions of revenue from local governments, and Federal funding from the Forest Service, Natural Resource Conservation Service, and Bureau of Land Management. The Rio Grande Water Fund shows how pooling resources from many sectors towards a common goal can create successful financing solutions.

### **Leveraging Insurance Premium Reductions to Incentivize Storm Resilient Homebuilding**

Hurricanes, thunderstorms, tornadoes, flooding, and other natural disasters have the potential to damage homes and businesses and harm families. Though storm risk is impossible to eliminate, both communities and individuals can undertake activities to enhance resilience and reduce insurance premiums. At the community level, FEMA's Community Rating System, part of the National Flood Insurance Program, is a voluntary incentive program that recognizes and encourages community floodplain management activities beyond the minimum requirements, resulting in a reduction of flood insurance premium rates for policyholders. This reduction reflects the reduced flood risk resulting from these actions. Individuals may also reduce their flood insurance premiums by building higher and stronger. According to the Insurance Information Institute, homeowners may also be able to save on premiums by adding storm shutters, reinforcing the roof, or buying stronger roofing materials, making their homes more disaster-resilient.<sup>42</sup>

To make energy sources more reliable, reduce costs to consumers, and reduce energy consumption, Federal agencies are working with energy utilities to better withstand increasing temperatures, reduce energy needs for manufacturing, increase renewable and clean energy and storage capacity, distribute energy across grids, spread the use of electric vehicles, and capture and store carbon. DOE works with utility companies through its “Partnership for Energy Sector Climate Resilience” to develop risk-based decision-making methods, conduct vulnerability assessments, and develop climate resilience plans. DOE has developed guidance<sup>43</sup> on approaches developed with these partners, including hardening existing assets, deploying climate resilient technologies (*e.g.*, distributed generation, smart grids, and microgrids), relocation, and policies to encourage investments in a climate-resilient energy system.

#### **Examples of Federal Resilience Technology R&D Efforts**

- Technology for agricultural and industrial applications to reduce water usage
- Desalination technologies to improve the availability of drinkable water in areas experiencing drought
- Technology improvements to help electricity transmission and distribution systems withstand higher ambient temperatures (*e.g.*, more heat-tolerant transformers)
- Thermoelectric cooling technologies (*e.g.*, dry cooling or wet-dry hybrid cooling technologies) for power generation facilities to reduce the needs for cooling water and the risk of shutdowns
- Technology improvements to address risks to transportation infrastructure and better withstand climate change impacts, such as extreme temperatures that can cause deterioration of expansion joints on bridges and adverse effects on aircraft performance. These include improvements to enhance resilience to potentially increased flood impacts on infrastructure.

# Integrating Climate Resilience into Federal Agency Missions, Operations, and Culture

The Federal Government has a duty to the American people to continue its statutory missions, operations, and programs in the face of climate change. It must protect Federal investments, infrastructure, and public resources in the short and long term and utilize taxpayer dollars efficiently. The Federal Government protects and ensures national security. It manages Federal buildings, infrastructure, and lands, helps communities respond to and recover from major disasters and emergencies, and protects workers from injury and illness. It manages important natural and cultural resources, ensures the provision of ecosystem services, conserves habitats for many fish and wildlife species, and protects our national parks, wildlife refuges, and national marine sanctuaries. It protects water and air quality, regulates commerce and food safety, and protects the health of Americans.

As noted above, the President has used executive action to build the foundation for climate resilience in the Federal Government. Agencies are implementing the President's Executive Orders to integrate climate resilience into their missions, operations, and programs. This ensures that the Federal Government continues to protect and serve citizens and that investments made with taxpayer dollars remain effective. Federal agencies have developed, published, and updated climate adaptation plans that they will continue to update regularly to respond to new understandings of climate science, ensure progress, and address common challenges to address climate change impacts.<sup>44</sup>

The Federal Government also has an important role in establishing and implementing policies to build resilience in communities, especially where Federal programs support state, tribal, and local action to build stronger infrastructure, protect the environment, or promote economic growth. Under Executive Order 13653, Federal agencies must modernize Federal programs to support climate resilience investments. The Federal Government can support, encourage, and advance climate resilient practices in communities and businesses through a mix of public policies and market-based incentives, which may include grant programs, tax credits, cost-share programs, and technical assistance.

For example, after Hurricane Sandy, the Department of Housing and Urban Development (HUD) launched the Rebuild by Design competition to promote the creation of innovative designs for resilient buildings, infrastructure, and plans that met local needs in Sandy-affected regions. Ten interdisciplinary teams of engineers, architects, urban planners, and social scientists worked closely with communities to develop locally tailored solutions. Afterwards, HUD set aside \$930 million in Community Development Block Grant Disaster Recovery funding to incentivize the implementation of winning projects. This is just one example among numerous Federal initiatives aimed at spurring innovation and delivery of resilience investments. Opportunities to build on this existing work are detailed below.

## Strengthen resilience coordination across Federal agencies

Strong coordination across the Federal Government creates the best outcomes. As already described, climate change is complex, and co-production of science and tools can help develop a holistic understanding of climate change impacts to support decision making in government, communities, and businesses. Incorporating this science into action also requires collaboration. By aligning the efforts of multiple agencies—especially those agencies that work directly with communities—the Federal

Government can eliminate duplication, learn from sharing best practices, and make it easier for communities to seek support from Federal agencies.

For example, several agencies that received Hurricane Sandy supplemental funding coordinated their efforts to rebuild infrastructure with state and local officials from New York and New Jersey through the Sandy Regional Infrastructure Resilience Coordination Group. In accordance with the Infrastructure Resilience Guidelines, which provided technical guidance, and consistent with grant requirements, government officials at all levels collaborated on the scope and timing of projects to make the best use of their resources.<sup>45</sup> Other successful regional efforts include the New England Federal Partners, Federal Climate Partners for the mid-Atlantic, the Missouri River Federal Partners, and the Southeast Natural Resources Leadership Group.

At the highest levels of the Federal Government, the Council on Climate Preparedness and Resilience (Resilience Council) coordinates the efforts of participating agencies under Executive Order 13653. Working groups within the Resilience Council focus on infrastructure, natural resources, best practices for adaptation, international development, and climate data and tools. The members of the Resilience Council are the leaders in their respective agencies on climate resilience, and the Resilience Council has served as an important forum for these leaders to work together towards shared goals. It is important to demonstrate continued leadership and direction in climate resilience to ensure that Federal agency missions, operations, and programs continue to serve and support communities and businesses.

## Strengthen Federal workforce capacity through leadership direction and training

Federal staff on the Resilience Council lead their agencies to carry out the requirements of Executive Order 13653, actions under the agency climate adaptation plans and recommendations of the State, Local, and Tribal Leaders Task Force. These leaders are helping staff throughout their agencies understand how climate change affects their work and what they can do to manage these impacts. By integrating climate resilience into everyday work, agencies ensure the continuity of Federal missions, operations and programs. Successful implementation of an agency's climate adaptation plan requires clear identification and assignment of actions, roles, and responsibilities. This can include guidance and directives to incorporate considerations of climate risk into specific agency functions. For example, the Department of Defense is updating current directives, instructions, and manuals to consider the effects of a changing climate on its operations.<sup>46</sup>

### National Guard Adaptation Planning Pilot Project

The Department of Defense (DoD) is leading a pilot project with local communities to develop a resilience plan for Camp Grayling, Michigan. It is a premier training center and the largest National Guard installation in the country, and has an annual impact of nearly \$50 million on the local economy. Wildfire, extreme heat, drought, invasive species, and energy security threats are some of the key resilience challenges facing the Grayling area. Installation leaders, state and local agencies, and the public worked together to identify local risks and opportunities associated with climate change. The team also conducted scenario activities to identify local solutions to a range of climate futures. The resulting action plan will guide activities by DoD, local governments, and non-governmental organizations to build resilience in the community.

It is critical to expand training and increase capacity to address climate change impacts throughout agencies, especially for staff working directly with communities and staff engaged in enterprise risk management, service and product line management, internal controls, capital asset acquisition,

procurement and budgeting, and technology development. Many agencies have already implemented climate-related training programs.<sup>47</sup> For example, EPA has trained over 6,000 employees (more than 40% of its workforce) on climate change impacts and adaptation practices and is conducting mandatory climate training for all new employees. Across the Federal Government, agencies are sharing best practices and ensuring that training occurs at all levels, especially those that work directly with communities. Through the Resilience Council's Climate Adaptation Community of Practice, practitioners share tools, information, and best practices and coordinate with USGCRP to develop Federal Government-wide goals and strategies on climate change training.

## **Expand incentives and requirements to increase the resilience of infrastructure and buildings**

Resilience investments in current and future infrastructure must consider current and projected risks. Such investments can be smart financial decisions because they could increase the lifespan of assets, reduce the cost of repair and rebuilding post-disaster, and reduce investment risk. Resilient infrastructure can also be designed to include energy efficiency and community spaces like parks. For states, cities, and local governments, these combined efforts can make projects more attractive to diverse investors and insurance companies.

Federal agencies increase the resilience of infrastructure across the nation by strengthening their own buildings and land and expanding incentives for state and local governments. Through climate change adaptation plans, Federal agencies have conducted vulnerability assessments of their infrastructure and are implementing plans to address the vulnerabilities identified. Agencies can share lessons learned and risk assessment and management tools to increase resilience of infrastructure across the Federal Government. As they rehabilitate key features of their infrastructure, agencies should develop strategies that incorporate cost-effective resilient design for current and future infrastructure, approaches for greenhouse gas mitigation, and the preservation and restoration of natural infrastructure.

The Federal Government can expand innovation and adoption of resilient infrastructure among communities and businesses through increased technical assistance, competitive grants, strategic partnerships, and standard setting, such as the establishment of the FFRMS.<sup>48</sup> For example, [Transportation Investment Generating Economic Recovery](#) (TIGER) grants<sup>49</sup> from the Department of Transportation (DOT) provide Federal funds to improve transportation infrastructure, generate economic recovery, and enhance resilience. Similarly, DOT's new program [Fostering Advancements in Shipping and Transportation for the Long-term Achievement of National Efficiencies](#) (FASTLANE)<sup>50</sup> funds critical freight and highway projects and includes climate resilience considerations as selection criteria for considering proposals. DOT has also provided tools and information to help state and local transportation agencies understand potential vulnerabilities and plan to enhance resilience.

Building developers and engineering trade associations have already begun to incorporate measures to increase resilience in the development and application of building codes and standards. Across the country, architects, engineers, and developers in both the public and private sectors are taking steps to design buildings that go beyond minimum safety requirements and incorporate the principles of resilient, performance-based design. FEMA is making similar strides. In September 2016, to promote resilience and reduce risk, FEMA adopted a new [Public Assistance Required Minimum Standards](#) policy that generally requires the integration and use of the hazard-resistant provisions of international building codes as a minimum design standard for Public Assistance projects.<sup>51</sup> The Federal government can increasingly align program requirements with the most recent model building codes and standards

for resilient construction and provide technical guidance that promotes resilience in infrastructure development.

Increasingly, advances in data and information, including mapping of natural hazards, informs Federal decisions to site and design facilities for increased resilience. The Federal Government can continue collaboration with the private sector to produce more precise and more accurate maps of current and future conditions. Additionally, the Federal Government should continue to improve coordination of mapping efforts across all Federal programs to better identify data gaps, reduce duplication of mapping efforts, and create accessible platforms for mapping data and visualizing risk to help state, local, tribal, and territorial efforts manage risks and reduce disaster costs.

### **Supporting Federal Resilient Investments**

President Obama’s Climate Action Plan directed Federal agencies to encourage and support smarter, more resilient investments through agency grants, technical assistance, and other programs across sectors such as transportation, water management, conservation, and disaster relief. Agencies across the Federal Government are evaluating their programs to remove barriers and support incentives that consider climate change.

One example of this effort is EPA’s Clean Water State Revolving Fund (CWSRF). In 2009, the EPA established the CWSRF Green Project Reserve, of which green infrastructure is a major component. Since then, EPA has provided more than \$3.8 billion in assistance to projects through the Green Project Reserve. Of this total, green infrastructure projects have received only 21% of this funding. EPA recently published a Green Infrastructure Best Practices Guide to highlight effective practices to incentivize green infrastructure. These incentives include marketing and outreach, prioritization, financial incentives, technical assistance, and formation of effective financing partnerships. EPA will track state progress towards funding green infrastructure projects, document success stories, and implement an annual awards program to recognize high quality, replicable green infrastructure projects and effective state incentive programs. Through these measures, EPA aims to increase the amount of financing for green infrastructure projects.

Similarly, the Federal Transit Administration’s Capital Investment Grants program, which funds major new transit capital projects, encourages project sponsors to incorporate resilience elements, in addition to required criteria, into their project designs.

## **Address national security risks from climate change**

Climate change poses a significant and growing risk to our national security. Internationally, climate change can affect nations that are already fragile. Extended drought, extreme floods, sea level rise, heat waves, water, food, and energy insecurities, and other climate change impacts can stress stable regions and can contribute to instability in vulnerable regions. Domestically, these impacts may lead to disruption of livelihoods and communities, destabilize health and well-being, and contribute to regional economic instability. Climate change can adversely affect the military’s operational readiness, impact military facilities and training, increase the need for military support to civil authorities, and increase military mission support for international stability operations.

To better understand and act on the impacts of climate change on national security, the President established a policy in September 2016 that “ensure[s] that the current impacts of climate change, and those anticipated in the coming decades, be identified and considered in the development and implementation of relevant national security doctrine, policies and plans.”<sup>52</sup> To implement this policy, Federal agency leaders are employing a strategic approach that allows policymakers to recognize, understand, and act on climate change impacts that threaten national security in an integrated, cohesive way. A working group of members of the climate science, intelligence, and national security policy communities is developing methods to understand how climate change affects national security interests and is integrating climate science research and modeling with intelligence analysis to inform national security policy development.

## Conserve, restore, and manage ecosystems to enhance resilience

Through the Resilient Lands and Waters Initiative, Federal agencies have been working together with partners to identify, conserve, and restore priority natural areas to make them more resilient to a changing climate. Healthy natural systems sustain diverse and abundant populations and critical ecosystem functions. Seven Resilient Lands and Waters partnerships have been established across the country to showcase the benefits of landscape-scale management approaches to both the health and resilience of ecosystems and the enhancement of the services they provide to the nation, such as carbon storage capacity.

Healthy ecosystems provide a range of additional services that can protect and enhance community resilience. Well-managed forests and floodplains reduce the risk of wildfire, flooding, and drought. Coastal ecosystems, such as wetlands and reefs, can provide a natural line of defense against sea level rise and storm surge. Natural infrastructure also provides co-benefits that can include fisheries habitat, carbon storage<sup>53</sup>, and recreational opportunities. These ecosystems not only help to build resilience to impacts of climate change, but can also support and enhance the social and economic vitality of communities. The Federal Government should conserve, restore, and manage ecosystems to sustain these valuable services. For example, NOAA works with partners in the Coastal Ecosystem Resiliency Grants Program to implement habitat restoration actions that build resilience of ecosystems and fisheries that coastal communities depend on.



### Natural Defenses to Enhance Resilience

The Department of the Interior is cleaning up and restoring natural resources damaged by Hurricane Sandy that provide flood protection and other important ecosystem services, including national parks and wildlife refuges, coastal marshes, and waterways that allow fish passage. Above, Fish and Wildlife Service staff remove the Hughesville Dam, which will reduce the risk of dam failure and upstream flooding, protect human safety, and restore access to habitats for migratory fish species. Restoration of the nearby Wreck Pond Inlet and Dunes provides storm surge protection for Sea Girt and Spring Lake, New Jersey.

Photo credit: Department of the Interior Fish and Wildlife Service.  
[https://www.fws.gov/hurricane/sandy/index.cfm?PageNum\\_Feature=2](https://www.fws.gov/hurricane/sandy/index.cfm?PageNum_Feature=2)

Understanding the benefits of healthy natural systems, the Coastal Green Infrastructure and Ecosystem Services Task Force recommended priority areas of research to support the integration of natural infrastructure into resilience planning.<sup>54</sup> The Federal Government should expand research on the costs, benefits, and tradeoffs associated with changes in ecosystem services. This information can then be incorporated into community planning and natural resource management, especially for Federal agencies that have been directed to consider ecosystem services in their decision making.<sup>55</sup>

#### Selected Natural Resources Resilience Strategies

- [Priority Agenda Enhancing the Climate Resilience of America's Natural Resources](#) and accompanying October 2014 [Fact Sheet](#) announcing related executive actions and stakeholder commitments
- [National Fish, Wildlife & Plants Climate Adaptation Strategy](#)
- [Long-Term Drought Resilience Federal Action Plan of the National Drought Resilience Partnership](#)
- [National Action Plan: Priorities for Managing Freshwater Resources in a Changing Climate](#)

### Apply climate-resilient approaches to international development

The Federal Government is working to ensure that international development investments—for example, in programs that provide clean water, increase agricultural production, build critical infrastructure, and promote health—are resilient to climate change. Screening investments for climate risk and building capacity to manage risks facilitates decision making that increases the lifespan and success of a project. Federal agencies are already screening new investments for climate-related risks and vulnerabilities.<sup>56</sup> These agencies should continue to implement tools that help screen for potential climate change impacts, establish a framework to receive feedback and measure the effectiveness of different approaches, and build capacity of field personnel through training to ensure appropriate consideration of climate change impacts on the ground.

USAID's programs in Ethiopia provide an example of addressing climate change risks in the context of international development. In 2012, USAID's Mission in Ethiopia released its [Country Development Cooperation Strategy](#), which identified climate change as a major threat to Ethiopia, increasing the risk of drought-induced food shortages. The Strategy called for climate considerations to be integrated across USAID's agriculture and food security programs. In response, USAID has been supporting programs such as [PRIME](#) (Pastoralist Areas Resilience Improvement through Market Expansion), a [Feed the Future](#) activity that is helping rainfall-dependent Ethiopian herders and farmers use climate information—including vulnerability assessments and improved early warnings—to make better decisions about which crops to plant and when to plant and harvest them. PRIME also includes risk mitigation and management strategies, such as improved water storage, better animal nutrition, and access to financial services used by farmers around the world, such as crop insurance. By increasing resilience, programs such as these can help to reduce the demand for humanitarian assistance in future droughts.

# Supporting Community Efforts to Enhance Climate Resilience

Communities are on the front lines of climate change impacts, and they are already taking significant actions to increase resilience. The Obama Administration has demonstrated its commitment to support communities as they develop strategies and partnerships for building climate resilience. The Federal Government can continue to support communities through stakeholder engagement to understand on-the-ground needs and build capacity.

In 2014, the State, Local, and Tribal Leaders Task Force provided the President with recommendations to support the work of communities across the country, including through efforts to strengthen infrastructure, manage natural and cultural resources, protect human health, promote hazard mitigation, facilitate disaster recovery, understand the economics of resilience, and build capacity in communities. The recommendations also emphasized the importance of supporting and engaging the communities that climate change will likely affect disproportionately, including those that already face economic or health-related challenges.

Resilience AmeriCorps is one outcome of implementing the State, Local, and Tribal Leaders Task Force Recommendations. The program is placing AmeriCorps VISTA members in cities throughout the nation to advance climate equity by facilitating resilience planning in low-income communities. The Administration has also spotlighted the work of community leaders in climate resilience, for example, by recognizing White House Champions of Change for Climate Equity, as described on the following pages.

The Federal Government can continue to support local leaders in building resilient communities through, for example, integrating resilience into social service delivery, simplifying grant programs, and encouraging broader pre-disaster hazard mitigation. Below are key opportunities to support community resilience as new climate information and models for collaborative work develop.

## **Build capacity, meaningfully engage the community, and invest in local leaders**

The Federal Government can support resilience planning and capacity building through a focus on meaningful public engagement. This involves expanding opportunities for providing training, tools, technical assistance, and relevant community-level climate data.

Meaningful engagement with communities can lead to community-driven plans that increase resilience and provide co-benefits that meet other local needs. For example, HUD's Sustainable Communities Initiative<sup>57</sup> made early investments in infrastructure, housing, and economic development through grant programs<sup>58</sup> and a companion stakeholder process to support transformative community engagement. The Initiative drove innovative planning at a regional scale and coordinated the efforts of multiple agencies, private expertise, and communities. Importantly, the program required that grantees commit 10% of regional planning budgets to activities that increased engagement with and participation of traditionally marginalized communities.

## Case Study: Advancing Climate Equity

Climate change exacerbates existing health and socioeconomic inequities, placing certain populations at higher risk. These populations can include people with low incomes, some communities of color, children, the elderly, people with disabilities, indigenous populations, and people with low English proficiency. Leaders at all levels are beginning to incorporate “climate equity” into climate change mitigation and resilience efforts. By considering climate equity, Federal, state, local, and tribal partners are working to ensure that all people have the opportunity to benefit equally from climate solutions and to diminish the disproportionate burden of climate impacts that some communities endure. Specifically, advancing climate equity involves the following:

- Providing full and equal access to opportunities for a resilient future, such as safe and affordable housing and transportation choices, water security, access to healthy food, and stable jobs.
- Diminishing deep-seated exclusion and barriers to participation by supporting community-driven efforts, meaningful public involvement, and outcomes that reflect local priorities.
- Planning that values sense of place, cultural practices, and traditional community knowledge of the local land and resources, especially for future land use decisions and hazard mitigation.
- Alleviating the impacts of heat, poor air quality, vector-borne disease, and other climate change impacts on physical and mental health, especially for the elderly, children, pregnant women, and outdoor workers.
- Reducing environmental harm (*e.g.*, pollution or flood hazard) and poor neighborhood conditions to support healthy, safe and resilient communities with healthy ecosystems and green space.

### Engaging All Stakeholders and Supporting Community-Driven Efforts to Ensure Climate Equity

Including all stakeholders in the climate resilience planning process is critical to building the capacity to recover from the impacts of natural disasters. The Administration has emphasized the importance of involving the [whole community](#) to ensure that minorities, low-income populations, limited English proficiency populations, people with disabilities, and others who have been historically excluded from the planning process are heard and considered in recovery and pre-disaster planning efforts. President Obama recognized Kristin Baja and Susana De Anda as [Champions of Change for Climate Equity](#)<sup>59</sup> for the way they have engaged communities in decision-making processes that help communities respond to natural disasters and persistent drought.

Kristin Baja—the Climate and Resilience Planner for Baltimore, Maryland—is employing groundbreaking outreach techniques to engage underserved populations in climate resilience planning to prepare for natural disasters. Kristin is building inclusive, meaningful public participation into the climate adaptation and hazard mitigation planning process to address access issues related to transportation and availability for public planning meetings. For example, to make



Kristin Baja works with residents at the Zeta Senior Center to make emergency plans and kits. Photo credit: Baltimore Office of Sustainability.

it easier for community members to participate in public meetings, Kristin's team provided buses, childcare, and food; joined other community meetings to reach a broad audience; and tailored presentations to reach the needs of a wide variety of community members.



Yolanda Serrato, resident of East Porterville, and Susana De Anda, founder of the Community Water Center. Photo credit: Community Water Center.

Susana De Anda—the founder of the Community Water Center in California's San Joaquin Valley—is helping provide clean water to residents struggling with water shortages caused by drought and exacerbated by contamination in public water supplies. Previously, low-income, rural, and Spanish speaking communities had no voice in decisions about their water supplies because information and the public planning process itself were not accessible to their communities. The Community Water Center trained 2,674 residents as clean water advocates and provided language support to empower residents to ask local water boards for clean water solutions.<sup>60</sup>

### Building Resilience Capacity and Economic Growth

Increasing temperatures drive up energy usage, energy bills and health-related impacts like heat exhaustion. To respond to these challenges, communities are getting creative about how to supply, store and pay for energy. With support and training from the Federal Government, they are creating high-quality green jobs, decreasing energy costs and reducing the Nation's carbon footprint. This is especially important for communities that can't keep up with rising energy costs, with health-related sensitivity to increased temperatures or that work outdoors.

Lyle Wilson—a professor at the Oglala Lakota College in South Dakota—helped students install a solar energy system on a mobile construction trailer, using a training offered by the U.S. Department of Energy's SunShot Solar Instructor Training Network. The project provides affordable power for maintenance projects such as the building where tribal elders eat meals. It is also building awareness and transferrable skills within the tribe to expand use of renewable energy. "Our students were actually sort of stunned to learn how easy it is to do something like this once they understand the fundamental concepts," said Wilson.<sup>61</sup>

The Blue Lake Rancheria Tribe of Northern California is reducing energy use, making energy affordable for low-income families, creating green jobs, and building the expertise to do those jobs. With technical assistance from DOE, the tribe began construction in 2016 of a 500-kilowatt solar array for a low-carbon, community-scale microgrid project. The tribe also installed solar arrays on tribal housing to provide low cost, clean energy sources for low-income families. With this training and experience, volunteers that helped with the project could pursue careers in the solar industry.



Students and instructors at Oglala Lakota College designed and built a mobile solar energy system. Photo credit: Oglala Lakota College. <http://energy.gov/articles/sioux-students-kindle-solar-knowledge>

The Mid-South Regional Greenprint and Sustainability Plan is one of the impressive outcomes of this capacity-building effort. The plan is a 25-year vision for connectivity, stormwater management, recreation, green space, and long-term resilience in Shelby County, Tennessee, and across the Greater Memphis region. It addresses housing and transportation alternatives, economic development, neighborhood engagement, food systems, health, and equity, and includes \$60.4 million in flood mitigation projects. Efforts under the plan are already underway, including the development of 100 miles of paths, trails, and green spaces.<sup>62</sup>

After powerful storms hit Shelby County in April 2011, Shelby developed a Greenprint for Resilience project—built on the existing Mid-South Regional Greenprint—that was awarded funding through the National Disaster Resilience Competition. The Greenprint for Resilience expands flood control (*e.g.*, wetland and floodplain water storage) and acquires land unsafe for residential use but well suited for expansion of trails and recreation areas

The Federal government could expand on the successes of the Sustainable Communities Initiative by undertaking new and expanded initiatives:

- Build relationships with trusted local leaders and better support these leaders' efforts to identify local resilience goals, facilitate community cohesion, and advance climate education;
- Empower charter groups, nonprofits, and advocates to deliver information and tools through the right entry points in ways that are appropriate for local cultures, literacy levels, languages, and beliefs and that resonate with the intended audiences;
- Provide transformative, targeted technical assistance to build capacity, incorporate demographic data about communities to help understand vulnerability, and prioritize resilience projects with multiple co-benefits to strengthen communities with the greatest risk; and
- Mobilize vehicles for developing and delivering technical assistance that meets community needs, including scientific organizations, place-based initiatives, web-sharing platforms, and experts in Federal agencies and the scientific community.

## Strengthen place-based approaches to climate resilience

Local residents understand the reality of how climate change affects their communities. Hurricanes and flooding, more frequent and more intense heat waves, and more frequent water shortages are all affecting people's homes, businesses, and the way they live. Communities are organizing themselves and taking actions to prepare for, adapt to, and respond to these climate change impacts. The Federal Government can support these communities through "place-based approaches" to climate resilience. Place-based approaches focus and coordinate the resources of multiple Federal agencies in communities and often engage in partnerships with community organizations to meet specific, on-the-ground needs for information, resources, and tools.

Place-based approaches for climate resilience leverage the resources of multiple Federal initiatives. The Partnership for Sustainable Communities, for example, has a broad mission to help communities nationwide improve access to affordable housing, increase transportation options, and lower transportation costs while protecting the environment. Likewise, the Climate Action Champions initiative is intended to accelerate community greenhouse gas emissions reductions. TIGER grants are given to stimulate investment in climate-resilient infrastructure.

These approaches support community efforts—locally and regionally—to address shared challenges. Regional coordination can focus on areas that face high risk from certain climate change impacts such as sea level rise in Alaska and the Pacific and Caribbean Islands, hurricanes along the East Coast and Gulf of Mexico, and water shortages and drought in the West and West Coast. The opportunity, *facilitate co-production of tools*, provides examples of effective models.

By working locally, the Federal Government can connect community leaders with each other through regional coordination and peer-to-peer learning to address shared climate change impacts through coordinated regional approaches. Regional coordination supports community leaders with varying expertise, perspectives, and capacity to manage resilience challenges for stronger outcomes. For example, similar projects from multiple communities in a region could be bundled to attract funding from government and the private sector.

#### **Selected Place-Based Approaches that Promote Climate Resilience**

- Climate Action Champions: <http://energy.gov/epa/climate-action-champions>
- Making a Visible Difference in Communities: <https://www.epa.gov/smartgrowth/making-visible-difference-communities>
- Partnership for Sustainable Communities: <https://www.sustainablecommunities.gov/>
- Partnership for Energy Sector Climate Resilience: <http://www.energy.gov/epa/partnership-energy-sector-climate-resilience>
- Rebuild by Design: <http://portal.hud.gov/hudportal/HUD?src=/sandyrebuilding/rebuildbydesign>
- Resilience AmeriCorps: <http://www.nationalservice.gov/programs/ameri-corps/ameri-corps-initiatives/resilience-ameri-corps>
- TIGER Grants: <https://www.transportation.gov/tiger>

Federal place-based approaches can promote climate equity by creating channels for communication and engagement. For example, Resilience AmeriCorps members are talking to community members where they live and engaging diverse communities through existing community organizations and trusted representatives.

Federal agencies can also align multiple programs to achieve more robust outcomes in instances where no single effort would meet resilience goals. In Alaska, the President designated the Denali Commission<sup>63</sup> as the lead Federal point of contact for Alaska Native coastal villages affected by coastal erosion, flooding, and related problems driven by climate change. The Commission hosts the first-ever catalog of grants and technical assistance available to Alaska Native villages. To build capacity in rural villages, the Commission is transforming the catalog to make it more accessible for village administrators and has funded project managers or project coordinators in each of the four most imminently threatened communities. In addition, DOI provided the State of Alaska with financial support to continue its efforts to coordinate resources and expand the scope of the Village Planning Committees, which brought Federal, state, local, and tribal governments together with nonprofits and the private sector.

Place-based approaches can also help to preserve community identity, sense of place, and social cohesion, which are important to both community responses to climate change impacts and for their

own value. Climate change not only disrupts infrastructure, services, and the local economy, but also damages symbols that contribute to community bonding and dislocates social networks as people are displaced from their homes. Climate change impacts can damage historic properties and neighborhoods, cultural institutions, tribal sites, and other heritage assets, which can irrevocably change a community's sense of place and erode community identity and stability. The Federal Government currently offers some guidance<sup>64</sup> on this issue and can work with state, local, and tribal governments to develop additional regionally- or locally-specific guidelines on building resilience for historic and cultural resources. To keep communities together in the face of sea level rise, the Federal Government is exploring ways to support community-led efforts to relocate.

## Integrate resilience into health and social service delivery

The Federal Government can build capacity to respond to climate change impacts by coordinating climate resilience planning with the delivery of social services. Federal agencies can help draw the connection between climate-related hazards and potential interruption of service delivery. Health and social services address a wide array of life-sustaining and critical human needs such as medical care, behavioral health, health surveillance, child care, elder care, and other basic support services. This web of services creates a safety net. Displaced and vulnerable populations—particularly children, seniors, people with disabilities, the homeless, and other underserved populations—require continuity of care and access to essential social services. Any gaps or delays in these services destabilize their health and

well being. The increase in the intensity and frequency of some extreme weather events as climate changes compromises this safety net.

Integrating resilience into health and social service delivery can help to ensure continuity of essential services. Bringing together Federal, state, local, and tribal climate experts, external stakeholders, and specialists in service delivery (*e.g.*, food, education, shelter and health care) can inform the development of wraparound services that limit disruptions and identify methods to build capacity for continuity in health and social service delivery. Wraparound services are individualized, holistic approaches to address different, but interrelated challenges that an individual or family faces.

Wraparound services at schools, job training centers, and other public service-delivery centers, can help communities address an individual's or family's needs that may be aggravated by climate impacts with comprehensive planning that works for them.

Resilience integration requires innovative solutions, such as a partnership between the American Red Cross and local homeless

### Understanding Climate Change Impacts on Human Health

In April 2016, the U.S. Global Change Research Program (USGCRP) published [a comprehensive assessment that articulated the impacts of climate change on human health](#). Increased temperatures and changes in weather extremes can have severe health impacts. Extreme heat can cause death and illness; poor air quality can increase the risk of cardiovascular and respiratory illnesses; changes in temperature and precipitation can cause vector-borne diseases, water-borne diseases, and food infections; and exposure to disasters can adversely impact mental health. While all Americans are at risk, some populations are disproportionately vulnerable, including those with low income, some communities of color, immigrant groups, indigenous peoples, children and pregnant women, older adults, vulnerable occupational groups, persons with disabilities, and persons with preexisting or chronic medical conditions. Understanding these impacts can help policymakers, healthcare providers, and communities plan and make decisions to respond effectively.

shelters to provide surge capacity in the event of extreme cold or heat, and including services for those with access and functional needs. It can mean helping service providers who deliver meals to the homebound or provide rides to dialysis patients plan for how to continue services in the event of flooding.

By planning for hazard preparation and the effects of slow-onset climate change impacts, we can improve overall resilience for those whose lives depend on the availability of critical service delivery. Potential areas of focus for this effort include the following:

- Aligning resilience strategies with housing and poverty prevention strategies to expand housing stability for low-income rental populations in ways that can reduce heating, cooling, and electricity costs and reduce threats from flooding;
- Incorporating resilience into community planning to improve food security and transportation needs and better consider how climate-related hazards may affect access and functional needs;
- Leveraging existing social service delivery structures to increase capacity for resilience by providing wraparound services at schools, job training centers, and other public service delivery centers to develop culturally relevant, individualized, and comprehensive plans addressing basic needs aggravated by climate change impacts. These basic needs can include, for example, mental and physical health, safety, living environment, education, and social, emotional, spiritual, and cultural needs; and
- Sharing best practices of continuity of care amongst service providers, e.g., [Sustainable and Climate Resilient Health Care Facilities Toolkit](#).

#### **Sustainable and Climate Resilient Health Care Facilities Initiative**

To assist with building resilience as promised in the [President's Climate Action Plan](#), the U.S. Department of Health and Human Services' [Sustainable and Climate Resilient Health Care Facilities Initiative](#) (SCRHCFI) is an effort to help ensure the continuity of quality health and human care before, during, and after extreme weather events. This web-based toolkit includes the SCRHCFI Best Practices document, a five-element framework that comprises a vulnerability assessment for medical facilities and suggestions for building resilience, checklists for each of the five elements, and additional resources that encourage practical steps for building resilience. The framework includes five elements:

- Climate Risks and Community Vulnerability Assessment
- Land Use, Building Design, and Regulatory Context
- Infrastructure Protection and Resilience Planning
- Essential Clinical Care Service Delivery Planning
- Environmental Protection and Ecosystem Adaptations

### **Improve navigability of Federal resources**

The climate-related challenges facing our Nation's communities are multi-dimensional and require complex, coordinated solutions. Federal agencies can help communities leverage multiple Federal sources to address large challenges—particularly when they stimulate additional public and private

investments. For example, combining multiple funding resources, where allowable under program authorities, could help Alaska Native villages relocate to higher ground, as discussed above.

Generally, available Federal funding and technical assistance can be difficult to navigate for states, tribes, and local communities. The Federal Government should improve the navigability of those resources so that states, tribes, and communities can access, understand, and target Federal assistance to meet their needs.

To help improve the navigability of its resources, the Federal Government could take the following steps, where possible:

- Streamline training and technical assistance resources for climate resilience;
- Cross-train Federal regional and field staff on the programs of multiple agencies to help community leaders develop holistic, localized approaches;
- Coordinate the use of transparent and consistent funding criteria;
- Utilize common reporting metrics to reduce unnecessary administrative burden on grantees; and
- Enhance partnerships with communities to achieve local goals.

For example, agencies could expand opportunities to employ the 2016 *Memorandum of Agreement on Interagency Technical Assistance*<sup>65</sup> between 16 Federal agencies to improve coordination of technical assistance efforts for communities. Streamlined, coordinated technical assistance is especially important in low-income and other communities that may lack the capacity to compete for funding.

## Encourage comprehensive preparedness

Public and private investments in preparedness before a disaster hits can dramatically reduce impacts to people and property. Smart mitigation investments decrease response and recovery costs.<sup>66</sup> For example, local governments can make climate-smart zoning decisions that prohibit development in areas with high wildfire risk. Similarly, they can adopt building codes that result in elevated houses with decreased flood risk. The private sector is also taking steps to prepare for climate change and reduce adverse impacts on revenue and performance. For example, companies are managing risk to supply chains by building in redundancies and geographic diversity in suppliers.

The Federal Government can increase awareness, expand pre-disaster hazard mitigation programs, and provide technical assistance to facilitate implementation of mitigation plans. For example, FEMA provides several forms of [hazard mitigation assistance](#). It has a [hazard mitigation grant program](#),<sup>67</sup> for which communities may become eligible after a Presidential Disaster Declaration under the Stafford Act. FEMA also has a [pre-disaster hazard mitigation grant program](#),<sup>68</sup> a [guide for potential mitigation actions](#)<sup>69</sup> that communities can undertake to plan for a variety of natural hazards, and a [catalog of tools](#)<sup>70</sup> to facilitate climate resilient mitigation activities. In addition, FEMA provides funds under the [flood mitigation assistance program](#)<sup>71</sup> for planning and projects to reduce or eliminate risk of flood damage to buildings insured under the National Flood Insurance Program. As of June 2016, all 50 states,<sup>72</sup> over 22,000 local governments, and 145 tribal governments have FEMA-approved mitigation plans, making them eligible for certain non-emergency FEMA grants.<sup>73</sup> Additionally, 12 states have received FEMA approval of their enhanced state mitigation plans, making them eligible to receive increased post-disaster hazard mitigation assistance.

The Federal Government has been working directly with several major cities on pilot programs to increase resilience, which are described in the “Preparedness Pilots” text box on the next page. In addition to these pilots, FEMA has conducted workshops in Anchorage, Alaska; Norfolk, Virginia; Miami, Florida; Salt Lake City, Utah; and New England. FEMA’s National Exercise Division developed a Climate Adaptation, Preparedness and Exercise training program supporting these workshops. The program includes a course curriculum and FEMA is developing an Exercise Resource Guide to help build and reinforce community-based resilience planning. Lessons from these pilots can be deployed to help other local, state, tribal, and regional efforts for resilience planning.

Currently, a group of Federal agencies is developing a National Mitigation Investment Strategy that will provide a framework to identify, prioritize, and guide Federal investments in hazard mitigation and disaster resilience and help communities better understand how to leverage Federal resources.

The Federal Government can expand opportunities for Federal Agencies to facilitate community pre-disaster recovery planning efforts before disasters strike. In a steady state before a catastrophic disruption, communities can plan for a more inclusive whole-community approach to assessing and implementing post-disaster recovery needs. Considering recovery needs before a disaster strikes—instead of waiting for a major disaster declaration or the activation of the National Disaster Recovery Framework—enables emergency planners to build relationships with local leaders and resilience capacity in low-income communities, limited English proficiency populations, and other communities that may need special assistance after disasters. Pre-disaster investments will improve the effectiveness of efforts to plan for, manage, and implement disaster recovery activities following large, unique, and catastrophic events.

### **Tribal Adaptation Planning and Hazard Mitigation**

American Indian and Alaska Native tribes are particularly vulnerable to adverse impacts resulting from climate change. Tribes have a unique historical and cultural relationship with their ancestral lands, and rely on them for subsistence, health, traditional practices, and economic growth. Existing socioeconomic stressors—such as high rates of poverty and unemployment, lack of health and community services or high levels of food insecurity—already disproportionately affect tribal communities.

Tribal climate adaptation and risk mitigation strategies are embedded in cultural heritage and will vary according to the circumstances, capacities, and needs of each tribe. However, only 145 out of 566 tribal governments, or 25% of all Federally recognized tribes, have tribal risk mitigation plans in place.

The Federal Government has a unique government-to-government relationship with American Indian and Alaska Native tribes. Through consultation and engagement with tribal governments through specialists such as agency tribal liaisons, the Federal Government can expand outreach, help build capacity, and utilize traditional ecological knowledge to co-develop pre-disaster hazard mitigation plans that meet the needs of tribes.

## Preparedness Pilots

NASA's Johnson Space Center—home to the human space flight program and other research to advance science, technology, engineering, and medicine—partnered with the City of Houston to address vulnerabilities to increasingly frequent and devastating storms along Houston's coastline on the Gulf of Mexico. In addition to Johnson Space Center, Houston is a hub for businesses that serve the energy needs of the whole country—about 40% of the Nation's petrochemical production capacity is in Houston—and the Port of Houston is among the highest ranked ports in the nation in volume of international and domestic cargo. Downtown Houston is about 15 meters above sea level and nearby Galveston, where much of the oil industry sits, is at a precarious six feet above sea level. Sea levels are expected to rise in the area by two to three inches by the 2020s, and as much as 11–20 inches by the 2080s. During Hurricane Ike—one of the most devastating storms in Houston's history—storm surge rose in the area of Johnson Space Center 10 - 13 feet. In April 2016, Houston experienced flooding following heavy rains that killed seven people and caused thousands to evacuate from homes and businesses. Economic loss from the flooding was estimated to be near five billion dollars immediately following the event. To ensure the protection of Houston's people and economy, the partnership compiled existing Federal climate preparedness data and strategies for the region and integrated them into local structures for preparedness through a robust identification process of key preparedness and response officials.

DOE is working with the State of Colorado on a pilot to address the effects of severe inland weather across the state. Climate change is anticipated to contribute to an increase in thunderstorms, heat waves, droughts, wildfires, windstorms, intense rainfall events, and flooding in Colorado. The DOE National Renewable Energy Laboratory (NREL) has partnered with the Colorado Governor's Resiliency and Recovery office to convene stakeholders from the Federal government and local governments in Colorado. This outreach has stimulated pre-disaster hazard mitigation planning to identify Colorado's exposure—including infrastructure and power supply—to these climate change-related weather risks. NREL is developing a resiliency roadmap that will describe how lessons learned in the Colorado pilot can be used in other cities, counties, and Federal agencies. The NREL roadmap site will outline the process for identifying stakeholders and interdependencies in a community, analyzing climate change exposure, establishing long-term goals for resilience, and providing place-based strategies to support continuity of energy and water service as extreme weather events increase in frequency and intensity.

In Hampton Roads, Virginia, many Federal agencies worked on the Intergovernmental Pilot Project (IPP) with local and state leaders, Old Dominion University, and other stakeholders to address rising sea levels and recurrent flooding in the region. Hampton Roads is home to valuable commercial, industrial, and military assets, which benefit directly from direct access to water. For example, Naval Station Norfolk is the largest naval base in the world and the Port of Virginia generates \$60 billion in annual spending. The IPP began in June 2014 as an effort to use the knowledge, skills and expertise of regional stakeholders to create a framework for intergovernmental strategic planning that could be used outside the region. In October 2016, the IPP completed their second report, which included a whole of government mitigation and adaptation planning process and integrated regional recommendations. Their full report can be found at: <http://www.centerforsealevelrise.org/>.

The Federal Government can also stimulate pre-disaster mitigation through incentives that, for example, leverage insurance premium reductions and other financial tools to help communities, businesses, and families invest in resilience.

The Federal Government can support and incentivize resilience investment in the following ways:

- Developing and providing resources on successful case studies of pre-disaster mitigation, including return on investment data and models for public-private partnerships;
- Advancing policies that create a market demand for resilience among individuals, businesses, and communities;
- Supporting efforts to increase resilient design and construction in communities, the private sector, and the Federal Government; and
- Requiring compliance and enforcement of stronger building codes for eligibility to grant programs.

# Conclusion

These opportunities are the product of the deep expertise of Federal agency staff and leaders in communities, businesses, academia, and other key stakeholder groups. For the last eight years, these leaders have worked together to take on one of the Nation's most pressing challenges. We have come a long way in understanding the effects of climate change, organizing communities, strengthening infrastructure, protecting our natural and cultural resources, developing technology, and planning for the future. Climate change impacts will continue to manifest for a long time to come, and we have more work to do to ensure that we prepare, we adapt, and we respond and recover quickly. Federal leadership remains important to understand climate change, to improve the resilience of its missions, operations, and programs that serve communities, and to support community efforts to enhance resilience.

The Council on Climate Preparedness and Resilience offers these opportunities to pass on the lessons learned from its experience in order to guide continuing action within Federal agencies and work with stakeholders in building resilient communities. The Council invites stakeholders to continue to work with Federal agencies on these opportunities, and over the next several years, the Council hopes that these opportunities will stimulate discussion on actions that we can take together to enhance the resilience of the Nation to climate change.

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<sup>1</sup> Executive Order No. 13653, 78 Fed. Reg. 66824 (Nov. 6, 2013), available at <https://www.gpo.gov/fdsys/pkg/FR-2013-11-06/pdf/2013-26785.pdf>. In this document, “climate resilience” will have the definition used in Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*, “the ability to anticipate, prepare for, and adapt to changing climate conditions and withstand, respond to, and recover rapidly from disruptions.” For purposes of this document, climate resilience includes climate preparedness and climate adaptation. Executive Order 13653 defines climate “preparedness” as “actions taken to plan, organize, equip, train, and exercise to build, apply, and sustain the capabilities necessary to prevent, protect against, ameliorate the effects of, respond to, and recover from climate change related damages to life, health, property, livelihoods, ecosystems, and national security.” Executive Order 13653 defines climate “adaptation” as “adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative effects.”

<sup>2</sup> U.S. Global Change Research Program, *Climate Change Impacts in the United States: The Third National Climate Assessment* (2014), available at <http://nca2014.globalchange.gov/> (In 1990, Congress passed the Global Change Research Act, which established the U.S. Global Change Research Program to support scientific research, observational capabilities, and assessments to improve our understanding of and response to climate change and its impacts on the Nation. The Fourth National Climate Assessment is underway).

<sup>3</sup> U.S. GOVT. ACCOUNTABILITY OFFICE, GAO-15-290, *High-Risk Series 67-93* (2015), available at <http://www.gao.gov/assets/670/668415.pdf>; OFFICE OF MGMT. & BUDGET, EXEC. OFFICE OF THE PRESIDENT, *Analytical Perspectives, Budget of the U.S. Government, Fiscal Year 2017* 361 (2016), available at [https://www.whitehouse.gov/omb/budget/Analytical\\_Perspectives](https://www.whitehouse.gov/omb/budget/Analytical_Perspectives).

<sup>4</sup> See generally KATE GORDON ET AL., *RISKY BUSINESS, RISKY BUSINESS: THE ECONOMIC RISKS OF CLIMATE CHANGE IN THE UNITED STATES* (2014), available at <http://riskybusiness.org/report/national/>. The report “quantifies some of these costs in agriculture, labor, health services, energy production and distribution, and infrastructure. It projects that on a business as usual emissions pathway, between \$66 billion and \$106 billion worth of existing coastal property will likely be below sea level nationwide. The report also finds that labor productivity of outdoor workers could be reduced by as much as 3% by the end of the century and that without adaptation, states in the Southeast, lower Great Plains, and Midwest risk up to a 50% to 70% loss in average annual crop yields. At a state level, the NCA3 indicates that the net present value of the extra cost of climate change to specific infrastructure elements in Alaska will be between \$2 and \$4 billion through 2030, and \$4 to \$8 billion through 2080.

<sup>5</sup> Executive Order No. 13514, 74 Fed. Reg. 52117-52127 (Oct. 8, 2009), available at <https://www.gpo.gov/fdsys/pkg/FR-2009-10-08/pdf/E9-24518.pdf>.

<sup>6</sup> Executive Order No. 13653, 78 Fed. Reg. 66821-22 (Nov. 6, 2013), available at <https://www.gpo.gov/fdsys/pkg/FR-2013-11-06/pdf/2013-26785.pdf>. (The requirement to develop and update Climate Change Adaptation Plans survives in Executive Order 13653, which supersedes Executive Order 13514).

<sup>7</sup> See HURRICANE SANDY REBUILDING TASK FORCE, *Hurricane Sandy Rebuilding Strategy: Stronger Communities, A Resilient Nation* (2013), available at <http://portal.hud.gov/hudportal/documents/huddoc?id=HSRebuildingStrategy.pdf>; See also HURRICANE SANDY REBUILDING TASK FORCE, FACT SHEET: PROGRESS TO DATE (2013), available at [http://portal.hud.gov/hudportal/documents/huddoc?id=HSRTF\\_FactSheet.pdf](http://portal.hud.gov/hudportal/documents/huddoc?id=HSRTF_FactSheet.pdf).

<sup>8</sup> SANDY PROGRAM MANAGEMENT OFFICE, *HURRICANE SANDY REBUILDING STRATEGY: PROGRESS REPORT* (2014), available at <http://portal.hud.gov/hudportal/documents/huddoc?id=HurrSandRebStratPRF2014.pdf>; See SANDY REBUILDING TASK FORCE, *Sandy Recovery Progress*, HUD.GOV, <http://portal.hud.gov/hudportal/HUD?src=/sandyrebuilding/recoveryprogress> (last visited Sept. 19, 2016).

<sup>9</sup> EOP, *The President’s Climate Action Plan* (2013), available at <https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf>.

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<sup>10</sup> *Supra* note 2 at 66819-23.

<sup>11</sup> STATE, LOCAL, & TRIBAL LEADERS TASK FORCE ON CLIMATE PREPAREDNESS & RESILIENCE, RECOMMENDATIONS TO THE PRESIDENT (2014), available at [https://www.whitehouse.gov/sites/default/files/docs/task\\_force\\_report\\_0.pdf](https://www.whitehouse.gov/sites/default/files/docs/task_force_report_0.pdf).

<sup>12</sup> Memorandum from Shaun Donovan & Christy Goldfuss for Executive Departments & Agencies, Strengthening Climate Adaptation Planning in Fiscal Year 2016 and Beyond (Apr. 29, 2016)(on file with author), available at <https://www.whitehouse.gov/sites/default/files/omb/memoranda/2016/m-16-09.pdf>.

<sup>13</sup> NOAA, 2015 FLASH FLOOD/RIVER FLOOD FATALITIES 1-2 (2016), available at <http://www.nws.noaa.gov/om/hazstats/flood15.pdf>.

<sup>14</sup> Exec. Order No. 13690, 80 Fed. Reg. 6425-28 (Jan. 30, 2015), available at <https://www.federalregister.gov/documents/2015/02/04/2015-02379/establishing-a-federal-flood-risk-management-standard-and-a-process-for-further-soliciting-and-considering-stakeholder-input>; *Federal Flood Risk Management Standard (FFRMS)*, FEMA (Aug. 23, 2016, 9:26 PM), <https://www.fema.gov/federal-flood-risk-management-standard-ffrms>.

<sup>15</sup> In January 2015, President Obama signed Executive Order 13690 Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, which amended Executive Order 11988, Floodplain Management, issued in 1977. An extensive interagency process soliciting stakeholder input and feedback was undertaken to inform the Guidelines for Implementing Executive Order 11988, Floodplain Management, and Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input which the Water Resources Council approved October 2015.

<sup>16</sup> *Id.* Federal agencies have implemented floodplain management for decades since Executive Order 11988, *Floodplain Management*, was signed by President Carter in 1977.

<sup>17</sup> Updates to Floodplain Management and Protection of Wetlands Regulations to Implement Executive Order 13690 and the Federal Flood Risk Management Standard, 81 Fed. Reg. 57401- (proposed Aug. 22, 2016)(to be codified at 44 C.F.R. pt. 9).

<sup>18</sup> *Guidelines for Implementing Executive Order 11988, Floodplain Management, and Executive Order 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input*, FEMA.ORG (Oct. 8, 2015), <https://www.fema.gov/media-library/assets/documents/110377>.

<sup>19</sup> *Resilience AmeriCorps*, CORP. FOR NAT'L & CMTY. SERV., <http://www.nationalservice.gov/programs/ameri-corps/ameri-corps-initiatives/resilience-ameri-corps> (last visited Sept. 19, 2016).

<sup>20</sup> *Id.* This and many other examples are described on the Resilience AmeriCorps website.

<sup>21</sup> *Climate*, DATA.GOV, <https://www.data.gov/climate/> (last visited Sept. 19, 2016).

<sup>22</sup> *Meet the Challenges of a Changing Climate*, U.S. CLIMATE RESILIENCE TOOLKIT, <http://toolkit.climate.gov/> (last visited Sept. 19, 2016).

<sup>23</sup> *The Climate Explorer*, U.S. CLIMATE RESILIENCE TOOLKIT, <https://toolkit.climate.gov/climate-explorer2/> (last visited Sept. 19, 2016).

<sup>24</sup> *The Climate Explorer*, U.S. CLIMATE RESILIENCE TOOLKIT, <https://toolkit.climate.gov/climate-explorer2/> (last visited Sept. 19, 2016).

<sup>25</sup> *Sea Level Rise Viewer*, NOAA OFFICE FOR COASTAL MGMT., DIGITAL COAST (August 31, 2015), <https://coast.noaa.gov/digitalcoast/tools/slr>.

<sup>26</sup> *The Social Vulnerability Index (SVI)*, AGENCY FOR TOXIC SUBSTANCES & DISEASE REGISTRY (May 9, 2013), <http://svi.cdc.gov/>.

<sup>27</sup> *Mit-FLG Community Resilience Indicators Project Data Viewer*, FEMA (June 23, 2016, 2:13 PM), <http://fema.maps.arcgis.com/apps/MapSeries/index.html?appid=795a15da7f2a45ad8839e569f7cf96d5>.

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- <sup>28</sup> *Show Don't Tell: Visualizing Sea Level Rise to Set Planning Priorities*, U.S. CLIMATE RESILIENCE TOOLKIT (August 29, 2016, 4:24 PM), <https://toolkit.climate.gov/case-studies/show-dont-tell-visualizing-sea-level-rise-set-planning-priorities>.
- <sup>29</sup> See generally Jason M. Evans & Jill Gambill, *Tybee Island Sea-Level Rise Adaptation Plan* (2016), available at [https://www.researchgate.net/publication/289999590\\_Tybee\\_Island\\_Sea-Level\\_Rise\\_Adaptation\\_Plan](https://www.researchgate.net/publication/289999590_Tybee_Island_Sea-Level_Rise_Adaptation_Plan).
- <sup>30</sup> Ron Francis, *Precise Soil, Climate, and Weather Data Help Dairy Optimize Water Use*, U.S. CLIMATE RESILIENCE TOOLKIT (August 9, 2016, 10:12 AM), <https://toolkit.climate.gov/case-studies/precise-soil-climate-and-weather-data-help-dairy-optimize-water-use>.
- <sup>31</sup> Joe Casola & Craig Zamuda, U.S. Dept. of Energy, *Watching for Wind: An Effort to Get the Upper Hand on Wildfire*, U.S. CLIMATE RESILIENCE TOOLKIT (August 29, 2016, 1:19 PM), <http://toolkit.climate.gov/case-studies/watching-wind-effort-get-upper-hand-wildfire>. Morgan Lee, *SDG&E wants 90-10 split on wildfire costs*, SAN DIEGO UNION-TRIB. (Sept. 25, 2015, 9:56 PM), available at <http://www.sandiegouniontribune.com/news/2015/sep/25/wildfire-costs-split/>.
- <sup>32</sup> J. Harry Jones, *Cedar fire's lessons, 10 years later*, SAN DIEGO UNION-TRIB. (Oct. 24, 2013, 4:10 PM), available at <http://www.sandiegouniontribune.com/news/2013/oct/24/wildfire-cedar-anniversary-fire/>.
- <sup>33</sup> See generally *supra* note 1; See generally *Supra* note 6; See generally TREVOR HOUSER ET AL., *ECONOMIC RISKS OF CLIMATE CHANGE: AN AMERICAN PROSPECTUS* (2015); See generally Carolyn Kousky, *Informing Climate Adaptation: A Review of the Economic Costs of Natural Disasters, Their Determinants, and Risk Reduction Options*, 46 ENERGY ECON. 576 (2014); See generally Carolyn Kousky & Roger Cooke, *Explaining the Failure to Insure Catastrophic Risks*, 37 GENEVA PAPERS ON RISK & INS. ISSUES PRACT 206 (2012).
- <sup>34</sup> EPA, *CLIMATE CHANGE IN THE UNITED STATES: BENEFITS OF GLOBAL ACTION* (2015), available at <https://www.epa.gov/sites/production/files/2015-06/documents/frontmatter.pdf>.
- <sup>35</sup> E. RESEARCH GRP. INC., *WHAT WILL ADAPTATION COST? AN ECONOMIC FRAMEWORK FOR COASTAL COMMUNITY INFRASTRUCTURE* (2013), available at <https://coast.noaa.gov/digitalcoast/training/adaptation-pub.html>.
- <sup>36</sup> Michael Knotek, *Launch of the Grid Modernization Laboratory Consortium*, ENERGY.GOV (Nov. 17, 2014, 9:51 AM), <http://energy.gov/articles/launch-grid-modernization-laboratory-consortium>.
- <sup>37</sup> See generally DOI METRICS EXPERT GROUP, *Report for the Department of the Interior: Recommendations for assessing the effects of the DOI Hurricane Sandy Mitigation and Resilience Program on ecological system and infrastructure resilience in the Northeast coastal region* (2015), available at <https://www.doi.gov/sites/doi.gov/files/migrated/news/upload/Hurricane-Sandy-project-metrics-report.pdf>.
- <sup>38</sup> See generally Abt Associates, *Developing Socio-Economic Metrics to Measure DOI Hurricane Sandy Project and Program Outcomes* (2015), available at [https://www.doi.gov/sites/doi.gov/files/uploads/Socio\\_Economic\\_Metrics\\_Final\\_Report\\_11DEC2015\\_0.pdf](https://www.doi.gov/sites/doi.gov/files/uploads/Socio_Economic_Metrics_Final_Report_11DEC2015_0.pdf).
- <sup>39</sup> See generally MULTIHAZARD MITIGATION COUNCIL, *NATURAL HAZARD MITIGATION SAVES: AN INDEPENDENT STUDY TO ASSESS THE FUTURE SAVINGS FROM MITIGATION ACTIVITIES* (2005), available at [http://www.floods.org/PDF/MMC\\_Volume1\\_FindingsConclusionsRecommendations.pdf](http://www.floods.org/PDF/MMC_Volume1_FindingsConclusionsRecommendations.pdf).
- <sup>40</sup> L.F. Chambers, *Wildfire-Related Tragedy Leads to Landmark Forest Restoration Partnership*, USDA BLOG (July 28, 2015, 11:00 AM), <http://blogs.usda.gov/2015/07/28/wildfire-related-tragedy-leads-to-landmark-forest-restoration-partnership/>.
- <sup>41</sup> See generally The Nature Conservancy, *Rio Grande Water Fund: Comprehensive Plan for Wildfire and Water Source Protection* (2014), available at [http://nmconservation.org/rgwf/rgwf\\_compplan.pdf](http://nmconservation.org/rgwf/rgwf_compplan.pdf).
- <sup>42</sup> *Twelve Ways to Lower Your Homeowners Insurance Costs*, INSURANCE INFORMATION INSTITUTE, <http://www.iii.org/article/twelve-ways-to-lower-your-homeowners-insurance-costs> (last visited Sept. 23, 2016).
- <sup>43</sup> The guidance documents are available at: <http://www.energy.gov/epso/initiatives/us-energy-sector-vulnerability-report>, and include: *Climate Change and the Electricity Sector: Guide for Climate Change Resilience*

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*Planning* (September 2016); *Climate Change and the Electricity Sector: Guide for Assessing Vulnerabilities and Developing Resilience Solutions to Sea Level Rise* (July 2016) and *Climate Change and the Electricity Sector: Guide for Climate Change and the U.S. Energy Sector: Regional Vulnerabilities and Resilience Planning* (October 2015).

<sup>44</sup> Executive Order 13653 requires Federal Agencies to update adaptation plans after the issuance of each National Climate Assessment. Under the recent “M-16-09 Strengthening Agency Climate Adaptation Planning Efforts in Fiscal Year 2016,” OMB and CEQ are engaging agencies in annual progress reviews of their adaptation plans.

<sup>45</sup> FEMA, Sandy Regional Infrastructure Resilience Coordination: Enhancing Coastal Infrastructure Resilience through Regional Coordination, PowerPoint Presentation (Oct. 16, 2014) *available at* [http://www.nafsma.org/sites/default/files/shared-files/chang-cimino\\_SandyRegionalResilience-Oct2014.pdf](http://www.nafsma.org/sites/default/files/shared-files/chang-cimino_SandyRegionalResilience-Oct2014.pdf).

<sup>46</sup> See generally DOD, Directive 4715.21, *Climate Change Adaptation and Resilience* (2016), *available at* <http://www.defense.gov/Portals/1/Documents/pubs/471521p.pdf>.

<sup>47</sup> OSTP, FACT SHEET: Lifting America’s Game in Climate Education, Literacy, and Training (Dec. 3, 2014)(on file with author), *available at* <https://www.whitehouse.gov/sites/default/files/microsites/ostp/climateed-dec-3-2014.pdf>.

<sup>48</sup> The Economic Development Administration requires planning grantees to incorporate economic resilience into their regional economic development strategies to help communities become more resilient to economic disruptions, including natural hazards, among others. Similarly, EPA issued guidance encouraging its programs to integrate climate adaptation into competitive grants, including for example, the Clean Water and Safe Drinking Water State Revolving Loan Funds Programs, which provides over \$2 billion in loans to states and tribes every year for water quality projects. EPA considers climate adaptation issues in its Brownfields clean-up grants, and under its regulatory work can build capacity of local governments to make sewer and stormwater systems more resilient as they are upgraded pursuant to enforcement actions.

<sup>49</sup> *TIGER Discretionary Grants*, DEPT. OF TRANSP. (July 29, 2016), <https://www.transportation.gov/tiger>.

<sup>50</sup> *FASTLANE Grants*, BUILD AMERICA BUREAU (Sept. 7, 2016), DEPT. OF TRANSP., BUILD AM. BUREAU <https://www.transportation.gov/FASTLANEgrants>.

<sup>51</sup> FEMA, PUBLIC ASSISTANCE REQUIRED MINIMUM STANDARDS, FEMA RECOVERY POLICY FP-104-009-4 (2016), *available at* [https://www.fema.gov/media-library-data/1475592732229-1773d9d032c89da0f4e201e1529feb29/PA\\_Minimum\\_Standards\\_Policy\\_508\\_FINAL.pdf](https://www.fema.gov/media-library-data/1475592732229-1773d9d032c89da0f4e201e1529feb29/PA_Minimum_Standards_Policy_508_FINAL.pdf) (generally requiring “the integration and use of the hazard-resistant provisions of the International Code Council’s (ICC) International Building Code (IBC), the International Existing Building Code (IEBC), and/or the International Residential Code (IRC) as a minimum design standard for all eligible building restoration projects where the design standard is triggered.”).

<sup>52</sup> Memorandum from the Executive Office of the President on Climate Change and National Security (Sept. 21, 2016) (on file with author), *available at* <https://www.whitehouse.gov/the-press-office/2016/09/21/presidential-memorandum-climate-change-and-national-security>.

<sup>53</sup> DOI & U.S. GEOLOGICAL SURVEY, BASELINE AND PROJECTED FUTURE CARBON STORAGE AND GREENHOUSE-GAS FLUXES IN ECOSYSTEMS OF THE EASTERN UNITED STATES: PROFESSIONAL PAPER 1804 (Zhiliang Zhu & B.C. Reed eds. 2014), *available at* <http://pubs.usgs.gov/pp/1804>. Ecosystems serve as important carbon sinks. A 2014 U.S. Geological Survey (USGS) Report found that ecosystems across the lower 48 states absorb about 474 million tons of carbon a year. This offsets nearly two years of U.S. car emissions, which is more than 20% of the total annual greenhouse gas emissions in the U.S. Without additional conservation efforts, the rate that ecosystems can absorb carbon will decline by more than 25% by 2050, in part from wildfires, urban development and increased demand for timber products.

<sup>54</sup> NAT’L SCI. & TECH. COUNCIL, ECOSYSTEM-SERVICE ASSESSMENT: RESEARCH NEEDS FOR COASTAL GREEN INFRASTRUCTURE (2015), *available at* [https://www.whitehouse.gov/sites/default/files/microsites/ostp/cgies\\_research\\_agenda\\_final\\_082515.pdf](https://www.whitehouse.gov/sites/default/files/microsites/ostp/cgies_research_agenda_final_082515.pdf).

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<sup>55</sup> Memorandum from Shaun Donovan & Christy Goldfuss for Executive Departments & Agencies, Strengthening Climate Adaptation Planning in Fiscal Year 2016 and Beyond (Apr. 29, 2016)(on file with author), *available at* <https://www.whitehouse.gov/sites/default/files/omb/memoranda/2016/m-16-09.pdf>.

<sup>56</sup> USAID, Millennium Challenge Corporation, Overseas Private Investment Corporation, United States Trade and Development Agency, United States Department of the Interior, United States Department of State and United States Department of Agriculture.

<sup>57</sup> *Office of Sustainable Communities*, HUD.GOV, <http://portal.hud.gov/hudportal/HUD?src=/hudprograms/sci> (last visited Sept. 12, 2016).

<sup>58</sup> *The Sustainable Communities Regional Planning Grants*, HUD.GOV, [http://portal.hud.gov/hudportal/HUD?src=/program\\_offices/economic\\_resilience/sustainable\\_communities\\_regional\\_planning\\_grants](http://portal.hud.gov/hudportal/HUD?src=/program_offices/economic_resilience/sustainable_communities_regional_planning_grants) (last visited Sept. 12, 2016); *The Community Challenge Planning Grants*, HUD.GOV, [http://portal.hud.gov/hudportal/HUD?src=/program\\_offices/administration/grants/nofa10/huddotnofa](http://portal.hud.gov/hudportal/HUD?src=/program_offices/administration/grants/nofa10/huddotnofa) (last visited Sept. 12, 2016).

<sup>59</sup> *Champions of Change*, WHITEHOUSE.GOV, <https://www.whitehouse.gov/champions#section-climate-equity> (last visited Sept. 23, 2016).

<sup>60</sup> *Mission & History*, COMMUNITY WATER CENTER, [http://www.communitywatercenter.org/mission\\_and\\_history](http://www.communitywatercenter.org/mission_and_history) (last visited Sept. 23, 2016).

<sup>61</sup> *EERE Success Story—Oglala Lakota College gets Hands-On Training for Off-Grid Solar*, ENERGY.GOV (Jul. 13, 2013, 4:58 PM), <http://energy.gov/eere/success-stories/articles/eere-success-story-ogla-lakota-college-gets-hands-training-grid>.

<sup>62</sup> A 2016 progress report notes other milestones, including adoption of the Greenprint vision by 21 Mid-South jurisdictions, designation of 35 projects across the region as “Greenprint Certified,” and completion of a second annual Greenprint Summit.

<sup>63</sup> At its first meeting on February 20, 2015, the Arctic Executive Steering Committee established under Executive Order 13689, *Enhancing Coordination of National Efforts in the Arctic*, created an interagency Community Resilience Working Group to coordinate the Federal response to these threats. Pursuant to the group’s recommendations, the President in September 2015 designated the Denali Commission, an independent Federal agency, as the lead Federal point of contact for affected villages.

<sup>64</sup> FEMA, INTEGRATING HISTORIC PROPERTY AND CULTURAL RESOURCE CONSIDERATIONS INTO HAZARD MITIGATION PLANNING: STATE AND LOCAL MITIGATION PLANNING HOW-TO GUIDE (2005), *available at* <http://www.fema.gov/media-library-data/20130726-1522-20490-2886/howto6.pdf>. FEMA has issued guidance on integrating historic and cultural resources into hazard mitigation planning, *Integrating Historic Property and Cultural Resource Considerations Into Hazard Mitigation Planning: State and Local Mitigation Planning How-To Guide*; U.S. DEPT. OF INTERIOR, COASTAL ADAPTATION STRATEGIES: CASE STUDIES (2015), *available at* <https://www.nps.gov/subjects/climatechange/upload/2015-11-25-FINAL-CAS-Case-Studies-LoRes.pdf>. The National Park Service has issued, *Coastal Adaptation Strategies: Case Studies*, which discusses impacts to cultural resources.

<sup>65</sup> Memorandum from the Executive Office of the President on Agreement on Interagency Technical Assistance (2016)(on file with author), *available at* <https://communitysolutions.sites.usa.gov/files/2016/03/Final-MOA.pdf>; EOP, FACT SHEET: Investigating in Federal Partnerships with Local Communities: A New Memorandum of Agreement for 16 Federal Agencies Fact Sheet (2016)(on file with author), *available at* <https://communitysolutions.sites.usa.gov/files/2016/03/MOA-Fact-Sheet.pdf>.

<sup>66</sup> *See generally* MULTIHAZARD MITIGATION COUNCIL, NATURAL HAZARD MITIGATION SAVES: AN INDEPENDENT STUDY TO ASSESS THE FUTURE SAVINGS FROM MITIGATION ACTIVITIES (2005), *available at* [http://www.floods.org/PDF/MMC\\_Volume1\\_FindingsConclusionsRecommendations.pdf](http://www.floods.org/PDF/MMC_Volume1_FindingsConclusionsRecommendations.pdf).

<sup>67</sup> *Hazard Mitigation Grant Program*, FEMA.GOV (June 24, 2016, 12:10 PM), <https://www.fema.gov/hazard-mitigation-grant-program>.

<sup>68</sup> *Pre-Disaster Mitigation Grant Program*, FEMA.GOV (Aug. 31, 2016, 8:10 PM), <http://www.fema.gov/pre-disaster-mitigation-grant-program>.

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<sup>69</sup> FEMA, MITIGATION IDEAS: A RESOURCE FOR REDUCING RISK TO NATURAL HAZARDS (2013), *available at* <http://www.fema.gov/media-library/assets/documents/30627>.

<sup>70</sup> *Climate Resilient Mitigation Activities for Hazard Mitigation Assistance*, FEMA.GOV (Aug. 11, 2016), <http://www.fema.gov/media-library/assets/documents/110202>.

<sup>71</sup> *Flood Mitigation Assistance Program*, FEMA.gov (Oct. 6, 2016), <https://www.fema.gov/flood-mitigation-assistance-grant-program>.

<sup>72</sup> (The District of Columbia and five U.S. island territories, including Guam, American Samoa, Northern Marianas islands, Puerto Rico, and the U.S. Virgin Islands, have FEMA-approved state mitigation plans).

<sup>73</sup> *Hazard Mitigation Plan Status*, FEMA.gov (July 26, 2016, 9:03 AM), <http://www.fema.gov/hazard-mitigation-plan-status>.