



Testimony

Before the Subcommittee on Transportation,  
Housing and Urban Development, and  
Related Agencies, Committee on  
Appropriations, U.S. Senate

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# PHYSICAL INFRASTRUCTURE

## Preliminary Observations on Options for Improving Climate Resilience of Transportation Infrastructure

Statement of Elizabeth Repko, Acting Director, Physical  
Infrastructure

Accessible Version

# GAO Highlights

Highlights of [GAO-21-561T](#), a testimony delivered to the Subcommittee on Transportation, Housing and Urban Development, and Related Agencies, Committee on Appropriations, U.S. Senate

## Why GAO Did This Study

Since 2013, GAO has included *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks* in its High Risk List. In addition, according to the U.S. Global Change Research Program, a changing climate threatens the performance of the U.S. transportation system across all modes, including roads. Congress authorized approximately \$43 billion of fiscal year 2021 formula funding for the U.S. Department of Transportation's FHWA's federal-aid highway program, which primarily funds highway planning and construction.

This testimony discusses (1) GAO's framework for identifying opportunities to enhance the climate resilience of transportation infrastructure; and (2) preliminary observations on actions taken and options to further enhance the climate resilience of federally funded roads. This work is based on GAO reports issued from 2014 through 2019, a review of literature, and interviews conducted with FHWA officials and knowledgeable stakeholders conducted as part of on-going work. GAO expects to issue a report on the results of its ongoing work in summer 2021.

## What GAO Recommends

In the prior work on which this testimony is based, GAO made three recommendations to federal agencies and proposed one matter for congressional consideration to take steps to enhance climate-related resilience. The recommendations and matter have not been implemented as of July 2020.

View [GAO-21-561T](#). For more information, contact Elizabeth Repko at (202) 512-2834 or [repkoe@gao.gov](mailto:repkoe@gao.gov).

May 13, 2021

## PHYSICAL INFRASTRUCTURE

### Preliminary Observations on Options for Improving Climate Resilience of Transportation Infrastructure

## What GAO Found

GAO's *Disaster Resilience Framework* serves as a guide for analysis of federal actions to facilitate and promote resilience to natural disasters and changes in the climate across many policy areas, including transportation. The framework is organized around three guiding principles—information, integration, and incentives—and a series of questions that can help identify opportunities to enhance federal efforts to promote disaster resilience. Specifically, the integration principle states that integrated analysis and planning can help decision makers take coherent and coordinated actions to promote resilience. For example, in October 2019, GAO reported that 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. GAO recommended that Congress consider establishing a federal organizational arrangement to periodically identify and prioritize climate resilience projects for federal investment.

The Federal Highway Administration (FHWA) has taken steps to encourage states to enhance the climate resilience of federally funded roads by developing agency policy, providing technical assistance to states, and supporting climate resilience research funding, among other actions. In addition, as part of ongoing work on FHWA's federal-aid highway program, GAO identified options that could further enhance the climate resilience of federally funded roads, based on a literature review and interviews with knowledgeable stakeholders (see table). Some of these options are similar to recommendations made previously by GAO. Further, according to FHWA officials, some of these options would likely require additional congressional direction or authority to implement.

#### Options to further enhance resilience of federally funded roads, as suggested by relevant literature and knowledgeable stakeholders

##### Option

- Integrate climate resilience into Federal Highway Administration policy and guidance.
- Update design standards to account for climate change and resilience best practices.
- Provide authoritative, actionable, forward-looking climate information.
- Add climate resilience funding eligibility requirements, conditions, or criteria to formula grant programs.
- Expand the availability of discretionary funding for climate resilience improvements.
- Alter the Emergency Relief (ER) program by providing incentives for, or conditioning funding on, pre-disaster resilience actions.
- Expand the availability of ER funding for post-disaster climate resilience improvements.
- Establish additional climate resilience planning or project requirements.
- Link climate resilience actions or requirements to incentives or penalties.
- Condition eligibility, funding, or project approval on compliance with climate resilience policy and guidance.

Source: GAO analysis of literature and interviews with knowledgeable stakeholders. | GAO-21-561T

May 13, 2021

Chairman Schatz, Ranking Member Collins, and Members of the Subcommittee:

Thank you for the opportunity to discuss our past and ongoing work on climate resilience and transportation infrastructure. The nation's surface transportation system—including highways, transit, and rail systems that move both people and freight—is critical to the economy and affects the daily lives of most Americans. However, changes in the climate pose a risk to the safety, efficiency, and reliability of the U.S. transportation system, according to the 2018 *Fourth National Climate Assessment*.<sup>1</sup> This assessment states that a changing climate undermines the transportation system's ability to perform reliably, safely, and efficiently. This report notes that heavy precipitation, river and coastal flooding, heat, and changes in average precipitation and temperature impact individual assets across all modes of transportation. These impacts threaten the performance of the entire network, with critical ramifications for safety, environmental sustainability, economic vitality and mobility, congestion, and system reliability, particularly for vulnerable populations and urban infrastructure, according to the report.

The rising number of natural disasters and increasing reliance on federal assistance by those in affected communities is a key source of federal fiscal exposure. As we stated in our report on the nation's fiscal health in March of 2021, since 2005, federal funding for disaster assistance has totaled at least \$524 billion.<sup>2</sup> This funding which consists of obligations for disaster assistance from 2005 through 2014 totaling about \$278 billion<sup>3</sup> and select appropriations for disaster assistance from 2015 to 2020

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<sup>1</sup> The Global Change Research Act of 1990, Pub. L. No. 101-606, § 103, 104 Stat. 3096, 3098, directed the President to establish the U.S. Global Change Research Program (USGCRP). USGCRP coordinates and integrates the activities of 13 federal agencies that research changes in the global environment and their implications for society. USGCRP most recently released a National Climate Assessment in 2018. See USGCRP, *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment*, vol. 2 (Washington, D.C.: 2018).

<sup>2</sup>GAO, *The Nation's Fiscal Health: After Pandemic Recovery, Focus Needed on Achieving Long-Term Fiscal Sustainability*, [GAO-21-275SP](#) (Washington, D.C.: Mar. 23, 2021).

<sup>3</sup> GAO, *Federal Disaster Assistance: Federal Departments and Agencies Obligated at Least \$277.6 Billion during Fiscal Years 2005 through 2014*, [GAO-16-797](#) (Washington, D.C.: Sept. 22, 2016).

totaling \$246 billion.<sup>4</sup> Disaster costs to the federal government are projected to increase as certain extreme weather events become more frequent and intense due to climate change, as observed and projected by the U.S. Global Change Research Program and the National Academies of Sciences, Engineering, and Medicine.

Since 2013, in recognition of the federal government's significant stake in managing climate-related disaster impacts, we have included *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks* in our High-Risk List.<sup>5</sup> We and others have recommended enhancing resilience to help limit the federal government's fiscal exposure to climate change because it can reduce the need for far more costly steps in the future.<sup>6</sup> Enhancing climate-related resilience means taking actions to reduce potential future losses by planning and preparing for

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<sup>4</sup>This total also includes \$188 billion in select supplemental appropriations to federal agencies for disaster assistance and approximately \$58 billion in annual appropriations to the Disaster Relief Fund for fiscal years 2015 through 2020. It does not include other annual appropriations to federal agencies for disaster assistance.

<sup>5</sup>We added *Limiting the Federal Government's Fiscal Exposure by Better Managing Climate Change Risks* to our High-Risk List in 2013. The High-Risk List identifies federal program areas that are at high risk of vulnerabilities to fraud, waste, abuse, and mismanagement or most in need of transformation. See GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: February 2013) and *High-Risk Series: Dedicated Leadership Needed to Address Limited Progress in Most High-Risk Areas*, [GAO-21-119SP](#) (Washington, D.C.: March 2021).

<sup>6</sup>For example, see, GAO, *Climate Change: Opportunities to Reduce Federal Fiscal Exposure*, [GAO-19-625T](#) (Washington, D.C.: June 2019); *Climate Change: Selected Governments Have Approached Adaptation through Laws and Long-Term Plans*, [GAO-16-454](#) (Washington, D.C.: May 2016); 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).

potential climate hazards, such as extreme rainfall, sea level rise, and drought.<sup>7</sup>

In 2020, Congress authorized for fiscal year 2021 about \$43.4 billion of formula funding for the federal-aid highway program through which the U.S. Department of Transportation's Federal Highway Administration (FHWA) provides the funding to the states for highway and bridge planning, maintenance, and construction activities for approximately 110,000 active federally funded projects.<sup>8</sup> FHWA annually distributes this funding to the states by statutory formula. FHWA also administers a variety of discretionary grant programs, through which it provides highway funding to grant applicants based on the eligibility and selection criteria specific to each program. FHWA is also authorized through its Emergency Relief Program to provide up to \$100 million annually to states to repair or reconstruct roads seriously damaged by natural disasters or a catastrophic failure from any external cause. Additional emergency relief funding can be made available by Congress as needed through supplemental appropriation acts.<sup>9</sup>

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<sup>7</sup>The National Academies of Sciences, Engineering, and Medicine 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. GAO, *Climate Resilience: A Strategic Investment Approach for High-Priority Projects Could Help Target Federal Resources*, [GAO-20-127](#) (Washington, D.C.: October 2019).

<sup>8</sup>Continuing Appropriations Act, 2021 and Other Extensions Act, Pub. L. No. 116-159, div. B, tit. I, § 1101, 134 Stat. 709, 725 (2020). The "federal-aid highway program" is an umbrella term for a collection of FHWA-administered formula and nonformula grant programs. Formula grant programs account for the majority of the total funding authorized for the federal-aid highway program.

<sup>9</sup>23 U.S.C. § 125. See also 23 C.F.R. § 668.111(c). As described in FHWA's Emergency Relief Manual, to be considered for Emergency Relief funding either the President must make a major disaster declaration under the Stafford Act or the governor of the state must issue an emergency or disaster proclamation and FHWA must concur with that declaration.

In January 27, 2021, the President issued *Executive Order 14008 on Tackling the Climate Crisis at Home and Abroad*. This order states that it is policy of the administration to deploy the full capacity of federal agencies to, among other things, combat climate change and implement a government-wide approach that increases resilience to the impacts of climate change.<sup>10</sup> The order directs agencies to submit and annually update climate action plans that describe steps the agency can take with regard to its facilities and operations to bolster adaptation and increase resilience to the impacts of climate change, and to make those action plans publicly available. The order's full impact will not be known for some time and its success will depend on sustained agency attention. As part of a government-wide effort, this order specifically calls on the Secretary of Transportation to, among other duties, prioritize action on climate change in policy-making and budget processes, in contracting and procurement, and in engagement with state, local, tribal, and territorial governments.

My statement today discusses (1) GAO's disaster resilience framework for identifying opportunities to enhance the climate resilience of transportation infrastructure; and (2) preliminary observations on actions taken and options to further enhance climate resilience of federally funded roads. In addition to describing GAO's disaster resilience framework for identifying opportunities to promote transportation and infrastructure resilience to climate risks, we reviewed prior GAO reports from 2014 through 2019 cited throughout the statement. Information on our objectives, scope, and methodology for that work can be found in the issued reports. As part of our on-going work in this area, we reviewed relevant documents, laws, and regulations, and interviewed FHWA officials to describe how FHWA tools have been used to support climate resilience in the federal-aid highway program.<sup>11</sup> In addition, as part of our on-going work, we reviewed relevant literature and interviewed knowledgeable stakeholders to identify options to further enhance climate resilience in FHWA's federal-aid highway program. Specifically, through a comprehensive literature search, we found 53 relevant reports and pieces of legislation to review for options to further enhance the resilience of federally funded roads. We then conducted 19 interviews with knowledgeable stakeholders that included representatives from the

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<sup>10</sup>86 Fed. Reg. 7619 (Feb. 1, 2021).

<sup>11</sup>We have on-going work examining FHWA actions and potential options to enhance the climate resilience of federally funded roads. FHWA officials reviewed an early draft of the report developed as part of this on-going work and provided comments, which we have incorporated into this testimony. We anticipate that we will issue a report on the results of our ongoing work in summer 2021.

American Association of State Highway and Transportation Officials, officials from several state departments of transportation, former U.S. Department of Transportation officials, and stakeholders from academic institutions, research organizations, think tanks, and consultancies. We used the results of the literature search to identify stakeholders with knowledge of both climate resilience and federal funding for roads. When identifying knowledgeable stakeholders, we primarily considered type of expertise, relevance of published work, and referrals from other stakeholders as criteria.

We conducted the work on which this statement is based 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.

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## GAO's Disaster Resilience Framework Identifies Opportunities to Enhance the Climate Resilience of Transportation Infrastructure

We have previously reported that the federal government has primarily funded disaster resilience projects in the wake of disasters—when damages have already occurred and opportunities to pursue future risk reduction may conflict with the desire for the immediate restoration of critical infrastructure.<sup>12</sup> In October 2019, we issued the *Disaster Resilience Framework* to serve as a guide for analysis of federal actions to facilitate and promote resilience to natural disasters and changes in the climate.<sup>13</sup> According to the framework, investments in disaster resilience are a promising avenue to address federal fiscal exposure because such investments offer the opportunity to reduce the overall impact of disasters. Users of the *Disaster Resilience Framework* can consider its principles and questions to analyze any type of existing federal effort,

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<sup>12</sup>See GAO, *Disaster Resilience Framework: Principles for Analyzing Federal Efforts to Facilitate and Promote Resilience to Natural Disasters*, [GAO-20-100SP](#) (Washington, D.C.: Oct. 23, 2019) and, for example, GAO, *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).

<sup>13</sup>[GAO-20-100SP](#).

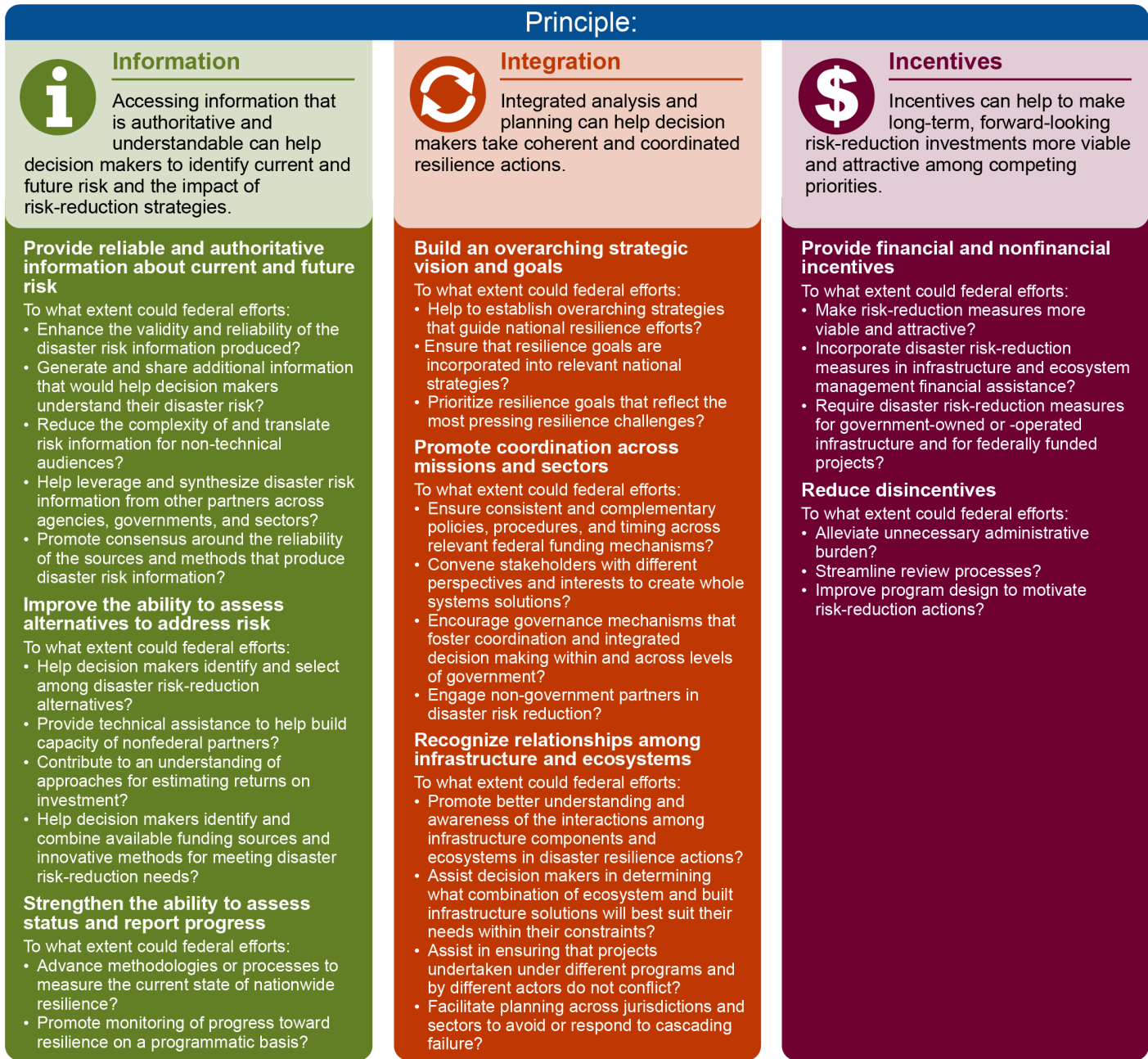
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identify gaps in existing federal efforts, or consider the federal role. Specifically, this framework can be used to identify opportunities to address gaps in federal efforts by, for example, supporting identification of options to address government-wide challenges that are of a scale and scope not addressed by existing programs.

The framework is organized around three guiding principles—information, integration, and incentives—and a series of questions that can help identify opportunities to enhance federal efforts to promote disaster resilience. (See fig. 1.) These principles can be applied to any federal effort—including the funding of transportation infrastructure—to help federal agencies and policymakers consider what kinds of actions to take if they seek to promote and facilitate disaster risk reduction.



Figure 1: GAO’s Disaster Resilience Framework



Source: GAO. | GAO-21-561T

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**Text of Figure 1: GAO's Disaster Resilience Framework**

**Information**

Accessing information that is authoritative and understandable can help decision makers to identify current and future risk and the impact of risk-reduction strategies.

*Provide reliable and authoritative information about current and future risk*

To what extent could federal efforts:

- Enhance the validity and reliability of the disaster risk information produced?
- Generate and share additional information that would help decision makers understand their disaster risk?
- Reduce the complexity of and translate risk information for non-technical audiences?
- Help leverage and synthesize disaster risk information from other partners across agencies, governments, and sectors?
- Promote consensus around the reliability of the sources and methods that produce disaster risk information?

*Improve the ability to assess alternatives to address risk*

To what extent could federal efforts:

- Help decision makers identify and select among disaster risk-reduction alternatives?
- Provide technical assistance to help build capacity of nonfederal partners?
- Contribute to an understanding of approaches for estimating returns on investment?
- Help decision makers identify and combine available funding sources and innovative methods for meeting disaster risk-reduction needs?

*Strengthen the ability to assess status and report progress*

To what extent could federal efforts:

- Advance methodologies or processes to measure the current state of nationwide resilience?

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- Promote monitoring of progress toward resilience on a programmatic basis?

### **Integration**

Integrated analysis and planning can help decision makers take coherent and coordinated resilience actions.

#### *Build an overarching strategic vision and goals*

To what extent could federal efforts:

- Help to establish overarching strategies that guide national resilience efforts?
- Ensure that resilience goals are  incorporated into relevant national strategies?
- Prioritize resilience goals that reflect the most pressing resilience challenges?

#### *Promote coordination across missions and sectors*

To what extent could federal efforts:

- Ensure consistent and complementary policies, procedures, and timing across relevant federal funding mechanisms?
- Convene stakeholders with different perspectives and interests to create whole systems solutions?
- Encourage governance mechanisms that foster coordination and integrated decision making within and across levels of government?
- Engage non-government partners in disaster risk reduction?

#### *Recognize relationships among infrastructure and ecosystems*

To what extent could federal efforts:

- Promote better understanding and awareness of the interactions among infrastructure components and ecosystems in disaster resilience actions?
- Assist decision makers in determining what combination of ecosystem and built infrastructure solutions will best suit their needs within their constraints?
- Assist in ensuring that projects undertaken under different programs and by different actors do not conflict?

- 
- Facilitate planning across jurisdictions and sectors to avoid or respond to cascading failure?

### Incentives

Incentives can help to make long-term, forward-looking risk-reduction investments more viable and attractive among competing priorities.

#### *Provide financial and nonfinancial incentives*

To what extent could federal efforts:

- Make risk-reduction measures more viable and attractive?
- Incorporate disaster risk-reduction measures in infrastructure and ecosystem management financial assistance?
- Require disaster risk-reduction measures for government-owned or -operated infrastructure and for federally funded projects?

#### *Reduce disincentives*

To what extent could federal efforts:

- Alleviate unnecessary administrative burden?
- Streamline review processes?
- Improve program design to motivate risk-reduction actions?

Source: GAO. | GAO-21-561T

- *Information.* We have found that accessing information that is authoritative and understandable can help decision makers identify current and future disaster and climate-related risks. Moreover, natural and climate disaster risk information that is accurate, comprehensive, and produced or endorsed by an authoritative source can help decision makers better assess their risk. However, this has historically been a challenge. For example, in November 2015, we reported that the climate information needs of federal, state, local, and private sector decision makers were not being fully met, while the federal government's own climate data—composed of observational records from satellites and weather stations and projections from climate models—were fragmented across individual agencies that use the information in different ways to meet their missions.<sup>14</sup> We

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<sup>14</sup>GAO, *Climate Information: A National System Could Help Federal, State, Local, and Private Sector Decision Makers Use Climate Information*, [GAO-16-37](#) (Washington, D.C.: Nov. 23, 2015).

recommended that the Executive Office of the President direct a federal entity to develop a set of authoritative climate change projections and observations and create a national climate information system with defined roles for federal agencies and nonfederal entities. As of December 2020, the office has not yet taken action to implement these recommendations.

- *Integration.* In addition, we have found that integrated analysis and planning can help decision makers take coherent and coordinated actions to promote disaster and climate-related resilience. For example, our October 2019 report shows that 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.<sup>15</sup> Such an approach could supplement individual agency climate resilience efforts and help target federal resources toward high-priority projects. We recommended that Congress consider establishing a federal organizational arrangement to periodically identify and prioritize climate resilience projects for federal investment. As of July 2020, Congress has not yet taken action to implement this matter.

We have also reported on how coordination across missions and sectors may help prioritize investments in resilience-related projects. For example, in our December 2014 report on transit system resilience, we found that transit agencies face challenges with placing priorities on resilience and with certain aspects of some grant programs.<sup>16</sup> Specifically, we observed that it is difficult for transit agencies to place priority on resilience activities because such activities compete with other priorities for funding. We reported that, while it is not possible to make a transit system completely immune to catastrophic events, continued efforts by all parties to place priority on and improve resilience through preparedness, response, recovery, and mitigation could help our nation's transit systems potentially better withstand and recover from such events and reduce human and economic impacts.

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<sup>15</sup>GAO, *Climate Resilience: A Strategic Investment Approach for High-Priority Projects Could Help Target Federal Resources*, [GAO-20-127](#) (Washington, D.C.: Oct. 23, 2019).

<sup>16</sup>GAO, *Public Transit: Federal and Transit Agencies Taking Steps to Build Transit Systems' Resilience but Face Challenges*, [GAO-15-159](#) (Washington, D.C.: Dec. 10, 2014).

- *Incentives.* We have also found that incentives can lower the costs or increase the benefits of disaster and climate resilience efforts. 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, and those decision makers face competing priorities. Incentives, such as legal or regulatory requirements attached to available federal funding, can help promote investments in disaster risk reduction and encourage disaster resilience decision making for infrastructure. An example of this is requiring building codes and standards based on the best available information for infrastructure built or repaired with federal funds. As we reported in November 2016, design standards, building codes, and voluntary certifications play a role in ensuring the resilience of federal and nonfederal transportation infrastructure to the effects of natural disasters and extreme weather.<sup>17</sup> We recommended a government-wide approach in which the National Institute of Standards and Technology (NIST) convene an ongoing government-wide effort to provide forward-looking climate information to standards organizations. As of April 2021, NIST had not yet taken action to implement this recommendation, but in January 2021, NIST held a workshop aimed at connecting the U.S. building codes and standards development communities with agencies and organizations collecting and disseminating climate change information.

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## Preliminary Observations on Actions Taken and Options to Enhance FHWA's Climate Resilience Activities

FHWA has implemented actions to encourage states to enhance the climate resilience of federally funded roads, and there are options to further enhance them. During the last 10 years, FHWA has developed agency policy, provided technical assistance to states, supported climate resilience research funding, and taken other steps to encourage states to enhance the climate resilience of roads in the federal-aid highway program. For example, FHWA provided states with technical assistance aimed at improving the climate resilience of federally funded roads. This assistance focused on developing tools that states can use to evaluate vulnerabilities and resilience options and to integrate climate change

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<sup>17</sup>GAO, *Climate Change: Improved Federal Coordination Could Facilitate Use of Forward-Looking Climate Information in Design Standards, Building Codes, and Certifications*, [GAO-17-3](#) (Washington, D.C. Nov. 30, 2016).

information into road projects. In addition, FHWA co-funded more than 50 resilience research pilot projects to assess vulnerabilities and options for improving resilience, evaluate the potential for nature-based features, such as wetlands, to protect coastal assets, and develop approaches for integrating climate resilience into state asset management plans and other processes.

Some states have leveraged FHWA’s activities to enhance climate resilience in some federal-aid highway projects. Specifically, in our ongoing work, we have found examples of projects that used FHWA resilience resources and climate projection information to plan or implement physical resilience enhancements on federally funded roads. For example, the Delaware Department of Transportation used FHWA resilience tools and resilience research funding to improve storm water drainage at a project site on Delaware State Route 1—a major access route to state beaches and tourist facilities—that closes to traffic due to flooding a few times every year and is vulnerable to sea level rise. Delaware Department of Transportation officials used FHWA guidance to identify which resources and data they would need to design a resilience project. They also used FHWA resilience research funding to, among other things, incorporate climate change information into site assessments. The resilience enhancements they implemented included building a sand dune levee and tidal marsh, stabilizing a beach with bags filled with oyster shells, repairing a rock wall, and replacing existing drainage. See figure 2 for a photograph of flooding along Delaware State Route 1 near Seashore State Park and a rendering of the resilience enhancements implemented at the project site in Dewey Beach.

**Figure 2: Flooding (Left) and Resilience Enhancements Made (Right) on Delaware State Route 1**



Source: Delaware Department of Transportation (2017 and 2018). Photo is from 2017 and the rendering was published in 2018. | GAO-21-561T

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As part of our ongoing work we identified—through a review of relevant literature and interviews with knowledgeable stakeholders—options that could further enhance climate resilience of projects funded by the federal-aid highway program. (See table 1.) Some of these options are similar to actions we have previously recommended in our prior work. The options include both actions that FHWA might undertake on its own and those that might require congressional action. For example, according to FHWA officials, putting in place resilience funding requirements or imposing conditions or providing incentives related to resilience would likely require congressional action. However, options such as further integrating resilience into FHWA policy and guidance or establishing additional climate resilience planning or project requirements are examples of activities the agency could potentially undertake on its own, according to FHWA officials.



**Table 1: Options to further enhance the climate resilience of federally funded roads, as suggested by relevant literature and knowledgeable stakeholders**

Option
• Integrate climate resilience into Federal Highway Administration (FHWA) policy and guidance <sup>a</sup>
• Update design standards to account for climate change and resilience best practices <sup>a</sup>
• Provide authoritative, actionable, forward-looking climate information <sup>a</sup>
• Add climate resilience funding eligibility requirements, conditions, or criteria to formula grant programs <sup>b</sup>
• Expand the availability of discretionary funding for climate resilience improvements <sup>a</sup>
• Alter the Emergency Relief program by providing incentives for, or conditioning funding on, pre-disaster resilience actions <sup>b</sup>
• Expand the availability of Emergency Relief funding for post-disaster climate resilience improvements <sup>b</sup>
• Establish additional climate resilience planning or project requirements <sup>a</sup>
• Link climate resilience actions or requirements to incentives or penalties <sup>b</sup>
• Condition eligibility, funding, or project approval on compliance with climate resilience policy and guidance <sup>b</sup>

Source: GAO analysis of literature and interviews with knowledgeable stakeholders. | GAO 21-561T

<sup>a</sup>Generally speaking, FHWA officials said they could likely implement aspects of this option under existing law and said specific proposals would need to be evaluated.

<sup>b</sup>Generally speaking, FHWA officials said they would likely need additional congressional direction or authority to implement this option and said specific proposals would need to be evaluated.

The appropriate mix of options to enhance the climate resilience of federally funded roads is a policy choice that requires complex tradeoff decisions. These tradeoffs should be made with full information about the strengths and limitations of different options and involvement from stakeholders including states, localities, and nongovernmental entities. However, these policy options may present an opportunity to improve resilience in the nation’s highway system and help ensure that federally funded roads and bridges can withstand or more easily recover from changes in the climate. Further, as noted in our *Disaster Resilience Framework*, enhancing resilience can reduce the need for federal disaster assistance and limit the federal government’s fiscal exposure in the future.

Chairman Schatz, Ranking Member Collins, and Members of the Subcommittee this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

## GAO Contacts and Staff Acknowledgements

If you or your staff have any questions about this testimony, please contact Elizabeth Repko, Acting Director, Physical Infrastructure, at (202) 512-2834 or [repkoe@gao.gov](mailto:repkoe@gao.gov). Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page

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of this statement. In addition to the contact named above, Alfredo Gomez (Director), Matt Voit (Assistant Director), Joe Thompson (Assistant Director), Maria Wallace (Analyst-in-Charge), Steve Cohen, Mary Koenen, and Elise Vaughan Winfrey made key contributions to the testimony. Other staff who made contributions to the ongoing work cited in this testimony were Andrew Edkins, Ivan Hernandez, Tara Congdon, Kevin Bray, Cindy Gilbert, Philip Farah, Susan Irving, Kathryn Godfrey, Melissa Greenaway, Holly Halifax, and Carolyn Blocker.

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