



Report to the Ranking Member,
Subcommittee on Transportation
and Infrastructure, Committee on
Environment and Public Works,
U.S. Senate

October 2019

CLIMATE RESILIENCE

A Strategic
Investment Approach
for High-Priority
Projects Could Help
Target Federal
Resources

Why GAO Did This Study

Federal funding for disaster assistance since 2005 has totaled at least \$450 billion, including a 2019 supplemental appropriation of \$19.1 billion for recent disasters. In 2018 alone, 14 separate billion-dollar weather and climate disaster events occurred across the United States, with total costs of at least \$91 billion including the loss of public and private property, according to the National Oceanic and Atmospheric Administration. Disaster costs will likely increase as certain extreme weather events become more frequent and intense due to climate change, according to the U.S. Global Change Research Program, a global change research coordinating body that spans 13 federal agencies. In 2013, GAO included “Limiting the Federal Government’s Fiscal Exposure by Better Managing Climate Change Risks” on its list of federal program areas at high risk of fraud, waste, abuse, mismanagement, or most in need of transformation.

The cost of recent weather disasters has illustrated the need to plan for climate change risks and invest in climate resilience. Investing in climate resilience can reduce the need for far more costly steps in the decades to come.

The Disaster Recovery Reform Act of 2018 provides one potential source of funding for climate resilience projects. In particular, it allows the President to set aside up to 6 percent of the estimated aggregate amount of grants from certain programs under a major disaster declaration to implement pre-disaster hazard mitigation activities. Officials estimate funds for the related program will average \$300 million to \$500 million annually.

View [GAO-20-127](#). For more information, contact J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov

CLIMATE RESILIENCE

A Strategic Investment Approach for High-Priority Projects Could Help Target Federal Resources

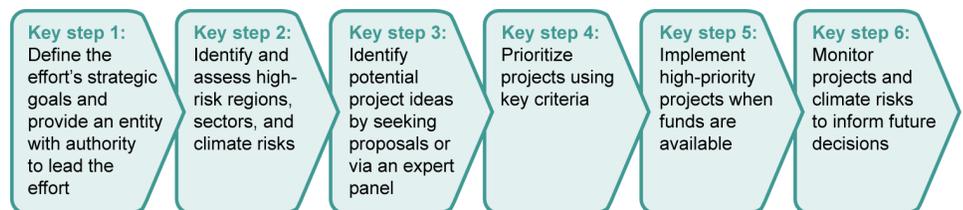
What GAO Found

The federal government has invested in projects that may enhance climate resilience, but it does not have a strategic approach to guide its investments in high-priority climate resilience projects. Enhancing climate resilience means taking actions to reduce potential future losses by planning and preparing for potential climate hazards such as extreme rainfall, sea level rise, and drought. Some federal agencies have made efforts to manage climate change risk within existing programs and operations, and these efforts may convey climate resilience benefits. For example, the U.S. Army Corps of Engineers’ civil works program constructs flood control projects, such as sea walls, that may enhance climate resilience. However, additional strategic federal investments may be needed to manage some of the nation’s most significant climate risks because climate change cuts across agency missions and presents fiscal exposures larger than any one agency can manage. GAO’s analysis shows the federal government does not strategically identify and prioritize projects to ensure they address the nation’s most significant climate risks. Likewise, GAO’s past work shows an absence of government-wide climate change strategic planning.

As of August 2019, no action had been taken to implement 14 of GAO’s 17 recommendations to improve federal strategic planning for climate resilience. GAO’s enterprise risk management framework calls for reviewing risks and selecting the most appropriate strategy to manage them. However, no federal agency, interagency collaborative effort, or other organizational arrangement has been established to implement a strategic approach to climate resilience investment that includes periodically identifying and prioritizing projects. Such an approach could supplement individual agency climate resilience efforts and help target federal resources toward high-priority projects.

Six key steps provide an opportunity for the federal government to strategically identify and prioritize climate resilience projects for investment, as GAO found based on its review of prior GAO work, relevant reports, and stakeholder interviews (see figure).

Six Key Steps for Identifying High-Priority Climate Resilience Projects for Federal Investment



Source: GAO analysis based on relevant reports, international standards, past GAO work, and stakeholder interviews. | [GAO-20-127](#)

GAO identified one domestic and one international example to illustrate these key steps: Louisiana’s Coastal Protection and Restoration Authority (CPRA) coastal master planning effort and Canada’s Disaster Mitigation and Adaptation Fund (DMAF).

GAO was asked to review the federal approach to prioritizing and funding climate resilience projects that address the nation's most significant climate risks. This report examines (1) the extent to which the federal government has a strategic approach for investing in climate resilience projects; (2) key steps that provide an opportunity to strategically prioritize projects for investment; and (3) the strengths and limitations of options for focusing federal funding on these projects.

GAO reviewed relevant reports and interviewed 35 stakeholders with relevant expertise, including federal officials, researchers, and consultants. In addition, during the course of this work, GAO identified domestic and international examples of governments that invest in climate resilience and related projects. GAO selected two of these examples for in-depth review and presentation in the report: the state of Louisiana's coastal master planning effort and Canada's Disaster Mitigation and Adaptation Fund.

What GAO Recommends

Congress should consider establishing a federal organizational arrangement to periodically identify and prioritize climate resilience projects for federal investment. Such an arrangement could be designed using the six key steps for prioritizing climate resilience investments and the opportunities to increase the climate resilience impact of federal funding options that are identified in this report.

The Federal Emergency Management Agency and two federal coordinating bodies reviewed a draft of this report and provided technical comments, which GAO incorporated as appropriate.

In the domestic example, in 2005 the Louisiana legislature consolidated coastal planning efforts previously carried out by multiple state entities into a single effort led by CPRA to address the lack of strategic coordination. CPRA periodically identifies high-priority coastal resilience projects designed to address two primary risks: flooding and coastal land loss. To identify potential projects, CPRA sought project proposals from citizens, nongovernmental organizations, and others. To prioritize projects, CPRA used quantitative modeling to estimate project outcomes under multiple future scenarios of varied climate and other conditions and coordinated with stakeholders to understand potential project impacts. In 2017, CPRA identified \$50 billion in high-priority projects to be implemented as funds become available.

In the international example, in 2018, the Canadian government launched the DMAF, a financial assistance program to provide US\$1.5 billion over 10 years for large-scale, nationally significant projects to manage natural hazard risks, including those triggered by climate change. Infrastructure Canada, the entity responsible for administering the DMAF, seeks project ideas from provinces and territories, municipal and regional governments, indigenous groups, and others. These entities apply directly to Infrastructure Canada for funding. According to Canadian officials, two committees of experts—one composed of experts from other federal departments and the other composed of nonfederal experts (e.g., urban planners and individuals with regional expertise)—provide feedback on potential projects. These projects are prioritized based on multiple criteria such as the extent to which they reduce the impacts of natural disasters.

On the basis of GAO's review of relevant reports and past GAO work, interviews with stakeholders, and illustrative examples, GAO identified two options—each with strengths and limitations—for focusing federal funding on high-priority climate resilience projects. The options are (1) coordinating funding provided through multiple existing programs with varied purposes and (2) creating a new federal funding source specifically for investment in climate resilience.

A strength of coordinating funding from existing sources is access to multiple funding sources for a project. For example, one stakeholder GAO interviewed—whose community used federal funding to implement large-scale resilience projects—said that having multiple programs is advantageous because when funding from one program is not available—such as when the project does not match that program's purpose or when there are insufficient funds—funds could be sought from another program. A limitation of that option, according to CPRA officials, is that coordinating funding from multiple sources could be administratively challenging and could require dedicated staff to identify programs, assess whether projects meet program funding criteria, apply for funds, and ensure program requirements are met. Alternatively, one strength of a new federal funding source is that it could encourage cross-sector projects designed to achieve benefits in multiple sectors. For example, according to one stakeholder, such a funding source could allow experts from multiple sectors—such as infrastructure, housing, transportation, and health—to collaborate on projects, leading to more creative, comprehensive approaches to enhance community resilience. However, such a new funding source would have to be created, which would require Congressional authorization.

In addition, GAO identified opportunities to increase the climate resilience impact of federal funding options. For example, a federal resilience investment effort presents an opportunity to encourage several types of complementary resilience activities by nonfederal actors such as states, localities, and private-sector partners. In this example, the federal government could require or provide incentives for communities to use and enforce climate-resilient building codes or limit development in high-risk areas through zoning regulations.

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Abbreviations

CPRA	Louisiana's Coastal Protection and Restoration Authority
DMAF	Canada's Disaster Mitigation and Adaptation Fund
DRRA	Disaster Recovery Reform Act of 2018
FEMA	Federal Emergency Management Agency
HUD	Department of Housing and Urban Development
OMB	Office of Management and Budget
USGCRP	U.S. Global Change Research Program

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October 23, 2019

The Honorable Benjamin Cardin
Ranking Member
Subcommittee on Transportation and Infrastructure
Committee on Environment and Public Works
United States Senate

Dear Senator Cardin:

Since 2005, federal funding for disaster assistance has totaled at least \$450 billion, including a supplemental appropriation of \$19.1 billion for recent disasters that was signed into law on June 6, 2019. In 2018 alone, 14 separate billion-dollar weather and climate disaster events occurred across the United States, with a total cost of at least \$91 billion, according to the National Oceanic and Atmospheric Administration.¹ The U.S. Global Change Research Program (USGCRP) projects that disaster costs will likely increase as certain extreme weather events become more frequent and intense due to climate change.² The rising number of natural disasters and increasing reliance on the federal government for assistance is a key source of federal fiscal exposure. Our work over the last decade has pointed to a key federal role in recognizing and managing climate risks to limit such fiscal exposure.³ In 2013, we added “Limiting the Federal Government’s Fiscal Exposure by Better Managing Climate Change Risks” as an area on our high-risk list—a list of federal programs and operations at risk of fraud, waste, abuse, and mismanagement or that

¹National Oceanic and Atmospheric Administration, National Centers for Environmental Information, “U.S. Billion-Dollar Weather and Climate Disasters,” accessed June 26, 2019, <https://www.ncdc.noaa.gov/billions/>.

²U. S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2 (Washington, D.C.: 2018). Under the Global Change Research Act of 1990, USGCRP coordinates and integrates global change research across 13 federal agencies. The Office of Science and Technology Policy within the Executive Office of the President oversees USGCRP.

³See, for example, GAO, *Climate Change: Opportunities to Reduce Federal Fiscal Exposure*, [GAO-19-625T](#) (Washington, D.C.: June 11, 2019); *Hurricane Sandy: An Investment Strategy Could Help the Federal Government Enhance National Resilience for Future Disasters*, [GAO-15-515](#) (Washington, D.C.: July 30, 2015); and *Climate Change Adaptation: Aligning Funding with Strategic Priorities*, [GAO-11-876T](#) (Washington, D.C.: July 28, 2011).

need transformation to address economy, efficiency, or effectiveness challenges.⁴

Greenhouse gases already in the atmosphere are expected to continue to alter the climate system into the future, regardless of efforts to control emissions, according to USGCRP and the National Academies of Sciences, Engineering, and Medicine (the National Academies).⁵ As a result, limiting the federal government's fiscal exposure to climate change risks will be challenging. The cost of recent weather disasters has illustrated the need to plan for climate change risks and consequences and to invest in climate resilience.⁶ We have previously reported that while it is not possible to link any individual weather event to climate

⁴GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: February 2013).

⁵Nevertheless, according to the *Fourth National Climate Assessment*, more immediate and substantial reductions in global greenhouse gas emissions, as well as regional adaptation efforts, are needed to avoid the most severe consequences of climate change in the long term. USGCRP, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume 2* (Washington, D.C.: 2018) and National Research Council of the National Academies, *Climate Change: Evidence, Impacts, and Choices; Answers to Common Questions About the Science of Climate Change* (Washington, D.C.: 2012). The National Research Council is the principal operating agency of the National Academies of Sciences, Engineering, and Medicine. The National Academies is a private, nonprofit society of distinguished scholars that provides independent, objective analysis and advice to the nation and conducts other activities to solve complex problems and inform public policy decisions.

⁶The National Academies defines resilience as the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. We reported in May 2016 that two related sets of actions can enhance climate resilience by reducing risk. These are climate change adaptation and pre-disaster hazard mitigation. In general, the term "adaptation" is used by climate change professionals, and "pre-disaster hazard mitigation" is employed by the emergency management community, often to speak about the same thing: becoming better prepared for climate change impacts. Adaptation is defined as adjustments to natural or human systems in response to actual or expected climate change. Pre-disaster hazard mitigation refers to actions taken to reduce the loss of life and property by lessening the impacts of adverse events. It applies to all hazards, including terrorism and natural hazards such as health pandemics or weather-related disasters. In this report, we use the term "climate resilience" for consistency and to encompass both sets of actions as they relate to addressing climate risks. See GAO, *Climate Change: Selected Governments Have Approached Adaptation through Laws and Long-Term Plans*, [GAO-16-454](#) (Washington, D.C.: May 12, 2016). The National Academies, Committee on Increasing National Resilience to Hazards and Disasters and Committee on Science, Engineering, and Public Policy, *Disaster Resilience: A National Imperative* (Washington, D.C.: 2012).

change, these events provide insight into the potential climate-related vulnerabilities the United States faces.⁷

Enhancing climate resilience means taking actions to reduce potential future losses by planning and preparing for potential climate hazards such as extreme rainfall, sea level rise, and drought. Investing in resilience can reduce the need for far more costly steps in the decades to come; therefore, we and others have recommended enhancing climate resilience to help limit the federal government's fiscal exposure to climate change.⁸ For example, in September 2018, we reported that elevating homes and strengthening building codes—two distinct efforts to enhance resilience—in Texas and Florida prevented greater damages during the 2017 hurricane season.⁹ Enhancing climate resilience can cost additional money up front, which may limit resources for other federal priorities, but it can also reduce potential future damage from climate-related events that would otherwise constrain federal programs.¹⁰

Many current and future climate change impacts require immediate actions; therefore, climate resilience efforts need to be focused where urgent action is needed, according to the National Academies.¹¹ In addition, while it will not be possible to eliminate all risks associated with climate change, if the nation prioritizes federal climate risk management activities, it may be possible to minimize negative impacts and maximize the opportunities associated with climate change, according to the National Academies. In September 2017, we recommended that the appropriate entities within the Executive Office of the President use

⁷GAO, *Extreme Weather Events: Limiting Federal Fiscal Exposure and Increasing the Nation's Resilience*, [GAO-14-364T](#) (Washington, D.C.: Feb. 12, 2014).

⁸See [GAO-19-625T](#), [GAO-16-454](#), and National Research Council of the National Academies, *America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, Adapting to the Impacts of Climate Change* (Washington, D.C.: 2010).

⁹Specifically, FEMA officials said Hurricane Harvey demonstrated how prior hazard mitigation projects prevented greater damages (e.g., elevated homes and equipment sustained less damage). FEMA officials said Florida strengthened its building codes for resilience after Hurricane Andrew in 1992 and Hurricane Matthew in 2016. GAO, *2017 Hurricanes and Wildfires: Initial Observations on the Federal Response and Key Recovery Challenges*, [GAO-18-472](#) (Washington, D.C.: Sept. 4, 2018).

¹⁰GAO, *High-Risk Series: Progress on Many High-Risk Areas, While Substantial Efforts Needed on Others*, [GAO-17-317](#) (Washington, D.C.: Feb. 15, 2017).

¹¹National Research Council of the National Academies, *America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, Adapting to Impacts*.

information on the potential economic effects of climate change to help identify and craft appropriate federal responses to significant climate risks facing the federal government.¹² Such responses could include establishing a strategy to identify, prioritize, and guide federal investments to enhance resilience against future disasters. The Executive Office of the President neither agreed nor disagreed with our recommendation and as of August 2019 had not implemented it.

Planning for federal investments in climate resilience projects to limit fiscal exposure is no longer a hypothetical issue. The Disaster Recovery Reform Act of 2018 (DRRA), enacted in October 2018, provides one potential source of funding for climate resilience projects. The act allows the President to set aside up to 6 percent of the estimated aggregate amount of grants from certain emergency programs under a major disaster declaration to implement pre-disaster hazard mitigation activities.¹³ The Federal Emergency Management Agency (FEMA) will administer the associated program—the Building Resilient Infrastructure and Communities program. As of August 2019, FEMA had not yet developed program guidance, although the agency has sought input from the public on program design. FEMA officials estimate annual funds for the program will average \$300 million to \$500 million.

Other legislation to fund climate resilience activities has been introduced in Congress but has not been enacted. For example, the Climate Change Resiliency Fund for America Act of 2019, introduced in the House of Representatives and the U.S. Senate in March 2019, would create a fund that would provide financial assistance for climate adaptation projects including infrastructure resiliency projects intended to reduce the

¹²GAO, *Climate Change: Information on Potential Economic Effects Could Help Guide Federal Efforts to Reduce Fiscal Exposure*, [GAO-17-720](#) (Washington, D.C.: Sept. 28, 2017).

¹³FAA Reauthorization Act of 2018, Pub. L. No. 115-254, div. D, §§ 1206(a)(3), 1234(a)(5) 132 Stat. 3186, 3440, 3462 (2018). The FAA Reauthorization Act of 2018, which included the DRRA, became law on October 5, 2018.

economic, social, and environmental impacts of the adverse effects of climate change.¹⁴

You asked us to review the federal approach to prioritizing and funding climate resilience projects that address the nation’s most significant climate risks.¹⁵ This report examines (1) the extent to which the federal government has a strategic approach for investing in climate resilience projects; (2) key steps that provide an opportunity for the federal government to strategically identify and prioritize climate resilience projects for federal investment; and (3) the strengths and limitations of options for focusing federal funding on high-priority climate resilience projects.

For all three objectives, we interviewed 35 stakeholders—including federal agency officials, researchers, and consultants—with expertise in climate resilience and related fields. We identified these stakeholders through a review of related reports and snowball sampling based on the stakeholders’ expertise related to our objectives.¹⁶ Because this is a nonprobability sample, our findings cannot be generalized to other stakeholders we did not interview. Rather, these interviews provided us with illustrative examples for our three objectives. We use the term “several” to represent three or more stakeholders or reports expressing a particular viewpoint. To determine the extent to which the federal government has a strategic approach for investing in climate resilience projects, we reviewed our past work on federal efforts related to climate resilience and climate change funding; Congressional Research Service and Congressional Budget Office reports; and reports from the Council on

¹⁴Climate Change Resiliency Fund for America Act of 2019 (S.763 and H.R. 1689). Among other things, this legislation would establish an advisory commission that would publish project selection criteria and establish guidelines for identifying categories of the most cost-effective investments and projects that emphasize multiple benefits. A similar bill, the Adapt America Fund Act of 2017, was introduced in the U.S. House of Representatives and the U.S. Senate in the 115th Congress but was not enacted. In addition, the Coastal Communities Adaptation Act of 2019, introduced in February 2019, would direct the U.S. Postal Service to introduce a new stamp, proceeds from which would fund, among other things, a competition to identify nature-based, innovative projects that advance coastal risk reduction and resilience (H.R. 1317).

¹⁵The term “funding” in this report refers to budget authority—the authority provided by federal law to enter into financial obligations that will result in outlays involving federal government funds.

¹⁶We use the term “report” to refer to journal articles; federal agency program reports; and publications by associations, nonprofit organizations, and think tanks.

Climate Preparedness and Resilience, USGCRP, and other sources. We also reviewed the National Mitigation Investment Strategy—a national strategy for mitigating natural hazards. We interviewed staff from USGCRP—the federal program mandated by Congress to coordinate federal climate change research and prepare the National Climate Assessment.¹⁷ We also interviewed officials from FEMA, which chairs the Mitigation Framework Leadership Group, an interagency group that developed the National Mitigation Investment Strategy under Presidential Policy Directive 8.¹⁸

To identify key steps that provide an opportunity for the federal government to strategically prioritize climate resilience projects for federal investment, we reviewed approximately 50 reports and other sources, several of which contained examples of potential criteria the federal government could consider when prioritizing these projects. We reviewed our prior work on risk management, climate change, climate resilience, and hazard mitigation, including our Disaster Resilience Framework and our past work on enterprise risk management.¹⁹ We also identified domestic and international examples of governments that invest in climate resilience and related projects. We selected an example of each for more in-depth review and presentation in the report—the state of Louisiana’s coastal master planning effort and the country of Canada’s Disaster Mitigation and Adaptation Fund (DMAF)—because they focus on projects that are large in scale, are of national or statewide significance, and have a strategic approach for identifying and prioritizing projects,

¹⁷The Global Change Research Act of 1990 requires that a scientific assessment analyzing the effects of global change on the natural environment, agriculture, and energy production and use be provided to the President and Congress not less frequently than every 4 years. USGCRP prepares this National Climate Assessment, the most recent of which was released in 2018.

¹⁸The Mitigation Framework Leadership Group was created to integrate federal efforts and promote a national cultural shift that incorporates risk management and hazard mitigation in all planning, decision-making, and development. It coordinates mitigation efforts across the federal government and assesses the effectiveness of mitigation capabilities as they are developed and deployed across the nation. Presidential Policy Directive 8 is aimed at strengthening the security and resilience of the United States through systematic preparation for the threats that pose the greatest risk to the security of the nation, including acts of terrorism, cyberattacks, pandemics, and catastrophic natural disasters.

¹⁹GAO, *Disaster Resilience Framework: Principles for Analyzing Federal Efforts to Facilitate and Promote Resilience to Natural Disasters*, [GAO-20-100SP](#) (Washington: D.C.: October 2019) and *Enterprise Risk Management: Selected Agencies’ Experiences Illustrate Good Practices in Managing Risks*, [GAO-17-63](#) (Washington, D.C.: Dec. 1, 2016).

among other factors. To examine the strengths and limitations of options for focusing federal funding on high-priority climate resilience projects, we identified examples of the strengths and limitations of federal funding options in several of the reports we mentioned above. We also interviewed stakeholders to discuss the strengths and limitations of options the federal government could use to fund climate resilience projects. For additional details on our scope and methodology, see appendix I.

We conducted this performance audit from January 2018 to October 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

This section describes (1) U.S. climate risks and related impacts, (2) enhancing climate resilience using a risk management strategy, (3) GAO's Disaster Resilience Framework, and (4) benefits and costs of climate resilience projects.

U.S. Climate Risks and Related Impacts

Climate change poses risks to many U.S. environmental and economic systems, according to USGCRP's *Fourth National Climate Assessment*.²⁰ For example, high temperature extremes, heavy precipitation events, high-tide flooding events along the U.S. coastline, ocean acidification and warming, and forest fires in the western United States and Alaska have been observed and are all projected to continue to increase. In contrast, land and sea ice cover, snowpack, and surface soil moisture have been declining and are expected to continue to decline in the coming

²⁰The assessment relies on a number of possible scenarios to evaluate the implications of different climate outcomes and associated impacts throughout the 21st century. These "representative concentration pathways" capture a range of potential greenhouse gas emissions pathways and associated atmospheric concentration levels through 2100. Representative concentration pathways drive climate model projections under futures that have either lower or higher greenhouse gas emissions, each leading to a different level of projected global temperature change. The effects of different future greenhouse gas emissions levels on global climate become more evident around 2050. Alexa Jay et al., "Overview," in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2 (Washington, D.C.: U.S. Global Change Research Program, November 2018).

decades.²¹ Climate change is also altering the characteristics of many extreme weather and climate-related events, according to the *Fourth National Climate Assessment*. Some of these events have already become more frequent, intense, widespread, or of longer duration, and many are expected to continue to increase or worsen. Furthermore, according to the assessment, many places are subject to more than one climate-related impact. Examples include extreme rainfall combined with coastal flooding, or drought coupled with extreme heat. The compounding effects of these impacts result in increased risks to people, infrastructure, and interconnected economic sectors.²²

According to the *Fourth National Climate Assessment*, without significant reductions in global greenhouse gas emissions and regional efforts to pursue climate resilience, climate change is expected to cause substantial losses to infrastructure and property and impede the rate of economic growth over this century.²³ The potential for losses in some economic sectors could reach hundreds of billions of dollars per year by the end of this century, according to the assessment.

Future climate risks are subject to several sources of uncertainty, as identified by USGCRP's *Fourth National Climate Assessment*. According to the assessment, climate scientists find varying ranges of uncertainty in many areas, including observations of climate variables, the analysis and interpretation of those measurements, the development of new

²¹According to the assessment, the severity of projected impacts and the risks they present to society is greater under futures with higher greenhouse gas emissions, especially if limited or no action is taken to enhance climate resilience. Some climate-related impacts, such as increasing health risks from extreme heat, are common to many regions of the United States, and others represent more localized risks, such as infrastructure damage caused by thawing of permafrost (long-frozen ground) in Alaska or threats to coral reef ecosystems from warmer and more acidic seas in the U.S. Caribbean, Hawaii, and the U.S.-affiliated Pacific Islands, according to the assessment.

²²According to the *Fourth National Climate Assessment*, impacts affecting interconnected systems can cascade across sectors and regions, creating complex risks and management challenges. For example, changes in the frequency, intensity, extent, and duration of wildfires can result in a higher instance of landslides that disrupt transportation systems and the flow of goods and services within or across regions. Many observed impacts reveal vulnerabilities in these interconnected systems that are expected to be exacerbated as climate-related risks intensify.

²³USGCRP uses the term "adaptation" in the *Fourth National Climate Assessment*. For consistency with the rest of our report, we use the term "climate resilience," which we have previously reported is synonymous with climate change adaptation. See [GAO-16-454](#).

observational instruments, and the use of computer-based models of the processes governing Earth's climate system. According to the assessment, the largest uncertainty in projecting future climate risks is the level of greenhouse gas emissions going forward, because the level of emissions depends on economic, political, and demographic factors that can be difficult to predict with confidence far into the future.

Enhancing Climate Resilience Using a Risk Management Strategy

According to the *Fourth National Climate Assessment*, enhancing climate resilience entails a continuing risk management process through which individuals and organizations become aware of and assess risks and vulnerabilities from climate and other drivers of change, take actions to reduce those risks, and learn over time. In December 2016, we reported on a risk management strategy that may help guide federal climate resilience efforts.²⁴ Enterprise risk management can help federal agencies identify, assess, and manage risks, such as preparing for and responding to natural disasters. In our report, we identified six essential elements of enterprise risk management: (1) aligning the enterprise risk management process to goals and objectives, (2) identifying risks, (3) assessing risk, (4) selecting a risk response based on risk appetite, (5) monitoring risks to see if responses are successful, and (6) communicating and reporting on risks.²⁵ For example, we reported that assessing risks involves considering both the likelihood of the risk and the impact of the risk on the mission to help prioritize risk response. We also reported that selecting a risk treatment response involves leaders reviewing the prioritized list of risks and selecting the most appropriate treatment strategy to manage the risk.

²⁴[GAO-17-63](#). In addition, according to OMB Circular A-123, federal leaders and managers are responsible for implementing management practices that effectively identify, assess, respond, and report on risks. Enterprise risk management is an effective agency-wide approach to addressing the full spectrum of the organization's external and internal risks by understanding the combined impact of risks as an interrelated portfolio, rather than addressing risks only within silos.

²⁵The six essential elements are generally consistent with the steps outlined in several resilience planning frameworks we reviewed, including in the National Infrastructure Protection Plan, a critical infrastructure risk management framework that includes five steps to protect critical infrastructure, manage risk, and increase resilience. The steps outlined in the National Infrastructure Protection Plan are (1) set goals and objectives, (2) identify infrastructure (i.e., assets, systems, and networks), (3) assess and analyze risks, (4) implement risk-management activities, and (5) measure effectiveness. See Department of Homeland Security, *NIPP 2013: Partnering for Critical Infrastructure Security and Resilience* (Washington, D.C.: 2013).

GAO's Disaster Resilience Framework

In October 2019, we issued the Disaster Resilience Framework to serve as a guide for analysis of federal action to facilitate and promote resilience to natural disasters.²⁶ The principles in this framework can help identify opportunities to enhance federal efforts to promote disaster resilience, including building resilience to climate change. According to the framework, strategic resilience goals integrated across relevant national strategies can help decision makers work toward a common vision and help ensure focus on a wide variety of opportunities to reduce disaster risk. Federal efforts can focus attention on disaster risk reduction by creating resilience goals in all relevant national strategies and linking those goals to an overarching strategic vision. Federal efforts can also facilitate coordination and promote governance approaches that mitigate fragmentation by requiring or funding mechanisms to enhance the continuity of different efforts across jurisdictions. In addition, because much of the nation's infrastructure is not owned and operated by the federal government, many resilience-related decisions ultimately are made by nonfederal actors, such as the states, and those decision makers face competing priorities. Incentives—in the form of federal regulatory requirements or as conditions of federal grant programs and cooperative agreements—can help promote investment in disaster risk reduction. As shown in figure 1, the framework is organized around three broad overlapping principles and a series of questions to guide analysis that can help users consider opportunities to enhance federal efforts to promote disaster resilience.

²⁶[GAO-20-100SP](#).

Figure 1: GAO’s Disaster Resilience Framework



Source: GAO. | GAO-20-127

Each of the principles includes more specific sets of actions that those who oversee or manage federal efforts can consider when analyzing opportunities to enhance national disaster resilience. For example, according to the framework, bringing together disparate agency missions and resources that support disaster risk reduction can help to build a

national culture of resilience. Accordingly, federal efforts can (1) facilitate coordination across programs, (2) facilitate the combination of federal funding streams, and (3) leverage the expertise of nonfederal partners.

Benefits and Costs of Climate Resilience Projects

Information on the benefits and costs of climate resilience projects suggests that such projects can convey benefits, such as protecting life and property from climate hazards, according to the *Fourth National Climate Assessment* and other reports we reviewed.²⁷ According to the *Fourth National Climate Assessment*, information on benefits is lacking in many sectors, though some information exists on the benefits and costs of resilience efforts in certain sectors, such as resilience efforts in coastal areas, resilience efforts designed to protect against riverine flooding (i.e., flooding that occurs when river flows exceed the capacity of the river channel), and resilience efforts related to agriculture at the farm level. According to this assessment, some of the actions in these sectors, at least in some locations, appear to have large benefit-cost ratios—both in addressing current variability and in preparing for future change. However, benefits may not exceed costs in some instances. According to the *Fourth National Climate Assessment*, more research is needed to comprehensively assess the benefits of specific strategies that individuals and organizations are considering.

Similarly, several other reports we reviewed also suggest that projects can convey benefits such as protecting life and property from climate hazards. For example, a 2018 interim report by the National Institute of Building Sciences estimated that benefits to society (i.e., homeowners and communities) would exceed costs for several types of resilience projects by protecting lives and property and preventing other losses, though precise benefits are uncertain.²⁸ Specifically, this interim report examined a sample of hazard mitigation grants awarded by FEMA, the Economic Development Administration, and the Department of Housing and Urban Development (HUD) from 1993 through 2016 to address

²⁷Lempert et al., “Reducing Risks through Adaptation Actions,” in *Fourth National Climate Assessment*, vol. 2.

²⁸Multihazard Mitigation Council, National Institute of Building Sciences, *Natural Hazard Mitigation Saves: 2018 Interim Report* (Washington, D.C.: 2018).

various hazards.²⁹ These hazards included fires in the wildland-urban interface (i.e., fires in areas where homes are built near or among lands prone to wildland fire), hurricane- and tornado-force winds, and riverine floods. According to the interim report, for every grant dollar the federal government spent across the projects examined in the report, over time, society is estimated to accrue benefits amounting to the following:

- About \$3 on average from projects addressing the effects of fire in the wildland-urban interface, with most benefits (approximately 70 percent) coming from the protection of property (i.e., avoiding property losses).
- About \$5 on average from projects to address hurricane- and tornado-force winds, with most benefits (approximately 90 percent) coming from the protection of lives. This includes avoiding deaths, nonfatal injuries, and cases of post-traumatic stress.
- About \$7 on average from projects that buy out buildings prone to riverine flooding, with most benefits (approximately 65 percent) coming from the protection of property.³⁰

The interim report also projected that society could accrue benefits amounting to about \$11 on average for every dollar invested in designing new buildings to meet the 2018 International Building Code and the 2018 International Residential Code—the model building codes developed by

²⁹Benefit estimates from federal grants convey the magnitude of potential long-term benefits to society, primarily homeowners and local residents, and are not precise estimates. For more information on these potential benefits, visit the following link: <https://www.nibs.org/page/mitigationsaves>. Multihazard Mitigation Council, National Institute of Building Sciences, *Natural Hazard Mitigation Saves: 2018 Interim Report*.

³⁰Mitigation strategies included in the evaluation of federal grants include managing vegetation to reduce fuels and replacing wooden water tanks and roofs for fire resistance; adding hurricane shutters, tornado-safe rooms, and other common measures for wind resistance; and acquiring and demolishing buildings for flood resistance. The interim report analyzes a small sample of grant projects for high-risk buildings selected using specific criteria. Extrapolation of this analysis to a broader set of grants needs to be interpreted in the context of the selected sample. Benefits in the interim report are estimated using many assumptions at all stages of the analysis and are subject to a high degree of model uncertainty and sensitivity. The interim report specifically assesses the impacts of 23 years of federal hazard mitigation grants and estimates that for every \$1 the federal government spent from 1993 through 2016, it could save \$6, on average, but this ratio includes efforts to address earthquakes, which are outside the scope of this review. Benefits are calculated over a 75-year benefit period, using a 2.2 percent discount rate for non-health benefits and a 0 percent discount rate for health and life-protection benefits. The interim report does not apply the time value of money to discount human deaths and health (i.e., nonfatal injuries and post-traumatic stress).

the International Code Council—with most benefits (about 45 percent) coming from the protection of property.³¹ The interim report has been cited by the Congressional Budget Office, in congressional hearings, and in other arenas to describe the benefits of investing in resilience. However, the benefit-cost ratios provided in the interim report are based on a relatively narrow set of disaster-loss data, and the report is not comprehensive.³²

In addition to conveying climate resilience benefits, such as protecting lives and property, climate resilience projects can also convey co-benefits—benefits beyond the primary protective function of resilience projects—according to the *Fourth National Climate Assessment* and several reports we reviewed. For example, according to a report by the National Academies, restoring coastal wetlands—a type of nature-based resilience project—may reduce an area’s vulnerability to coastal storms but could also provide co-benefits such as increasing biodiversity by creating new breeding grounds for fish and improving recreation and tourism amenities, thereby expanding the total potential benefits of a project.³³ USGCRP officials we interviewed also told us that projects can

³¹Code-related mitigation strategies include: (1) for flood resistance, incorporating at least 1-foot freeboard into the elevation requirements to comply with the 2018 international codes (potentially saving \$6 on average); (2) for resistance to hurricane winds, complying with roofing and a variety of openings and connection detailing requirements in the 2018 international codes (potentially saving \$10 on average); and (3) for resistance to earthquakes, building new buildings stronger and stiffer relative to 1990 construction to comply with the 2018 international codes (potentially saving \$12 on average). However, as mentioned earlier, earthquakes are outside the scope of this review. Potential beneficiaries for code-related mitigation strategies include developers, title holders and lenders, and tenants and communities. The International Code Council is a member-focused association with over 64,000 members dedicated to developing model codes and standards used in the design, build, and compliance process to construct safe, sustainable, affordable, and resilient structures. The report used a baseline of buildings constructed to a prior generation of codes represented by 1990s-era design and National Flood Insurance Program requirements.

³²Methods used in the report to produce results vary considerably across types of climate hazards and categories of benefits. Benefits are estimated across several categories of avoided damages, including property damage, temporary living expenses, insurance costs, business interruptions, mortality, injury, and mental health conditions.

³³According to the National Oceanic and Atmospheric Administration’s Office of Coastal Management, wetlands can protect coastal communities from powerful storm surge by buffering waves and absorbing additional water. The National Oceanic and Atmospheric Administration estimates that coastal wetlands in the United States provide about \$23 billion in storm protection services each year. See <https://coast.noaa.gov/data/nationalfacts/pdf/hand-out-natural-infrastructure.pdf> and National Research Council of the National Academies, *America’s Climate Choices: Panel on Adapting to the Impacts of Climate Change, Adapting to Impacts*.

convey a broad range of other co-benefits, including improvements in economic opportunity, human health, equity, and national security. However, according to the *Fourth National Climate Assessment*, quantifying these co-benefits can be difficult because different people value benefits differently.

Several factors can influence the likelihood that the benefits from resilience projects exceed the cost of implementing and maintaining the projects. For example, benefits from climate resilience projects implemented in high-risk locations, such as areas more exposed to hurricanes, are likely to be higher and therefore exceed project costs than projects implemented in other, lower-risk areas, according to one report we reviewed.³⁴ Similarly, projects that protect high-value assets may also be more likely to have benefits that exceed costs, according to this report. Several factors that affect the extent to which project benefits exceed costs remain uncertain, according to several reports. For example, according to the *Fourth National Climate Assessment*, benefit–cost ratios can have large uncertainties associated with estimates of costs, the projection of benefits, and the economic valuation of benefits. Furthermore, according to the assessment, the benefits and costs of resilience projects are larger in scenarios with high emissions, but the level of future emissions remains uncertain.

The Federal Government Has Invested in Projects That May Convey Some Climate Resilience Benefits but Does Not Have a Strategic Investment Approach

Individual federal agencies have provided ad hoc funding for projects that may convey some climate resilience benefits, but our past work demonstrates an absence of government-wide strategic planning for climate change, and the federal government has not implemented key recommendations to improve strategic planning for climate resilience. In addition, the federal government does not have a strategic federal approach for investing in the highest priority climate resilience projects that includes periodically identifying and prioritizing projects as supported by enterprise risk management practices and our Disaster Resilience Framework.

³⁴Reguero et al., “Comparing the Cost Effectiveness of Nature-based and Coastal Adaptation: A Case Study from the Gulf Coast of the United States,” *PLoS ONE*, vol. 13, no. 4 (2018).

The Federal Government Has Invested in Projects That May Convey Some Climate Resilience Benefits

Individual federal agencies have provided ad hoc funding, using existing federal programs, for projects that may convey some climate resilience benefits. However, current federal climate resilience investments primarily address agencies' own mission areas in the context of both authorized activities and investment guidelines put forth by the Office of Management and Budget (OMB), according to one official associated with the Mitigation Framework Leadership Group who commented on a draft of this report.³⁵ While the primary purpose of these programs is not defined as enhancing resilience to climate change and the programs are not coordinated to achieve a strategic climate resilience goal, agencies have used these programs to fund projects that, in practice, can help communities become more resilient to hazards that may become more frequent and intense as a result of climate change. For example:

- FEMA's Pre-Disaster Mitigation Grant Program provides funding to assist states, local governments, territories, and tribes in their efforts to enhance disaster resilience against various natural hazards before a disaster occurs and, according to FEMA officials, to reduce loss of life and damages from future disasters.³⁶ The program's authorizing legislation, section 203 of the Stafford Act, does not specifically mention climate change, but in practice, individual mitigation projects may convey climate resilience benefits. However, as we reported in July 2015, program rules emphasized planning as opposed to "brick

³⁵This official explained that investments federal agencies make according to their missions and operations must conform to OMB guidelines and, by law, agencies cannot make other kinds of investments. This official also explained that many federal agencies incorporate climate preparedness and resilience into planning and implementation and that climate change is one of a number of conditions that present challenges, opportunities, and constraints for federal investments.

³⁶According to FEMA officials, the Flood Mitigation Assistance Grant Program is another proactive program aimed at building community resilience before a disaster strikes by reducing overall risk to the population and structures from future hazard events while also reducing reliance on federal funding in future disasters.

and mortar” projects, according to FEMA officials.³⁷ Furthermore, funding for this program has historically fluctuated and been small compared to total disaster funding. Additionally, individual funding awards have been capped. This may preclude funding of large-scale climate resilience projects, according to FEMA officials. However, as a result of DRRRA, FEMA developed a new program—the Building Resilience Infrastructure and Communities Program—with annual appropriations that are expected to increase, and the agency is currently developing new program rules.³⁸

- HUD provides funding for disaster recovery and hazard mitigation using Community Development Block Grant Disaster Recovery funds—flexible funds to address a wide range of community development needs after a disaster. Enhancing resilience to climate change is not a primary purpose of these funds, and funds are appropriated irregularly through supplemental appropriations legislation tied to specific disasters. Nevertheless, when funds are appropriated, they can be used for mitigation projects that could convey climate resilience benefits. For example, in 2013 and 2014, HUD funded two competitions—Rebuild by Design (\$930 million) and the National Disaster Resilience Competition (\$1 billion)—aimed at promoting community resilience to future disasters. In 2018, HUD also allocated nearly \$16 billion to support mitigation activities.³⁹
- The U.S. Army Corps of Engineers funds large-scale civil works projects—such as sea walls and levees—that, among other things,

³⁷We reported that the Pre-Disaster Mitigation Grant Program limited states to a certain number of applications per year. For instance, in fiscal year 2014, states could submit a maximum of 11 applications, of which only two could be for projects, as opposed to hazard mitigation planning or management costs. According to officials, this limits the states’ capacities to implement “brick and mortar” hazard mitigation projects with the pre-disaster grant funds. [GAO-15-515](#). According to FEMA officials, FEMA’s Advance Assistance Program is now eligible for funding under the Pre-Disaster Mitigation Grant program. This program can be used to develop mitigation strategies and obtain data to prioritize, select, and develop community mitigation projects for future funding, although there is no funding guarantee, according to these officials.

³⁸See Congressional Research Service, *The Disaster Recovery Reform Act of 2018 (DRRA): A Summary of Selected Statutory Provisions*, R45819 (Washington, D.C.: July 8, 2019).

³⁹According to HUD, the department made nearly \$16 billion in grants available through the Community Development Block Grant Disaster Recovery program to support mitigation activities in areas that experienced major presidentially declared disasters since 2015.

Federal Mainstreaming Efforts

Some agencies have made efforts to manage climate change risk within existing programs and operations—a concept known as mainstreaming—and these efforts may convey climate resilience benefits. For example, an agency planning to build a seawall to protect a coastal facility might build it higher to account for rising sea level projections. Alternatively, the U.S. military may consider climate change as part of existing construction plans on coastal installations by, for example, raising a building to include a “sacrificial” first floor and protecting critical assets—such as computer servers—from potential flooding by locating them on the building’s higher floors. The agency may use the sacrificial floor for parking.

According to the U.S. Global Change Research Program’s *Fourth National Climate Assessment*, a significant portion of climate risk can be addressed by mainstreaming, which can provide many climate resilience benefits. However, according to the assessment, the practice may prove insufficient to address the full range of climate risks.

Additional, strategic federal investments in large-scale projects—such as those discussed in our report—may also be needed to manage some of the nation’s most significant climate risks, since climate change cuts across agency missions and poses fiscal exposures larger than any one agency can manage.

Source: GAO analysis based on review of past work, including GAO, *Climate Change Adaptation: DOD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts*, [GAO-14-446](#) (Washington, D.C.: May 30, 2014); and U.S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2. (Washington, D.C.: 2018). | GAO-20-127

aim to reduce flooding and storm damage.⁴⁰ These and other projects have the potential to convey climate resilience benefits by protecting communities from damage from flooding, storms, and other extreme weather events that may be exacerbated by climate change. The Corps of Engineers’ policy is to integrate climate change preparedness and resilience in all activities—a concept known as mainstreaming.⁴¹ However, the Corps’ civil works program balances several diverse missions related to navigation, ecosystems management, and flood control, among others. As a result, while projects may individually incorporate consideration of climate change risk and resilience, they may not be prioritized to address the most severe expected future climate change risks.

Even with ad hoc agency efforts, federal investment in projects specifically designed to enhance climate resilience to date has been limited. As stated in our Disaster Resilience Framework, most of the federal government’s efforts to reduce disaster risk are reactive, and many revolve around disaster recovery.⁴² To a lesser extent, the federal government also invests in activities to reduce risks not associated with a specific, recent disaster. As we reported in April 2018, since 1993 OMB has reported more than \$154 billion spread across the government for federal activities to understand and address climate change.⁴³ However,

⁴⁰According to the U.S. Army Corps of Engineers website, the civil works program includes water resource development activities such as flood risk management, navigation, recreation, and infrastructure and environmental stewardship. U.S. Army Corps of Engineers, “Civil Works,” accessed May 22, 2019, <https://www.usace.army.mil/Missions/Civil-Works/>

⁴¹U.S. Army Corps of Engineers, *Adaptation Policy Statement* (June 2014).

⁴²[GAO-20-100SP](#).

⁴³OMB has reported federal climate change funding in three main categories since 1993—clean energy technology to reduce emissions; science to better understand climate change; and international assistance for adaptation, clean energy, and sustainable landscapes. Most federal funding since 1993 has been dedicated to technology efforts. See GAO, *Climate Change: Analysis of Reported Federal Funding*, [GAO-18-223](#) (Washington, D.C.: Apr. 30, 2018).

over that time frame, OMB reported only minimal funding directed specifically at climate resilience projects.⁴⁴

Our Past Work Shows an Absence of Government-wide Strategic Planning for Climate Change

We have issued multiple reports that review the federal government's approach to addressing climate change, and these reports demonstrate an absence of government-wide strategic planning for climate change.⁴⁵ Specifically, our past work identifies limitations related to strategic planning for climate change that include a lack of coordination, prioritization, and consolidation of strategic priorities. For example, we reported in October 2009 that the federal government's emerging climate resilience activities were carried out in an ad hoc manner and were not well coordinated across federal agencies.⁴⁶ In May 2011, we reported that federal officials did not have a shared understanding of strategic government-wide priorities related to climate change.⁴⁷ In the same report, we found that there was not a consolidated set of strategic priorities integrating climate change programs and activities across the federal government.

In our March 2019 high-risk update, we reported that one area of government-wide action needed to reduce federal fiscal exposure is in the federal government's role as the leader of a strategic plan that coordinates federal efforts and informs state, local, and private-sector

⁴⁴As we found in April 2018, OMB reported on federal funding for wildlife and natural resource climate resilience activities from fiscal years 2010 through 2013. However, the data OMB reported in the climate resilience category do not fully represent federal climate resilience funding because they only include data from the Department of the Interior. OMB reported Department of the Interior funding for climate resilience as follows: fiscal year 2010, \$65 million; fiscal year 2011, \$87 million; and fiscal year 2012, \$88 million. [GAO-18-223](#).

⁴⁵Several federal agencies prepared climate change adaptation plans that outline strategies to reduce the vulnerability of federal programs, assets, and investments to the impacts of climate change. These plans were prepared in response to the 2013 Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*, which has been rescinded. These plans were agency-specific and do not represent a government-wide strategic planning effort for climate change.

⁴⁶GAO, *Climate Change Adaptation: Strategic Federal Planning Could Help Government Officials Make More Informed Decisions*, [GAO-10-113](#) (Washington, D.C.: Oct. 7, 2009).

⁴⁷GAO, *Climate Change: Improvements Needed to Clarify National Priorities and Better Align Them with Federal Funding Decisions*, [GAO-11-317](#) (Washington, D.C.: May 20, 2011).

action.⁴⁸ For this 2019 high-risk update, we assessed the federal government's progress since 2017 related to climate change strategic planning against five criteria and found that the federal government had not met any of the criteria for removal from the high-risk list. Specifically, since GAO's 2017 high-risk update, four ratings regressed to "not met" and one remained unchanged as "not met." (See fig. 2). We have made 62 recommendations related to the climate change high-risk area, 17 of which address improving federal climate change strategic planning. As of August 2019, no action had been taken toward 14 of those 17 recommendations—one dating back to 2003.⁴⁹

⁴⁸[GAO-19-157SP](#).

⁴⁹Based on the most current information available as of August 2019, of the 17 recommendations related to strategic planning, 11 were closed as not implemented, three were closed as implemented, and three remain open.

Figure 2. Federal Progress since 2017 Related to Climate Change Strategic Planning

GAO's High-Risk List

Since the early 1990s, GAO's high-risk list has called attention to agencies and program areas that are at high risk due to their vulnerabilities to fraud, waste, abuse, and mismanagement, or are most in need of transformation. Every 2 years at the start of a new Congress, GAO reevaluates agency progress in addressing issues on the high-risk list against five criteria to determine if progress has been made. The criteria are (1) leadership commitment to address the risk, (2) agency capacity to resolve the risk, (3) a corrective action plan for addressing the risk, (4) a program to monitor the effectiveness of corrective measures, and (5) ability to demonstrate progress in resolving the high-risk area.

• **Leadership commitment:** not met. A March 2017 Executive Order (E.O. 13783) revoked policies, including the Climate Action Plan and a 2013 Executive Order (E.O. 13653), that we previously found had demonstrated leadership support for reducing aspects of fiscal exposure to climate change.^a

• **Capacity:** not met. A May 2018 Executive Order (E.O. 13834) revoked a 2013 Executive Order (E.O. 13693), which we had previously found partially met this criterion.^b Specifically, E.O. 13693 had directed the Office of Personnel Management to include resilience in federal training and also directed the creation of interagency workgroups to address, among other things, resilience planning in coordination with states and other stakeholders.

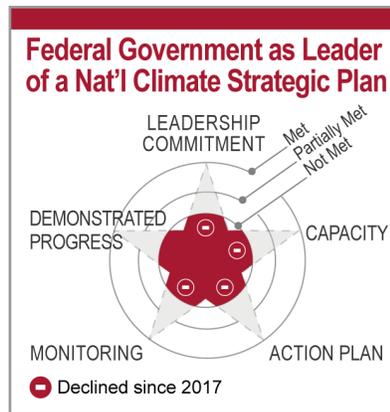
• **Action plan:** not met. The two aforementioned executive orders (13783 and 13834) withdrew previous direction to develop resilience plans and strategic sustainability performance plans that identified agency actions to prepare for climate change impacts and improve resilience.^c

• **Monitoring:** not met. Executive orders 13783 and 13834 also eliminated monitoring mechanisms that we previously found had partially met this criterion. Specifically, E.O. 13783 revoked

E.O. 13653, which had directed agencies to submit resilience plans to Council on Environmental Quality and the Office of Management and Budget (OMB) for review, and E.O. 13834 revoked E.O. 13693, which had directed OMB to evaluate agencies' strategic sustainability performance.

• **Demonstrating progress:** not met. The federal government has not implemented key recommendations in this area. This includes (1) a May 2011 recommendation to develop a strategic plan to guide the nation's efforts to adapt to climate change that includes clear federal priorities that reflect the full range of climate-related federal activities and that establishes clear roles, responsibilities, and working relationships among federal, state, and local governments; (2) a September 2017 recommendation to use information on potential economic effects from climate change to help identify significant climate risks and craft appropriate federal responses; and (3) an April 2018 recommendation to provide information on fiscal exposures related to climate change

to Congress in conjunction with future reports on climate change funding.^d As of our 2019 update to our high-risk list, the Executive Office of the President and OMB had not implemented any of these recommendations.^e



Source: GAO-19-157SP (GAO High Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas). | GAO-20-127

^aExecutive Order 13783, *Promoting Energy Independence and Economic Growth* (Mar. 28, 2017). Executive Order 13653, *Preparing the United States for the Impacts of Climate Change* (revoked) (Nov. 6, 2013).

^bExecutive Order 13834, *Efficient Federal Operations* (May 17, 2018). Executive Order 13693, *Planning for Federal Sustainability in the Next Decade* (revoked) (Mar. 19, 2015).

^cThe Mitigation Framework Leadership Group, an intergovernmental coordinating body, finalized the National Mitigation Investment Strategy in August 2019. However, as noted, our review of the strategy indicates that it does not include a detailed strategic approach to prioritize investments for disaster risk reduction that explicitly accounts for future climate change risks. According to FEMA officials, the strategy sets goals and recommendations that set the stage for developing approaches to address changing conditions.

^dGAO, *Climate Change: Improvements Needed to Clarify National Priorities and Better Align Them with Federal Funding Decisions*, GAO-11-317 (Washington, D.C.: May 20, 2011); *Climate Change:*

Information on Potential Economic Effects Could Help Guide Federal Efforts to Reduce Fiscal Exposure, [GAO-17-720](#) (Washington, D.C.: Sept. 28, 2017); and *Climate Change: Analysis of Reported Federal Funding*, [GAO-18-223](#) (Washington, D.C.: Apr. 30, 2018).

[°]GAO, *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas*, [GAO-19-157SP](#) (Washington, D.C.: Mar. 6, 2019).

The Federal Government Does Not Have a Strategic Approach for Investing in Climate Resilience Projects

The federal government does not have a strategic approach for investing in climate resilience projects—that is, an intentional, cross-cutting approach in which the federal government identifies and prioritizes projects for the purpose of enhancing climate resilience.⁵⁰ Federal agencies may take actions to invest in projects with potential climate resilience benefits related to their own mission areas using funds from federal programs designed for other purposes. In addition, the National Climate Assessment provides high-level information on what is known about observed and projected climate risks in the United States. However, no federal entity looks holistically at the federal government’s investments to strategically prioritize projects to ensure they address the nation’s most significant climate risks and provide the highest net benefits relative to other potential projects. Several stakeholders told us that the federal government’s emphasis has been on funding post-disaster efforts instead of funding resilience projects before a disaster occurs. This is consistent with findings from our July 2015 report that most federal funding for hazard mitigation is only available after a disaster.⁵¹ In addition, according to FEMA officials, some of the agency’s hazard mitigation programs are designed to empower state and local governments to determine their mitigation funding priorities, and these state and local priorities may or may not align with the federal interest.

Although we did not identify a government-wide strategic approach specifically for investing in climate resilience projects, the National Mitigation Investment Strategy—a national effort under way to plan for pre-disaster resilience investments—represents a potential cross-agency vehicle for climate resilience planning. However, the strategy does not

⁵⁰To make this assessment, we reviewed documents describing federal climate change activities, past GAO work, and related reports as well as confirmed this finding with stakeholders we interviewed, including those from USGCRP and the Mitigation Framework Leadership Group.

⁵¹For example, we reported that for fiscal years 2011 through 2014, FEMA obligated more than \$3.2 billion for the Hazard Mitigation Grant Program for post-disaster hazard mitigation while obligating approximately \$222 million for the Pre-Disaster Mitigation Grant Program. [GAO-15-515](#). In providing comments on a draft version of this report, FEMA officials told us that post-disaster hazard mitigation assistance could also reduce the impacts of future events.

specifically address climate change or identify and prioritize specific climate resilience projects. In July 2015, we recommended that the Mitigation Framework Leadership Group—a multi-agency group led by FEMA to promote coordination of hazard mitigation efforts across the federal government—establish an investment strategy to identify, prioritize, and guide federal investments in disaster resilience and hazard mitigation-related activities and make recommendations to the President and Congress on how the nation should prioritize future disaster resilience investments.⁵² In response, in August 2019, the Mitigation Framework Leadership Group released a national strategy for advancing mitigation investment in the United States and increasing the nation’s resilience to natural hazards. The strategy acknowledges our 2015 recommendation and articulates several high-level recommendations that relate generally to climate resilience, including aligning program requirements and incentives. Specifically, the strategy states that successful risk mitigation requires shared priorities, consistent approaches, aligned funding, expanded incentives, and coordination between the federal government and nonfederal partners (i.e., state, local, tribal, and territorial governments and nonfederal organizations). However, the strategy does not explicitly address future climate change risks or include a strategic approach to identify and prioritize specific climate resilience projects for federal investment. According to FEMA officials, the strategy provides an overarching framework that can accommodate strategic investment related to changing conditions that impact disaster resilience. FEMA officials also told us that specific implementation strategies will be addressed in a later phase of the high-level strategy.

A Strategic Approach for Identifying and Prioritizing Resilience Projects Could Better Target Federal Investment at the Greatest Climate Risks

While current federal climate resilience investments are ad hoc and not aligned with the nation’s most significant climate risks, our past work and other sources show that an iterative and strategic risk-informed approach for identifying and prioritizing climate resilience projects could better target federal investment. In particular, in December 2016, we reported that enterprise risk management—which involves identifying and assessing risks, as well as preparing appropriate risk responses—can help federal agencies manage risks, such as preparing for and responding to natural disasters.⁵³ Elements of enterprise risk

⁵²[GAO-15-515](#).

⁵³[GAO-17-63](#).

management call for reviewing a prioritized list of risks and selecting the most appropriate strategy to manage those risks. Furthermore, according to our 2019 Disaster Resilience Framework, the integration of strategic resilience goals across relevant national strategies can help decision makers work toward a common vision and help ensure focus on a wide variety of opportunities to reduce disaster risk.⁵⁴ For example, our framework states that in some cases federal efforts have been hindered by multiple agencies pursuing individual efforts without overarching strategies. In addition, the National Academies highlights the importance of an iterative approach to prioritizing climate resilience actions. According to the National Academies, many current and future climate change impacts require immediate actions to improve the nation's ability to adapt, and possible options need to be prioritized based on where and when urgent action is needed.⁵⁵ In addition, because knowledge about future impacts and effectiveness of response options will evolve, policy decisions to manage climate change risks can be improved if they are made in an iterative fashion, according to the National Academies.

However, no federal entity has been established to implement a strategic investment approach for climate resilience that includes identifying and prioritizing projects for federal investment in an iterative fashion. According to FEMA officials, without Congressional direction, no federal entity will identify and prioritize climate resilience projects for federal investment because existing federal programs are not designed to serve this purpose. Furthermore, investments by federal agencies are made according to their missions and operations within the federal investment guidelines put forth by OMB, according to officials from the Mitigation Framework Leadership Group. These officials explained that by law, agencies cannot make other investments, which hinders a more formalized climate resilience investment strategy at the agency level.

Several stakeholders told us that a strategic approach would allow for a more purposeful, coordinated, and comprehensive federal response to climate risks. Such an approach could help target federal resources toward high-priority projects—namely, those that address the nation's most significant climate risks and provide the greatest expected net benefits relative to other potential projects—that are not already

⁵⁴[GAO-20-100SP](#).

⁵⁵National Research Council of the National Academies, *America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, Adapting to Impacts*.

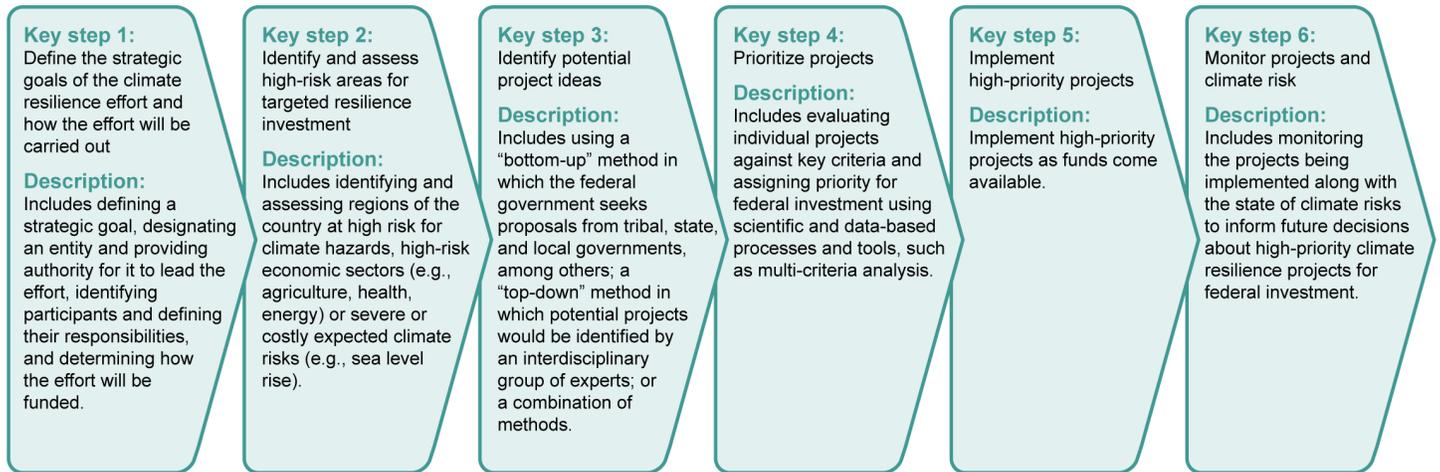
addressed through existing federal programs. In particular, a strategic and iterative risk-informed approach for identifying and prioritizing climate resilience projects for federal investment could supplement the agency-specific approaches to climate resilience investment currently carried out by individual agencies with different statutes, goals, constituencies, and funding streams. Such an approach presents an opportunity to enhance the nation's resilience to climate change and reduce federal fiscal exposure.

Six Key Steps Provide an Opportunity for the Federal Government to Strategically Identify and Prioritize Climate Resilience Projects

Six key steps provide an opportunity for the federal government to strategically identify and prioritize climate resilience projects, based on our review of reports (including a National Academies report and the *Fourth National Climate Assessment*) that discuss adaptation as a risk management process, international standards, our past work (including our enterprise risk management criteria), and interviews with stakeholders.⁵⁶ The six key steps are (1) defining the strategic goals of the climate resilience investment effort and how the effort will be carried out, (2) identifying and assessing high-risk areas for targeted resilience investment, (3) identifying potential project ideas, (4) prioritizing projects, (5) implementing high-priority projects, and (6) monitoring projects and climate risks. See Figure 3.

⁵⁶International Organization for Standardization, *ISO 14090:2019, Adaptation to Climate Change—Principles, Requirements and Guidelines* (June 2019). ASTM International, *Standard ASTM E3032-15e1: Guide for Climate Resiliency Planning and Strategy* (2015). The International Organization for Standardization is a worldwide federation of national standards bodies. ASTM International develops voluntary consensus industry standards.

Figure 3: Key Steps for Identifying High-Priority Climate Resilience Projects for Federal Investment



Source: GAO analysis based on relevant reports, international standards, past GAO work, and stakeholder interviews. | GAO-20-127

We use domestic and international examples—the Louisiana coastal master planning effort and the Canadian Disaster Mitigation and Adaptation Fund (DMAF), respectively—and the aforementioned sources to illustrate the six key steps for identifying and prioritizing climate resilience projects (see text box).

Domestic and International Examples of Approaches for Identifying and Prioritizing Climate Resilience Projects

Two efforts—the Louisiana coastal master planning effort and the Canadian Disaster Mitigation and Adaptation Fund—illustrate approaches for identifying and prioritizing resilience projects. The scale and purpose of each of these approaches is distinct, but both seek to identify projects that help enhance community resilience to several emerging risks, including risks associated with climate change.

Louisiana coastal master planning process: In 2005, the state of Louisiana consolidated coastal planning efforts previously carried out by multiple state and local entities into a single effort carried out by the Coastal Protection and Restoration Authority (CPRA). In this effort, CPRA periodically identifies high-priority coastal resilience projects designed to reduce flood risk and coastal land loss. With involvement from stakeholders from private industry and local communities, CPRA has published three coastal master plans in which it identified and evaluated potential projects. In Louisiana’s 2017 Comprehensive Master Plan for a Sustainable Coast, CPRA identified \$50 billion in high-priority projects to be implemented as funding becomes available.

Canadian Disaster Mitigation and Adaptation Fund: In 2018, the federal government of Canada launched the Disaster Mitigation and Adaptation Fund (DMAF), which seeks to enhance resilience by addressing the potential impacts of climate change in Canada. Canada’s DMAF is a financial assistance program that provides funds to other entities (e.g., Canadian provinces and territories, not-for-profit and for-profit organizations, local governments, and indigenous communities) for implementation. This US\$1.5 billion fund will provide contributions over 10 years for large-scale, nationally significant projects that address a myriad of risks triggered by natural hazards such as floods, wildfires, and droughts. The DMAF also encourages partnerships between eligible recipients, according to a DMAF official. Canada’s DMAF effort is under way.

Source GAO. | GAO-20-127

Step 1. Define the Climate Resilience Investment Effort’s Strategic Goals and How the Effort Will Be Carried Out

Reports, our past work, stakeholders, and our examples from Louisiana and Canada illustrate the importance of several steps to define the climate resilience investment effort, including defining the efforts’ strategic goals, designating an entity and providing authority for it to lead the effort, identifying participants and defining responsibilities, and determining how the effort will be funded.

Defining the Strategic Goals of the Effort

Clear strategic goals can yield more effective decisions about which projects to prioritize and increase the likelihood that projects are strategically aligned around a common purpose. In October 2011, we

reported that strategic goals explain the purpose of agency programs and the results that they intend to achieve.⁵⁷ Our domestic and international examples also demonstrate the importance of having defined strategic goals. Specifically, Louisiana’s Coastal Protection and Restoration Authority (CPRA) defined five goals to guide its coastal master planning effort: reducing economic losses to homes and business from storm surge-based flooding, promoting sustainable coastal ecosystems, providing habitats for a variety of commercial and recreational activities across the coast, sustaining coastal Louisiana’s cultural heritage, and maintaining a viable working coast to support businesses and industry. The goal of Canada’s DMAF is to strengthen the resilience of Canadian communities through investments in large-scale infrastructure projects of national importance—including natural infrastructure projects—enabling these communities to better manage the risk associated with current and future natural hazards such as floods, wildfires, and droughts. This includes natural hazards that may be exacerbated by climate change.

Several stakeholders we interviewed identified potential strategic goals for a federal climate resilience investment effort, including increasing the resilience of communities to climate hazards and reducing federal fiscal exposure to climate change. Furthermore, several stakeholders explained that a goal of federal resilience investment should include helping communities that do not have the capacity to implement climate resilience projects on their own for various reasons such as limited funds to plan and implement such projects. According to one stakeholder we interviewed, because the federal role in investing in climate resilience projects could be broad, it will be necessary to precisely define the nature and scope of the funding effort in a way that is manageable, potentially restricting funding to resilience projects that would not occur without federal intervention. For example, federal resilience investment could focus on large-scale, long-term climate resilience projects that are otherwise too big, expensive, or cross-jurisdictional for local, state, or private-sector actors to address, according to several stakeholders.

⁵⁷GAO, *Environmental Justice: EPA Needs to Take Additional Actions to Help Ensure Effective Implementation*, [GAO-12-77](#) (Washington, D.C.: Oct. 6, 2011). In December 2016, we reported that an essential element of federal enterprise risk management involves aligning the risk management process to agency goals and objectives. In particular, we reported that by aligning the risk management process to the agency mission, agency leaders can address risks via an enterprise-wide, strategically aligned portfolio rather than addressing individual risks within silos. Thus, agency leaders can make better, more effective decisions when prioritizing risks and allocating resources to manage risks to mission delivery. [GAO-17-63](#).

Designating an Entity and Providing Authority for It to Lead the Effort

Based on our review of several reports and past GAO work and discussions with several stakeholders, various types of entities could lead a federal climate resilience investment effort. This could include various organizational arrangements such as a federal entity or interagency collaborative effort—task forces, special councils, interagency offices, or interagency working groups led by agency and department heads or program-level staff.⁵⁸

According to one stakeholder we interviewed, a federal climate resilience investment effort would need a high level of political support to be effective. Several other stakeholders explained that clear authority for the entity to conduct its work would be important to provide legitimacy for the effort and create buy-in among participants and the public. Authority for conducting a resilience effort could be provided via a legislative mandate or executive order. For example, in the case of Louisiana, the state legislature passed a law establishing CPRA, a state agency, in 2005 and providing it with a mandate to develop, implement, and enforce a comprehensive coastal protection and restoration master plan.⁵⁹

Identifying Participants and Defining Responsibilities

Identifying participants and defining responsibilities could involve identifying an interdisciplinary team of experts to help evaluate climate risk, generate project ideas, and evaluate projects. According to several stakeholders, experts should have a breadth of expertise in disciplines such as climate science, resilience, social sciences (e.g., economics), engineering, finance, urban planning, infrastructure, and knowledge of affected systems (e.g., transportation systems, public health, and ecosystems). Several reports and several stakeholders also identified the importance of involving representatives from the communities and groups impacted by potential projects, explaining that doing so can increase

⁵⁸GAO, *Managing for Results: Key Considerations for Implementing Interagency Collaborative Mechanisms*, [GAO-12-1022](#) (Washington, D.C.: Sept. 27, 2012).

⁵⁹The 2005 act stated that coastal land loss in Louisiana continues in catastrophic proportions. Wetlands loss threatens valuable fish and wildlife production and the viability of residential, agricultural, and industrial development in coastal Louisiana. The act also stated that in the past, efforts by the state to address the myriad, interrelated problems of coastal land loss have been inadequate, fragmented, uncoordinated, and lacking in focus and strong direction. Meanwhile, coastal deterioration has escalated to such a point that the potential for vegetated wetlands restoration and enhancement in particular is declining rapidly. A subsequent amendment provided that the state must have a single agency with the authority to articulate a clear statement of priorities and to focus development and implementation of efforts to achieve comprehensive coastal protection.

support for the process and help ensure projects meet communities' needs. For example, a CPRA official told us that building trust and communicating projects' necessity with external stakeholders is extremely important when prioritizing projects because some stakeholders will be directly impacted by certain projects. For this reason, according to CPRA officials, CPRA conducted extensive outreach with community groups and other stakeholders to understand their perspectives on projects under consideration and their potential impacts.

In addition, past GAO work identifies agreement on roles and responsibilities as one of several practices to enhance and sustain collaborative efforts.⁶⁰ According to our September 2012 report, this includes considering clarity of roles and responsibilities and articulating and agreeing to a process for making and enforcing decisions.

Determining How the Effort Will Be Funded

Determining how the effort will be funded includes identifying potential funding options (discussed later in this report) and establishing a budget for investments in resilience projects. Based on the domestic and international examples we reviewed, there are different ways to identify a budget for resilience projects. The budget for Canada's DMAF—the equivalent of about US\$1.5 billion over 10 years—was established through the Canadian budget process. In contrast, Louisiana's CPRA used economic analysis to identify the optimal budget for the coastal master planning effort—\$50 billion—with funds for specific projects to be solicited from various federal and nonfederal sources.⁶¹

⁶⁰[GAO-12-1022](#).

⁶¹CPRA identified a budget of \$50 billion in both its 2012 and 2017 coastal master plans. According to a 2016 performance audit from the Louisiana Legislative Auditor, CPRA had identified \$19.5 billion in potential funding of the \$50 billion needed for projects identified in the 2012 Master Plan. In addition, the audit found that only \$9.7 billion of this potential funding was guaranteed. The audit recommended that CPRA continue to proactively identify additional sources of guaranteed revenue in order to fully implement all Master Plan projects. Louisiana Legislative Auditor, *Oversight of Project Funding and Outcomes. Coastal Protection and Restoration Authority* (January 2016).

Step 2. Identify and Assess High-Risk Areas for Targeted Resilience Investment

High-risk areas for targeted resilience investment could include regions of the country at high risk for climate hazards, economic sectors at high risk (e.g., agriculture, health, or energy), or severe or costly expected climate hazards (e.g., sea level rise), based on our review of several reports, illustrative examples, and interviews with several stakeholders.⁶²

According to the National Academies and several stakeholders we interviewed, climate resilience actions should address climate hazards that are acute (e.g., the risk of more frequent or intense extreme weather) and chronic (e.g., sea level rise).⁶³ In Louisiana, CPRA identified two climate risks—flooding risk and loss of coastal land—for targeted resilience investment.

The U.S. Climate Resilience Toolkit, a website designed to help people find and use tools, information, and subject matter expertise to build climate resilience, and several reports we reviewed identified several factors that influence a community's level of climate risk.⁶⁴ This information can help decision makers identify high-risk areas for targeted resilience investment. First, a community's exposure is influenced by the population or assets exposed to a potential climate hazard (e.g., sea level rise, wildfire). For example, according to the *Fourth National Climate Assessment*, the expansion of human activity into forests and other wildland areas has been observed over the past few decades and is

⁶²This step aligns with the second and third essential elements of the enterprise risk management framework—identify and assess risks—described in our December 2016 report on enterprise risk management. [GAO-17-63](#). Identifying risks involves assembling a comprehensive list of risks, both threats and opportunities that could affect how the agency achieves its goals and objectives. Assessing risks to help prioritize risk response involves examining risks, including considering the risk sources, potential events, their consequences, and their likelihood.

⁶³National Research Council of the National Academies, *America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, Adapting to Impacts*. According to this report, building climate resilience requires actions to address chronic, gradual, long-term changes such as ecosystem shifts and sea level rise, and actions to address natural hazards that may become more frequent or intense. Similarly, according to ISO Standard 14090:2019: *Adaptation to Climate Change*, an organization's assessment of how it will be impacted by climate change should consider chronic, slow-onset impacts as well as acute, sudden impacts due to extreme events.

⁶⁴This interagency initiative operates under the auspices of USGCRP. The site is managed by the National Oceanic and Atmospheric Administration's Climate Program Office and is hosted by the agency's National Centers for Environmental Information. U.S. federal government, "U.S. Climate Resilience Toolkit," accessed July 26, 2019, <https://toolkit.climate.gov/>.

expected to further increase the exposure of people and property to fire risk.⁶⁵ Second, the level of expected impact a community faces from a given climate hazard is influenced by the probability of a given climate hazard and its expected magnitude. Third, a community's vulnerability to these hazards is influenced by its sensitivity to a given climate risk and its adaptive capacity—the ability to cope with stress or adjust to new situations. An area with high exposure but low sensitivity to a given climate hazard may have lower overall risk than an area with lower exposure to the same hazard but higher sensitivity. The degree of adaptive capacity can also serve to increase or decrease risks. For example, according to the *Fourth National Climate Assessment*, tribal nations are especially vulnerable to climate change because of their reliance on threatened natural resources for their cultural, subsistence, and economic needs.⁶⁶

We reported in September 2017 that while estimates of the economic effects of climate change are imprecise due to modeling and information limitations, they can convey useful insight into broad themes about potential damages in different U.S. sectors or regions.⁶⁷ This information could help decision makers identify significant climate risks as an initial step toward managing them and provide insight into high-risk areas for targeted investment. For example, we reported in September 2017 that the two national-scale studies available at the time that examined the economic effects of climate change across U.S. sectors suggested that the potential economic effects of climate change could be significant and

⁶⁵B.M. Sleeter, et al., "Land Cover and Land-Use Change," in *Fourth National Climate Assessment*, vol. 2.

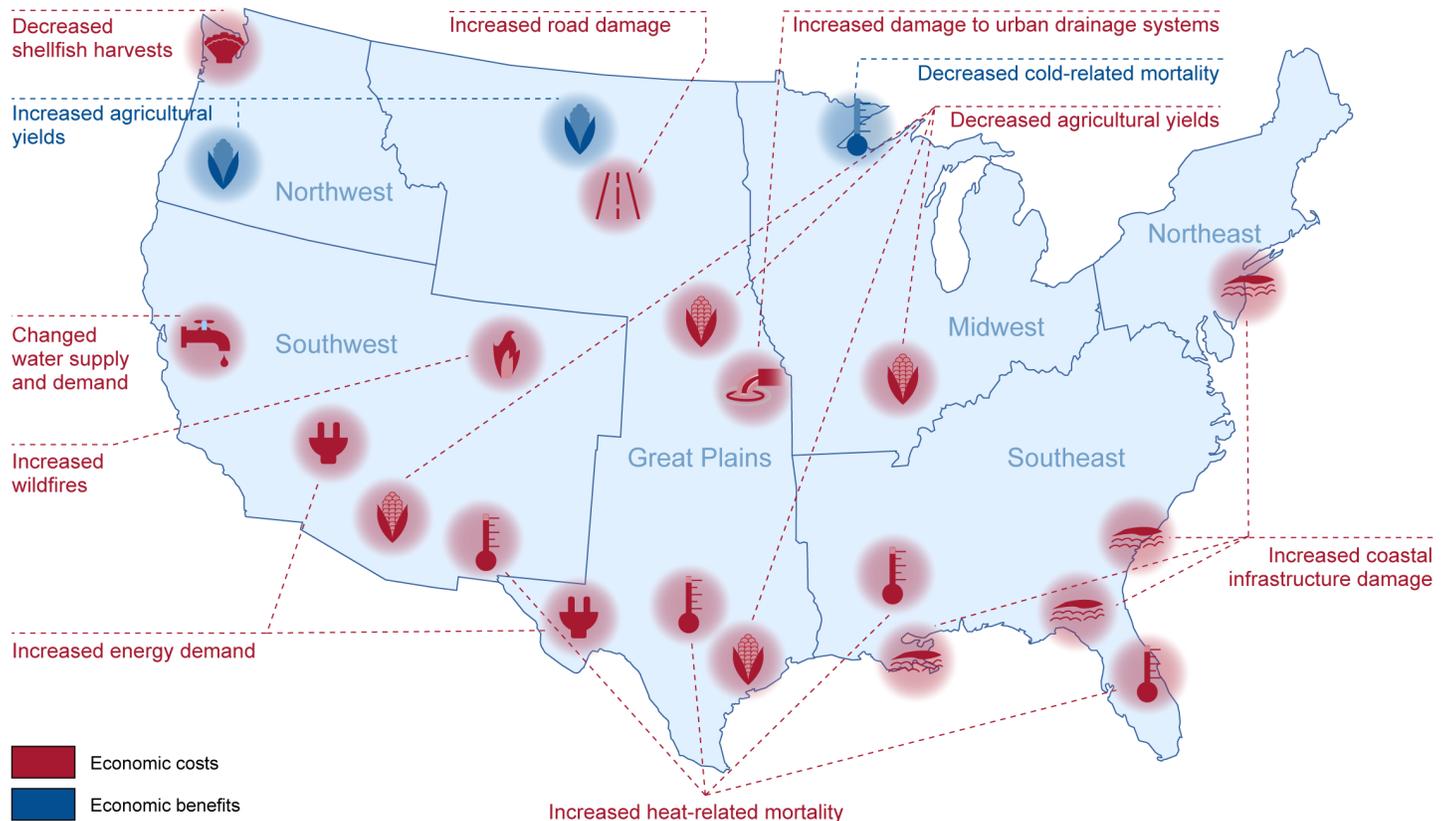
⁶⁶J. Angel, et al., "Midwest," in *Fourth National Climate Assessment*, vol. 2.

⁶⁷[GAO-17-720](#) and [GAO-19-625T](#).

unevenly distributed across sectors and regions.⁶⁸ According to one of the studies, the Southeast, Midwest, and Great Plains regions likely will experience greater combined economic effects than other regions, largely because of coastal property damage in the Southeast and changes in crop yields in the Midwest and Great Plains. (See fig. 4).

⁶⁸These national-scale studies were the Environmental Protection Agency's *Climate Change Impacts and Risk Analysis*—a summary study of an ongoing EPA project—and the Rhodium Group's *American Climate Prospectus*. See Environmental Protection Agency, Office of Atmospheric Programs, *Climate Change in the United States: Benefits of Global Action*, EPA 430-R-15-001 (Washington, D.C.: 2015). The EPA project on which the summary study was based was coordinated by EPA's Office of Atmospheric Programs—Climate Change Division with contributions from national laboratories and the academic and private sectors. The detailed methods and results of the project were published in a 2014 special issue of the peer-reviewed journal *Climatic Change* entitled "A Multi-Model Framework to Achieve Consistent Evaluation of Climate Change Impacts in the United States." An update to this project was used in the *Fourth National Climate Assessment*. Also see Rhodium Group, LLC, *American Climate Prospectus: Economic Risks in the United States* (New York: October 2014). The *American Climate Prospectus* project was funded by the Risky Business Project (a project funded by Bloomberg Philanthropies, the Paulsen Institute, and TomKat Charitable Trust), the Skoll Global Threats Fund, and the Rockefeller Family Fund. The Rhodium Group, LLC, a research consultancy and advisory company, coordinated the effort, which involved authors from universities and the private sector. This study was later published by the Columbia University Press in 2015: Trevor Houser et al., *Economic Risks of Climate Change: An American Prospectus* (New York: Columbia University Press, 2015). An update to this analysis was published in *Science* in June 2017: Solomon Hsiang et al., "Estimating Economic Damage from Climate Change in the United States," *Science*, vol. 356 (2017). [GAO-17-720](#).

Figure 4: Examples of Potential Economic Effects from Climate Change by 2100



Sources: GAO analysis of Environmental Protection Agency, *Climate Change Impacts in the United States: Benefits of Global Action* (Washington, D.C.: 2015), and Solomon Hsiang et al., "Estimating Economic Damage from Climate Change in the United States," *Science*, vol. 356 (2017); Map Resources (map). | GAO-20-127

Note: Examples are shown in approximate locations and do not reflect the relative magnitudes of potential economic effects. In addition, this figure does not depict Alaska, the U.S. Caribbean, Hawaii, and the U.S.-affiliated Pacific Islands, which are where some of the largest observed and projected risks are concentrated, according to USGCRP officials.

In addition, several stakeholders told us that USGCRP’s National Climate Assessment, which describes potential climate change risks to the United States, could help inform decisions about which regions of the country or climate risks to target for resilience investment. In addition, the Notre Dame Global Adaptation Initiative has developed an interactive database that provides information on the level of climate risk U.S. cities face and

these cities' readiness to enhance resilience.⁶⁹ Nevertheless, one official from the Mitigation Framework Leadership Group noted that identifying climate risks is challenging, in part, because opinions about which risks are most urgent will vary according to the perspective of the observer. According to the National Academies, even though there are still uncertainties about the nature, timing, and magnitude of climate change impacts, mobilizing now to increase the nation's resilience can be viewed as an insurance policy against climate change risks.⁷⁰

Step 3. Identify Potential Project Ideas

Identifying potential project ideas that align with high-risk areas for targeted resilience investment is the third step in the process for identifying and prioritizing climate resilience projects for federal investment.⁷¹ Potential projects may differ in purpose and location and could include constructing hard infrastructure (e.g., flood defenses such as seawalls) and natural infrastructure (e.g., wetlands in coastal areas) to protect against climate hazards, relocating a community out of harm's way, or developing a suite of projects designed to collectively address a climate hazard (e.g., wildfire risk or drought) in a particular region of the country, according to several stakeholders we interviewed and based on our review of several reports.⁷² From our interviews with several stakeholders and our review of our examples from Canada and Louisiana, we noted two methods for identifying ideas for resilience

⁶⁹The University of Notre Dame's Global Adaptation Initiative includes an interactive database that provides information on the level of risk cities face from hazards such as flooding, sea level rise, and extreme heat and cold. The database also provides information on these cities' readiness to adapt to these climate risks as measured by several governmental, social, and economic metrics. We did not assess the accuracy of the tool or the appropriateness of its methodology. Nevertheless, it provides an example of the type of information that decision makers may be able to use when identifying high-risk areas on which to focus resilience projects.

⁷⁰National Research Council of the National Academies, *America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, Adapting to Impacts*.

⁷¹This step aligns with the fourth essential element of the enterprise risk management framework—selecting a risk response—described in our December 2016 report on enterprise risk management. This element involves reviewing a prioritized list of risks and selecting the most appropriate treatment strategy to manage the risk. [GAO-17-63](#).

⁷²In addition to climate resilience projects, several reports we reviewed identified other non-project actions that can be taken to build resilience to climate change, including changes to government policies and programs and social and behavioral changes (e.g., household disaster preparation or changing agricultural practices).

projects—“bottom up” and “top down”—that can be used individually or in combination.

Bottom-Up Method

Several stakeholders told us that project ideas could come from a “bottom-up” method in which the federal government seeks proposals from tribal, state, and local governments; regional groups; or other stakeholders for projects. For example, Infrastructure Canada, the federal department that administers the DMAF, sought project ideas from provinces, territories, municipal and regional governments, indigenous groups, and others. Under the DMAF, these entities applied directly to Infrastructure Canada for funding. Likewise, in Louisiana, CPRA also used a “bottom-up” method to identify projects by allowing citizens, state agencies, nongovernmental organizations, academics, and others to submit project ideas. Where necessary, staff at CPRA developed the more detailed plans needed to evaluate and operationalize the projects. CPRA officials said that involving the communities where climate resilience projects will be located in the project identification process helped create support for these projects.

Two stakeholders explained that the process for identifying potential project ideas must be sensitive to the fact that some communities do not have the administrative capacity to develop proposals. Otherwise, project ideas will primarily come from communities with ample institutional capacity, and locations with less administrative capacity—and the climate risks associated with these locations—will be missed. According to a 2014 report by the President’s State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, the federal government can drive more resilient community choices by, among other things, providing technical assistance to states, territories, tribes, and communities that lack capacity to adapt to climate change.⁷³ In 2014, HUD launched the National Disaster Resilience Competition to fund disaster recovery and long-term community resilience in parts of the country that had recently been affected by major disasters. During the first phase of the competition, eligible states and communities impacted by a disaster from 2011 through 2013 could obtain technical assistance through resilience workshops. According to HUD, these workshops

⁷³President’s State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, *Recommendations to the President* (November 2014). The President’s State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience was established by Executive Order 13653, *Preparing the United States for the Impacts of Climate Change*, on November 1, 2013.

provided information and expertise to help communities understand resilience and identify various threats, hazards, economic stresses, and other potential shocks that could impact each community. The workshops also offered eligible applicants tools and concepts to better identify and assess their risk, engage with their communities, choose resilience-building opportunities, and develop strong applications.⁷⁴

Top-Down Method

Several stakeholders told us that projects could be identified through a “top-down” method, in which potential projects would be identified by an interdisciplinary group of federal officials and other experts. According to one stakeholder, a “top-down” method could facilitate consideration of cross-cutting projects that address multiple climate risks and regions of the country. In addition, according to two stakeholders, such a top-down method could help identify projects unlikely to be suggested by local stakeholders for various reasons, such as the local communities not having the administrative capacity to develop and submit such proposals or a local community’s interest being at odds with the national interest (e.g., relocation of a high-risk community when relocation would result in the loss of local tax revenue). However, officials from the Mitigation Framework Leadership Group explained that without the involvement of communities and prioritization of local needs, a top-down approach could be viewed as disconnected from community needs. In Louisiana, CPRA supplemented its “bottom-up” method with “top-down” identification of additional potential projects by, among other things, reconsidering past project proposals that were not selected and working with stakeholders to design potential projects.

Step 4. Prioritize Climate Resilience Projects

Prioritizing projects is the fourth key step in the process for identifying high-priority projects for federal investment.⁷⁵ Based on our review of several reports and interviews with several stakeholders, prioritizing projects for federal investment should involve evaluating individual projects using scientific and data-based processes. For example, according to a 2010 report by the National Academies, managing risk in the context of enhancing resilience to climate change involves using the

⁷⁴In January 2016, the competition awarded almost \$1 billion to eight states and five communities throughout the United States.

⁷⁵This step aligns with the fourth essential element of the enterprise risk management framework—selecting a risk response—described in our 2016 report on enterprise risk management. This element involves reviewing a prioritized list of risks and selecting the most appropriate treatment strategy to manage the risk. [GAO-17-63](#).

best available social and physical science to understand the likelihood of climate impacts and their associated consequences and then selecting and implementing the response options that seem most effective.⁷⁶ Stakeholders we interviewed, the Louisiana example, and our past work indicate the need to solicit feedback from communities on the potential impacts of proposed projects.⁷⁷ Furthermore, according to several stakeholders we interviewed, projects should be prioritized by an independent, interdisciplinary group of experts capable of assessing projects against measurable criteria. For example, according to Canadian officials, Infrastructure Canada seeks considerations on potential projects from two committees of experts: the first one is comprised of a panel of experts from other federal departments, and the other is comprised of nonfederal experts, including urban planners, sustainability professionals, and individuals with various regional expertise. We identified several potential criteria and tools that could be used to evaluate projects and identify those that are high priority, as described below.

Potential Criteria for Evaluating Projects

We identified various potential criteria for evaluating projects and assigning priority for federal investment, based on our review of reports, interviews with stakeholders, and the Louisiana and Canadian examples. Potential criteria fell into three general categories: goal-oriented criteria (i.e., criteria that measure the extent to which a project enhances resilience and meets other goals), efficiency criteria (i.e., criteria that measure a project's ability to maximize efficiency, including by maximizing benefits and minimizing costs), and administrative criteria (i.e., other criteria that program administrators may want to consider). See table 1 for more details. The federal government can select a limited number of criteria for evaluation that align with the overall strategic goals of the climate resilience investment effort, based on our discussions with stakeholders.

⁷⁶National Research Council of the National Academies, America's Climate Choices: Panel on Adapting to the Impacts of Climate Change, *Adapting to Impacts*.

⁷⁷According to our 2016 report on enterprise risk management, when selecting the risk response, subject matter experts noted that it is important to involve stakeholders that may also be affected not only by the risk, but also by the risk treatment. [GAO-17-63](#).

Table 1: Examples of Potential Criteria for Evaluating Proposed Climate Resilience Projects

Goal-oriented criteria	Efficiency criteria	Administrative criteria
Extent to which project reduces the vulnerability of communities, environments, and assets to climate hazards	Extent to which a project is cost-effective—achieves a given benefit at a low cost compared to alternative projects	Extent to which project is feasible
Extent to which project addresses climate hazards that are severe, costly, and likely	Extent to which project’s current and future benefits and co-benefits exceed current and future costs	Extent to which project can be replicated in other communities if successful
Extent to which project helps communities with a high degree of exposure to a climate hazard (e.g., as measured by expected loss of life and health or safety impacts absent a resilience project)	Extent to which project provides net benefits under a wide range of future climate scenarios and time scales	Extent to which project demonstrates novel resilience technique
Extent to which project protects unique or sensitive environments, habitat, and species	Extent to which project is directed toward a community with financial need	Extent to which project diversifies the distribution of projects across hazards and regions
Extent to which project protects assets that are critical, high value, or economically or culturally significant	Extent to which limited alternative options exist to reduce climate risk absent project	Extent to which stakeholders and governments demonstrate interest and commitment in project (e.g., as evidenced by stakeholder and government participation in or financial support of project)
Extent to which project considers system-wide impacts and hazards (e.g., by considering project benefits and risks to neighboring communities)	Extent to which project is unlikely to be implemented without federal investment	Extent to which project is timely and stakeholders are ready to enhance resilience
	Extent to which project enables and complements other resilience efforts	Extent to which project outcomes can be monitored in order to inform future resilience decisions
	Extent to which project reduces current and future federal fiscal exposure	
	Extent to which a project can be modified if future conditions change	
	Extent to which a community being protected by a project is viable in the long-term	

Source: GAO analysis based of related reports and interviews with stakeholders. | GAO-20-127.

- Goal-oriented criteria.** We identified several goal-oriented criteria—criteria that measure the extent to which a project enhances resilience to climate change and meets other goals—that decision makers may want to consider when evaluating which projects to prioritize, based on several reports we reviewed and stakeholders we interviewed. Several reports and several stakeholders suggested prioritizing projects that, among other things, focus on severe or costly climate hazards as well as climate hazards about which there is the most scientific certainty. Several stakeholders we interviewed explained that when prioritizing projects for implementation, it is important to consider a project’s potential to enhance resilience by protecting human lives, health, and safety, and assets that are critical, high-value, or culturally significant.

In addition, several stakeholders told us that decision makers should not place too much emphasis on the monetary value of avoided

property losses from a project because doing so can overemphasize projects that protect high-value assets and leave socially vulnerable populations with limited economic resources less protected. According to one report, the loss of assets is more difficult for a poor household to absorb than a wealthy household that has more assets to begin with and more access to insurance and credit.⁷⁸ Similarly, the *Fourth National Climate Assessment* notes that poor or marginalized populations often face a higher risk from climate change because they live in areas with higher exposure, are more sensitive to climate impacts, or lack the capacity to respond to climate hazards.⁷⁹ Several stakeholders told us that to account for a lack of social equity, it is important to prioritize projects in communities that have limited capacity to enhance resilience without federal financial assistance, including communities with limited financial means.

In addition to these factors, several reports and several stakeholders discussed the importance of considering a project's impacts on the environment, including its ability to protect unique or sensitive environmental habitats or species. Finally, several reports discussed the importance of considering the potential system-wide impacts of a project, including a project's potential to provide benefits as well as the potential that risk may be transferred to neighboring communities. The DMAF applicant's guide provides an example of potential risk transfer, explaining that the construction of new dikes along a river to protect a segment of the floodplain may confine the river, raising water levels upstream and increasing the velocity of the river downstream. This may reduce the hazard in the segment of river immediately adjacent to the structure but will transfer risk to upstream and downstream communities.

- **Efficiency criteria.** We identified several efficiency criteria—criteria that measure a project's ability to maximize net benefits—that decision makers may want to consider when evaluating which projects to prioritize.⁸⁰ Several reports we reviewed identified the importance

⁷⁸Leonardo Martinez-Diaz, "Investing in Resilience Today to Prepare for Tomorrow's Climate Change," *Bulletin of the Atomic Scientists*, vol. 74, no. 2 (2018): p. 70.

⁷⁹Lempert et al., "Reducing Risks through Adaptation Actions," in *Fourth National Climate Assessment*, vol. 2.

⁸⁰OMB Circular A-94, *Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs*, promotes efficient resource allocation through well-informed decision-making by the federal government and provides general guidance for conducting benefit-cost and cost-effectiveness analyses.

of considering how a project's expected benefits compare to its costs to help ensure a project represents an efficient use of federal dollars. With respect to costs, one stakeholder identified the importance of considering the current costs of implementing a project as well as how costs might change in the future if a project's implementation is delayed to a later date. With respect to benefits, several stakeholders indicated that while it can be difficult to estimate the monetary value of some benefits, it is important to consider all expected benefits—including co-benefits—as fully as possible to draw accurate conclusions about how a project's benefits compare to its costs. For example, several stakeholders discussed the need to account for future benefits because much of the value of a climate resilience project may be realized far in the future as climate risks become more pronounced.

In addition, several reports identified ways to account for uncertainty about the specific nature of future climate risks when making decisions about which projects to prioritize. This includes, for example, prioritizing projects that provide benefits under a wide range of future climate scenarios or prioritizing projects that can be modified if future climate conditions are different than expected. In addition to these considerations, several stakeholders also suggested considering the long-term viability of communities being helped by a project. These stakeholders explained that some communities may face climate risks that are so severe over the long term that they preclude cost-effective investments in resilience. They explained that rather than make costly resilience investments in these communities, a more efficient use of federal funds might involve making investments in projects that help transition a community to a safer location. Similarly, according to a 2015 study by the U.S. Army Corps of Engineers, given current and projected sea level and climate change trends, some of the built environment will become unsustainable for communities presently located there, which may mean that communities may have to relocate in a responsible manner to sustain their economic viability and social resilience.⁸¹ Another stakeholder suggested prioritizing resilience projects that are unlikely to be funded without federal investment, such as projects for the public good that do not generate revenue and likely would not attract private investors.

⁸¹U.S. Army Corps of Engineers, *North Atlantic Coast Comprehensive Study: Resilient Adaptation to Increasing Risk* (January 2015).

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- **Administrative criteria.** We identified several additional criteria that federal decision makers investing in climate resilience projects may want to consider when evaluating which projects to prioritize, including whether the project is feasible and timely. One stakeholder identified the importance of using federal dollars to invest in projects with novel resilience techniques since these projects otherwise might be unlikely to receive investment from other sources. For example, the Canadian DMAF awards merit to projects that offer effective solutions through unique innovative ideas. One stakeholder suggested that the federal government may want to consider the overall distribution of projects across hazards and regions to ensure that all hazards and regions of the country are getting at least some investment in resilience.

Tools for Evaluating Projects

Based on our review of several reports and illustrative examples, various tools used individually or in combination could help decision makers evaluate projects in order to identify high-priority ones and visualize project trade-offs.⁸² For example, using multi-criteria analysis involves decision makers identifying potential criteria, assigning weights to the criteria, ranking proposed projects against the weighted criteria, and using the results to compare projects and inform decisions about which projects to implement. In Canada, officials with the DMAF use multi-criteria analysis to rank potential resilience projects against multiple criteria including the extent to which projects strengthen community resilience and reduce the impacts of natural disasters.

Quantitative modeling is another tool that can help decision makers visualize the potential benefits and costs of proposed projects under multiple future climate change scenarios, and thus facilitate identification of high-priority projects. For example, in Louisiana, CPRA used computer modeling tools to evaluate how projects could reduce future land loss and flooding risk, among other effects.⁸³ To account for uncertainty about future climate and economic conditions, the modeling tools estimated project outcomes under multiple future scenarios representing varied

⁸²Several analytical methods can be used to evaluate projects, including benefit-cost analysis, which compares the benefits and costs of different proposed projects. Additionally, “robust decision-making” seeks to estimate how proposed projects perform under a range of plausible futures with the goal of helping decision makers distinguish future conditions in which projects perform well from those in which projects perform poorly. We did not assess the strengths and limitations of these and other analytical methods.

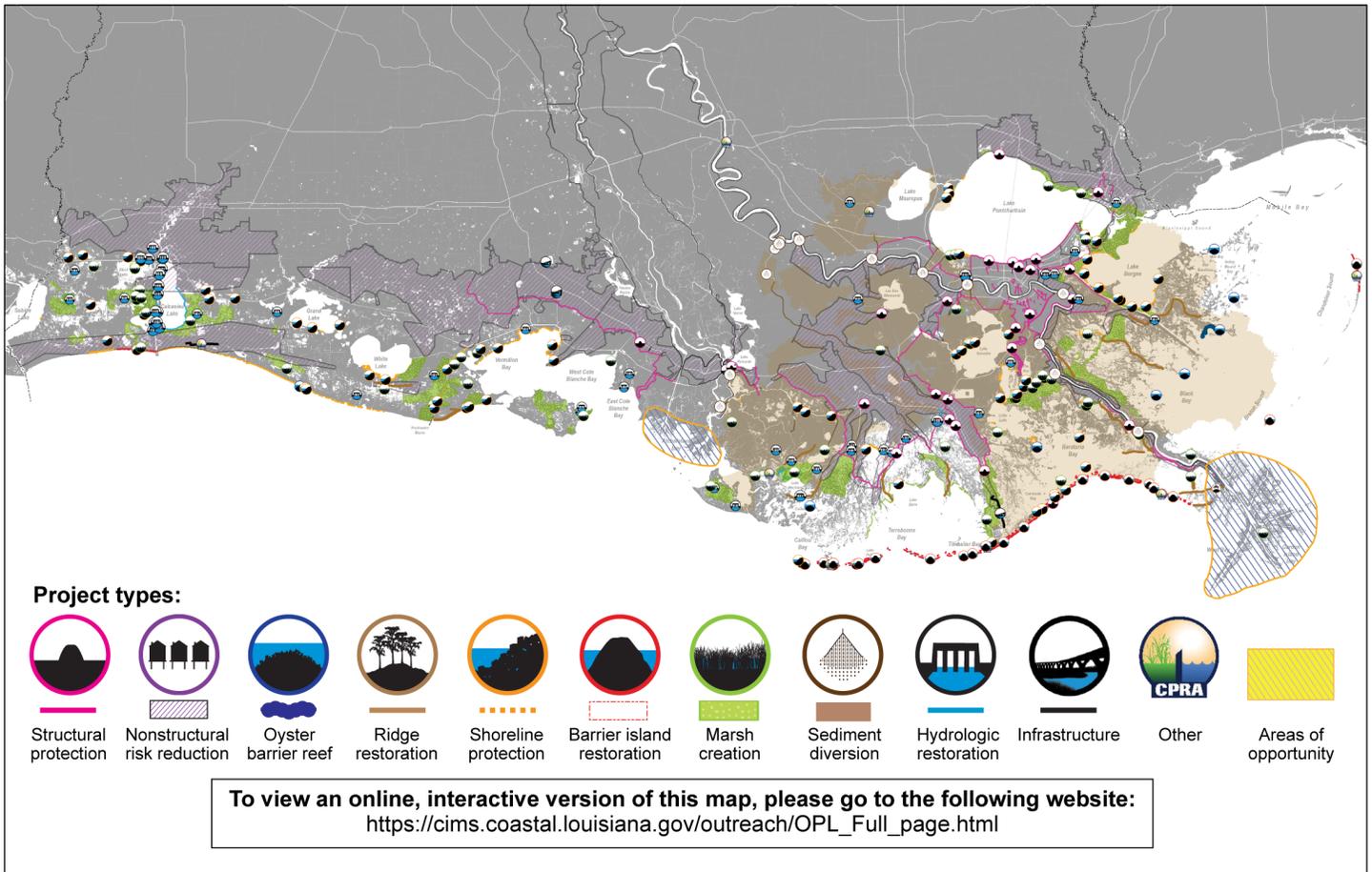
⁸³For more information, see Louisiana Coastal Protection and Restoration Authority, “2017 Coastal Master Plan, Appendix D: Planning Tool” (April 2017).

climate conditions (e.g., sea level rise and the frequency and intensity of storms), economic growth conditions, and other factors. According to the Comprehensive Master Plan for a Sustainable Coast, information from the modeling tools helped support deliberations between CPRA and coastal stakeholders that helped identify high-priority projects for implementation.

Step 5. Implement High-Priority Projects

High-priority resilience projects can be implemented as funds become available, while decision makers consider the optimal timing of project implementation. For example, in Louisiana's coastal master planning effort, CPRA identified \$50 billion in projects to be implemented as various federal and nonfederal funding sources become available. CPRA sequences project implementation based on project effectiveness and benefits in the near term or the long term. See figure 5 for completed, ongoing, and planned projects.

Figure 5: Completed, Ongoing, and Planned Projects Identified through the Louisiana Coastal Master Planning Effort



Source: Louisiana Coastal Protection and Restoration Authority. | GAO-20-127

Project implementation may be influenced by the presence of “windows of opportunity”—periods of time when outside factors make it advantageous or cheaper to implement a project, based on our review of several reports. For example, according to the *Fourth National Climate Assessment*, many jurisdictions and businesses have significant stocks of aging transportation, water, energy, housing, and other infrastructure, and new infrastructure investments and capital stock turnover provides one particularly favorable opportunity for low-cost, proactive climate resilience

investment.⁸⁴ In addition to the availability of funding and windows of opportunity, projects may also need final approval from a decision-making entity—the Minister of Infrastructure, in the case of Canada’s DMAF—before implementation. In the case of Louisiana, the state legislature must approve the overall master plan, although, according to a CPRA official, the legislature does not approve the inclusion of individual projects or project concepts.

Step 6. Monitor Projects and Climate Risk

Physical Model of Lower Mississippi River

Louisiana’s Coastal Protection and Restoration Authority (CPRA) conducts activities to understand the condition of Louisiana’s coast to inform future resilience efforts. For example, CPRA and the Louisiana State University Center for River Studies collaboratively operate a large-scale (90-foot by 120-foot) physical model of the lower Mississippi River (pictured below). The model simulates the Mississippi River’s depth, sediment, and flow and replicates the flow, water levels, and sediment transport of the river. This model simulates 1 year of the Mississippi River in 1 hour. The model serves as an important research and education tool to test large-scale management strategies in the river and the delta. For more information, see the Louisiana State University video at: http://coastal.la.gov/wp-content/uploads/2018/01/CPRA_LSU-Center-for-River-Studies-promo.mp4.



Source: GAO. | GAO-20-127

Monitoring the projects being implemented and the state of climate risks can provide information to inform future decisions about high-priority climate resilience projects for federal investment.⁸⁵ According to the 2010 report by the National Academies, policy decisions to manage risk can be improved if they incorporate the concept of “adaptive management”—monitoring progress in real time and changing management practices based on learning about and recognizing changing conditions.⁸⁶ As an example, Louisiana’s CPRA monitors the performance of projects and the condition of the Louisiana coast using the results from these activities to adjust project management actions and inform future coastal master planning efforts.

⁸⁴Lempert et al., “Reducing Risks through Adaptation Actions,” in *Fourth National Climate Assessment*, vol. 2. According to one official associated with the Mitigation Framework Leadership Group who commented on a draft of this report, age is not a metric for performance or reliability. In some instances aging infrastructure may be functional if well-maintained and may not need to be replaced.

⁸⁵This step and the previous step align with the fifth essential element of the enterprise risk management framework—monitor risks—described in our related 2016 GAO report. This involves monitoring how risks are changing and if responses are successful. [GAO-17-63](#).

⁸⁶National Research Council of the National Academies, *America’s Climate Choices: Panel on Adapting to the Impacts of Climate Change, Adapting to Impacts*.

Options for Focusing Federal Funding on High-Priority Climate Resilience Projects Have Strengths and Limitations

We identified two options for focusing federal funding on high-priority climate resilience projects—coordinating funding provided through multiple existing federal programs with various purposes and creating a new federal funding source specifically for high-priority climate resilience projects—and these options have strengths and limitations.⁸⁷ In addition, our analysis of these sources identified opportunities to increase the climate resilience impact of these two funding options.

Options for Focusing Federal Funding on High-Priority Climate Resilience Projects Have Strengths and Limitations

Options for focusing federal funding on high-priority climate resilience projects—coordinating funding provided through multiple existing federal programs with varied purposes and creating a new federal funding source specifically for high-priority climate resilience projects—have strengths and limitations, based on our review of our prior work, relevant reports, and the Louisiana and Canadian examples, as well as interviews with stakeholders.⁸⁸ See table 2.

⁸⁷We identified these options based on our review of reports and past GAO work, proposed and enacted legislation, discussions with stakeholders, and the Louisiana and Canadian examples.

⁸⁸Stakeholders we interviewed explained that funding for climate resilience can come from many sources in addition to the federal government, including state and local governments and the private sector.

Table 2: Strengths and Limitations of Options for Focusing Federal Funding on High-Priority Climate Resilience Projects

Option	Strengths	Limitations
Coordinating funding from multiple existing federal programs with varied purposes	<ul style="list-style-type: none"> • Leverages existing federal programs • Provides access to specialists and expertise • Provides access to multiple funding sources 	<ul style="list-style-type: none"> • Administratively challenging to coordinate • Programs may be siloed • Programs' primary focus is not climate resilience • Existing programs may be reactive, not proactive
New federal funding source specifically for high-priority climate resilience projects	<ul style="list-style-type: none"> • Administrative simplicity • Focus on high-priority climate resilience projects • Encouragement of cross-sector projects 	<ul style="list-style-type: none"> • Presents practical challenges (e.g., fund would have to be created) • Potential discouragement of mainstreaming in existing federal programs

Source: GAO analysis of reports, prior GAO work, domestic and international examples, and stakeholder interviews. | GAO-20-127.

Multiple Existing Federal Programs with Varied Purposes

One option for focusing funding on high-priority climate resilience projects involves coordinating funds from multiple existing federal programs with varied purposes that were not designed specifically for climate resilience but whose purpose may be compatible with these projects. For example, the state of Louisiana’s coastal master planning effort uses multi-program coordination to fund projects. Specifically, funding for high-priority resilience projects identified in the master plan is provided via several federal and nonfederal programs designed for wetlands restoration, hurricane risk reduction, oil spill recovery, and community development, among other purposes, when the program’s purpose aligns with the project’s purpose. For example, the National Fish and Wildlife Foundation Gulf Environmental Benefit Fund—established in early 2013 as an outcome of plea agreements for the Deepwater Horizon explosion and oil spill—has been used to fund some projects consistent with the master plan that restore barrier islands and implement river diversions. Administrators of these federal and nonfederal funding programs, rather than CPRA, make decisions about how funds are to be spent, but they coordinate with CPRA to ensure decisions are consistent with the master plan.

As with the Louisiana example, high-priority climate resilience projects could be funded via one or more federal programs compatible with the project’s purpose. We identified federal programs related to flood control and hazard mitigation that could be used to fund individual projects that may convey climate resilience benefits, including FEMA’s hazard

mitigation assistance programs (i.e., Building Resilient Infrastructure and Communities, Pre-Disaster Mitigation, Flood Mitigation Assistance, and Hazard Mitigation Grant programs), HUD's Community Development Block Grant Disaster Recovery program, and the U.S. Army Corps of Engineers' civil works program. These programs are managed individually within their agencies and operate under different statutory authorities. However, no federal entity oversees funding for high-priority climate resilience projects, for example, by identifying which existing federal programs could be used to fund particular high-priority projects and coordinating the use of these programs to fund particular projects.

Based on our review of the Louisiana example, interviews with stakeholders, and a report we reviewed, we identified several strengths of coordinating multiple existing federal programs with varied purposes to fund high-priority climate resilience projects:

- **Leveraging existing programs.** This option leverages an existing architecture of related federal programs and could encourage consideration of climate change in routine agency decisions, based on our interviews with several stakeholders and review of a related report. The federal government already has programs that address natural resources (e.g., coastlines, water resources, and forests) and human systems (e.g., public health, housing, and infrastructure) that will be affected by climate change, according to a 2010 report we reviewed and two stakeholders we interviewed.⁸⁹ According to this report and stakeholders, rather than create an additional program to address climate change, it would be better to incorporate consideration of climate change into existing federal decision-making processes. Providing funding for high-priority climate resilience projects via existing federal programs could encourage agencies to think more intentionally about climate change on a regular basis when implementing their programs, according to several stakeholders we interviewed.
- **Providing access to specialists and expertise.** Federal officials who have specialized, sector-specific knowledge (e.g., infrastructure, agriculture, or ecosystems) that can be useful when evaluating which

⁸⁹Joel B. Smith et al., *A Call for Federal Leadership* (March 2010). This report discusses proposals for how the federal government could mainstream climate resilience within and across the federal government. According to the report, many of the natural resources and human systems that will be affected by climate change are already heavily managed systems.

projects to fund may have a greater opportunity to provide input if funding decisions are made within existing federal programs, according to several stakeholders. According to one stakeholder, specialized knowledge that resides within federal agencies is necessary when evaluating the trade-offs of potential projects that address diverse systems and assets. This stakeholder explained that, for example, evaluating a project to strengthen a shipping port against hurricanes requires different expertise than evaluating a project to protect the surrounding community against these hurricanes, and agency officials' specialized knowledge would be useful in evaluating the value of such distinct projects.

- **Providing access to multiple funding sources.** Using multiple existing federal programs means that multiple potential funding streams are available for projects. For example, one stakeholder whose community previously used federal funding to implement large-scale resilience projects said that when funding from one program is not available—for example, because the project does not match that program's purpose or because of insufficient funds—having multiple existing programs from which to seek funding is advantageous. Similarly, Louisiana makes use of multiple federal and nonfederal funding sources to implement projects identified through its master planning effort.

On the basis of our review of the Louisiana example, relevant reports, and interviews with stakeholders, as well as our past work—including the Disaster Resilience Framework—we identified several limitations of using existing programs to fund high-priority climate resilience projects:⁹⁰

- **Administratively challenging to coordinate.** Several stakeholders and a 2016 report we reviewed identified potential administrative challenges associated with using multiple existing programs with varied purposes to fund high-priority projects. For example, CPRA officials told us that the process of coordinating funding from multiple programs for coastal projects is complicated and requires dedicated staff to identify programs, assess whether projects meet program funding criteria, apply for funds, and ensure that program requirements are met. Several stakeholders told us that the budgets of existing programs may be too limited to fund large-scale climate

⁹⁰Some of the limitations discussed in this report stem from difficulties in using multiple programs to invest in climate resilience projects (e.g., the challenge of coordinating programs), while other limitations (e.g., that climate resilience is not the primary focus) relate to program design.

resilience projects and that acquiring funding for a single project through multiple federal programs can be difficult. For example, FEMA officials told us that a potentially relevant FEMA program—the Pre-Disaster Mitigation Grant Program—has limited overall funding and restricts the financial size of a project, making it challenging to fund large-scale projects such as community relocation. Furthermore, according to a 2016 report about lessons learned from the HUD Rebuild by Design competition, grantees faced challenges combining funds from multiple programs to support comprehensive rebuilding visions because each program had its own procedural and administrative requirements, including different timelines for how and when the funds were made available.⁹¹ Similarly, according to our Disaster Resilience Framework, when multiple programs and activities and multiple funding streams are involved, there is a risk that the array of requirements will increase administrative complexity.⁹² As we reported in July 2015, jurisdictional officials engaged in disaster recovery have encountered complex review processes, conflicting federal guidance, and competing federal priorities that diminished the desire of localities to participate in resilience programs.⁹³

- **Programs may be siloed.** Existing federal programs may be “siloed,” according to several stakeholders and two reports we reviewed, meaning that agencies may have limited visibility over how their projects affect other agencies’ mission areas or a limited ability to consider those effects. The two reports we reviewed identified challenges with siloed agency programs, including that they can discourage more holistic resilience projects with benefits in multiple sectors.⁹⁴ For example, according to the 2016 report about lessons learned from the HUD Rebuild by Design competition, program rules may restrict the use of federal funds to certain activities (e.g., flood

⁹¹Rebuild by Design, the Rockefeller Foundation, and the Georgetown Climate Center, *Rebuilding with Resilience: Lessons from the Rebuild by Design Competition After Hurricane Sandy* (November 2016).

⁹²[GAO-20-100SP](#).

⁹³[GAO-15-515](#).

⁹⁴Rebuild by Design, the Rockefeller Foundation, and the Georgetown Climate Center, *Rebuilding with Resilience*. Enterprise, 100 Resilient Cities, and Rebuild by Design, *Safer and Stronger Cities: Strategies for Advocating for Federal Resilience Policy* (March 2018). In discussing infrastructure programs that could be used to fund resilience projects, the *Safer and Stronger Cities* report states that infrastructure investments are made in agency silos and fail to adequately recognize interdependencies between systems or opportunities to design projects that deliver multiple community benefits and services.

control), which can make it difficult to justify the additional cost of a more holistic resilience project with benefits in other sectors (e.g., a larger-scale flood control project with water quality co-benefits). According to the National Academies, climate resilience activities have the potential to be redundant or to work at cross purposes if they are not coordinated across sectors, actors, scale, and time frames.⁹⁵ For example, the National Academies identified potential tradeoffs between resilience activities in the agricultural, water, and ecosystem sectors, such as increased irrigation in response to drought competing with natural ecosystem flows and domestic water needs.

- **Climate resilience is not the primary focus.** Though it may be possible to use some existing federal programs to fund high-priority climate resilience projects, the primary purpose of these programs is not enhancing resilience to climate change, and they are not coordinated toward a common climate resilience goal, according to our work for this report. As a result, relying on existing programs for funding could result in inadvertent, ad hoc funding rather than intentional, coordinated, and strategic funding of high-priority projects, based on our past work and interviews with several stakeholders. In particular, according to FEMA officials, statutory and regulatory limitations could make it challenging to incorporate consideration of climate resilience into existing programs. Furthermore, according to several stakeholders, program funding criteria may not relate directly to climate resilience—this can lower the chance that climate resilience projects will receive funding. In our May 2014 report about DOD’s consideration of climate change in infrastructure planning, we reported that military installation officials rarely proposed climate resilience projects because the services’ criteria for ranking and funding potential military construction projects did not include climate change adaptation.⁹⁶ In addition, a 2018 report about federal resilience policy we reviewed and several stakeholders we interviewed identified challenges with how cost-benefit formulas account for future climate risk when evaluating the costs and benefits

⁹⁵National Research Council of the National Academies, America’s Climate Choices: Panel on Adapting to the Impacts of Climate Change, *Adapting to Impacts*.

⁹⁶GAO, *Climate Change Adaptation: DOD Can Improve Infrastructure Planning and Processes to Better Account for Potential Impacts*, [GAO-14-446](#) (Washington, D.C.: May 30, 2014).

of a project under consideration.⁹⁷ Two stakeholders we interviewed told us that the discount rate—the interest rate used to convert benefits and costs occurring in different time periods to a common present value—used in federal cost benefit formulas may too heavily discount future benefits. They explained that when benefits accrue over long time horizons, this can result in future climate benefits appearing small relative to the current cost of project implementation and thus result in some climate resilience projects not being funded.⁹⁸

- **Existing programs may be reactive, not proactive.** Some existing programs—for example, HUD’s Community Development Block Grant Disaster Recovery program and FEMA’s Hazard Mitigation Grant Program—are limited to funding resilience projects after a disaster occurs, which may result in reactive instead of proactive funding, based on our review of our past work and discussions with several stakeholders.⁹⁹ We concluded in July 2015 that funding hazard mitigation efforts in a post-disaster environment can create a reactive and fragmented approach in which disasters determine when and for what purpose the federal government invests in disaster resilience.¹⁰⁰ Furthermore, tying climate resilience funding to a disaster can result in

⁹⁷Enterprise, 100 Resilient Cities, and Rebuild by Design, *Safer and Stronger Cities*. According to this report, typical agency cost-benefit methods do not properly account for the increasing potential for loss in consideration of future risks, such as the impacts of climate change.

⁹⁸Benefits from climate resilience projects may be realized far into the future as climate change becomes more pronounced. OMB Circular A-4 states that federal agencies conducting regulatory analysis should provide estimates of net benefits and costs using both a 3 percent and 7 percent discount rate. If the rule will have important intergenerational benefits or costs, the agency should consider a lower but positive discount rate in addition to using the discount rates of 3 percent and 7 percent. OMB Circular 4-A is designed to assist regulatory agencies in conducting regulatory analysis and standardizing the way in which benefits and costs of federal regulatory actions are measured and reported.

⁹⁹In addition, the Disaster Recovery Reform Act of 2018, which authorized the development of the Building Resilient Infrastructure and Communities program, ties funding amounts to disaster spending and limits funding to states that have had a major disaster declaration in the last 7 years.

¹⁰⁰[GAO-15-515](#). Nevertheless, according to one official associated with the Mitigation Framework Leadership Group who commented on a draft of this report, there are many reasons to further integrate traditional hazard mitigation and climate change resilience into the disaster recovery process. The patchwork of federal funding for disaster recovery is often guided by state and local decision makers, and state and local will to build resilience is often higher after a disaster. Some of the best opportunities to retrofit our nation’s existing infrastructure and building stock occur during rebuilding efforts, according to this official.

projects going unfunded in communities where there has not yet been a disaster but where there are legitimate risks from future climate change impacts—including chronic climate hazards such as sea level rise—according to several stakeholders we interviewed. For example, our past work and several stakeholders identified challenges in accessing funding from existing federal programs to relocate communities threatened by climate hazards, such as Alaskan native villages threatened by flooding and erosion caused by sea level rise. According to our June 2009 report, since many Alaskan native villages facing gradual erosion problems had not received a declared disaster designation, they did not qualify for some FEMA disaster recovery and hazard mitigation programs.¹⁰¹ In addition, according to a 2016 report we reviewed, disaster recovery programs tend to be reactive and backward looking, focusing on areas immediately affected by a disaster.¹⁰² This can limit the ability of grantees to fund projects that could more holistically reduce the full suite of future risks that a region or community face.

New Climate Resilience Funding Source

Another option for focusing federal funding on high-priority climate resilience projects involves creating a new funding source specifically for such projects. We identified two main ways a new funding source could be designed in the United States: (1) a federal financial assistance program that could provide grants, loans, or loan guarantees to nonfederal entities implementing high-priority climate resilience projects, or (2) a climate resilience infrastructure bank that could combine federal funds with funds from other sources to provide funding to nonfederal entities for implementing high-priority climate resilience projects.

The government of Canada employs both of these methods. Specifically, Canada created the DMAF as a one-time, centralized fund of about US\$1.5 billion dollars for climate resilience projects over a 10-year period. Applications not eligible for or not selected to receive DMAF funding could be eligible under other infrastructure programs. Projects that could

¹⁰¹GAO, *Alaska Native Villages: Limited Progress Has Been Made on Relocating Villages Threatened by Flooding and Erosion*, [GAO-09-551](#) (Washington, D.C.: June 3, 2009).

¹⁰²Rebuild by Design, the Rockefeller Foundation, and the Georgetown Climate Center, *Rebuilding with Resilience*.

generate revenue are shared with Canada's Infrastructure Bank for consideration.¹⁰³

Based on our review of the DMAF and interviews with stakeholders, we identified several strengths of creating a new funding source for high-priority climate resilience projects:

- **Administrative simplicity.** Several stakeholders said that a new funding source avoids the administrative challenge of coordinating multiple funding sources to implement a large project or portfolio of projects. According to two stakeholders, such an option would avoid the challenge of having to utilize multiple programs with varying program rules, solicitation periods, and funding terms. Another stakeholder suggested that a single source would make it easier to track spending on climate resilience projects.
- **Focusing on high-priority climate resilience projects.** Several stakeholders said that an advantage of a new funding source is that it would provide dedicated funding for projects undertaken for the explicit purpose of climate resilience. For example, Canadian officials said that with the DMAF, climate resilience projects do not have to compete with other infrastructure projects for funding as they do within other programs administered in Canada that include multiple eligible project categories (e.g., water, wastewater, public transit). Canadian officials told us that this increases the likelihood that large-scale, nationally significant climate resilience projects will be funded. According to another stakeholder, a new funding source for high-priority climate resilience projects would allow for a proactive focus on the most pressing climate resilience needs instead of reactive project funding through post-disaster spending. In addition, another stakeholder told us this option could encourage communities to think "intentionally" about developing resilience, rather than climate resilience being an afterthought. Furthermore, several stakeholders said that such a funding source could be used for projects that otherwise would not receive funding through existing programs. For example, some projects may not receive funding because they are not

¹⁰³The purpose of the Canada Infrastructure Bank is to use federal support to attract private-sector and institutional investment for new, revenue-generating infrastructure projects that are in the public interest. The bank plans to invest the equivalent of approximately US\$3.8 billion from the federal government in green infrastructure projects, including those that make Canadian communities more resilient to climate change, natural disasters, and extreme weather events. Resilience projects funded through the bank must be nature-based.

compatible with current programs or because current programs have limited funding.

- **Encouraging cross-sector projects.** Several stakeholders told us that a new funding source for high-priority climate resilience projects could encourage cross-sector projects designed to achieve benefits in multiple sectors. According to one of these stakeholders, a dedicated fund for climate resilience could allow experts from multiple sectors—such as infrastructure, housing, transportation, and health—to collaborate on projects, leading to more creative, comprehensive approaches to enhance community resilience than would occur when funding projects through individual, existing federal programs. According to the *Fourth National Climate Assessment*, exploring the climate resilience nexus between sectors can identify co-benefits of resilience solutions and inform cost-effective resilience strategies.¹⁰⁴ For example, the assessment describes co-benefits that resilience actions related to water consumption can have on the electricity sector. According to the assessment, California’s mandate to reduce urban water consumption to address drought conditions in 2015 resulted in significant reductions in both water use and use of electricity to treat and convey water and wastewater.

Based on interviews with stakeholders, we identified some limitations of creating a new funding source for high-priority climate resilience projects:

- **Practical challenges.** Several stakeholders identified practical challenges with a funding source specifically for high-priority climate resilience projects. For example, such a funding source in the United States does not exist and would have to be created, which would require Congressional authorization. Furthermore, several stakeholders identified decisions that would have to be made about how to design such a funding source, including which agencies would be responsible for administering the fund. Two stakeholders identified additional challenges to success, such as designing effective programmatic rules and eliminating duplication with existing programs. For instance, if the funding source had overly restrictive or poorly designed rules, it might be challenging to use and provide only limited benefits relative to existing programs, according to one of these stakeholders.

¹⁰⁴Craig Zamuda et al., “Energy, Supply, Delivery, and Demand,” in *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2.

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- **Discouraging mainstreaming in existing federal programs.** Several stakeholders raised concerns that a new funding source for high-priority climate resilience projects could discourage mainstreaming climate change considerations into existing federal programs or lead to the elimination of other sources of funding for climate resilience projects. Several stakeholders explained that mainstreaming is a fundamental way the federal government will enhance resilience to climate risks. In particular, several stakeholders raised concerns that if federal agencies viewed a single funding source specifically for climate resilience projects as sufficient for addressing climate resilience, federal agencies might be less likely to consider climate change impacts when making routine agency decisions or place a lower value on climate resilience project attributes when making funding decisions.

Opportunities Exist to Increase the Climate Resilience Impact of Federal Funding Options

Opportunities exist to increase the climate resilience impact of options for focusing federal funding on high-priority climate resilience projects, based on our review of our past work, related reports, an international standard, and the Louisiana and Canadian examples, as well as interviews with stakeholders:

- **Using both existing and new funding options.** Several stakeholders told us that using both funding options—multiple, existing federal programs with varied purposes and a new funding source for high-priority climate resilience projects—in a strategic, coordinated way could help increase the impact of federal investment. Several stakeholders told us that directing both funding options at high-priority projects could result in a more effective approach that makes it less likely that high-priority projects fall through the cracks and more likely that these projects will help agencies work toward a common strategic goal.¹⁰⁵ Two stakeholders told us that in practice, multiple, existing federal funding sources that are not specific to climate resilience could be coordinated to fund projects when their purposes and rules align and adequate funding is available. A funding source specifically for climate resilience could be used to fund proposed projects when no related program exists or when existing programs do not have sufficient funding available, according to these and other stakeholders.

¹⁰⁵In commenting on a draft of this report, an official from the Mitigation Framework Leadership Group explained that changes may also be needed within existing programs to improve their ability to provide funds for climate resilience projects.

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- **Helping ensure adequate and consistent funding.** Several stakeholders we interviewed identified the need for adequate and consistent funding to implement high-priority climate resilience projects. For example, according to one stakeholder we interviewed, inconsistent, inadequate funding makes it difficult to complete large-scale projects and can lead to additional costs if significant delays occur during which existing work deteriorates. In addition, according to some international officials we interviewed for a May 2016 report, long-term consistency in budgeting provides predictable, reliable resources for climate resilience projects.¹⁰⁶ According to USGCRP's *Fourth National Climate Assessment*, adequate funding is a factor that contributes to the successful adoption and implementation of climate resilience by public-sector organizations.¹⁰⁷ Furthermore, an industry standard identified the need to ensure that resources—including financial, human, and technical resources—needed for climate resilience actions are available.¹⁰⁸ In addition to adequate and consistent funding, funding options should be designed to accommodate long-term projects since high-priority climate resilience projects can take multiple years to design and implement, according to two stakeholders we interviewed.
 - **Encouraging nonfederal investment.** Several stakeholders we interviewed told us that the federal government could use a federal climate resilience investment effort to encourage nonfederal investment in high-priority climate resilience projects, thereby increasing the impact of federal investment. For example, several stakeholders identified the importance of a cost-share component so that funding recipients are invested in a project's success. Canada's DMAF encourages nonfederal investment by partially funding projects of national significance and requiring different levels of cost-share from funding recipients, ranging from 25 percent for Indigenous recipients to 75 percent for private-sector and other for-profit recipients. Several stakeholders also identified potential funding mechanisms—for example, public-private partnerships and loan guarantees—that could leverage federal dollars to encourage additional investment in climate resilience projects by nonfederal

¹⁰⁶[GAO-16-454](#).

¹⁰⁷Lempert, et al., "Reducing Risks Through Adaptation Actions," in *Fourth National Climate Assessment*, vol. 2.

¹⁰⁸International Organization for Standardization, *ISO Standard 14090:2019: Adaptation to Climate Change*.

entities, including the private sector.¹⁰⁹ According to the 2014 President's State, Local, and Tribal Leaders Task Force report, one way the federal government can drive more resilient community choices is by encouraging innovative approaches that leverage private capital.¹¹⁰

- **Encouraging complementary resilience activities.** To increase the impact of federal investment, a federal resilience investment effort presents an opportunity to encourage complementary resilience activities by nonfederal actors such as states, localities, and private-sector partners, based on interviews with several stakeholders, the Canadian example, and reports we reviewed. Several stakeholders suggested establishing conditions that funding recipients must meet in exchange for receiving federal funding. Alternatively, according to the 2014 President's State, Local, and Tribal Leaders Task Force report and two stakeholders we interviewed, the federal government could use incentives (e.g., providing greater federal cost-share or giving additional preference in the project prioritization process) to encourage complementary resilience activities by nonfederal actors.¹¹¹ Furthermore, our Disaster Resilience Framework states that incentives can make long-term, forward-looking risk reduction investments more viable and attractive among competing priorities. Specifically, incentives can lower the costs or increase the benefits of risk-reduction measures, which can help stimulate investment by state and local governments, individuals, and the private sector.

¹⁰⁹Public-private partnerships are a contractual arrangement in which a public entity contracts with a private-sector partner to contribute to the provision of a public service by planning, financing, designing, constructing, or operating and maintaining a facility or system. See GAO, *Wastewater Infrastructure Financing: Stakeholder Views on a National Infrastructure Bank and Public-Private Partnerships*, [GAO-10-728](#) (Washington, D.C.: June 30, 2010). Loan guarantees are any guarantees, insurance, or other pledges with respect to the payment of all or a part of the principal or interest on any debt obligation of a nonfederal borrower to a nonfederal lender. See GAO, *Credit Reform: Current Method to Estimate Credit Subsidy Costs Is More Appropriate for Budget Estimates Than a Fair Value Approach*, [GAO-16-41](#) (Washington, D.C.: Jan. 29, 2016).

¹¹⁰President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, *Recommendations to the President*.

¹¹¹President's State, Local, and Tribal Leaders Task Force on Climate Preparedness and Resilience, *Recommendations to the President*. According to this report, federal policies and programs should provide incentives to support climate-smart land use and development that actively assesses and manages climate-related risks. State and local governments, tribes, and territories that employ such practices should receive preferential consideration, a greater federal cost share, and/or more favorable financing terms from federal programs that fund infrastructure, community, and housing development.

The federal government could use a federal resilience investment effort to encourage several types of complementary resilience activities by nonfederal actors. For example, the federal government could encourage the use and enforcement of building codes that require stronger risk-reduction measures, according to two reports we reviewed and several stakeholders we interviewed.¹¹² In the case of the DMAF, to be eligible for federal funding, all projects under the DMAF must meet or exceed building code requirements for their jurisdiction. In addition, several stakeholders suggested using a federal investment effort to encourage communities to limit or prohibit development in high-risk areas to minimize risks to people and assets exposed to future climate hazards. One example of this would be through zoning regulations. Another stakeholder suggested that communities receiving federal funding for resilience projects should be adequately insured against future climate risks so they have a potential source of funding for rebuilding in the event of a disaster.

- **Allowing funds to be used at various stages of project development.** Several stakeholders suggested that federal funds be allowed for use at multiple stages of project development—such as project design, implementation, or monitoring—to increase the impact of federal funds. For example, two stakeholders we interviewed told us that resilience projects can require significant amounts of design work to develop an implementable and effective project concept and that making funds available for project design could improve the quality of project proposals, thereby maximizing the impact of federal funds. Similarly, a CPRA official explained that many project proposals for Louisiana’s Comprehensive Master Plan for a Sustainable Coast are in the “concept stage” when they are received so funds are needed to refine the concept and craft an implementable project design. In addition to providing federal funds for project design, one stakeholder suggested making federal funding available to measure project outcomes (e.g., how effectively projects increased

¹¹²See Council on Climate Preparedness and Resilience, *Opportunities to Enhance the Nation’s Resilience to Climate Change* (Washington, D.C.: October 2016). According to this report, the federal government can support and incentivize resilience investment by, among other things, supporting efforts to increase resilient design and construction in communities as well as requiring compliance and enforcement of stronger building codes for eligibility to grant programs. See also Congressional Budget Office, *Expected Costs of Damage from Hurricane Winds and Storm-Related Flooding* (Washington, D.C.: April 2019). According to this report, the federal government could reduce the size of expected flood losses by enacting policies that would facilitate the use—and enforcement—of building codes that require stronger risk-reducing measures in new buildings.

resilience) to improve future decisions by both the federal government and others making resilience investments.

Conclusions

Individual federal agencies have provided ad hoc funding for projects that may convey some climate resilience benefits using existing federal programs. However, the federal government does not have a strategic approach for investing in climate resilience projects that targets federal resources toward projects that address the nation's most significant climate risks. USGCRP projects that disaster costs will likely increase as certain extreme weather events become more frequent and intense due to climate change. The rising number of natural disasters and increasing reliance on the federal government for assistance is a key source of federal fiscal exposure. Investment in climate resilience projects can help prepare the country for the effects of climate change. We found that to strategically identify and prioritize climate resilience projects for federal investment, the federal government could take six key steps, based on reports we reviewed, past GAO work, international standards, and stakeholders we interviewed. In addition, opportunities exist to increase the climate resilience impact of funding options, such as by encouraging the use of climate-resilient building codes. However, no federal agency, government-wide coordinating body, or other organizational arrangement has been established to periodically identify and prioritize climate resilience projects for federal investment.

Our past work and other sources highlight the importance of a strategic and iterative risk-informed approach to climate change and the need to reduce the federal government's fiscal exposure. However, the federal government has made little measurable progress since 2017 to reduce its fiscal exposure to climate change. Although we have made 17 recommendations that address improving federal climate change strategic planning, as of August 2019, no action had been taken toward implementing 14 of those recommendations—one dating back to 2003. A strategic and iterative risk-informed approach for identifying and prioritizing climate resilience projects for federal investment, with an appropriate organizational arrangement, could help target federal resources toward climate resilience projects that have the greatest expected net benefit and that address the nation's most significant climate risks.

Matter for Congressional Consideration

Congress should consider establishing a federal organizational arrangement to periodically identify and prioritize climate resilience projects for federal investment. Such an arrangement could be designed for success by considering the six key steps for prioritizing climate resilience investments and the opportunities to increase the climate resilience impact of federal funding options identified in our report. (Matter for Consideration 1)

Agency Comments

We provided a draft of this report to the U.S. Global Change Research Program, the Federal Emergency Management Agency, and the Mitigation Framework Leadership Group for review and comment. These entities provided technical comments, which we incorporated as appropriate.

As agreed with your office, unless you publicly announce the contents of this report earlier, we plan no further distribution until 30 days from the report date. At that time, we will send copies to the appropriate congressional committees, the Executive Director of the U.S. Global Change Research Program, the Acting Secretary of the Department of Homeland Security, and other interested parties. In addition, the report will be available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or gomezj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix II.

Sincerely yours,



J. Alfredo Gomez
Director, Natural Resources and Environment

Appendix I: Objectives, Scope, and Methodology

In this report, we examine (1) the extent to which the federal government has a strategic approach for investing in climate resilience projects; (2) key steps that provide an opportunity for the federal government to strategically prioritize climate resilience projects for federal investment; and (3) strengths and limitations of options for focusing federal funding on high-priority climate resilience projects.

To address all three audit objectives, we conducted semi-structured interviews with 35 stakeholders with relevant expertise, including federal officials, researchers, and consultants. We used a snowball approach to identify stakeholders with expertise on the topics addressed by our report. This involved identifying an initial list of stakeholders with expertise in climate resilience and hazard mitigation by reviewing related reports and based on stakeholder involvement in related present or past federal efforts—for example, work conducted by the U.S. Global Change Research Program (USGCRP)—the federal program responsible for coordinating climate change research and preparing the *Fourth National Climate Assessment*.¹ We identified additional stakeholders with expertise in these and other relevant areas through interviews with this initial group of stakeholders and review of additional reports. We considered several factors when selecting stakeholders: the relevance of their expertise, the number of times they were recommended to us by other stakeholders as having relevant expertise, and their current or previous federal experience. We sought a balanced set of stakeholders with expertise in a variety of fields that could inform climate resilience decisions: climate resilience, decision sciences, hazard mitigation, economics and finance, insurance, engineering and project design, economic and community development, potentially related federal programs (e.g., Federal Emergency Management Agency [FEMA] hazard mitigation programs), and several affected resources (e.g., coasts, infrastructure, water resources, and ecosystems). We use the term “several” to represent three or more stakeholders or reports expressing a particular viewpoint. In other cases, we provide the exact number of stakeholders expressing a particular viewpoint. Because this is a nonprobability sample, our findings cannot be generalized to other stakeholders we did not interview. Rather, these interviews provided us with illustrative examples of (1) the extent to which the federal

¹U. S. Global Change Research Program, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2. (Washington, D.C.: 2018). We use the term “report” to refer to journal articles; federal agency program reports; and publications by associations, nonprofit organizations, and think tanks.

government has a strategic approach for investing in climate resilience projects, (2) key steps that provide an opportunity for the federal government to strategically prioritize climate resilience projects for federal investment, and (3) strengths and limitations of options for focusing federal funding on high-priority climate resilience projects. In addition, the specific areas of expertise varied among the stakeholders we interviewed, so not all of the stakeholders commented on all of the interview questions we asked.

To determine the extent to which the federal government has a strategic approach for investing in climate resilience projects, we reviewed past GAO work on federal efforts related to climate resilience and climate change funding as well as reports from the Congressional Research Service, Congressional Budget Office, the Council on Climate Preparedness and Resilience, USGCRP, and other sources. We also reviewed federal documents, including the National Mitigation Investment Strategy—a national strategy for mitigating natural hazards. We interviewed officials from USGCRP and FEMA, the federal agency responsible for leading the Mitigation Framework Leadership Group, the interagency group that developed the National Mitigation Investment Strategy under Presidential Policy Directive 8. We also interviewed several other stakeholders on the extent to which the federal government has a strategic approach for investing in climate resilience projects and the nature and scope of the Mitigation Framework Leadership Group’s activities. We reviewed federal documents and websites to identify examples of instances in which federal programs and funding sources designed for other purposes, such as disaster funding, have been used to invest in climate resilience projects.

To identify key steps that provide an opportunity for the federal government to strategically prioritize climate resilience projects for federal investment, we reviewed our prior work related to risk management, climate change, climate resilience, and hazard mitigation, including our Disaster Resilience Framework and enterprise risk management report.² We also reviewed approximately 50 reports and other sources to identify steps that provide an opportunity for the federal government to

²GAO, *Disaster Resilience Framework: Principles for Analyzing Federal Efforts to Facilitate and Promote Resilience to Natural Disasters*, [GAO-20-100SP](#) (Washington: D.C.: October 2019) and *Enterprise Risk Management: Selected Agencies’ Experiences Illustrate Good Practices in Managing Risks*, [GAO-17-63](#) (Washington, D.C.: Dec. 1, 2016).

strategically identify high-priority climate resilience projects, several of which contained examples of potential criteria the federal government could consider when prioritizing these projects. We identified these reports and other sources through our review of other reports and related news, discussions with stakeholders, and searches of databases such as Scopus and ProQuest. The reports we reviewed included climate resilience planning guidebooks that outline steps communities can follow to design a resilience plan to address climate risks.³ We also interviewed stakeholders with relevant expertise to gather information on key steps the federal government could take and criteria it could consider to strategically prioritize climate resilience projects for federal investment. During the course of this work, we identified domestic and international examples of governments that invest in climate resilience and related projects. We selected two of these examples for more in-depth review and presentation in the report: the state of Louisiana's coastal master planning effort and the country of Canada's Disaster Mitigation and Adaptation Fund. These examples represent distinct approaches for investing in high-priority projects that help communities adapt to emerging risks such as those associated with climate change. We selected these examples for further review because they focus on projects that are large in scale; are of national or statewide significance; address multiple risks; represent well-defined, current processes for identifying and prioritizing projects; and had sufficient information available to understand their approach.

To examine the strengths and limitations of options for focusing federal funding on high-priority climate resilience projects, we identified relevant examples of the strengths and limitations of federal funding options in several of the reports we mentioned above. Where appropriate, we supplemented this review with a review of additional reports that discussed specific financial mechanisms that the federal government could use to fund large-scale climate resilience projects. We also

³The adaptation assessment guidebooks we reviewed were written for various audiences, including state and local governments, but the principles they outline can be applied at the federal level. While the resilience actions discussed in these guidebooks were broader than those within the scope of our review, the overall steps for identifying these actions were directly applicable to the process of identifying high-priority climate resilience projects for federal investment. Two examples of guidebooks we consulted are The Center for Climate Strategies, *Adaptation Guidebook: Comprehensive Climate Action* (Washington D.C.: December 2011) and Amy Snover et al., *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments* (King Oakland, CA: ICLEI—Local Governments for Sustainability, 2007).

interviewed stakeholders to discuss the strengths and limitations of options the federal government could use to fund climate resilience projects. When available, we gathered their views on specific funding sources that the federal government could use to fund large-scale climate resilience projects and additional steps that the federal government could take to enable more targeted federal resilience investment.

We conducted this performance audit from January 2018 to October 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

J. Alfredo Gómez at (202) 512-3841 or gomezj@gao.gov

Staff Acknowledgments

In addition to the individual named above, Joe Thompson (Assistant Director), Paige Gilbreath (Analyst in Charge), Taiyshawna Battle and Celia Rosario Mendive made key contributions to this report. Also contributing to this report were Colleen M. Candrl, Alicia P. Cackley, Kendall Childers, Steven Cohen, Christopher Curry, Cindy Gilbert, Kathryn Godfrey, Holly Halifax, Carol Henn, Susan Irving, Richard Johnson, Gwendolyn Kirby, Caroline N. Prado, Joseph Maher, Gregory Marchand, Diana Maurer, Kirk Menard, Tim Persons, William Reinsberg, Oliver Richard, Danny Royer, Jeanette Soares, Kiki Theodoropoulos, Sarah Veale, Patrick Ward, Jarrod West, Kristy Williams, Eugene Wisnoski, and Melissa Wolf.

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