2025

U.S. NATIONAL ADAPTATION AND RESILIENCE PLANNING STRATEGY

Cover Images: Top Left: Ree Nancarrow, Spruce Smoke (*2012, Quilted Fur*); Top Right: Todd Anderson, Andrews Glacier: Romo, The Last Glacier (*2021, Woodcut on Wash*); Bottom Left: Ritika S., Youth Entry, Grade 8, Redrawing the Earth (*2023, Colored Pencil*); Bottom Right: Simona Clausnitzer, In the Eye of the Storm (*2020, Linocut Print)*

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Introduction

The devastating impacts of climate change are being felt by every country and continent on Earth. Across the United States, climate change is accelerating the frequency and fueling the severity of extreme weather events, resulting in tragedies and new realities that once seemed unimaginable. In 2024 alone, Phoenix, Arizona experienced 113 consecutive days of temperatures in excess of 100 degrees Fahrenheit, leading to heat emergencies which disrupted schools and businesses. Devastating floods in Iowa and Minnesota forced thousands to evacuate and wiped-out roads and rail lines. Hurricanes supercharged by warm ocean water ravaged communities in the Southeast, killing hundreds and cutting communities off from power and water. Raging wildfires in New Mexico, Oregon, and California destroyed entire neighborhoods. Communities in every corner of the country are being directly impacted by the effects of climate change. Even minor increases in temperature create worse economic outcomes: workers exposed to more heat risk adverse workplace outcomes, including more frequent injury and death. In addition to posing direct threats to lives and livelihoods, extreme weather events – which are becoming increasingly extreme due to the climate crisis – have had significant economic impacts: in 2024 in the United States, there were 27 disasters costing $1 billion or more, for a total of $182.7 billion in damages. This is the fourth highest cost total recorded since the National Oceanic and Atmospheric Administration started collecting this data, and nearly twice the cost of disasters in 2023.

These are the consequences of living on a rapidly warming planet. In the United States, temperatures have already risen by 2.5 degrees Fahrenheit in the contiguous states and by 4.2 degrees Fahrenheit in Alaska since 1970. Relative to the early 20th century (1901-1960), in the last two decades, areas of the central and eastern United States are 5-15% wetter while the southwest and Hawai'i are 10-15% drier. Even as the world works to limit future pollution, greenhouse gas emissions, and temperature rise, all countries, regardless of their geographic location or development status, will need to adapt to the impacts of a changing climate. National adaptation planning is critical to enable and accelerate the adjustments needed to prepare for and manage the immediate, medium-, and long-term effects of climate change.

Accordingly, the Biden-Harris Administration has taken historic steps to provide the federal support, resources, and investments needed to help America's communities meet the climate challenges of today - and prepare for the climate challenges of tomorrow. In his first week in office, President Biden signed Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, mobilizing the first ever, whole-of-government approach to addressing climate change. In addition, the Bipartisan Infrastructure Law and the Inflation Reduction Act are supporting the implementation of adaptation through investing roughly $50 billion to advance climate resilience strategies in communities across America. These federal investments have

stimulated the private sector to mobilize capital and investments in innovation that will scale and accelerate adaptation implementation.

The U.S. approach to national climate adaptation planning broadly consists of four parts:

- A periodic **climate risk and vulnerability assessment**;
- **Planning and identification of adaptation options** facilitated by an overarching national framework accompanied by a suite of federal agency adaptation plans and assessments of climate security risks;
- **Implementation** through adjustments to federal policies and programs and through provision of federal investments to enable state, Tribal, territorial, and local adaptation action; and
- Agency-specific efforts to track results and promote effective **monitoring, evaluation, and learning (MEL)**.

This approach, coupled with U.S. support for adaptation and resilience planning and implementation in developing countries, also reflects U.S. efforts to contribute to global adaptation progress, noting the centrality of national adaptation planning processes to achieving the targets in the UAE Framework for Global Climate Resilience and the Paris Agreement's global goal on adaptation.

The U.S. submission of its National Adaptation and Resilience Planning Strategy provides further details on this four-part approach through the inclusion of the following documents:

- **The 5th National Climate Assessment.** A Congressionally-mandated interagency effort that provides a scientific foundation to support informed decision-making about climate action and to identify promising adaptation options across the United States.
- **The National Climate Resilience Framework**. A first-of-its-kind federal framework to identify key values, priorities, and objectives to help expand and accelerate nationally comprehensive, locally tailored, and community-driven climate resilience strategies.
- **Federal Agency Climate Adaptation Plans.** A set of agency-specific plans that describe how agencies are mainstreaming adaptation into their policies, programs, and planning and ensuring federal facilities, employees, resources, and operations are resilient to climate change impacts.
- **The American Conservation and Stewardship Atlas.** A data and mapping project that aims to reflect and describe the scope, scale, and progress of nature conservation and restoration efforts across the U.S., bringing together science, data, and knowledge on biodiversity, climate change impacts, and equity to inform locally-led, partnership-driven conservation and restoration work.
- **Climate Resilience Game Changers Assessment.** An assessment intended for use by a diverse set of stakeholders, including private, philanthropic, and non-governmental organizations, as well as federal, state, Tribal, territorial, and local governmental entities, to help generate new ideas and align potentially catalytic investments and incentives to build and empower a climate-resilient nation.

- **National Security Memorandum on Critical Infrastructure Security and Resilience.** A policy that aims to enhance the security and resilience of the United States' critical infrastructure through a comprehensive sectoral risk management approach that takes into consideration the impacts of climate change.
- **The 2024 Biennial Transparency Report Chapter 4 on Climate Change Impacts and Adaptation.** A requirement of parties to the Paris Agreement, Biennial Transparency Reports detail climate change polices and measures, progress toward Nationally Determined Contributions, as well as a specific chapter on climate change impacts and adaptation measures.

The initial and technical United Nations Framework Convention on Climate Change guidelines for the process to formulate and implement national adaptation plans ("the NAP process") outline specific steps or phases for identifying and implementing adaptation options. Due to a combination of factors, including the relevant distribution of authorities and responsibilities between levels of governance in the United States, the U.S. approach to national adaptation planning tracks closely though is not perfectly aligned with such guidelines.

Three areas for additional work to build on and improve upon current efforts include:

- Increased vertical and horizontal integration of climate risks and adaptation measures in a comprehensive manner across all sectors and levels of governance (i.e., mainstreaming);
- Establishment of a formalized process for regular whole-of-government and community consultation with territories and Tribal Nations, as well as stakeholders, including particularly vulnerable and marginalized populations; and
- A more systematic process for adaptation monitoring, evaluation, and learning inclusive of metrics and data collection approaches appropriate for all sectors and levels of governance.

The national adaptation planning process is iterative in nature and should build upon and update existing efforts. In that regard, further work in these areas can be advanced through implementation of the recommendations presented in the National Climate Resilience Framework and the adaptation options outlined in federal agency climate adaptation plans.

Although our nation is moving quickly to address the projected risks and impacts of climate change, there is far more work to do in the years ahead. The National Climate Resilience Framework makes clear that building a climate-resilient nation will require an all-hands-on-deck effort across all levels of government (state, local, Tribal, and territorial), leaders of all political backgrounds, and the wide range of philanthropic, non-profit, academic, and private sector institutions. The sections immediately below briefly describe the four-part U.S. approach to national adaptation planning and highlight areas where further work is needed to support achievement of resilience objectives.

In total, this document offers a blueprint, and a series of critical steps needed to save lives and livelihoods, protect business investments and our economy, safeguard national security, and help secure a cleaner, healthier future for our nation.

Part 1: Climate Risk and Vulnerability Assessment

Understanding climate risks and vulnerability is essential to informing adaptation action. Information about climate risks helps support farmers who are deciding what crops to plant; city policymakers who are developing land use plans and zoning; and state and federal officials and private sector leaders who are designing investments, economic policies, programs, and insurance regimes. This information is critical for water and electric power utilities, which are highly susceptible to production and service disruptions caused by extreme weather events like droughts, floods, heatwaves, wildfires, and storms. The federal government aims to equip communities with the information and resources needed to assess their climate risks and support development of the climate resilience solutions most appropriate for them. The National Climate Assessment provides authoritative climate information across all U.S. regions and key sectors. In addition, the federal government, the private sector, academia, and other entities provide communities with evidence-based and easy-to-use information, tools, and services.

The National Climate Assessment: The Global Change Research Act of 1990 mandates that the U.S. Global Change Research Program, a body which coordinates and integrates federal research on changes in the global environment, deliver a report to Congress and the President not less frequently than every four years that "integrates, evaluates, and interprets the findings of the Program and discusses the scientific uncertainties associated with such findings; analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and analyzes current trends in global change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years."

Since 2001, five National Climate Assessments have been released, with each drawing on the best-available data for observations and climate projections. The most recent assessment, the *Fifth National Climate Assessment*, was released in 2023 and summarizes the impacts of climate change on the United States now and in the future, providing usable information which can inform a variety of climate relevant decisions, including national adaptation planning. The report examines how climate change will affect 17 national-level topics and includes 10 regional chapters covering the entire United States, including U.S. territories. This topic- and region-specific information guides federal agencies, states, local, Tribal, and territorial governments, non-governmental organizations, the private sector, and others in the formulation and implementation of adaptation and resilience strategies.

Equipping Communities with Information Needed to Assess Risk: Communities require accurate and localized observed and projected climate data to assess vulnerability and develop climate adaptation and resilience strategies. The U.S. government is an authoritative source of

climate information, with wide-reaching data, capacity, and expertise, and is working alongside partners to develop and provide evidence-based and actionable resources and technical assistance. The Climate Mapping for Adaptation and Resilience tool, for example, provides observed and projected climate data at the county scale for Americans to explore the impacts of climate change in their own communities.[1] Additional portals and tools, such as the U.S. Sea Level Change Portal, the National Climate Assessment Atlas, the National Integrated Heat Health Information System, and the Federal Emergency Management Agency's Climate Risk and Resilience Portal are examples of the growing number of federal resources designed to assist communities and businesses in their evaluation of current and future climate risks.

State, local, Tribal, and territorial governments are also increasingly investing in their own climate service capabilities to support climate action. For example, the State of California has long supported the CalAdapt system that allows researchers, government agencies and others to access the climate data used in the California Climate Change Assessments.[2] States such as Washington and Minnesota have leveraged academic researcher expertise and capacity to develop localized climate projections and have invested in the creation of climate-focused technical assistance programs, while the City of New York has its own climate assessment body, the New York City Panel on Climate Change, to guide and inform the City on climate risks and vulnerabilities.

In addition to providing climate-related information, many communities need technical assistance and support to understand and utilize information in their decision-making processes. Federal agencies provide and enable on-the-ground support to produce relevant data products and align climate information with decision needs. For example, the Department of Transportation Climate Change Center serves as a clearinghouse of resources, including those that can help mitigate the effects of climate change on the transportation sector. Regional science and services organizations, such as the National Oceanic and Atmospheric Administration's Climate Adaptation Partnerships program, the U.S. Department of Agriculture's Climate Hubs, the Department of the Interior U.S. Geological Survey's Climate Adaptation Science Centers, the Department of the Interior Bureau of Indian Affairs' Regional Tribal Climate Resilience Liaison Program, and the Environmental Protection Agency's Regional Climate Adaptation Network provide important place-based resources and assistance to help communities and businesses adapt to their unique climate challenges.

Stakeholder engagement and participatory approaches: U.S. adaptation actions are guided by and seek to empower the communities they serve. Indigenous and Traditional Knowledge has played a large role in the development of climate resilience efforts. The United States continues to dedicate significant resources towards collaboration with and empowerment of Tribal climate resilience. Not only is Indigenous expertise critical to the success of adaptation goals, but for

[1] USGCRP, "Climate Mapping for Resilience and Adaptation," CMRA (National Oceanic and Atmospheric Administration), https://resilience.climate.gov/.
[2] Geospatial Innovation Facility, University of California, Berkeley, "Explore and Analyze Climate Data from California's Climate Change Assessments," Cal-Adapt (California Energy Commission, 2025), https://cal-adapt.org/.

many Indigenous Peoples and Tribal Nations, stewardship of lands and waters is integral to their cultural identity. The United States also recognizes that gender-responsive climate action is necessary to achieve our climate goals. This is demonstrated, for example, through the National Strategy on Gender Equity and Equality, which calls for people of all genders to be fully empowered as leaders at all levels to advance climate goals, including climate adaptation strategies and climate disaster response.

Engagement with historically marginalized communities who have faced longstanding environmental injustices and inequities has been a key part of U.S. resilience efforts. Through Executive Order 14008, the Biden-Harris Administration issued a government-wide goal to direct 40 percent of the overall benefits of certain federal climate and clean energy investments, including climate resilience, and other investments, to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution (known as the Justice40 Initiative). Through the release of the Climate and Economic Justice Screening Tool, a geospatial mapping tool, federal agencies were able to identify disadvantaged communities, including all federally recognized Tribes regardless of whether they have land, in order to direct the overall benefits to those communities. To help communities remain up-to-date on programs and funding opportunities, federal agencies organize formal and informal engagements and educational opportunities.

Gaps and Opportunities for Additional Work to Improve Assessment of Climate Risks and Vulnerabilities: Climate information and other data, including socioeconomic indicators, could be better integrated and tailored to inform adaptation decisions. There remain opportunities for improved coordination in the development and delivery of federal climate data, information, and services to support adaptation across the United States. To help address this need, the National Science and Technology Council established the Subcommittee on Climate Services under the U.S. Global Change Research Program, chartered in January 2024, to improve interagency coordination of federal climate services, better linking both producers and users of climate data, tools, information, and technical assistance to facilitate improved decision-making and disaster preparedness efforts. Other federal efforts are working to develop tools and online data platforms to streamline access to federal decision-relevant information, with the aim to better enable users inside and outside of government to easily find and customize federal climate information for their needs. States, academia, and the private sector are also important developers and providers of climate services. They support local and regional efforts to address current data and information gaps, including increasing accessibility and usability of climate services.

Finally, significant financial risks are emerging as homes and buildings across the country are facing more frequent and severe weather events due to climate change. The growing risk is making home insurance in many areas unaffordable—and in some cases, unattainable. Insurance is driving up the price of housing in the form of higher, unpredictable insurance premiums, which is making it difficult to secure both single and multifamily mortgages. Higher insurance premiums are also creating risk and uncertainty in affordable multifamily housing markets, jeopardizing the financing of their construction. The Department of Treasury's Federal

Insurance Office is conducting a nationwide analysis of homeowners insurance policies to inform national, state, and local conversations about how state and federal authorities may work together to increase insurance availability in the face of increasing losses from climate events, and safeguard property owners and the housing market.

Part 2: Planning and Identification of Adaptation Options

Several key principles guide U.S. national adaptation planning and the process for identifying adaptation options. These include the importance of mainstreaming climate adaptation, the need for proactive and durable solutions to address current and future climate risks, and a preference for multi-benefit solutions to achieve community, economic, and societal objectives. To facilitate the identification of adaptation options in accordance with these principles, a range of institutional arrangements provides guidance incorporating the expertise and perspective of various stakeholders.

The National Climate Resilience Framework: Recognizing that addressing the projected risks and impacts of climate change requires an all-hands-on-deck effort, coordinated across the federal government, with all levels of sub-national government, and with a wide range of non-governmental institutions, President Biden directed the creation of a first-ever National Climate Resilience Framework. The Framework articulates a common vision and fundamental principles that guide the U.S. approach to achieving a climate-resilient nation. It also identifies six core objectives that are critical to strengthening the nation's resilience to the impacts of climate change and making communities safe, healthy, equitable, and economically strong. These objectives—and the specific actions identified to help achieve them—were developed in coordination with adaptation and resilience experts across the federal government. They were further informed by the insights of non-federal climate resilience stakeholders and recommendations from the U.S. Government Accountability Office and the President's Council of Advisors on Science and Technology. The objectives are to:

- Embed climate resilience into planning and management;
- Increase resilience of the built environment to both acute climate shocks and chronic stressors;
- Mobilize capital, investment, and innovation to advance climate resilience at scale;
- Equip communities with information and resources needed to assess their climate risks and develop the climate resilience solutions most appropriate for them;
- Protect and sustainably manage lands and waters to enhance resilience while providing numerous other benefits; and
- Help communities become not only more resilient, but also more safe, healthy, equitable, and economically strong.

Federal Agency Climate Adaptation Plans: While the National Climate Resilience Framework lays out the U.S. government's vision for advancing climate resilience and serves as an overarching framework, individual federal agencies have taken on increased responsibility to manage and address current climate impacts and future climate risks to their own mission-

delivery and operations and procurement. In 2014, federal agencies first developed Federal Agency Climate Adaptation Plans, which were subsequently revised in 2021 and again in 2024, reflecting the increasing maturity and expertise of federal agencies to (1) address the risks posed by climate change to their operations and management and (2) better serve their stakeholders in a changing climate through adjustments in policies and programs. As of December 2024, 28 federal agencies have prepared climate adaptation plans. Key elements of the most recently updated 2024-2027 Federal Agency Climate Adaptation Plans include:

- Descriptions of efforts to mainstream adaptation and resilience into agency policies, programs, planning, budget formulation, and external funding;
- Links between climate adaptation actions and other priorities, including advancing environmental justice, strengthening engagement with Tribal Nations, supporting land and water conservation efforts, scaling up nature-based solutions, mobilizing the next generation of climate resilience workers through the American Climate Corps, and addressing the causes of climate change through climate mitigation;
- Use of historical data and projections to assess exposure of assets to climate-related hazards, including extreme heat and precipitation, sea level rise, flooding, and wildfires;
- Actions to manage climate risk to federal facilities, employees, lands and waters, and supply chains; and
- Adoption of common progress indicators across agencies to assess the progress of federal climate adaptation efforts.

For example, the Environmental Protection Agency is integrating consideration of climate risks in the development of rules, policy, and guidance; permitting and environmental reviews; monitoring, enforcement, and compliance activities; and grant making, when appropriate and consistent with existing authorities. The Department of Transportation has launched its first program dedicated to resilience, the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program, which can be used to support evacuation routes, coastal resilience efforts, infrastructure improvements, and relocation. The U.S. Department of Agriculture's Forest Service is updating or proposing climate-informed revisions to guidance and policies related to silviculture practices, beneficial uses of forest restoration byproducts, recreation, habitat and water resource management, and forest-level land management planning. The Department of Housing and Urban Development is including climate change preference points in Notices of Funding Opportunities to encourage applications that invest in climate resilience, energy efficiency, and renewable energy. The Department of the Interior's Strategic Hazard Identification and Risk Assessment (SHIRA) project provides data, tools, and training that enable its staff to assess and plan for threats to Department assets, resources, and people.

U.S. Framework for Climate Resilience and Security: Growing climate vulnerabilities have profound impacts on U.S. national security, economic security, and strategic interests – through, for example, threats to critical U.S. infrastructure, military bases, and communities. The U.S. Framework for Climate Resilience and Security offers a whole-of-government approach to addressing these threats and strengthening the resilience and stability of communities both in

the U.S. and around the world in the face of a changing climate. It does so through three actions: (1) assessing climate-related threats and opportunities, (2) partnering for an integrated approach, and (3) investing in collective resilience.

American Conservation and Stewardship Atlas: In January 2021, President Biden established the United States' first-ever national conservation goal: to protect, conserve, and restore at least 30 percent of U.S. lands and waters by 2030. To help reach this goal, the Biden-Harris administration launched the *America the Beautiful* initiative – a decade-long effort to tackle the climate and nature crises, create jobs and strengthen the economy, and increase equitable access to nature by supporting locally-led, voluntary, community-designed, and partnership-driven work to conserve the lands and waters.[3] As part of the *America the Beautiful* initiative, federal agencies began working to develop the American Conservation and Stewardship Atlas (Atlas) – a data and mapping project that aims to better reflect the full scope, scale, and progress of conservation efforts across the U.S.[4] The Atlas projects that U.S. protection, conservation, and restoration efforts will need to stay at or above 2021-2023 levels of expansion to achieve the 30 percent goal for lands by 2030 and to expand geographic and biological representation to ensure ecosystem health and resilience.

National Heat Strategy: In August 2024, the National Integrated Heat Health Information System (NIHHIS) and the White House Interagency Working Group on Extreme Heat (IWG) released a National Heat Strategy for 2024-2030. This strategy will aid federal agencies in developing science-based solutions and improving resources, communications and decision-making related to hazardous heat. The strategy facilitates proactive coordination around heat planning, response, and resilience. More information about the strategy and efforts to build resilience to extreme heat can be found at heat.gov.

Sub-national Adaptation Planning Efforts: U.S. adaptation objectives cannot be achieved through federal action alone. In addition to federal-level adaptation plans, many state and local governments, companies, and non-governmental organizations have developed individual sustainability, resilience, or adaptation plans. As of December 2024, eighteen states have climate adaptation plans and another six states have plans underway. Twenty-three states have an interagency coordinating body for resilience activities. Twelve states have official resilience offices to coordinate resilience activities within their state, and thirteen states have chief resilience officers.[5]

There are numerous instances of collaboration between federal, state, and local actors at the sectoral level. For example, the Voluntary Community-Driven Relocation Program, a multi-

[3] "America the Beautiful Initiative," Conservation.gov, https://www.conservation.gov/pages/america-the-beautiful-initiative.
[4] "American Conservation and Stewardship Atlas," Conservation.gov, https://www.conservation.gov/pages/atlas-and-data.
[5] David Morely, "Planning for State Resilience: A 50-State Breakdown," APA (American Planning Association, March 28, 2024), https://storymaps.arcgis.com/stories/b8255f7e733d40f4945946839fb21340.

agency effort launched at the Tribal Nations Summit in November 2022, provided $25 million to Newtok Village, a Yup'ik community of 400 residents located on the Ninglick River in Alaska. The village has faced coastal erosion from ocean storms and degrading permafrost; with this federal investment, the village is moving nine miles away to a new community of Mertavik. In Puerto Rico, officials assessed the impacts of increased drought conditions during planning efforts to safeguard local water supplies. With Bipartisan Infrastructure Law funds, Puerto Rico is working towards quantifiable and sustained water savings by protecting watersheds and restoring aquatic habitats and stream beds in the Punta Tuna Natural Reserve in Maunabo, Puerto Rico.

Elsewhere, the U.S. Department of Agriculture is working with universities and Cooperative Extension to help land and natural resource managers and communities assess and manage climate change impacts. Several Extension programs in states such as Arizona, Minnesota, Montana, and Illinois, among others, have Extension faculty focused on research and programming related to climate science, climate risk management, and climate adaptation. With funding from the Agriculture and Food Research Initiative's Foundational and Applied Sciences program, the National Institute of Food and Agriculture supported the development of a Cooperative Extension-wide climate action plan that will direct efforts to help producers, land managers, and rural communities address the causes and consequences of climate change. Similarly, for over 50 years, the National Oceanic and Atmospheric Administration's National Sea Grant College Program has supported coastal, marine, and Great Lakes communities with research, extension, and education, including efforts to address coastal hazards in a changing climate.

Gaps and Opportunities for Additional Work to Enhance Climate Adaptation Planning: To build a resilient nation where climate considerations are integrated throughout decision-making processes, it is essential that leaders across all governance levels do even more to increase the nation's collective climate literacy and strengthen and invest in the capacity and capabilities needed to plan and act. The 2024 Climate Literacy Guide, published in September, promotes greater climate literacy by providing an educational and communication framework for use by educators, communicators, and decision-makers.[6] To maximize effectiveness, climate adaptation plans must be connected to other planning documents and processes, such as assessment of climate-related financial risk to the federal government; organizational performance goals; enterprise risk management efforts; and federal, state, and local budgets. There is a particular need to better link climate considerations with emergency preparedness and disaster risk planning. While eighteen states have developed climate adaptation plans, thirty-two states lack a public adaptation plan, a select few U.S.-based companies have disclosed adaptation-related actions they are taking, and very few jurisdictions have adaptation plans co-designed between the public and private sectors.

A significant opportunity also exists through the provision of either public or private insurance products to incentivize property owners to adopt more climate resilient technologies, practices,

[6] USGCRP, "Climate Literacy: Essential Principles for Understanding and Addressing Climate Change" (Washington, D.C., USA: U.S. Global Change Research Program, 2024), https://doi.org/10.7930/clg2024.

or building retrofits. For instance, the Federal Emergency Management Agency's National Flood Insurance Program is helping communities proactively protect their homes, businesses, and belongings from unexpected flood damage before a loss occurs, including providing guidance to communities on how they can mitigate their flood risk. Insurance providers can utilize similar approaches to protect communities and property owners from other climate-related risks, including hurricanes and wildfires. States and localities can also reduce the overall risk pool and stabilize the insurance market through home hardening and resiliency by requiring or incentivizing building codes, energy codes, FORTIFIED (a voluntary construction and re-roofing standard), and other resiliency standards. For example, Alabama, Louisiana, Minnesota, Mississippi, and Oklahoma require insurance discounts for homeowners that have a FORTIFIED designation, and Louisiana requires the most recent building codes and energy codes, ensuring homes and people are protected in major storm events and energy costs and building emissions are low. An opportunity also exists to create new federal resiliency standards to help protect federally funded buildings and projects from additional climate-related risks, building on the Federal Flood Risk Management Standard, which currently does so for flood risk. Additionally, agencies can operationalize best practices to enhance the climate resilience of federally funded infrastructure, as referenced in the Office of Budget and Management memorandum on Advancing Climate Resilience through Climate-Smart Infrastructure Investments and Implementation Guidance for the Disaster Resiliency Planning Act. Finally, the root cause of climate change must be addressed by requiring and incentivizing emissions reductions in buildings.

Part 3: Implementation

Effective implementation of adaptation plans relies on strong coordination between different parts of the government, as well as vertical integration and coordination between national governments and sub-national entities. Strong and predictable policy frameworks support private investment in innovation and deployment of critical technologies and infrastructure, spurring markets that drive continued progress.

Coordinating with Sub-National Government Entities and Other Stakeholders: In the United States, many types of organizations make decisions about adaptation, including federal, state, territorial, Tribal, and local governments; businesses; nonprofits; households; and individuals—all with varying and overlapping jurisdictions. While some adaptation decisions are made unilaterally, most decisions involve multiple organizations. Adaptation networks have become more sophisticated in the last decade, involving a greater number of actors from more diverse organizational backgrounds over a sustained period. For example, following multiple wildfires and post-fire floods, the Tribal community of Santa Clara Pueblo collaborated with multiple federal agencies, the State of New Mexico, and several other Tribes to restore their watershed and to build resilience against future floods. Coordinating hubs can help bridge activities of disparate actors while having well-defined roles and responsibilities can reduce and even avoid duplicative efforts. In some cases, strong collaborations across government and other stakeholders already exist. For example, at the Department of the Interior, the United States Geological Survey leads the National and Regional Climate Adaptation Science Centers, a

partnership-driven program that teams scientists with natural and cultural resource managers and local communities to help fish, wildlife, water, land, and people adapt to a changing climate.

Federal Support for Implementation: The United States is in the process of implementing an array of programs and projects supported by the federal government that shape and prioritize national climate resilience. Together, the Bipartisan Infrastructure Law and the Inflation Reduction Act represent over $50 billion in federal support for national and sub-national adaptation efforts. Specifically, the $30 billion investment from the Bipartisan Infrastructure Law includes extensive funding toward rehabilitation and adaptation of infrastructure, flood management, evacuation planning and support, and other community resilience measures to ensure sustainable and justice-oriented climate development. Notably, the Bipartisan Infrastructure Law includes $8.7 billion for the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation program to support resilience of transportation infrastructure. As part of this effort, nearly $830 million in grants were awarded in 2024 to states and local communities, the first of their kind dedicated to transportation resilience. These grants are helping to fund a complete stormwater drainage system on New York City's busiest subway line; the upgrading of aging water infrastructure throughout downtown Kalamazoo; and the raising of floodwalls in Pittsburgh among dozens of other projects. Simultaneously recognizing that healthy ecosystems are a critical part of the nation's infrastructure, the Bipartisan Infrastructure Law authorized significant funding to the Department of the Interior and the Department of Agriculture to advance ecosystem restoration and resilience across U.S. lands and waters.

The Inflation Reduction Act allocates $20.5 billion towards various initiatives aimed at mitigating drought, reducing air pollution, making renewable energy and energy storage technologies available to communities, improving ecological integrity, expanding data collection and availability, enhancing coastal habitat and community resilience, and building the capacity of disadvantaged communities to engage with state and federal decision-making processes. Key allocations include over 200 drought mitigation projects led by the Department of the Interior Bureau of Reclamation in the Colorado River Basin and across the American West, urban tree canopy projects, sustainable retrofits for U.S. Department of Housing and Urban Development-assisted multifamily properties, collaboration with private forest landowners, and significant support for Tribal climate resilience planning led by the Department of the Interior Bureau of Indian Affairs.

Mobilizing Capital and Innovation for Resilience: Mobilizing capital, investment, and innovation in climate resilience will help the nation better prepare for climate impacts. In July 2024, the White House released *The Climate Resilience Game Changers Assessment*, which focuses on the American innovation needed to build and empower a climate-resilient nation and is intended for use by a diverse set of stakeholders, including private, philanthropic, and non-governmental organizations to help generate new ideas and align potentially catalytic investments and incentives. The *Climate Resilience Game Changers Assessment* considers management practices and methodologies, technologies, and institutional, financial, and governance structures, that

(1) have been identified, prototyped, developed, or significantly refined in the last ten years; (2) have not reached the point of widespread adoption; and (3) if widely and appropriately adopted, would achieve or substantially advance one or more of the objectives of the National Climate Resilience Framework. Ultimately, the *Climate Resilience Game Changers Assessment* is a step toward coordinating and catalyzing philanthropic and private investments in climate resilience innovation.

Gaps and Opportunities for Additional Work to Enhance Implementation of Adaptation Actions: The federal government plays a key role in mobilizing resources and creating enabling conditions for state, territorial, Tribal, and local governments, as well as businesses and nonprofits to implement adaptation solutions. Critically, the Bipartisan Infrastructure Law and Inflation Reduction Act represent significant federal allocations that enable sub-national entities to implement adaptation activities relevant to local circumstances. More information on resources that can be accessed by states and municipalities can be found in:

- A Guidebook to the Bipartisan Infrastructure Law[7]
- A Guidebook to the Inflation Reduction Act[8]

The *Climate Resilience Game Changers Assessment* provides an overview of where key investments in research, development, and deployment by governmental and non-governmental partners will be critical in the coming years. Additional work to improve access to federal resources, engage academia and the private sector in research and development for adaptation solutions, and to coordinate investments to maximize the co-benefits of reducing greenhouse gas pollution and enhancing nature-based solutions is needed. For example, during the White House Summit on Building Climate Resilient Communities, participants discussed the need for alternative structures for nature-based solutions and that Green Banks and community lenders could provide financial support through funding pools with partnership requirements.[9]

Part 4: Monitoring, Evaluation and Learning (MEL)

As is the case in most countries, an important characteristic of national adaptation planning in the United States is the continuous and iterative nature of the process due to the medium-to-long-term timeframes over which adaptation takes place. Given this longer timeframe and the importance of assessing adaptation effectiveness and sufficiency, defining metrics and indicators and establishing a system for data collection is a requirement for ensuring progress towards adaptation objectives and, ultimately, the overarching goal of enhancing adaptive

[7] "Building a Better America: A Guidebook to the Bipartisan Infrastructure Law for State, Local, Tribal, and Territorial Governments, and Other Partners" (The White House, May 2022), https://www.whitehouse.gov/wp-content/uploads/2022/05/BUILDING-A-BETTER-AMERICA-V2.pdf.
[8] "Building a Clean Economy: A Guidebook to the Inflation Reduction Act's Investments in Clean Energy and Climate Action" (The White House, January 2, 2023), https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf.
[9] "White House Summit on Building Climate Resilient Communities" (The White House, September 28, 2023), https://www.whitehouse.gov/wp-content/uploads/2023/11/PROCEEDINGS_White-House-Summit-on-Building-Climate-Resilient-Communities_092823.pdf.

capacity, strengthening resilience, and reducing vulnerability to climate change. To date, assessments of the effectiveness of adaptation actions have generally been limited to project-specific performance against a limited set of extreme events or climate conditions.

Challenges of Adaptation Measurement: Adaptation researchers and practitioners have begun to track the number of actions that have occurred across the United States and to evaluate adaptation projects in a limited manner. However, efforts to assess trade-offs, effectiveness, sufficiency, and long-term consequences of incremental and transformational adaptation actions are still largely theoretical and will need more research and experience to implement and consistently track over time. Metrics will need to be granular enough to observe disparities among communities to reduce potential inequities.

U.S. Monitoring Efforts: The United States does not currently have a single, coordinated federal MEL framework or data collection system to systematically assess ongoing adaptation efforts across multiple sectors and levels of governance. However, individual federal agencies have developed indicators and results frameworks to support domestic adaptation MEL. From 2022 to 2023, the Council on Environmental Quality partnered with federal agencies preparing climate adaptation plans to develop a collection of indicators that could be used to assess climate resilience efforts across all federal agencies and ensure these indicators could also be applied at the sub-agency level. To facilitate identification of a common set of metrics, in 2022 to 2023, the Council on Environmental Quality held a series of workshops with adaptation and resilience leaders from federal agencies with diverse missions, assets, geographic distributions, and workforces. The initial focus of this effort was on the development of process-related indicators. Building off the collaborative interagency process, in June 2024, the Council on Environmental Quality introduced a common set of process-related indicators and metrics for the 2024-2027 Climate Adaptation Plans.[10]

Gaps and Opportunities for Additional Work to Enhance Resilience: Additional work by researchers and practitioners to better measure the effectiveness of adaptation actions is needed at the local, regional, national, and global level. Additionally, efforts to identify how to link progress at the local and sub-national level to federal efforts could help improve how the federal government continues to facilitate adaptation action.

[10] "Assessing the Progress and Impact of Federal Climate Adaptation: Developing Climate Resilience Indicators and Metrics" (White House Council on Environmental Quality, June 2024), https://www.sustainability.gov/pdfs/indicatorsmetrics-2024-cap.pdf.

Todd Anderson
Andrews Glacier: Romo, The Last Glacier
(2021, Woodcut on Wash)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.

Overview: Understanding Risks, Impacts, and Responses

Chapter 1. Overview: Understanding Risks, Impacts, and Responses

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Tammy West

The Fifth National Climate Assessment documents observed and projected vulnerabilities, risks, and impacts associated with climate change across the United States and provides examples of response actions underway in many communities. This Overview presents highlights from the Assessment, providing summary findings and a synthesis of material from the underlying chapters. Curly brackets indicate cross-references to full chapters (e.g., {Ch. 2}), Key Messages (e.g., {2.1}), figures (e.g., {Figure 32.8}), and other text elements.

Table of Contents

Ellen Anderson

Margaret Plumley

How the United States Is Addressing Climate Change

The effects of human-caused climate change are already far-reaching and worsening across every region of the United States. Rapidly reducing greenhouse gas emissions can limit future warming and associated increases in many risks. Across the country, efforts to adapt to climate change and reduce emissions have expanded since 2018, and US emissions have fallen since peaking in 2007. However, without deeper cuts in global net greenhouse gas emissions and accelerated adaptation efforts, severe climate risks to the United States will continue to grow.

Future climate change impacts depend on choices made today

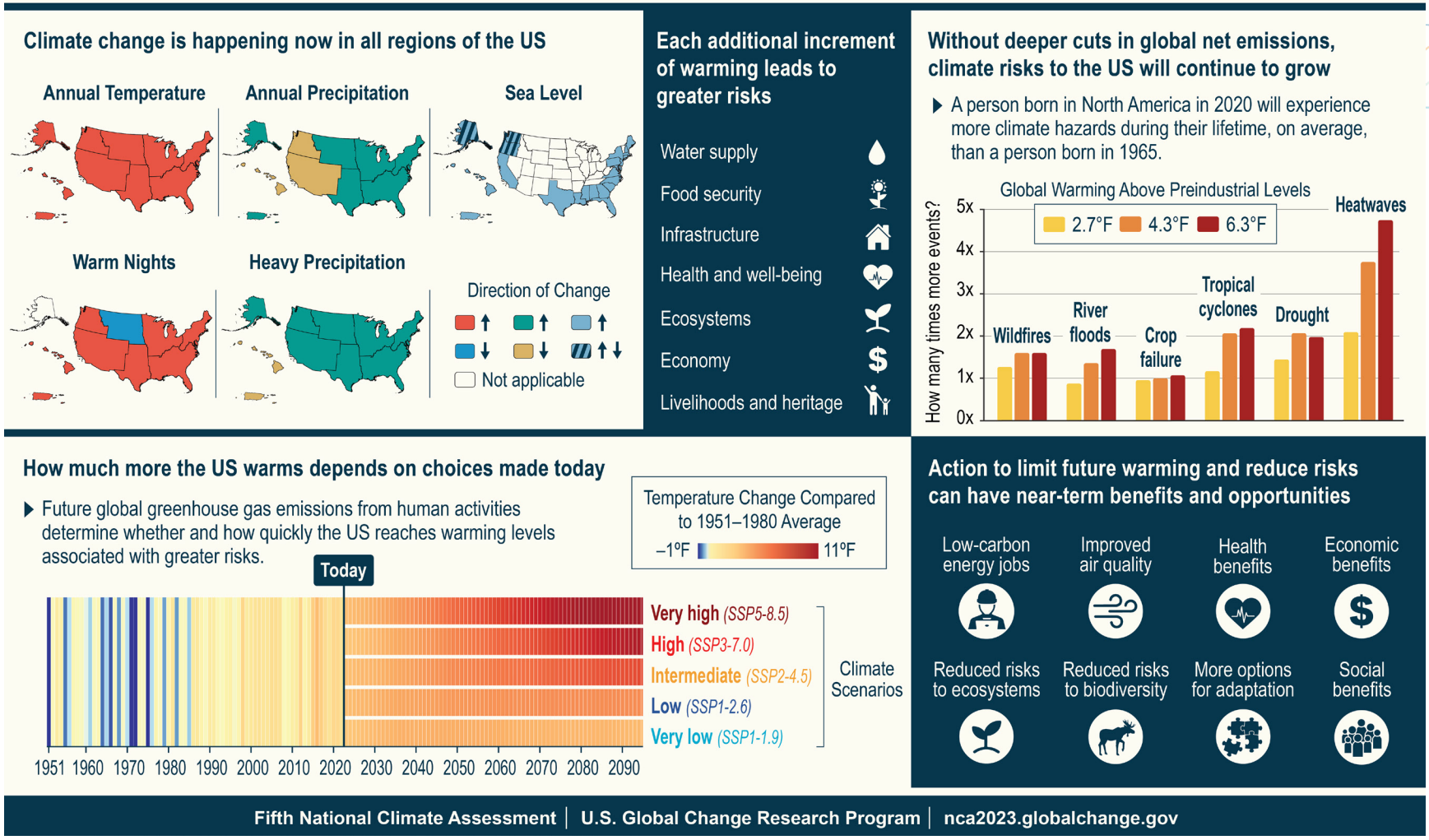
The more the planet warms, the greater the impacts. Without rapid and deep reductions in global greenhouse gas emissions from human activities, the risks of accelerating sea level rise, intensifying extreme weather, and other harmful climate impacts will continue to grow. Each additional increment of warming is expected to lead to more damage and greater economic losses compared to previous increments of warming, while the risk of catastrophic or unforeseen consequences also increases. {2.3, 19.1}

However, this also means that each increment of warming that the world avoids—through actions that cut emissions or remove carbon dioxide (CO_2) from the atmosphere—reduces the risks and harmful impacts of climate change. While there are still uncertainties about how the planet will react to rapid warming, the degree to which climate change will continue to worsen is largely in human hands. {2.3, 3.4}

In addition to reducing risks to future generations, rapid emissions cuts are expected to have immediate health and economic benefits (Figure 1.1). At the national scale, the benefits of deep emissions cuts for current and future generations are expected to far outweigh the costs. {2.1, 2.3, 13.3, 14.5, 15.3, 32.4; Ch. 2, Introduction}

Taelyn B.

Climate Change Risks and Opportunities in the US



Climate change presents risks while action to limit warming and reduce risks presents opportunities for the US.

Figure 1.1. (**top left**) Changes in multiple aspects of climate are apparent in every US region. The five maps present observed changes for five temperature, precipitation, and sea level rise metrics: 1) warming is apparent in every region (based on changes in annual average temperature in 2002–2021 compared to the 1901–1960 average for the contiguous United States, Hawai'i, and Puerto Rico and to 1925–1960 for Alaska); 2) the number of warm nights per year (days with minimum temperatures at or above 70°F in 2002–2021 compared to 1901–1960) is increasing everywhere except the Northern Great Plains, where they have decreased, and in Alaska, where nights above 70°F are not common; 3) average annual precipitation is increasing in most regions, except in the Northwest, Southwest, and Hawai'i, where precipitation has decreased (same time periods as annual average temperature); 4) heavy precipitation events are increasing everywhere except Hawai'i and the US Caribbean, where there has been a decrease (trends over the period 1958–2021); and 5) relative sea levels are increasing along much of the US coast except in Oregon, Washington, and Alaska, where there is a mix of both increases and decreases (trends over 1990–2020). {2.2, 9.1; Figures 2.4, 2.5, 2.7, 2.8}

(**top center**) Every fraction of a degree of additional warming will lead to increasing risks across multiple sectors in the US (see Table 1.2 and "Current and Future Climate Risks to the United States" below). Without rapid, substantial reductions in the greenhouse gases that cause global warming, these climate risks in the US are expected to increase.

(**top right**) People born in North America in 2020, on average, will be exposed to more climate-related hazards compared to people born in 1965. How many more extreme climate events current generations experience compared to previous generations will depend on the level of future warming. {Figure 15.4}

(**bottom left**) This climate stripes chart shows the observed changes in US annual average surface temperature for 1951–2022 and projected changes in temperature for 2023–2095 for five climate scenarios, ranging from a very high scenario, where greenhouse gas emissions continue to increase through most of the century, to a very low scenario, where emissions decline rapidly, reaching net zero by around midcentury (see Figure 1.4 and Table 3 in the Guide to the Report). Each vertical stripe represents the observed or projected change in temperature for a given year compared to the 1951–1980 average; changes are averaged over all 50 states and Puerto Rico but do not include data for the US-Affiliated Pacific Islands and the US Virgin Islands (see also Figure 1.13).

(**bottom right**) Although climate benefits from even the most aggressive emissions cuts may not be detectable before the middle of the century, there are many other potential near-term benefits and opportunities from actions that reduce greenhouse gas emissions. {2.3, 8.3, 10.3, 13.3, 14.5, 15.3, 19.1, 31.3, 32.4}

Figure credits: (top left, top center, top right, bottom right) USGCRP, USGCRP/ICF, NOAA NCEI, and CISESS NC; (bottom left) adapted from panel (c) of Figure SPM.1 in IPCC 2023.

Box 1.1. Mitigation, Adaptation, and Resilience

Throughout this report, three important terms are used to describe the primary options for reducing the risks of climate change:

- **Mitigation**: Measures to reduce the amount and rate of future climate change by reducing emissions of heat-trapping gases (primarily carbon dioxide) or removing greenhouse gases from the atmosphere.
- **Adaptation**: The process of adjusting to an actual or expected environmental change and its effects in a way that seeks to moderate harm or exploit beneficial opportunities.
- **Resilience**: The ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions.

James Keul

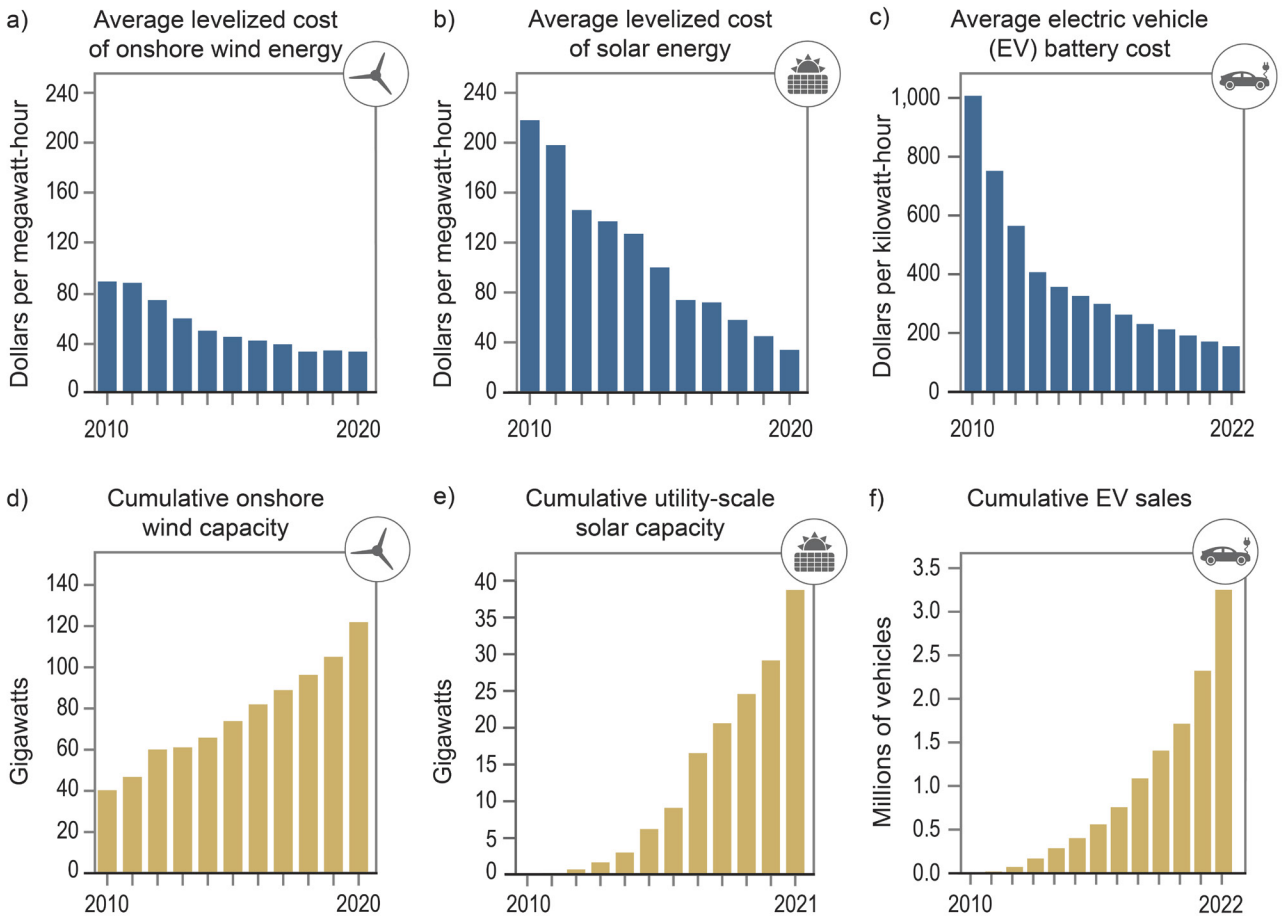
US emissions have decreased, while the economy and population have grown

Annual US greenhouse gas emissions fell 12% between 2005 and 2019. This trend was largely driven by changes in electricity generation: coal use has declined, while the use of natural gas and renewable technologies has increased, leading to a 40% drop in emissions from the electricity sector. Since 2017, the transportation sector has overtaken electricity generation as the largest emitter. {11.1, 13.1, 32.1; Figures 32.1, 32.3}

As US emissions have declined from their peak in 2007, the country has also seen sustained reductions in the amount of energy required for a given quantity of economic activity and the emissions produced per unit of energy consumed. Meanwhile, both population and per capita GDP have continued to grow. {32.1; Figures 32.1, 32.2}

Recent growth in the capacities of wind, solar, and battery storage technologies is supported by rapidly falling costs of zero- and low-carbon energy technologies, which can support even deeper emissions reductions. For example, wind and solar energy costs dropped 70% and 90%, respectively, over the last decade, while 80% of new generation capacity in 2020 came from renewable sources (Figures 1.2, 1.3). {5.3, 12.3, 32.1, 32.2; Figure A4.17}

Across all sectors, innovation is expanding options for reducing energy demand and increasing energy efficiency, moving to zero- and low-carbon electricity and fuels, electrifying energy use in buildings and transportation, and adopting practices that protect and improve natural carbon sinks that remove and store CO_2 from the atmosphere, such as sustainable agricultural and land-management practices. {11.1, 32.2, 32.3; Boxes 32.1, 32.2; Focus on Blue Carbon}



Historical Trends in Unit Costs and Deployment of Low-Carbon Energy Technologies in the United States

Increasing capacities and decreasing costs of low-carbon energy technologies are supporting efforts to further reduce emissions.

Figure 1.2. Costs of onshore wind (**a**), solar photovoltaics (**b**), and electric vehicle (EV) batteries (**c**) have decreased sharply since 2000 (data shown here start in 2010), as the cumulative capacities of wind and solar generation (**d** and **e**) and the cumulative number of EVs sold (**f**) have increased. {Figure 32.8} Figure credit: Electric Power Research Institute, National Renewable Energy Laboratory, NOAA NCEI, and CISESS NC.

Accelerating advances in adaptation can help reduce rising climate risks

As more people face more severe climate impacts, individuals, organizations, companies, communities, and governments are taking advantage of adaptation opportunities that reduce risks. State climate assessments and online climate services portals are providing communities with location- and sector-specific information on climate hazards to support adaptation planning and implementation across the country. New tools, more data, advancements in social and behavioral sciences, and better consideration of practical experiences are facilitating a range of actions (Figure 1.3). {7.3, 12.3, 21.4, 25.4, 31.1, 31.5, 32.5; Table 31.1}

Actions include:

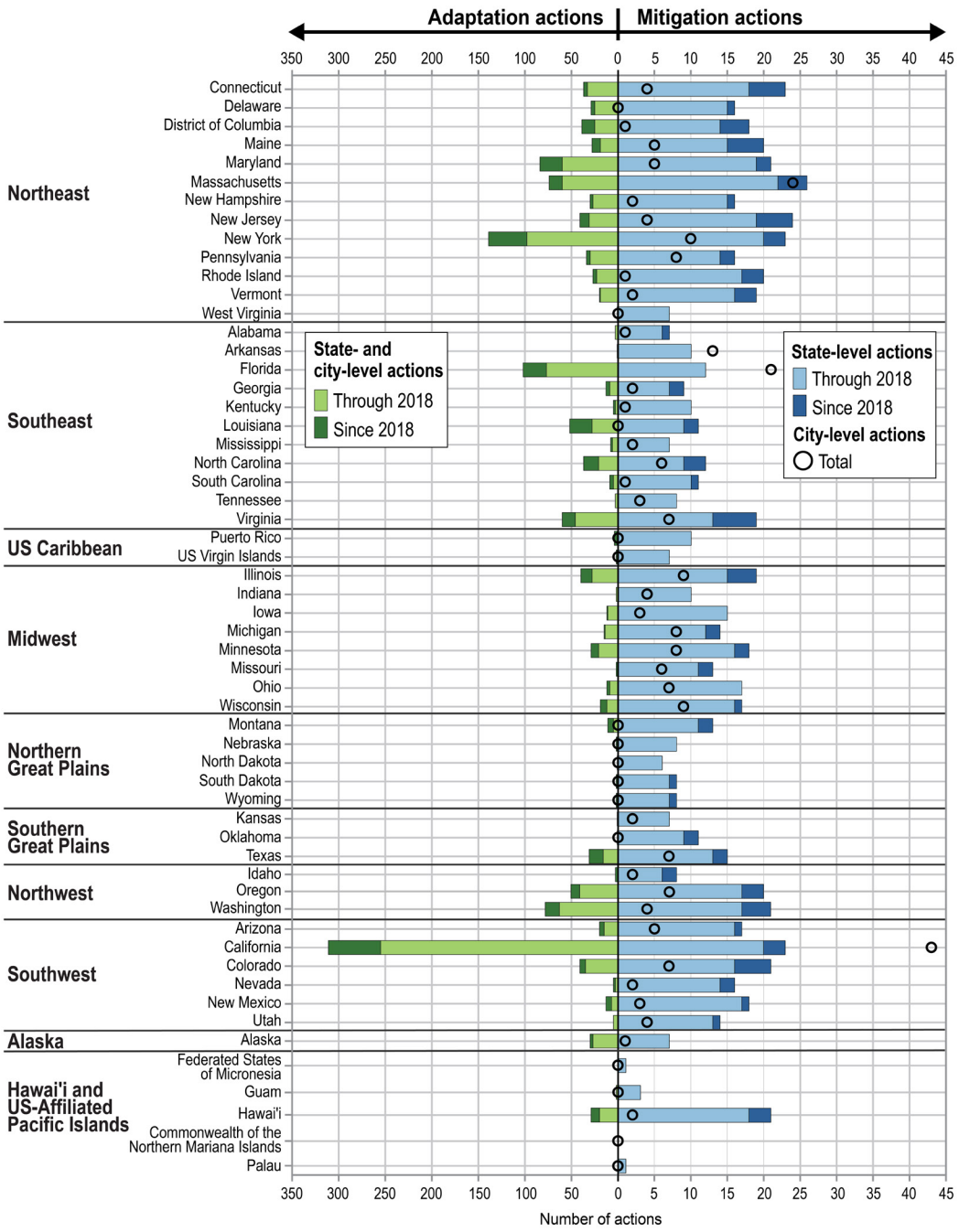
- Implementing nature-based solutions—such as restoring coastal wetlands or oyster reefs—to reduce shoreline erosion {8.3, 9.3, 21.2, 23.5}
- Upgrading stormwater infrastructure to account for heavier rainfall {4.2}
- Applying innovative agricultural practices to manage increasing drought risk {11.1, 22.4, 25.5}
- Assessing climate risks to roads and public transit {13.1}
- Managing vegetation to reduce wildfire risk {5.3}
- Developing urban heat plans to reduce health risks from extreme heat {12.3, 21.1, 28.4}
- Planning relocation from high-risk coastal areas {9.3}

Despite an increase in adaptation actions across the country, current adaptation efforts and investments are insufficient to reduce today's climate-related risks and keep pace with future changes in the climate. Accelerating current efforts and implementing new ones that involve more fundamental shifts in systems and practices can help address current risks and prepare for future impacts (see "Mitigation and adaptation actions can result in systemic, cascading benefits" below). {31.1, 31.3}

Pam DeChellis

Climate action has increased in every region of the US

Efforts to adapt to climate change and reduce net greenhouse gas emissions are underway in every US region and have expanded since 2018 (Figure 1.3; Table 1.1). Many actions can achieve both adaptation and mitigation goals. For example, improved forest- or land-management strategies can both increase carbon storage and protect ecosystems, and expanding renewable energy options can reduce emissions while also improving resilience. {31.1, 32.5}



US Adaptation and Mitigation Actions

Cities and states are acting on climate change, with a substantial increase in new activities underway since 2018.

Figure 1.3. Since 2018, city- and state-level adaptation plans and actions (**green bars**, left) increased by 32%, complemented by a 14% increase in the total number of new state-level mitigation activities (**blue bars**, right; 69% have updated their policies). In 2021 there were 271 city-level mitigation actions in place (**open circles**, right), according to the Global Climate Action Tracker. Renewable energy and energy efficiency projects on Tribal lands have also expanded (not shown). {31.1, 32.5; Figure 16.4; Table 1.1} Figure credit: US Army Corps of Engineers, EPA, Pennsylvania State University, NOAA NCEI, and CISESS-NC.

Climate adaptation and mitigation efforts involve trade-offs, as climate actions that benefit some or even most people can result in burdens to others. To date, some communities have prioritized equitable and inclusive planning processes that consider the social impacts of these trade-offs and help ensure that affected communities can participate in decision-making. As additional measures are implemented, more widespread consideration of their social impact can help inform decisions around how to distribute the outcomes of investments. {12.4, 13.4, 20.2, 21.3, 21.4, 26.4, 27.1, 31.2, 32.4, 32.5; Box 20.1}

Table 1.1. Climate Actions Are Taking Place Across All US Regions

Examples of recent local adaptation, resilience, and mitigation actions around the country follow.

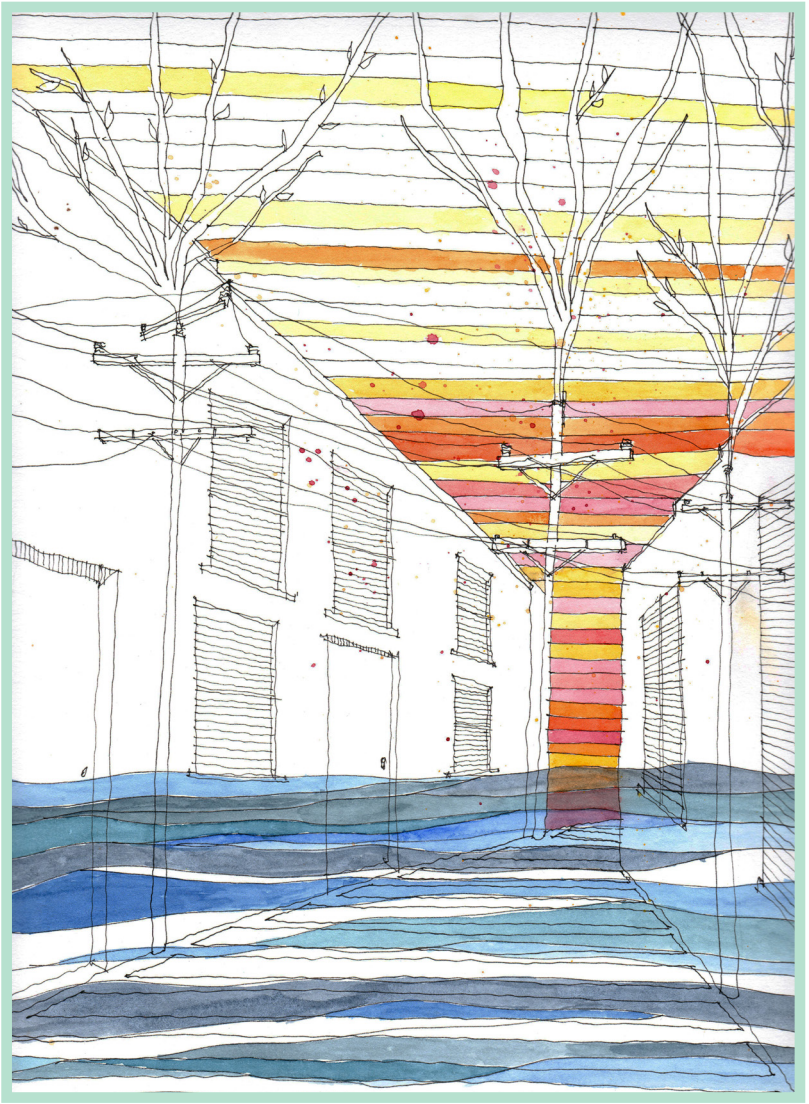
Region	Action
Northeast	The 2022 stormwater code in Pittsburgh, Pennsylvania, requires new developments to plan for projected increases in heavy rainfall under climate change rather than building to historical rainfall amounts. In 2021, the city also committed to achieve carbon neutrality by 2050. {Box 21.1}
Southeast	Following repeated flooding from multiple hurricanes, measures to reduce flood risk in Princeville, North Carolina, include buyouts, elevating homes, and building housing that meets local flood standards. In Orlando, Florida, the city and businesses are adopting commercial building energy-efficiency requirements and electric vehicle readiness policies and have used wastewater and food scraps from parks and resorts to generate renewable biogas. {Boxes 22.1, 32.3}
US Caribbean	Many community-based organizations in Puerto Rico have undertaken actions to advance adaptation, social transformation, and sustainable development. These organizations work to expand renewable energy and equitable access to energy resources, prepare for disasters, restore ecosystems, strengthen agriculture and food security, and protect public health. {23.5}
Midwest	A wetland creation project in Ashtabula, Ohio, restored habitat displaced by shoreline development, improving coastal protection for the port on Lake Erie. In Michigan, some state forestlands are being managed to bolster carbon storage and to support recreation and wildlife habitat. {24.2, 24.4; Figure 24.9}
Northern Great Plains	The Nebraska Natural Resources Conservation Service supported farmers in testing soil health and evaluating soil management practices that promote climate adaptation. Across the region, wind electricity generation tripled between 2011 and 2021, with a growing number of Tribes leading the Nation's renewable energy transition by installing wind, solar, and hydropower. {25.3, 25.5; Box 25.3}
Southern Great Plains	Texas- and Kansas-based groups are supporting soil and land management practices that increase carbon storage while protecting important ecosystems. Wind and solar energy generation and battery storage capacities have also grown, with the region accounting for 42% of national wind-generated electricity in 2022. {26.2}
Northwest	The Confederated Tribes of the Colville Reservation are prioritizing carbon capture in their forest and timber management efforts, leading to improved air and water quality and wildlife habitat as well as preservation of cultural areas and practices. {27.3}
Southwest	In response to severe drought, seven Colorado River basin states, the US and Mexican governments, and Indigenous Peoples are collaborating to improve water conservation and develop adaptation solutions. Dozens of cities are committed to emissions reductions; for instance, Phoenix is on track to meet a 2030 goal of 50% reduction in greenhouse gas emissions from 2018 levels. {Ch. 28, Introduction; Box 28.1}
Alaska	To address climate threats to traditional foods, the Chugach Regional Resources Commission is integrating Indigenous Knowledge and Western scientific methods in its adaptation efforts, including weekly water sampling for harmful algal blooms and restoring clam populations. Kelp farming is also being developed to reduce the effects of ocean acidification, serve as a carbon sink, and generate income. {29.7; Box 29.7}
Hawai'i and US-Affiliated Pacific Islands	The Kaua'i Island Utility Cooperative achieved a 69.5% renewable portfolio standard in 2021, and the island is occasionally 100% renewably powered during midday hours; it is projected to achieve a 90% renewable portfolio by 2026. Guam, the Republic of the Marshall Islands, the Federated States of Micronesia, and Palau plan to use blue carbon ecosystems to offset emissions while also protecting coastal infrastructure. {30.3; Box 30.3}

Meeting US mitigation targets means reaching net-zero emissions

The global warming observed over the industrial era is unequivocally caused by greenhouse gas emissions from human activities—primarily burning fossil fuels. Atmospheric concentrations of carbon dioxide (CO_2)—the primary greenhouse gas produced by human activities—and other greenhouse gases continue to rise due to ongoing global emissions. Stopping global warming would require both reducing emissions of CO_2 to net zero and rapid and deep reductions in other greenhouse gases. Net-zero CO_2 emissions means that CO_2 emissions decline to zero or that any residual emissions are balanced by removal from the atmosphere. {2.3, 3.1; Ch. 32}

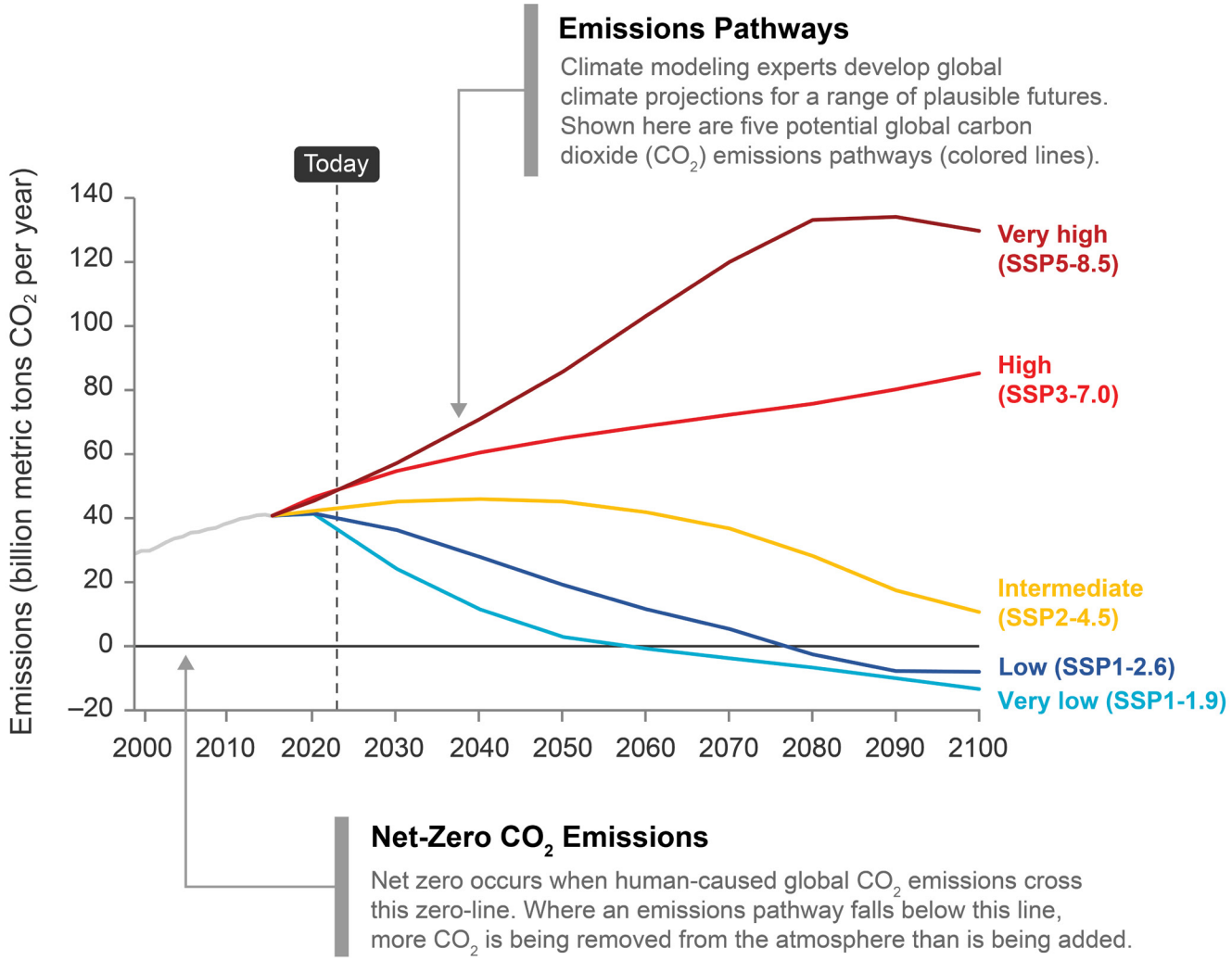
Once CO_2 emissions reach net zero, the global warming driven by CO_2 is expected to stop: additional warming over the next few centuries is not necessarily "locked in" after net CO_2 emissions fall to zero. However, global average temperatures are not expected to fall for centuries unless CO_2 emissions become net negative, which is when CO_2 removal from the atmosphere exceeds CO_2 emissions from human activities. Regardless of when or if further warming is avoided, some long-term responses to the temperature changes that have already occurred will continue. These responses include sea level rise, ice sheet losses, and associated disruptions to human health, social systems, and ecosystems. In addition, the ocean will continue to acidify after the world reaches net-zero CO_2 emissions, as it continues to gradually absorb CO_2 in the atmosphere from past emissions. {2.1, 2.3, 3.1; Ch. 2, Introduction}

National and international commitments seek to limit global warming to well below 2°C (3.6°F), and preferably to 1.5°C (2.7°F), compared to preindustrial temperature conditions (defined as the 1850–1900 average). To achieve this, global CO_2 emissions would have to reach net zero by around 2050 (Figure 1.4); global emissions of all greenhouse gases would then have to reach net zero within the following few decades. {2.3, 32.1}



Andrea Ruedy Trimble

Future Global Carbon Dioxide Emissions Pathways



Different scenarios of future carbon dioxide emissions are used to explore the range of possible climate futures.

Figure 1.4. The five scenarios shown (colored lines) demonstrate potential global carbon dioxide (CO_2) emissions pathways modeled from 2015 through 2100, with the solid light gray line showing observed global CO_2 emissions from 2000 to 2015. See Table 3 in the Guide to the Report for scenario definitions. Many projected impacts described in this report are based on a potential climate future defined by one or more of these scenarios for future CO_2 emissions from human activities, the largest long-term driver of climate change. The vertical dashed line, labeled "Today," marks the year 2023; the solid horizontal black line marks net-zero CO_2 emissions. Adapted with permission from Figure TS.4 in Arias et al. 2021.

While US greenhouse gas emissions are falling, the current rate of decline is not sufficient to meet national and international climate commitments and goals. US net greenhouse gas emissions remain substantial and would have to decline by more than 6% per year on average, reaching net-zero emissions around midcentury, to meet current national mitigation targets and international temperature goals; by comparison, US greenhouse gas emissions decreased by less than 1% per year on average between 2005 and 2019. {32.1}

Many cost-effective options that are feasible now have the potential to substantially reduce emissions over the next decade. Faster and more widespread deployment of renewable energy and other zero- and low-carbon energy options can accelerate the transition to a decarbonized economy and increase the chances of meeting a 2050 national net-zero greenhouse gas emissions target for the US. However, to reach the US net-zero emissions target, additional mitigation options need to be explored and advanced (see "Available mitigation strategies can deliver substantial emissions reductions, but additional options are needed to reach net zero" below). {5.3, 6.3, 32.2, 32.3}

David Zeiset

How the United States Is Experiencing Climate Change

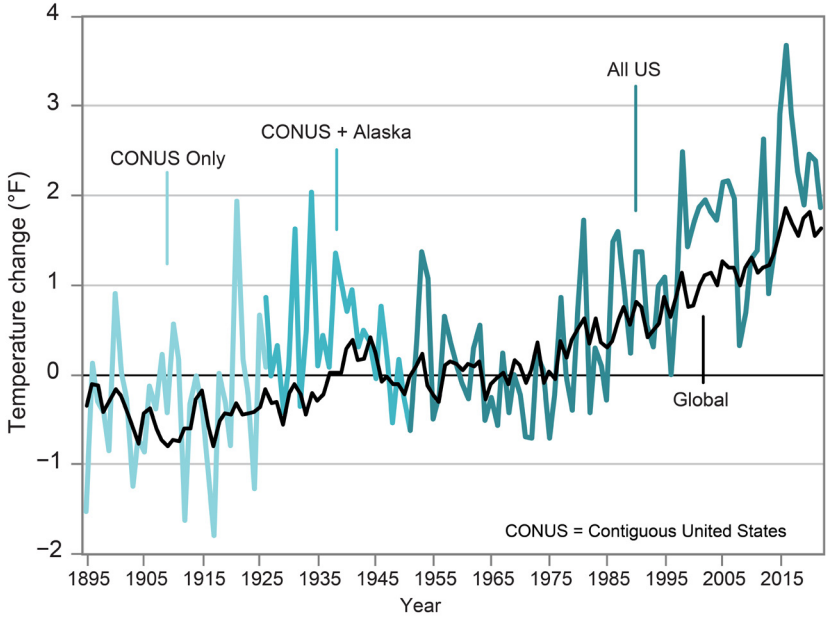
As extreme events and other climate hazards intensify, harmful impacts on people across the United States are increasing. Climate impacts—combined with other stressors—are leading to ripple effects across sectors and regions that multiply harms, with disproportionate effects on underserved and overburdened communities.

Current climate changes are unprecedented over thousands of years

Global greenhouse gas emissions from human activities continue to increase, resulting in rapid warming (Figure 1.5) and other large-scale changes, including rising sea levels, melting ice, ocean warming and acidification, changing rainfall patterns, and shifts in timing of seasonal events. Many of the climate conditions and impacts people are experiencing today are unprecedented for thousands of years (Figure 1.6). {2.1, 3.1; Figures A4.6, A4.7, A4.10, A4.13}

As the world's climate has shifted toward warmer conditions, the frequency and intensity of extreme cold events have declined over much of the US, while the frequency, intensity, and duration of extreme heat have increased. Across all regions of the US, people are experiencing warming temperatures and longer-lasting heatwaves. Over much of the country, nighttime temperatures and winter temperatures have warmed more rapidly than daytime and summer temperatures. Many other extremes, including heavy precipitation, drought, flooding, wildfire, and hurricanes, are becoming more frequent and/or severe, with a cascade of effects in every part of the country. {2.1, 2.2, 3.4, 4.1, 4.2, 7.1, 9.1; Ch. 2, Introduction; App. 4; Focus on Compound Events}

US and Global Changes in Average Surface Temperature



The US has warmed rapidly since the 1970s.

Figure 1.5. The graph shows the change in US annual average surface temperature during 1895–2022 compared to the 1951–1980 average. The temperature trend changes color as data become available for more regions of the US, with Alaska data added to the average temperature for the contiguous US (CONUS) beginning in 1926 (medium blue line) and Hawai'i, Puerto Rico, and US-Affiliated Pacific Islands data added beginning in 1951 (dark blue line). Global average surface temperature is shown by the black line. Figure credit: NOAA NCEI and CISESS NC.

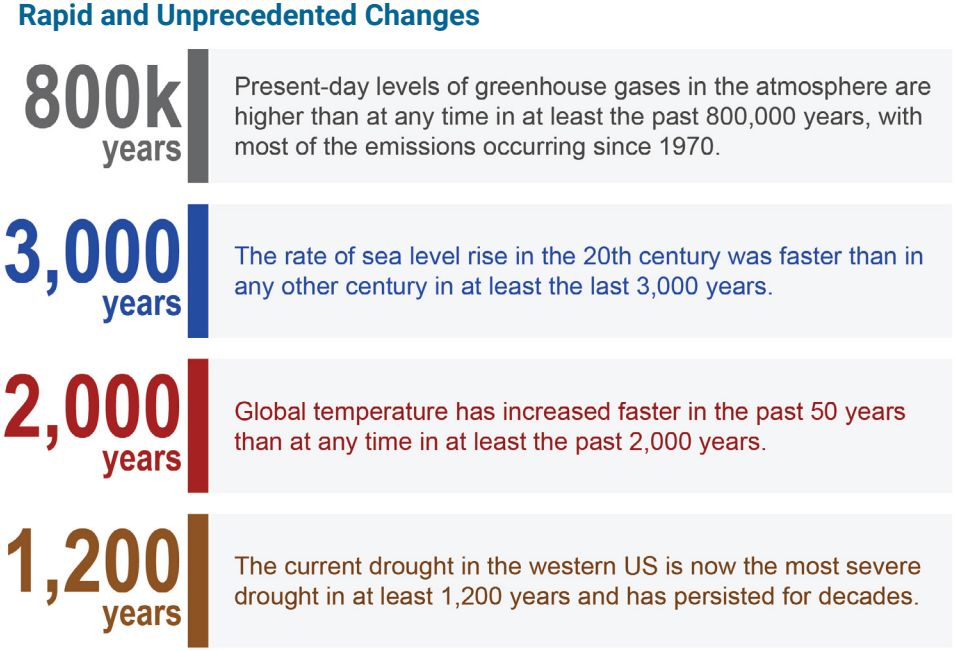


Figure 1.6. Human activities since industrialization have led to increases in atmospheric greenhouse gas concentrations that are unprecedented in records spanning hundreds of thousands of years. These are examples of some of the large and rapid changes in the climate system that are occurring as the planet warms. (Greenhouse gas concentrations {2.1}; sea level rise {3.4}; global temperature {2.1}; drought {2.2, 3.5}) Figure credit: USGCRP and ICF.

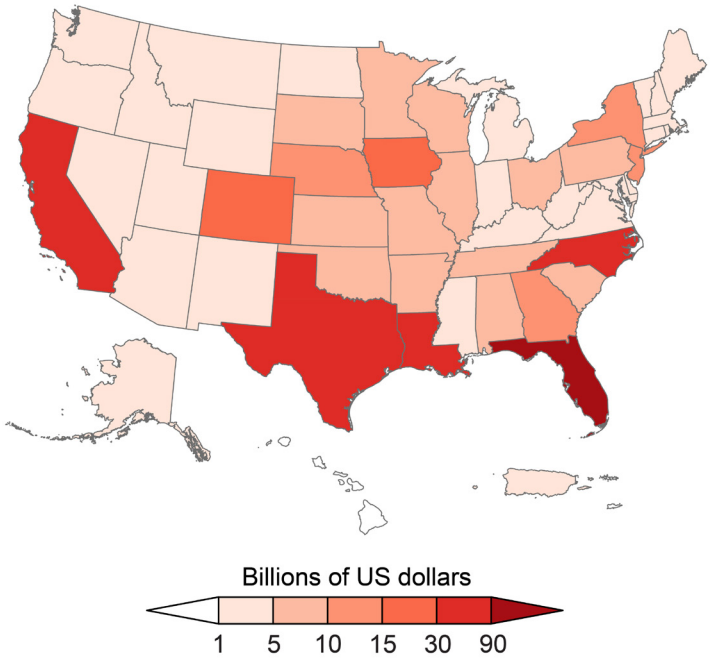
Risks from extreme events are increasing

One of the most direct ways that people experience climate change is through changes in extreme events. Harmful impacts from more frequent and severe extremes are increasing across the country—including increases in heat-related illnesses and death, costlier storm damages, longer droughts that reduce agricultural productivity and strain water systems, and larger, more severe wildfires that threaten homes and degrade air quality. {2.2, 4.2, 12.2, 14.2, 15.1, 19.2; Focus on Western Wildfires}

Extreme weather events cause direct economic losses through infrastructure damage, disruptions in labor and public services, and losses in property values. The number and cost of weather-related disasters have increased dramatically over the past four decades, in part due to the increasing frequency and intensity of extreme events and in part due to increases in assets at risk (through population growth, rising property values, and continued development in hazard-prone areas). Low-income communities, communities of color, and Tribes and Indigenous Peoples experience high exposure and vulnerability to extreme events due to both their proximity to hazard-prone areas and lack of adequate infrastructure or disaster management resources. {2.2, 4.2, 17.3, 19.1; Focus on Compound Events}

In the 1980s, the country experienced, on average, one (inflation-adjusted) billion-dollar disaster every four months. Now, there is one every three weeks, on average. Between 2018 and 2022, the US experienced 89 billion-dollar events (Figure 1.7). Extreme events cost the US close to $150 billion each year—a conservative estimate that does not account for loss of life, healthcare-related costs, or damages to ecosystem services. {2.2, 19.1; Ch. 2, Introduction; Figures 4.1, A4.5}

Damages by State from Billion-Dollar Disasters (2018–2022)



The US now experiences, on average, a billion-dollar weather or climate disaster every three weeks.

Figure 1.7. Billion-dollar weather and climate disasters are events where damages/costs reach or exceed $1 billion, including adjustments for inflation. Between 2018 and 2022, 89 such events affected the US, including 4 droughts, 6 floods, 52 severe storms, 18 tropical cyclones, 5 wildfires, and 4 winter storm events (see Figure A4.5 for the number of billion-dollar disasters per year). During this period, Florida had the highest total damages ($140 billion) and experienced the highest damages from a single event—Hurricane Ian ($113 billion). Over the 1980–2022 period, Texas had the highest total damages ($375 billion). While similar data are not available for the US-Affiliated Pacific Islands, Super Typhoon Yutu caused $500 million in property damage alone in Saipan and the northern Marianas in 2018 (NCEI 2019). Increasing costs over time are driven by changes in the assets at risk and the increase in frequency or intensity of extreme events caused by climate change. Adapted from NCEI 2023.

Cascading and compounding impacts increase risks

The impacts and risks of climate change unfold across interacting sectors and regions. For example, wildfire in one region can affect air quality and human health in other regions, depending on where winds transport smoke. Further, climate change impacts interact with other stressors, such as the COVID-19 pandemic, environmental degradation, or socioeconomic stressors like poverty and lack of adequate housing that disproportionately impact overburdened communities. These interactions and interdependencies can lead to cascading impacts and sudden failures. For example, climate-related shocks to the food supply chain have led to local to global impacts on food security and human migration patterns that affect US economic and national security interests. {11.3, 17.1, 17.2, 17.3, 18.1, 22.3, 23.4, 31.3; Introductions in Chs. 2, 17, 18; Focus on Compound Events; Focus on Risks to Supply Chains; Focus on COVID-19 and Climate Change}

The risk of two or more extreme events occurring simultaneously or in quick succession in the same region—known as compound events—is increasing. Climate change is also increasing the risk of multiple extremes occurring simultaneously in different locations that are connected by complex human and natural systems. For instance, simultaneous megafires across multiple western states and record back-to-back Atlantic hurricanes in 2020 caused unprecedented demand on federal emergency response resources. {2.2, 3.2, 15.1, 22.2, 26.4; Focus on Compound Events; Ch. 4, Introduction}

Compound events often have cascading impacts that cause greater harm than individual events. For example, in 2020, record-breaking heat and widespread drought contributed to concurrent destructive wildfires across California, Oregon, and Washington, exposing millions to health hazards and straining firefighting resources. Ongoing drought amplified the record-breaking Pacific Northwest heatwave of June 2021, which

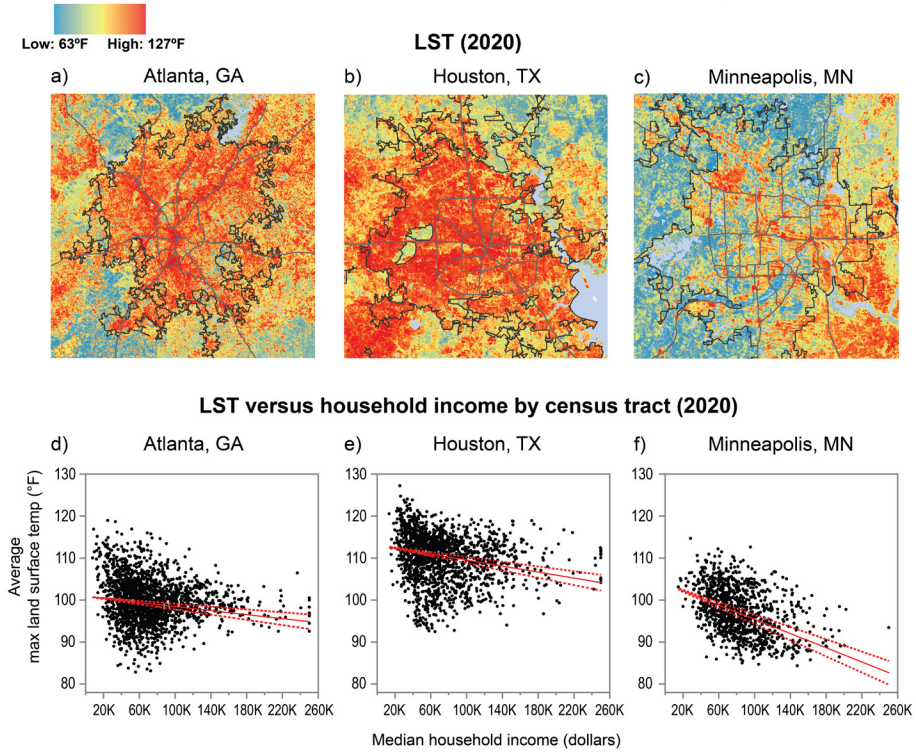
was made 2° to 4°F hotter by climate change. The heatwave led to more than 1,400 heat-related deaths, another severe wildfire season, mass die-offs of fishery species important to the region's economy and Indigenous communities, and total damages exceeding $38.5 billion (in 2022 dollars). {27.3; Ch. 2, Introduction; Focus on Compound Events, Focus on Western Wildfires}

Climate change exacerbates inequities

Some communities are at higher risk of negative impacts from climate change due to social and economic inequities caused by ongoing systemic discrimination, exclusion, and under- or disinvestment. Many such communities are also already overburdened by the cumulative effects of adverse environmental, health, economic, or social conditions. Climate change worsens these long-standing inequities, contributing to persistent disparities in the resources needed to prepare for, respond to, and recover from climate impacts. {4.2, 9.2, 12.2, 14.3, 15.2, 16.1, 16.2, 18.2, 19.1, 20.1, 20.3, 21.3, 22.1, 23.1, 26.4, 27.1, 31.2}

For example, low-income communities and communities of color often lack access to adequate flood infrastructure, green spaces, safe housing, and other resources that help protect people from climate impacts. In some areas, patterns of urban growth have led to the displacement of under-resourced communities to suburban and rural areas with less access to climate-ready housing and infrastructure. Extreme heat can lead to higher rates of illness and death in low-income neighborhoods, which are hotter on average (Figure 1.8). Neighborhoods that are home to racial minorities and low-income people have the highest inland (riverine) flood exposures in the South, and Black communities nationwide are expected to bear a disproportionate share of future flood damages—both coastal and inland (Figure 1.9). {4.2, 11.3, 12.2, 15.1, 22.1, 22.2, 26.4, 27.1; Ch. 2, Introduction}

Land Surface Temperature and Its Relationship to Median Household Income for Three Cities

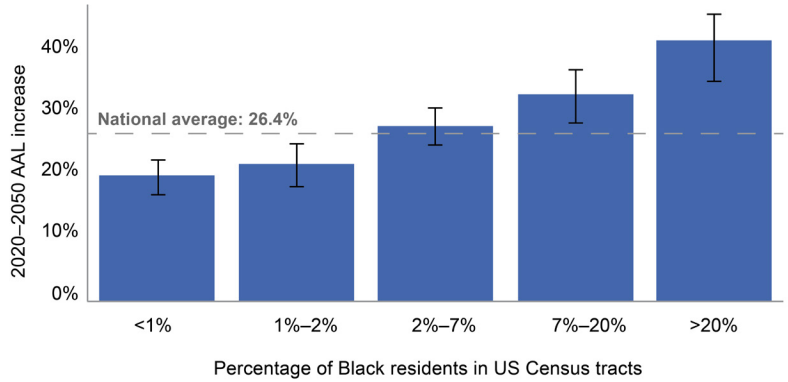


Lower-income urban neighborhoods experience higher surface temperatures.

Figure 1.8. The figure shows the spatial distribution of maximum land surface temperature (LST) in 2020 for Atlanta (**a**), Houston (**b**), and Minneapolis (**c**). Graphs (**d**), (**e**), and (**f**) depict the relationship between maximum LST and median household income across census tracts in each city (see also Figure A4.4). A statistical trend analysis (the Theil-Sen estimator) returns negative values for all three cities, indicating that LST decreases as income increases (solid red line). Dashed red lines indicate the 95% confidence interval, meaning that the true slope of the trend is expected to fall within this range. Note that LST is measured at ground level and may differ from surface air temperature, which is measured at a height of 2 meters. {Figure 12.6} Portions of this figure include intellectual property of Esri and its licensors and are used under license. Copyright © 2020 Esri and its licensors. All rights reserved. Figure credit: University of California, Davis; University of Texas at El Paso; Massachusetts Institute of Technology; City of Phoenix, Arizona; and USGS.

These disproportionate impacts are partly due to exclusionary housing practices—both past and ongoing—that leave underserved communities with less access to heat and flood risk-reduction strategies and other economic, health, and social resources. For example, areas that were historically redlined—a practice in which lenders avoided providing services to communities, often based on their racial or ethnic makeup—continue to be deprived of equitable access to environmental amenities like urban green spaces that reduce exposure to climate impacts. These neighborhoods can be as much as 12°F hotter during a heatwave than nearby wealthier neighborhoods. {8.3, 9.2, 12.2, 15.2, 20.3, 21.3, 22.1, 26.4, 27.1, 32.4; Ch. 2, Introduction}

Projected Increases in Average Annual Losses (AALs) from Floods by 2050



Losses due to floods are projected to increase disproportionately in US Census tracts with higher percentages of Black residents.

Figure 1.9. The bars show that the average annual losses—or the economic damage in a typical year—due to floods in census tracts with a Black population of at least 20% are projected to increase at roughly twice the rate of that in tracts where Black populations make up less than 1% of population. {Figure 4.14} Adapted from Wing et al. 2022 [CC BY 4.0].

Harmful impacts will increase in the near term

Even if greenhouse gas emissions fall substantially, the impacts of climate change will continue to intensify over the next decade (see "Meeting US mitigation targets means reaching net-zero emissions" above; Box 1.4), and all US regions are already experiencing increasingly harmful impacts. Although a few US regions or sectors may experience limited or short-term benefits from climate change, adverse impacts already far outweigh any positive effects and will increasingly eclipse benefits with additional warming. {2.3, 19.1; Ch. 2, Introduction; Chs. 21–30}

Table 1.2 shows examples of critical impacts expected to affect people in each region between now and 2030, with disproportionate effects on overburdened communities. While these examples affect particular regions in the near term, impacts often cascade through social and ecological systems and across borders and may lead to longer-term losses. {15.2, 18.2, 20.1; Figure 15.5; Ch. 20, Introduction}

Table 1.2. Climate Change Is Already Affecting All US Regions and Will Continue to Have Impacts in the Near Term

The table shows three climate impacts of significant concern to each US region between now and 2030. Icons indicate general categories of impacts: infrastructure, water supply, health and well-being, food security, economy, livelihoods and heritage, and ecosystems. More information can be found in the regional chapters (Chs. 21–30).

Infrastructure | Water Supply | Health and Well-Being | Food Security | Economy | Livelihoods and Heritage | Ecosystems

Northeast

- Extreme weather events damage critical infrastructure. {21.1}
- Warming temperatures shift distributions of coastal and marine species and habitats. {21.2}
- Extreme heat and flooding disproportionately impact overburdened communities. {21.3}

Southeast

- Sea level rise and coastal flooding harm rapidly growing communities. {22.1}
- Extreme heat threatens human health, especially stressing urban communities. {22.2}
- Heavy rain and longer dry spells reduce water supply and access. {22.4}

US Caribbean

- Agricultural losses, especially from tropical cyclones, threaten food security. {23.1}
- Severe drought leads to large agricultural and economic losses. {23.3}
- Rising temperatures increase mortality and power demand; hurricanes and storms stress power grids. {23.2, 23.4}

Midwest

- Rising temperatures and extreme events threaten livelihoods and trades. {24.2}
- Extreme weather events harm public health. {24.3}
- Rising temperatures and extreme rainfall damage buildings, homes, and businesses. {24.4}

Northern Great Plains

- Rising temperatures and decreasing snowpack reduce water supply. {25.1}
- Increases in extreme heat, wildfire, and flooding harm physical and mental health. {25.1, 25.2}
- Livelihoods are at greater risk, especially in agriculture, recreation, and energy sectors. {25.3}

Southern Great Plains

- Drier conditions threaten agriculture, ecosystems, and water supplies. {26.1, 26.2, 26.5}
- Extreme heat and high humidity harm human health and exacerbate inequities. {26.4}
- Multiple stressors and extreme events disrupt business, outdoor recreation, and leisure activities. {26.1, 26.2, 26.3}

Northwest

Less water is available for hydropower, rural communities, and aquatic ecosystems. {27.1, 27.2, 27.4}

Extreme heat and wildfire smoke endanger at-risk urban, rural, and Tribal communities. {27.1, 27.3, 27.5}

Wildfire, extreme heat, and floods threaten livelihoods and heritage tied to natural resources. {27.1, 27.3, 27.6}

Alaska

Landscape degradation increases damage to private and municipal infrastructure. {29.2, 29.4}

Reduced fish stocks harm local economies, Tribal sovereignty, and overall well-being. {29.6, 29.7}

Diminished access to mammals, seabirds, fish, and vegetation decreases local food security. {29.5}

Southwest

Intensifying drought and decreases in groundwater recharge reduce water supply. {28.1}

Economic losses to farmers and ranchers increase. {28.3}

Extreme heat, drought, wildfire smoke, and coastal flooding harm physical and mental health. {28.3, 28.4}

Hawai‘i and US-Affiliated Pacific Islands

Sea level rise and saltwater intrusion reduce irrigation and drinking water supply. {30.1}

Damages to the coastal built environment, including traditional structures, increase. {30.3, 30.5}

Risks to unique and biodiverse flora and fauna continue to grow. {30.4}

Current and Future Climate Risks to the United States

Climate changes are making it harder to maintain safe homes and healthy families; reliable public services; a sustainable economy; thriving ecosystems, cultures, and traditions; and strong communities. Many of the extreme events and harmful impacts that people are already experiencing will worsen as warming increases and new risks emerge.

Safe, reliable water supplies are threatened by flooding, drought, and sea level rise

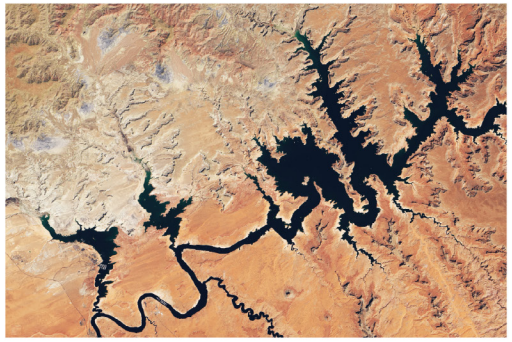
More frequent and intense heavy precipitation events are already evident, particularly in the Northeast and Midwest. Urban and agricultural environments are especially vulnerable to runoff and flooding. Between 1981 and 2016, US corn yield losses from flooding were comparable to those from extreme drought. Runoff and flooding also transport debris and contaminants that cause harmful algal blooms and pollute drinking water supplies. Communities of color and low-income communities face disproportionate flood risks. {2.2, 4.2, 6.1, 9.2, 21.3, 24.1, 24.5, 26.4; Figure A4.8}

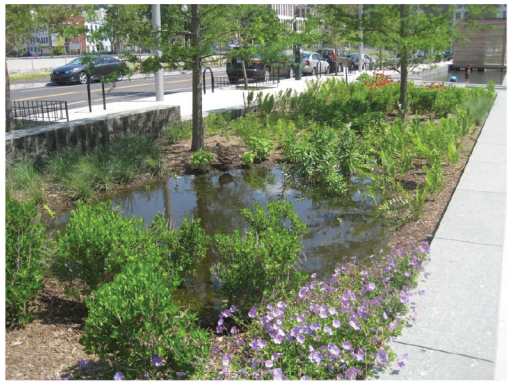
Between 1980 and 2022, drought and related heatwaves caused approximately $328 billion in damages (in 2022 dollars). Recent droughts have strained surface water and groundwater supplies, reduced agricultural productivity, and lowered water levels in major reservoirs, threatening hydropower generation. As higher temperatures increase irrigation demand, increased pumping could endanger groundwater supplies, which are already declining in many major aquifers. {4.1, 4.2; Figure A4.9}

Droughts are projected to increase in intensity, duration, and frequency, especially in the Southwest, with implications for surface water and groundwater supplies. Human and natural systems are threatened by rapid shifts between wet and dry periods that make water resources difficult to predict and manage. {2.2, 2.3, 4.1, 4.2, 5.1, 28.1}

In coastal environments, dry conditions, sea level rise, and saltwater intrusion endanger groundwater aquifers and stress aquatic ecosystems. Inland, decreasing snowpack alters the volume and timing of streamflow and increases wildfire risk. Small rural water providers that often depend on a single water source or have limited capacity are especially vulnerable. {4.2, 7.2, 9.2, 21.2, 22.1, 23.1, 23.3, 25.1, 27.4, 28.1, 28.2, 28.5, 30.1; Figure A4.7}

Many options are available to protect water supplies, including reservoir optimization, nature-based solutions, and municipal management systems to conserve and reuse water. Collaboration on flood hazard management at regional scales is particularly important in areas where flood risk is increasing, as cooperation can provide solutions unavailable at local scales. {4.3, 9.3, 26.5; Focus on Blue Carbon}





(**left**; Toledo, Ohio) Rising temperatures are intensifying harmful algal blooms, negatively affecting human and animal health. (**top right**; Utah, Arizona) Water levels on Lake Powell have fallen to historic lows in recent years, affecting millions of people across the Southwest. (**bottom right**) Rain gardens, a form of green infrastructure, absorb excess stormwater. Photo credits: (left) Aerial Associates Photography Inc. by Zachary Haslick; (top right) NASA Earth Observatory images by Lauren Dauphin, using Landsat data from the USGS; (bottom right) Alisha Goldstein, EPA.

Disruptions to food systems are expected to increase

As the climate changes, increased instabilities in US and global food production and distribution systems are projected to make food less available and more expensive. These price increases and disruptions are expected to disproportionately affect the nutrition and health of women, children, older adults, and low-wealth communities. {11.2, 15.2}

Climate change also disproportionately harms the livelihoods and health of communities that depend on agriculture, fishing, and subsistence lifestyles, including Indigenous Peoples reliant on traditional food sources. Heat-related stress and death are significantly greater for farmworkers than for all US civilian workers. {11.2, 11.3, 15.1, 15.2, 16.1; Focus on Risks to Supply Chains}

While farmers, ranchers, and fishers have always faced unpredictable weather, climate change heightens risks in many ways:

- Increasing temperatures, along with changes in precipitation, reduce productivity, yield, and nutritional content of many crops. These changes can introduce disease, disrupt pollination, and result in crop failure, outweighing potential benefits of longer growing seasons and increased CO_2 fertilization. {11.1, 19.1, 21.1, 22.4, 23.3, 24.1, 26.2}
- Heavy rain and more frequent storms damage crops and property and contaminate water supplies. Longer-lasting droughts and larger wildfires reduce forage production and nutritional quality, diminish water supplies, and increase heat stress on livestock. {23.2, 25.3, 28.3}
- Increasing water temperatures, invasive aquatic species, harmful algal blooms, and ocean acidification and deoxygenation put fisheries at risk. Fishery collapses can result in large economic losses, as well as loss of cultural identity and ways of life. {11.3, 29.3}

In response, some farmers and ranchers are adopting innovations—such as agroecological practices, data-driven precision agriculture, and carbon monitoring—to improve resilience, enhance soil carbon storage, and reduce emissions. Across the Nation, Indigenous food security efforts are helping improve community resilience to climate change while also improving cultural resilience. Some types of aquaculture have the potential to increase climate-smart protein production, human nutrition, and food security, although some communities have raised concerns over issues such as conflict with traditional livelihoods and the introduction of disease or pollution. {10.2, 11.1, 29.6, 25.5; Boxes 22.3, 27.2}

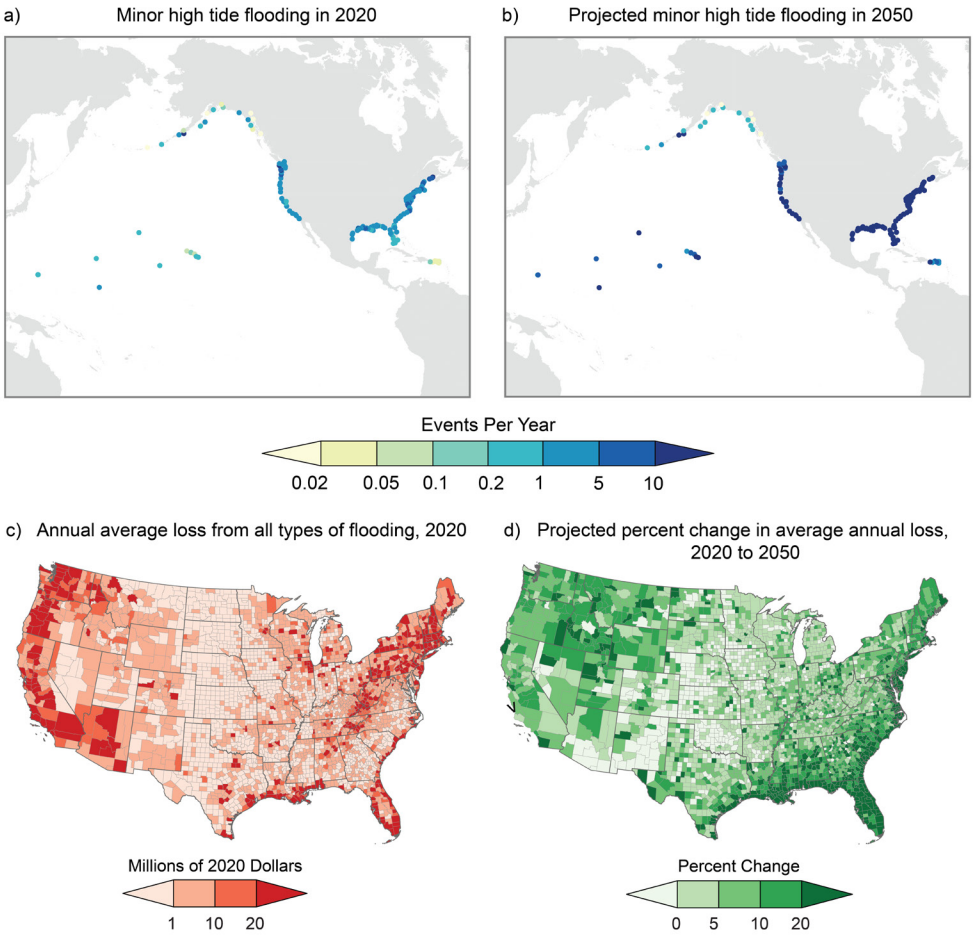
(**left**; Baltimore, Maryland) Urban farms offer the potential to reduce carbon emissions while helping to improve community food security. (**top right**; California) A Northern California vineyard is affected by wildfire. (**bottom right**; Kenai River, Alaska) Recent climate extremes have contributed to declines in many salmon populations. Photo credits: (left) Preston Keres, USDA/FPAC; (top right) Ordinary Mario/iStock via Getty Images; (bottom right) Eric Vance, EPA.

Homes and property are at risk from sea level rise and more intense extreme events

Homes, property, and critical infrastructure are increasingly exposed to more frequent and intense extreme events, increasing the cost of maintaining a safe and healthy place to live. Development in fire-prone areas and increases in area burned by wildfires have heightened risks of loss of life and property damage in many areas across the US. Coastal communities across the country—home to 123 million people (40% of the total US population)—are exposed to sea level rise (Figure 1.10), with millions of people at risk of being displaced from their homes by the end of the century. {2.3, 9.1, 12.2, 22.1, 27.4, 30.3; Figures A4.10, A4.14; Focus on Western Wildfires}

People who regularly struggle to afford energy bills—such as rural, low-income, and older fixed-income households and communities of color—are especially vulnerable to more intense extreme heat events and associated health risks, particularly if they live in homes with poor insulation and inefficient cooling systems. For example, Black Americans are more likely to live in older, less energy efficient homes and face disproportionate heat-related health risks. {5.2, 15.2, 15.3, 22.2, 26.4, 32.4; Figure A4.4}

Accessible public cooling centers can help protect people who lack adequate air-conditioning on hot days. Strategic land-use planning in cities, urban greenery, climate-smart building codes, and early warning communication can also help neighborhoods adapt. However, other options at the household scale, such as hardening homes against weather extremes or relocation, may be out of reach for renters and low-income households without assistance. {12.3, 15.3, 19.3, 22.2}



US Flooding Risks in 2020 and 2050

Increasing flooding puts more people and assets at risk.

Figure 1.10. (**top row**) Maps show (**a**) the average number of minor high tide flooding events per year in 2020 (with historical sea level rise) and (**b**) the expected number of events per year in 2050 (when driven by extrapolated sea level rise). (**bottom row**) Maps show (**c**) average annual loss (AAL) from all types of flooding in millions of dollars in 2020 and (**d**) the projected changes in AAL in 2050 relative to 2020. AAL estimates were made only for the contiguous US. Over the next three decades, the number of flooding days along all coastlines of the US is expected to increase. These increases in the occurrence of flooding will drive greater AALs, especially in coastal areas of the US. (a, b) Adapted from Sweet et al. 2022; (c, d) adapted from Wing et al. 2022 [CC BY 4.0].

Box 1.2. Migration and Displacement

Extreme events, such as extended drought, wildfire, and major hurricanes, have contributed to human migration and displacement. For example, numerous extreme events over the last two decades drove migration of vulnerable communities in Puerto Rico and the US Virgin Islands to the mainland. {9.2, 15.1, 17.2, 19.2, 23.1, 23.5; Box 18.2}

In the future, the combination of climate change and other factors, such as housing affordability, is expected to increasingly affect migration patterns. More severe wildfires in California, increasing sea level rise in Florida, and more frequent flooding in Texas are expected to displace millions of people. Climate-driven economic changes abroad, including reductions in crop yields, are expected to increase the rate of emigration to the United States. {9.2, 17.2, 19.2, 30.3}

From Alaska to low-lying Pacific atolls, forced migrations and displacements driven by climate change disrupt social networks, decrease housing security, and exacerbate grief, anxiety, and negative mental health outcomes. Indigenous Peoples, who have long faced land dispossession due to settler colonialism, are again being confronted with displacement and loss of traditional resources and practices. {4.2, 15.1, 16.1, 19.1, 20.1, 20.3, 22.1, 22.2, 29.1, 30.3; Box 18.2}

(**left**; Cedar Rapids, Iowa) More frequent and intense heavy precipitation events are already evident, particularly in the Northeast and Midwest. (**right**; Arizona) The 2021 Telegraph Fire destroyed homes and property. Photo credits: (left) Don Becker, USGS; (right) Andrew Avitt, USDA Forest Service.

Infrastructure and services are increasingly damaged and disrupted by extreme weather and sea level rise

Climate change threatens vital infrastructure that moves people and goods, powers homes and businesses, and delivers public services. Many infrastructure systems across the country are at the end of their intended useful life and are not designed to cope with additional stress from climate change. For example, extreme heat causes railways to buckle, severe storms overload drainage systems, and wildfires result in roadway obstruction and debris flows. Risks to energy, water, healthcare, transportation, telecommunications, and waste management systems will continue to rise with further climate change, with many infrastructure systems at risk of failing. {12.2, 13.1, 15.2, 23.4, 26.5; Focus on Risks to Supply Chains}

In coastal areas, sea level rise threatens permanent inundation of infrastructure, including roadways, railways, ports, tunnels, and bridges; water treatment facilities and power plants; and hospitals, schools, and military bases. More intense storms also disrupt critical services like access to medical care, as seen after Hurricanes Irma and Maria in the US Virgin Islands and Puerto Rico. {9.2, 23.1, 28.2, 30.3}

At the same time, climate change is expected to place multiple demands on infrastructure and public services. For example, higher temperatures and other effects of climate change, such as greater exposure to stormwater or wastewater, will increase demand for healthcare. Continued increases in average temperatures and more intense heatwaves will heighten electricity and water demand, while wetter storms and intensified

hurricanes will strain wastewater and stormwater management systems. In the Midwest and other regions, aging energy grids are expected to be strained by disruptions and transmission efficiency losses from climate change. {23.4, 24.4, 30.2}

Forward-looking designs of infrastructure and services can help build resilience to climate change, offset costs from future damage to transportation and electrical systems, and provide other benefits, including meeting evolving standards to protect public health, safety, and welfare. Mitigation and adaptation activities are advancing from planning stages to deployment in many areas, including improved grid design and workforce training for electrification, building upgrades, and land-use choices. Grid managers are gaining experience planning and operating electricity systems with growing shares of renewable generation and working toward understanding the best approaches for dealing with the natural variability of wind and solar sources alongside increases in electrification. {5.3, 12.3, 13.1, 13.2, 22.3, 24.4, 32.3; Figure 22.17}

Climate change exacerbates existing health challenges and creates new ones

Climate change is already harming human health across the US, and impacts are expected to worsen with continued warming. Climate change harms individuals and communities by exposing them to a range of compounding health hazards, including the following:

- More severe and frequent extreme events {2.2, 2.3, 15.1}
- Wider distribution of infectious and vector-borne pathogens {15.1, 26.1; Figure A4.16}
- Air quality worsened by smog, wildfire smoke, dust, and increased pollen {14.1, 14.2, 14.4, 23.1, 26.1}
- Threats to food and water security {11.2, 15.1}
- Mental and spiritual health stressors {15.1}

(**left**; Oregon) The Hooskanaden Landslide, triggered by heavy rainfall, caused substantial road damage. (**right**; Maunabo, Puerto Rico) Punta Tuna Wetlands Nature Reserve, which helps buffer the coastline from extreme events, was severely damaged during Hurricane Maria in 2017. Photo credits: (left) Oregon Department of Transportation [CC BY 2.0]; (right) Kenneth Wilsey, FEMA.

While climate change can harm everyone's health, its impacts exacerbate long-standing disparities that result in inequitable health outcomes for historically marginalized people, including people of color, Indigenous Peoples, low-income communities, and sexual and gender minorities, as well as older adults, people with disabilities or chronic diseases, outdoor workers, and children. {14.3, 15.2}

The disproportionate health impacts of climate change compound with similar disparities in other health contexts. For example, climate-related disasters during the COVID-19 pandemic, such as drought along the Colorado River basin, western wildfires, and Hurricane Laura, disproportionately magnified COVID-19 exposure, transmission, and disease severity and contributed to worsened health conditions for essential workers, older adults, farmworkers, low-wealth communities, and communities of color. {15.2; Focus on COVID-19 and Climate Change}

Large reductions in greenhouse gas emissions are expected to result in widespread health benefits and avoided death or illness that far outweigh the costs of mitigation actions. Improving early warning, surveillance, and communication of health threats; strengthening the resilience of healthcare systems; and supporting community-driven adaptation strategies can reduce inequities in the resources and capabilities needed to adapt as health threats from climate change continue to grow. {14.5, 15.3, 26.1, 30.2, 32.4}

(**left**; New York, New York) The Empire State Building is shrouded in a haze caused by smoke from the 2023 Canadian wildfires. (top right; Charleston, South Carolina) An ambulance drives through floodwaters. (bottom right; Atlanta, Georgia) Heatwaves in the Southeast are happening more frequently. Park amenities, such as trees and splash pads, help cool people on hot days. Photo credits: (left) Anthony Quintano [CC BY 2.0]; (top right) US Air National Guard photo by Tech. Sgt. Jorge Intriago; (bottom right) ucumari photography [CC BY-NC-ND 2.0]

Box 1.3. Indigenous Ways of Life and Spiritual Health

Indigenous communities, whose ways of life, cultures, intergenerational continuity, and spiritual health are tied to nature and the environment, are experiencing disproportionate health impacts of climate change. Rising temperatures and intensifying extreme events are reducing biodiversity and shifting the ranges of culturally important species like Pacific salmon, wild rice, and moose, making it more difficult for Indigenous Peoples to fish, hunt, and gather traditional and subsistence resources within Tribal jurisdictions. Heatwaves can prevent Tribal members from participating in traditional ceremonies, while flooding, erosion, landslides, and wildfires increasingly disrupt or damage burial grounds and ceremonial sites. {16.1, 15.2, 27.6}

Indigenous Peoples are leading numerous actions in response to climate change, including planning and policy initiatives, youth movements, cross-community collaborative efforts, and the expansion of renewable energy (Figure 1.11). Many of these efforts involve planning processes that start with place-based Indigenous Knowledge of local climate and ecosystems. {16.3}

Exemplifying Indigenous Resilience

Figure 1.11. For over 2,000 years, the Hopi People have farmed on land with only 6–10 inches of annual precipitation. Today, Hopi children learn both the practices and process of Hopi dryland farming and the values, customs, and identities that underpin them. Photo credit: ©Michael K. Johnson. {Panel from Figure 16.6}

Ecosystems are undergoing transformational changes

Together with other stressors, climate change is harming the health and resilience of ecosystems, leading to reductions in biodiversity and ecosystem services. Increasing temperatures continue to shift habitat ranges as species expand into new regions or disappear from unfavorable areas, altering where people can hunt, catch, or gather economically important and traditional food sources. Degradation and extinction of local flora and fauna in vulnerable ecosystems like coral reefs and montane rainforests are expected in the near term, especially where climate changes favor invasive species or increase susceptibility to pests and pathogens. Without significant emissions reductions, rapid shifts in environmental conditions are expected to lead to irreversible ecological transformations by mid- to late century. {2.3, 6.2, 7.1, 7.2, 8.1, 8.2, 10.1, 10.2, 21.1, 24.2, 27.2, 28.5, 29.3, 29.5, 30.4; Figure A4.12}

Changes in ocean conditions and extreme events are already transforming coastal, aquatic, and marine ecosystems. Coral reefs are being lost due to warming and ocean acidification, harming important fisheries; coastal forests are converting to ghost forests, shrublands, and marsh due to sea level rise, reducing coastal protection; lake and stream habitats are being degraded by warming, heavy rainfall, and invasive species, leading to declines in economically important species. {8.1. 10.1, 21.2, 23.2, 24.2, 27.2; Figures 8.7, A4.11}

Increased risks to ecosystems are expected with further climate change and other environmental changes, such as habitat fragmentation, pollution, and overfishing. For example, mass fish die-offs from extreme summertime heat are projected to double by midcentury in northern temperate lakes under a very high scenario (RCP8.5). Continued climate changes are projected to exacerbate runoff and erosion, promote harmful algal blooms, and expand the range of invasive species. {4.2, 7.1, 8.2, 10.1, 21.2, 23.2, 24.2, 27.2, 28.2, 30.4}

While adaptation options to protect fragile ecosystems may be limited, particularly under higher levels of warming, management and restoration measures can reduce stress on ecological systems and build resilience. These measures include migration assistance for vulnerable species and protection of essential habitats, such as establishing wildlife corridors or places where species can avoid heat. Opportunities for nature-based solutions that assist in mitigation exist across the US, particularly those focused on protecting existing carbon sinks and increasing carbon storage by natural ecosystems. {8.3, 10.3, 23.2, 27.2; Focus on Blue Carbon}

(**top left**; Nags Head Woods, North Carolina) Coastal ghost forests result when trees are killed by sea level rise and saltwater intrusion. (**top right**; Molokai Island, Hawai'i) High island ecosystems are at risk due to invasive species, habitat destruction, intensifying fire, and drought. (**bottom**; Florida) A diver works on coral reef restoration around Florida Keys National Marine Sanctuary. Photo credits: (top left) NC Wetlands [CC BY 2.0]; (top right) Lucas Fortini, USGS; (bottom) Mitchell Tartt, NOAA.

Climate change slows economic growth, while climate action presents opportunities

With every additional increment of global warming, costly damages are expected to accelerate. For example, 2°F of warming is projected to cause more than twice the economic harm induced by 1°F of warming. Damages from additional warming pose significant risks to the US economy at multiple scales and can compound to dampen economic growth. {19.1}

- International impacts can disrupt trade, amplify costs along global supply chains, and affect domestic markets. {17.3, 19.2; Focus on Risks to Supply Chains}
- While some economic impacts of climate change are already being felt across the country, the impacts of future changes are projected to be more significant and apparent across the US economy. {19.1}
- States, cities, and municipalities confront climate-driven pressures on public budgets and borrowing costs amid spending increases on healthcare and disaster relief. {19.2}
- Household consumers face higher costs for goods and services, like groceries and health insurance premiums, as prices change to reflect both current and projected climate-related damages. {19.2}

Mitigation and adaptation actions present economic opportunities. Public and private measures—such as climate financial risk disclosures, carbon offset credit markets, and investments in green bonds—can avoid economic losses and improve property values, resilience, and equity. However, climate responses are not without risk. As innovation and trade open further investment opportunities in renewable energy and the country continues to transition away from fossil fuels, loss and disposal costs of stranded capital assets such as coal mines, oil and gas wells, and outdated power plants are expected. Climate solutions designed without input from affected communities can also result in increased vulnerability and cost burden. {17.3, 19.2, 19.3, 20.2, 20.3, 27.1, 31.6}

Many regional economies and livelihoods are threatened by damages to natural resources and intensifying extremes

Climate change is projected to reduce US economic output and labor productivity across many sectors, with effects differing based on local climate and the industries unique to each region. Climate-driven damages to local economies especially disrupt heritage industries (e.g., fishing traditions, trades passed down over generations, and cultural heritage–based tourism) and communities whose livelihoods depend on natural resources. {11.3, 19.1, 19.3}

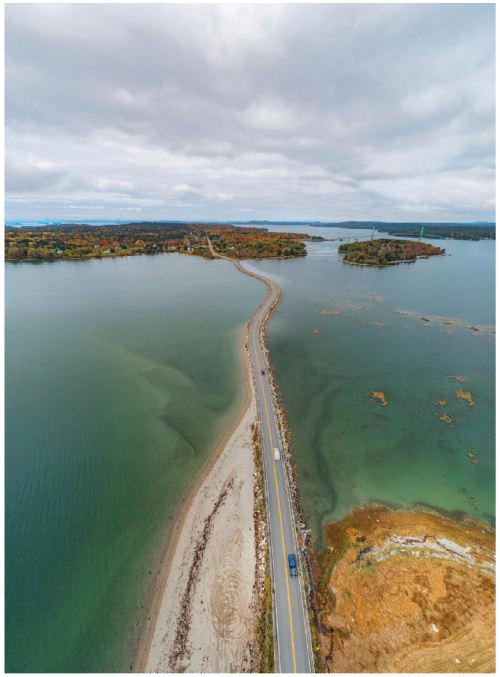
- As fish stocks in the Northeast move northward and to deeper waters in response to rapidly rising ocean temperatures, important fisheries like scallops, shrimp, and cod are at risk. In Alaska, climate change has already played a role in 18 major fishery disasters that were especially damaging for coastal Indigenous Peoples, subsistence fishers, and rural communities. {10.2, 21.2, 29.3}
- While the Southeast and US Caribbean face high costs from projected labor losses and heat health risks to outdoor workers, small businesses are already confronting higher costs of goods and services and potential closures as they struggle to recover from the effects of compounding extreme weather events. {22.3, 23.1}
- Agricultural losses in the Midwest, including lower corn yields and damages to specialty crops like apples, are linked to rapid shifts between wet and dry conditions and stresses from climate-induced increases in pests and pathogens. Extreme heat and more intense wildfire and drought in the Southwest are already threatening agricultural worker health, reducing cattle production, and damaging wineries. {24.1, 28.5}
- In the Northern Great Plains, agriculture and recreation are expected to see primarily negative effects related to changing temperature and rainfall patterns. By 2070, the

Southern Great Plains is expected to lose cropland acreage as lands transition to pasture or grassland. {25.3, 26.2}

- Outdoor-dependent industries, such as tourism in Hawai'i and the US-Affiliated Pacific Islands and skiing in the Northwest, face significant economic loss from projected rises in park closures and reductions in workforce as continued warming leads to deterioration of coastal ecosystems and shorter winter seasons with less snowfall. {7.2, 8.3, 10.1, 10.3, 19.1, 27.3, 30.4}

Mitigation and adaptation actions taken by businesses and industries promote resilience and offer long-term benefits to employers, employees, and surrounding communities. For example, as commercial fisheries adapt, diversifying harvest and livelihoods can help stabilize income or buffer risk. In addition, regulators and investors are increasingly requiring businesses to disclose climate risks and management strategies. {10.2, 19.3, 26.2}

Scarlett W.



(**top left**; Fort Myers Beach, Florida) Shops and restaurants were severely damaged or completed destroyed by Hurricane Ian in 2022. (**bottom left**; Whatcom County, Washington) Snow-based recreational industries, such as skiing in the Pacific Northwest, are projected to lose revenue due to declining snowpack. (**right**; Maine) A causeway connecting Little Deer Isle to Deer Isle (the largest lobster port in the state) is threatened by sea level rise. Photo credits: (top left) Coast Guard Petty Officer 3rd Class Gabriel Wisdom; (bottom left) US Forest Service–Pacific Northwest Region; (right) ©Jack Sullivan, Island Institute.

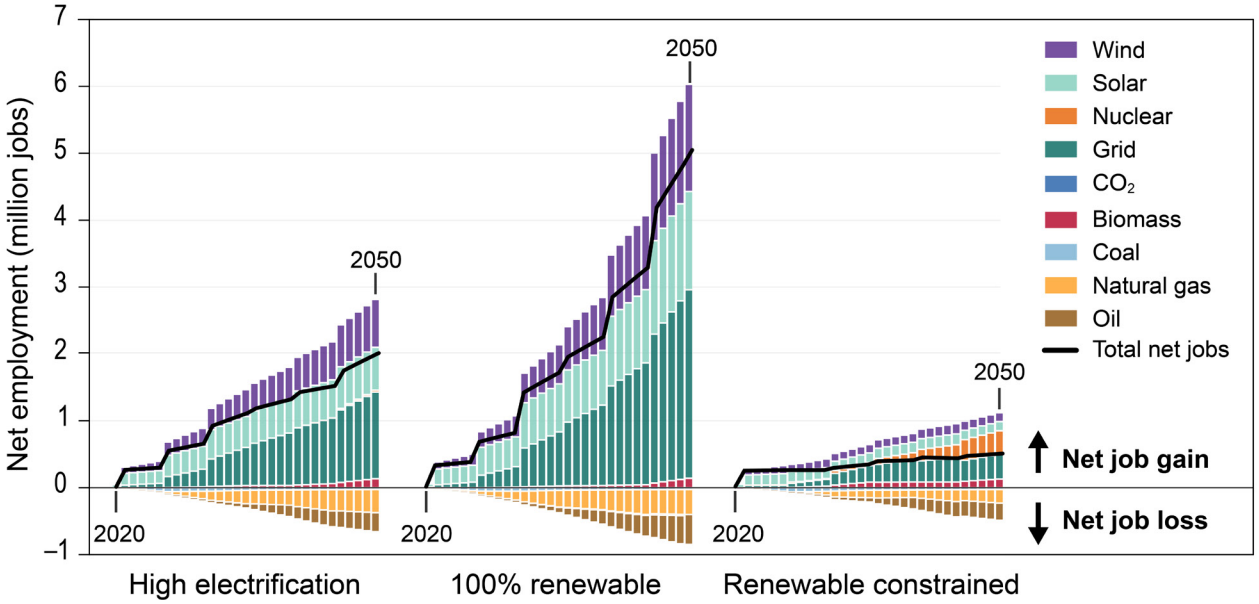
Job opportunities are shifting due to climate change and climate action

Many US households are already feeling the economic impacts of climate change. Climate change is projected to impose a variety of new or higher costs on most households as healthcare, food, insurance, building, and repair costs become more expensive. Compounding climate stressors can increase segregation, income inequality, and reliance on social safety net programs. Quality of life is also threatened by climate change

in ways that can be more difficult to quantify, such as increased crime and domestic violence, harm to mental health, reduced happiness, and fewer opportunities for outdoor recreation and play. {11.3, 19.1, 19.3}

Climate change, and how the country responds, is expected to alter demand for workers and shift where jobs are available. For example, energy-related livelihoods in the Northern and Southern Great Plains are expected to shift as the energy sector transforms toward more renewables, low-carbon technologies, and electrification of more sectors of the economy. Losses in fossil fuel–related jobs are projected to be completely offset by greater increases in mitigation-related jobs, as increased demand for renewable energy and low-carbon technologies is expected to lead to long-term expansion in most states' energy and decarbonization workforce (Figure 1.12). Grid expansion and energy efficiency efforts are already creating new jobs in places like Nevada, Vermont, and Alaska, and advancements in biofuels and agrivoltaics (combined renewable energy and agriculture) provide economic opportunities in rural communities. {10.2, 11.3, 19.3, 25.3, 26.2, 29.3, 32.4}

Additional opportunities include jobs in ecosystem restoration and construction of energy-efficient and climate-resilient housing and infrastructure. Workforce training and equitable access to clean energy jobs, which have tended to exclude women and people of color, are essential elements of a just transition to a decarbonized economy. {5.3, 19.3, 20.3, 22.3, 25.3, 26.2, 27.3, 32.4}



Energy Employment (2020–2050) for Alternative Net-Zero Pathways

Employment gains in electrification and renewable energy industries are projected to far outpace job losses in fossil fuel industries.

Figure 1.12. Despite decreases in the number of fossil fuel–related jobs, the overall number of energy jobs (specifically those involved in the supply of energy) relative to 2019 is generally projected to increase in net-zero-emissions energy scenarios between 2020 and 2050, although by much more in some scenarios than in others. {Figure 32.17} Adapted with permission from Jenkins et al. 2021.

(**top**; Golden, Colorado) Solar panels are pictured on the campus of the National Renewable Energy Laboratory. (**bottom left**; San Antonio, Texas) Participants in the 2022 Collegiate Wind Competition focus on offshore wind projects. (**bottom right**; Lexington, Virginia) Workers install fiber-optic cables. Rural broadband deployment is associated with higher incomes and lower unemployment rates. Photo credits: (top and bottom left) Werner Slocum/NREL [CC-BY-NC-ND 2.0]; (bottom right) Preston Keres, USDA

Climate change is disrupting cultures, heritages, and traditions

As climate change transforms US landscapes and ecosystems, many deeply rooted community ties, pastimes, Traditional Knowledges, and cultural or spiritual connections to place are at risk. Cultural heritage—including buildings, monuments, livelihoods, and practices—is threatened by impacts on natural ecosystems and the built environment. Damages to archaeological, cultural, and historical sites further reduce opportunities to transfer important knowledge and identity to future generations. {6.1, 7.2, 8.3, 9.2, 10.1, 12.2, 16.1, 22.1, 23.1, 26.1, 27.6, 28.2; Introductions in Chs. 10, 30}

Many outdoor activities and traditions are already being affected by climate change, with overall impacts projected to further hinder recreation, cultural practices, and the ability of communities to maintain local heritage and a sense of place. {19.1}

For example:

- The prevalence of invasive species and harmful algal blooms is increasing as waters warm, threatening activities like swimming along Southeast beaches, boating and fishing for walleye in the Great Lakes, and viewing whooping cranes along the Gulf Coast. In the Northwest, water-based recreation demand is expected to increase in spring and summer months, but reduced water quality and harmful algal blooms are expected to restrict these opportunities. {24.2, 24.5, 26.3, 27.6}

- Ranges of culturally important species are shifting as temperatures warm, making them harder to find in areas where Indigenous Peoples have access (see Box 1.3). {11.2, 24.2, 26.1}
- Hikers, campers, athletes, and spectators face increasing threats from more severe heatwaves, wildfires, and floods and greater exposure to infectious disease. {15.1, 22.2, 26.3, 27.6}

Nature-based solutions and ecosystem restoration can preserve cultural heritage while also providing valuable local benefits, such as flood protection and new recreational opportunities. Cultural heritage can also play a key role in climate solutions, as incorporating local values, Indigenous Knowledge, and equity into design and planning can help reaffirm a community's connection to place, strengthen social networks, and build new traditions. {7.3, 26.1, 26.3, 30.5}

(**top left**; Glacier National Park, Montana) Wildfire smoke jeopardizes participation in outdoor sports and recreation. (**top right**; Boston Harbor, Massachusetts) Sea level rise threatens historical and archaeological sites on the Boston Harbor Islands. (**bottom**; Goose Island, Texas) Whooping cranes, which draw birdwatchers to the Gulf of Mexico, are at risk due to flooding, drought, and upstream water use. Photo credit: (top left) Andrew Parlette [CC BY 2.0]; (top right) cmh2315fl [CC BY-NC 2.0]; (bottom) Alan Schmierer [CC0 1.0].

The Choices That Will Determine the Future

With each additional increment of warming, the consequences of climate change increase. The faster and further the world cuts greenhouse gas emissions, the more future warming will be avoided, increasing the chances of limiting or avoiding harmful impacts to current and future generations.

Societal choices drive greenhouse gas emissions

The choices people make on a day-to-day basis—how to power homes and businesses, get around, and produce and use food and other goods—collectively determine the amount of greenhouse gases emitted. Human use of fossil fuels for transportation and energy generation, along with activities like manufacturing and agriculture, has increased atmospheric levels of carbon dioxide (CO_2) and other heat-trapping greenhouse gases. Since 1850, CO_2 concentrations have increased by almost 50%, methane by more than 156%, and nitrous oxide by 23%, resulting in long-term global warming. {2.1, 3.1; Ch. 2, Introduction}

The CO_2 not removed from the atmosphere by natural sinks lingers for thousands of years. This means that CO_2 emitted long ago continues to contribute to climate change today. Because of historical trends, cumulative CO_2 emissions from fossil fuels and industry in the US are higher than from any other country. To understand the total contributions of past actions to observed climate change, additional warming from CO_2 emissions from land use, land-use change, and forestry, as well as emissions of nitrous oxide and the shorter-lived greenhouse gas methane, should also be taken into account. Accounting for all of these factors and emissions from 1850–2021, emissions from the US are estimated to comprise approximately 17% of current global warming. {2.1}

Tami Phelps

Carbon dioxide, along with other greenhouse gases like methane and nitrous oxide, is well-mixed in the atmosphere. This means these gases warm the planet regardless of where they were emitted. For the first half of the 20th century, the vast majority of greenhouse gas emissions came from the US and Europe. But as US and European emissions have been falling (US emissions in 2021 were 17% lower than 2005 levels), emissions from the rest of the world, particularly Asia, have been rising rapidly. The choices the US and other countries make now will determine the trajectory of climate change and associated impacts for many generations to come (Figure 1.13). {2.1, 2.3; Ch. 32}

George Lorio

Box 1.4. Global Warming Levels

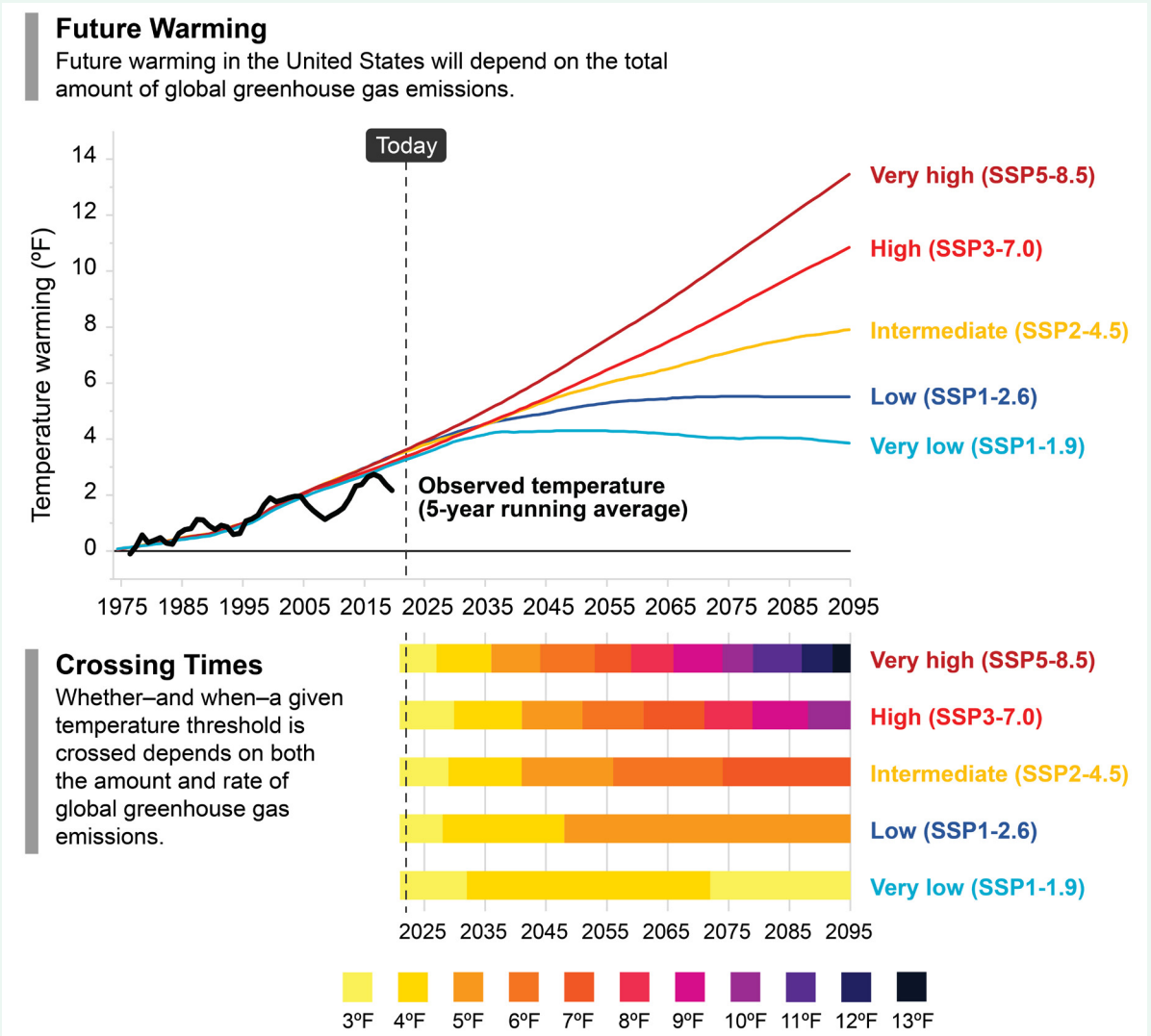
Because long-term societal actions are uncertain, climate modeling experts use different scenarios of plausible futures to represent a range of possible trajectories. These scenarios capture variables such as the relationship between human behavior, greenhouse gas emissions, Earth's responses to changes in the concentration of greenhouse gases in our atmosphere and ocean, and the resulting impacts, including temperature change and sea level rise. {3.3; Guide to the Report; App. 3}

Since there are uncertainties inherent in all of these factors—especially human behavior and the choices that determine emissions levels—the resulting range of projections are not predictions but instead reflect multiple potential future pathways. Future climate change under a given scenario is often expressed in one of two ways: as a range of potential outcomes in a future year (Figure 1.13a) or the time at which a specific outcome is expected (Figure 1.13b). {2.3, 3.3; App. 3}

Over the next decade, projected global warming is very similar across all scenarios. Updating energy infrastructure or making systemic economic and political changes takes time, thus temperature trajectories under different scenarios take time to diverge. {2.3}

By midcentury (2040–2070), differences between projected temperatures under higher and lower scenarios become apparent. By the end of the century, the global warming level—that is, how much the global average surface temperature increases above preindustrial levels—is expected to exceed 5.4°F (3°C) under high and very high scenarios (SSP3-7.0 and SSP5-8.5, respectively), and the world could see more than 7.2°F (4°C) of warming under a very high scenario (SSP5-8.5). Long-term global warming is expected to stay below 3.6°F (2°C) under a low scenario (SSP1-2.6) and can be limited to 2.7°F (1.5°C) only under a very low scenario (SSP1-1.9). {2.3}

The risk of exceeding a particular global warming level depends on future emissions. This means that projections are conditional: when or if the world reaches a particular level of warming is largely dependent on human choices. {2.3}



Potential Warming Pathways in the United States

When or if the US reaches a particular level of warming depends on global greenhouse gas emissions from human activities.

Figure 1.13. How much warming the US will experience—and when a given temperature threshold is crossed—depends on future global emissions. The **top graph** shows observed change in US surface temperature during 1975–2022 (black line, 5-year averaged) and modeled historical (1975–2014) and projected (2015–2095) change in surface temperature compared to 1951–1980, annually averaged over all 50 states and Puerto Rico under different climate scenarios (multicolored lines; see Table 3 in the Guide to the Report). The **bottom graph** shows the same projections in a different way, highlighting the year in which the US crosses temperature thresholds under each scenario. The vertical dashed line represents the year 2023. Data for the US-Affiliated Pacific Islands and the US Virgin Islands are not available. See Figure 1.5 for observed US and global temperature changes since 1895. Adapted with permission from Figure TS.1 in Arias et al. 2021.

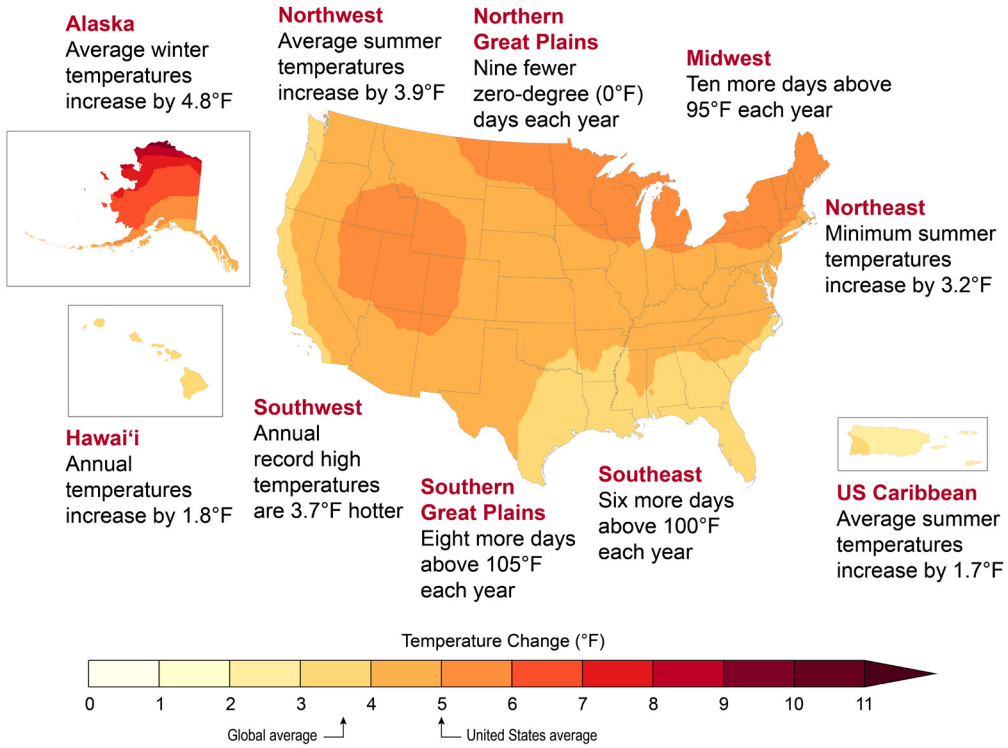
Rising global emissions are driving global warming, with faster warming in the US

The observed global warming of about 2°F (1.1°C) over the industrial era is unequivocally caused by greenhouse gas emissions from human activities, with only very small effects from natural sources. About three-quarters of total emissions and warming (1.7°F [0.95°C]) have occurred since 1970. Warming would have been even greater without the land and ocean carbon sinks, which have absorbed more than half of the CO_2 emitted by humans. {2.1, 3.1, 7.2; Ch. 2, Introduction; Figures 3.1, 3.8}

The US is warming faster than the global average, reflecting a broader global pattern: land areas are warming faster than the ocean, and higher latitudes are warming faster than lower latitudes. Additional global warming is expected to lead to even greater warming in some US regions, particularly Alaska (Figure 1.14). {2.1, 3.4; Ch. 2, Introduction; App. 4}

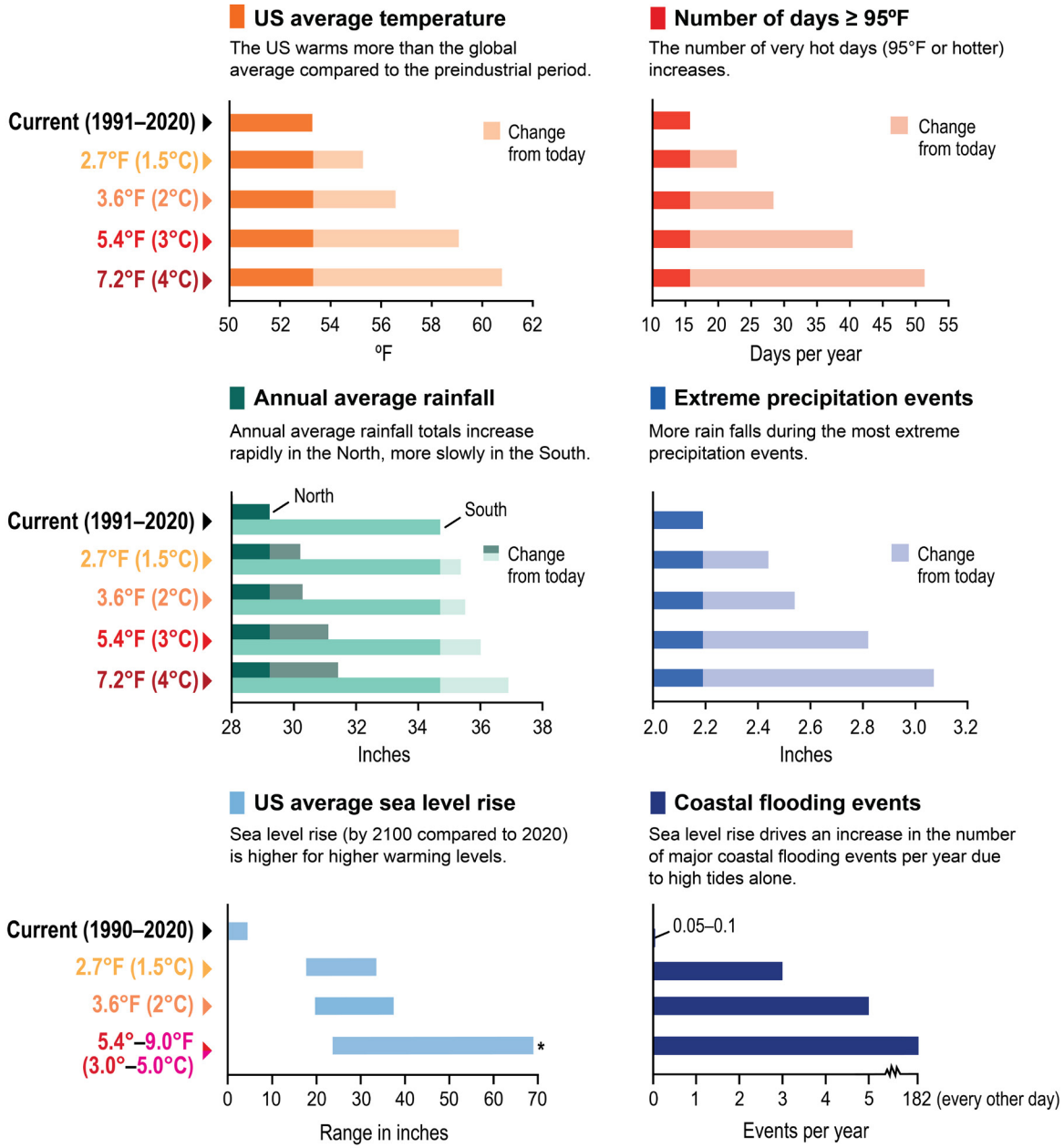
Warming increases risks to the US

Rising temperatures lead to many large-scale changes in Earth's climate system, and the consequences increase with warming (Figure 1.15). Some of these changes can be further amplified through feedback processes at higher levels of warming, increasing the risk of potentially catastrophic outcomes. For example, uncertainty in the stability of ice sheets at high warming levels means that increases in sea level along the continental US of 3–7 feet by 2100 and 5–12 feet by 2150 are distinct possibilities that cannot be ruled out. The chance of reaching the upper end of these ranges increases as more warming occurs. In addition to warming more, the Earth warms faster in high and very high scenarios (SSP3-7.0 and SSP5-8.5, respectively), making adaptation more challenging. {2.3, 3.1, 3.4, 9.1}



What would 3.6°F (2°C) of global warming feel like in the United States?

Figure 1.14. As the world warms, the United States warms more on average. The map shows projected changes in annual surface temperature compared to the present day (1991–2020) under a global warming level of 3.6°F (2°C) above preindustrial levels (see Figure 2.9). Regional examples show how different temperature impacts would be experienced across the country at this level of warming. Figure credit: USGCRP, NOAA NCEI, and CISESS NC.



*Rise at the upper end of this range cannot be ruled out due to the possibility of rapid ice sheet loss. The amount of warming required to trigger such loss is not currently known but is assessed to be above 3.6°F (2°C).

Consequences Are Greater at Higher Global Warming Levels

At higher global warming levels, the US will experience more severe climate impacts.

Figure 1.15. With each additional increment of global warming, climate impacts in the US are projected to be more severe: US average temperature warms more than the global average (**top left**), and the number of days per year at or above 95°F in the US increases (**top right**). Annual average US rainfall increases rapidly in the North and more slowly in the South (**center left**), and more rain falls during the most extreme precipitation events (**center right**). Sea level rise (range of projected increases by 2100 compared to 2020) is higher (**bottom left**), driving an increase in the number of major coastal flooding events per year due to high tides alone (**bottom right**). Temperature (averages and extremely hot days; top row) and extreme rainfall projections (center right) are averages for all 50 states and Puerto Rico. Average rainfall projections (center left) are shown for both the northern and southern US (above and below 37° latitude, respectively). Sea level rise (bottom left) and coastal flooding (bottom right) projections are averages for the contiguous United States. For sea level change estimates outside of the contiguous US, see Chapter 23 (for Puerto Rico and the US Virgin Islands), Chapter 30 (for Hawai'i and the US-Affiliated Pacific Islands), and Sweet et al. 2022 (for Alaska). Global warming levels refer to warming since preindustrial temperature conditions, defined as the 1851–1900 average. Figure credit: USGCRP, NOAA NOS, NASA, NOAA NCEI, and CISESS NC.

How Climate Action Can Create a More Resilient and Just Nation

Large near-term cuts in greenhouse gas emissions are achievable through many currently available and cost-effective mitigation options. However, reaching net-zero emissions by midcentury cannot be achieved without exploring additional mitigation options. Even if the world decarbonizes rapidly, the Nation will continue to face climate impacts and risks. Adequately and equitably addressing these risks involves longer-term inclusive planning, investments in transformative adaptation, and mitigation approaches that consider equity and justice.

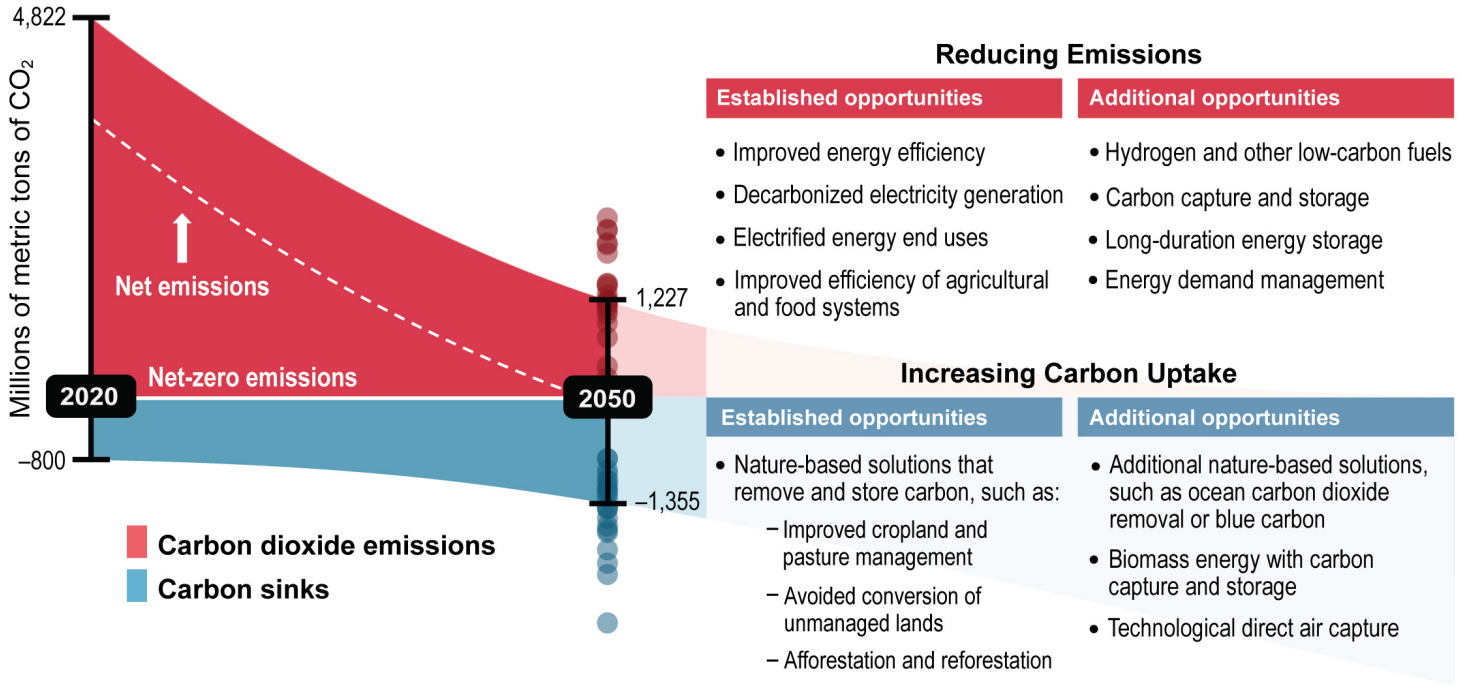
Available mitigation strategies can deliver substantial emissions reductions, but additional options are needed to reach net zero

Limiting global temperature change to well below 2°C (3.6°F) requires reaching net-zero CO_2 emissions globally by 2050 and net-zero emissions of all greenhouse gases from human activities within the following few decades (see "Meeting US mitigation targets means reaching net-zero emissions" above). Net-zero emissions pathways involve widespread implementation of currently available and cost-effective options for reducing emissions alongside rapid expansion of technologies and methods to remove carbon from the atmosphere to balance remaining emissions. However, to reach net-zero emissions, additional mitigation options need to be explored (Figure 1.16). Pathways to net zero involve large-scale technological, infrastructure, land-use, and behavioral changes and shifts in governance structures. {5.3, 6.3, 9.2, 9.3, 10.4, 13.2, 16.2, 18.4, 20.1, 24.1, 25.5, 30.5, 32.2, 32.3; Focus on Blue Carbon}

Scenarios that reach net-zero emissions include some of the following key options:

- Decarbonizing the electricity sector, primarily through expansion of wind and solar energy, supported by energy storage {32.2}
- Transitioning to transportation and heating systems that use zero-carbon electricity or low-carbon fuels, such as hydrogen {5.3, 13.1, 32.2, 32.3}
- Improving energy efficiency in buildings, appliances, and light- and heavy-duty vehicles and other transportation modes {5.3, 13.3, 32.2}
- Implementing urban planning and building design that reduces energy demands through more public transportation and active transportation and lower cooling demands for buildings {12.3, 13.1, 32.2}
- Increasing the efficiency and sustainability of food production, distribution, and consumption {11.1, 32.2}
- Improving land management to decrease greenhouse gas emissions and increase carbon removal and storage, with options ranging from afforestation, reforestation, and restoring coastal ecosystems to industrial processes that directly capture and store carbon from the air {5.3, 6.3, 8.3, 32.2, 32.3; Focus on Blue Carbon}

Portfolio of Mitigation Options for Achieving Net Zero by 2050



Reaching net zero by 2050 in the US will involve a mix of reductions in greenhouse gas emissions and increases in carbon dioxide removal.

Figure 1.16. Reaching net-zero emissions (horizontal white line) by midcentury in the US would mean deep reductions in emissions of carbon dioxide (CO_2) and other greenhouse gases (**top side of figure**; red), with residual emissions balanced by additional removal of CO_2 from the atmosphere (**bottom side of figure**; blue). The dashed white line shows net emissions to the atmosphere (the sum of carbon sources and carbon sinks). The dots at 2050 show ranges of emissions and uptake for energy model scenarios explored in detail in Chapter 32. Model scenarios that achieve these targets project a mix of established opportunities for reducing emissions and increasing carbon sinks. Among these, energy efficiency, decarbonized electricity (mainly renewables), and end-use electrification are critical for the energy sector. While not exhaustive, the list also includes additional opportunities, many of which are emerging technologies that will be integral to reaching net zero. These include options like use of hydrogen and low-carbon fuels to further reduce emissions in difficult-to-decarbonize sectors and greatly increasing CO_2 removal. Figure credit: EPA; University of California, Irvine; NOAA NCEI; and CISESS NC.

Due to large declines in technology and deployment costs over the last decade (Figure 1.2), decarbonizing the electricity sector is expected to be largely driven by rapid growth in renewable energy. Recent legislation is also expected to increase deployment rates of low- and zero-carbon technology. To reach net-zero targets, the US will need to add new electricity-generating capacity, mostly wind and solar, faster than ever before. This infrastructure expansion may drastically increase demand for products (batteries, solar photovoltaics) and resources, such as metals and critical minerals. Near-term shortages in minerals and metals due to increased demand can be addressed by increased recycling, for example, which can also reduce dependence on imported materials. {5.2, 5.3, 17.2, 25.3, 32.2, 32.4; Focus on Risks to Supply Chains}

Most US net-zero scenarios require CO_2 removal from the atmosphere to balance residual emissions, particularly from sectors where decarbonization is difficult. In these scenarios, nuclear and hydropower capacity are maintained but not greatly expanded; natural gas–fired generation declines, but more slowly if coupled with carbon capture and storage. {32.2}

Nature-based solutions that restore degraded ecosystems and preserve or enhance carbon storage in natural systems like forests, oceans, and wetlands, as well as agricultural lands, are cost-effective mitigation strategies. For example, with conservation and restoration, marine and coastal ecosystems could capture and store enough atmospheric carbon each year to offset about 3% of global emissions (based on 2019 and 2020 emissions). Many nature-based solutions can provide additional benefits, like improved ecosystem resilience, food production, improved water quality, and recreational opportunities. {8.3; Boxes 7.2, 32.2; Focus on Blue Carbon}

Adequately addressing climate risks involves transformative adaptation

While adaptation planning and implementation has advanced in the US, most adaptation actions to date have been incremental and small in scale (see Table 1.3). In many cases, more transformative adaptation will be necessary to adequately address the risks of current and future climate change. {31.1, 31.3}.

Table 1.3. Incremental Versus Transformative Adaptation Approaches

	Examples of incremental adaptation	Examples of transformative adaptation
	Using air-conditioning during heatwaves	Redesigning cities and buildings to address heat
	Reducing water consumption during droughts	Shifting water-intensive industry to match projected rainfall patterns
	Elevating homes above flood waters	Directing new housing development to less flood-prone areas

Transformative adaptation involves fundamental shifts in systems, values, and practices, including assessing potential trade-offs, intentionally integrating equity into adaptation processes, and making systemic changes to institutions and norms. While barriers to adaptation remain, many of these can be overcome with financial, cultural, technological, legislative, or institutional changes. {31.1, 31.2, 31.3}.

Adaptation planning can more effectively reduce climate risk when it identifies not only disparities in how people are affected by climate change but also the underlying causes of climate vulnerability. Transformative adaptation would involve consideration of both the physical and social drivers of vulnerability and how they interact to shape local experiences of vulnerability and disparities in risk. Examples include understanding how differing levels of access to disaster assistance constrain recovery outcomes or how disaster damage exacerbates long-term wealth inequality. Effective adaptation, both incremental and transformative, involves developing and investing in new monitoring and evaluation methods to understand the different values of, and impacts on, diverse individuals and communities. {9.3, 19.3, 31.2, 31.3, 31.5}

Transformative adaptation would require new and better-coordinated governance mechanisms and cooperation across all levels of government, the private sector, and society. A coordinated, systems-based approach can support consideration of risks that cut across multiple sectors and scales, as well as the development of context-specific adaptations. For example, California, Florida, and other states have used informal regional collaborations to develop adaptation strategies tailored to their area. Adaptation measures that are designed and implemented using inclusive, participatory planning approaches and leverage coordinated governance and financing have the greatest potential for long-term benefits, such as improved quality of life and increased economic productivity. {10.3, 18.4, 20.2, 31.4}

Ritika S.

Joan Hart

Mitigation and adaptation actions can result in systemic, cascading benefits

Actions taken now to accelerate net emissions reductions and adapt to ongoing changes can reduce risks to current and future generations. Mitigation and adaptation actions, from international to individual scales, can also result in a range of benefits beyond limiting harmful climate impacts, including some immediate benefits (Figure 1.1). The benefits of mitigation and proactive adaptation investments are expected to outweigh the costs. {2.3, 13.3, 14.5, 15.3, 17.4, 22.1, 31.6, 32.4; Introductions in Chs. 17, 31}

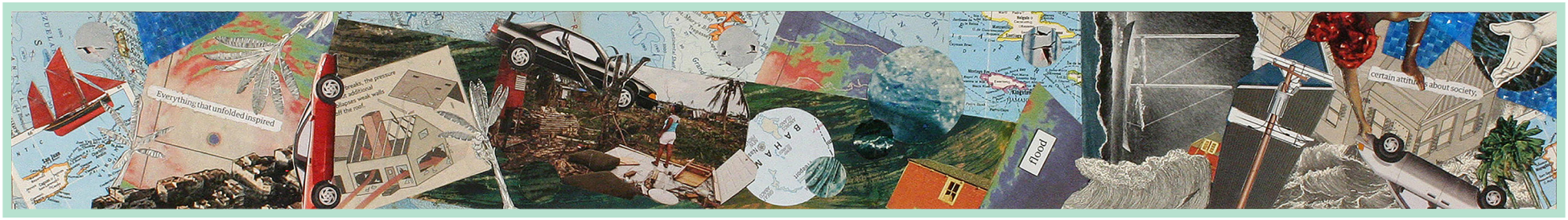
- Accelerating the deployment of low-carbon technologies, expanding renewable energy, and improving building efficiency can have significant near-term social and economic benefits like reducing energy costs and creating jobs. {32.4}
- Transitioning to a carbon-free, sustainable, and resilient transportation system can lead to improvements in air quality, fewer traffic fatalities, lower costs to travelers, improved mental and physical health, and healthier ecosystems. {13.3}
- Reducing emissions of short-lived climate pollutants like methane, black carbon, and ozone provides immediate air quality benefits that save lives and decrease the burden on healthcare systems while also slowing near-term warming. {11.1, 14.5, 15.3}
- Green infrastructure and nature-based solutions that accelerate pathways to net-zero emissions through restoration and protection of ecological resources can improve water quality, strengthen biodiversity, provide protection from climate hazards like heat extremes or flooding, preserve cultural heritage and traditions, and support more equitable access to environmental amenities. {8.3, 15.3, 20.3, 24.4, 30.4; Focus on Blue Carbon}
- Strategic planning and investment in resilience can reduce the economic impacts of climate change, including costs to households and businesses, risks to markets and supply chains, and potential negative impacts on employment and income, while also providing opportunities for economic gain. {9.2, 19.3, 26.2, 31.6; Focus on Risks to Supply Chains}
- Improving cropland management and climate-smart agricultural practices can strengthen the resilience and profitability of farms while also increasing soil carbon uptake and storage, reducing emissions of nitrous oxide and methane, and enhancing agricultural efficiency and yields. {11.1, 24.1, 32.2}

Climate actions that incorporate inclusive and sustained engagement with overburdened and underserved communities in the design, planning, and implementation of evidence-based strategies can also reduce existing disparities and address social injustices. {24.3, 31.2, 32.4}

Transformative climate actions can strengthen resilience and advance equity

Fossil fuel–based energy systems have resulted in disproportionate public health burdens on communities of color and/or low-income communities. These same communities are also disproportionately harmed by climate change impacts. {13.4, 15.2, 32.4}

A "just transition" is the process of responding to climate change with transformative actions that address the root causes of climate vulnerability while ensuring equitable access to jobs; affordable, low-carbon energy; environmental benefits such as reduced air pollution; and quality of life for all. This involves reducing impacts to overburdened communities, increasing resources to underserved communities, and integrating diverse worldviews, cultures, experiences, and capacities into mitigation and adaptation actions. As the country shifts to low-carbon energy industries, a just transition would include job creation



Melanie Mills

and training for displaced fossil fuel workers and addressing existing racial and gender disparities in energy workforces. For example, Colorado agencies are creating plans to guide the state's transition away from coal, with a focus on economic diversification, job creation, and workforce training for former coal workers. The state's plan also acknowledges a commitment to communities disproportionately impacted by coal power pollution. {5.3, 13.4, 14.3, 15.2, 16.2, 20.3, 31.2, 32.4; Figure 20.1}

A just transition would take into account key aspects of environmental justice:

- Recognizing that certain people have borne disparate burdens related to current and historical social injustices and, thus, may have different needs
- Ensuring that people interested in and affected by outcomes of decision-making processes are included in those procedures through fair and meaningful engagement
- Distributing resources and opportunities over time, including access to data and information, so that no single group or set of individuals receives disproportionate benefits or burdens

{20.3; Figure 20.1}

An equitable and sustainable US response to climate change has the potential to reduce climate impacts while improving well-being, strengthening resilience, benefiting the economy, and, in part, redressing legacies of racism and injustice. Transformative adaptation and the transition to a net-zero energy system come with challenges and trade-offs that would need to be considered to avoid exacerbating or creating new social injustices. For example, transforming car-centric transportation systems to emphasize public transit and walkability could increase accessibility for underserved communities and people with limited mobility—if user input and equity are intentionally considered. {13.4, 20.3, 31.3, 32.4; Ch. 31, Introduction}

Equitable responses that assess trade-offs strengthen community resilience and self-determination, often fostering innovative solutions. Engaging communities in identifying challenges and bringing together diverse voices to participate in decision-making allows for more inclusive, effective, and transparent planning processes that account for the structural factors contributing to inequitable climate vulnerability. {9.3, 12.4, 13.4, 20.2, 31.4}

Fifth National Climate Assessment: Chapter 31

Adaptation

Chapter 31. Adaptation

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Introduction

Changes in the climate have been observed and experienced across every region of the United States (Ch. 3). Chronic changes such as increasing temperatures, sea level rise, and changing precipitation patterns are affecting the frequency and intensity of diverse extreme weather events. These changes directly impact many millions of people and ecosystems (Ch. 2)[1] and are projected to increase in the future. Adaptation is essential for human and ecological survival in this rapidly changing, complex, and interconnected world.

Adaptation refers to actions taken to reduce risks from today's changed climate conditions and to prepare for further impacts in the future. It includes diverse activities designed to reduce climate-related risks and increase capacity to prepare for climate impacts (Table 31.1). Actions taken to adapt to climate change often provide major opportunities to create a healthier and more resilient future for generations to come. Through these actions, billions of dollars can be saved by investing now and avoiding future losses, new jobs can be created, innovative solutions can be realized, and productivity and efficiencies can be increased across all sectors. Done well, adaptation can protect human lives, improve quality of life, enhance social equity, reduce healthcare costs, and safeguard and restore the natural ecosystems on which society depends for its very survival.

The various risks driven by climate change are extensive, diverse, and intensifying, and they interact with complex social, geographic, economic, and political contexts to exacerbate underlying stresses in overburdened and frontline communities. These communities already experience disproportionate impacts of climate change, and these impacts will only increase over time if equitable adaptation actions are not taken now (KM 31.2). The loss of biodiversity and ecosystem services, the displacement of people due to rising sea levels and more frequent extreme weather events, the loss of natural resources, the increased demand on the aging energy grid and critical infrastructure, and many other challenges will only get worse if society does not transform the way it tackles climate change in the US today.

The urgency for climate adaptation is clear and very well documented.[1,2,3,4,5] The benefits of climate adaptation can be immense and felt by everyone if advanced and scaled sufficiently in relation to the pace of climate change (KM 31.1), if equity is centered from the start (KM 31.2), and if both transformative and incremental adaptation actions are taken now (KM 31.3). Transformative adaptation aims to reduce risks through fundamental shifts in systems, values, and practices. Equitable adaptation intentionally incorporates recognitional, procedural, contextual, and distributional principles of equity in design, planning, and execution. Equitable adaptation addresses the disproportionate effects of climate change for overburdened and frontline communities. It dismantles barriers, considers underlying stresses, creates opportunities, and enables learning through iterative evaluation and sustained engagement.[6]

Effective adaptation governance needs to empower all voices to navigate (e.g., discuss, weigh, and prioritize) competing goals in a collaborative manner (KM 31.4), and adaptation-related services need to go beyond the traditional offerings of science, data, and information to be more accessible and to meet the needs of overburdened and frontline communities (KM 31.5). Adaptation finance and investments will be needed to scale, support, and implement adaptation, and systems will need to be developed to adequately track and evaluate the effectiveness of these investments (KM 31.6). In brief, widespread and dedicated adaptation efforts will be essential for securing a sustainable and prosperous future for all.

Table 31.1. Example Climate-Related Adaptation Actions

This table provides examples of incremental and transformative actions being implemented at various scales across US regions and sectors and by various actors to adapt to a range of different climate hazards. See cross-references to other chapters for more detail on certain adaptation actions. The "action" categories in this table have been adapted from Biagini et al. 2014, Hicke et al. 2022, and GCC 2022.[1,7,8]

Action	Description
Capacity Building	Community building (KM 23.5); interdisciplinary public education, literacy, and outreach at all age levels; trainings (KM 21.4) and workshops; knowledge and skill development; technical assistance; dissemination of decision-useful information; equitable partnerships (KM 24.5); sharing best and leading practices; local groups and coalitions to assist communities (KM 25.5)
Early Warning and Observing Systems	Developing, testing, and deploying monitoring and observing systems; early warning systems (e.g., for heat, famine, drought, wildfire); strategic foresight; upgrading weather or hydrometeorological services
Financing	Insurance (KM 21.5); microfinance; funding; investments; grants; contingency funds; environmental impact bonds (KM 21.4); land trusts (KM 21.5); equitable availability and accessibility of capital before and after disasters (KM 31.6); community-based public–private partnership (KM 24.4)
Physical Infrastructure	Coastal accommodation; ecosystem-based adaptation; minimizing ecosystem stressors; restoration or creation of natural areas (KMs 23.5, 31.4); revegetation; afforestation woodland management; increased landscape cover; natural coastal embankments; floodable parks and parking structures; flood mitigation (Box 22.1; KM 24.4); urban flood management (KM 31.4); stormwater management (KM 21.4); retention and detention ponds; "living" roofs; rain gardens; green space (KM 21.3); building or retrofitting infrastructure to withstand future climate change (KM 31.5); water capture and storage; water supply and distribution; infrastructure for health services; improvements to water and sanitation infrastructure; adaptive buildings; reservoirs for water storage; irrigation systems (KM 31.3); canal infrastructure; seawalls; solar infrastructure for electrification; restoration of native species diversity; increase in structural diversity (e.g., variation in age structure; KM 24.2); air conditioners (KM 21.1); cooling centers (KM 31.2); sustainable development (KM 23.5)
Information	Decision support tools (KM 21.1); data analytics; public reporting and disclosures; visualization tools; data acquisition efforts; digital databases; remote communication technologies; climate hazard, vulnerability, and probabilistic mapping tools (KM 21.1); collaboration and coproduction of data and information (KM 24.2); toolkits (KMs 21.1, 31.5)
Management and Planning	Scenario-based planning (KM 25.5); spatial planning; incorporating climate change and adaptation into planning (e.g., hazard mitigation plans), design standards, management, and decisions (KM 21.1); collaborative adaptation planning at multiple scales (e.g., federal, regional, state, territorial, Tribal, local, organizational [public and private]); assessing underlying conditions and needs (KM 21.4), risks (KM 23.5), adaptive capacity, and options; adaptive management; cooperative governance (KM 31.4); cultural adaptation; regional collaboratives (KM 31.4)
Policy	Law and governance (KMs 21.3, 23.5); local climate policy (KMs 21.3, 23.5, 27.1); revised design parameters, adaptive building codes, and integration of future climate projections into codes and standards (KMs 12.3, 31.5); creation of new policies or revisions of policies or regulations to allow flexibility to adapt; mainstreaming adaptation into development policies; improvement of water resource governance
Practice and Behavior	Institutional change; changes to diets and food waste; diversification of livelihoods and income sources; adaptive farm, fishery, or livestock practices (Box 29.5); improved crop varieties; food storage, distribution, and security; disaster risk reduction; permanent migration, planned retreat, or relocation (KMs 21.3, 24.4); seasonal or temporary mobility; social safety nets and cohesion; adaptive social protection; water use and demand; soil or land management techniques; post-harvest storage; rainwater collection; expanding integrated pest management; strategic coastal retreat (KM 9.3); land protection; changes in transportation habits; improved public health (KM 23.5)
Technology	Developing new or expanding existing technologies to enable and advance adaptation; water use or water access improvement technologies; solar energy capacity; wind power; energy storage; biogas; water purification; solar salt production; microgrids; artificial intelligence and machine learning

Key Message 31.1

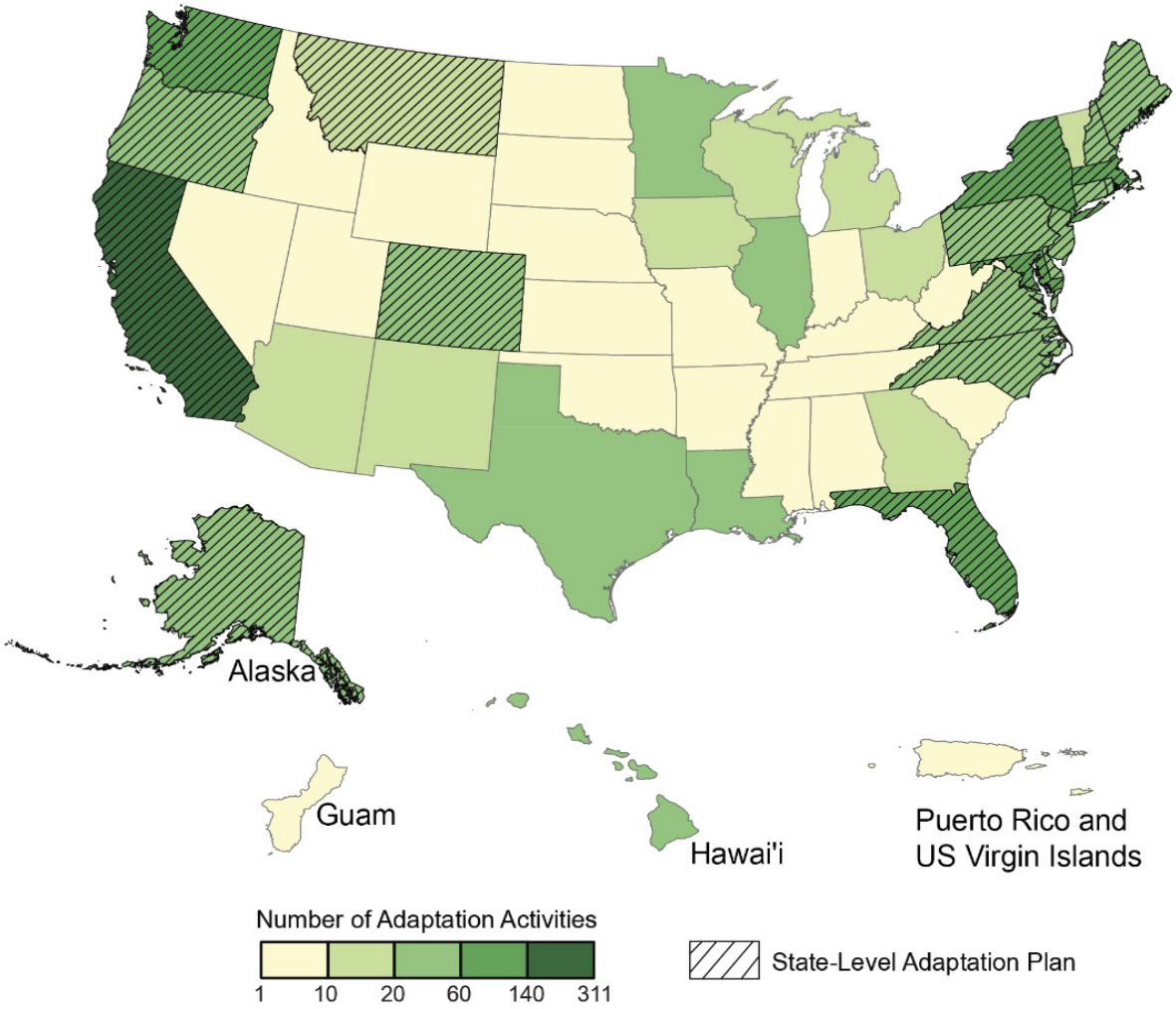
Adaptation Is Occurring but Is Insufficient in Relation to the Pace of Climate Change

Diverse adaptation activities are occurring across the US (*very high confidence*). Adaptation activities are increasingly moving from awareness and assessment toward planning and implementation (*medium confidence*), with limited advancement toward monitoring and evaluation (*high confidence*). Numerous social, economic, physical, and psychological barriers are preventing more widespread adoption and implementation of adaptation (*high confidence*). Current adaptation efforts and investments are insufficient to reduce today's climate-related risks (*high confidence*) and are unlikely to keep pace with future changes in the climate (*medium confidence*).

Actors, stakeholders, and rights-holders (hereafter actors)—from individuals and organizations to companies, communities, and government entities across all levels, regions, and sectors—are already investing in adaptation measures (Figure 31.1) to reduce the harms caused by climate change and leverage new opportunities to enhance their ability (or capacity) to adapt.[9,10,11,12,13,14] The extent, type, and stage (Box 31.1) of these activities vary regionally and across sectors (Figure 31.1; Chs. 4–16, 21–30). Adaptation has increasingly progressed from the awareness and assessment stages toward planning and implementation (Box 31.1). However, few adaptation activities advance monitoring or evaluation.

To date, adaptation across the US has been incremental in nature, and given the expected future pace of climate change, more action is needed at greater rates and larger scales, across more sectors, and in context-specific ways.[1,15,16,17,18] Historically, actions to adapt often have not centered equity (KM 31.2) and were not designed using a systems-oriented, regional, or collaborative approach for transformation (KM 31.3). Adaptation lacks the attention, investment, financing, and monitoring needed to prepare for both acute and chronic climate impacts (KM 31.6).

Number of Publicly Documented Adaptation Activities (2018–2022)



The level of documented public- and private-sector adaptation activity varies widely across US states and territories.

Figure 31.1. This figure illustrates the number of public- and private-sector adaptation activities—see examples offered in Table 31.1—publicly documented and/or updated since 2018. There are several states that have publicly documented numerous adaptation activities, while others have very few or have not documented the activities. Figure credit: WSP, University of Delaware, and University of California, Irvine. See figure metadata for additional contributors.

Box 31.1. Evidence of Adaptation Occurring Across the Five Adaptation Stages

Adaptation actions are generally categorized into five stages, from raising awareness to implementation and evaluation.[4,19] Evidence of action exists along the five adaptation stages at varying scales and levels.

Stage 1: Awareness and Engagement

American adults understand that climate change is happening (72%).[20] However, they have low risk awareness (e.g., they underappreciate how severely climate change might affect themselves and society) and lack a clear understanding of adaptation and its importance (KM 31.2).

Stage 2: Assessment

Approximately 40% of US states have assessed their climate change risks.[8] Of US-based companies disclosing through CDP (formerly the Carbon Disclosure Project), 88% have assessed their climate-related financial risks in alignment with the Task Force on Climate-related Financial Disclosures (KM 31.6)[21] and, if material, disclosed such risks in their financial statements. Assessments of adaptive capacity (the potential of a system to adjust to climate change) and climate resilience have progressed but lag assessments of climate risks, raising concerns that some actors, including local governments, may be ill-equipped to prepare for climate change. There is an increase in the number of publicly available datasets and tools to inform assessments, as well as use of Traditional Knowledge and climate storytelling.

Stage 3: Policy and Planning

Many governments and organizations have individual sustainability, resilience, or adaptation plans (Figure 31.1). Eighteen states have climate adaptation plans, and another six states have plans underway. Thirty-two states lack a public adaptation plan, a select few US-based companies have disclosed adaptation-related actions they are taking, and very few jurisdictions have adaptation plans co-designed between the private- and public-sectors. Across jurisdictions, plans are developed for different reasons (e.g., climate impacts, investor requests, regulatory requirements) and rarely in a coordinated, collaborative, or regional manner.[22,23] As required in Executive Orders 14008 and 14057, more than 20 federal agencies have prepared and updated climate adaptation plans.[24] Funding and implementation of adaptation plans remains moderate or low (KM 31.6).[1,25] Climate adaptation–related congressional legislation is becoming more prevalent, but it is often embedded within other topics (e.g., infrastructure, disaster relief, water). Federally funded opportunities remain untapped and inaccessible to overburdened and frontline communities.[26]

Stage 4: Implementation

Implementation of adaptation actions has made some progress. However, most actions have been incremental in nature; have focused on acute extreme weather events rather than systemic, chronic climate change; and/or involve small infrastructure changes to business-as-usual activity, such as changing irrigation systems or expanding stormwater pipes to withstand increased flooding.[1,15] Current levels and types of adaptation being implemented are insufficient to deal with future climate change.[1,15,27,28]

Stage 5: Monitoring and Evaluation

Adaptation researchers and practitioners are starting to track the number of actions, assess the adaptation effectiveness of those that have occurred, and evaluate the long-term sufficiency of adaptation projects. However, frameworks, monitoring, indicators, and evaluations that assess adaptation practices, co-benefits, equality, and implementation at appropriate levels of granularity are still under development.[1,29,30,31,32,33,34,35] Research is focused on evaluating adaptation-enabling governance structures and barriers to adaptation.[36,37]

Evidence of Adaptation Barriers

Although adaptation is occurring across the US, barriers remain. These barriers can mostly be overcome with financial, cultural, technological, legislative, or institutional changes.[38,39]

There is growing divergence in the ways government, private industry, and civil society are planning for climate adaptation, with each focusing on a subset of climate vulnerability—disaster resilience, risk and liability, and equity and justice, respectively[40]—and individual climate hazards (e.g., sea level rise, flooding, heat), instead of compounding and complex events (Focus on Compound Events). This incoherence increases the potential for investments that may unintentionally exacerbate climate-related risks or overlook the need to target adaptations for frontline communities that experience a plethora of compounding issues (both chronic and acute), creating greater societal vulnerability to climate impacts (KM 31.3).[41] It is also important to distinguish between *planning* for adaptation and *actually* adapting; there is still more of the former than the latter. The ability to adapt is uneven and inequitable: communities or businesses with means, wealth, or access to resources are more able to adapt, while those with fewer means or opportunities are less able to adapt. The gap between planning and action could also be due to the ease of tracking adaptation plans compared to tracking evidence of systems, people, or environments that are adapting, which can take years to show progress.[1] With the lack of consistent tracking and evaluation of adaptive capacity and how effectively society and ecosystems are adapting to climate change, it is challenging to measure progress, continually improve, and understand the overall impact of adaptation actions and investments.[42]

Adaptation is routinely limited by a range of political, structural, psychological, and normative barriers.[1] Few regulatory requirements focus directly on adaptation.[26] Existing environmental and disaster policies, frameworks, and governance systems are ill-suited to handle the long-term, widespread, transformative changes needed to adapt to climate change; tend to be reactive rather than proactive; and assume fixed rather than dynamic environments.[43,44,45]

Methodologies and tools to assess climate risks, adaptive capacity, and adaptation options are lacking in transparency or are nascent (KM 31.5). While there are many datasets and tools to inform adaptation, their usefulness for decision-making remains uncertain.[46] Resources remain constrained and dispersed when it comes to assessing climate change and adaptation.[43,44,47,48] There is a lack of clear pathways for sharing datasets and tools among multiple actors and jurisdictions (KM 31.4) and a lack of streamlined and transparent processes for integrating local and Traditional Knowledge. The inherent time lag in the scientific peer-review process of science and assessments does not allow for progress to be made swiftly.

Competing values and goals held by diverse public entities and organizations and differentiated responsibilities across levels of government or types of organizations create challenges in developing shared goals (KM 31.4).[44,45,48] The lack of coordination across government agencies at all scales and with diverse actors creates a fragmented and ineffective adaptation governance system.[47,48,49,50,51] The continued reliance on fossil fuel economies discourages transition and economic diversification,[52,53,54] limiting collaborative planning with these high-emitting industries.

Justice and equity are rarely centered in adaptation activities by all sectors and actors (public and private; KM 31.2).[55] In many settings, there is not a widely accessible forum for local participation, particularly of Indigenous communities living in remote and vulnerable locations. Social hierarchies and structures can prevent overburdened groups from sharing their opinions, preventing achieving equitable adaptation. Frontline communities are hit first and worst by climate change, and oftentimes adapting to climate change may not be their immediate concern. Intentionally centering equity in adaptation solutions in partnership with frontline communities has the potential to improve some systemic issues such as inequality, discrimination, and limited access to essential resources and opportunities (KM 31.2).[56]

Finally, there remains a minimal degree of investment and funding for adaptation. As for the funding that is available, communities with the highest climate vulnerability do not have adequate and equitable access to these funds (KM 31.6).[43] Organizations often do not understand potential returns on investment in adaptation, so there is less appetite for expensive measures (KM 31.6).[57]

Key Message 31.2

Effective Adaptation Requires Centering Equity

People and communities are affected by climate change in different ways (*very high confidence*). How people and institutions adapt depends on social factors, including individual and community preferences, capacity, and access to resources (*very high confidence*). Adaptation processes, decisions (about whether, where, and how adaptation occurs), and actions that do not explicitly address the uneven distribution of climate harms, and the social processes and injustices underlying these disparities, can exacerbate social inequities and increase exposure to climate harms (*high confidence*).

Climate adaptation that responds to people's values, concerns, and priorities requires not only identifying disparities in how people are affected by climate change but also understanding the underlying causes and conditions of climate vulnerability. Vulnerability (predisposition to adverse impacts) is shaped by interactions across physical, social, and ecological processes (Chs. 3, 20).[58] The places most vulnerable to climate change share traits of high *exposure* to climate change and climate hazards (e.g., long-term water scarcity and extreme drought), high *susceptibility* to adverse impacts, and constraints on *capacity* to adapt.[1] The specific mechanisms that produce vulnerability vary from place to place and over time; are shaped by historical racial, ethnic, gender, and socioeconomic inequalities (Chs. 16, 20);[59] and are sensitive to climatic and demographic change in the future.[60]

Inequalities in social, economic, and political power and resources[61] mean that populations marginalized by society and underserved by government or private-sector systems often face disproportionately worse effects of hazards. For example, higher proportions of Native American, Hispanic, Asian and Pacific Islander, and African American populations live in places prone to extreme wildfire, heat, floods, and permafrost thaw.[62,63,64,65,66,67] Such differential exposure often results from historical injustices such as housing discrimination, forced displacement, social exclusion, lack of investment in hazard mitigation, and lack of provision of other social services by government or the private sector (e.g., insurance, mortgage lending).

Uneven patterns of climate hazard exposure are well documented. Recent work is helping to untangle context-specific processes through which the geographic distribution of climate hazards and social inequality interact to shape local experiences of vulnerability (Ch. 20). Examples include illuminating how disaster damage exacerbates long-term wealth inequality,[68] how disaster assistance distribution policies and differential access constrain recovery outcomes,[69,70] and the influence of racial and economic privilege in flood buyout programs.[71,72,73] Greater understanding of the complex human drivers of climate vulnerability can illustrate how and why transformative adaptations may be required (see KM 31.3) to address interlocking social processes and to remedy vulnerability at its roots (Ch. 20).[40] This improved understanding reinforces why effective adaptation extends beyond cost efficiency and technocratic concerns to intentionally incorporate equity and environmental justice principles.[18,74] Effective adaptation that centers equity is needed to address disparities in the causes and effects of climate risks, dismantle barriers, and create opportunities for all people to thrive.

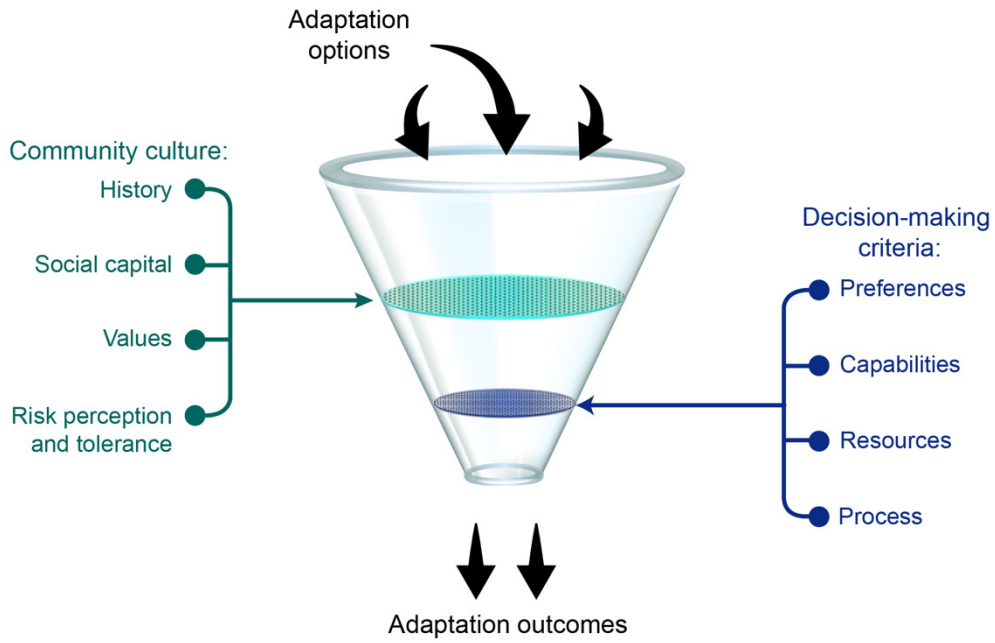
Whether, when, and how people adapt to climate change depends on complex geographic, political, economic, social, and cultural contexts (Chs. 18, 20; Figure 31.2). The ability of individuals and institutions to engage in adaptation is affected by their access to resources, which is unevenly distributed and mediated by factors such as income, race, ethnicity, and gender.[72,75,76,77,78] Factors such as citizenship status and land ownership can create administrative hurdles.[79,80] Federal or state resources for adaptation are often available to individuals, communities, and Tribes only if they navigate bureaucratic systems or succeed in competitions. Equity concerns arise when the system privileges those who already have resources—time, English-language skills, personnel, power, and/or funds to acquire adaptation resources.[68,81,82] Rural or less populous towns, for example, may have fewer professionals to dedicate time to grant applications, fewer resources to meet federal cost-share requirements, or difficulty in proving that adaptation would be cost effective (Ch. 11; KMs 11.3, 31.6). Private-sector adaptation resources are similarly more available to some people than others, as when insurance companies cease to offer wildfire insurance in some risk-prone areas.[83]

Social factors—including place attachment, identity, social capital, and perceptions of what is fair and effective—influence the adaptation actions people are willing and able to pursue.[84,85,86,87] Risk perceptions and risk tolerances are influenced by social factors such as experience, culture, and demographics, and increased risk awareness alone does not predict increased adaptation.[88,89] For example, a survey of Puerto Rican farmers found that half did not engage in adaptation even though they perceived themselves to be at risk and to be capable of taking action.[89] A survey of homeowners in North Carolina found that knowledge of climate change and its risks had no effect on the adaptation actions taken.[88]

Geographic, political, economic, social, and cultural contexts also influence how people adapt (Figure 31.2). Different types of adaptation actions reduce risk to different degrees and in different ways, cost different amounts, have different downsides, and benefit and harm different groups.[90,91,92] Individual and community values, circumstances, and priorities shape which benefits are considered most important, which trade-offs people are willing to endure, and what opportunities they are willing to forego. For example, building seawalls can disconnect communities from the water, which may affect their place attachment, recreational and economic amenities, sense of identity, local ecosystems, and long-term risk profile, while providing short-term gains in safety and property values.[93,94] Culture, heritage, and traditional ties to the land influence adaptation preferences[95,96] and can be important sources of motivation and guidance, especially for locally led adaptation efforts.[97] People may disagree about the goals of adaptation and their preferences for trade-offs, values, or risk tolerance levels, and how these disagreements are handled within a community or institution further shapes adaptation practices.

Participatory processes create space for people to discuss goals, values, social factors, and resources and are a necessary element of participatory justice, which holds that those affected by decisions should be involved in the decision-making process. Such processes benefit from practices that facilitate participation, such as convenient meeting times, language translation, and provision of transportation, food, and childcare. To more deeply embed equity, participatory processes designed to stunt power imbalances—such as those featuring transparency, information access, and opportunities for substantive influence—are most likely to represent the full range of people affected by a decision.

Adaptation Actions Defined by Multiple Factors



Adaptation outcomes are the result of individual and group values and decision-making processes and constraints.

Figure 31.2. The path from potential adaptation options to adaptation outcomes is filtered through culture and decision-making criteria, processes, and resources. Individual traits, circumstances, and preferences mean that adaptation outcomes are not identical for all members of a community. These social factors may create, perpetuate, or exacerbate existing social inequities in a systemic fashion, such that even passive actions can produce inequitable outcomes. Intentionally integrating equity into adaptation, which requires accounting for differences in access, capacity, and resources, can lead to more inclusive and sustainable outcomes. Figure credit: ICF, University of Delaware, and University of Iowa.

Failure to intentionally center equity—as in the distribution of resources, participatory processes, and recognition of local contexts—may unintentionally increase the vulnerability of people and places.[98] This is a type of maladaptation, in which efforts to address a climate vulnerability unintentionally increases vulnerability.[99,100] Maladaptation can occur, for example, if engineered infrastructure (e.g., levees) or disaster response programs create a false sense of security that incentivizes continued development in hazardous areas, which in turn produces higher losses in the event of system failure—a situation known as the safe development paradox.[101,102,103] Adaptation tailored to a specific context can become maladaptive if subjected to a different hazard type or context, as when crowded spaces in community shelters or cooling centers contribute to the spread of a pandemic.[104,105] Interventions advanced in the name of engineering adaptation may undermine ecological adaptation, and adaptation for some people (e.g., wealthy communities, homeowners) may lead to maladaptive outcomes for others (e.g., low- to moderate-income communities, renters). Given the potential for maladaptation to substantially redistribute or amplify risk, the topic would benefit from significant attention from practitioners and policymakers.[106,107,108]

Intentionally centering equity in the design, planning, and implementation stages of adaptation would require a paradigm shift. This shift would include asking a number of questions: For whom, with whom, and by whom would proposed adaptation actions be undertaken? Who would benefit and who would be burdened by these actions? Are steps being taken to lessen the burdens borne by underserved populations (Ch. 20; Figure 20.1)?[109,110] This type of proactive engagement from disadvantaged and frontline communities

would be especially important in transformative adaptations that may cause substantial social upheaval (KM 31.3). Accounting for intersecting identities and structural inequalities as organizing principles of adaptation planning could help produce adaptation actions that simultaneously mitigate the effects of climate change and address compounding social inequities.[111,112] Other strategies for equity-centric adaptation include prioritizing adaptation actions and assessing adaptation effectiveness based on satisfying the needs and preferences of the most vulnerable.[113] Adaptation equity and environmental justice involve multiple concepts, including recognition of how past injustices have contributed to current patterns of exposure and capacity, consideration of cultural values and norms, fair decision-making processes and distribution of resources, and efforts to redress past and current injustices.[95,108,114,115,116] Adaptation efforts that center equity and justice are best positioned to avoid perpetuating social injustices.[40,113,117]

The Justice40 Initiative[118] is an example of public policy that centers the redress of social inequity in adaptation. Justice40 defines investment focus areas of climate change, energy, health, transit, affordable housing, pollution reduction, water infrastructure, and workforce development. It calls for 40% of benefits from federal investments in these areas to occur in communities disadvantaged by historical marginalization, pollution hazards, and long-standing underinvestment. To identify disadvantaged communities, the White House Council on Environmental Quality developed an online geospatial application called the Climate and Economic Justice Screening Tool (CEJST). CEJST is primarily designed to be used by federal agencies[119] and could significantly shape the distribution of adaptation resources by the Department of Energy, Department of Housing and Urban Affairs (HUD), Federal Emergency Management Agency (FEMA), and other agencies. CEJST can also inform adaptation investment decisions by business and philanthropic organizations and raise public awareness of the social factors that shape climate vulnerability and adaptation.

Key Message 31.3

Transformative Adaptation Will Be Needed to Adequately Address Climate-Related Risks

Climate adaptation actions undertaken in the United States to date have generally been small in scale and incremental in approach, involving minor changes to business as usual (*very high confidence*). Transformative adaptation, which involves more fundamental shifts in systems, values, and practices, will be necessary in many cases to adequately address the risks of current and future climate change (*high confidence*). New monitoring and evaluation methods will also be needed to assess the effectiveness and sufficiency of adaptation and to address equity (*high confidence*).

Most adaptation efforts across a wide range of sectors across the United States have involved incremental adaptation: minor shifts in usual practices that affect small geographic areas and that have been limited in their ability to affect multiple sectors or hazards by technical, social, and economic barriers.[1,15,27,120] Although the performance of adaptation actions is difficult to assess, the available evidence suggests that many US adaptation practices are not sufficient to deal with either current or future climate change.[27,121] Future adaptation may require not only more adaptation efforts (more actions, scaled up, across a wider range of actors, sectors, and systems) but also more transformative adaptation: actions that involve persistent, novel, in-depth changes that shift the fundamental traits of institutions, behaviors, values, or technologies across multiple scales and sectors.[90,122,123] Transformative adaptation can involve changes to the built environment,

or it may involve fundamental changes in economic and governance paradigms to redress historical injustices and center equity and justice.[40]

Adaptation actions in the US more often involve using air-conditioning during heatwaves, increasing irrigation or temporarily reducing water consumption to address frequent droughts, using sandbags to resist coastal erosion, redefining fisheries boundaries in response to shifting habitats, or elevating homes above flood waters—rather than more transformative actions such as redesigning cities and buildings to address heat, shifting water-intensive industry to match new rainfall patterns, or directing new housing development to less flood-prone areas.[1,15,27,120,124] A range of cognitive biases sometimes make people favor incremental change, such as status quo bias (an inclination to preserve the current state even if changes would bring greater benefits).[73,125] However, preserving the status quo can perpetuate existing systems of inequality (KM 31.2).[116,126] Incremental adaptation has also been favored in part due to the framing of adaptation as a type of disaster risk reduction rather than long-term planning (e.g., response to hurricanes rather than permanent inundation due to sea level rise).[15,127,128,129] For instance, a national survey of metropolitan transit organizations found that most agencies rely on traditional emergency management approaches to address extreme weather during or after the event, rather than advance planning for such events and making changes to preemptively avoid harms.[130] Disaster risk reduction provides an important set of tools and frameworks, but responding to and preparing for permanent changes in climatic conditions requires a different set of approaches than reactively responding to extreme events or sudden hazards. In the long term, an overemphasis on incremental adaptation can lead to maladaptation, where efforts to address climate risk unintentionally increase risk.[99,100] A classic example is that using more air-conditioning to deal with rising temperatures and extreme heat events may increase fossil fuel consumption (if the electricity is generated from fossil fuels), contributing to more climate change and even higher temperatures.

Other incremental adaptation actions may displace risk,[131,132] such as when one home is elevated on a filled mound that pushes rain and floodwaters onto neighboring homes, or have unintended consequences, such as reducing motivation to engage in adaptation (KM 12.4). An emphasis on financially conservative "no regret" decision-making, which limits current costs and prioritizes adaptation options that would be justified under all plausible future climate scenarios, may lead to less expensive but less effective actions.[15,90] Local governments, individuals, communities, or businesses may have insufficient capital to cover the up-front costs of transformation even if those actions would produce long-term gains (KMs 31.5, 31.6). For example, in the short term, reducing agricultural water use through improved irrigation (an incremental change) is cheaper and easier than fundamentally reimagining how and where crops are produced, stored, and transported across the US (transformative change). However, improved irrigation may be insufficient to adapt to long-term effects of climate change and may be less cost-effective in the medium and long term than more transformative options.[27,121]

Climate change will cause both chronic shifts in baseline conditions—such as rising temperatures, sea levels, and water insecurity—and acute risks through extreme events and increased variability (Chs. 2, 3), and these effects will interact with and compound multiple complex (Ch. 18) non-climate stressors such as public health concerns (e.g., pandemics, epidemics; Ch. 15), economic events (e.g., recession, depression), and social injustices (e.g., systemic racism; Ch. 18). Complex social, economic, ecological, and technological systems can be challenging to adapt because elements within the systems reinforce and constrain one another.[1,133,134,135] Transformative adaptation—spanning both social and physical systems—may be needed to address the increasingly intense and nonlinear effects of climate change and their complex interactions with multiple non-climate stressors (Ch. 18).[28,40,136,137] Adaptation actions that consider co-benefits where possible (including contributing to climate mitigation but also biodiversity, pollution reduction, social justice, and others) are expected to provide the greatest social gains and long-term sustainability.

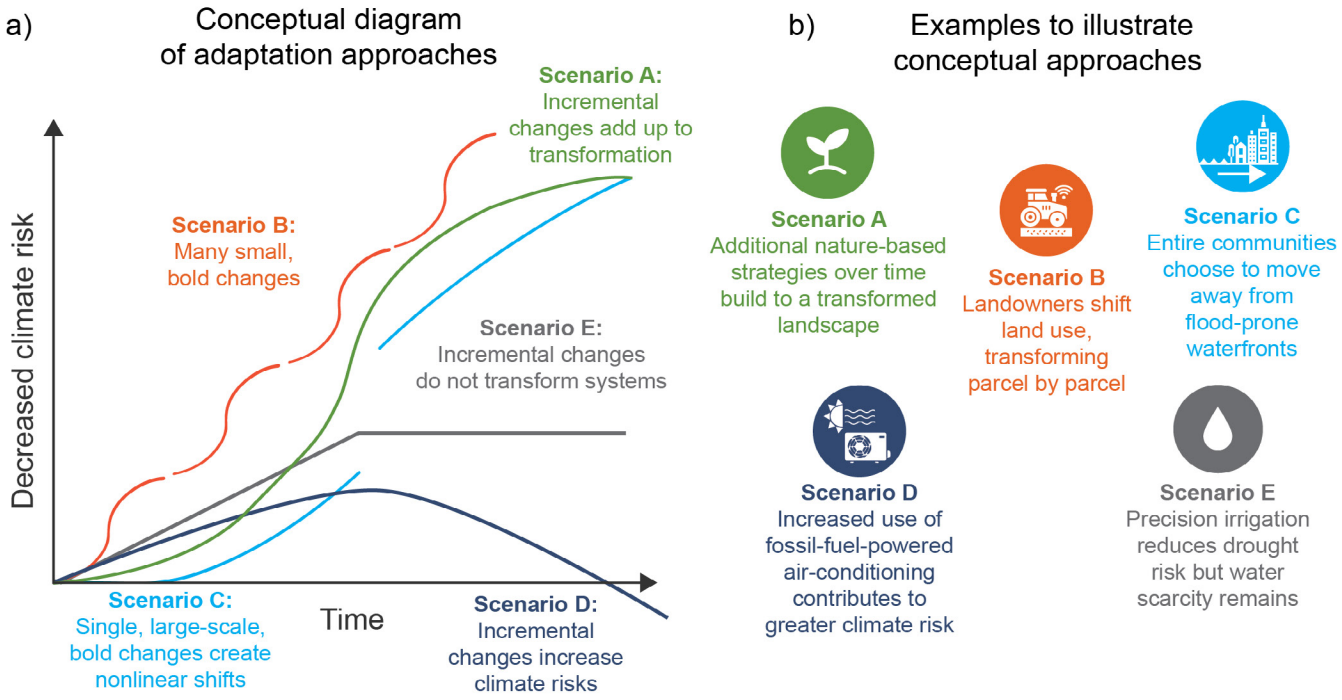
Adaptation may increasingly require a systems approach to focus on how multiple systems (e.g., social, political, cultural, ecological, physical infrastructure, energy, water, food) interact with and shape one another and to identify adaptation actions that cut across or leverage multiple systems.[6,138] Compared with transformative adaptation, most incremental adaptation requires less coordination across interested parties, making it appealing to actors working within a single sector of a larger system and where coordination is difficult to achieve. A systems approach, for example, would consider vulnerabilities across different modes within a system (e.g., highways and public transit) or across systems such as transportation, water, the electric grid, telecommunications, supply chains, stormwater management, and land-use or development patterns. A systems approach to adaptation might argue for adaptation efforts to occur in different government offices (e.g., in transportation planning and housing as well as in emergency management and environmental agencies), for coordination of public and private efforts, or for greater cooperation across silos to support transformative adaptations (KM 31.4). Adaptation actions that take a systems approach to assessing vulnerabilities and adaptation opportunities are expected to be more transformative insofar as they affect multiple systems at multiple scales.[90]

Transformative adaptation may also involve changes to systems and paradigms in ways that redress historical injustices and center equity.[40] Transformative adaptation has the potential to perpetuate or exacerbate social injustices, but inequities are not inevitable.[137,139,140] Addressing them requires express consideration of equity and justice along with direct engagement with disadvantaged and underserved communities (KM 31.2), and lessons can be learned from the "just transitions" literature and movements (Ch. 20; KM 20.6).[108,141,142,143] For example, transforming car-centric transportation systems to emphasize public transportation and walkability could increase accessibility for underserved communities and people with limited mobility if the transformation intentionally includes user input to address accessibility and equity from the start. Transformations may also advance equity by reforming systems and institutions that perpetuate inequities. For example, the reliance of local governments on property tax revenue as a major source of funding has contributed to disaster risk reduction and adaptation governance systems that sometimes prioritize protection of property values rather than people or ecosystems.[144,145] Transformations to these and similar underlying systems may be needed to address climate adaptation equitably.[40] Congressional efforts to reform to the National Flood Insurance Program, for example, have struggled to balance, on the one hand, the need to increase premiums and enrollment to accurately reflect risk and, on the other, the need to keep premiums affordable. Solutions to this problem may require broader transformations in the way insurance and risk information are provided.[146,147,148] Transformative actions are also expected to be necessary to address numerous systemic inequities such as colonialism, systemic racism, wealth inequality and distribution, and economies based on extractive industries.

Adaptation actions are not divided distinctly between incremental or transformative actions (Figure 31.3). In some cases, incremental adaptation actions add up to transformative change if they are widespread enough; however, the place-based nature of adaptation can make this particularly difficult to achieve. In others, incremental adaptation can lead to a limited degree of change that may be insufficient in the face of future climate conditions. Similarly, transformative adaptation can take different forms (Figure 31.3). The exact blend of incremental and transformative actions that will be needed across the United States is not clear, but given the current predominance of incremental action, it is expected that future adaptation will need to include more transformation. The more and faster the climate continues to change (e.g., if global greenhouse gas emissions are not aggressively cut in the near term; Ch. 32), the more severe and spatially uneven climate change impacts will be and the more transformative adaptation will be needed at greater rates, scales, and extents. Transformation and even creative incremental adaptation may be able to overcome soft limits—challenges such as affordability that may be surmounted with additional research or investment—but if global emissions continue unabated, systems and communities will eventually encounter hard limits, points beyond which adaptation cannot avoid intolerable risks and impacts.[149,150]

The pros and cons of different types of adaptation are difficult to compare because adaptation, in general, is difficult to evaluate since it involves measuring harms that do not occur (e.g., avoided losses). Assessments of the effectiveness of adaptation actions have generally been limited to project-specific performance against a limited set of extreme events or climate conditions.[32,151,152,153,154] Adaptation researchers and practitioners have begun to track the number of actions that have occurred across the US and to evaluate adaptation projects in a limited manner (KM 31.1; Figure 31.1). However, efforts to assess trade-offs, effectiveness, sufficiency, and long-term consequences of incremental and transformative adaptation actions are still largely theoretical and will need more work to implement and consistently track over time. Metrics will need to be granular enough to observe disparities among communities to reduce potential inequities.[32,33]

Incremental and Transformative Adaptation Approaches



Incremental and transformative adaptation may take many forms, but incremental adaptation involves small changes while transformative adaptation involves profound shifts.

Figure 31.3. (**a**) Adaptation actions can involve small changes to business as usual (incremental) or bold measures that break from past practices and create new systems (transformative). In some cases, incremental changes may add up to a transformation of the overall system (Scenario A). In other cases, they may not (Scenario E), or they may even cause maladaptation (Scenario D). Transformative adaptation can also take different forms, including a series of small-scale transformations (Scenario B) or larger one-time shifts (Scenario C). Neither incremental nor transformative adaptation is always preferable, and both approaches may exacerbate injustices if equity is not centered (KM 31.2). The examples in panel (**b**) illustrate these conceptual approaches to incremental and transformative change; each could be equitable if it follows the principles of equitable adaptation. Current adaptation practices in the US are predominantly incremental and do not clearly add up to system-wide transformation. Adaptation in the future, therefore, is expected to require a greater degree of transformative adaptation in the overall portfolio. Figure credits: (a) adapted with permission from Fisher and Williams 2020;[155] (b) University of Delaware and National Institute of Standards and Technology.

Key Message 31.4

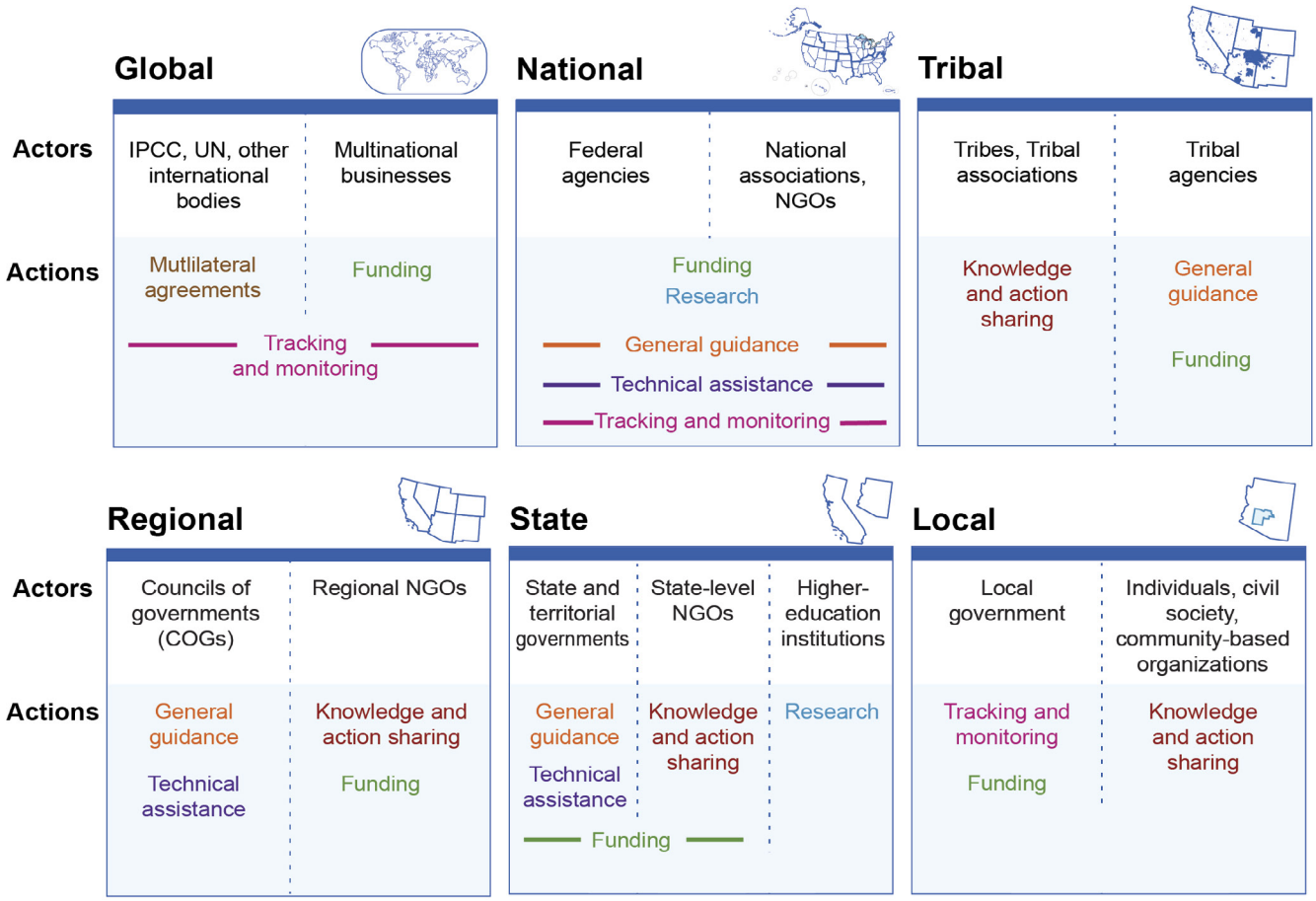
Effective Adaptation Governance Empowers Multiple Voices to Navigate Competing Goals

Adaptation involves actors from government, private-sector, nongovernmental (e.g., nonprofit and for-profit institutions), and civil society organizations, which often have different priorities and approaches (*high confidence*). Adaptation decision-makers must balance competing goals while also addressing uncertainties regarding future climate change and the ways that political, social, and technological systems will be transformed (*high confidence*). To minimize the potential for adaptation actions to benefit some at the expense of others, adaptation processes must emphasize collaboration, center equity and justice, and incorporate a wide range of values and knowledge sources (*medium confidence*).

Governance refers to the structures and processes used by governments and other decision-makers to develop and implement policies, programs, and institutions.[156] Compared to many policy fields, formal governance of adaptation is relatively underdeveloped, with weakly defined ambitions, responsibilities, routines, and evaluation methods and no overarching federal policy framework for adaptation.[157,158] Nonetheless, numerous organizations are engaging in adaptation governance in a more bottom-up fashion.[15,40] For example, urban flood management may be directed by local actors coordinating activities without a higher-level directive.

Many different types of organizations make decisions about adaptation, including federal, state, territorial, Tribal, and local governments; businesses; nonprofits; households; and individuals—all with variably overlapping jurisdictions (Figure 31.4). While some adaptation decisions are made unilaterally, such decisions often involve multiple organizations; adaptation networks have become more complex in the last decade, involving more actors from more diverse organizational backgrounds.[159] The actors involved often have distinct (and at times conflicting) views of the problem, risk tolerance levels, priorities, preferred solutions, and ideal futures.[160,161,162,163,164]

Organizations and Actors in Adaptation Governance



Climate adaptation involves numerous actions by different actors at multiple jurisdictional scales.

Figure 31.4. Climate adaptation governance occurs at multiple scales, with numerous government, private, and civil-society organizations supporting adaptation through funding, guidance, and other activities. While all actors can directly implement adaptation activities, activities implemented in a coordinated fashion and with technical assistance, funding, and monitoring provided by actors across sectors and scales have the potential to be more effective and transformative. Figure credit: University of California, Irvine, and National Institute of Standards and Technology.

When organizations have an explicit focus on adaptation, they tend to organize their governance activities in diverse ways. For instance, some cities, states, and utilities have created centralized offices focused on overall resilience and/or sustainability, while others have distributed climate adaptation tasks across critical functions, each focusing to varying degrees on hazards, social resilience, and/or environmental protection.[165] At the federal level, legal frameworks for climate adaptation cover a broad range of agencies, and these agencies may differ from those mandated to conduct research on the efficacy of adaptation governance (e.g., Executive Order 14008, Section 203[118]).

Given this complexity, adaptation governance is often fragmented and uncoordinated, with the diverse actors operating independently and ignoring potential side effects or spillovers.[48,49,50,51] This problem exists even in settings where actors recognize the need for more coordinated governance.[166] Finally, while there is increasing recognition of cross-jurisdictional impacts, fragmented governance systems are not structured to handle impacts that cross geographic borders.

Leading practices in adaptation governance are based on credible science and involve ongoing open processes to support multiple voices across government, civil society, and expert advisors (Ch. 2).[156,167,168]

Linking adaptation policy and governance involves timely and salient communication across actors, involving media, lobbyists, and boundary organizations that help translate scientific information and co-develop technical support relevant to local communities.[169,170,171]

Effective and equitable adaptation governance also benefits from intentional engagement and coordination among all involved actor groups over a sustained period.[1,51,165,172,173] For example, following multiple wildfires and postfire floods, Santa Clara Pueblo collaborated with multiple federal agencies, the state of New Mexico, and several other Tribes to restore their watershed and build resilience against future floods.[174] Such collaboration is particularly effective when a single government agency leads coordination of an interorganizational group to oversee adaptation activities.[175,176,177] Alternatively, coordinating hubs can help bridge activities of disparate actors;[178] having well-defined roles and responsibilities can avoid duplicated efforts.[165] However, federal agencies can face administrative barriers when engaging with community and nongovernmental actors, such as the Paperwork Reduction Act's requirement of extensive documentation when collecting information from the public.

Well-functioning, multilevel governance helps in adaptation strategy development.[179,180] For example, California, Florida, and other states have used informal regional collaborations (e.g., Southeast Florida Regional Climate Compact, Alliance of Regional Collaboratives for Climate Adaptation) to share resources and develop adaptation strategies that serve regional needs. The Coastal Zone Management Act,[181] which requires federal, state, territorial, Tribal, and local coordination in a single review of newly developed laws beyond borders to protect and develop coasts, is a potential model for encouraging greater cross-scale actions. Vertical linkages between governance levels can help bridge the gap between community-based and national-level adaptation efforts[179] and enhance horizontal linkages across public and private actors and institutions. Horizontal network linkages enable diffusion of information and resources across similar organizations; for example, horizontal connections between community groups facilitate selective adoption of context-specific adaptations and the scaling out of successful adaptation actions.[182]

In instances when adaptation governance brings together groups that traditionally have not worked together, guidance from conflict resolution and collaborative governance can help.[183,184] Ensuring that decision-making processes regarding adaptation planning and implementation are inclusive is necessary to enable a just and equitable distribution of burdens and benefits (KM 31.2). Additionally, adaptation decision-making structures are most effective when they allow for innovation, learning, feedback, and continual improvement.[165,173]

At the federal level, much adaptation has been governed through disaster policies (e.g., through FEMA hazard mitigation planning and grants and HUD disaster recovery grants).[185,186] These policies may not be adequate or appropriate for long-term and systemic adaptation because they are often framed in ways that may not address local adaptation needs and focus mostly on critical infrastructure and disaster response rather than institutional change.[187] Either those systems will need to be transformed or new systems will need to be developed for the US to adequately adapt to future climate hazards.

Another key issue in adaptation governance tends to be unfunded mandates or responsibilities assigned to regions or communities without dedicated increases in funding and capacity.[1,188,189] Government-led adaptation planning would benefit from a greater focus on understanding community-driven adaptation before making significant resource-allocation decisions, given the inherently local nature of adaptation.[190] Development of enabling conditions and frameworks to support adaptation is best guided by recognizing local values, competence, interest, awareness, and analytical capacity.[171,191]

Most governance institutions were created when climate change was not recognized and the climate system was relatively stationary.[123,192] New and revamped governance arrangements face tensions with structures of pre-existing institutions that are strongly embedded and may be protected by long-standing power

dynamics.[123,193] Creating adaptive systems will require fundamental changes across multiple systems and sectors, such as infrastructure, agriculture, public health, and natural resource management (KM 31.3; Chs. 6, 11, 12, 15, 18). Additionally, transformative adaptation benefits from aspirational vision and leadership, as transformative adaptation can upend existing norms and practices.[194]

Systemic change can be facilitated through changes in laws, codes, and standards; data collection (e.g., disaggregated demographic data); and regulations that shape decision-making for intentional and equitable adaptation. For example, laws requiring cost–benefit analyses prioritize infrastructure investments in neighborhoods with high-value properties unless explicit practices to target specific beneficiaries are included and the disaggregated data to identify desired beneficiaries exist.[195,196] Likewise, laws that prescribe the types of science used in decision-making may exclude local or Indigenous Knowledge, limiting both participation in decision-making and incorporation of multiple actors' views and priorities (KM 16.2).

The body of research to inform effective and equitable adaptation governance is growing, but knowledge gaps and a need for translating research findings into on-the-ground implementation action remain. Adaptation researchers can inadvertently create gaps, make translation more difficult, or duplicate efforts if they do not fully reference previous works or if the field becomes too fragmented across disciplinary or topical silos.[197] Local governments can prioritize adaptation activities and avoid maladaptation and unintended side effects by effectively identifying and assessing synergies and trade-offs that are context specific.[198,199] Building local capacity can also support more equitable adaptation governance.[197] Research on adaptation governance may increasingly address a rise in climate litigation, with thousands of US cases identified in climate litigation databases.[200] A key driver for litigation is compensation for the costs of adaptation. The dynamic sociopolitical and scientific context in which climate litigation takes place makes it challenging to assess its impact.[201] Finally, identifying institutional and systemic shifts that may support more coordinated and transformative governance would require more research.

Key Message 31.5

Adaptation Requires More Than Scientific Information and Understanding

Effective adaptation to a changing climate requires both decision-relevant climate information and evidence-based decision-making approaches (*high confidence*). Adaptation requires that researchers intentionally collaborate with communities to identify goals, assess vulnerability, improve capacity, and address contextual factors, such as values, culture, risk perception, and historic injustices (*medium confidence*). Climate services can be improved by ensuring access for historically disinvested communities and by attention to procedural and recognitional equity when scientists work with communities and decision-makers (*medium confidence*).

Climate data and information remain a limiting factor for adaptation. However, many people and organizations, especially those in historically disinvested communities, require more than scientific data and information to adapt.

Cities and states use climate data, information, and decision-support tools in adaptation decisions (Table 31.2) to, among other things, identify, assess, plan, and reduce risks. For example, the city of New York recently legislated Climate Resiliency Design Guidelines,[202] which, among other things, determine the height of flood protection measures using climate projections from the New York City Panel on Climate Change. Tools like the US Climate Resilience Toolkit,[203] Climate Mapping for Resilience and Adaptation,[204] the Sea Level Projection Tool,[205] and even the web-based format of the National Climate Assessment (NCA)[206] provide broad access to climate information across the US. Several states have developed climate data portals to

provide communities with location- and sector-specific climate hazard data (e.g., Cal-Adapt in California,[207] the New York Climate Change Science Clearinghouse,[208] and the New Mexico Climate Risk Map[209]). These tools are particularly useful for organizations with the technical and technological expertise to interpret and customize the data (e.g., insurance companies, larger cities and states, and other entities). However, many adaptation decisions are made without customized adaptation decision support,[162,210] which may be due to the overwhelming number and complexity of tools that exist.

A growing number of efforts provide science- and evidence-based support that extends beyond climate data and information. These efforts are referred to by many names, including climate services,[47,211,212,213,214] technical assistance,[215,216] decision support,[217] sustained assessment,[218] and boundary spanning.[219,220] These terms are not synonymous in that they have distinct approaches related specifically to adaptation that go beyond technical support. These various efforts might

- consider context and need in early stages of development to increase scientific adequacy and to respect processes of knowledge creation involving people with diverse values and lived experiences;[211, 221,222,223,224,225]
- honor Traditional Knowledge systems[226] and Indigenous self-determination (KM 16.2);
- address contextual factors such as risk perception, decision-making authority, and organizational agility;[227,228,229]
- customize data and information to fit the time frame and spatial scale of interest;[222,229,230]
- manage uncertainty about the extent and timing of climate change and its effects, as well as about potential social–economic–environmental futures;[161,231,232,233,234]
- plan for and anticipate multiple possible futures to respond to changing conditions and unforeseen consequences;[235,236,237,238]
- strengthen public participation and democracy by engaging multiple actors in negotiating goals, evaluating trade-offs, and making adaptation decisions (KM 31.3);[10,84,227,239,240,241,242,243,244] and
- develop evidence-based strategies for changing behaviors and systems and evaluating outcomes.[151,245,246,247,248]

There are several Federal programs that provide broader forms of climate decision support. For example, NOAA's Climate Adaptation Partnerships Program, USDA's Climate Hubs, USGS's National and Regional Climate Adaptation Science Centers, National Park Service's Climate Change Response Program, EPA's Environmental Justice Thriving Communities Technical Assistance Centers, and Department of Energy's national labs[47,249] all provide climate services for a range of sectors and regions. Similarly, the Tribal Climate Adaptation Menu (Dibaginjigaadeg Anishinaabe Ezhitwaad),[250] developed by numerous stakeholders in Minnesota, provides a framework to integrate Indigenous and Traditional Knowledge into the climate adaptation planning process. Despite these existing efforts, there are still limitations on awareness of and access to services, especially for historically disinvested communities.

Access to broader forms of technical support varies, with underserved communities facing critical gaps (KMs 16.2, 29.4). Not all regions are covered. Some sectors are further along in climate adaptation planning than others. While there has been some research on gaps by region and sector,[249] no comprehensive nationwide evaluation exists that assesses the availability of climate services, and most existing evaluations are largely based on geographic and sectoral coverage, not differential exposure and factors related to social vulnerability. Moreover, many emerging forms of support are not explicitly focused on climate services. Instead, they are providing climate-related technical assistance, which is unfamiliar to some environmental justice communities and Tribal Nations.[215,216,251] Additionally, environmental justice communities and Tribal Nations face barriers to obtain federal funding for technical assistance because there is a high level of

technical skill required to apply and/or strict eligibility criteria.[252] When, how, where, why, and for whom climate services and climate-related technical assistance are distributed can be tied to transformative and equitable adaptation (Table 31.2).

Table 31.2 Climate Services Can Be Designed to Support Transformative and Equitable Adaptation

Climate services can be aligned to the level of community engagement and the impact of adaptation efforts. Climate services are not about supporting decisions in a vacuum. They can be designed to avoid engagement fatigue and advance transformative adaptation. Climate services can assess vulnerability and adaptive capacity to support actions to reduce unjust, maladaptive choices. Engaging communities in the development of climate services related to adaptation can empower environmental justice communities and Tribal Nations. Data and information tools can help reduce engagement fatigue if the goals, outcomes, and values have been established. If community engagement is needed to codevelop goals and values necessary to evaluate the consequences of transformative adaptation options, institutional partnerships can build and sustain the inclusive participation of diverse community voices.

Level of Community Engagement in Climate Services	Incremental Approach to Adaptation	Transformative Approach to Adaptation
Low	**Are services enabling maladaptation?** Consider services that assess vulnerability and adaptive capacity to account for injustices.	**Are services supporting equity?** Consider services that remove barriers to participation in climate adaptation, including knowledge generation.
High	**Are services operationalized?** Consider services that provide decision tools to reduce engagement fatigue.	**Are services sustained and mainstreamed?** Consider institutional arrangements that maintain trust, credibility, and saliency and embed services into decision processes.

Adaptation decisions range from smaller-scale, incremental decisions with clearer and limited participants to far-reaching, transformative changes with multiple decision points and decision-makers. Climate services can support adaptation and equity by encouraging discussion between historically disinvested communities and decision-makers regarding relevant climate risks and trade-offs between adaptation options.[56,253,254,255] In some cases, the trust and relationships built through an inclusive decision-support process lead to collective learning and adaptation over time, sometimes referred to as coproduction.

Coproduction encompasses a range of collaboration modes—from consultative to collegial—that structure science and decision support to advance societal goals.[151,227,247,248,256,257,258] Coproduction involves iterative, multiway processes that can strengthen procedural equity through power sharing and collaborative knowledge creation. For example, Looking Forward, Looking Back: Building Resilience Today, a partnership between the Alaska Climate Adaptation Science Center and the Aleutian Pribilof Islands Association, involved five community teams with leaders from each spanning multiple governing bodies, including the Tribal Council, the city governments, and the village corporations.[259] Training and workshops in each community were designed to support the development of climate adaptation plans.

Coproduction needs to be structured in ways consistent with the need and potential adaptation impact (Table 31.2). Coproduction is time- and resource-intensive, which can be another burden on disinvested communities,[260] especially given that language differences, remote locations, and other logistical challenges (e.g., lack of childcare) present barriers to participation and engagement. Additionally, there is a risk of unintentionally creating competing and unaligned goals across community members, technical experts, and government officials.[227] There are also often mismatches between the urgency for climate action, the long-term development of scientific evidence, and governmental decision processes.

To improve adaptation practice, adaptation-needs assessments—not solely focused on science gaps but also on adaptation barriers—can identify how practitioners and communities are or are not supported by

the scientific community in their adaptation efforts and in what contexts different forms of support are preferred over others.[261,262,263]

In particular, decision-makers can benefit from access to or the development of methods, metrics, and indicators (App. 4.7) that support trade-off analysis when making adaptation decisions.[264] Additionally, to evaluate adaptation choices, decision-makers can

- use these tools to track progress on adaptation efforts and outcomes;[33,153]
- assess short-, medium-, and long-term adaptation effectiveness;[151,152,265] and
- evaluate the advantages and disadvantages, including cost-effectiveness, of incremental and transformative adaptation.[152,154]

Although vulnerability indicators have been developed and thoughtfully used in planning efforts,[266,267,268] and resilience indicators have gained traction recently to assess community impacts or resilience factors,[269,270,271] adaptation indicator development has lagged, because assessments of effectiveness and comparisons against baselines have been limited to evaluation of specific projects.[32] Indicators need to consider context, audience, and use to be effective, including the multiple ways that adaptation affects communities and ecosystems. For example, building a seawall may reduce the likelihood of floodwaters reaching the homes behind the wall (risk outcome), but the wall may also increase erosion of neighboring properties (risk outcome to people outside the wall), narrow the beach and affect coastal species (environmental outcomes), and cut off access to the shore, changing the way people in the community interact with the coast (social outcomes).[93,272]

Key Message 31.6

Adaptation Investments and Financing Are Difficult to Track and May Be Inadequate

Investments in adaptation are being made at the federal, state, territorial, Tribal, and local levels, as well as within the private sector, but they are not always evenly distributed, coordinated, tracked, or reported (*high confidence*) and may be inadequate (*medium confidence*). Future adaptation investment needs are expected to be significant, although projected amounts vary due to uncertainty in future emissions trajectories, associated impacts, and the timing of implementation (*high confidence*). Proactive adaptation can reduce some of the most severe costs of future climate change, particularly under very high emissions scenarios in the late 21st century (*medium confidence*), although adaptation is still needed in the present for communities and infrastructure that may not be well adapted to face current climate conditions (*high confidence*).

Estimates of the damages and associated costs of climate change without adaptation can reach into the hundreds of billions of dollars by the end of the century (Table 19.1).[273,274] Although there are national-level estimates of the economic cost (total damage) of climate change (Ch. 19),[273] there are no comprehensive national-level estimates of adaptation costs for the US. Across adaptation economics assessments, there is little consistency regarding which future emissions scenarios are considered in projecting impacts, the sectors evaluated, the types of damages considered (e.g., direct and/or indirect), the time horizon for cost estimates, and the costs of implementation.[1,275] Despite these differences, studies in the US consistently project adaptation costs on the order of hundreds of millions to billions of dollars.[273,274,276,277,278,279]

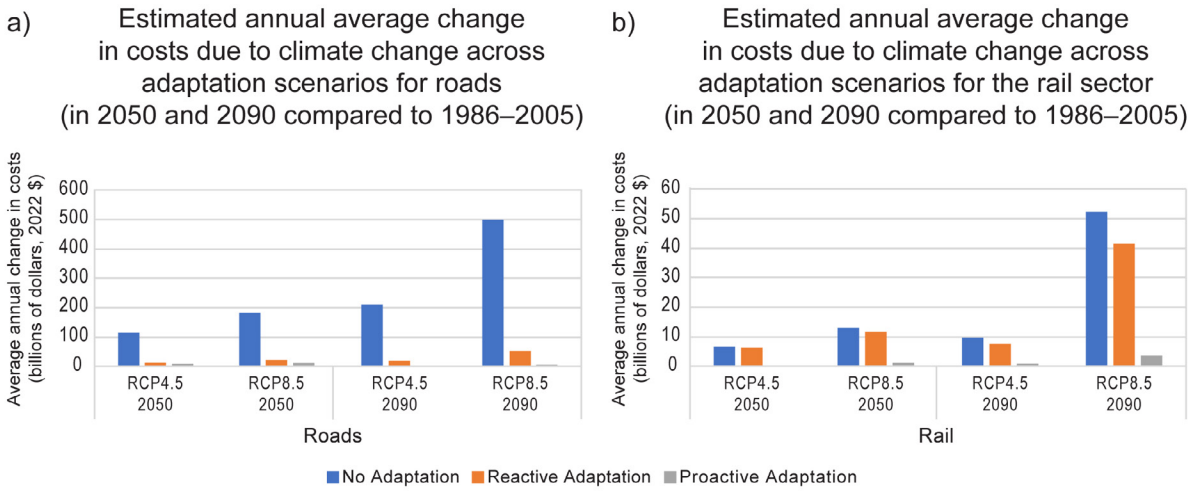
Determining how much and where to invest in adaptation involves decision-making under uncertainty, evaluation of trade-offs, and assessment of the risks associated with delaying action. Generally, this involves quantifying the projected economic impacts of climate change (KM 19.1), the projected costs of adaptation actions, and the expected benefits and/or avoided harms from those actions, all of which can be deeply uncertain. Other essential considerations include efforts to determine ideal levels of adaptation given resource constraints and how to efficiently and equitably allocate costs and benefits among stakeholders. Considerations that are implicit or explicit in adaptation-related economic analyses include questions of who pays for or benefits from adaptation, how to account for the nonmonetary or difficult-to-quantify costs of climate change (e.g., the emotional and physical toll of experiencing extreme weather events, displacement of community after an event, loss of traditional ways of living, and loss of sites of cultural significance; KM 19.1), and what stakeholder interests are reflected in the valuation (both cross-sectionally, in terms of different stakeholder groups, and temporally, as in the choice of discount rate). Some organizations have generated benefit–cost ratios to reduce the impacts of climate hazards through adaptation planning. For example, the National Institute of Building Sciences suggests a 4:1 benefit–cost ratio for hazard mitigation work, with federal grants spent on resilience achieving a 6:1 benefit–cost ratio.[280] However, even when adaptation implementation is favored, other factors such as finances, risk perceptions, inadequate incentives, community capacity, competing priorities, or social and political influences may lead individuals and communities to underinvest.[279,281]

Improvements have been made in the ability to quantify and monetize the physical impacts of climate change (KM 19.1), which are used to estimate both the costs and value of various adaptation actions,[273] although uncertainty and limitations in these estimates remain.[150,282,283] Estimating the aggregated and disaggregated (e.g., sectoral or regional) costs of adaptation, risks of inaction, and value of adaptation actions involves several methodological challenges:[284] developing damage functions that represent impacts of climate change and account for adaptation;[282] understanding the limits of adaptation options and capacity (e.g., effective options may not be presently known or adaptation limits may have been reached); analyzing the behavior of different cost estimation methodologies across climate scenarios and time horizons; incorporating the context specificity of adaptation choices and outcomes into analysis, especially at larger scales (KMs 31.2, 31.4);[285] and evaluating the effectiveness and sufficiency of the actions taken to adapt to climate change.

Both the Fifth and Sixth Assessment Reports of the Intergovernmental Panel on Climate Change state that the benefits of adaptation are expected to be larger than the costs.[284,286] However, both reports note important limitations in estimating aggregate climate damages, costs of adaptation options, and avoided damages from adaptation implementation that create uncertainty and can make it difficult to compare across studies (Cross-Working Group Box Economic in O'Neill et al 2022[150]). Proactive adaptation (e.g., actions, which can be transformative or incremental, taken with the goal of preventing repair costs associated with future climate change) has been shown to reduce climate change damage–related costs for some sectors compared to reactive adaptation (e.g., repairs to damaged infrastructure that do not generally include consideration of future climate change but do consider current climate conditions; Figure 31.5)[128,274,277,281] or no adaptation. In the context of electricity distribution infrastructure, for example, proactive adaptation might entail updating wooden pole designs to account for expected temperature and precipitation conditions over the full future life span of the asset.[128] Reactive adaptation would entail replacing the poles with designs that are only reflective of current climate; no adaptation would entail using designs that do not account for any climate change that already may have occurred.[128]

Despite the estimated value of proactive adaptation, real-world impediments to proactive adaptation, such as ill-timed revision of infrastructure codes and inadequate incentives, can inhibit feasibility of implementation,[128,274] and findings may not be applicable in all sectors.[273] In many studies, proactive adaptation becomes increasingly valuable with greater levels of warming (e.g., under higher emissions scenarios), with benefits accruing over time, particularly in the later decades of the 21st century.[274,277] Where there is considerable current risk to infrastructure and assets from climate conditions (e.g., flood-related risk), it can be cost effective to implement adaptation now even if future benefits from proactive adaptation are small when discounted to the present.[279]

Estimated Annual Change in Costs Due to Climate Change



Future costs associated with climate change will depend on adaptation efforts and scenarios.

Figure 31.5. In some sectors, proactive adaptation can help reduce projected damages from climate change. Estimates are shown for a 5-model ensemble for two sectors (roads [**a**] and rail [**b**]), two time periods (2050 and 2090), and two scenarios—an intermediate scenario (RCP4.5) and a very high scenario (RCP8.5). The three adaptation scenarios reflect the nature in which adaptation has been implemented. Estimates include only costs incurred above historical climate conditions (e.g., climate conditions associated with historical climatology) and assume that adaptation can be readily implemented. Findings should be interpreted only for the sectors shown. Adapted from Neumann et al. 2021[274] [CC BY 4.0].

The scale of the adaptation challenge requires multiple streams of investment (personal, private, and public) and multiple financing options for individuals and communities that may struggle to finance it on their own (KM 21.5). Investments in adaptation[287] are being made at the federal, state, territorial, Tribal, and local levels, as well as within the private sector, but they are not always evenly distributed, coordinated,[288] tracked, or reported.

Adaptation finance relates to monetary investments that reduce the vulnerability or increase the resilience of human and ecological systems to negative climate change impacts.[289] Funding for adaptation, which to date has traditionally originated within the public sector, lags financing for mitigation-related projects (e.g., renewable energy development, energy efficiencies).[275,290,291,292] In addition, adaptation funding is tracked and reported more transparently at the international level than in the US, both in terms of total volume of investment and flows between countries.[284,291] In 2019 and 2020, the annual average of global adaptation finance investments was approximately $55 billion, compared to $659 billion for mitigation projects (in 2022 dollars).[291] Funding is largely funneled through public lending institutions such as multilateral and national

development finance institutions but can also originate from other sources, including commercial finance institutions, governments, and corporations. Tracking of domestic public-sector and overall private-sector adaptation-related investment and financing is a known gap.[284] However, given their cross-cutting nature and co-benefits, investments in adaptation are not always clearly demarcated or obviously identified, making it difficult to explicitly track them and ultimately evaluate their effectiveness. Funding for infrastructure hardening, home weatherization, or cooling centers, all of which can be considered adaptation-related investments (and more incremental), may come from diverse organizations, be dispersed across programs, or not be clearly tagged as adaptation-related expenditures.

Federal and state budget and expenditure tracking does not always distinguish between mitigation- and adaptation-related activities (Box 12.1).[25] Assessing the landscape and uptake of available financing instruments can illuminate where adaptation finance presently originates and is concentrated. Several toolkits, such as the Equitable Adaptation Legal and Policy Toolkit[287] and Ready-to-Fund Resilience Toolkit,[293] provide an overview of different funding (e.g., government grants) and financing (e.g., debt or equity financing) options that are available and help communities design and finance adaptation projects. Services from network organizations such as the American Society of Adaptation Professionals facilitate exchange of leading practices and collaborative spaces for trusted partnerships to form and co-investments to occur for climate adaptation. Understanding how to utilize funding sources would also require understanding levels of vulnerability, hazard exposure, and adaptation and resilience requirements in a future climate context.

At the federal level, government entities such as the Department of Treasury and FEMA provide grants and manage national tax credit and similar financing programs. Other Federal Government entities such as the Department of Transportation, NOAA, and the Department of Energy fund projects to advance adaptation at various levels of government and sectors (KMs 5.3, 9.3, 13.1).

Private-sector investments in adaptation can include funding or financing options (e.g., grants from private and philanthropic organizations, impact investing from private and development finance institutions, incentives for adaptation measures from insurance companies [KM 21.5], and/or loans from green banks), as well as direct investments from private companies to implement adaptation measures to reduce physical climate risk. There has been increased activity in the private sector exploring adaptation to physical and transition risks. This activity has been driven partially by investors requesting increased transparency in climate-related and environmental, social, and governance impacts (e.g., the Task Force on Climate-related Financial Disclosures) and ranges from climate risk disclosure to organizational resilience and from capital stress testing to adaptive asset management. Private-sector organizations have also made independent and regulatory-required adaptation-related investments after natural disaster events (e.g., asset hardening after a severe storm). With limited information on corporate and other private-sector adaptation, it is hard to know the scale and sufficiency of actions implemented to date, but overall, adaptation planning and investments appear to lag significantly behind low-carbon transition planning.

Data on corporate and other private-sector investments in adaptation are very limited, in part due to confidentiality restrictions, uncertain causality, and lack of agreed-upon impact metrics.[275,294] Lack of data makes it difficult to determine where private-sector investment is occurring and any gaps in sectoral, geographic, or community access to privately funded opportunities. Investments in adaptation by the private sector may face more hurdles due to greater challenges with quantifying return on investment compared to mitigation-related projects, uncertainty in policy and regulatory environments, mismatched investment time horizons, and challenges in mapping climate impacts to business-related activities.[57] Increasing transparency in climate-related disclosures that describe the actions corporations and other private-sector entities are taking to minimize the physical and transition risks to their organization, their value chain,

and the communities where they reside and operate may advance the ability to track action and progress toward adaptation where climate risks are extensive. Concerns remain, however, about the comprehensiveness, alignment, and quality of information included in disclosures, as well as the ability to compare across responses.[295] Responses also overwhelmingly skew toward large corporations in specific sectors, in part due to the significant resources required to prepare disclosure responses.[295]

In practice, there are multiple examples of communities leveraging the diversity of investment instruments, risk finance mechanisms, and broader finance-relevant solutions to support adaptation. Examples include federal and state public funding (e.g., Louisiana's Strategic Adaptations for Future Environments program[296]), municipal public–private funding (e.g., DC Water's Environmental Impact Bond[297]), development institution investment (e.g., Coastal Enterprises Inc., a community development financial institution based in Maine[298]), and public–private risk transfer (e.g., a parametric insurance program for the Miami-Dade School District, developed by reinsurer Swiss Re). Financial instruments can serve multiple purposes—to finance activities that reduce direct exposure and vulnerability to physical climate change impacts and to transfer and/or reduce risk where physical climate impacts are difficult to eliminate through more direct measures (e.g., through insurance and other instruments). In late 2022, the 117th Congress passed the Community Disaster Resilience Zones (CDRZ) Act[299], requiring FEMA to continue to maintain a natural hazard assessment program, designate community disaster resilience zones based on census tract hazard-risk ratings, and provide an increased federal cost share to those communities. The CDRZ Act is an amendment to the 1988 Stafford Act,[300] requiring the identification and improvement of the climate and natural hazard resilience of vulnerable communities. FEMA will engage with state, territorial, Tribal, and local emergency management partners to identify how the designation of the zones can benefit these government entities.

Despite these and other actions, several gaps limit the efficacy and volume of adaptation finance in the US, including the following:

- **Challenges in tracking and assessing adaptation finance flows:** As previously stated, sparse data on public and private adaptation-related investments inhibit the ability to track finance flows and overall investment levels within the US. Work to establish a process for tracking these data would be an important first step in better understanding the sufficiency and efficacy of adaptation investments. Adaptation finance gaps are also generally assessed in terms of aggregated finance volume (e.g., a country or regional average of adaptation finance), which does not capture the efficacy of finance.[301] Impact metrics are crucial for a full accounting of adaptation finance.
- **Upfront or operational costs of adaptation are, or are perceived to be, high or are inhibited by other factors:** Many interventions that could strengthen adaptation have, or are perceived to have, high up-front costs or uncertainty in total costs (especially if the costs or benefits are difficult to quantify) and may not be viewed as viable within many institutions' or communities' financial capacity. Local adaptation plan cost estimates sometimes exceed local governments' entire municipal budgets,[302] leaving very little budget to implement the actions identified in the plan.
- **Private entities have historically lacked incentives to invest in adaptation, but this may be changing:** Investments in adaptation can be perceived as public goods, limiting private-sector involvement.[57,286] Many private financiers have faced difficulties incorporating the economic benefits from avoided losses into their investment decision-making.[303] Emerging evidence points to increased investor, insurer, and credit rating agency attention to climate risk and the associated financial impacts or cost of capital for borrowers vulnerable to climate risk.[304,305] More publicly traded companies are estimating and disclosing the financial impacts of climate change and the investments made to reduce climate-related risks and to maximize the opportunities.[306] These evolutions may cause a shift in perspective by private investors if investment returns are perceived to be at risk from climate change.

- **Unsupportive legal and regulatory environment:** Although there are examples of regulatory mandates for adaptation planning (e.g., California Public Utilities Commission Rulemaking R.18-04-019[307] and New York State Senate Bill 7802[308]), in many contexts, the legal and regulatory institutions and infrastructure that support adaptation investment are insufficient, either because they are themselves underfunded (KM 31.3) or because political support is lacking (or both). Insufficient, weak, or nonexistent regulatory and policy frameworks (e.g., lack of or delayed adoption of forward-looking infrastructure codes and standards; KM 12.3) create barriers to action and investment. Such policy decisions limit incentives to address physical climate risk and reduce the likelihood of mobilization of finance.

Traceable Accounts

Process Description

Adaptation to climate change has the potential to affect people from all walks of life, so the author team was selected to represent people from a diverse range of disciplines including social sciences and engineering, as well as professional practitioners focused on adaptation. Care was taken to ensure that the team included both early-career and senior professionals from across industry, academia, and government who come from varying geographic areas and personal backgrounds. The authors were selected from the list of individuals who responded to the Federal Register Notice or otherwise directly contacted the US Global Change Research Program to volunteer. Authors met virtually on a weekly or bi-weekly basis throughout the assessment to build consensus, incorporate feedback from stakeholders received during the public workshops and comment periods, and collaborate and cross-reference other Fifth National Climate Assessment chapters where relevant.

It is important to note that while the terms "adaptation" and "resilience" are complementary concepts, there are distinct and important differences between the meanings of these terms, and confusion arises since they are often used interchangeably in policy and academic discourse. "At its most basic, adaptation refers to a process or action that changes a living thing so that it is better able to survive in a new environment, whereas resilience describes the capacity or ability to anticipate and cope with shocks, and to recover from their impacts in a timely and efficient manner. However, in practice, the distinctions and relationships between resilience and adaptation are more complicated and less easily defined."[309]

Historically, resilience was referenced as "bouncing back" and involved a return to baselines—such as a community recovering to its pre-disaster state after an acute climate-related event, such as an earthquake or hurricane.[310] More recently, however, the disaster planning and adaptation communities have realized that "bouncing back" to the status quo can be harmful. Therefore, the term "resilience" has recently been discussed as "bouncing forward"—changing a system or community to be better prepared for future conditions, whether those are sudden shocks like hurricanes or long-term stressors like drought and sea level rise. Bouncing forward implies that there has been reflection, growth, and learning, which does not always occur and is not always captured and evaluated after shocks and stresses have occurred. There are also communities that are forced to be resilient and can either bounce forward or bounce back depending on their access to the resources and support that meet their specific needs in both the short and long term. This chapter focuses on actions that help communities "bounce forward" to prepare for and thrive under future conditions.

Key Message 31.1

Adaptation Is Occurring but Is Insufficient in Relation to the Pace of Climate Change

Description of Evidence Base

The state of climate adaptation in the US has been somewhat well-documented through literature and organizations capturing publicly available adaptation actions to date at multiple scales, such as the Georgetown Climate Center, the Intergovernmental Panel on Climate change,[150] the Global Adaptation Mapping Initiative,[15] and this National Climate Assessment. In addition, there are numerous studies documenting diverse barriers to adaptation, including psychological, regulatory, financial, and political barriers.[43,44,45,48] The chapter authors, as adaptation practitioners and researchers, understand in depth the current state

of adaptation and progress—or lack thereof—being made across the US from the local to the national scale and wove that into the evidence base. The authors were able to capture evidence of progress and barriers along the various stages of the adaptation cycle from recent research and literature, public comments, and their professional experience. Although there is progress being made across the US, there are still significant barriers to overcome for Americans to adapt to climate change now and into the future. The chapter documents these barriers further in the Key Message narrative and highlights some on-the-ground examples to illustrate these barriers.

Major Uncertainties and Research Gaps

Given the lack of research on evaluating the effectiveness and sufficiency of adaptation actions across multiple sectors, scales, and regions, the authors focused on evaluating the current status of and barriers to adaptation across the five stages of the adaptation cycle. Authors felt as though the previous graphics[4,19] that illustrate progress along the adaptation cycle do not accurately reflect the varying levels of progress from the national to local scale. For example, a rural town in Kansas may be at the awareness stage, whereas the City of New York is in between the implementation and monitoring and evaluation stages of the cycle. Given this disparity in the level of progress along the cycle, authors included examples—captured from literature and author experience—of progress and barriers to each stage of the adaptation cycle.

Description of Confidence and Likelihood

Very high confidence in the diversity of adaptation actions occurring across the US stems from widespread and well-documented academic and policy reports about adaptation. While there are few documented examples of fully implemented adaptations, a lack of systematic studies of adaptation implementation that enable a comparison over time and the difficulty of comparing across regions and sectors yield *medium confidence* that adaptation is moving from the planning to implementation phase. Available research agrees that few implemented adaptations are being evaluated (*high confidence*) and that organizations face numerous barriers to developing and implementing adaptations (*high confidence*). Most available sources agree that current adaptation efforts and investments are incremental in nature and are insufficient to address future climate risks (*high confidence*). However, projecting and evaluating actual levels of risk reduction remains difficult, which leads to our statement of *medium confidence* related to current adaptation efforts and investments being unlikely to keep pace with future changes in the climate.

There is no consistent or regularly updated and tracked source for adaptation actions across the US at multiple scales, regions, or sectors, and many actions that may be considered adaptation may not be publicly known or captured through sources currently available that do track adaptation actions (e.g., the Intergovernmental Panel on Climate Change [IPCC] and the Georgetown Climate Center [GCC]). Therefore, the chapter's authors can provide confidence levels but not likelihood assessments.

Key Message 31.2

Effective Adaptation Requires Centering Equity

Description of Evidence Base

A substantial number of peer-reviewed papers, government data and reports, and accounts from extreme weather and climate events illustrate the uneven effects of climate change (Chs. 16, 18, 20).[62,63,64,65,66] Specifically, there is mounting evidence of the ways climate change disproportionately impacts low-income communities with higher percentages of Black, Indigenous, and Latin people, women, and younger or older adult populations, among others. Research and government reports document numerous ways in which government and private-sector systems contribute to differential effects through discrimination, displace-

ment, or underinvestment in hazard mitigation, other public infrastructure, or disaster response (e.g., Frank 2020;[69] Wilson et al. 2021;[70] Howell and Elliott 2019[68]). Some disparities are better documented than others, but the finding that climate change affects populations differently and that some of these differences are driven by government (in)actions and social systems is not disputed in the literature.

There is a converging body of evidence that demonstrates that individual and social factors play a significant role in whether people have the resources to reduce or avoid climate impacts (e.g., adaptation), as is the case in other areas of society (e.g., access to education as a limiting factor to job security).[84,85,86,87] The specific reasons why individuals and communities adapt the way they do remains an area for research, but there is robust evidence and high consensus that psychological, cultural, historical, geographical, and social factors play a role and that individual or community values are important drivers in the adaptation process.[95,96,311,312]

Maladaptation is a well-established concept in the adaptation literature, and cases of maladaptation have been well documented in numerous cases by a range of author teams,[106,107] although the exact criteria used to determine when an action is maladaptive often differ according to context. A growing body of research documents the ways that centering equity in the design, planning, and implementation stages of adaptation leads to improved outcomes.[40,113,117]

Major Uncertainties and Research Gaps

A source of uncertainty is the lack of standardized methods to evaluate the social justice or equity implications of climate adaptation. Numerous studies have documented inequities and injustices in adaptation or hazard risk-reduction programs and actions (e.g., Frank 2020;[69] Wilson et al. 2021;[70] Howell and Elliott 2019[68]), but different author teams use different metrics and concepts, including participatory, distributive, or recognition justice. The different methods make comparative analyses challenging, although notably the many methods and teams reach similar conclusions about the desirability of centering equity and justice to both improve quality of life for affected communities and reduce climate-related risks.

Description of Confidence and Likelihood

There is strong evidence from a wide range of academic studies and government reports, with high levels of agreement across numerous research teams, that people are affected by climate change in different ways and to different degrees and that these differences are affected by historical and contemporary social systems. This statement therefore warranted *very high confidence*. Similarly, there is widespread, robust evidence with strong consensus that adaptation choices are influenced by preferences, capacity, and access to resources as well as personal and community values, so this statement was also considered to have *very high confidence*. The statement that adaptation actions that do not center equity and underlying causes of injustice can exacerbate inequity and increase climate risk is considered *high confidence* because there is widespread consensus about this claim, but the evidence is slightly less robust due to a lack of standardized methods to assess the social justice of adaptation outcomes. Studies documenting maladaptation when equity is not centered also bolster this conclusion.

Key Message 31.3

Transformative Adaptation Will Be Needed to Adequately Address Climate-Related Risks

Description of Evidence Base

There is a significant and robust literature documenting the occurrence and type of adaptation practices globally and in the United States.[15] Technical contributors to this chapter reviewed adaptation actions as

documented in government reports and adaptation plans, as collected by the GCC Adaptation Clearinghouse and a systematic review. Researchers use several frameworks to assess transformative adaptation actions, but core principles relate to the depth or novelty of the change, the scale of the change (e.g., geographic or across multiple sectors), and the ability to address fundamental traits of systems or to challenge constraints of adaptation.[40,90,122,123] The IPCC Sixth Assessment Report, Working Group 2, for example, reviewed the relative frequency of incremental and transformative adaptation in over 1,800 studies using a modified version of the Termeer et al. (2017)[123] framework.[150]

Determining whether transformative adaptation is necessary in a particular case or whether incremental adaptation is sufficient for a given location or sector requires evaluation of not only individual adaptation actions but also suites of actions. Adaptation actions are difficult to evaluate, as the goals of adaptation are often contested, and the effectiveness or sufficiency of actions may not become apparent for a long time[16,313,314] (see discussion below in "Major Uncertainties and Research Gaps"). Nevertheless, a common finding within the literature is that most adaptation actions are incremental, small in scale, and limited by soft and hard constraints on adaptation.[1,15] Studies that assess the sufficiency of adaptation actions to address future climate change impacts routinely find that current incremental actions may be insufficient,[27,120] where sufficiency is determined based on projected climate change effects and limitations of adaptation actions (e.g., the ability of irrigation systems to handle future droughts). While the degree to which future actions will need to be transformative is uncertain (e.g., whether some, most, or all actions will need to be transformative), the literature supports *high confidence* that more actions will need to be transformative in the future than is current practice. That is, the US adaptation portfolio will need to include more transformative adaptation to adequately address future climate risks.

Major Uncertainties and Research Gaps

The major source of uncertainty is a lack of consistent, high-quality methods to evaluate the sufficiency of adaptation actions to address future climate-related risks. Methods are being developed (e.g., Parker et al. 2020[27]), but lack of consistency across the field makes comparative studies difficult and complicates efforts to pin down optimal adaptation portfolios. Methods for decision-making under uncertainty are growing for this reason, as are methods to identify actions and portfolios of actions that are robust under numerous climate futures. Efforts to evaluate both the effectiveness of adaptation actions and portfolios in addressing current climate-related risks and the sufficiency of actions and portfolios to address future climate risks are areas for continuing research.

Description of Confidence and Likelihood

There is *very high confidence* that climate adaptation actions in the United States to date have been incremental, because numerous information sources reporting adaptation actions in academic and government literature document these results and generally agree on the incremental nature of the adaptation actions. Although there is evidence of a few examples of transformative action, the overall statement that actions are generally small in scale and incremental remains robustly supported with strong evidence and high consensus. The necessity of transformative adaptation is assigned *high confidence* because numerous author teams and government reports reach this conclusion, but there is less robust evidence to support the extent of transformation that will be necessary. Similarly, numerous research teams conclude that monitoring and evaluation of adaptation will need to improve, both in terms of the methods used and the data collection and processes, to better understand what adaptation actions are effective to deal with current risks or sufficient to address future climate risks. However, not all teams agree on the nature of these monitoring and evaluation methods, so the need for improvement is assigned *high confidence*. The finding that adaptation actions in the United States (both the type and extent of actions) are generally insufficient to deal with future climate risks is not controversial in the literature. Likelihood

statements were not provided because they represent probabilistic assessments of uncertainty that are inappropriate for this type of analysis.

Key Message 31.4

Effective Adaptation Governance Empowers Multiple Voices to Navigate Competing Goals

Description of Evidence Base

Research on adaptation governance and how adaptation decisions are made is a less developed topic relative to research on mitigation policy and governance,[156,158] especially for papers empirically focused on the US. Over the last five years, an increasing number of case studies have focused on adaptation governance in specific locations and sectors, such as sea level rise in San Francisco[159] or flood risk in the Upper Mississippi basin.[48] Existing case studies of adaptation governance display a high level of agreement with respect to its multi-actor, fragmented nature, wherein actors working in distinct organizations and sectors make independent decisions related to adaptation in an uncoordinated fashion.[48,49,50,159,165,166] This literature also highlights that these organizations have distinct goals, values, risk perceptions, and capabilities that lead to inconsistent and sometimes conflicting adaptation choices.[160,161,162,163,164] Both theoretical and empirical literature on adaptation governance also emphasize the benefits of increased coordination and collaboration across organizations, sectors, and levels of government.[1,51,165,172,173]

Major Uncertainties and Research Gaps

The major source of uncertainty is a lack of systematic, cross-case research comparing adaptation governance approaches across multiple sectors, types of adaptation, or geographies. The majority of evidence stems from single case studies or comparisons of two or three city or community cases. The lack of larger comparative studies creates uncertainty about the specific contexts in which governance approaches work and more universal challenges in implementation. Comparative research has assessed the use of specific policy tools to promote adaptation[315,316] but rarely focuses on broader governance arrangements, such as who is involved in decision-making and the roles they play (an exception is Fastiggi et al. 2021[165]). Likewise, there is minimal research evaluating the outcomes of governance approaches on adoption of adaptation actions, risk reduction, or equity.

Description of Confidence and Likelihood

High confidence about the diversity of actors involved in adaptation governance and the challenge of balancing competing goals signals that these statements rely on many high-quality papers that show the same general trends. *Medium confidence* about the need for collaboration and diversity of values and knowledge signals that there is a lower overall number of papers showing empirically the value of these approaches.

Key Message 31.5

Adaptation Requires More Than Scientific Information and Understanding

Description of Evidence Base

Many integrated, science-based approaches are used to help manage decisions under uncertainty and decisions spanning future social–economic–environmental futures.[162,163,210] Even though some future uncer-

tainties cannot be reduced (Ch. 18) for particular strategies, many other strategies can take advantage of computing power and artificial intelligence to reduce future uncertainty, hedge against uncertainty by selecting actions that work across multiple possible futures, or approach adaptation decisions as a long-term process to be revisited over time.[195,235,317,318,319,320,321,322,323,324,325,326,327,328,329,330,331,332,333,334,335] Tools include modifications to traditional approaches like cost–benefit analysis, scenario planning, and multicriteria decision analysis; more participatory versions such as participatory mapping and serious gaming;[240,244] computational methods such as robust decision-making, probabilistic decisions, and real-options analysis; less computationally intense options such as heuristics, a growing area of research; and flexible options such as dynamic adaptation policy pathways[235] and adaptive management and governance systems.

A wealth of peer-reviewed literature over at least the past two decades provides formal and informal evaluation of specific climate service efforts and examines the use of climate information for a variety of decision-making contexts and applications. Recent research in this body of literature made strides by illustrating that equally important to whether climate information is used is how climate information is used. Specifically, it is important to acknowledge that any one specific climate service effort need not change a specific policy or real-world condition to benefit progress toward those or other outcomes.

Climate services can have numerous societal benefits and support diverse outcomes (see, for example, the Pacific Islands Regional Climate Assessment Evaluation[336]).[246,248] Over the past two decades, social science has improved the development of climate services by evaluating the usability of services,[337] prescriptively improving public data products,[338,339] and, more recently, expanding the degree to which various service efforts support adaptation and related societal benefits. Social science, including formal and informal evaluation of climate services, has improved our ability to generate usable and actionable climate information.[151,228,247,337,340] Additionally, social and behavioral science illustrate that actionable climate information can be complemented with new models of participatory, adaptive decision-making geared toward long-term behavior change.[162,231,232,234,337,341,342,343,344,345,346,347]

While the aforementioned literature evaluating climate services speaks to trust, legitimacy, and other important indications that dimensions of equity (e.g., procedural) may or may not have been achieved in different climate service efforts, the body of research only recently has started to examine equity as a critical component of climate services, as an intentional or deliberate part of both the evaluation and the climate service effort itself. Furthermore, equity in adaptation is a relatively new area of literature, and efforts to link the two bodies of work may also be limited by ambiguity over the definition of what constitutes a climate service. Additionally, attribution remains a thorny problem for evaluation research and investigations into the use of climate information, as well as for equity in adaptation. More work will be needed to determine the relative influence of a climate service effort alone versus the combination of a climate service effort and preexisting community organizing efforts to make a difference in catalyzing equitable adaptation. Nevertheless, of the climate service efforts proven to have a range of societal impacts leading to positive social and environmental outcomes and/or adaptive decisions, many have drawn on foundational work by Cash et al. (2003),[221] rooted in the concepts of legitimacy and saliency defined from a stakeholder perspective.

Major Uncertainties and Research Gaps

Additional research would be beneficial to evaluate how well different models of climate service 1) align with different decision contexts, 2) contribute to societal benefits/impacts and outcomes, and 3) support dimensions of equity, particularly around racial and economic disparity. Spanning all three issues related to climate services, more research would be needed to more fully investigate the efficacy of various forms of engagement and collaborative decision-making and how they factor into coproduced climate services. More institutional research would also be needed to determine ways that for-profit services can generate value (e.g., empowerment, revenue) for lower-income communities.

Description of Confidence and Likelihood

High confidence stems from a wealth of literature that climate services do provide a range of benefits and have met a range of needs. *Medium confidence* stems from less literature on equity in adaptation and climate services specifically, and, where that research exists, definitional ambiguity and problems with attribution of societal outcomes directly to climate services, as opposed to a combination of factors.

Key Message 31.6

Adaptation Investments and Financing Are Difficult to Track and May Be Inadequate

Description of Evidence Base

The author team reviewed the literature by searching databases, inviting technical contributions from subject-matter experts, and soliciting feedback during public meetings.

Economic analysis of the costs and benefits of adaptation is a significant research field with numerous studies covering a range of sectors and geographies. Relevant studies include Melvin et al. (2017);[277] Reguero et al. (2018);[278] Martinich and Crimmins (2019);[273] Fant et al (2020);[128] Lorie et al. (2020);[281] Neumann et al. (2021);[274] Wobus et al. (2021);[279] LeRoy et al. (2019);[348] and Clavet et al. (2021).[349]

The peer-reviewed literature abounds with studies estimating the costs of adaptation, although these examples tend to coalesce around a subset of climate hazards, mostly flooding and other hydroclimate-related hazards (e.g., Clavet et al. 2021;[349] Lorie et al. 2020;[281] Melvin et al. 2017;[277] Neumann et al. 2021;[274] Reguero et al. 2018;[278] Wobus et al. 2021[279]); around a subset of sectors, historically agriculture, energy, and water; and in specific geographies, although there are several recent studies that evaluate the economics of adaptation for the continental US.[273,274,276,279] Time horizons for implementation of adaptation options vary across studies (e.g., next decades versus midcentury versus end of century), which can make it difficult to compare cost and benefit estimates. Recent studies (e.g., Neumann et al. 2021[274]) have attempted to incorporate estimation of the indirect costs of climate change on different sectors (e.g., train delays resulting from effects of temperature on rail lines) and these estimates' effect on evaluation of adaptation options.

Since the publication of the Fourth National Climate Assessment, there has been increased research into the effects of different adaptation implementation scenarios (e.g., proactive, reactive, and no adaptation) on damages associated with climate change (e.g., Martinich and Crimmins 2019;[273] Fant et al 2020;[128] Neumann et al 2021[274]), with much of this work supported by the EPA's Climate Change Impacts and Risk Analysis project.

Many organizations have climate investment tracking initiatives and publish regular reports on investment levels and flows (e.g., Climate Policy Initiative, World Bank, United Nations Environment Programme). This tracking is most robust at the international level and at monitoring investment and finance flows between countries, specifically transfers from developed nations to developing nations or transfers to international adaptation funding mechanisms.[284] Specific statistics on investment levels within countries, including the US, are more challenging to find. This is due in part to the fact that adaptation-related investments are not always labeled as such, especially when compared to climate change mitigation–related investments. Finally, tracking of public sector climate investment flows (e.g., from governments or multilateral institutions such as development banks) is also more robust than tracking of private-sector climate flows.

Major Uncertainties and Research Gaps

Despite the multiple case studies of individual examples of adaptation, evidence is unclear about how coordinated or transformative these activities are. The lack of detailed information on adaptation-related investment does not indicate that it is not occurring but rather that it may be uneven, uncoordinated, or underreported. Thus, a major source of uncertainty in assessing the current state of adaptation is assessing the extent to which it is being adequately funded and financed in a coordinated way. Research gaps center on improved tracking of within-country and private-sector adaptation investments; identifying methods to track investment needs or levels when it is difficult to categorize adaptation-related investments; and developing improved metrics and methods for justifying adaptation-related investments.

More finance options have emerged to assist communities with covering the costs of adaptation. The chapter briefly cites four examples: the Louisiana's Strategic Adaptations for Future Environments, a fund administered by the State of Louisiana to provide community-driven adaptation support to residents, targeting the housing, transportation, and energy sectors; the DC Water's Environmental Impact Bond, an environmental impact bond to share with investors the financial performance risk associated with projects to respond to water stress facing the systems; investments from community development financial institutions, such as Coastal Enterprises Inc. in Maine; and a parametric insurance program for the Miami–Dade School District, developed by reinsurer Swiss Re. More research, specifically in the US, investigating the rates of uptake and share of different financing types utilized compared to others would be valuable.

Description of Confidence and Likelihood

Multiple sources[275,284,290,291,295] consistently call out the lack of data on private-sector investments in adaptation, especially when compared to data on public-sector investments and financing. New et al. (2022)[284] note that progress has been made in tracking climate finance internationally but identify tracking of domestic public-sector and overall private-sector investments as critical gaps. For these reasons, there is *high confidence* that more investment in adaptation and improved tracking of domestic adaptation-related investments would be significantly beneficial.

Where adaptation may be occurring, the literature does cite evidence of underinvestment. Lorie et al. 2020[281] cite studies that reported that observed adaptation is lower than what would be expected from traditional cost–benefit analyses. There are many factors that influence the decision to adapt, including finances, lack of incentives, and technological unavailability, suggesting barriers to the decision to invest. Without a full picture of where adaptation investments are occurring and the nature of adaptation investments across sectors and communities, it is difficult to determine the adequacy of these investments. For these reasons, the authors decided to assign *medium confidence* to the statement that investments may be inadequate.

Studies that evaluate differences in aggregate costs of climate change across different scenarios consistently project higher economic costs under very high scenarios (e.g., RCP8.5) compared to intermediate (e.g., RCP4.5) or lower scenarios. Estimates of adaptation costs, which can translate into future investment needs, are consistently in the hundreds of millions to billions of dollars.[273,274,276,277,278,279] As many of these estimates are for specific sectors (as opposed to a comprehensive national-level assessment) and do not evaluate all possible climate impact pathways (for example, Fant et al. 2020[128] does not account for the impact of floods, hurricanes, and ice storms on transmission and distribution infrastructure), they may underestimate the total costs of climate change–related damages and total benefits of adaptation. For these reasons, there is *high confidence* that future investments needs will be significant but still substantial uncertainty as to what those figures will actually be.

Proactive adaptation has been shown to reduce costs compared to reactive and no adaptation scenarios,[128,274] with most benefits accruing in the later decades of the 21st century as warming levels increase under

high scenarios. The choice of discount rate influences the additional cost reductions of proactive adaptation relative to reactive adaptation. Because of this and the fact that analyses of the effects of different adaptation scenarios are limited to select sectors, there is *medium confidence* in this part of the Key Message.

Multiple examples of events in recent decades that have caused significant economic damages and loss of life suggest that communities are not well adapted to face current climate conditions, including ways in which current climate conditions have changed with global warming. Events such as the Texas winter storm in February 2021, where cold temperatures were extreme but not unprecedented in the historical record, demonstrate that many communities are unprepared for current climate conditions. Similarly, Wobus et al. (2021)[279] report that current flood-related risk is serious enough in many locations to justify adaptation-related investments now. For this reason, there is *high confidence* that adaptation is needed to address the risks posed by current climate conditions.

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Xavier Cortada
Elevation Drive: 7 Feet Above Sea Level
(2018, Water-Based Paint on Asphalt)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.

National Climate Resilience Framework

SEPTEMBER 2023

THE WHITE HOUSE
WASHINGTON

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Introduction

> *"Throughout our history, we're the only nation in the world that has come out of every crisis we've entered stronger than we went into it. We're doing it again here on the climate crisis."* —President Biden, June 19, 2023

Across America, climate change is accelerating the frequency and fueling the severity of extreme weather events—resulting in tragedies and new realities that once seemed unimaginable. One hundred million Americans have been personally affected by an extreme weather event over the past two years. [1] Communities are enduring historic and catastrophic flooding, wildfires, extreme heat, drought, and more, while longer-term changes in temperature affect ecosystems and the economies that depend on them. The intensifying impacts of climate change are costing lives, disrupting livelihoods, and causing billions of dollars in damages.[2]

In the face of these perils, Americans are not standing idle; they are rising to confront the risks and challenges of climate change in extraordinary and inspiring ways. Communities are restoring natural infrastructure, such as marshes and wetlands, to defend against flooding; installing solar panels and battery storage to limit the strain on the grid and function as back-up power; and integrating Indigenous Knowledge to improve forestry practices that will reduce the likelihood of catastrophic wildfires. These are the types of locally tailored and community-driven solutions that are at the center of the Biden-Harris Administration's climate resilience strategy—and that are essential to building a climate resilient nation.

The Administration has taken historic steps to provide the Federal support, resources, and investments needed to help America's communities meet the climate challenges of today—and prepare for the climate stressors of tomorrow. In his first week in office, President Biden signed Executive Order 14008, Tackling the Climate Crisis at Home and Abroad, mobilizing the first-ever, whole-of-government approach to address climate change. Under the President's direction, every Federal department and agency is focused on strengthening the Nation's climate resilience, including by tightening flood risk standards, strengthening building codes, scaling technology solutions, protecting and restoring our lands and waters, and integrating nature-based solutions.

At the center of this work is President Biden's Investing in America agenda – the largest investment in clean energy and climate action in history. The Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA) dedicate more than $50 billion to advance climate resilience strategies in every community in America now, while also slashing greenhouse gas emissions to reduce climate impacts in the future. Because of these signature laws, roads and bridges are being elevated above projected flood zones; the grid is being made cleaner, more flexible, and more reliable; coastal ecosystems are being restored to buffer the impacts of hurricanes; Federal firefighters are getting a boost in pay; housing and buildings are being constructed and retrofitted to better withstand extreme weather; and public lands, forests, and

[1] FACT SHEET: Biden-Harris Administration Makes Historic Investments to Build Community Climate Resilience | The White House

[2] Who will pay for the damage caused by climate change? - BBC Future; Billion-Dollar Weather and Climate Disasters | National Centers for Environmental Information (NCEI) (noaa.gov)

waters are being managed to mitigate and withstand wildfires and droughts. These Federal investments have also emboldened the private sector to mobilize capital and investments in innovation.

In delivering these transformational investments and driving much-needed policy changes, the Administration is laser-focused on ensuring that no community is left behind. The Administration recognizes that not only are the risks and impacts of climate change disproportionately concentrated in low-income communities and communities of color, as well as in Tribal Nations, but that these communities often face a steeper road to recovery when disaster strikes. To protect all communities in harm's way, the Administration has placed environmental and economic justice at the center of its climate resilience agenda. Executive Order 14096, "Revitalizing Our Nation's Commitment to Environmental Justice for All," which President Biden signed on April 21, 2023, directs every Federal agency to advance environmental justice for all, including work to better protect communities with environmental justice concerns from the increasing impacts of climate change. It is also vital that the Administration is implementing the historic Justice40 Initiative, which set the goal that 40 percent of the overall benefits of certain Federal investments in climate and other key areas flow to disadvantaged communities. Many of the investments in climate resilience discussed in this Framework are Justice40 covered programs.[3] These investments are already resulting in stronger protections from floods, fires, heat, storms, drought, and other climate-related impacts in neighborhoods across America.

[3] For the most current list of Justice40 covered programs, see Justice40 Initiative | Environmental Justice | The White House. For additional information on agency-specific Justice40 work, see Phase One of the Environmental Justice Scorecard (geoplatform.gov), release April 2023, pursuant to Executive 14008.

A National Climate Resilience Framework

Although our nation is moving quickly to address the projected risks and impacts of climate change, there is far more work to do in the years ahead. To guide this work, in June 2023 President Biden directed the creation of a first-ever National Climate Resilience Framework to identify key values, priorities, and objectives to help expand and accelerate nationally-comprehensive, locally-tailored, and community-driven resilience strategies.

This National Climate Resilience Framework ("the Framework") makes clear that building a climate-resilient nation will require an all-hands-on-deck effort across all levels of government (State, local, Tribal, and territorial), leaders of all political backgrounds, and the wide range of philanthropic, non-profit, academic, and private sector institutions. The U.S. Government will and must serve as an active, flexible, coordinated, and committed partner with these entities in helping design and implement resilience strategies that meet the vision and needs of every community. In order to serve in this partner role, the Federal Government will need to have a continued focus on reforming and modernizing Federal programs and policies in ways that strengthen climate resilience – for example, embedding environmental justice into the DNA of Federal departments and agencies, or doubling down on making science, resources, and technologies accessible to everyone. The U.S. Government must also center effective Tribal consultation, respect for sacred sites, and recognition of Tribal sovereignty as important components of climate resilience planning and hazard response.

In addition to reimagining the Federal Government's role in advancing climate resilience, the Framework also identifies six core objectives—supported by specific actions—that are critical to strengthening the nation's protections against the impacts of climate change; that make communities safe, healthy, equitable, and economically strong; and that can and should be a focus of climate resilience efforts at all levels:

- Embed climate resilience into planning and management.
- Increase resilience of the built environment to both acute climate shocks and chronic stressors.
- Mobilize capital, investment, and innovation to advance climate resilience at scale.
- Equip communities with information and resources needed to assess their climate risks and develop the climate resilience solutions most appropriate for them.
- Protect and sustainably manage lands and waters to enhance resilience while providing numerous other benefits.
- Help communities become not only more resilient, but also more safe, healthy, equitable, and economically strong.

These objectives—and the specific actions identified to help achieve them—were developed in coordination with resilience experts across the Federal Government. They were further informed by the insights of non-Federal climate resilience stakeholders and recommendations from the

U.S. Government Accountability Office[4] and the President's Council of Advisors on Science and Technology.[5]

The Framework was designed to function as a foundation for near-term and longer-term climate resilience efforts across the Federal Government, in coordination with non-Federal partners, including through follow-on implementation plans and actions.

The Framework articulates a common definition of resilience and fundamental principles that will guide the Federal Government's approach to achieving resilience. The Framework then expands on the six core objectives listed above by providing a high-level description of what each objective would entail, an overview of notable Federal investments and initiatives that have supported the objective to date, and an illustrative list of specific opportunities for cross-sectoral action.

[4] Thompson, J., Halifax, H., Need, Z., Norris, C., and Royer, D., (2022). *Climate Change: Enhancing Federal Resilience* (GAO-22-106061). Government Accountability Office.

[5] https://www.whitehouse.gov/wp-content/uploads/2023/04/PCAST_Extreme-Weather-Report_April2023.pdf

Becoming a Climate-Resilient Nation

For purposes of this framework resilience is defined as *the ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions*. A climate resilient nation is one that is able to cope, adapt, and evolve in the face of current and future climate conditions—ensuring all individuals, households, sectors, and communities have access to safe and affordable housing, flourishing natural ecosystems, equitable health care, nutritious, affordable, and sufficient food supply and clean water, robust education and workforce opportunities, secure and clean sources of energy, and the capacity to thrive. This Framework uses the term "climate resilience" in a manner that is intentionally broad and inclusive of the term "climate adaptation" (i.e., the process of adjusting systems in response to the actual and projected consequences of a changing climate).

Principles of Climate Resilience

The Federal Government will use the following principles to guide activities and investments to strengthen climate resilience at all levels.

- **Proactive.** Implement solutions that anticipate and address climate threats and impacts before damages occur. Prioritize activities and investments through risk-based approaches, including approaches that account for complex risks, like cascading impacts and concurrent events, as well as approaches that account for differences in vulnerability and response capabilities within and across communities.
- **Whole-System.** Consider the ways in which communities and natural systems are interconnected, including recognizing that risks and impacts from climate change are borderless. Strive both to leverage synergies (e.g., when increased resilience of one community contributes to the resilience of others) and to avoid maladaptive activities (e.g., when efforts to increase resilience in one community impose harms on another).
- **Equitable and Just.** Pursue solutions that address, and do not exacerbate, disparities between and within communities. Ensure that strategies respond to the needs of underserved and marginalized communities that have historically borne a disproportionate share of climate impacts and costs.
- **People-Centered.** Position the well-being of individuals, families, communities, and society at the center of goals and solutions. Consider the needs and perspectives of all community members, including those that are most vulnerable and have been historically marginalized or disadvantaged.
- **Collaborative and Inclusive.** Work across sectors to identify and pursue shared goals. Create pathways for all community members to be meaningfully involved in decision-making, and conduct active outreach to raise awareness of these pathways and address barriers to participation.
- **Durable.** Implement solutions that serve current and future needs. Ensure that there is continuity of technical expertise and leadership as needed, including by enhancing or building community capacity to sustain and adapt solutions for the long term.

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- **Multi-Benefit.** Prioritize solutions, including nature-based solutions, that enhance climate resilience, while simultaneously advancing other community, economic, and societal objectives.

Objective 1: Embed climate resilience into planning and management.

Building a climate-resilient nation requires evaluating climate alongside other considerations (e.g., financial, workforce, equity) in planning, management, and policy processes. Climate should be evaluated in ways that consider both near-term climate variability and weather extremes, as well as longer-term changes in climate and associated impacts to people along with the natural and built environments. Multiple studies show that the benefits of proactively accounting for and building resilience to climate impacts upfront will typically mitigate the resulting impacts, save lives, and mitigate the costs of damages following an event. Research conducted by the National Institute of Building Sciences found that on average, every $1 spent by the Federal Government on disaster mitigation returns $6 worth of societal benefits, including from reduced future disaster losses.[6]

While adaptation activities are gaining traction across different sectors, adaptation as a whole is not occurring fast enough to keep up with the rate at which the climate is changing. Effectively integrating climate change into planning, design, and management means reducing reliance on past events as analogues for the future. As concluded in the 4th U.S. National Climate Assessment, successful adaptation has been hindered by the false assumption that future climate conditions will be similar to past climate conditions. The Assessment noted that incorporating information on current and future climate conditions into design guidelines, standards, policies, and practices would reduce climate risks and impacts. In other words, all elements of planning and management need to seriously and rigorously consider a world in which extreme weather events and natural hazards occur with increasing frequency and severity, and in which many communities and regions face compounding risks.

A community, business, agency, or institution can begin to embed climate considerations in its decision making by conducting a climate risk assessment to understand its particular vulnerabilities to climate change, and developing a climate action and adaptation plan that lays out an appropriate response (see Objective 4). For example, President Biden's Executive Order on Climate-Related Financial Risk directed the Federal Government to annually publish an assessment of its exposure to climate risk and to analyze and manage risks that climate change poses to departments and agencies, homeowners, workers, and the financial system. Moreover, at President Biden's direction, nearly 30 Federal agencies have developed Climate Adaptation Plans to integrate adaptation into their mission delivery and increase resilience to the impacts of climate change. By investing to protect military installations and water systems from climate impacts, building out microgrids at Federal facilities, and updating internal policies to center and mainstream climate resilience in program management and delivery, the ongoing implementation of these plans is meaningfully strengthening our Nation's climate resilience. However, further

[6] https://www.nibs.org/files/pdfs/NIBS_MMC_MitigationSaves_2019.pdf

investment in Federal and private sector foundational climate risk data sets and financial models are still needed to more accurately assess climate risk at the local and regional levels.

To maximize effectiveness, climate adaptation plans must be connected to other planning documents and processes, such as organizational performance goals and budgets. In 2021, the Administration laid the foundation for formally accounting for climate risks in the President's Budget. Federal departments and agencies are also integrating climate resilience into grants, loans, and disaster assistance, ensuring that investments made with taxpayer dollars lead to outcomes that are effective even as the climate changes. For example, the Department of Transportation is, as appropriate and consistent with existing law, incorporating resilience as part of the selection criteria in Notices of Funding Opportunity for discretionary grant programs such as the Rebuilding American Infrastructure with Sustainability and Equity (RAISE) program, which has a long history of funding large infrastructure projects that have a significant local or regional impact.[7]

There is a particular need to better link climate considerations to emergency preparedness and disaster risk planning. The traditional disaster response and recovery cycle is based on assumptions of single events distributed relatively predictably in time and place, and does not account for increasing frequency and severity of future weather events, nor increased vulnerabilities during an emergency due to chronic climate impacts. Building climate-resilient communities will require developing capacity to respond to emergencies—including multiple concurrent emergencies—as well as far greater efforts to reduce risks and make long-term investments in resilient structures and infrastructure (see Objective 2).

At the Federal level, departments and agencies are complementing traditional disaster-response and recovery capabilities with additional services that reduce risks (ensuring that buildings and infrastructure remain safe and functional during and after a disaster) and rebuild better (helping communities rebuild in ways that are more resilient to future threats). For example, the Department of Housing and Urban Development directly supports community resilience planning through its Community Development Block Grant Disaster Recovery (CDBG-DR) programs, with an emphasis on activities in low-income areas.

Opportunities for Action

- **Advance and simplify community climate planning.** Underserved communities are less likely to have the financial resources needed to plan for current and future climate threats, but are more likely to be at elevated risk of climate-related impacts. The Federal Government can harmonize planning requirements to eliminate the need for communities to develop multiple plans (e.g., hazard mitigation plans, asset management plans, resilience plans) to access Federal funding that supports community resilience. The Federal Government and its partners can also specifically assist Tribal Nations by supporting their sovereign right to safeguard their lands, culture, and infrastructure, and their authority to pursue Presidential emergency or major disaster declarations in response to extreme-weather events. The Community Disaster Resilience Zones recently designated by the Federal Emergency Management Agency should help to focus resources to communities most in need.

[7] https://www.transportation.gov/sites/dot.gov/files/2022-02/FINAL-2022-RAISE-NOFO.pdf and FY 2023 RAISE Grants Notice of Funding Opportunity | US Department of Transportation

- **Strengthen interagency coordination bodies to support community resilience**. A coordination body comprised of experts across all levels of government can help integrate all aspects of climate resilience to address interagency coordination challenges, strategically enhance interagency effectiveness, and work directly with communities to listen to priorities and facilitate place-based technical assistance. Existing structures help coordinate climate resilience building efforts across the Federal government and with partners. For example, the Thriving Communities Network work with public and private sector leaders while the Mitigation Framework Leadership Group coordinates across State, local, Tribal, and territorial governments. Each offers a unique opportunity to strengthen these types of coordination models to bolster place-based community resilience.
- **Tailor and vet future climate risk information and tools**. Transparent and authoritative projections of future risk are essential when planning for climate change, including for emergency management capacity planning, hazard mitigation, and adaptation strategies. Federal agencies need to ensure that information and tools derived from climate projections—such as for floods, sea-level rise, water resources, and wildfires—are responsive to user needs, validated, and accessible. At the Federal level, agencies can follow best practices, such as the U.S. Global Change Research Program's approach to using third-party data in the forthcoming Fifth National Climate Assessment. The Climate Risk and Resilience Portal, developed through a public-private collaboration provides free, dynamically downscaled climate data in useable formats for overlays with the Federal Emergency Management Agency's Resilience Analysis and Planning Tool. Together, these tools provide an important picture of today's infrastructure and people in tomorrow's environment. Non-Federal information and tools need to be vetted before adoption by the Federal Government. These steps will make it easier for communities to accurately assess their exposure to climate risk and safely invest in, design, and retrofit climate resilient infrastructure.
- **Require disclosure of climate risks**. Accurate and broadly shared information on climate risks is essential for evaluation of private assets, well-functioning markets, and financial stability. By requiring disclosure of these risks where feasible and appropriate, Federal, State, Tribal, territorial, and local agencies can help investors make more climate-informed decisions and encourage companies to increase risk-mitigation efforts. For instance, a proposed rule by the Securities and Exchange Commission would require companies to disclose information on the risks that climate change poses to their strategies, business models, and outlooks, and to describe how they plan to manage these risks. Public and private funders (e.g., grantmaking agencies, venture capitalists) could attach similar risk-disclosure requirements to funding opportunities.
- **Evaluate and monitor efforts to increase access to climate resilience funding**. Federal agencies evaluate BIL- and IRA-funded programs (e.g., pre- and post-evaluation designs for comparing and contrasting alternate program strategies and their associated outcomes) to assess whether programs successfully increased disadvantaged communities' access to resilience funding, what barriers remain (e.g., statutory match requirements, limitations on providing technical assistance to applicants), and what policies, regulations, or legal changes could be implemented to further increase access or remove barriers. Evaluating the effectiveness of agencies' BIL- and IRA-funded projects in delivering tangible resilience

benefits—and synthesizing these evaluation results—can inform future investments by the Federal Government and non-Federal partners.

- **Set targets and indicators to measure climate adaptation and resilience progress**. Analog targets set to reduce greenhouse gas emissions have been extremely successful at driving progress on climate emissions reduction in the United States. Appropriate shared targets can similarly advance climate resilience through enabling opportunities for rigorous progress assessment. As part of their Climate Adaptation Plans, Federal agencies should set targets and indicators to measure how they are advancing climate adaptation and resilience efforts to address various key aspects of climate resilience, including risk reduction, ecosystem health, human health and well-being, operational durability over time, and economic vibrancy.

Objective 2: Increase resilience of the built environment to both acute climate shocks and chronic stressors.

The built environment shapes the way people live, work, recreate, and interact. From housing, commercial buildings, and industrial facilities to transportation, power and water utilities, and public spaces and parks, every community's unique built environment is a significant determinant of quality of life. As such, investments in the built environment are also investments in community well-being. The built environment should be considered holistically with the natural environment, since people experience them together and the resilience of one affects the resilience of the other (see Objective 5). A resilient built environment—one that is constructed to the latest building codes, renovated to high-performance resilience standards, and located away from hazard zones where possible, while ensuring there is an adequate and affordable housing supply—protects people from climate impacts, supports quicker recovery from disruptions, and helps communities thrive (see Objective 6).

Climate resilience should be a key consideration in planning and design for land use and the built environment. Modernized land use development and building codes are key to achieving these objectives. President Biden's National Initiative to Advance Building Codes is accelerating adoption of modern building and energy codes that protect people from extreme-weather events and save communities an estimated $1.6 billion a year in avoided damages. Among other outcomes, this initiative will harness $225 million in BIL funding and $1 billion in IRA funding from the Department of Energy to support implementation of updated building and energy codes, provide incentives and technical support for communities to adopt modern codes, and provide mapping tools to track code adoption. The initiative is further working to update Federal assistance programs that support the construction and renovation of buildings with the latest building and energy codes and high-performance standards.

Federal agencies are also working directly with codes and standards development organizations to develop resilient and sustainable codes for adoption to ensure buildings and infrastructure are built to the highest standards to be protected from extreme weather and hazards. For instance, the National Oceanic and Atmospheric Administration has formally partnered with the American Society of Civil Engineers to ensure that Federal climate data, observations, and projections are providing the civil engineering community with the information it needs to plan, design, and operate climate-resilient and sustainable infrastructure and housing.

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President Biden's Investing in America Agenda is deploying record investments in climate-resilient infrastructure, including reliable and affordable high-speed internet and electricity, safer roads and bridges, modern wastewater and sanitation systems, and clean drinking water in a manner that creates good paying jobs in every community. Examples include:

- The Department of Housing and Urban Development's (HUD) Green and Resilient Retrofit Program, which will bring $830 million of direct funding and $4 billion in loan commitment authority to HUD-funded properties that invest in climate resilience, energy efficiency and emissions reductions, clean energy, and low-carbon materials.
- The Department of Energy's Grid Resilience and Innovation Partnerships (GRIP) Program, which is enhancing grid flexibility and preparing the U.S. power system for growing threats of extreme weather and climate change.
- The Department of Transportation's PROTECT program, which is making surface transportation more resilient to natural hazards through support of planning activities, resilience improvements, community resilience and evacuation routes, and strengthening at-risk coastal infrastructure.
- The Department of Homeland Security's Federal Emergency Management Agency's Building Resilient Infrastructure and Communities (BRIC) Program, which supports a variety of hazard-mitigation projects in communities and special districts with approved hazard mitigation plans.
- The U.S. Department of Agriculture's Rural Development agencies are enhancing the resilience of critical infrastructure in rural communities through investments like Community Facilities Disaster Grants.
- The Department of Health and Human Services developed a guide to opportunities through the IRA to improve the climate resilience of hospitals, health care facilities, and health-sector supply chains.
- The Department of the Interior supports adaptation and funds community relocation planning and design for Tribal communities impacted by rising seas, coastal erosion, and storm surge through the Bureau of Indian Affairs' Branch of Tribal Climate Resilience.
- The National Endowment for the Humanities' Climate Smart Humanities Organizations and Sustaining Cultural Heritage Collections programs are improving resilience of cultural and educational organizations through evaluations of existing buildings and sites and funding improvements to collection and exhibition spaces.

Furthermore, many local government partners are overhauling zoning ordinances to integrate resilience while reducing barriers to adequate housing supply. For example, in Norfolk, Virginia, a new zoning ordinance requires all new development within the city to meet a resilience quotient. This requirement is measured on a points system covering three separate resilience elements: (1) risk reduction, (2) stormwater management, and (3) energy resilience. At the same time the ordinance encourages development in higher elevation areas to ensure housing supply needs are met. This type of local leadership is essential and should be supported across the Nation. In addition, built environment investments and design should support and

leverage resilience of the natural environment (see Objective 5). Land use planning substantially affects ecosystems and natural resources within and around communities. Facilitating infill development, building conversion, and redevelopment as viable alternatives to green field development are approaches that communities are taking to reimagine their built environments to achieve community goals and plan for long-term climate impacts. Leveraging investments in nature-based solutions and coordinating siting and design of buildings and infrastructure are essential to ensuring that the built and natural environments work in tandem to support climate-resilient communities.

Opportunities for Action

- **Incorporate climate information into engineering and architectural standards and planning practice.** Consensus-based engineering standards provide the basis for design of the built environment, but many do not sufficiently address designing to future climate conditions and future climate-related loads (e.g., increased precipitation on roadways, increased energy demand during heat waves, changing geographical extent of extreme heat and cold). The Federal Government can support development of climate resilient standards by engaging in standards-development processes, partnering with architectural, engineering, and planning professional associations, and providing the climate data and projections needed for standards development organizations to incorporate future climate considerations in engineering and architectural design standards that include nature-based features.
- **Ensure that public funding requires climate-resilient infrastructure investments**. Government at all levels can drive climate resilience of the built environment by adopting the latest consensus engineering standards or encouraging their adoption through funding opportunity requirements for all publicly funded or financed infrastructure projects. Federal agencies should include requirements that all Federally-funded and financed infrastructure projects address vulnerabilities posed by future climate impacts over the full-service life of the proposed project, and encourage the use of nature-based features to reduce impacts from climate hazards like stormwater flooding. Agencies should also identify ways to further mitigation opportunities after disasters strike, better connecting resilience funding with disaster recovery efforts. When community infrastructure is being rebuilt, there is an opportunity to ensure the increasing risk is considered. (See Objective 5).
- **Expand adoption of the latest consensus-based building and energy codes and high-performance standards**. Adoption of the latest consensus-based building and energy codes and high performance-standards protects buildings, infrastructure, housing, and people from climate risks. Government agencies can work with communities, standards development organizations, and code and trade organizations to prioritize existing funding and provide technical assistance to increase adoption of these codes and standards across government and non-government owned buildings. Governments can also partner with workforce networks, educational institutions, unions, and associations to efficiently expand the training needed to implement building and energy codes and high-performance standards. Agencies should adopt these codes and high-performance standards for the construction or substantial rehabilitation of publicly funded or financed homes and buildings.
- **Promote resilient energy solutions to protect people and preserve affordable housing and infrastructure**. Incorporating energy-efficient technologies and energy resilience

practices can reduce electricity demand, provide energy backup to housing facilities when there is a power failure, and protect Americans during times of extreme temperatures. Collaboration among Federal agencies and State, local, Tribal, and territorial governments can support the place-based integrative design of distributed energy resources and microgrids, turn housing into distributed power plants, harness rooftop and community solar storage, and enable local generation and consumption of clean electricity.

- **Support climate-resilient land use and zoning reforms to sustainably densify development in lower-risk areas**. Development continues to expand into high climate-risk areas, in large part due to lack of affordable, developable land in less risky areas. Effective land use and zoning designations establish the foundation for decades of development and are key to avoiding future climate impacts. The Federal Government can partner with State, local, Tribal, and territorial governments, as well as professional planning associations to provide technical assistance and share best land use, zoning, and siting practices that ensure adequate housing supply and reduce long-term climate risk. Collaboration across these sectors can advance best practices such as optimizing property acquisition funding with comprehensive planning and zoning reforms that reduce climate vulnerabilities and ensure communities can grow.
- **Require consideration of nature-based solutions for Federal investments wherever appropriate**. Nature-based solutions can be entirely non-structural or can replace or support built infrastructure. Encouraging Federal activities and projects to incorporate nature-based solutions that enhance resilience will reinforce a culture of "starting with nature." To support this, Federal agencies can issue or update departmental directives, policies, and guidance to require robust consideration of nature-based alternatives and make it easier to deploy those alternatives at the state and local levels.

Objective 3: Mobilize capital, investment, and innovation to advance climate resilience at scale.

Climate change poses threats to U.S. financial markets and institutions, businesses, and manufacturers, as well as non-profit institutions—including libraries, schools, museums, and other cultural organizations—that are central to community health and economic development. The U.S. Government is already investing in and making rapid progress on the game-changing clean energy technologies and projects needed to achieve national climate mitigation objectives.

There is tremendous opportunity to further harness U.S. innovation capacity towards climate resilience. Building a climate-resilient nation will require development, improvement, and scaling of advanced water treatment systems and drought-tolerant crops, efficient cooling technologies and building materials that reflect heat and insulate, forecasting and surveillance systems to track wildfires, and myriad other solutions. Mobilizing capital, investment, and innovation in climate resilience will both help the Nation better prepare for climate impacts and position the United States at the forefront of a global climate resilience market that could be worth as much as $2 trillion per year by 2026.

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Yet innovators and startups often struggle to move promising ideas from the research and development phase to the scaling and commercialization phase. Bridging the gap that separates the "lab" and the "market" often requires dedicated support. At the Federal level, the Environmental Protection Agency's $14 billion National Clean Investment Fund is awarding grants to national nonprofit financing institutions capable of partnering with the private sector to provide accessible, affordable financing for tens of thousands of clean-technology and resilience-building projects across the country. This new financing will be focused on enabling families, small businesses, communities, and others to access the capital they need to support projects—with at least 40% of capital flowing into low-income and disadvantaged communities. The Department of Energy's Solar and Wind Grid Services and Reliability Demonstration Program provides $26 million for industry, utilities, and laboratories to test projects that will enhance energy security and yield a more reliable power grid. The National Oceanic and Atmospheric Association's Ocean-Based Climate Resilience Accelerators Program includes a $60 million investment in small businesses to accelerate climate resilience technologies including modeling tools to translate coastal, ocean, and Great Lakes data into resilience decision support services.

Building a climate-resilient nation also requires greater availability of flexible and patient financial resources for climate resilience projects. Resilience projects are underinvested in due to numerous factors like payback periods that can be long and/or uncertain, benefits may go to a community rather than solely to investors, and traditional accounting mechanisms tend to focus on direct financial benefits (e.g., losses avoided), while limiting consideration of many indirect benefits (e.g., water quality improvement or cultural preservation). The Office of Management and Budget is developing new guidance to help Federal agencies and other institutions better account for many of these indirect benefits when performing cost-benefit analysis. Federal agencies are also working with states and the private sector to expand financing for climate resilience. For instance, the Department of Energy's Commercial Property Assessed Clean Energy (CPACE) initiative provides financing that building owners and operators can use to make resilience upgrades in states with enabling legislation.

Furthermore, property and casualty (P&C) insurance is a critical tool for protecting against climate risks. When structured as an appropriate risk-transfer mechanism, P&C insurance can encourage pre-disaster mitigation efforts through lower premiums for more resilient properties, as well as signal areas at greater risk through appropriate premium increases. Appropriately structured P&C insurance can also speed post-disaster recovery by providing greater financial relief and stability than typical emergency assistance. However, as climate change increases the frequency of catastrophic, very high-loss events, P&C insurance and reinsurance are becoming increasingly unattainable and unaffordable. The Department of the Treasury is currently working with insurers to assess how climate risks are impacting insurance markets across the country—paving the way for data-driven policies that address gaps in coverage and affordability. Joint investments in climate risk reduction can also create a more attractive marketplace for insurers.

Opportunities for Action

- **Increase access to early-stage capital for climate adaptation and resilience.** Businesses and incubators—including climate resilience start-ups—need working capital to build and operate, yet accessing working capital is challenging for businesses with no proven record. Public and private funders can support these startups by creating financial products that

provide working capital to businesses. The Small Business Administration's Small Business Investment Company program can be used to drive greater access to patient capital for climate entrepreneurs in underserved communities.

- **Support research-to-market pathways for climate resilience innovators**. Incentivizing and creating an environment conducive to climate-based innovation is key to developing climate resilience. Supporting technology incubators and innovation clusters (e.g., advance market commitments, low-interest financing, and grant funding) can drive development and implementation of regionally relevant climate adaptation solutions in ways that harness community-based expertise and deliver economic benefits.
- **Utilize the power of procurement**. Leveraging government purchasing power and awarding contracts for mission-critical goods and services that are managing their exposure to physical and transition risks from climate change—such as data and telecommunications infrastructure, medical supplies, food, and energy—is key to ensuring the climate resilience of our day-to-day services. At the same time, integrating climate risk considerations into purchasing power can shape markets, accelerate innovation, and incentivize Federal dollars being spent to achieve resilience goals. In addition to purchasing and awarding contracts for durable goods that minimize climate risks, the Federal Government can improve energy security and catalyze supply chain benefits by leveraging its capacity to reward utilities for rapidly deploying carbon-free electricity at scale.
- **Expedite climate resilience patents**. Intellectual property protections can encourage private investments in priority areas, including climate resilience. The Federal Government has already established programs designed to expedite patents for climate mitigation technologies, and should continue to consider the extent to which a parallel program could be developed for climate resilience.
- **Expand and explore insurance solutions to improve climate resilience**. Insurance-related investments that promote resilience and risk mitigation may contribute to keeping insurance premiums affordable. Offering discounted insurance premiums to policyholders for implementing mitigation measures can encourage resilience investments, which may reduce economic and insured losses from climate-related events. Insurers, State insurance regulators, and communities can collaborate on expanding existing state premium discount programs, by looking at Federal programs such as the Community Rating System (CRS) for the National Flood Insurance Program (NFIP). Insurers, communities, and State and Federal policymakers also can continue to explore potential technological, modeling, and other innovations in the insurance sector for analyzing and reducing risk. The Federal and State governments can continue to promote awareness of risk mitigation discount programs and other efforts to promote resilience. Flood insurance—whether purchased from the NFIP or private insurance companies—is a key tool for property owners to protect themselves financially from losses caused by floods. For low- and moderate-income households in particular, the high cost of flood insurance can be a significant barrier to obtaining coverage. As flood risk increases with climate change, Americans need solutions that make flood insurance more affordable so that they can plan for and protect against their flood risk.
- **Comprehensively assess the availability of insurance coverage**. The Federal Government, through the Department of the Treasury's Federal Insurance Office (FIO), is working with leading insurance carriers and other stakeholders to assess insurance coverage availability,

particularly in regions of the country vulnerable to climate-related impacts. FIO has proposed the collection and analysis of homeowners' insurance data from large insurers, which is part of an ongoing, iterative process to assess the potential for major disruptions of private insurance coverage. This analysis, combined with continuing engagement with interagency and external stakeholders, may help pave the way for solutions that address issues surrounding coverage availability in underserved and high-risk communities, including for Tribes and territories.

Objective 4: Equip communities with information and resources needed to assess their climate risks and develop the climate resilience solutions most appropriate for them.

There is no one-size-fits-all approach to building climate resilience; communities experience climate change in different ways and respond according to their unique capabilities and cultures. A key objective of climate resilience efforts should therefore be to ensure that communities are equipped to assess their risks and prepare accordingly. Central to this approach is providing communities with evidence-based and easy-to-use information, tools, and services. Just as a revenue forecast helps a city set a budget, and a weather app helps people decide what to wear in the morning, so too can forward-looking climate resources help individuals and communities "know what's coming" and take steps to reduce their climate risks and vulnerability.

The U.S. Government is an authoritative source of climate information, data, and modeling, with wide reach and resources, and is working alongside partners to develop and provide evidence-based and actionable resources. The Administration has created a number of products that draw upon extensive climate information to give a comprehensive picture of how the climate is changing and what that means for our communities—the forthcoming Fifth National Climate Assessment (NCA5), for example, will provide a rich source of authoritative climate information across all U.S. regions and key sectors. The Climate Mapping for Resilience and Adaptation (CMRA) portal and the Sea Level Rise Viewer allow users to interactively explore climate hazards in their area, while the Climate and Economic Justice Screening Tool (CEJST) can guide investments in climate resilience by identifying disadvantaged communities likely to be disproportionately impacted by climate change, along with other environmental and socioeconomic burdens. Through its groundbreaking Held in Trust initiative, the National Endowment for the Humanities is working with cultural experts to develop resources tailored to the cultural sector, including risk maps, learning modules to develop climate action and resilience plans, and establishing local communities of practice to promote mutual aid and preparedness efforts. These resources are examples of the information available to aid community climate and resilience planning.

Research shows that resources to inform decision making are often most effective when developed in collaboration (or are "co-produced") with community members, through meaningful engagement. Community leaders, public officials, and individuals generally get more value out of informational resources that integrate relevant, community-specific perspectives, insights, knowledge, and experiences. Co-production is also key to identifying and filling information gaps and to building sustained relationships between subject-matter experts and information users. The Administration is elevating Indigenous Knowledge in Federal

research, policy, and decision making—and identifying promising practices for relationship building and knowledge co-production—through a first-of-a-kind Indigenous Knowledge Guidance for Federal Agencies. This is just one example of ways in which government agencies can work with communities to develop valuable and needed information resources to support climate resilience.

The *availability* of information resources is often not sufficient to support communities. Communities must be able to *identify, access, navigate,* and *use* relevant resources to design and adopt appropriate solutions to the specific climate risks they face. This often requires additional support and technical assistance that the Administration is directly providing to disadvantaged communities. Federal agencies are designing and adopting tailored solutions through technical assistance centers like the Environmental Justice Thriving Communities Technical Assistance Centers. Federal agencies are also providing on-the-ground support to connect climate information with decision needs through regional science and services organizations, such as the National Oceanic and Atmospheric Administration's Climate Adaptation Partnerships program, the U.S. Department of Agriculture's Climate Hubs, the U.S. Geological Survey's Climate Adaptation Science Centers, the Bureau of Indian Affairs' Regional Tribal Climate Resilience Liaison Program, and the Environmental Protection Agency's Regional Climate Adaptation Network. The U.S. Global Change Research Program also developed a guide on Selecting Climate Information to Use in Climate Risk and Impact Assessments to help Federal agency officials and others incorporate climate science into planning and decision making. In addition, the U.S. Climate Resilience Toolkit provides a Steps to Resilience framework to help decision makers identify climate hazards and develop solutions. For cultural organizations, the Smithsonian's Cultural Rescue Initiative compiles Federal and private resources for non-profits, homeowners, Tribes, and local governments on protecting cultural heritage threatened or impacted by disasters.

To build a resilient nation where climate considerations are embedded throughout decision-making processes (Objective 1), it is essential that the Federal Government and partners do even more to increase the Nation's collective climate literacy and strengthen the capacity to plan and act. Engaging with individuals and organizations at all scales, and increasing capacity to understand and apply climate information, will enable the design of solutions that meet communities' needs.

Opportunities for Action

- **Train additional technical assistance providers.** Many communities need support identifying their climate risks, vulnerabilities, and options. Skilled "translators" can articulate and align climate science and data (including the limitations and uncertainties in these data) and help communities identify and address their climate risks, vulnerabilities, and needs. These "translators" also act as force multipliers of Federal Government resources, including funding opportunities, research, and decision-support tools. Through existing programs, including the Federal Emergency Management Agency's Direct Technical Assistance opportunity within its Building Resilient Infrastructure and Communities (BRIC) program, Federal Interagency Thriving Communities Network, USDA's Rural Partners Network, Silver Jackets, the Cooperative Extension System and Sea Grant Extension, and regional science and service organizations, the Federal Government can catalyze a new

generation of "translators" who are trusted and well-positioned to increase climate resilience capacity as experts in local communities.

- **Emphasize meaningful involvement and community engagement in public participatory approaches to drive implementation of resilience and adaptation programs and services**. Community engagement and participatory approaches—including culturally-informed approaches, as well as co-production of data, tools, and solutions—are critical in ensuring that public programs aiming to support climate resilience are responsive to community needs and that goals and objectives are achieved. Federal agencies can advance appropriate and sustained community engagement around climate information through implementation of *A Federal Framework and Action Plan for Climate Services* and other relevant efforts. Public and private cultural funders can establish community archiving and documentation programs to demonstrate the impact of a changing climate on endangered cultural communities and resources and to highlight successful adaptation solutions, through close engagement with affected communities.
- **Accelerate action to ensure coordinated, effective, and efficient development and delivery of climate services across agencies**. This action is needed to increase the utility and accessibility of climate information for communities and others. Multiple agencies currently provide climate services to their constituents, underscoring the need for good coordination and communication. The National Science and Technology Council's Fast Track Action Committee concluded that the 14-agency U.S. Global Change Research Program (USGCRP) should provide enhanced coordination and the FY25-OMB-OSTP Budget Priorities Memo highlights this coordination by USGCRP and acceleration of climate services as a top-level budget priority. As an initial step, the USGCRP should conduct an inventory of key climate services to identify capabilities, gaps, and areas of needed efficiency.
- **Address key data and information gaps**. Current information gaps are hindering the development of actionable information for communities. While maintaining U.S. climate information and data networks, prioritization should be focused on enhancing information and services in geographies where climate data are sparse and climate-related vulnerabilities are high (e.g., Alaska, Hawaii, U.S. territories); developing and deploying improved, accessible early-warning systems provided in multiple-languages for climate-related threats and hazards, building off work on drought and heat; and improving integration of physical, natural, and social sciences to gain a more comprehensive picture of climate risks, options for adaptation (including costs, benefits, and tradeoffs between gray, green, and hybrid solutions), and decision making under uncertainty. Emphasis should be placed on increasing accessibility of climate services by a broad range of users, including individuals with limited English proficiency and people with disabilities. A Federal data policy could be developed to guide the design and deployment of climate data and services, adhering to open science principles and providing a mechanism for maintaining quality assurance to ensure services are scientifically-credible and usable.
- **Advance and deploy online information resources to support climate resilience solutions and planning**. Better online climate information, at the scales appropriate to inform decision making, is needed across the country. The U.S. Climate Resilience Toolkit and Climate Mapping for Resilience and Adaptation (CMRA) portal will be updated and leveraged as

primary knowledge-sharing hubs underpinning co-design and co-production of adaptation and resilience solutions, including by sharing real-world case studies on past and current resilience-building efforts. The Federal Government will also deploy the National Climate Assessment Interactive Atlas, an online mapping tool that will share downscaled projections of temperature and precipitation at decision-relevant timescales and spatial scales. These pilots are implementations of the Climate Resilience Information System, which will provide the information infrastructure needed for easy and consistent access to observed climatologies, climate projections, and other decision-relevant climate-related data. Collectively, these online resources represent a major opportunity to better support communities in localizing climate hazard data with other relevant information, such as infrastructure and social and economic conditions.

- **Enhance climate models and model-derived risk projections**. Climate models provide information that decision makers need in order to plan and develop strategies for addressing the impacts of climate change (e.g., to inform building codes and standards, see Objective 2). There are a number of opportunities where the Federal Government and partners can enhance the quality of projections available, including vetting and expanding foundational climate risk data sets; developing models with high spatial resolution within and outside of the Continental United States (OCONUS) areas; using specialized, hazard-specific models to assess current and future climate-related hazards and risks; and enhancing modeling of extreme weather risks at higher-resolution spatial scales (as recommended by the President's Council of Advisors on Science and Technology). Equally important will be research and development of models and risk projections that integrate information on projected changes in land use, population, the built environment, and local economies to assess future risks to communities and economic sectors. Lastly, the Federal Government can develop a strategy for incorporating climate science into catastrophe risk modeling, and improve public access to this information, leveraging existing capabilities in climate, environment, weather, and natural hazard modeling.

- **Improve capabilities to understand and address flood risk**. Federal agencies can advance the science of flood risk through targeted interagency research and coordination, focusing on areas of greatest uncertainty (e.g., rain-induced flooding, storm-water driven flooding, unmapped areas). The flood science community can also enhance the availability and accessibility of climate-informed scientific products to Federal agencies and stakeholders, providing information that enhances communities' ability to access and apply this information. The Federal Government also needs to map large swaths of the United States that have not yet been mapped for flood risk. Efforts should also focus on supporting Federal agency implementation of the Federal Flood Risk Management Standard (FFRMS), including the development of a FFRMS Decision Support Tool and trainings to enhance the abilities of agencies and non-Federal partners to apply flood-related climate-informed science data and tools.

- **Improve capabilities to understand and address wildfire risk**. Federal agencies can improve interagency coordination, expand joint activities, and strengthen existing partnerships with State, local, Tribal, and territorial governments and the private sector to better prepare for, manage, and recover from wildfires. Comprehensive and collaborative assessments, such as those that informed the National Cohesive Wildland Fire Strategy and the final report of the Wildland Fire Mitigation and Management Commission, can guide

whole-of-government efforts to mitigate wildfire risk, especially the growing risk posed by catastrophic wildfire to our communities and natural landscape.

- **Support both new and existing robust communities of practice to enable peer-to-peer learning around climate science information, adaptation planning and implementation, and navigating Federal programs and resources**. Many communities across the nation applying for Federal dollars or undergoing adaptation planning would benefit from mutual assistance and support from peers. The Federal Government can support these communities of practice by convening knowledge exchanges through boundary organizations (e.g., regional science and services organizations), fostering emerging public-private partnerships, especially those with frontline communities, and amplifying "resilience accelerators" to connect communities, researchers, planners, and designers.
- **Promote place-based, people-centered climate solutions**. As established throughout this Framework, climate resilience must be tailored to communities' specific needs. To enable this tailored approach, the Federal Government can strengthen engagement with mayors, county officials, and regional entities, focusing on the development of co-designed climate service solutions and capacity-building initiatives. This could include incorporating climate resilience considerations into landscape conservation designs and leveraging capacity building programs to ensure communities have access to data and information. Following implementation, existing programs can be leveraged to showcase these climate solutions and successes in regions, cities, and towns, and to summarize adaptation and resilience strategies, building an evidence base useful for all communities.
- **Work alongside Indigenous scholars and community experts on data, science, and trainings**. Indigenous communities are keepers of their Indigenous Knowledge and have their own expertise, experience, and approaches in how to pass on and share that knowledge. Federal programs must provide access to the data it has available to support Indigenous decision making, while also seeking to incorporate Indigenous Knowledge in management and scientific research, where appropriate, and respecting and protecting data sovereignty. The Administration should ensure that Tribal Nations, territorial governments, and Indigenous communities have access to data, address existing data gaps on Tribal lands in Federal Government data systems, and support partnerships with Tribal Colleges and Universities to develop curricula, Tribal- and Indigenous-led training, and experiences that bring together Indigenous Knowledge and science to address climate resilience. Federal agencies should align their efforts with, and continue to advance implementation of the White House Guidance on Indigenous Knowledge.
- **Support local and regional coordination amongst Tribal, territorial, and Indigenous communities that results in peer-to-peer learning and sharing of resilience and adaptation best practices**. The Bureau of Indian Affairs' Regional Tribal Climate Resilience Liaison Program is a model of a Federal program for effective coordination executed in partnership with and under the leadership of inter-Tribal organizations. The Administration should also continue to support information sharing efforts, such as the Indigenous Peoples, Lands, and Resources chapter of the Fifth National Climate Assessment, continued updates to the Status of Tribes and Climate Change Report, the biennial National Tribal and Indigenous Climate Conference, and the Indian Country Energy and Infrastructure Working Group.

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Objective 5: Sustainably manage lands and waters to enhance resilience while providing numerous other benefits.

The country's lands, waters, and oceans and the many important services that they provide to nature and society, are at increasing risk due to climate change. Agricultural production has been affected by increases in temperatures affecting farmworker health and more occurrences of heat stress in livestock, as well as more frequent extreme weather events that include drought and flooding that reduce crop yield. Critical ocean habitats, like California's kelp forests and Florida's coral reefs, have declined by 90 percent in less than 10 years due to above normal ocean temperatures and increased ocean acidification. Forests are experiencing more frequent and intense wildfires often turning them from an important tool in the fight against climate change (a carbon sink) into the opposite (a carbon emission source). Water temperatures in freshwater lakes and rivers are warming, creating breeding grounds for the spread of invasive species. Domestically and abroad, scientists are sounding the alarm that a biodiversity crisis—driven by habitat loss frequently linked with climate change—threatens nearly one million species with extinction, undermining the health of the natural systems that supply our food, air, water, medicines, and other societal benefits and impacting the ability of our private lands to produce food, fiber, and fuel. Climate impacts not only affect biodiversity, but are also altering the way humans, animals, and environments interface, contributing to disease spread and outbreaks among vulnerable species.

Investments in nature through conservation and restoration are critical for managing these impacts and are equally integral as *solutions* to the climate crisis. Some researchers estimate that nature-based solutions can boost progress towards climate mitigation goals by up to 30%. Nature-based solutions can also enhance climate resilience, reducing impacts from climate-related hazards, protecting human health and well-being, supporting biodiversity, and providing clean air and water, while helping to create and retain natural resource-related jobs, sustaining livelihoods, and boosting local economies. For example, investments in well-managed forests can reduce risks of catastrophic wildfire and harmful smoke, while also providing clean drinking water, increased recreational opportunities, cultural and subsistence resources, and long-term sustainability of the forest product industry. Similarly, investments in restoring and connecting wetlands and floodplains can mitigate flooding, while also improving water quality, enhancing agricultural productivity, and providing critical habitat for wildlife.

Building a climate-resilient nation requires significant efforts to protect, restore, connect, and conserve the country's nature and natural systems. President Biden's America the Beautiful Initiative is a call to action for the Federal Government and non-Federal partners to advance voluntary conservation and stewardship efforts led by State, Tribal, and local governments, communities, fishers, ranchers, farmers, and landowners. Already, the Administration has made great strides in delivering on the America the Beautiful Initiative. President Biden conserved more lands and waters in his first year than any president since John F. Kennedy; to date, he has conserved more than 21 million acres of lands and waters.

Through the Investing in America Agenda, tens of billions of dollars are being directed to conservation, restoration, and nature-based solutions with climate resilience benefits. In March 2023, the Department of the Interior unveiled its Restoration and Resilience Framework, which will guide $2 billion in IRA and BIL funding to restore ecosystems and revitalize local economies. The framework has guided awards of hundreds of millions of dollars already

awarded to projects across the country. Meanwhile, there is over $2 billion across multiple agencies to support restoring streams and rivers to allow fish to move freely and restore freshwater systems, including $250 million from the U.S. Fish and Wildlife Service who is working alongside NOAA to expand marine ecosystems that also enhance fisheries and benefit local communities. The IRA also directs more than $18 billion to U.S. Department of Agriculture conservation programs to support the adoption of agricultural practices with demonstrated greenhouse gas reduction or carbon sequestration benefits; many of these techniques, such as the use of cover crops, also have climate resilience co-benefits.

In addition to mobilizing historic levels of investment, the Biden-Harris Administration has advanced first-of-its kind policy specific to nature-based solutions and land and water management. In November 2022, the Administration released the first-ever National roadmap for accelerating and addressing barriers to nature-based solutions and a companion Resource Guide to help Federal agencies and partners implement these solutions. The Administration is also embedding nature into planning and management decisions (see Objective 1), and the White House Office of Management and Budget recently released draft guidance strongly encouraging Federal agencies to consider nature-based solutions and nature-based features in their infrastructure investments (see Objective 2). Further, the Administration established a system of Natural Capital Accounts to measure the economic value—including the resilience benefits—that natural systems deliver. These accounts will enable us as a society to more accurately connect changes in nature with changes in economic performance and invest accordingly.

The Federal Government must also take into account future climate conditions and ecological transformations that are underway in order to protect both nature and people. The U.S. Global Change Research Program is conducting the first-ever National Nature Assessment to take stock of the country's lands and waters, the benefits they provide, and their intersections with climate change. Meanwhile, agencies like the U.S. Department of Agriculture that support public and private land management are integrating climate adaptation into their programs and forward-looking decision-making through implementation of strategies to address the wildfire crisis, water availability in the West, and reforestation in the National Forest System.

At the core of all Federal investments and actions related to climate resilience of our Nation's lands and waters is meaningful community leadership and engagement including consultations and partnerships with Tribal Nations, local stakeholders, and those who own, manage, and rely on the country's lands and waters. Federal programs are already investing more in engagement and consultation up front, and are building sustained Federal community partnerships, such as the Thriving Communities Network as well as the Ocean Justice Strategy called for in the Ocean Climate Action Plan. These investments will ensure that local communities and stakeholders are leading on conservation and restoration and advance environmental justice and equity, including for disadvantaged and historically underserved communities, improve the distribution of benefits from nature-based projects to reach those most vulnerable to climate risks, expand opportunities for incorporating local and Indigenous Knowledge into informational resources (see Objective 4), and increase returns on nature-based investments by ensuring that they are community-led.

Opportunities for Action

- **Continue to support locally-led conservation and restoration efforts through the America the Beautiful Initiative.** Agencies can and should continue to expand their work to support voluntary, locally-led efforts to protect, conserve, connect, and restore key lands

and waters that may also assist in offsetting greenhouse gas emissions—such as wetlands (including nearshore habitats, mangroves, and peatlands), coral reefs, and ancient and mature forests—while at the same time providing strongholds for species richness in the midst of climate change.

- **Integrate changing climatic conditions into natural resource management plans**. Continuing to consider and prioritize climate change in Federal natural resource planning will improve outcomes of conservation and sustainable management, resulting in climate-resilient ecosystems and ecosystem services. When appropriate, these plans should seek to maintain intact and connected landscapes, support wildlife, increase ecological connectivity, establish migration corridors, sequester and store carbon, use technology to facilitate monitoring of climate resilience and mitigation potential, and promote watershed and ecosystem function.
- **Continue to increase the role of Tribal Nations in land management**. The Biden-Harris Administration has made strides in elevating Nation-to-Nation engagement, incorporating Indigenous Knowledge into Federal decision-making, and ensuring Tribal co-stewardship of lands and waters including through a number of new commitments and initiatives announced at the November 2022 Tribal Nations Summit. Recognizing Tribal Nations as stewards of the country's lands and waters since time immemorial, it remains critical to continue to invest in and support Tribal capacity to protect, conserve, and restore Tribal and Federal lands and waters.
- **Ground nature-based solutions in Indigenous Knowledge**. Indigenous communities have long utilized nature-based solutions—such as cultural fire for catastrophic fire prevention and ecosystem health—to enhance climate resilience. In December 2022, the Administration released guidance for Federal agencies on how to incorporate Indigenous Knowledge into Federal decision-making. This guidance will also support better consultation and engagement with Tribes and other indigenous communities with an aim of including traditional nature-based solutions in climate resilience planning and implementation, and to facilitate the co-management and co-stewardship of natural and cultural resources.
- **Prevent, eradicate, and control invasive species**. Agencies can strengthen coordinated Federal and non-Federal approaches to prevent, eradicate, and control the highest risk invasive species, a number of which are increasing in range due to climate change by advancing the efforts of the Department of the Interior's National Invasive Species Council. This includes integrating climate science planning to inform strategic invasive species management actions, and integrating invasive species awareness (through literacy and training) and risk mitigation into broader climate resilience efforts (for example, infrastructure, supply chains, and transportation) to help safeguard those investments.
- **Support private landowners and businesses to innovate and adapt to a changing climate**. Integrating consideration of climate risk and adaptation options into financial and technical assistance programs that incentivize climate-smart land management can help families and businesses manage their climate-related risks. Such programs could, for example, fund conservation practices that maintain and improve soil health, water quality, and watershed and habitat function. Ensuring collaboration with State, local, Tribal, and territorial partners will also be essential to maximize the climate-related benefits of these programs.

- **Establish minimum criteria for nature-based alternatives**. Developing government-wide minimum design and planning criteria for nature-based solutions can support broader understanding of what constitutes a "nature-based" alternative. This improved understanding can lead to broader deployment of nature-based solutions.
- **Support practices for effective, efficient, and transparent Federal, State, local, Tribal, territorial government permitting processes for nature-based solutions**. Accelerating permitting processes for appropriate, well-established, nature-based solutions can speed implementation of resilience-enhancing actions. Agencies should create new mechanisms to improve Federal permitting and review processes, and support similar efforts among State, local, Tribal, or territorial governments.
- **Document performance of nature-based solutions**. Conducting systematic research on the reliability, operation, and maintenance of nature-based solutions will increase confidence in their use, support maintenance and upgrades, and enable their integration into decision support tools. In particular, research is needed on the performance of nature-based solutions at large scales and over long time periods to ensure longevity of function and durability of installation.
- **More fully account for natural assets' contributions to adaptation and resilience in Federal decision making**. Aligning agency guidance, practices, and capacities on valuing environmental and ecosystem services can improve accounting for resilience costs and benefits in benefit-cost analyses. In addition, agencies can better reflect the value of resilience to the nation's economy by contributing capacity, data, and resources to the Natural Capital Accounts and the underlying System of Environmental Economic Statistics.
- **Integrate changing wildfire risks into resource management, wildland fire mitigation, and emergency management actions**. Agencies can assist landscapes, communities, and the wildland fire workforce adapt to novel fire regimes and longer fire seasons, while reducing risks to people and to nature. Federal actions for natural resource management, wildland fire mitigation, and emergency management should be informed by fire-related climate science, fire ecology, interdisciplinary perspectives, Indigenous Knowledge, and best practices in adaptive management. Land use practices should also be evaluated to determine how they can reduce wildland fire risks. The National Cohesive Wildland Fire Strategy and Wildfire Mitigation and Management Commission final report provides specific recommendations for addressing impacts across landscapes and communities.
- **Protect wetlands and other key freshwater and coastal resources in the face of climate change and other stressors**. Well-managed floodplains and wetlands provide myriad benefits to human health and safety, including crucial flood control benefits, water quality, and healthy habitats for fish and wildlife. The natural benefits that rivers, lakes, wetlands, and coastal ecosystems like marshes and mangroves provide food security benefits through productive fisheries and flood protection through flow regulations and will only become more important as our climate changes. Federal agencies should increase coordination and work within their existing authorities to conserve and restore freshwater and coastal ecosystems under their jurisdictions, and should partner with State, local, Tribal, and territorial governments to enhance stewardship at all levels of government. This includes working with ranchers, farmers, and resource-dependent businesses to improve water

conservation, and land and forest stewardships to restore degraded watersheds in priority drought impacted areas to improve water security.

- **Continue to invest in creating green spaces and protect urban natural spaces to mitigate extreme heat and air pollution**. Offering Federal funding, tools, and expertise to help communities implement tree-planting and greenscaping programs can reduce the impacts of extreme heat and improve air quality, particularly in nature-deprived communities in urban areas resulting in positive contributions to overall community wellness. The U.S. Department of Agriculture Forest Service Urban and Community Forestry program is one vehicle for providing technical and financial assistance to communities for urban forests and tree canopies, with a particular focus on disadvantaged communities who are most affected by climate impacts. Urban greening programs can reduce cooling costs for low-income and overburdened communities, reducing health conditions that are exacerbated by heat and poor air quality.
- **Increase opportunities for public-private partnerships that advance conservation for climate resilience**. Federal agencies that manage lands and waters are uniquely situated to advance public-private partnerships to incentivize delivery of conservation actions on natural and working lands and waters to advance climate resilience while maximizing co-benefits, such as provision of carbon storage and biodiversity benefits.

Objective 6: Help communities become not only more resilient, but also more safe, healthy, equitable, and economically strong.

A community's climate resilience is closely linked to its economic, social, and physical well-being. Communities with diverse economies, strong civic engagement, food and water security, and access to essential services like equitable transportation, affordable housing and health care will be more resilient to climate threats. For example, investments in a community's health care system—including in medical supply chains, health care facilities, and outreach networks—will improve not just the overall health and well-being of community members during normal operations, but also their capacity to mitigate, adapt to, and recover from the compounding impacts of extreme weather events and long-term climate stresses. Moreover, individuals with underlying health conditions tend to be more vulnerable to extreme weather events, such as heat waves, meaning that measures that improve communal health improve climate resilience. The Federal Plan for Equitable Long Term Recovery and Resilience presents opportunities for leveraging Federal resources to promote social, behavioral, and community health alongside climate resilience.

Increasing the water and energy efficiency of our housing stock through opportunities such as the Department of Housing and Urban Development's Green and Resilient Retrofit Program makes homes more resilient to climate impacts like intense hurricanes and heat waves. Installing community-scale solar and storage, microgrids powered by renewable energy, and other distributed clean energy resources through opportunities such as the Department of Energy's Community Power Accelerator program, improve local air quality, while creating local energy systems that provide power during grid disruptions. Planting trees and expanding greenspaces in

urban environments improves physical and mental health and increases food security and recreational opportunities, while mitigating extreme heat and flooding (see Objective 5).

Across sectors, workforces and workplaces must adapt to climate change. Investments in climate resilience can deliver tangible workforce benefits. These include the development of new local jobs, new specialties in existing jobs, and improved health and safety. For example, the National Oceanic and Atmospheric Administration's Climate-Ready Workforce plan will invest $60 million to place workers in high-quality jobs that advance climate resilience and the American Climate Corps will train young people in high-demand skills for jobs in the clean energy economy. Yet providing climate-related job and training opportunities is necessary, but not sufficient for ensuring workers' health, safety, and resilience, especially when job opportunities are often outdoors or otherwise exposed to climate hazards like heat or floods. This is why incorporating worker health and safety protections that take climate impacts into account is necessary for a thriving workforce today and in decades to come. The public sector at all levels can reform processes and policies related to climate-ready workforce development to prioritize considerations and protections for worker health and safety. Moreover, collective bargaining can strengthen workers' protections against climate-exacerbated issues in the workplace, which underscores the importance of ensuring workers have good jobs with the free and fair choice to join a union.

Communities can establish local "resilience hubs" to capitalize on the cross-cutting benefits of resilience-related investments. These hubs can be community centers, libraries, cultural organizations, parks and recreation buildings, and other public-serving spaces that serve communities year-round as gathering places and as critical safe spaces before, during, and after disasters. These buildings and sites are designed or retrofitted to withstand multiple types of disasters and climate threats. Resilience hubs—and the trusted staff that work there—can offer workforce development and training opportunities related to sustainability and resilience; deliver needed and uninterrupted social, legal, and health services; help preserve cultural practices and heritage at risk from climate threats; and build community capacity to develop the climate resilience solutions most appropriate to them (see Objective 4). A variety of Federal funding is available for communities to launch resilience hubs, including through the Federal Emergency Management Agency's Building Resilient Infrastructure and Communities (BRIC) program, the Department of Energy's Energy Efficiency and Conservation Block Grant Program, and the Environmental Protection Agency's Environmental and Climate Justice Communities Grants.

In some cases, helping communities thrive means supporting communities who may want to relocate away from places that climate change is rendering uninhabitable. Rising sea levels could displace 2 million Americans by 2100; millions more are likely to move due to intensified severe weather, wildfire, and chronic stresses like drought and extreme heat. Supporting voluntary relocation of communities, neighborhoods, and families at severe risk of personal injury, property damage, or loss of livelihood who need and desire to move is sometimes the best or only strategy for meaningfully reducing that risk. Supporting community-driven relocation also means supporting receiving communities—the places where people may relocate to—such as by directing funding and capacity for social services or expediting development of additional affordable housing. The Department of Housing and Urban Development's Climate Resilience Implementation Guide for Community Driven Relocation provides a step-by-step guide for communities seeking to implement a community-driven relocation program. Additionally, through BIL and IRA funding, as well as other appropriations, the Department of the Interior, the

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Federal Emergency Management Agency, and the Denali Commission have committed $135 million to support the relocation efforts of 11 severely impacted Tribal Nations. The U.S. Department of Agriculture is also supporting relocation activities for 14 rural Alaskan villages and Tribes through the Natural Resource Conservation Service Watershed and Flood Prevention Operations Program.

Opportunities for Action

- **Ensure access to lifeline services remains stable through both acute and chronic climatic events.** Disruptions to lifelines—such as energy, communications, water, health, and transportation services—because of climate change increases threats to health and wellbeing across communities. In order to help communities recover lifelines post-disaster, the Federal Government can continue to partner with local utilities, hospitals, governments, and the private sector to proactively build resilience and reduce disruption across these services in anticipation of climate events.
- **Build a climate-ready and climate-educated workforce**. Building a climate-ready and climate-educated workforce requires broad and comprehensive education and professional development. The Federal Government can invest in all levels of education—including K-12, vocational schools, college, and postsecondary education and training—to ensure the workforce is prepared to implement strategies that reduce risk, maximize resilience, safeguard cultural heritage, and respond to community needs. Agencies can implement curricular resources and leverage existing climate training opportunities to equip workers with essential principles on climate resilience and trade-specific competencies—this includes supporting registered apprenticeship programs and partnerships between labor unions, employers, and community/technical colleges. The Federal Government can also expand and create fellowships and peer-to-peer climate resilience-focused changes to promote networks, transferrable learning, and collaborative training opportunities between the governments, labor unions, educational institutions, the private sector, and communities.

  This can be facilitated through the following ways:

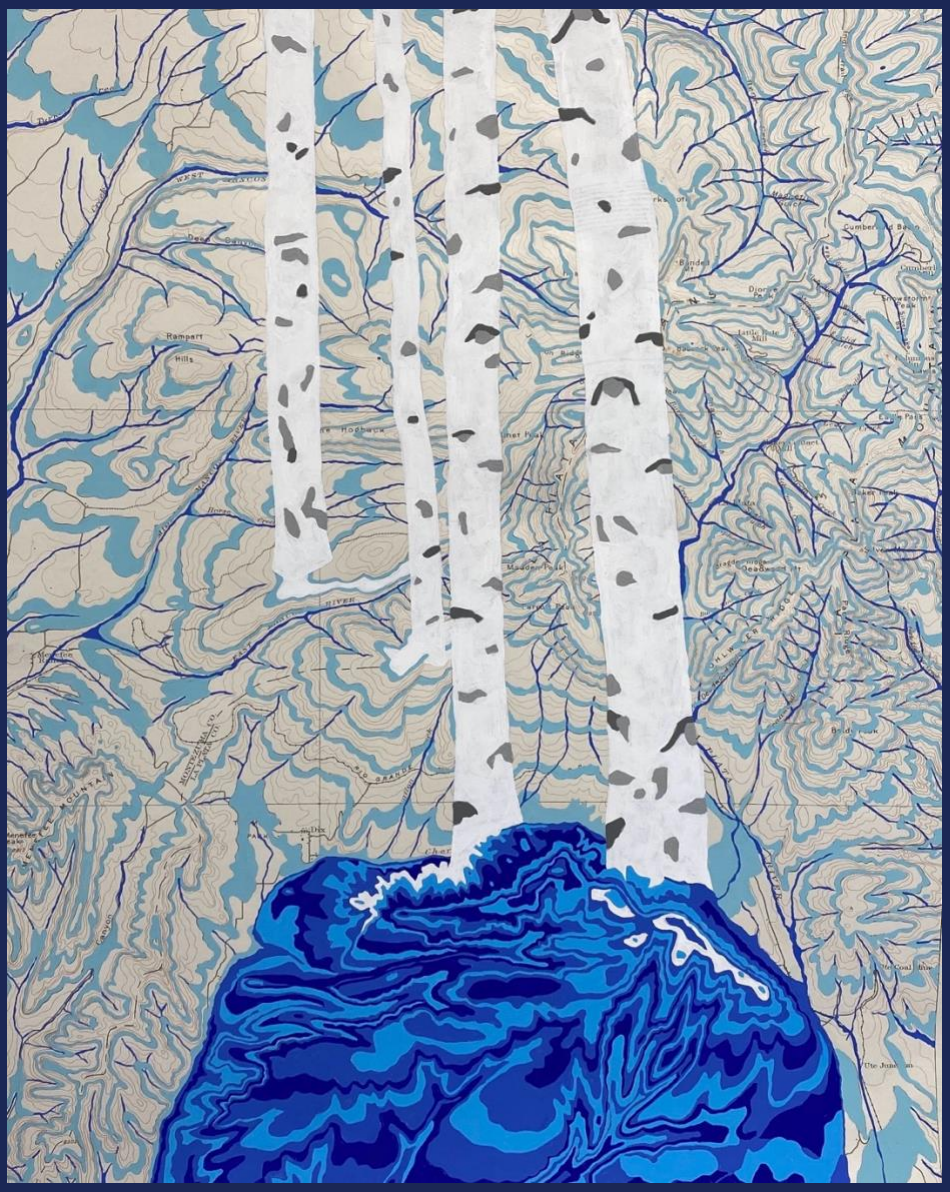
  - Work with public universities, Tribal Colleges and Universities (TCUs), Historically Black Colleges and Universities (HBCUs), and Minority-Serving Institutions, including Hispanic Serving Institutions, and community colleges to cultivate opportunities and networks that expand the workforce needed to build a climate resilient nation.
  - Provide support for innovative curriculum development through partnership development and place-based learning. For example, the Federal Government can implement place-based, climate resilience-oriented national service and career training programs through agencies like AmeriCorps that support a range of disciplines.
  - Work with schools and colleges to creative innovative fellowship and mentorship programs that let students work on real-world climate issues.
  - Attract top international talent in STEM fields through using the expanded access of legal immigration through J-1, O1-A, and F-1 visas, as well as through sponsoring fellowships put in place by the Biden-Harris Administration.

  - Find state and local workforce development boards to engage relevant partners including employers, community colleges and other institutions of higher education, labor unions, community-based organizations, and others who make up the education and workforce development ecosystem. Workforce development boards may also be able to assist partners in accessing services and Federal funds provided by the Workforce Innovation and Opportunity Act (WIOA).

- **Facilitate access to funding and technical assistance for community-driven relocation**. Community-driven relocation requires extensive services to support both communities and individuals (transportation, housing, schools, jobs, and counseling services) thrive. Agencies can increase access to funding by improving regional coordination with trusted community partners to help communities assess their options, and by identifying and removing barriers in funding application processes, including waving cost share for communities undertaking significant community-wide relocation efforts.
- **Support State, local, Tribal, and territorial governments developing resilience plans that consider impacts for both relocating and receiving communities**. Deliberate, strategic planning of relocation logistics can help reduce disruptions and empower self-determination of individuals and communities who choose to relocate. Such planning can also better align the financing of the relocating and receiving communities, minimize the impact on families, and restore or protect relinquished lands. Supporting receiving communities is closely linked to expansion of affordable, climate-resilient housing (see Objective 2); one of the driving reasons that individuals and communities do not relocate before, or even after a disaster is difficulty finding comparable housing at an affordable price.
- **Expedite and improve voluntary buyout processes**. Voluntary buyouts can be a key driver of relocation, but must be developed equitably, to ensure they are more accessible to underserved groups. The Federal Government can improve this means of relocation by promoting buyouts as part of a local government's comprehensive community-wide resilience plan. For instance, the Federal Government could explore accessing and establishing a uniform, coordinated Federal application process for buy-out projects with simplified damage assessments and cost-benefit analyses, thereby reducing the burden on homeowners. Federal actors can also provide up-front funding and capacity building for state and local authorities, which would help communities incorporate buyouts in a pre-disaster hazard mitigation plan.
- **Evaluate community-driven relocation programs to improve policies over time**. Evaluating relocation programs and processes and facilitating knowledge sharing between communities considering or undergoing relocation is critical to understanding and improving their effectiveness. Federal agencies should evaluate their acquisition and regulatory tools that facilitate relocation, including buyout programs, the transfer of development rights, leasebacks, land swaps, and conservation land trusts, as well as ongoing Tribal relocation demonstration projects.
- **Increase awareness and training for climate-related health risks**. Climate change poses threats to individuals' current and future health conditions and exacerbates existing health threats, particularly for vulnerable populations, such as the elderly, the young, pregnant women, and those living with chronic disease. The Federal Government can work alongside the medical community and local governments to enhance monitoring of climate-related

hazards such as impaired air quality and extreme heat. The Federal Government can also work with non-Federal partners to ensure that health providers are literate, trained in, and ready to respond to potential health threats from climate change and to ensure that the public is aware of actions they can take to protect themselves from climate-related hazards.

- **Support essential workers, first responders, and health professionals in responding to climate stresses**. Climate impacts like extreme heat, wildfire, and severe storms increase demands across public service sectors. The often-strenuous conditions of responding to climate emergencies can take a toll on the mental and physical health of the essential workers, first responders, and health professionals who support continuity of public services during these emergencies. The resilience of services depends on the resilience of these workers, and governments at all levels should ensure that these workers are provided with the personal protective equipment, training, adequate staffing, and access to care they need to remain healthy and ready to work.
- **Enhance the resilience of the nation's health care system with a focus on safety net institutions**. Extreme weather events such as heat waves can result in tighter allocation of energy resources and disruptions of water resources and supply chains, threatening the continuity and effective functioning of health systems and the health of people that rely on them. The Federal Government can support health system resilience through an integrated program of tools and resources, technical assistance, and dedicated funding for resilience retrofits.



Meredith Nemirov
Rivers Feed the Trees #467 (Aquifers)
(2022, Acrylic on Historic Topographic Map)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.

DEPARTMENT OF THE INTERIOR

CLIMATE ADAPTATION PLAN

2024

Deb Haaland
Secretary
United States Department of the Interior

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EXECUTIVE SUMMARY

The Department of the Interior (Interior, Department) has significant responsibilities, including managing 20 percent of the Nation's lands; supplying water and hydropower in the 17 Western States; conserving plants, fish and wildlife, and their habitats; preserving historic and cultural resources; providing geological, hydrological, and biological science; fulfilling trust responsibilities or special commitments to American Indians, Alaska Natives, Native Hawaiians, and affiliated island communities; providing recreational opportunities to the public; and responsibly managing renewable and nonrenewable energy and mineral development on public lands and the Outer Continental Shelf (OCS).

This Climate Adaptation Plan (Plan) was prepared in accordance with guidance for Federal climate adaptation planning from the White House Council on Environmental Quality (CEQ). The information presented here aligns with adaptation and resilience requirements in section 211 of Executive Order (EO) 14008, entitled "Tackling the Climate Crisis at Home and Abroad"; section 5(d) of EO 14030, entitled "Climate-Related Financial Risk"; and section 503 of EO 14057, entitled "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability." This work also describes how the Department is contributing to the objectives and opportunities for action identified in the Biden-Harris administration's National Climate Resilience Framework.

The Plan builds on the Department's 2021 Climate Action Plan by quantifying, at a high level, exposure to climate hazards—including extreme heat, extreme precipitation, flooding, wildfire, and sea level rise—that can affect the Department's ability to meet its mission in the coming years. The impact of the projections is significant—nearly every building and employee will face hotter temperatures and more extreme precipitation events. Sea level rise will affect hundreds of Interior-managed sites, from national parks and wildlife refuges to historic sites. Uncharacteristically severe wildfire already affects millions of acres of lands managed by the Department. In addition, other climate change-influenced drivers of change, such as drought and invasive species, will also affect the natural and cultural resources the Department stewards in the years to come.

The Plan also provides updates on important progress made since publication of the 2021 Climate Action Plan, including the following:

- Significant investments in the stewardship of lands, waters, and facilities, including through funding from the Bipartisan Infrastructure Law (BIL), Inflation Reduction Act (IRA), and Great American Outdoors Act (GAOA), and the establishment of a restoration and resilience framework to advance the impacts of the Department's work.
- Funding for American Indian, Alaska Native, Native Hawaiian, and insular area communities to increase their resilience in the face of climate change.
- Updates to Departmental policy to better factor climate change into its work.

As the Department plans for the next several years, it will build on this foundation to address the hazards presented by climate change. This plan outlines steps for the Department to take through 2027, organized under three overarching themes, that will strengthen its adaptive capacity and resilience:

- **Understand and assess current and future impacts of climate change on Department assets, mission, operations, and services**. This includes improving understanding of key vulnerabilities, pursuing research on climate hazards and stressors, and integrating findings into decision support tools and enterprise-wide planning.
- **Prioritize and scale adaptation and resilience efforts.** This includes implementation of new Department policies, targeted investments in conservation and resilience, wider adoption of NBS, and enhancement of equitable funding opportunities for communities and partners to adapt to climate change.
- **Build capacity for adaptation within the Department's workforce and through partnerships.** This includes developing new guidance, training, and performance expectations for the Department's workforce, and continued meaningful engagement and collaboration with communities, including American Indians, Alaska Natives, Native Hawaiians, and affiliated island communities.

The Plan identifies potential opportunities that will help to inform the Federal budget development process, but it is not a budget document and does not imply approval of any specific action or investment. All activities and recommendations included in the report are subject to resource constraints and weighing of priorities as part of the annual budget formulation process, as well as the availability of appropriations provided by Congress.

Through its Plan, the Department is also able to advance environmental justice as part of its mission, consistent with EO 14008 and with EO 14096, entitled "Revitalizing Our Nation's Commitment to Environmental Justice for All." As the Department implements its Plan to increase the resilience of its facilities and operations, the agency shall, as appropriate and consistent with applicable law (1) address disproportionate and adverse environmental and health effects (including risks) and hazards, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns, and (2) provide opportunities for the meaningful engagement of persons and communities with environmental justice concerns.

In addition, as a member of the White House Environmental Justice Interagency Council (WHEJAC), the Department received recommendations on climate planning, preparedness, response, recovery and impacts. The Department is reviewing the recommendations and, as appropriate and to the maximum extent permitted by law, is taking steps to address the WHEJAC's recommendations.

KEY TERMS

Adaptive Capacity: The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.

Climate Adaptation: In human systems, the process of adjustment to actual or expected climate and its effects to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects. Human intervention may facilitate adjustment to expected climate and its effects.

Climate Mitigation: Measures to reduce the amount and rate of future climate change by reducing emissions of heat-trapping gases or removing carbon dioxide from the atmosphere.

Climate Resilience: The capacity of interconnected social, economic, and ecological systems to cope with a climate change event, trend, or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure. Climate resilience is a subset of resilience against climate-induced or climate-related impacts.

Environmental Justice: The just treatment and meaningful involvement of all people, regardless of income, race, color, national origin, Tribal affiliation, or disability, in agency decision making and other Federal activities that affect human health and the environment so that people:

> (i) are fully protected from disproportionate and adverse human health and environmental effects (including risks) and hazards, including those related to climate change, the cumulative impacts of environmental and other burdens, and the legacy of racism or other structural or systemic barriers; and
>
> (ii) have equitable access to a healthy, sustainable, and resilient environment in which to live, play, work, learn, grow, worship, and engage in cultural and subsistence practices. (Source: EO 14096, section 2(b), 88 FR 25251 (Apr. 26, 2023)).

Exposure: The presence of people, assets, and ecosystems in places where they could be adversely affected by hazards. (U.S. Climate Resilience Toolkit).

Hazard mitigation: Any sustained action taken to reduce or eliminate the long-term risk to human life and property from hazards.

Nature-based Solutions: Actions to protect, sustainably manage, or restore natural or modified ecosystems as solutions to address societal challenges, simultaneously providing benefits for people and the environment. (Nature Based Solutions: Guidance and Examples).

Risk: Threats to life, health and safety, the environment, economic well-being, and other things of value. Risks are evaluated in terms of how likely they are to occur (probability) and the damages that would result if they did happen (consequences).

**Definitions used are from the Fifth National Climate Assessment, unless noted otherwise.

SECTION 1: AGENCY PROFILE

Agency Mission	The Department protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its trust responsibilities or special commitments to American Indians, Alaska Natives, Native Hawaiians, and affiliated island communities.
All Agency Bureaus Included in Climate Adaptation Plan	▪ Bureau of Indian Affairs ▪ Bureau of Indian Education ▪ Bureau of Land Management ▪ Bureau of Ocean Energy Management ▪ Bureau of Reclamation ▪ Bureau of Safety and Environmental Enforcement ▪ Bureau of Trust Funds Administration ▪ National Park Service ▪ Office of Surface Mining Reclamation and Enforcement ▪ U.S. Fish and Wildlife Service ▪ U.S. Geological Survey ▪ Office of the Assistant Secretary – Insular and International Affairs ▪ Departmental Offices
Agency Climate Adaptation Official	Joan Mooney, Principal Deputy Assistant Secretary for Policy, Management and Budget
Agency Risk Officer	Patricia Currier, Director of Planning and Performance Management
Point of Public Contact for Environmental Justice	Eric Werwa, Ph.D., Acting Director, Office of Congressional and Legislative Affairs Environmental Justice Contact: environmental_justice@ios.doi.gov

Owned Buildings	41,800 owned buildings/ more than 99,000,000 square feet (Fiscal Year (FY) 2023 Federal Real Property Profile)
Leased Buildings	310 commercial leases accounting for nearly 2,800,000 Rentable Square Feet (RSF) (FY 2023 Federal Real Property Profile). Approximately 775 U.S. General Services Administration (GSA) Occupancy Agreements accounting for nearly 12,900,000 RSF (FY 2023 Occupancy Agreement Data from GSA).
Employees	77,070 full-time employees (Interior Office of Human Capital FY23 data)
Federal Lands and Waters	• 480 million acres of public lands • 700 million acres of subsurface mineral responsibilities • 3.2 billion acres of the OCS[1]
Budget:[2] ***($000s)***	**FY22 Enacted:** $16,208,272 **FY23 Enacted:** $17,334,379 **FY24 Enacted:** $16,865,543 **FY25 President's Budget:** $17,999,149 **Does not include supplemental or permanent appropriations*
Key Areas for Climate Adaptation Efforts	• Fulfilling trust and special responsibilities to American Indians, Alaska Natives, Native Hawaiians, and insular communities. • Conserving, protecting, managing, and restoring natural and cultural resources. • Providing recreational opportunities to the public • Managing water resources. • Responsibly managing energy development on public lands and in offshore environments. • Maintaining facilities and services that support fulfillment of the Department's mission. • Training the Department's workforce and ensuring a safe working environment.

SECTION 2: ASSESSING CLIMATE RISKS

A key first step to achieving resiliency is to understand where hazards are likely to occur and how different assets are exposed to them. This provides a foundation for evaluating how that exposure translates into risk—for buildings, employees, or other resources of interest.

The Department used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App), which was developed for Federal agencies by CEQ and the National Oceanic and Atmospheric Administration (NOAA), to conduct a high-level screening of climate hazard exposure for Federal facilities and personnel. The Department also used the Strategic Hazard Identification and Risk Assessment (SHIRA) project, developed by the U.S. Geological Survey (USGS) and Interior's Office of Emergency Management. The SHIRA is available to Interior employees and includes numerous data layers (including risk data that is both climate and non-climate-related). These data were used to complement results from the Federal Mapping App and provide additional context about what climate exposure means to assets and operations.

The Department assessed the exposure of its buildings and employees to five climate hazards: extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk. These five hazards represent key vulnerabilities to Department assets and sufficient data coverage exists for their assessment for many geographies. However, hazards not included in this study (e.g., drought, invasive pests, etc.) may pose additional risk to staff, facilities, and operations. The Plan also presents a summary of climate hazards that affect the lands, waters, and cultural and natural resources the Department manages. Additional information about the data used in this exposure assessment can be found in appendix A.

Table 1. Climate Data Used in Agency Risk Assessment

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS and AK
Sea Level Rise	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High sea level rise scenarios are used as proxies for RCP 4.5 and 8.5, respectively. Projections of inundation extents from the 2017 NOAA report, "Global and Regional Sea Level Rise Scenarios for the United States," available through the SHIRA hazard exposure dashboard, were used for areas outside the 48 contiguous States and Puerto Rico.	RCP 4.5	CONUS, HI, and territories
		RCP 8.5	CONUS, HI, and territories
Wildfire Risk	Measured as whether an asset is in a location is rated as high, very high, or extreme risk based on the U.S. Forest Service (USFS) Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1 percent annual chance of flooding) or 500-year floodplain (0.2 percent annual chance of flooding). Data from the Federal Emergency Management Agency National Flood Hazard Layer and First Street Foundation's Flood Model were used.	Historical and 2052 (First Street only)	All 50 States and PR

Exposure to extreme heat, extreme precipitation, and sea level rise were evaluated at mid- (2050) and late-century (2080) under two emissions scenarios, Representative Concentration Pathway (RCP) 4.5 and RCP 8.5.[3] Exposure to flooding and wildfire risk were only evaluated for the present day due to data constraints.

Table 2. Climate Scenarios Considered in Agency Risk Assessment

Scenario Descriptor		Summary Description from the 5th National Climate Assessment
RCP 8.5	Very High Scenario	This scenario reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46 percent less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

Additional details about the data used in this assessment are provided in appendix A.

GEOGRAPHIC LIMITATIONS TO ASSESSING EXPOSURE

Relative to the contiguous United States, other regions of the United States, including Alaska, the Hawaiian Islands and U.S.-affiliated Pacific islands (USAPI), Puerto Rico, and the U.S. Virgin Islands are lacking data to inform climate risk projections. This has implications for portfolio-wide assessments of Department-managed assets, and for assessment of region-specific hazards.

At the national level, these data gaps limit our ability to fully assess the impact of hazards. Sea level rise in the Pacific provides an example of the importance of closing these gaps. Studies are in progress to assess sea level rise impacts on U.S. Fish and Wildlife Service (FWS) refuges and national parks in Hawaii and the USAPI. In Hawaii, local vulnerability assessments project a sea level increase of 3.2 to 3.9 feet above year 2000 levels by 2100 in the intermediate sea level rise scenario, or as soon as 2070 under the high scenario. Approximately 3 feet of sea level rise is projected in Guam, affecting at least 58 percent of its built environment. The combination of sea level rise and storm surge or king tides is currently impacting buildings and infrastructure, including National Park Service (NPS) sites such as the Pearl Harbor National Memorial. The SHIRA project uses sea level rise data created by NOAA that map the extent of sea level rise in 1-foot increments, which can serve as a proxy for different emissions scenarios where data gaps occur, but no similar data are available for hazards like extreme heat or extreme precipitation.

Regional hazards—like tropical storms and permafrost changes—have important implications for decision making. For example, in Alaska, 80 percent of the State is underlain by permafrost. Buildings and other infrastructure are at risk due to temperature increases and resulting permafrost degradation, but precise information of projected impacts is lacking. Impacts of thawing permafrost in Interior-managed lands have already been observed; for example, in 2021, a landslide from a thawing rock glacier in Denali National Park cut off a section of the Denali Park Road, with further slumping occurring through summer in 2022. The cost estimates for addressing the damage to restore visitor access is at least $102 million.[4] The SHIRA project includes data on permafrost extent, and the USGS Alaska Climate Adaptation Science Center is supporting region-specific research to understand how permafrost and other important features of Alaska are changing and developing platforms to share the resulting data.[5]

2A. Climate Risks Affecting Mission, Operations and Services

The work of the Bureaus and Offices that comprise the Department is varied, including the provision of services such as stewarding resources; facilitating energy development; and supporting outdoor recreation; and delivering water, power, and other services to communities. While each of the Bureaus within the Department has its own distinct mission, the impacts of climate change will be felt across the agency. The following section includes a table of crosscutting areas of impact (table 3) followed by a description of each Interior Bureau's mission and examples of Bureau-specific climate impacts.

Table 3. Summary of Key Current and Projected Climate Hazard Exposures and Impacts

Area of Impact	*Description*	*Identified Climate Hazard*[6,7,8]	*Potential Impacts*
Biodiversity	*The Department is charged with conservation and management of millions of acres of public lands and waters. Maintaining healthy ecosystems, protecting native species, and safeguarding biodiversity are some of the main goals of natural resource conservation.*	• Increased severity of wildfires • Ocean acidification • Sea level rise • Changing precipitation patterns • Increased temperatures • Increased severity of drought	• Habitat loss and range shifts • Biodiversity loss • Changes in invasive species abundance, density, and range
Cultural Resources	*Interior protects and manages a wide range of cultural resources, such as archeological sites, historic structures, collections of museum objects, and cultural landscapes.*	• Increased flood risk • Increased temperatures • Increased severity of wildfires • Melting permafrost • Sea level rise	• Flooded/destroyed historic resources including landscapes, structures, and archeological sites • Loss of/damage to archaeological resources • Changes to/loss of natural processes, flora, fauna, etc. that have cultural significance to specific peoples • Stress on, or loss of, historic structures
Freshwater Resources	*The Department, through the Bureau of Reclamation (BOR), plays an integral role in managing water in the Western United States, and BOR's facilities provide much of the infrastructure critical to storing and distributing water in the West. The Department, through NPS and FWS, works to conserve, protect, and restore water resources.*	• Changing precipitation and runoff patterns • Increasing severity of drought • Decreased water availability • Increased temperatures • Loss of snowpack • Sea level rise • Increased flooding • Increased severity of wildfire	• Changes to water supply and demand • Decreased water quality • Degraded infrastructure • Degraded habitat • Impacts to aquatic species and waterfowl • Impacts to recreation
Infrastructure	*Interior manages a wide variety of infrastructure, including buildings, roads, dams, scientific labs, water delivery systems, fences, tunnels, and other equipment. This infrastructure allows millions of visitors to enjoy public lands, provides water to the West, and powers Tribal communities.*	• Changing precipitation patterns • Higher storm surges • Increased flood risk • Increased temperatures • Sea level rise • Increased severity of wildfire	• Damage to/decreased access/loss of access to infrastructure • Altered functionality (operations, efficiency, and safety) of existing infrastructure • Visitor safety concerns

Area of Impact	*Description*	*Identified Climate Hazard*[6,7,8]	*Potential Impacts*
Island Communities	*The Department has responsibilities to effectuate and implement the special political and legal relationship between the United States and the Native Hawaiian Community and continue the process of reconciliation with the Native Hawaiian people. It is also responsible for coordinating Federal policy with respect to the territories of American Samoa, Guam, the U.S. Virgin Islands, and the Commonwealth of the Northern Mariana Islands, and administering and overseeing U.S. Federal assistance provided to the freely associated states of the Federated States of Micronesia, the Republic of the Marshall Islands, and the Republic of Palau.*	• Changing precipitation patterns • Increasing severity of drought • Higher storm surges • Increased flood risk • Increased temperatures • Sea level rise • Increased severity of wildfire	• Damage to/decreased access/loss of access to infrastructure and other critical components of a community, resulting in community-managed retreat and/or relocation • Decreased access to clean freshwater • Decreased reliability of electricity due to severe storms • Decline of culturally significant endemic species • Increasing technical and financial assistance needs • Increased fire risk to communities
Energy and Mineral Development	*Interior, through the Bureau of Land Management (BLM), manages about 245 million surface acres and 700 million subsurface acres, located primarily in 12 Western States, including Alaska, many of which are open to energy and mineral development. In addition, the Department manages energy and mineral development on the 3.2-billion-acre OCS, through the Bureau of Ocean Energy Management and Bureau of Safety and Environmental Enforcement, and regulates coal mines and assures that land is restored to beneficial use post-mining (Office of Surface Mining Reclamation and Enforcement).*	• Changing precipitation patterns • Decreased water availability • Increased flood risk • Increased temperatures • Increased severity of wildfires • Storm intensity/extreme events • Melting permafrost • Sea level rise • Changes in sediment demand, supply, and availability	• Changes in access to energy and minerals (melting permafrost, shrinking sea ice opening potential for new resources) • Changes to water supply and demand • Damage or decreased access to, or loss of infrastructure • Damage to closed or abandoned well-heads and other energy infrastructure • Changes in energy production
Livestock Grazing	*Interior, through BLM, manages livestock grazing on approximately 155 million acres of public lands, administering nearly 18,000 permits and leases held by ranchers who graze their livestock on more than 21,000 allotments.*	• Changing precipitation patterns • Increasing severity of drought • Increased temperatures • Increased severity of wildfires	• Invasive species encroachment • Changes in forage availability

Area of Impact	*Description*	*Identified Climate Hazard*[6,7,8]	*Potential Impacts*
Coastal/ Marine Resources	*The Department manages, protects, and provides access to significant ocean, coastal, and Great Lakes resources, including 34 million acres in over 100 marine and coastal national parks, more than 35,000 miles of coastline, over 180 marine and coastal national wildlife refuges (NWR), and more than a million square miles of marine national monuments. In addition, the Department manages energy and mineral development on the 3.2-billion-acre OCS.*	• Changing precipitation patterns • Storm intensity/extreme events • Higher storm surges • Coastal erosion and soil erosion from wildfires • Increased flood risk • Increased temperatures • Ocean acidification • Sea level rise • Changes in sediment demand, supply, and availability	• Biodiversity loss • Damage to/decreased access/loss of coastal infrastructure • Habitat loss • Decline of coral ecosystems • Damage to cultural resources and culturally significant resources • Impacts to fisheries • Loss of coastal groundwater resources due to sea level rise
Recreation	*Each year, more than 400 million people visit Interior-managed areas to participate in recreational activities such as camping, hunting, fishing, hiking, boating, mountain biking, birding and wildlife viewing, photography, climbing, winter sports, and visiting natural and cultural heritage sites. The Department's recreation resources and visitor services support strong local economies and public land conservation.*	• Changing precipitation patterns • Increasing severity of drought • Coastal erosion • Increased flood risk • Increased temperatures • Melting glaciers • Sea level rise • Increased severity of wildfire (including wildfire smoke)	• Changing recreational opportunities (types, quality, quantity available) • Changing visitation patterns (timing, location, amounts of visitors) • Increased health and safety risks • Decreased access to potable water • Decreased access to trails, other infrastructure
American Indian and Alaska Native Communities	*The Department is the primary Federal agency charged with carrying out the United States' trust responsibility to American Indians and Alaska Natives, maintaining the government-to-government relationship with federally recognized Tribes, and promoting and supporting Tribal self-determination. It provides services to nearly 2 million American Indians and Alaska Natives, including education, social services, economic development, law enforcement, Tribal court administration, housing improvement, disaster relief, road maintenance, and resource management.*	• Changing precipitation patterns • Increased severity of drought • Coastal erosion • Increased flood risk • Increased temperatures • Increased severity of wildfires • Melting permafrost • Sea level rise • Shrinking sea ice extent and timing	• Damage to/decreased access/loss of access to infrastructure and other critical components of a community, resulting in community-managed retreat and/or relocation • Decreased access to clean freshwater • Loss of traditional ways of life (hunting, fishing, gathering) • Loss of cultural resources • Reduced food security (declining subsistence resources; drought, invasive species, etc. affecting agriculture; access to water; access to clean, affordable energy; loss of subsistence way of life)

Interior Bureaus and Offices

Bureau of Land Management (BLM) manages public lands for a variety of uses such as energy development, livestock grazing, recreation, conservation, and timber harvesting while ensuring natural, cultural, and historic resources are maintained for present and future use. The BLM National Conservation Lands System is a subset (approximately 15 percent) of the overall system of public lands that are managed to conserve, protect, and restore nationally significant landscapes that have outstanding cultural, ecological, and scientific values for the benefit of current and future generations. The BLM wildlife habitat, aquatic ecosystems, recreation opportunities, forest and woodlands resources, air quality, water rights, and wildland fire management efforts (including preparedness, suppression, and post-fire restoration) are often impacted directly by changing climate conditions. Drought conditions are particularly relevant to BLM management of several programs within the agency, including livestock grazing, wild horses and burros, and the management of wildland fire.[9]

Bureau of Ocean Energy Management (BOEM) and Bureau of Safety and Environmental Enforcement (BSEE) have closely intertwined missions in support of offshore resource conservation and development. The BOEM manages development of U.S. OCS energy, mineral, and geological resources in an environmentally and economically responsible way, while BSEE provides regulatory oversight and enforcement to promote safety, protect the environment, and conserve resources offshore. Climate change impacts such as sea level rise, more intense and frequent storms, and ocean acidification and hypoxia can negatively affect ecosystems, leading to declines in fishery productivity and biodiversity, changes in wildlife behavior and migratory patterns, as well as increases in flooding and shoreline erosion.[10] In addition, changes in temperature, precipitation, sea level rise, storm intensity and wave regime can also affect coastal and offshore energy exploration, production, and transportation.[11,12]

Bureau of Reclamation (BOR) manages, develops, and protects water and related resources in an environmentally and economically sound manner in the interest of the American public. The BOR constructed many dams, powerplants, and canals in the 17 Western States and is currently the largest wholesaler of water[13] and the second-largest producer of hydroelectric power in the United States. Climate change affects BOR's ability to deliver water and generate power in an economically and environmentally sound manner.[14] Drought fueled by climate change impacts the quantity and quality of water available to meet competing objectives. Below-average inflows and depleted reservoir levels reduce allocations and deliveries to customers, degrade production of clean energy via hydropower facilities, and make it difficult to meet flow and temperature targets for threatened and endangered species. Similarly, the changing dynamics of wildfire create acute and long-term challenges for water management. Fire has the potential to damage water and power infrastructure, and burned watersheds can experience radical changes that impact water quality and runoff characteristics.

Indian Affairs (IA) supports federally recognized Tribal Nations and American Indian/Alaska Native trust beneficiaries nationally, regionally, and locally. IA contains four related components:

- Office of the Assistant Secretary – Indian Affairs (OAS-IA)
- Bureau of Indian Affairs (BIA)
- Bureau of Indian Education (BIE)

- Bureau of Trust Funds Administration (BTFA)

Each IA component supports federally recognized American Indian/Alaska Native Tribal governments by directly administering or funding tribally administered programs. Indigenous people face harms and risks from climate change that negatively affect their health and well-being, economic sustenance, and cultural integrity and continuity.[15] IA supports climate preparedness and resilience for all federally recognized Tribal Nations and Alaska Native villages through technical and financial assistance, access to scientific resources, and educational opportunities.

U.S. Fish and Wildlife Service (FWS) works with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. Climate change presents a growing threat to America's fish, wildlife, plants, and their habitats; because of climate change, some species populations may decline, many will shift their ranges substantially, and others will face increased risk of extinction.[16] The FWS also manages the National Wildlife Refuge System (NWRS), which is comprised of 571 NWRs and 38 wetland management districts that make up 95 million acres of land and 760 million acres of submerged lands and waters.

National Park Service (NPS) preserves unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education, and inspiration of this and future generations. Rising temperatures, droughts, wildfires, sea-level rise, and extreme weather are transforming national park sites, resulting in habitat and biodiversity loss, declining freshwater availability, outbreaks of pests and diseases, damage to—or loss of—cultural resources, deteriorating infrastructure, and visitor safety concerns, among others.[17]

Office of Surface Mining Reclamation and Enforcement (OSMRE) works in cooperation with States and Tribes to ensure that coal mines are operated in a manner that protects citizens and the environment during mining, assure that land is restored to beneficial use following mining, and mitigate effects of past mining by pursuing reclamation of abandoned coal mines. Changes in climate may have an impact on the effectiveness of reclamation efforts—successful recovery of disturbed lands will require that reclamation efforts consider changing climatic conditions and environmental variables and engineer ecosystems capable of adapting in step with the changing climate (rather than habitats suited only to the pre-disturbance climate).[18]

U.S. Geological Survey (USGS) monitors, analyzes, and predicts current and evolving Earth-system interactions and delivers actionable information at scales and timeframes relevant to decision makers. This includes providing science about the natural hazards that threaten lives and livelihoods; the water, energy, minerals, and other natural resources humans rely on; the health of ecosystems and environment; and the impacts of climate and land-use change. As the science arm of the Department, USGS plays an important role in investigating the causes and consequences of climate change and helping decision makers to develop more informed adaptation and mitigation strategies.[19]

2B. Climate Risks Affecting Interior Buildings

Table 4. Climate Hazard Exposure to Interior Buildings

Indicators of Exposure of Buildings to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of buildings projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually) from 1976-2005	>99%	>99%	>99%	>99%
Extreme Precipitation: Percent of buildings projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually) from 1976-2005	98%	>99%	99%	99%
Sea Level Rise: Percent of buildings projected to be inundated by sea level rise*	<1%	1%	<1%	>2%

	High Risk	Very High Risk	Extreme Risk
Wildfire: Percent of buildings at highest risk to wildfire	17%	4%	2%

	100- or 500- year floodplain
Flooding: Percent of buildings located within floodplains	34%

Note: Interior buildings are geographically dispersed across the Contiguous United States (CONUS) and exposure to climate hazards varies across regions. This has operational implications for asset management, asset risks, and health impacts on asset users. Please see appendix B for more information on:

- The distribution of extreme heat exposure to Interior buildings across regions
- Projected distribution of extreme precipitation events impacting Interior buildings across regions
- Regional exposure to inundation due to sea level rise
- Distribution of exposure to wildfire risk across regions
- Flood risk exposure of Interior buildings, including 100-year flood plain (1% annual exceedance probability)) and the 500-year flood plain (0.2% annual exceedance probability) exposures

* Buildings are reported as inundated if the centroid that marked their location was within projected sea level rise inundation extents—considered here as at or below the elevation of the mean higher high water mark—for a scenario. Note that this is an underestimate of the exposure to climate hazards associated with sea level rise, which extend beyond inundation and include, for example, storm surge, tidal flooding, and saltwater intrusion.

The Department owns or manages more than 41,800 buildings across the country that serve a wide range of functions, including the following:

- visitor centers
- school buildings

- offices
- museums
- housing units
- restaurants
- warehouses

Climate change will generally disrupt the services the Department provides and affect the safety and comfort of visitors, students, and staff who rely on Interior buildings. In addition, many of the buildings the Department owns or manages have special historical significance—climate change impacts on those buildings affect connections with the country's heritage. The climate hazards described in table 4 will affect Department buildings in a number of ways.

Extreme Heat

An increase in days with maximum temperature exceeding the current 99th percentile maximum is expected for nearly every building under every emissions scenario (see appendix B for more information on the scale of increased temperatures across regions). Depending on location and scenario, many places could experience high temperatures for weeks or months each year that meet or exceed the hottest three to four days of a year in the past.

While these changes may not necessarily influence building lifespans, they affect operations—with extreme heat, heating, ventilation, and air conditioning (HVAC) systems may be overused or inadequate, which may result in increased cooling costs or elevated indoor temperatures. For the Department's buildings across the contiguous United States, the number of cooling degree days (a measure of demand for climate control in buildings) are projected to increase 48-65 percent by mid-century, and 65-129 percent by late century.[20] Heating degree days (a measure of demand for building heat) are projected to decrease 16-20 percent by mid-century, and 21-35 percent by late century.[21]

The Department owns approximately 600 visitor centers, 340 school buildings, 2300 offices, and more than 8000 housing units, and these increases in severe heat will affect their operation and the services they provide. In addition, many of the Department's buildings house museum collections or other important cultural items, and extreme heat would affect their preservation.

The buildings data used for this assessment did not include information on whether individual buildings are equipped to handle these changes. Some buildings with HVAC systems may need to operate those systems more frequently—a change that may affect energy consumption, sustainability goals, and equipment lifespans— while others without these systems may need to be replaced with units more suitable for future climate.

Extreme Precipitation and Flooding

As with extreme heat, nearly all Interior-owned or managed buildings are projected to experience increases in single-day precipitation under both scenarios at mid- and late-century, although the magnitude of that change is not as great, and variability is higher. SHIRA tools include projected

changes in precipitation events greater than 2 inches, which is useful for considering engineering and site design vulnerabilities and flash flood potential. Across the full suite of Interior-owned or managed buildings, there is a projected increase in the frequency of this type of precipitation event of 20-29 percent by mid-century and 30-51 percent by late century.

Approximately 27 percent of Interior-owned or managed buildings in the contiguous United States are currently located in an area with a 1 percent annual exceedance probability (AEP) of flood, with an additional 6 percent in an area with a 0.2 percent AEP flood.[22] The SHIRA tools also include a floodplain data layer, created by the First Street Foundation, that projects floodplain changes at mid-century. This projection is not included in table 4 above but indicates that the flood potential will increase such that slightly more of the Department's current building portfolio (~300 buildings) are within areas with an AEP of at least 0.2 percent at mid-century. This has implications for decisions regarding how to maintain or protect those buildings. More broadly, these data are useful for planning the location of new buildings in the coming decades given projected changes in flood probability.

Wildfire

Approximately 25 percent of Interior-owned or managed buildings in the contiguous United States are in areas where wildfire presents a high-to-extreme risk to structures. This includes more than 2,500 housing structures, nearly 500 office buildings, and over 90 visitor centers—a portfolio with a replacement value of more than $49 billion.[23] Exposure levels are similar across the Bureaus, with highest exposures in the Upper Colorado Basin (42 percent), California-Great Basin (41 percent), and Columbia-Pacific Northwest (39 percent) regions (see appendix B – table A10). Wildfires have the potential to damage or destroy buildings and to disrupt critical services such as power, gas, communications, transportation, and water supply.

Sea Level Rise

Rising sea levels have detrimental impacts on infrastructure, causing flooding, erosion of supporting soils, building collapses, saltwater surges into waterways, and transportation delays. A relatively small percentage of buildings owned by Interior, primarily located in the Southeast, are projected to be inundated due to sea level rise under any scenario. However, they represent a significant overall investment[24] for specific Bureaus, namely FWS and NPS, that manage cultural, historical, and natural resources in coastal areas.

2C. Climate Risks Affecting Federal Employees

The table below summarizes exposures to climate hazards for Department employees. The text below the table provides context on what these exposures mean across the Department's Bureaus and Offices.

Table 5. Climate Hazard Exposure to Interior Employees

Indicators of Exposure of Employees to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005*	99%	99%	99%	99%
Extreme Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005*	99%	99%	99%	99%
Sea Level Rise: Percent of employees duty-stationed in counties projected to be inundated by sea level rise**	12%	19%	13%	21%
	High Risk		**Very High Risk**	**Extreme Risk**
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire**	30%		5%	6%

Notes:
***** The number of extreme heat days, and number and frequency of extreme precipitation events, impacting employees varies across Interior regions, please see appendix C for more details.
****** The percentage of employees exposed to inundation from sea level rise and to wildfire risk varies greatly across regions, please see appendix C for details.

The Department employs more than 77,000 people and a cadre of volunteers to perform a wide range of duties that span various positions, including the following:

- park rangers
- natural resource (e.g., forestry, biological science, hydrologic) technicians and managers
- wildland firefighters
- scientists
- cultural resource (e.g., archeology, history, architecture, anthropology) technicians and managers

- law enforcement officers
- maintenance mechanics
- administrative and program staff (human resources, financial, budget staff)
- engineers
- custodial workers

The Department manages public lands and waters in all 50 States, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam and supports communities across the United States and territories. As such, the Department's workforce is very geographically distributed, but has large concentrations (>1000 employees) in locations, including the following:

- Jefferson County, CO
- District of Columbia
- Fairfax County, VA
- Ada County, ID
- Bernalillo County, NM
- Sacramento County, CA
- Anchorage Borough, AK
- Coconino County, AZ

All Department employees will experience one or more of the impacts of climate change through 2080, and some workers will be more vulnerable to impacts than others. Climate-related impacts may make existing health and safety issues worse or lead to new hazards. Some of the most pressing climate-related occupational hazards and exposures for Interior employees include the following:

- ***Heat Stress.*** An increasing number of hotter days is expected across nearly all Department worksites under every emissions scenario (table 5, see also appendix C – tables A12 and A13). This change will be experienced through higher average temperatures, more frequent extreme heat events (such as heat waves), and shifting and expanding hot seasons.[25] Higher temperatures increase worker risk for heat-related morbidity including heat stroke and exhaustion. Heat-related fatigue can impact workers' alertness to other on-the-job hazards, increasing the chance of injury.[26] Heat stress is especially hazardous for the Department's outdoor workers, many of whom work outside through the hottest months of the year. Employees who serve in firefighting or emergency responder roles that require intense physical activity even during extreme heat events will be disproportionately affected.
- ***Health Impacts from Wildfires***. More than two in five Interior employees (41 percent) currently work in locations with high to extreme wildfire risk (table 5) and many more work in locations that experience air pollution due to wildfires extending well beyond fire locations. Climate change is projected to increase the number and severity of wildfires in parts of the United States, which will increase air pollution (emissions of particulate matter and ozone precursors).[27] This air pollution can cause acute health effects (e.g., short-term coughing and eye irritation) and long-term health effects (e.g., heart disease, respiratory diseases, and allergic disorders), and can be exacerbated by extreme heat.[28] These impacts will be especially hazardous for the Department's outdoor workers, including wildland firefighters subject to close exposure to fire and smoke. In addition, the increasing risk and frequency of wildfires close to home can have mental health effects on the wildland firefighter workforce.

- ***Biological Hazards.*** Changes in temperature and precipitation enable population growth, range shifting, or range expansion of organisms that can be harmful to human health.[29] This includes vectors (fleas, ticks, mosquitoes), pathogens (bacteria and viruses), and allergens (pollen, mold), which can spread disease and trigger asthma and allergies. As with heat stress and wildfires, impacts of these changes will likely fall on outdoor workers.
- ***Extreme Weather and Natural Disaster Dangers.*** Increasing extreme weather events or natural hazards such as floods, landslides, storms, droughts, and wildfires can contribute to occupational deaths, injuries, and diseases.[30] This is especially true for workers involved in rescue, cleanup, and restoration efforts, as these workers may be exposed to hazardous conditions both during and after extreme weather events.
- ***Productivity and Workplace Disruptions.*** Climate change may lead to work disruptions, as hazards like extreme precipitation events, fire, or coastal flooding amplified by sea level rise affect commutes, close offices, or otherwise challenge workers' ability to do their job safely and effectively.

2D. Climate Risks Affecting Federal Lands, Waters and Cultural Resources

Climate change will impact nearly all—if not all—of the lands and waters that the Department stewards. Summarizing the myriad ways in which these impacts will be expressed is beyond the scope of this Plan, but responding to them will dominate the work of the Department's Bureaus and Offices in the coming decades. The table below presents several of the most significant climate hazards to Interior-managed lands, waters, and cultural and natural resources, and the narrative elaborates on the implications of these potential changes.

Table 6. Key Climate Hazard Exposures to Interior-Managed Lands, Waters, and Associated Resources[31,32,33]

Resource Type	Federal Asset	Current Climate Hazard Impact or Exposure	Future Climate Hazard Impact or Exposure
Cultural Resources	Recreation and tourism on Interior-managed public lands	Extreme heat and wildfire influence visitation and public safety.	Increases in extreme temperature and changes in the presence of wildfire smoke will affect visitation patterns across Department-managed sites.
	Sites in the National Register of Historic Places and other historic sites	Storm surges and sea level rise, inundation and erosion, and uncharacteristically severe wildfire activity threaten historic places.	Changing weather patterns, stronger hurricanes, other extreme weather events, sea level rise, nuisance flooding, and king tides are causing flooding of historic places. Flooding events are occurring at increased frequency and magnitude. Some historic properties that have never flooded before may now be exposed to this risk, and those that flooded infrequently in the past may experience more instances of flooding or of water reaching higher levels than ever before. In addition, uncharacteristically severe wildfires increase the risk of loss of historic places.
	Archeological resources	Sea level rise, uncharacteristically severe wildfire activity, and permafrost loss lead to deterioration of archeological resources due to exposure to the elements.	Depending on location, the impacts of climate change can accelerate the deterioration and loss of archeological resources. Sea level rise and uncharacteristically severe wildfire activity may have locally and regionally significant impacts, as would permafrost loss in Alaska.
	Cultural landscapes	Decline or disappearance of important values (e.g., important species, landscape features) or loss of use due to events like natural disasters or long-term changes.	Cultural landscapes reveal the history of human relationships with the land and its natural systems, and a wide variety of cultural traditions, habits and practices. The range of climate hazards discussed in this Plan will affect cultural landscapes. Changes in temperature and precipitation will affect where species are found, where historic features can be sustained, and whether certain resources are available in the same places over time. Other events, including sea level rise, storm surge, and

Resource Type	Federal Asset	Current Climate Hazard Impact or Exposure	Future Climate Hazard Impact or Exposure
			uncharacteristically severe wildfire, will have similar impacts on the presence of important wildlife and plants (e.g., salmon, wild rice), and may limit or eliminate access to certain places entirely.
Natural Resources	Ecosystems nationwide	Temperature and precipitation changes are affecting the timing of biological events and driving range shifts for wildlife and plants, including invasive species. A changing climate, along with the impacts of fire suppression, invasive species, and land use change, have altered fire regimes in many ecosystems. Climate change also impacts disturbance regimes, including flooding, fire (both frequency and intensity), and extreme weather events.	Changes in precipitation and temperature will continue to affect species ranges and survival, potentially transforming ecosystems. This could threaten species with extinction and affect ecological resilience and function, including the provision of ecosystem services. Climate change is likely to alter precipitation and temperature in ways that increase the likelihood and severity of wildfire, which will have consequences for vegetation composition and structure and wildlife in many landscapes.
	Coastal Lands	Low-lying areas of Interior-managed lands—especially in southern Florida, along the Gulf Coast and Atlantic Coastal Plain, the Caribbean, the central California coast, Hawaii, and USAPI —are exposed to sea level rise. Coastal areas are vulnerable to extreme precipitation events.	Approximately 200 units (e.g., national parks, NWRs, BLM-managed national monuments) are projected to be affected by mid-century (195-200 units) and late-century (197-207 units). Effects include inundation of lands as well as exposure to stronger hurricanes, storm surges and saltwater intrusion that will transform local ecologies.
	Arctic Lands	Permafrost, glaciers, and sea ice are being lost as temperatures increase.	Continued increases in temperatures in these regions will continue to reduce the extent of permafrost, glaciers, and sea ice in Arctic regions. This will have significant impacts on local ecologies.
	Managed Water Resources	Warming/Aridification Drought Intensification from Warming Changing Precipitation Patterns	Long-term warming and changes in annual precipitation amounts set up aridification, drought intensification, and transitions from snow to rain during precipitation events, all affecting the management and delivery of water for irrigation, generation of hydropower, and other uses.

Cultural Resources

Broadly speaking, cultural resources represent a record of the human experience. Cultural resources managed by the Department are varied, and include historic buildings and sites, archeological sites, ethnographic resources and cultural landscapes, and museum collections.[34] Museums are included in section 2B; the other resources described here share a common vulnerability in that they are exposed to environmental forces, including forces that will be shaped by climate change.

The specific impacts of climate change on cultural resources can be broadly categorized into two types of impact: (1) changes that degrade the physical qualities of the resource and (2) loss of use for the groups for whom the resource is important. Changes in temperature or precipitation can accelerate degradation of resources, and severe wildfire or inundation as sea levels rise may result in complete loss of resources. Loss of use can occur due to physical changes in a cultural resource (e.g., the loss of important species in a given location as habitats change) or due to climate hazards like extreme heat that limit opportunities to visit and engage with landscapes or sites that are culturally important.[35]

Natural Resources

A changing climate will influence the condition of the natural resources managed by the Department at different scales, ranging from the timing of seasonal events and composition of species present, to significant changes in the physical environment with the potential to affect the ecology of a location well into the future.

Examples of the former include changes in freshwater runoff due to earlier snowmelt or shifts in precipitation from snow to rain. This could cause deviations from historical streamflow and water temperature patterns that affect aquatic species, like salmon or other cold-water species. For example, NPS staff in Glacier National Park have relocated bull trout, which is listed as threatened under the Endangered Species Act (ESA), within park watersheds to drainages that are projected to retain cold water temperatures.[36] This introduction is intended to protect the park's population from warming water temperatures and the invasive lake trout.

These changes may influence human and wildlife health. For example, climate driven changes in seasonal weather patterns, including longer warm seasons, affect the transmission of *Borrelia burgdorferi*, the bacteria that causes Lyme disease, from infected nymphal black-legged ticks to uninfected larval ticks.[37] Simultaneous feeding of nymphal and larval ticks facilitates successful transmission of the pathogen to larvae.[38] This influences its prevalence in the environment, which in turn could increase the probability of transmission to humans.

Changes in climate will also affect life cycles of species and ecological patterns.[39] These impacts can happen broadly across ecosystems—and can also influence changes in species composition, as changes pass thresholds where certain organisms are able to persist, causing declines in or extirpation of historically occurring species while allowing colonization by new species.

Wildfire is one key example of a natural process that will impact Interior-managed lands as climate changes.[40] Millions of acres of Department-managed lands are at high risk of wildfire, including more severe fires that depart from historic fire regimes. This acreage is concentrated in the Western United States. Climate change will exacerbate conditions for more frequent high-severity fire, which, when combined with a history of fire suppression, invasive species, and changes in land use that have altered vegetation structure and composition, could lead to substantial ecological transformations in many locations and further increase hazard potential.

Finally, long-term changes in the physical world, driven by climate change, will affect the distribution and condition of natural resources in the future. Trends in permafrost in Alaska are one example—the extent of permafrost is declining as temperatures increase, with consequences for Arctic ecosystems, wildlife, and communities.[41] Sea level rise is another—changing sea levels will inundate coastal lands and ecosystems, but also alter patterns of erosion, tidal extents, and groundwater resources upslope in ways that local species and ecosystems may not be able to withstand.[42] Hundreds of coastal Interior-managed units are exposed to sea level rise, especially along the Gulf Coast, Caribbean, Atlantic Seaboard, and in the Pacific region, and will need to adapt to this change in their environment.[43]

2E. Climate Risks Affecting Tribal Nations and Indigenous Communities

There are many communities, including federally recognized Tribes, the Native Hawaiian community, and communities in the U.S. territories with strong cultural connections to the lands and waters managed by the Department. The climate hazards mentioned above threaten many of these cultural connections, including availability of foods that support subsistence lifestyles, cultural sites that are important to community history and identity, and culturally important practices.[44] Some of these connections are reflected in treaties as reserved rights.

At the same time, communities themselves are being impacted by climate change. Permafrost loss and coastal erosion affect Alaska Native villages, sometimes requiring relocation of communities and infrastructure.[45,46] Sea level rise, increasing ocean temperatures, variability in rainfall and storm intensity are degrading natural infrastructure in the Pacific islands, like coral reefs, as well as communities themselves.[47,48,49] Warming air and ocean temperatures are also expected to impact food systems and human health in the region.[50] Addressing these exposures is a consideration of the Department given its responsibilities to fulfill trust responsibilities and special commitments to federally recognized Tribes, the Native Hawaiian community, the territories of American Samoa, Guam, the U.S. Virgin Islands, and the Commonwealth of the Northern Mariana Islands, and overseeing U.S. Federal assistance provided to the freely associated states.

2F. Impacts from Additional Hazards

There are several hazards that are linked to climate change and have clear potential effects on the missions, operations, and services provided by Interior Bureaus and Offices. Two are described here: invasive species, and drought and changing precipitation patterns.

Invasive Species

Invasive species impose substantial costs on the environment and society. Economic costs have exceeded $26 billion every year in North America for the last decade.[51] Invasive species outcompete native species and are a major contributing factor in native species extirpation and extinction. Invasive species also disrupt ecosystem functions, deplete resources important to cultural heritage and subsistence living, exacerbate the threat of wildfire (e.g., cheatgrass in sagebrush ecosystems), increase the cost of delivering water and power, damage infrastructure, diminish recreation activities, and spread pathogens that transmit disease in both wildlife and human populations.[52]

Climate change exacerbates risks from invasive species. It can accelerate their spread and amplify adverse impacts and costs. Invasive species can also dramatically reduce the resilience of lands and waters to climate change. Furthermore, invasive species can inhibit the success of resilience and adaptation efforts implemented to forestall climate change impacts. The Invasive Species Advisory Committee released a white paper in 2024 that provides an overview of the interactions of invasive species and climate change.[53] They include the following:

- Damage to ecosystem function that affects the efficacy of NBS.
- Degradation of natural and built infrastructure, impacting rural and urban communities. Including coastal communities' resilience to storms, erosion, flooding.
- Impacts to indigenous cultural practices, food security, and ways of life.
- Threats to island sustainability, human health, food systems, and traditional practices.

Drought and Changing Precipitation Patterns

The precipitation figures in sections 2B and 2C above project increasing extreme precipitation events (i.e., more instances of heavy precipitation). In addition to these extreme precipitation projections, some areas may experience increased drought conditions (i.e., periods of low precipitation). The impacts of climate change on precipitation can manifest in several ways, including the following:[54]

- Long-term decreases in precipitation, potentially spanning decades, that constrain water availability and the ability to protect natural resources and water supplies for communities.
- Shifts in precipitation from snow to rain that alter the timing of water flows and availability.
- Onset of drought conditions, including rapid onsets, that stress vegetation and soils, alter wildfire regimes, and increase the risk of severe wildfire.
- Increasing evapotranspiration, accelerated snowmelt, and soil desiccation due to temperature increases.

Drought has significant implications for Interior's mission, operations, and services—affecting terrestrial and freshwater ecosystems and their associated wildlife and cultural resources, as well as the capacity to deliver water through Bureau of Reclamation projects.

Distinct from drought is the matter of warming that leads to aridification.[55] Without any change in precipitation pattern, warming leads to increased landscape evapotranspiration, reduced precipitation-runoff efficiency, increased drought intensity, and long-term reduction in water availability as a result. This hazard exists in much of the Southwest United States, including the Colorado River Basin. It contributes to the wildfire hazard and has significant impacts on ecosystems—causing tree mortality events and other ecological transformations—and on human communities.[56]

The NPS has projected drought conditions for all park units in the lower 48. The BOR has developed tools, including the 2021 SECURE Water Act Report[57] that provide information on projected changes in the intensity, duration, and frequency of drought due to climate change—specifically, that drought duration and variability are likely to increase for the Western United States, along with drought severity. These data were not used to assess exposures in this update as they cover specific regions and resources but represent an important line of work within the Department (section 3A3).

SECTION 3: PLANNING FOR ADAPTATION AND RESILIENCE

The following section provides an overview of work the Department has undertaken since its 2021 Climate Action Plan was posted, including implementation of BIL, IRA, and appropriated funds toward climate adaptation and resilience, updates to Departmental policy, and steps to improve sustainability and climate literacy across the Department. It also outlines actions Interior plans to take to continue building adaptive capacity and resilience throughout its work.

Section 3A outlines steps the Department plans to take to address the exposures and corresponding impacts of climate change on the Department's buildings, its employees, and the lands, waters, and natural and cultural resources it stewards.

Sections 3B1-5 provide an overview of Department progress toward incorporating climate adaptation and resilience into its operations, including by accounting for climate risk in planning and decision making (section 3B1), incorporating climate risk assessments into budgeting (section 3B2), updating and implementing Department policies and programs (section 3B3), by identifying key supply chains and making them more resilient (section 3B4), by incorporating adaptation and resilience into grants, loans, and agreements with external parties (section 3B5).

Section 3C describes the Department's work to date to advance climate literacy across its workforce, as well as steps that will be taken over the lifespan of this Plan.

3A. Addressing Climate Hazards and Risks

The sections below provide an overview of the Department's work to date and planned actions specific to addressing the exposure of its buildings, employees, and lands and waters (and associated natural and cultural resources) to climate hazards. This includes specific planned investments and initiatives (sections 3A1-3).

Overall, these actions fall into 3 broad themes aligned with best practices for achieving resilience:[58]

- **Understand and assess current and future impacts of climate change on Department assets, mission, operations, and services**. This includes improving understanding of key vulnerabilities, pursuing research on climate hazards and stressors, and integrating findings into decision support tools and enterprise-wide planning.
- **Prioritize and scale adaptation and resilience efforts.** This includes implementation of new Department policies, targeted investments in conservation and resilience, wider adoption of NBS, and enhancement of equitable funding opportunities for communities and partners to adapt to climate change.
- **Build capacity for adaptation within the Department's workforce and by strengthening partnerships.** This includes developing new guidance, training, and performance expectations for the Department's workforce, and continued meaningful engagement and collaboration with communities, including American Indians, Alaska Natives, Native Hawaiians, and affiliated island communities.

1. Addressing Climate Risks Affecting Interior Buildings

Table 7. Prioritized Actions to Address Climate Hazard Exposures and Impacts Affecting Federal Buildings.

Climate Hazard	Overarching Theme	Priority Action	Timeline for implementation (2024-2027)
All climate hazards, including extreme heat, extreme precipitation, flooding, sea level rise, and wildfire risk. Nationwide: specific risks vary by region.	Understand climate hazards and assessing exposure	**Incorporate natural disaster resilience into individual projects by assessing climate hazards and natural disaster risk.** Utilize SHIRA Risk Mapper tool (or approved Bureau alternative) to assess climate hazards and natural disaster risks for individual projects to help determine how to design projects and address risks.	Initiated 2024-2025, ongoing
All climate hazards, including extreme heat, extreme precipitation, flooding, sea level rise, and wildfire risk. Nationwide: specific risks vary by region.	Understand climate hazards and assessing exposure	**Review major investments for risk and resiliency measures through quarterly Capital Planning and Investment Control reviews**, to implement Department policy "Addressing Natural Hazards Risk for Real Property Assets."	2024-2027

Climate Hazard	Overarching Theme	Priority Action	Timeline for implementation (2024-2027)
All climate hazards, including extreme heat, extreme precipitation, flooding, sea level rise, and wildfire risk. Nationwide: specific risks vary by region.	Prioritize and scale adaptation	**Incorporate hazard resilience into individual projects by using design standards and building codes, such as the Federal Flood Risk Management Standard (FFRMS).** Use applicable and current design standards (exceeding standards where necessary based on professional judgment) and building codes in new construction and repair projects.	2024-2027
Impacts to building design and operations, and to employee/visitor health and wellness – nationwide.	Prioritize and scale adaptation	**Incorporate applicable sustainability and resiliency measures into all new construction and building modernizations and implement the Guiding Principles for Sustainable Federal Buildings at existing buildings greater than 25,000 gross square feet,** which include risk assessments and the incorporation of resilient design and operational adaptation strategies.	2024-2027. Bureau progress tracked annually through Sustainability Organizational Assessment.

Interior will make progress to address the exposure of its buildings to climate hazards through several strategies, including updating Department-level asset management policy and guidance to include best practices for resiliency and sustainability, incorporating climate hazards and natural disaster risk into decision support tools that staff can use to assess risk, and pursuing Bureau and agency-level efforts to stepdown policy and practices to address specific hazards.

Implement Department-Level Changes to Asset Management Policy

Departmental policy requires Bureaus and Offices to identify and avoid investments that are likely to be undermined by climate change impacts, such as investing in infrastructure likely to be adversely affected by repeated floods or inundation. The Department's policy, "Addressing Natural Hazards Risk for Real Property Assets" (DOI-AAAP-0026), outlines specific actions for Bureau asset managers to take such as conducting vulnerability assessments, incorporating resilient codes and standards, including the FFRMS and Standards of Seismic Safety for Existing Federally Owned and Leased Buildings, deploying NBS, and considering relocation and divestment in master planning activities. Department policy is updated to meet the requirements of the Disaster Resiliency Planning Act and the Office of Management and Budget's (OMB) Memo M-24-03.[59]

Addressing exposure to hazards is only one aspect of preparing the Department's building portfolio for a changing climate. Recently, a sub-working group under the Department's Sustainability Council created implementing guidance for incorporating resilient and sustainable measures into project design, addressing both new construction and retrofits. This guidance is intended to serve as a reference for Bureau sustainability managers, architects, and engineers who will play a major role in how Interior buildings function for the next generation. In addition to adaptation measures, building

electrification, deep energy retrofits, carbon-pollution free electricity, and net zero emissions building design are emphasized.

Major facility investments funded by appropriations are integrated into the Department's 5-year real property capital plan. Interior's Lifecycle Investment Planning Guidance, updated annually, describes Bureau responsibilities for creating the 5-year plan and requires Bureaus to incorporate all applicable climate adaptation and mitigation strategies, including sustainability components required by EO 14057, into projects. These projects are reviewed for compliance by Bureau Investment Review Boards and—in the case of projects $20 million and greater—by the Department. As individual projects move through the 5-year plan from programming to design to construction, they are reviewed as part of the Department's Capital Planning and Investment Control (CPIC) process. This oversight, which aligns with OMB's A-11 Capital Programming Guide, helps to ensure that opportunities to implement adaptive measures are not missed. Other programs, including the GAOA Legacy Restoration Fund, have developed selection criteria that consider climate resilient approaches.

During the coming years, the Department will work to improve the resilience of its buildings by evaluating site-specific vulnerabilities and updating construction and management standards in line with guidance laid out in DOI-AAAP-0026 and the Guiding Principles for Sustainable Federal Buildings. If tools such as SHIRA's Risk Mapper receive support to include climate hazards, guidance will be updated to incorporate its use and enable finer-scale evaluation of resilience across Department buildings (rather than exposure, which is reported in section 2B).

Incorporate Climate Hazards and Natural Disaster Risk into Decision-Support Tools

Management decisions, including relocation or divestment, are often made at the local site level. Vulnerability assessments are also often conducted at the local—or sometimes regional—level. To make climate-informed decisions, staff need tools and accessible information about the present and probable future scenarios.

The Department is investing in internal tools—led by USGS—to extend its use of future climate risk hazard information broadly through the SHIRA project. The SHIRA project's tools, which are freely available to all Department staff, identify risks to Interior real property and personnel both in real-time and in a series of forward-looking timeframes. As that development is supported, the Department will incorporate use of Risk Mapper (or of an approved alternative) into policy for Bureaus to screen major investments for climate and natural hazard risks and to demonstrate how project designs address these risks during the CPIC review process.

Examples of climate-informed project design could include the following:

- Elevating buildings that cannot be moved out of the floodplain.
- Sizing heating, ventilation, and air conditioning equipment for predicted future temperature extremes.
- Integrating NBS such as green roofs and bioswales.
- Using fire-resistant building materials, following building codes and standards to protect against fire risk, and designing defensible space around facilities in the Wildland Urban Interface.

In addition to its work on SHIRA's Risk Mapper, the Department is participating in interagency efforts to develop a Governmentwide decision support tool as part of the Federal FFRMS to help manage the exposure of Federal buildings to future floods. As with SHIRA, this tool reaches will inform Department vulnerability assessments as it reaches maturity.

Bureaus pursuing best practices to address climate hazards to buildings—and other facilities

Similar changes to Bureau-level policy are accompanying the Department-level changes described above. NPS, for example, released its NPS Facility Investment Strategy in October 2023, which includes requirements for proposed project investments to consider sustainability and climate resilience before they are presented for approval by the Investment Review Board. Subject matter experts within NPS, including its Climate Change Response Program, review projects to ensure that climate change vulnerabilities are addressed during project development, and a climate change and natural hazards checklist has been developed for project proponents to identify potential hazards and adapt plans to improve resiliency, including through relocation of key functions and potentially disinvestment in facilities.

Work like this helps Interior Bureaus manage more than buildings. It also guides planning and investment in facilities and structures that are central to their missions, from hiking trails and scenic viewpoints to levees and dams. Other examples of hazard-specific responses underway at the Bureau-level include the following:

- Applying results of climate change vulnerability assessments for coastal NPS units in FYs 2024-2026 to complete adaptation strategies for park infrastructure.
- The NPS National Capital Region is developing a dynamic flood risk assessment model in FYs 2023-2025 to address flash flooding risks to historic structures and cultural resources.
- The FWS is beginning to implement a Rapid Vulnerability and Risk Assessment Methodology for FWS-managed infrastructure.
- The BIA Tribal Climate Resilience Annual Awards Program Request for Proposals includes funding for implementation for relocation, managed retreat, or protect-in-place actions, climate adaptation planning, and implementation for climate adaptation strategies.
- Through its Climate Change Adaptation Strategy, BOR's Asset Management Division is including climate change in tools that support capital investment and repair decisions. Climate change impacts are also being incorporated into facility reliability ratings.
- The BOR is also working with water management partners to develop guidance on how to mainstream climate change into water and hydropower management.

2. Addressing Climate Risks Affecting Interior Employees

Table 8. Prioritized Actions to Address Climate Hazard Exposures and Impacts Affecting Interior Employees.

Climate Hazard	Overarching Theme	Priority Actions	Timeline for implementation (2024-2027)
Heat Stress	Prioritize and scale adaptation	**Finalization of the National Integrated Heat Health Information System (NIHHIS) draft National Heat Strategic Plan**, followed by implementation.	2024
	Prioritize and scale adaptation	**Improve communication approaches** to raise awareness and adoption of best practices to reduce negative health effects of extreme heat.	2024
	Prioritize and scale adaptation	**Update contingency plans** to meet occupational health and safety and public health standards in response to changes in the frequency of extreme heat.	2024
Health Impacts from Wildfires	Understand climate hazards and assess exposure	**Work to understand the effects of smoke on the general public** as part of a 2024 Memorandum of Understanding (MOU) between the U.S. Department of Agriculture (USDA), Interior, U.S. Environmental Policy Agency (EPA), and Centers for Disease Control and Prevention (CDC).	2024-2027
	Understand climate hazards and assess exposure	**Invest in research and equipment**, in coordination with USDA and National Institute for Occupational Safety and Health (OSHA), to mitigate impacts to firefighter health and safety.	Initiated in 2024, ongoing.
	Prioritize and scale adaptation	**Adapt policies to promote best practices in fire management while protecting the wildland fire workforce**, building on recently started research and data collection initiated under the Dingell Act.	Initiated in 2024, ongoing.
	Understand climate hazards and assess exposure; Build capacity	**Work with EPA and public health agencies to increase staffing and expertise** to support work on fire emissions.	Initial staffing efforts are underway, with a response due to the Government Accountability Office (GAO) by Oct. 1, 2024.
Health and Safety Related to All Climate Hazards	Build Capacity	**Ensure adherence to occupational safety and health standards are enforced.**	Ongoing

Almost the entire Interior workforce will experience one or more impacts of climate change—from increases in extreme heat and extreme precipitation events to increased risk of wildfire—at mid-century and late-century under both emissions scenarios (section 2C).

The occupational hazards associated with these changes in climate present significant workforce-specific challenges for the Department. For some employees, risks due to heat stress, health impacts from wildfire, and extreme weather and natural disaster dangers can be mitigated through early warning systems, sheltering, and other emergency management best practices. However, the tasks and responsibilities of many Department employees require long periods of outdoor work—often strenuous in nature—that are not compatible with public health and occupational safety guidance and regulations during periods of extreme temperatures, wildfire, and extreme weather.

In addition to protecting the health and safety of more than 70,000 employees and more than 200,000 volunteers, Interior Bureaus, such as NPS, offer recreational and learning experiences for more than 300 million annual visitors. Adapting operations to climate change may affect visitor experiences and help the Department reduce one of the risks visitors may face while enjoying public lands and resources.

The Department's planned efforts to increase its adaptive capacity and the well-being of its employees are described below. These efforts complement the Department's obligations under OSHA and its policy on worker safety, which remain in effect and guide its work.

Better understand the risks to employees from climate hazards and natural disasters

Research on the human health and safety risks associated with climate change continues to advance, and the Department is active in working groups and other interagency efforts to understand these risks and identify best practices to create safe working environments and visitor conditions.

For example, the Department has an MOU with EPA, CDC, and USDA, to understand the effects of smoke on the general public and apply lessons to managing its lands and the safety of its visitors while increasing the use of prescribed fire. It is also working to implement the recommendations from GAO, published in a report on wildland fire and smoke emissions, to better coordinate with EPA and public health agencies and increase expertise, internally and with partners, on fire emissions.

Improve the adaptive capacity of the workforce

The Department will work to scale best practices to improve the adaptive capacity of its workforce, as many climate-related hazards are already having impacts on Interior employees and visitors.

Raising Awareness. One mechanism for expanding adaptation actions is by raising awareness. The Department is engaged in the development of the White House Heat Illness Strategic Plan, which will support more aligned, consistent, and coordinated messaging across the Nation to address extreme heat. In addition, with the increased incidence and risk of extreme heat conditions, the NPS

Public Risk Management Program has launched a heat safety campaign to provide safety messages and guidance for parks to better communicate risk to the public. Individual parks have also implemented messaging campaigns around heat illness prevention, including online warnings and information, wayside information, signs along trails, newspaper briefings upon entry to parks, and information provided at visitor centers.

Reducing Worker Risk. Because many employees serving in Interior Bureaus have jobs requiring them to be outdoors and potentially at risk for extreme heat, smoke, and other harmful exposures, adherence to occupational safety and health standards is imperative and enforced. This includes taking actions such as monitoring conditions, requiring and providing personal protective equipment, reducing exposures where possible (relocating or rescheduling work tasks to less hazardous areas or times of day), requiring or encouraging breaks, reducing levels of physical activity where possible, and making other accommodations for workers to perform their duties in ways that reduce exposure.[60] The Department is also acting on workforce recommendations delivered to Congress in the Wildland Fire Mitigation and Management Commission's final report in September 2023. In the near term, this includes investing in research and equipment to mitigate wildfire impacts to firefighter health and safety, taking steps to build and maintain a workforce with capacity to manage prescribed fire and wildfire, and adapting policies to promote basic smoke management practices to predict, reduce, and document impacts, communicate with communities, and enable interagency coordination. In addition, the Interagency Wildland Fire Air Quality Response Program uses air resource advisors with incident management teams to forecast smoke impacts and communicate with State, Tribal, and local public health agencies.

Protecting workers from the impacts of climate changes may require making decisions that reduce the ability to address the agency's mission critical functions—limiting employee outdoor engagement may impact provision of visitor services as well as resource protection activities such as maintenance activities, wildlife support and management work, and biological and/or wildlife research activities. The Department must consider these impacts carefully and prepare for these contingencies.

3. Addressing Climate Risks Affecting Interior-Managed Lands, Waters and Resources

Table 9. Prioritized Actions to Address Climate Hazard Exposures and Impacts Affecting Interior-Managed Lands and Waters.

Hazard/ Resource	Overarching Theme	Priority Action	Timeline for implementation (2024-2027)
All hazards and resources	Understand climate hazards and assess exposure	**Develop more comprehensive and actionable climate hazard information.** This includes improving data availability and projections for specific geographies (e.g., outside the contiguous United States) and additional climate hazards.	Ongoing
	Understand climate hazards and assess exposure	**Conduct vulnerability assessments**, engaging with Tribal Nations and Indigenous communities as appropriate, as part of the implementation of 523 DM 1 – Climate Change Policy.	Ongoing
Wildfire	Understand climate hazards and assess exposure	**Work through the Joint Fire Science Program to understand fire management approaches for ecological and air quality benefits.** Identify practices for prescribed fire and fire management based on insights from Western science and Indigenous Knowledge (IK).	Through 2024
Offshore Sand and Sediment Resources	Understand climate hazards and assess exposure	**Advance the National Offshore Sand Inventory initiative to improve our understanding and management of sediment resources on the U.S. OCS.** Data availability and accessibility will help to reduce response time in disaster recovery and facilitate long-term planning to strengthen the resilience of coastal communities and infrastructure as climate changes.	Ongoing
All hazards and resources	Prioritize and Scale Adaptation	**Develop guidance and training for landscape-scale conservation, NBS, and inclusion of IK**. Guidance on implementing these DM chapters will enable staff to adopt best practices as part of their adaptation and resilience efforts.	2024-2025
	Prioritize and Scale Adaptation	**Implement a landscape-level approach to restoration and resilience**. Building evidence through the Restoration and Resilience Framework and the Keystone Initiatives will support future work.	2025
Drought and Freshwater Resources	Prioritize and Scale Adaptation	**Implement the Bureaus' climate change adaptation strategies**. Strategies focus on increasing water management flexibility, enhancing climate adaptation planning, improving infrastructure resilience, identifying priority water needs, using scenario planning, working with permittees on range management, and expanding information sharing.	Ongoing
Invasive Species	Prioritize and Scale Adaptation	**Implement the Department's Invasive Species Strategic Plan**. Plan activities include reducing the risk of invasive species introduction by using best management practices, including during the response to and recovery from disasters, and	Ongoing

Hazard/ Resource	Overarching Theme	Priority Action	Timeline for implementation (2024-2027
		prioritizing strategic control and eradication efforts where success is likely and climate preparedness and resilience goals can be met.	
	Prioritize and Scale Adaptation	**Advance the National Early Detection and Rapid Response Framework.** This Keystone Initiative helps develop capacity, tools, and processes to find and eradicate invasive species before they become established.	Initiated in 2023, ongoing
All hazards and resources	Build Capacity	**Support jobs in restoration and resilience**. The American Climate Corps, and Indian Youth Service Corps, provide a pathway to careers with the Department and support current resilience work.	Ongoing
	Build Capacity	**Update guidance and resources for partnerships.** The Department's newly established Office of Partnerships will help Bureaus and Offices work with external organizations to pursue strategic priorities, including adaptation and resilience.	2025
	Build Capacity	**Implement Equity Action Plan.** Strategies in the Equity Action Plan promote partnership with communities with environmental justice concerns and strengthen capacity to support their climate adaptation and resilience efforts.	2024-2027
	Build Capacity	**Collaborate with White House offices, including the White House Initiative on Asian Americans, Native Hawaiians, and Pacific Islanders, and White House Council on Native American Affairs, to build capacity**. These offices are working to identify funding and capacity barriers, and help communities address them.	2024-2027
Invasive Species	Build Capacity	**Support regional and national networks to address invasive species.** This includes support for the Regional Invasive Species and Climate Change Management Networks.	Ongoing

The Department is the single largest land managing entity in the United States and is also responsible for the stewardship of large portions of the country's marine areas. The lands, waters, and associated natural and cultural resources that Interior stewards are projected to face substantial and varied hazards and stressors due to climate change. The Department also has significant commitments and responsibilities to Tribes, the Native Hawaiian community, and the U.S. territories and freely associated states that will be affected by climate change.

Adaptation and resilience on Interior-managed lands and waters requires several strategies, including the following:

- Improving our understanding of climate change impacts and the approaches that will increase resilience.

- Applying insights and best practices to make decisions that increase adaptation and resilience.
- Building capacity for adaptation and resilience within its workforce and with partners.

Improve understanding of climate change impacts and the approaches that will increase resilience of lands, waters, and associated natural and cultural resources.

Research capacity across the Department is already leveraged to advance understanding of climate change impacts and to translate that information to inform plans and actions. Major research programs—including the USGS Climate Adaptation Science Centers and other USGS centers, BOR's Research and Development Office and Water Resources Planning Office, and BOEM's Environmental Studies Program—work to understand climate change trends and potential impacts on the lands, waters, and resources the Department manages.

Yet gaps remain that limit the ability of the Department and its partners to plan for and adapt to climate change. Over the time period covered by this Plan, the Department will work to close data gaps and improve available data, assess vulnerabilities of the lands and waters it manages to climate change, and integrate climate change into its actions in line with updated Departmental policy.

Develop more comprehensive and actionable climate hazard information

There are several key data gaps that currently affect the ability of the Department to evaluate climate risks:

- **Data coverage outside the contiguous United States.** Many regions outside the contiguous United States (lower 48), have limited representation within current climate projections, which hinders the ability of Department staff and their partners and neighbors in Alaska, Hawaii, and the U.S. territories to evaluate climate risks. Many of these geographies are affected by data inequities for social and economic indicators as well. The Department has already taken steps to address the latter and ensure disadvantaged communities in the U.S. territories are able to access Federal resources.[61] The Department and its Bureaus will work through their research centers and with partners to ensure that all U.S. communities have relevant, informative climate projections as they adapt to climate change.
- **Data availability in offshore marine environments**. Bureaus with responsibilities in marine environments, such as BOEM and BSEE, have identified climate projections in offshore environments as an area of need for updating policy to plan and manage offshore energy operations safely. Relatedly, data on climate hazards (e.g., tropical storms) and stressors (e.g., marine heat effects on coral ecosystems) that affect marine, coastal, and island environments would be useful for management of Interior units and for communities. Closing these data gaps will support community and region-level climate adaptation planning and Departmental operations, including resilience efforts such as the National Offshore Sand Inventory.
- **Data gaps for specific climate hazards and stressors**. The impacts of climate change are complex, and the prevalence and intensity of hazards vary by location. The Department is already working to develop hazard data tailored to specific regions—for example, permafrost loss in Alaska as temperatures rise—and will work with field staff and partners

to research and develop useful projections related to drought, invasive species, and other hazards and stressors at relevant scales.

Conduct vulnerability assessments of lands and waters

The Department's updated Departmental Manual (DM) chapter 523 DM 1, "Climate Change Policy," (section 3B3) clarifies Departmental approaches to incorporating climate change into its planning and operations, including the use of vulnerability assessments to identify potential impacts of climate change on resources. These assessments are a key step toward making informed decisions, and several efforts across the Department provide examples of how the Department will conduct assessments and use them to prioritize actions during the lifespan of this Plan (see text box).

In the coming years, the Department and its Bureaus will extend the application of climate change vulnerability assessments to all its managed lands and waters, contingent on resources and capacity. These vulnerability assessments will enable prioritization of management actions. As appropriate, Bureaus will engage with Tribal Nations, the Native Hawaiian community, and U.S. territories when identifying resources and threats to consider in an assessment.

Progress toward assessing vulnerability across Interior

Climate change vulnerability assessments are an important tool for adaptation and resilience—bridging the knowledge gap between assessing exposure to climate hazards and stressors and planning and implementing actions to address them. In addition to assessing exposure, vulnerability assessments consider the sensitivity of a resource to a climate hazard, and the adaptive capacity of the resource. Some examples of Department efforts to extend vulnerability assessments are below.

- In late 2023, FWS published a Water Resource Inventory and Assessment[62] of 471 NWR units, over half of which identified at least one climate-related threat serious enough to potentially compromise their conservation mission. Work is ongoing at the regional and field office level to take specific actions where appropriate. For example, sea level rise and storm events are impacting Crocodile Lake NWR in the Florida Keys, depleting sandy areas needed for crocodile nesting habitat. The refuge is providing "built" sand mounds as habitat for crocodiles to protect the population.
- The NPS has developed the NPVuln project[63] to assess risks to parks in a management-relevant way and is using IRA funding to conduct vulnerability assessments in several regions, including evaluations of risk from sea level rise and flooding in the Northeastern United States, and wildfire in Alaska and the Western United States. The NPS is also working with the National Conference of State Historic Preservation Officers to develop protocols for conducting climate change vulnerability assessments for cultural resources, which is expected to be complete in 2026.
- The USGS has developed mapping tools to assess coastal marsh vulnerability that are used by Department Bureaus and other partners.
- The BOR is implementing the SECURE Water Act by using the best available science to assess climate change risks to water supplies in each major BOR basin, analyze potential impacts on water uses and services, and use those insights to develop mitigation strategies.

Apply insights and best practices to implement adaptation efforts.

The Department invests in a wide range of conservation and restoration actions every year across the lands and waters it stewards. It is also committed to a leadership role in whole-of-government efforts, including the America the Beautiful initiative (see text box) and work under the National Climate Resilience Framework to enhance resilience on lands and waters and achieve climate, equity, and biodiversity benefits.[64]

The Department will continue to make these contributions going forward. It also commits to equipping staff with guidance and tools that enable climate adaptation and resilience decisions and to supporting learning through implementation of new approaches—including landscape-scale approaches to management and the use of NBS—that will help improve outcomes for natural and cultural resources in the face of climate change and other stressors.

Develop policy guidance and other tools that enable adaptation decisions

Guidance and tools help staff translate insights from climate change research and vulnerability assessments into plans and action. The Department will work with Bureaus and Offices to update or develop appropriate policies, guidance, and decision support tools that enable better decisions.

At the Department level, work is underway to develop a range of relevant guidance—on the application of climate science to planning and decision making; seeking and incorporating IK; managing cultural and natural resources at the landscape-scale in both terrestrial and marine environments; and identifying co-benefits of NBS to inform planning and monitoring processes. These efforts help staff apply the best available science and knowledge to address climate risks. For more information, see section 3B3.

Guidance is also being developed at the Bureau and Office level to enable field staff to plan and implement projects and programs that promote adaptive capacity and resilience. Some examples include the following:

- Development of best practices guidance and tools by BOR to build climate resilience into river and ecosystem restoration activities.
- An agreement between FWS's Science Applications team and the NWRS to work together on landscape conservation planning, design, and implementation. The work integrates landscape-scale principles into NWRS Comprehensive Conservation Plans.
- Updates to both general Bureau guidance and the "Guidelines on Flood Adaptation for Rehabilitating Historic Buildings" by NPS to include adaptation methods from "The Secretary of the Interior's Standards for the Treatment of Historic Properties."

As guidance is being developed, the Department is supporting improvements in knowledge and technical capacity that enable adaptation. For example, the Department is working through the Joint Fire Science Program to identify fire management strategies that promote land health and reduce potential smoke emissions, using insights from Western science and IK.

As appropriate, the Department and its Bureaus will incorporate new research into guidance and tools for planning and decision-making. The SHIRA project includes data layers relevant to evaluating climate risks across the Department's lands and waters—including flooding, wildfire, and

sea level rise. As resources are available, other hazards, such as temperature and precipitation projections, will be evaluated for inclusion in SHIRA tools. Similarly, region-specific tools, such as the Sagebrush Conservation Design, will be supported as resources are available to help the Department and its partners plan investments in conservation and restoration.

Implement a landscape-scale approach to restoration and resilience

Since the release of the 2021 Climate Action Plan, the Department has received significant resources through BIL and IRA. The Department has leveraged funding from BIL and IRA to strategically amplify existing programs and implement new landscape-scale restoration efforts. In March 2023, the Department announced the Restoration and Resilience Framework, including nine keystone initiatives through which BIL and IRA investments could be coordinated to achieve greater landscape-scale impact. Implementation efforts included the following:

- Investing in priority projects for impact at scale in sagebrush, grasslands, and salt marsh ecosystems; advancing resilience and reducing hazards in Appalachia, salmon spawning grounds of Alaska, and the Klamath basin; working to halt the extinction of Hawaiian forest birds; and making substantial investments in proactive planning and actions for the National Seed Strategy and the National Early Detection and Rapid Response Framework for invasive species.
- Strategically directing funding from BIL, IRA, GAOA, and annual appropriations to efforts to improve resilience, such as greatly expanding the National Fish Passage Program which improves aquatic climate resilience and using BIL Ecosystem Restoration Program funding to institute NBS, such as beaver dam analogs to rewet wetlands and funding science and planning tools to identify recreational resources most at-risk.
- Coordinating efforts to establish shared learning questions for restoration and resilience and facilitate adaptive program management, as well as funding a project to develop a pilot restoration outcome monitoring framework, through the BIL Ecosystem Restoration Program, intended to build the Department's ability to use data and evidence to assess impact at the landscape scale and inform priorities.

Similar investment strategies have been coordinated at the Bureau level as well. The BLM, for example, announced 21 Restoration Landscapes in 2023, which serve as a tool to focus funding of restoration and resilience funding received through IRA for greater impact. In addition to strategically funding vulnerability assessments, the National Park Service is directing some of its resilience funding through IRA to projects that support forest resiliency in the Northeast, Midwest, and Southeast regions.

Identifying and applying lessons learned from these efforts to coordinate restoration and resilience investments and build evidence regarding the outcomes will improve the Department's present and future landscape-level, cross-Bureau initiatives. Moreover, this evaluation will lay the groundwork for implementing best practices in landscape-level resource management more comprehensively across the Department, in accordance with 604 DM 1 (section 3B3). Ultimately, this evaluation framework will enable the Department to better synergize work across Bureaus, programs, and regions, thereby maximizing outcomes for communities and ecosystems throughout the country and delivering a high return on investment. As such, much of this work is also relevant to the America the Beautiful Initiative (see text box).

Build capacity for adaptation internally and through partnerships.

Section 2 of this Plan provides high-level perspective on the scale of the challenges that climate change will present to Department-managed lands and waters, and they exceed the capability of a business-as-usual approach to getting work done on the ground. Working at scale will require capacity, and the Department will take steps to develop the workforce needed to adapt to climate change, and to strengthen its work with partners, including Tribes.

The Department's next steps for building a climate-literate workforce are discussed in section 3C. These broad steps cut across roles and responsibilities within the Department, including budget, procurement, and leadership positions. At the same time, the Department will also work to recruit the next generation of its workforce, including through the Indian Youth Service Corps—part of the American Climate Corps initiative—and the various fellowship and training programs managed by Bureaus.

Partnerships are another key opportunity area for generating and deploying resources toward adaptation. The Department currently engages with a wide range of partners, including Federal and State agencies, nongovernmental organizations, and philanthropic entities to plan, finance, and implement projects. Over the course of this Plan, the Department will enhance this work, including through the following actions:

- Partnering with other Federal agencies on efforts that advance conservation and climate resilience, including its work with USDA and the Department of Defense on the Sentinel Landscapes program, as it implements its landscape-level approach to resource management.
- Supporting Department and Bureau/Office ability to enter partnerships. The Department's newly established Office of Partnerships will develop guidance and best practices for working with external partners to achieve their missions. This could include adaptation and resilience actions, such as NBS.
- Supporting national and regional networks that address climate hazards such as the Regional Invasive Species and Climate Change Management Networks, which works to prevent the introduction, establishment, and spread of invasive species and the National Fish, Wildlife, and Plants Climate Adaptation Network.
- Partnering with the National Conference of State Historic Preservation Officers through the NPS to significantly advance both internal and external tools, resources, and guidance related to several cultural resources-specific initiatives, including improving compliance pathways for adaptation projects, developing menus of adaptation strategies, and creating minimum necessary benchmarks for inventory and monitoring.

Enabling partnerships is also an avenue for the Department to advance environmental justice and fulfill its trust responsibilities. The Department will continue to follow direction in Joint Secretarial Order 3403, entitled "Joint Secretarial Order on Fulfilling the Trust Responsibility to Indian Tribes in the Stewardship of Federal Lands and Waters," including development of collaborative and cooperative agreements with Tribes. For example, BLM provided additional guidance to its staff through Permanent Instruction Memorandum 2022-011[65] to help identify opportunities for Tribes to shape the direction of BLM's land management activities and has developed State-level plans to build relationships and collaborative and formal co-stewardship opportunities.

The Department will also work to ensure potential partners have the capacity and opportunities they need to work toward their climate adaptation and resilience priorities. Interior's 2024 Equity Action Plan outlines several strategies to achieve this, including through advancing equity through contracting practices and ensuring communities with environmental justice concerns benefit from Department programs (sections 3B3 and 3B5). In addition, the Department will collaborate with White House offices such as the White House Initiative on Asian Americans, Native Hawaiians, and Pacific Islanders, and White House Council on Native American Affairs to build capacity for disadvantaged communities to better compete for grants and cooperative agreements.

Advancing the America the Beautiful Initiative

This Plan's summary of the myriad threats that will affect lands and waters managed by the Department—and the ecosystems and cultural resources they contain—highlight the need for actions commensurate with the scale of the challenge. The America the Beautiful initiative is an acknowledgement of that need, and an acknowledgement of the value of locally led and collaborative conservation.

The Department's contributions to America the Beautiful are reflected in the initiative's annual report, but several actions are worth noting here as examples that advance climate adaptation and resilience.

- **New tools to support conservation and restoration actions that improve adaptation and resilience.** The Department partnered with USDA, the Department of Commerce's NOAA, and CEQ to launch conservation.gov in 2024. This website provides a clearinghouse for the public to find opportunities for conservation funding and partnerships. It also hosts the American Conservation and Stewardship Atlas, a webtool that helps document conservation and restoration work across the United States.
- **Designations on public lands**, including the Avi Kwa Ame National Monument in Nevada and Baaj Nwaavjo I'tah Kukveni – Ancestral Footprints of the Grand Canyon National Monument. The proclamation for Avi Kwa Ame calls for BLM and NPS to manage the monument in partnership with several Tribes through a co-stewardship agreement. This will help ensure that cultural resources important to these Tribes are considered in future climate adaptation planning for these units.
- **Establishment of new conservation areas**, including the Paint Rock River NWR in Tennessee, which will help connect habitats so wildlife can respond to climate change.
- **Resources for locally led conservation,** including through the America the Beautiful Challenge grants and the America the Beautiful Freshwater Challenge.

3B. Climate-Resilient Operations

Sections 3B1-5 provide an overview of Department progress toward incorporating climate adaptation and resilience into its operations, including by accounting for climate risk in planning and decision making (section 3B1), incorporating climate risk assessments into budgeting (section 3B2), updating and implementing Department policies and programs (section 3B3), identifying key supply chains and making them more resilient (section 3B4), and incorporating adaptation and resilience into grants, loans, and agreements with external parties (section 3B5).

1. Accounting for Climate Risk in Planning and Decision Making

Department Bureaus and Offices have varied missions and responsibilities (section 2A). As a result, the incorporation of climate risk into planning and decision making varies across those Bureaus and Offices. Updates to the DM make climate change adaptation Department policy, and Bureaus and Offices will work to ensure their policy and guidance integrate adaptation into their planning and decision making given their missions and authorities.

Several Bureaus with resource management responsibilities have well-developed guiding documents to help staff apply risk assessments into plans and decisions. The NPS has a suite of policy guidance (see appendix D) that lays out processes for its units to incorporate vulnerability assessments into park planning and decisions, and both NPS and USGS use climate risk measures as part of their decision frameworks for capital investments. The BOR coordinates basin studies—exercises with stakeholders to assess water supply and demand into the future—as a strategy for identifying potential water shortfalls and approaches to address them. The BOR is also developing guidance to apply climate change information into its decision making, which is expected to be released in 2024.

In other Bureaus, the application of climate risk occurs for specific programs. The FWS uses risk assessments in its Ecological Services program, management of the NWRS and assessing invasive species risk in the Fish and Aquatic Conservation program. Similarly, BIA uses risk registers and other risk management approaches for its Safety of Dams and Tribal Climate Resilience programs.

For some Bureaus establishing the process for incorporating climate risk into planning and decision making is underway. While BOEM considers climate change in its National Environmental Policy Act (NEPA) documents, as appropriate, BSEE's actions have to-date not necessitated climate risk assessments in its work. As information on climate change impacts to the safety and performance of offshore operations improves, BSEE will update its procedures, as applicable. The OSMRE does not currently incorporate climate risk into its decision making but intends to revisit its policies as Department implementation of NBS and other adaptation and resilience policies advances.

In late 2023, Interior published several new DM chapters that provide direction on considering climate change in Department decisions (section 3B3). In addition to 523 DM 1, which sets Department policy on climate change adaptation, other chapters set policy on tools and approaches to use the best available science and practice to make informed decisions and increase adaptation

and resilience. They provide a standard for incorporating climate risk across the Department and complement the Bureau efforts to incorporate climate risk into their work. Additional detail on Bureau-level incorporation of climate risk into plans and decisions is included in appendix D.

2. Incorporating Climate Risk Assessment into Budget Planning

Responses to the risks of climate change are incorporated into budgeting for the Department's programs primarily through field-level identification of current and future needs. For existing programs, resource needs to address climate risks are identified during planning (e.g., incorporation of insights from vulnerability assessments), or in response to observed changes on the ground. Additionally, programs have been established to specifically address climate change impacts.

The Department will prioritize available resources to address climate risk through formulation of the Interior budget and through enterprise risk management. Interior budget formulation will incorporate policy and on-the-ground information using bottom-up and top-down processes to make climate-smart, resilient decisions.

Interior's program staff are leaders in evaluating climate risk and developing and deploying climate adaptation tools and strategies to inform planning and budgeting decisions (section 3A1 and appendix D for summaries). Field units within Bureaus and Offices evaluate climate risk for individual projects and mission-delivery responsibilities, which includes the effects of climate change on their mission-critical assets, natural resources, surrounding communities, and the health and safety of the public and employees. This guides their budgeting for specific risk mitigation, adaptation, and resiliency actions.

Interior has promulgated guidance to Bureaus and Offices to incorporate climate risk into project planning and budgeting (section 3B3 below). Implementing this guidance will help expand the application of climate science to decisions, use of vulnerability assessments, and development of other tools and strategies that inform budgeting to make the Department more resilient and help avoid maladaptive actions.

For example, Interior owns more than 41,800 buildings and 80,000 structures. Climate risks can be significant and varied across this portfolio of assets, many of which are situated in environments subject to temperature and precipitation extremes. This portfolio includes buildings and structures that are historic or iconic for the United States, which cannot easily be adapted or relocated to respond to changing climate. Updated guidance and tools from the Department and its Bureaus (section 3A1) will help identify opportunities to increase resilience among existing structures and avoid identified risks in the siting and design of new facilities.

The NBS provide another example of how this works. After Hurricane Sandy decimated the Mid-Atlantic coast in 2012, many wildlife refuges along the Atlantic Flyway lost critical feeding wetlands and nesting habitat to storm surge. With both supplemental and regular appropriations, Interior invested in dozens of projects that helped communities prepare for and protect against increasingly frequent intense storms. At Prime Hook NWR, land managers and partners at the refuge executed a

plan that let natural patterns lead in restoring the marsh and correcting the site's water flow, making the refuge and the surrounding communities safer and more resilient. This sort of project, based on augmenting and enabling natural processes, has become a model for restoration projects nationwide. Project budgets are built from these approaches to ensure they include the costs of climate risk mitigation.

Some programs have an explicit mandate to focus on climate risks through climate adaptation and resilience. The BIA's Branch of Tribal Climate Resilience provides funding through its Tribal Climate Resilience Annual Awards to Tribal Nations to mitigate climate risks and facilitate resilience activities. These historically underserved and underrepresented communities exist at some of the places most vulnerable to climate change. Incorporating climate risk mitigation into the budget is critical to helping these communities remain on their homelands, delivering not just transformational assistance in the face of climate change, but also advancing environmental justice and upholding the Federal Government's trust responsibilities.

Interior has made substantial progress in evaluating climate risk to specific programs and sharpened understanding of the largest impacts of climate change on the mission requirements. This includes pursuing many pathways to decarbonize Interior assets and using a broad portfolio of research, planning, and deployment support activities to facilitate meeting the President's goal of building a clean energy economy. Through Interior's budget development process, at each stage, we identify the benefits of carbon reduction investments, conservation, and hazard mitigation measures to deliver adaptation and resilience, and scientific pursuits that proactively address climate risks.

3. Incorporating Climate Risk into Policy and Programs

Department policy provides a mechanism for incorporating climate risks into agency actions, and for aligning work on conservation, equity, and climate change mitigation in ways that also produce adaptation and resilience benefits. Since the publication of the 2021 Climate Action Plan, the Department has updated policy to improve adaptive capacity and resilience, incorporate NBS, and better engage with Tribal Nations, the Native Hawaiian community, and insular area communities. At the same time, its climate mitigation policies have been updated in ways that integrate adaptation principles.

Climate Adaptation and Resilience

The Department completed a major series of policy updates in 2023 that enable increased resilience and adaptive capacity across its Bureaus and Offices. Six DM chapters were published that lay out the Department's approach to considering climate change and climate science, utilizing adaptive management and NBS, applying landscape-level approaches to resource management in both terrestrial and marine environments, and elevating IK, and a seventh chapter is in review at the time of publication of this Plan. The full list of DM chapters follows:

- **301 DM 7, Indigenous Knowledge** requires the promotion and inclusion of IK in Departmental decision-making and developing lasting relationships with holders of IK. ***(New chapter)***
- **522 DM 1, Adaptive Management Implementation Policy** emphasizes increasing need for Adaptive Management to increase the effectiveness of resource management under uncertainty. ***(Updated chapter)***
- **523 DM 1, Climate Change Policy** emphasizes that consideration of changing climate is the default for planning and decision making to support adaptation and resilience. ***(Updated chapter)***
- **526 DM 1, Applying Climate Change Science** reinforces the need to apply high-quality climate information and consider climate uncertainty in resource management planning and decisions. ***(Updated chapter)***
- **600 DM 7, Nature-based Solutions** provides overarching guidance for consistent NBS delivery and implementation principles. ***(New chapter)***
- **604 DM 1, Implementing Landscape-Level Approaches to Resource Management** provides guidance on implementing landscape-level approaches to natural and cultural resource management. ***(Updated chapter)***
- **604 DM 3, Landscape-level Mitigation** mitigates adverse impacts to trust resources in the context of landscape-level considerations and processes. ***(Under review in early 2024)***

The Department has established several working groups called for in the DM chapters to develop tools, guidance, and metrics. Organized through the Coordination Program on Resilience and Environment, which is housed in the Office of the Secretary, the working groups have been rostered and have developed workplans. They are now developing guidance, training resources, and other products and are working with the Office of Planning and Performance Management to develop metrics to evaluate their integration into and impact on Department actions.

As part of their workplans, the working groups are updating several key policies and guidance documents. These include the following:

- A handbook and training in implementing and including IK in Departmental actions and scientific research.
- Technical guidance on the application of climate science to Department decisions,
- Updates to the Department's adaptive management technical guidance.
- A Department NBS Roadmap (*completed; see below*).
- Guidance on implementing landscape level approaches to conservation (section 3A3).

These updates are intended to be complete by the end of calendar year 2025. At the same time, Bureaus have been updating their own policies, as needed, to align with these Department-level changes.

Nature-based Solutions

The DM chapter (600 DM 7) on NBS is a first-of-its-kind policy for the Department. The Department also developed the recently published Interior NBS Roadmap as guidance for implementing the chapter.[66] The Department has formally chartered the NBS Working Group (NBSWG), which is working to refine and revise its FY 24/25 Work Plan. The working group is currently finalizing recommendations on funding and, partnerships and on evaluation, monitoring, and metrics.

The Department has set up an internal SharePoint site with resources for permitting, funding and partnerships, relevant NBS laws and policies, and additional tools and resources. The Department is also investing in the development of an online, searchable version of the Department's NBS Roadmap, a suite of Interior NBS Case Studies, an NBS gap analysis, and a metrics framework for assessing the human and environmental co-benefits of NBS implementation, produced in conjunction with partners at Duke University. This is expected to be complete by the end of FY 2025.

As those online resources mature, Bureaus will work internally and across the Department and agencies to scale best practices, overcome barriers to NBS adoption, and build capacity. For example, FWS has already hired a dedicated Nature-based Resiliency Coordinator. The Green Infrastructure Federal Collaborative—an interagency group—is developing guidance on best practices for NBS permitting. The Department's NBSWG will be developing reporting guidance to ensure Department level success in implementing 600 DM 7 as a biennial report, starting in 2025, and evidence building activities for metrics and monitoring.

Environmental Justice

In October 2022, the Department convened the Environmental Justice Steering Committee (EJSC) to evaluate opportunities to advance environmental justice across Interior programs and activities. The Department's EJSC reports to the Department's Climate Task Force and is chaired by the Department's Environmental Justice Officer. The Department's Environmental Justice Officer is also its Climate Adaptation Official and has reviewed this plan for consistency with the Department's environmental justice priorities and implementation.

In April 2023, the EJSC developed a work plan that includes updating the Department's Environmental Justice Strategic Plan and Environmental Justice Implementation Policy, providing Departmental environmental justice, incorporating environmental justice in employee performance evaluations, developing a stakeholder engagement toolkit, and developing barriers analysis around grants and technical assistance, among others.

The Department included environmental justice and the evaluation of IK in the recently approved climate related polices – Nature-based Solutions, Adaptive Management, Climate Change, Climate Change Science, and Landscape-level Approaches. For example, in the NBS Chapter, the Department focuses on equity and environmental justice through the following actions:

- Implementing NBS in a manner that does not exclude or discriminate, nor has adverse disproportionate impacts to, communities with environmental justice concerns, or Tribal Nations.
- Incorporating equity and environmental justice principles in the NBS feasibility, siting, design, and delivery process by meaningfully engaging with relevant communities, whenever possible.
- Encouraging implementation of NBS in communities experiencing or at risk of experiencing disproportionate and adverse environmental and climate-change impacts.

Tribal Nations

As the agency responsible for fulfilling government-to-government responsibilities with all federally recognized Tribes, and for working with the Native Hawaiian community, the Department has had numerous consultations and meetings related to climate adaptation and resilience. A full list of past consultations and meeting are available on BIA and Department websites, but several are worth calling out given their connection to climate change adaptation and resilience. They include the following:

- Implementation of Joint Secretarial Order 3403 on collaboration and co-stewardship.
- An interagency MOU to protect and increase access to Indigenous sacred sites.
- Implementation of Tribal and Native Hawaiian climate resilience programs.

In December 2023, the Department announced a policy to respect, and equitably promote the inclusion of, IK in the Department's decision making, program implementation, and other activities. The evaluation of IK in climate policy and activities advances environmental justice through meaningfully engaging with and evaluating impacts on Indigenous people.

Climate Mitigation Policies and Adaptation Co-Benefits

The Department has been deliberate in integrating climate change adaptation into its climate change mitigation actions, as have its Bureaus. In addition to the policy updates above, the Department is taking steps to promote renewable energy development that incorporates climate change adaptation to better inform decision making.

Some examples of mitigation policies that integrate adaptation principles and/or identify co-benefits include the following:

- The BLM updated land management planning and regulations to promote renewable energy, including wind and solar energy development. In line with this effort, BLM has signed an MOU with FWS that incorporates conservation recommendations into its 11-State programmatic Environmental Impact Statement on solar energy development on public lands. This helps ensure that development aligns with identified climate adaptation needs for species.

- The BOR has updated its climate change adaptation-associated guidance, which supports management of water resources.
- The BOEM has contributed to the Ocean Climate Action Plan and the Ocean Justice Strategy, which incorporate adaptation and equity into climate mitigation priorities, including the deployment of offshore wind projects and development of an offshore carbon sequestration program.
- The Department has incorporated adaptation principles into its 5-year lifecycle investment plan. As discussed in section 3A, prioritization of major real property investments conforms to the guidance and ranking criteria within the Interior's Lifecycle Investment Planning Guidance (LIPG). The LIPG emphasizes a lifecycle cost-effectiveness approach, and measures such as energy efficiency, sustainability, and resilient design are required where applicable and strongly encouraged in all projects. Incorporating sustainable and resilient design into projects saves taxpayer money over the life of the investment and improves mission delivery in the event of natural hazards and climate impacts.

4. Climate-Smart Supply Chains and Procurement

The Department has conducted a thorough assessment of climate hazard risks associated with its critical supplies and services. Utilizing the GSA Framework for Managing Climate Risks to Federal Agency Supply Chains, the Department has systematically evaluated five critical supplies or services, employing a risk management approach to address the challenges posed by a changing climate. These five areas include data centers, construction materials, electric fleet vehicles, emergency management services, and communications infrastructure.

In alignment with the Department's commitment to climate resilience, a comprehensive policy has been enacted, compelling all Bureaus and Offices to integrate sustainability and resilience principles into various aspects of agency operations. This encompasses real and personal property management, fleet and energy management, acquisition, solid waste management, and capital planning.

To better identify potential risks related to climate, the Department included the Associate Director for Asset Management in the Acquisition Program Advisory Council (APAC) Review of all major acquisitions involving Federal facilities or infrastructure, with a total value of $50 million or greater. The APAC includes a presentation of all known acquisition risks. The Department has also added a sustainability section to its Acquisition Toolkit, which shares resources for contracting officers such as the GSA Federal Contractor Climate Action Scorecard, EPA's Significant New Alternatives Policy (SNAP) Program, and the Federal Buy Clean Initiative.

Recognizing the evolving climate landscape, the Department is currently in the process of revising its Incident Response Business Management Handbook. This revision aims to enhance preparedness and procurement process for extreme weather events and climate change impacts such as wildfires, floods, and storms. The improved guide will comprehensively address the spectrum of climate-related events, ensuring readiness and resilience in the face of changing environmental conditions.

While the Department has identified five supply chains or services that are most at-risk to potential disruption due to acute weather events or the effects of long-term climate change, it is important to note that specific goals and a formalized plan to assess progress are currently under development. The Department is actively working on formulating precise goals and an effective monitoring framework to track and evaluate advancements in climate resilience strategies for critical supplies and services. This ongoing process underscores the Department's commitment to continuous improvement and proactive management in the face of climate challenges. As the Department moves forward, Interior is monitoring the FAR guidance in this area to influence the formulation of our precise goals. Table 10 below outlines priority actions.

Table 10. Summary of Department Progress toward Addressing Risks to Critical Supplies and Services Identified in 2021 CAP.

At Risk Supplies/Services	Actions to Address Hazards	Progress Towards Addressing Hazards
Data Centers (Flooding, wildfire, other extreme weather cam damage data centers)	Partner with the Office of the Chief Information Officer (OCIO) to ensure risks are handled in accordance with the Department's Security Controls Standard and the NIST 800-53 guidance/guidelines for Data Centers.	The OCIO and the Office of Acquisition and Property Management (PAM) have jointly issued the Department's Information and Communications technology Supply Chain Risk Management (SCRM) Strategy. In major acquisitions, the Contracting Officer works to identify the risk items and mitigation strategies in the Acquisition Program Advisory Council. Both the Senior Procurement Executive and the Chief Information Officer sit on this Council.
Emergency Management Services (Flooding, wildfire, other extreme weather can increase demand for services)	Ensure acquisition workforce has access to adequate tools and training for emergency acquisition.	The Acquisition Management Partnership hosted the first emergency management sprint to discuss needed tools for acquisition workforce for effective emergency management operations. The collaboration included acquisition representation from all Bureaus, Department Incident Response Acquisition SMEs, and the Office of the Solicitor. The sprint narrowed down existing resources and tools we can provide to the acquisition workforce and identified necessary policy development actions. PAM also established a landing page and links for emergency acquisition tools for the acquisition workforce. Shared best tools and practices among Bureaus. PAM hosted an acquisition-focused town hall to review all emergency acquisition resources to help the acquisition workforce effectively tackle climate concerns. This resulted in connections with the Office of Emergency Management and Federal Emergency Management Agency (FEMA) to prepare training best practices for effective emergency management. In addition, PAM collaborated with all the Bureaus and the Office of Emergency Management (OEM) to develop a Draft Department of the Interior Incident Response Business Management Handbook to ensure this handbook would be a resource for the acquisition workforce.

At Risk Supplies/Services	Actions to Address Hazards	Progress Towards Addressing Hazards
Construction (Multiple supply chain exposures to climate hazards)	Updated guidance on acquiring construction materials.	In major construction acquisitions, the Contracting Officer identifies supply chain risk areas and mitigation strategies to the Acquisition Program Advisory Council. We have also updated our economic price adjustment guidance for use when appropriate to help with supply chain issues on construction materials. The USGS is pursuing complementary work. The USGS Earth Mapping Resources Initiative is using disaster supplemental funding to collect foundational data to identify potential construction resources in Florida and Puerto Rico following recent hurricanes. Understanding sources of construction materials – particularly sand, gravel, stone, rock, and cement –will strengthen supply chains for these materials.
Communications Infrastructure (Operations are vulnerable to extreme weather events)	Ensure effective acquisition and implementation of resilient modern connectivity communications and IT solutions for real time distribution of information during emergency management events.	Progress has not yet been made.

5. Climate Informed Funding to External Parties

Department Bureaus and Offices offer a wide range of financial assistance to support climate adaptation and resilience of communities, ecosystems, and infrastructure. In FY 2023, the Department managed more than 90 financial assistance programs with direct relevance to climate adaptation and resilience. In total, these programs provided more than $4.8 billion in Federal assistance in FY 2023.

Several established financial assistance programs have criteria to incentivize projects and activities that promote climate adaptation and resilience (see text box). Some of these programs were bolstered by funding made available by BIL and IRA. In addition, BIL and IRA funding supported several additional financial assistance activities/programs which consider climate change criteria. These include the following:

- America the Beautiful Challenge Grants (Interior contributed to this National Fish and Wildlife Federation-administered program).
- Restoration and Resilience (NPS).
- Refuge System Resiliency (FWS).
- Conservation, Resilience, and Ecosystem Restoration (BLM).
- Climate Change Technical Assistance for Territories (Office of Insular Affairs).
- Community-Driven Relocation Initiative and Demonstration Projects (BIA).
- Kapapahuliau Native Hawaiian Climate Resilience (Office of Native Hawaiian Relations).

The Department will pursue agencywide steps to encourage climate-adapted and resilient investments through its financial mechanisms (i.e., grants, cooperative agreements, loans, technical assistance, contracts, and awards), as appropriate. This will be accomplished by taking the following actions:

- Identifying financial assistance programs where the outcomes (e.g., facility development, ecological restoration, site cleanups) are sensitive to climate change.
- Including a requirement for evaluation of climate risk and/or consideration of climate adaptation and resilience in funding announcements, as appropriate and consistent with existing law.
- Factoring climate change considerations into the evaluation process for discretionary grants and awards.

As the Department takes steps to better integrate climate adaptation and resilience considerations into its financial assistance programs, it is also working to ensure that historically marginalized communities have greater input on and receive enhanced benefits from the financial assistance that the agency provides to support climate adaptation and resilience though efforts such as the following:

- **Justice40 Initiative.** Many of these programs promote climate adaptation and resilience, while also helping to advance environmental justice because they are covered programs within the Justice40 Initiative, which sets a goal that 40 percent of the overall benefits of certain Federal climate and other investments flow to disadvantaged communities that are

marginalized by underinvestment and overburdened by pollution.[67] Consistent with the Memorandum 23-09[68], the Department uses the Climate and Economic Justice Screening Tool (CEJST) to assist in identifying disadvantaged communities for the Justice40 Initiative and programs where a statute directs resources to disadvantaged communities, to the maximum extent possible and permitted by law.

- **Equity Action Plan.** In early 2024, the Department released its updated Equity Action Plan,[69] which included an analysis of the barriers faced by Tribes when accessing Interior's discretionary grants. Many of the barriers that Tribes reported have also been highlighted as issues for other communities with environmental justice concerns. The Department is working to incorporate environmental justice considerations into policies and program designs and expand outreach to communities with environmental justice concerns to increase the proportion of the benefits of the Department's Justice40 Initiative covered programs that reach disadvantaged communities.
- **Tribal Climate Resilience Liaison Program.** The BIA Regional Tribal Climate Resilience Liaison Program is a model Federal program for effective coordination for climate resilience executed in partnership with and under the leadership of inter-Tribal organizations[70] The resource managers established through the program are a multiregional support network that helps Tribal Nations and Alaska Native villages incorporate climate considerations into planning and decision making. They serve as extension agents facilitating research, linking Tribal needs to available resources and coordinating trainings, workshops, forums and exchanges, including incorporating climate science into adaptation planning efforts through resources available through the Department's Climate Adaptation Science Centers.
- **Territorial Climate and Infrastructure Workshop and Insular Area Ecosystem Restoration funding**. The Office of Insular Affairs has held two workshops with over 350 local, Federal, and territorial representatives to discuss territorial climate and infrastructure needs as well as agency resources and technical assistance. Topics ranged from energy and broadband to invasive species and NBS, and enabled territories to pursue funding, including $12 million for climate change adaptation and resilience and $4 million for ecosystem restoration available through BIL.
- **Kapapahuliau Climate Resilience Program.** In November 2023, the Office of Native Hawaiian Relations announced a $20 million climate resilience initiative that is funded by the IRA.[71] The program reflects ongoing engagement with the Native Hawaiian Community to identify strategies to cope with and adapt to climate change while maintaining community identity and integrity.

As the Department implements this Plan, it will take steps to address lessons learned since the 2021 Climate Action Plan was released, as well as recommendations provided by the WHEJAC on climate planning, preparedness, response, and recovery. This includes the development of goals and timelines for climate resilience funding to Tribal communities provided through BIL.

The wide breadth of funding programs managed by Interior

Below is a non-exhaustive list of programs managed by the Department that support climate adaptation and resilience.

- Small Surface Water and Groundwater Storage Projects (BOR)
- Snow Water Supply Forecasting (BOR)
- Water Recycling and Desalination Construction Programs (BOR)
- WaterSMART (Sustain and Manage America's Resources for Tomorrow) (BOR)
- Cooperative Watershed Management (BOR)
- Applied Science Grants (BOR)
- SECURE Water Act Research Agreements (BOR)
- Aquatic Ecosystem Restoration Program (BOR)
- Emergency Supplemental Historic Preservation Fund (also known as Disaster Recovery Grants) (NPS)
- Recreation and Visitor Services cooperative agreements and grants (BLM)
- National Landscape Conservation System cooperative agreements and grants (BLM)
- National and Regional Climate Adaptation Science Centers cooperative agreements and grants (USGS)
- Tribal Climate Resilience (BIA)

3C. Building a Climate Informed Workforce

In the 2021 Climate Action Plan guidance, agencies were asked to describe the priority offices and management with the most critical need for climate literacy training, and how the agency provides climate literacy training. Agencies were also requested to provide an estimate of the timeline and any measures for indicating annual progress and success.

The table and narrative below articulate progress on the Department's agencywide climate adaptation training initiatives, including development of new training and efforts to extend training to the Senior Executive Service as well as acquisition, budget, and planning staff.

Table 11. Tracking Department Progress on Training and Building Capacity for a Climate-Informed Workforce

Agency Climate Training Efforts	Percent of the agency's Federal staff that have taken a 60+ minute introductory climate training course (e.g., Climate 101).	1%
	Percent of the agency's senior leadership (e.g., Secretary, Deputy Secretary, SES members, Directors, branch chiefs, etc.) that have completed climate adaptation training.	<19%[72]
	Percent of budget officials that have received climate adaptation related training.	0.2%
	Percent of acquisition officials that have received climate adaptation related training.	0.2%
Agency Capacity	Number of full-time Federal staff (FTE) across the agency that have tasks relevant to climate adaptation in their job description.	No data are available on the number of Federal or contracting staff with tasks relevant to climate adaptation in their job description. However, 86 percent of respondents to a Departmentwide needs assessment survey agree that climate change "will have an impact on my work."

Following the release of the 2021 Climate Action Plan, Interior established a Climate Training Working Group (CTWG) to plan and coordinate climate training across the Department. The CTWG developed a detailed 3-year workplan to improve the availability of climate training resources to staff across the Department through a wide range of activities. Some of these activities include the following:

- Establishing agreements among Interior Bureaus to improve access to training for employees of other Bureaus and Offices.
- Creating a one-hour basic climate training, accessible to all Interior employees, explaining the basics of climate science and how it affects Interior's mission.
- Developing an inventory of climate trainings offered at Interior to make it easier for interested staff to find them.
- Assembling new communications tools, such as a Departmentwide intranet site and email lists, to publicize climate training and other climate learning resources.
- Developing climate-related competencies for use in employee performance plans.

Since the CTWG was established in 2021, the working group and its partners across Interior Bureaus and Offices have made progress in a number of areas. Accomplishments thus far include the following:

- A full-day "Climate 101" training session has been developed and is offered annually to Senior Executive Service candidates as part of the Candidate Development Program (CDP).
- A 2023 needs assessment survey of Interior employees to gather data on their needs and preferences for climate training, gathering over 2,000 responses (3 percent of Interior employees).
- Performance criteria encouraging climate training and the use of climate considerations in management decisions was developed for Senior Executive Service employees and will be incorporated into their performance plans.
- An initial inventory of over 70 climate trainings was assembled and made available to all Interior employees on an internal SharePoint site.
- A set of training metrics and a survey instrument for tracking these metrics have been developed for assessing the effectiveness of climate trainings.

In 2024, the CTWG will complete development of a Basic Climate Training module accessible to all Department staff and begin exploring applied trainings for specific topics and job series. The CTWG will also work to establish inter-Bureau agreements to share training, develop an internal communications strategy to improve awareness of climate literacy resources, and work to expand use and awareness of the products already developed, such as the metrics survey instrument and the training inventory.

As of 2024, the Department is in the early stages of implementing its efforts to expand climate training and build a climate literate workforce. Because many of these efforts are preliminary, only limited data are available to estimate their early effects on climate literacy at Interior generally. Most of percentages provided in the table above—those reporting employees who have taken an introductory climate course, budget employees who have taken an adaptation course, and acquisition employees who have taken an adaptation course—are based on the completion records of nine different climate training courses offered through Interior's online learning management system, DOI Talent.[73] While these data are the best available primary data on climate training completion, they do not include trainings for which records were not available in DOI Talent, such as the

region-specific Climate 101 trainings through the USGS Climate Adaptation Science Center network, or in-person courses through universities or other agencies.

Data from DOI Talent are complemented by responses from the December 2023 needs assessment survey, which asked respondents whether they had taken a 1-hour basic climate training course or a training on climate adaptation. Of the 2,099 respondents (approximately 3 percent of Interior's workforce), 1 percent reported having taken a one-hour basic training course. Additionally, 19 percent of senior leaders, 8 percent of budget staff and 4 percent of acquisitions staff reported having taken a climate adaptation course. However, participation in the survey was voluntary, and results may reflect relatively higher response rates by employees with interest in climate-related issues.

SUMMARY OF PRIORITY ACTIONS

Section 3A. Addressing Climate Risks and Hazards

Section	Theme	Description of Action	Timeline	Indicators for success
Buildings (Section 3A1)	Understand climate hazards and assessing exposure	Incorporate natural disaster resilience into individual projects by assessing climate hazards and natural disaster risk.	Initiated 2024-2025, ongoing	Internal rollout of climate hazard exposure functionalities. Incorporation into guidance, and implementation of guidance for new projects and across the Department's building portfolio.
Buildings (Section 3A1)	Understand climate hazards and assessing exposure	Implementation of Department policy "Addressing Natural Hazards Risk for Real Property Assets."	2024-2027	Number of vulnerability assessments conducted.
Employees (Section 3A2)	Understand climate hazards and assessing exposure	Understanding the effects of smoke on firefighters and the general public.	2024-2027	Research findings relevant to operational and public health policy.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Understand climate hazards and assessing exposure	Improved data on climate hazards and stressors with a geographic scope outside the lower 48 (e.g., Alaska, Hawaii, insular areas, offshore).	Ongoing	Releases and updates of climate hazard data that close the following gaps: • Outside the lower 48 • For offshore marine environments • For regionally significant climate hazards/stressors
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Understand climate hazards and assessing exposure	Conducting vulnerability assessments of lands and waters.	Ongoing	Percent of Department-managed units that have conducted a vulnerability assessment. Percent of Interior-managed units that have taken an action to improve conditions based on a climate change vulnerability assessment.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Understand climate hazards and assessing exposure	Advance the National Offshore Sand Inventory initiative to improve our understanding and management of sediment resources on the U.S. OCS.	Ongoing	Completion of the inventory. Response time for coastal disaster recovery.
Buildings (Section 3A1)	Prioritize and scale adaptation	Incorporate appropriate design standards and codes for resiliency and sustainability in new construction and retrofits.	2024-2027	Adoption of practices reported as part of review processes, as well as project level tracking through the following: • Strategic Sustainability Plan submissions • OMB Scorecard reporting • Annual Department Sustainability Organizational Assessments.

Section	Theme	Description of Action	Timeline	Indicators for success
Employees (Section 3A2)	Prioritize and scale adaptation	Develop communication approaches and contingency plans to respond to increasing frequency of extreme heat.	2024	Rollout of comms strategies and plan updates. Influenced by recommendations in the NIHHIS draft National Heat Strategic Plan
Employees (Section 3A2)	Prioritize and scale adaptation	Adapt policies to promote best practices in fire management while protecting its workforce, including application of Western science and IK.	Initiated in 2024, ongoing	Updates to policies.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Prioritize and scale adaptation	Develop policy guidance and metrics for climate science applications, landscape-level management, IK, and NBS to help Interior staff use best-available tools and practices, and monitor outcomes.	2024-2025	See below, row for section 3B3.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Prioritize and scale adaptation	Invest in targeted adaptation efforts—such as land acquisitions to promote connectivity and restoration to improve ecological function—across the lands and waters that the Department manages.	Ongoing	Activities and impacts reported through America the Beautiful, the BIL-ER monitoring framework, or similar effort.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Prioritize and scale adaptation	Build the Department's ability to use data and evidence to assess impact at the landscape scale.	Through 2026	Develop a pilot restoration outcome monitoring framework.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Prioritize and scale adaptation	Implement the Bureaus' climate change adaptation strategies.	Ongoing	Varies by Bureau (see, for example, the Bureau of Reclamation Climate Change Adaptation Strategy)
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Prioritize and scale adaptation	Implementation of the Invasive Species Strategic Plan and supporting national and regional efforts to prevent the introduction, establishment, and spread of invasive species, including partnerships and joint educational efforts such as the Regional Invasive Species and Climate Change Management Networks.	Through 2025	Performance metrics are listed in appendix D of the Invasive Species Strategic Plan.
Employees (Section 3A2)	Build capacity	Working with EPA and public health agencies and increase staffing and expertise on fire emissions.	2024	Staffing levels

Section	Theme	Description of Action	Timeline	Indicators for success
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Build capacity	Developing the Indian Youth Service Corps as part of the American Climate Corps initiative.	Initiated 2023, ongoing	Corps Enrollment Projects completed
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Build capacity	Establishment of the Department's Office of Partnerships.	2025	Development of policy and guidance by the Office to support Bureaus and Offices.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Build capacity	Continuing to implement Joint Secretarial Order 3403, including development of collaborative and cooperative agreements with Tribal Nations.	Ongoing	Number of agreements. Input from Tribes on their implementation.
Lands, Waters, and Cultural and Natural Resources (Section 3A3)	Build capacity	Collaborate with White House offices such as the White House Initiative on Asian Americans, Native Hawaiians, and Pacific Islanders, and White House Council on Native American Affairs to build capacity for disadvantaged communities to better compete for grants and cooperative agreements.	Ongoing	Identification of barriers and capacity needs.

Section 3B. Climate-Resilient Operations

Section	Description of Action	Climate Risk Addressed	Timeline	Indicators for success
Incorporating Climate Risk into Policy and Programs (Section 3B3)	Implementation of WG workplans, specifically development of the following: • A handbook and training in implementing and including IK in Departmental actions and scientific research, • Technical guidance on the application of climate science to Department decisions, • Updates to the Department's adaptive management technical guidance, • A Department NBS Roadmap (*completed; see below*), and • Guidance on implementing landscape level approaches to conservation (section 3A3).	*All hazards*	Through 2025	Publication of working group guidance and handbooks Utilization of knowledge projects (specific metrics are under development by working groups and the Office of Planning and Performance Management)

Section	Description of Action	Climate Risk Addressed	Timeline	Indicators for success
Climate-Smart Supply Chains and Procurement (Section 3B4)	Developing an implementation plan for addressing risks to critical supplies/services and applying it.	*All hazards*	2024-2027	Development of a plan. Implementation of plan.
Climate-informed Funding to External Parties (Section 3B5)	Identifying all financial assistance programs that can include climate risk.	*All hazards*	2024-2025	Process metric.
Climate-informed Funding to External Parties (Section 3B5)	Updating requirements and evaluation processes for discretionary grants and awards, as practicable and consistent with existing law.	*All hazards*	Ongoing	Updated announcements and review instructions.

Section 3C. Building a Climate-Informed Workforce

Section	Description of Action	Climate Risk Addressed	Timeline	Indicators for success
Climate Training and Capacity Building for a Climate Informed Workforce (Section 3C)	Complete a Basic Climate Training module.	*All hazards*	2024	Utilization of training module.
Climate Training and Capacity Building for a Climate Informed Workforce (Section 3C)	Establish inter-Bureau agreements to share training.	*All hazards*	2024-2025	Number of agreements Assessment of training needs

SECTION 4: DEMONSTRATING PROGRESS

4A. Measuring Progress

The table below captures Department progress related to several performance indicators and process metrics that will be used across the Federal Government to track climate resilience and adaptive capacity.

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in planning and budgeting of agency programs by 2027.

Section of the CAP	Process Metric	Agency Response
3A –Addressing Climate Hazard Impacts and Exposure	Step 1: Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. (Y/N/Partially)	*Step 1.* ***Yes****, the implementation plan reflects that linkage between exposure to climate hazards and discrete actions.*
	Step 2: Agency has a list of discrete actions that will be taken through 2027 as part of their implementation plan. (Y/N/Partially)	*Step 2.* ***Partially****. Many actions are planned through 2025, longer term actions may reflect strategic commitments rather than discrete projects.*
3B1 – Accounting for Climate Risk in Decision-making	Agency has an established method of including results of climate hazard risk exposure assessments in planning and decision-making processes. (Y/N/Partially)	***Partially.*** *Some Bureaus within the Department have established methods for including results of climate hazard risk exposure assessments in planning and decision-making processes. See section 3B1 for additional details.*
3B2 – Incorporating Climate Risk Assessment into Budget Planning	Agency has an agencywide process and/or tools that incorporate climate risk into planning and budget decisions. (Y/N/Partially)	***Partially****. The agency has an agencywide enterprise risk management system maintained by the Office of Planning and Performance Management. Regarding budget decisions, the functions and responsibilities of the Department's Bureaus and offices vary significantly, and there is no single process for incorporating climate risk into budget decisions.*
3B5 – Climate Informed Funding to External Parties	Step 1: By July 2025, agency will identify grants that can include consideration and/or evaluation of climate risk.	*Step 1.* ***Yes****. The agency will identify grants.*
	Step 2: Agency modernizes all applicable funding announcements/grants to include a requirement for the grantee to consider climate hazard exposures. (Y/N/Partially)	*Step 2.* ***Partially****. The agency is considering options to incorporate climate hazard exposures into funding announcements and grants.*

Key Performance Indicator: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.

Section of the CAP	Process Metric	Agency Response
3A –Addressing Climate Hazard Impacts and Exposure	Agency has identified the information systems that need to incorporate climate change data and information and will incorporate climate change information into those systems by 2027. (Y/N/Partially)	***Partially****. SHIRA currently serves as a useful tool for emergency management, and it includes some climate change information, which can be extended through additional support and funding. At the same time, the Office of Planning and Performance Management has an enterprise risk management system that includes climate risks.*

Key Performance Indicator: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate NBS, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives.

Section of the CAP	Process Metric	Agency Response
3B3 – Incorporating Climate Risk into Policy and Programs	By July 2025, 100 percent of climate adaptation and resilience policies have been reviewed and revised to (as relevant) incorporate NBS, mitigation co-benefits, and equity principles. (Y/N/Partially)	***Partially****. Following on the publication of updated DM chapters, Bureaus/offices and Departmentwide working groups are updating policies and guidance identified as playing key roles in adaptation and resilience.*

Key Performance Indicator: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.

Section of the CAP	Process Metric	Agency Response
3B4 – Climate-Smart Supply Chains and Procurement	Step 1: Agency has assessed climate exposure to its top-five most mission-critical supply chains. (Y/N/Partially)	*Step 1.* ***Partially****, the supply chains have been identified and methods for assessments have been reviewed.*
	Step 2: By July 2026, agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards. (Y/N/Partially)	*Step 2.* ***Partially****, a process to meet this deadline is being developed but awaits implementation.*
	Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services. (Y/N/Partially)	***Partially****. The Department has successfully identified priorities pertaining to the five critical supplies or services areas through a comprehensive assessment of climate hazard risks, but specific goals and a formalized plan to assess progress are currently under development.*

Key Performance Indicator: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures.

Section of the CAP	Process Metric	Agency Response
3C – Climate Training and Capacity Building for a Climate Informed Workforce	Step 1: By December 2024 100 percent of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. (Y/N/Partially)	*Step 1.* ***Yes****. Agency leadership, via the Department's Climate Task Force, have been briefed in February 2024.*
	Step 2: Does the agency have a Climate 101 training for your workforce? (Y/N/Partially) If yes, what percent of staff have completed the training?	*Step 2.* ***Partially****. This training is currently under development and is planned for release at the end of June 2024.*
	Step 3: By July 2025, 100 percent of employees have completed climate 101 trainings. (Y/N/Partially)	*Step 3.* ***No****. Such training will be available in July 2024, and Departmental leadership will promote it widely to all employees, but completion is not expected to be mandatory.*

4B. Adaptation in Action

While this update to the Department's climate adaptation plan highlights several ongoing and planned efforts, it does not capture the full range of actions we have taken to address the priorities identified in our previous CAP, released in 2021. Several of these accomplishments are listed below, along with references to previous sections of this Plan where related work is described.

2021 CAP Priority Actions	Key Accomplishments
Action #1. Promote Climate-Resilient Lands, Waters, and Cultural Resources (Section 3A3, 3A4, 3A5, 3B, 3D)	Key accomplishments here include steps the Department has taken to direct funding from BIL/IRA into meaningful conservation and restoration actions that increase adaptive capacity and resilience, including the following: • Contributions to the America the Beautiful Challenge. • Establishment of the Restoration and Resilience Framework, which provides a lens for making strategic investments in conservation and restoration. • Advancement of NBS in policy and Department investments, including the Department's NBS Roadmap.
Action #2. Advance Climate Equity (Sections 3A2, 3B, 3D)	Several Department accomplishments to-date are described in section 3. Advancing on these initiatives and looking toward their implementation, it is also important to note in this Plan the work of the Environmental Justice Steering Committee (EJSC), which reports to the Department's Climate Task Force. In addition to updating Department policy, the EJSC is pursuing a workplan including barrier analyses and a toolkit (including screening tools) for Department staff that will make it easier for equity to be incorporated into programs and decisions.
Action #3. Transition to a Resilient Clean Energy Economy (Section 3B, 3C)	Key accomplishments include the following: • Investing in research and partnerships to inform development of renewable energy in both on- and offshore environments, including BSEE's funding to the Ocean Energy Safety Institute's Wind Energy Roadmap, and an FWS-BLM NEPA cooperating agency MOU to include conservation recommendations in BLM's programmatic Environmental Impact Statement on solar energy development on public lands. • Working with communities to ensure informed decision-making as regulations are developed or updated for carbon sequestration and renewable energy, including consultations with Tribes. • Updating policy to enable renewable energy development in a safe, responsible way, including proposed rules from BOEM and BLM. • Approvals of significant offshore wind farms along the Atlantic coast, with potential to add over 7 gigawatts of clean, renewable energy—enough to power more than 2.2 million homes each year.

Action #4. Support Tribal and Insular Community Resilience (Sections 3A3, 3B, 3D)	Many of the Department's key accomplishments are described above in section 3. Important specific activities to note are the development of the Tribal Climate Resilience Program, the Kapapahuliau Climate Resilience Program, and Insular Area Ecosystem Restoration funding.
Action #5. Empower the Next Generation of Conservation and Resilience Workers (Sections 3A2, 3B, 3D, 3E)	Several Bureau-level accomplishments—including NPS's Scientists in Parks program and BIA-FWS collaborations to offer conservation leadership training—were highlighted in past CAP progress reporting. In 2022, the Department announced the Indian Youth Service Corps (IYSC), and in 2023 the IYSC was expanding through a $15 million commitment as part of the launch of the American Climate Corps.

Implementation of the actions above is a testament to the dedication of Department staff and provides some key insights for advancing the priorities in this Plan. They include the following:

1. **The importance of guidance and frameworks as tools for prioritizing and scaling adaptation**. The 2021 CAP acknowledges the key role of policy and guidance to mainstream adaptive capacity and resilience at scale. Updating these policies has taken time—the DM chapters were released in 2023—and provide important groundwork for implementation in the coming years.
2. **Consultation and public input as keys for incorporating adaptation into programs.** Department Bureaus and Offices engage in consultation on a number of topics, it is important to acknowledge the value of consultation and outreach specifically to the development of resilience programs. Engagement led by the Office of Native Hawaiian Relations to develop the Kapapahuliau Climate Resilience Program, for example, helped incorporate community values into the program structure and ensure funding can be directed to community priorities.
3. **Alignment of climate with other aspects in Department work.** Gathering data and applying it to decisions, targeting work to improve outcomes, and building capacity are not priorities unique to climate adaptation and resilience, and absent coordination other aspects of the Department's work—to improve equity or address biodiversity loss, for example—could advance in ways that are duplicative of adaptation efforts or inefficient. Building on the 2021 CAP, the Department has maintained a focus on advancing these lines of work in a coordinated manner.

APPENDIX A: RISK ASSESSMENT DATA

The Federal Mapping App uses the following building and personnel data, in addition to the climate hazard data described in table 1.

Buildings

Buildings data comes from the publicly available Federal Real Property Profile (FRPP). The GSA maintains FRPP data and Federal agencies are responsible for submitting detailed asset-level data to GSA on an annual basis. Although FRPP data is limited—for example, not all agencies submit complete asset-level data to GSA, building locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures, and properties may be excluded on the basis of national security determinations— it is the best available public dataset for Federal real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of Federal buildings to climate hazards.

Personnel

Personnel data comes from the Office of Personnel Management's (OPM) nonpublic dataset of all personnel employed by the Federal Government that was provided in 2023. The data contains a number of adjustments, including exclusion of military or intelligence agency personnel, aggregation of personnel data to the county level, and suppression of personnel data for duty stations of less than five personnel. Despite these adjustments, this data is still useful for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

In addition to these data, the Department used data layers available in the SHIRA project tools:

Personnel

The SHIRA tools include the OPM non-public dataset described above but are not aggregated to the county-level. Results in table 5 reflect overlay of climate hazard data on this nonaggregated layer, but these nonaggregated data were not used elsewhere in the Plan.

Additional Climate Hazard Data

The SHIRA team worked with the Department's Office of Policy Analysis to validate results from the Federal Mapping App and, where possible, apply data layers available through SHIRA or the CMRA tool that provide additional insight into the exposure assessment. They include the following:

- *Alternative flood potential data*. In addition to the FEMA National Flood Hazard Layer, the SHIRA project tools include flood potential data released by the First Street Foundation. More information on their flood model is available here.
- *Complementary sea level rise data*. The SHIRA tools include sea level rise data released by NOAA in 2017 and available in 1-foot increments, with coverage that extends to Alaska, Hawaii, the U.S. Virgin Islands, and the U.S.-affiliated Pacific islands. Categorization of inundation followed source methods, in which a location was considered inundated if it was within a raster boundary for the mean higher high water level, which is typically used as a tidal line for coastal boundaries, regardless of depth. To align with the scenarios described in section 2, the following sea level rise extents were used:
    - Sea Level Rise Intermediate (mid-century) – 2 feet
    - Sea Level Rise Intermediate (late-century) – 3 feet
    - Sea Level Rise Intermediate-High (mid-century) – 2 feet
    - Sea Level Rise Intermediate-High (late-century) – 4 feet

The SHIRA team also worked with CMRA data to provide additional detail in the implications of change in extreme heat and extreme precipitation events, specifically the types of changes that would affect management for Department buildings and the well-being of Department employees and visitors. They included the following:

- Cooling Degree Days, defined as the annual cumulative number of degrees in which the daily average temperature is greater than 65°F.
- Heating Degree Days, defined as the annual cumulative number of degrees by which the daily average temperature is less than 65°F.
- Annual number of days with a maximum temperature greater than 95°F.
- Days with more than 2 inches of precipitation.

Listening Session Input

The CEQ recommended that agencies engage with Tribes, the Native Hawaiian community, and insular area communities, as feasible, to inform decision making. The Department held six listening sessions during the development of this Plan—four for Tribal audiences, one for the Native Hawaiian community, and one for the U.S. territories—in 2024 to gather input on data sources to evaluate climate risk, important resources to include in adaptation planning, and barriers their communities face as they plan and implement climate adaptation and resilience efforts. Written and oral comments from these listening sessions were referenced in the development of this Plan.

APPENDIX B. ADDITIONAL INFORMATION ON CLIMATE RISKS AFFECTING INTERIOR BUILDINGS

In addition to reporting high-level exposure to climate hazards under different climate scenarios, the SHIRA project also provides data on the future estimates of meteorological conditions, which can be evaluated by facility, unit (e.g., national park, NWR), agency, or region.

The tables below break down projected changes in exposure of Interior-owned or managed buildings to the climate hazards reported in section 2B by Unified Interior Regions, along with projected exposure to several additional climate hazards that help contextualize the impacts of climate change. Table A1 shows the distribution of buildings across the Unified Regions.

Table A1. Percentage of Interior-owned or managed buildings in each Unified Interior Region.

Unified Interior Region	Percentage of Interior-owned or managed buildings
Alaska	4%
Arkansas-Rio Grande-Texas Gulf	4%
California-Great Basin	12%
Columbia-Pacific Northwest	10%
Great Lakes	6%
Lower Colorado Basin	14%
Mississippi Basin	4%
Missouri Basin	8%
North Atlantic-Appalachian	17%
Pacific Islands	2%
South Atlantic Gulf	8%
Upper Colorado Basin	18%
Total	100%

Extreme Heat

As is reported in section 2, nearly every building owned or managed by the Department will experience an increase in the number of days where temperatures exceed the 99th percentile of high temperatures observed from 1977-2005. The projected increase in exposure to extreme heat varies by geography.

Tables A2 and A3 below break down the changing exposure to extreme heat by Department region, providing greater context on how the temperature changes will be experienced across the lower 48. For example, increases are especially large in the South Atlantic-Gulf region and the Upper Colorado Basin.

This increase in temperature affects operation of Interior-owned and managed buildings. Table A4 shows projected changes in cooling degree days,[74] by region and RCP scenario. Across the Interior building portfolio, the number of cooling degree days projected to increase by 48 to 129 percent, with notable regional increases in regions like the Great Lakes and Pacific Northwest.

Table A5 depicts projected changes in the number of heating degree days the average building in each Department region will experience under different RCP scenarios. In every Department region, the number of heating degree days is projected to decrease under both RCP4.5 and RCP8.5 scenarios at both mid- and late-century.

Table A2. Average percent increase in extreme heat days (where temperatures exceed historical highs) for an Interior-owned or managed building in a given region.

Region	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	462%	690%	667%	1628%
California-Great Basin	346%	527%	500%	1126%
Columbia-Pacific Northwest	287%	445%	419%	969%
Great Lakes	364%	558%	547%	1246%
Lower Colorado Basin	437%	643%	632%	1480%
Mississippi Basin	478%	713%	697%	1624%
Missouri Basin	336%	502%	487%	1118%
North Atlantic-Appalachian	365%	543%	544%	1295%
South Atlantic Gulf	611%	915%	904%	2012%
Upper Colorado Basin	505%	729%	730%	1573%
Total	**414%**	**616%**	**605%**	**1380%**

Table A3. Average number of extreme heat days (where temperatures exceed historical highs) for an Interior-owned or managed building in a given region.

Region	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	17	25	24	60
California-Great Basin	13	19	18	41
Columbia-Pacific Northwest	10	16	15	36
Great Lakes	13	20	20	46
Lower Colorado Basin	16	24	23	54
Mississippi Basin	18	26	26	59
Missouri Basin	12	18	18	41
North Atlantic-Appalachian	13	20	20	47
South Atlantic Gulf	22	34	33	74
Upper Colorado Basin	19	27	27	58
Total	**15**	**23**	**22**	**51**

Table A4. Percent change in cooling degree days for an Interior-owned or managed building in a given region.

Region	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	32%	42%	42%	79%
California-Great Basin	53%	77%	74%	157%
Columbia-Pacific Northwest	93%	138%	131%	294%
Great Lakes	73%	101%	99%	200%
Lower Colorado Basin	39%	52%	52%	100%
Mississippi Basin	39%	51%	50%	96%
Missouri Basin	67%	93%	90%	187%
North Atlantic-Appalachian	56%	75%	74%	147%
South Atlantic Gulf	34%	45%	45%	84%
Upper Colorado Basin	73%	100%	100%	216%
Total	**48%**	**65%**	**65%**	**129%**

Table A5. Percent change in heating degree days for an Interior-owned or managed building in a given region.

Region	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	-20%	-26%	-26%	-43%
California-Great Basin	-17%	-23%	-22%	-37%
Columbia-Pacific Northwest	-16%	-21%	-20%	-34%
Great Lakes	-16%	-21%	-19%	-33%
Lower Colorado Basin	-18%	-23%	-23%	-38%
Mississippi Basin	-18%	-23%	-21%	-36%
Missouri Basin	-12%	-18%	-17%	-29%
North Atlantic-Appalachian	-16%	-21%	-20%	-33%
South Atlantic Gulf	-18%	-23%	-22%	-36%
Upper Colorado Basin	-17%	-21%	-20%	-34%
Total	**-16%**	**-21%**	**-20%**	**-35%**

Extreme Precipitation and Flooding

As shown in tables 6 and 7, nearly every Interior-owned or managed building will be exposed to an increase in extreme precipitation events under both RCP 4.5 and RCP 8.5 scenarios at mid- and late-century.

Table A6 shows the average increase in frequency of these events, by Interior region. Table A7 includes historical frequency of these events, along with their frequencies under different climate scenarios, to provide additional context on what these changes will look like across Department regions.

Changes in extreme precipitation are not perfectly correlated with flood frequencies, but table A8 provides a breakdown, by Interior region, of First Street Foundation flood data for present-day (2022) exposure of Department buildings to 1 percent and 0.2 percent annual exceedance probability flood events.

Table A6. Average annual increase in extreme precipitation events for an Interior-owned or managed building in a given region.

Region	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	16%	21%	22%	31%
California-Great Basin	11%	20%	21%	39%
Columbia-Pacific Northwest	19%	28%	25%	44%
Great Lakes	57%	59%	72%	132%
Lower Colorado Basin	48%	70%	60%	107%
Mississippi Basin	19%	29%	31%	46%
Missouri Basin	23%	32%	31%	57%
North Atlantic-Appalachian	35%	52%	47%	89%
South Atlantic Gulf	17%	26%	24%	37%
Upper Colorado Basin	45%	67%	62%	105%
Total	**20%**	**30%**	**29%**	**51%**

Table A7. Average annual number of precipitation events over 2 inches for an Interior-owned or managed building in a given region.

Region	Historical	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	0.71	0.83	0.86	0.87	0.94
California-Great Basin	1.64	1.83	1.96	1.98	2.27
Columbia-Pacific Northwest	1.55	1.84	1.99	1.94	2.24
Great Lakes	0.16	0.26	0.26	0.28	0.38
Lower Colorado Basin	0.05	0.08	0.09	0.08	0.11
Mississippi Basin	1.28	1.52	1.66	1.68	1.88
Missouri Basin	0.25	0.31	0.33	0.33	0.39
North Atlantic-Appalachian	0.63	0.85	0.96	0.93	1.20
South Atlantic Gulf	1.42	1.66	1.79	1.76	1.95
Upper Colorado Basin	0.02	0.03	0.03	0.03	0.04
Total	**0.68**	**0.82**	**0.89**	**0.88**	**1.03**

Table A8. Percentage of Interior-owned or managed buildings in a region that are located in an area with 1 percent or 0.2 percent AEP flood risk.

Region	2022 1% AEP	2022 0.2% AEP	Total
Arkansas-Rio Grande-Texas Gulf	30%	5%	35%
California-Great Basin	27%	7%	34%
Columbia-Pacific Northwest	43%	9%	52%
Great Lakes	22%	6%	28%
Lower Colorado Basin	14%	7%	21%
Mississippi Basin	31%	5%	36%
Missouri Basin	21%	6%	27%
North Atlantic-Appalachian	29%	5%	34%
South Atlantic Gulf	54%	5%	59%
Upper Colorado Basin	22%	6%	28%
Total	**28%**	**6%**	**34%**

Sea Level Rise

Table A9 provides a breakdown, by Interior region, of the percentage of Interior-owned or managed buildings that would be inundated under different climate scenarios. Note that this dataset does include the Pacific Islands region (Region 12), and that it does not evaluate exposure to storm surge, saltwater intrusion, or other hazards beyond inundation that are linked to sea level rise, and so likely underestimates overall exposure to sea level rise-associated risks.

Table A9. Number (Percent) of Interior-owned or managed buildings inundated under different sea level rise scenarios, by Interior region.

Region	Sea Level Rise Intermediate (2050)	Sea Level Rise Intermediate (2090)	Sea Level Rise Intermediate-High (2050)	Sea Level Rise Intermediate-High (2090)
Alaska (No 2017 data)	N/A	N/A	N/A	N/A
Arkansas-Rio Grande-Texas Gulf	1 (0.07%)	7 (0.48%)	3 (0.2%)	20 (1.36%)
California-Great Basin	19 (0.39%)	35 (0.72%)	28 (0.58%)	50 (1.04%)
Columbia-Pacific Northwest	4 (0.1%)	9 (0.23%)	7 (0.18%)	18 (0.46%)
Great Lakes	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Lower Colorado Basin	1 (0.02%)	1 (0.02%)	1 (0.02%)	1 (0.02%)
Mississippi Basin	17 (1.17%)	22 (1.51%)	19 (1.30%)	40 (2.75%)
Missouri Basin	0 (0%)	0 (0%)	0 (0%)	0 (0%)
North Atlantic-Appalachian	37 (0.54%)	148 (2.14%)	86 (1.24%)	410 (5.93%)
Pacific Islands	1 (0.15%)	1 (0.15%)	1 (0.15%)	14 (2.05%)
South Atlantic Gulf	44 (1.43%)	310 (10.06%)	143 (4.64%)	614 (19.92%)
Upper Colorado Basin	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Total	**124 (0.30%)**	**533 (1.31%)**	**288 (0.71%)**	**1167 (2.87%)**

Wildfire

Nearly one-quarter of Department buildings are in areas with high, very high, or extreme risk to potential structures from wildfire. As shown in table A10, highest overall exposures in this category are observed in regions in the Western United States, this is discussed in section 2B.

However, extreme exposures are highest in the South Atlantic-Gulf and Arkansas-Rio Grande-Texas Gulf regions—areas with high levels of lightning-ignited fires and historically short fire return intervals.

Table A10. Percent of Buildings in Each Risk Category, by Risk Category and Region

Region	None	Low	Moderate	High	Very High	Extreme
Arkansas-Rio Grande-Texas Gulf	2%	18%	48%	18%	3%	11%
California-Great Basin	5%	9%	46%	28%	10%	2%
Columbia-Pacific Northwest	10%	33%	18%	28%	7%	3%
Great Lakes	14%	74%	10%	1%	1%	>1%
Lower Colorado Basin	16%	31%	23%	24%	3%	3%
Mississippi Basin	6%	28%	57%	5%	>1%	2%
Missouri Basin	3%	15%	51%	31%	1%	0%
North Atlantic-Appalachian	30%	54%	15%	2%	0%	>1%
South Atlantic Gulf	8%	22%	43%	9%	3%	15%
Upper Colorado Basin	3%	18%	38%	36%	5%	1%
Total	**11%**	**30%**	**32%**	**17%**	**4%**	**2%**

APPENDIX C. ADDITIONAL INFORMATION ON CLIMATE RISKS AFFECTING INTERIOR EMPLOYEES

The SHIRA project can also be used to assess exposure of Department employees to future estimates of meteorological conditions related to climate hazards, including by Unified Interior Region. The distribution of employees across unified regions is shown in table A11.

Table A11. Percentage of Interior employees with a duty station in each Unified Interior Region.

Unified Interior Region	Percentage of Interior Employees
Alaska	4%
Arkansas-Rio Grande-Texas Gulf	3%
California-Great Basin	10%
Columbia-Pacific Northwest	11%
Great Lakes	5%
Lower Colorado Basin	9%
Mississippi Basin	3%
Missouri Basin	7%
North Atlantic-Appalachian	19%
Pacific Islands	1%
South Atlantic Gulf	6%
Upper Colorado Basin	22%
Total	100%

The tables below break down projected changes in exposure of Interior employees to some of the climate hazards reported in section 2C—specifically the extreme heat and wildfire hazards.

Extreme Heat

As is reported in section 2, nearly every employee at the Department will experience an increase in the number of days where temperatures exceed the 99th percentile high temperatures observed from 1977-2005. The scale of the projected increase in exposure to extreme heat varies by geography and is shown in table A12.

Table A13 provides regional projections of the increased exposure of Interior employees to days with high temperatures that exceed 95 degrees Fahrenheit. Significant increases are projected across all Department regions, with the greatest increases in the South Atlantic Gulf and Lower Colorado Basin, where employees can be expected to experience these high temperatures for several months each year.

Table A12. Average percent increase in extreme heat days (where temperatures exceed historical highs) for an Interior employee in a given region.

Region	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	451%	673%	647%	1557%
California-Great Basin	323%	484%	460%	1027%
Columbia-Pacific Northwest	309%	472%	443%	1014%
Great Lakes	398%	609%	598%	1322%
Lower Colorado Basin	419%	621%	604%	1435%
Mississippi Basin	513%	780%	762%	1806%
Missouri Basin	337%	506%	493%	1135%
North Atlantic-Appalachian	387%	573%	578%	1347%
South Atlantic Gulf	605%	906%	897%	2012%
Upper Colorado Basin	511%	730%	736%	1616%
Total	**419%**	**620%**	**611%**	**1391%**

Table A13. Average number of days >95F an average Interior employee will experience in a given region, historically and under each climate scenario.

Region	Historical	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Arkansas-Rio Grande-Texas Gulf	39	76	87	85	121
California-Great Basin	27	46	52	51	71
Columbia-Pacific Northwest	9	22	28	27	45
Great Lakes	2	12	18	18	40
Lower Colorado Basin	69	91	98	98	121
Mississippi Basin	14	47	58	56	96
Missouri Basin	10	27	34	33	57
North Atlantic-Appalachian	4	19	26	26	53
South Atlantic Gulf	7	31	42	42	81
Upper Colorado Basin	11	30	38	38	66
Total	**17**	**36**	**43**	**43**	**69**

Wildfire

Section 2C included an assessment of employees working in counties with high, very high, and extreme risk to wildfire. The SHIRA project enables duty station-level assessments of exposure for Interior employees, which is reported by region in table A14.

Over one in ten Department employees work at duty stations with high, very high, or extreme risk to potential structures from wildfire. Highest overall exposures in this category are observed in regions in the Western United States, this is discussed in section 2B. However, extreme exposures are highest in the South Atlantic-Gulf and Arkansas-Rio Grande-Texas Gulf regions—areas with high levels of lightning-ignited fires and historically short fire return intervals.

It is also worth noting that this dataset—Risk to Potential Structures—does not reflect the impact of wildfire smoke.

Table A14. Percentage of a region's employees with a duty station at a given level of wildfire risk.

Region	None	Low	Moderate	High	Very High	Extreme
Arkansas-Rio Grande-Texas Gulf	26%	22%	45%	5%	2%	0%
California-Great Basin	34%	14%	24%	23%	4%	3%
Columbia-Pacific Northwest	42%	22%	20%	13%	1%	2%
Great Lakes	39%	51%	9%	0%	0%	0%
Lower Colorado Basin	32%	38%	13%	17%	1%	1%
Mississippi Basin	46%	33%	20%	1%	0%	0%
Missouri Basin	31%	25%	33%	10%	0%	0%
North Atlantic-Appalachian	46%	48%	6%	0%	0%	0%
South Atlantic Gulf	26%	23%	38%	5%	0%	8%
Upper Colorado Basin	43%	24%	20%	12%	0%	0%
Total	39%	30%	19%	9%	1%	1%

APPENDIX D. BUREAU APPROACHES TO INCORPORATING CLIMATE RISK ASSESSMENTS INTO PLANNING AND DECISION MAKING

Bureau/Office	*Approach to using climate risk assessments in planning and decision-making*
National Park Service	Several documents guide how national park units address climate change vulnerability assessments in planning and decisions, including the following: ○ Policy Memo 15-01 (*Addressing Climate Change and Natural Hazards for Facilities*) *and the associated Climate Change and Natural Hazards Handbook (*updated 2023) ○ Policy Memo 14-02 (*Climate Change and Stewardship of Cultural Resources*) ○ Policy Memo 12-02 *(Applying NPS Management Policies in the Context of Climate Change)* ○ *Cultural Resources Climate Change Strategy* ○ *Planning for a Changing Climate* The *NPS Facility Investment Strategy* includes environmental sustainability and climate resiliency when considering whether to approve proposed facility investments. Project proponents are required to identify potential natural and climate change related hazards, how those hazards may be addressed, and include review by subject matter experts at concept development and design stages. Numerous projects in NPS (>$18M) funded through IRA directly address climate change vulnerabilities in national park units, focusing on issues including the vulnerability of water supplies, floodplains (riparian habitat and infrastructure), museum facilities, cultural resources, fish species, Joshua trees, and others. Results from these projects will inform decisions regarding adaptation strategies.
Bureau of Reclamation	The BOR has established a Climate Change Community of Practice reaching all employees having roles in adaptation and building resilience, has several lines of work that support climate risk assessments, and has developed guidance for staff to share findings with stakeholders and incorporate them into decision making. *Reclamation Basin Studies* are cost-shared, stakeholder-driven studies to assess water supply and demand within a river basin now and in the future, considering existing infrastructure and operations, and projected changes to water supplies resulting from population growth, changes in water demands and changes to the hydrologic regime due to climate change. They bring together basin partners and stakeholders—frequently including groups with competing demands—to identify potential strategies to resolve water supply shortfalls and avoid conflict. *Reclamation's Climate Informed Decision-making Guidance (Guidance)* will provide a roadmap to incorporate climate change information into existing BOR decision-making processes. The goal of the Guidance is to make climate analysis methods more widely available across the organization; help staff determine the adequacy of data; address uncertainty; and address current and future risks associated with climate change. Target release of the Guidance is mid-2024.

Bureau/Office	*Approach to using climate risk assessments in planning and decision-making*
Bureau of Reclamation (cont'd.)	*Building climate resilience through planning and environmental review processes.* The BOR's Directives and Standards for Water and Related Resources Planning (CMP P09), Water and Related Resources Appraisal and Special Studies (CMP 09-01), Water and Related Resources Feasibility Studies (CMP 09-02), and Planning for Major Rehabilitation and Replacement of Existing Assets (CMP 09-04), will be revised to require BOR to do the following: • Engage with stakeholders in the project formulation and design phases, before formal planning begins, to prioritize climate resilient building opportunities, challenges, and costs. • Incorporate a quantitative climate change analysis in planning and environmental review processes, as appropriate, including: (1) identifying problems, needs, and opportunities; (2) inventorying existing resources; (3) formulating action alternatives; (4) forecasting future conditions to evaluate action alternatives for feasibility; and (5) in the case of a NEPA or ESA study, analyzing the environment of the area(s), species, or habitat to be affected or created by the alternatives considered. This activity is ongoing and the completion of updates to CMP 09-02 and CMP 09-04 are expected in early 2024 and end 2024, respectively. *Incorporating Climate Change impacts and considerations in infrastructure investment and decision-making.* The BOR's Asset Management Division will incorporate climate change into infrastructure investment decision making by adding "Climate Change" to a list of "Mission Enhancements" tied to each activity in the Capital Investments and Repair Needs (CIRN) application. The CIRN users will be able to select this option if their activity supports climate change adaptation. This activity is ongoing, and completion is expected in FY 2025. *Incorporating climate change science into operations and maintenance processes.* The goal of this activity is to incorporate climate change impacts and considerations in Facility Reliability Rating score methodology and reservoir sediment monitoring plans. The BOR plans to begin with its reserved works facilities and then provide guidance to its transferred works partners on how they can also consider climate change at their facilities. This activity was implemented in FY 2023 and is ongoing. *Estimating climate change-driven extreme precipitation and runoff impacts to dams.* This activity advances dam safety and the protection of downstream public safety by improving the community's ability to identify climate change effects on flood risks and potential dam failure. This activity is ongoing and expected to be complete in FY 2025.
U.S. Fish and Wildlife Service	The FWS uses risk assessments in some aspects of its work, including management of the NWRS and its Ecological Services program.

Bureau/Office	*Approach to using climate risk assessments in planning and decision-making*
	Management of Species and Refuges. The FWS has collaborated with other Interior Bureaus to develop the Resist-Accept-Direct Framework, which is a decision-making tool that helps resource managers make informed strategies for responding to ecological changes resulting from climate change. The FWS has developed technical guidance to support incorporation of climate change data into assessments of at-risk, threatened, and endangered species. The Fish and Aquatic Conservation program is working to provide future climate match information in Ecological Risk Screening Summaries to inform invasive species prevention and control efforts. The NWRS conducts climate change vulnerability assessments. The NWRS is working to improve its capacity to conduct these assessments across the entire NWRS to better understand and address risks. The NWRS also utilizes a landscape resiliency ranking within the Targeted Resource Acquisition Comparison Tool to provide leadership with climate related information when making land acquisition decisions. *Asset Management*. The Infrastructure Management Division developed a 20-year horizon document for planning—the National Long Range Transportation Plan—that outlines six goals for selecting transportation projects. The Asset Management goal is driven by climate change and is defined as: "The program will operate and maintain a functional, financially sustainable, and resilient transportation network to satisfy current and future land management needs in the face of a changing climate."
U.S. Geological Survey	The USGS supports science that other Interior Bureaus and Offices can use to assess climate risk and has guidance for incorporating risk assessment into its capital investment decisions. *Science Programs*. The USGS develops the science necessary to incorporate risk into planning and decision processes The SHIRA project mentioned in this plan is led by the Natural Hazards Mission Area Risk Project, which conducts risk research and provides applications and services to support efforts like the CAP. The USGS also operates the Science and Decisions Center (SDC) and other decision support operations within its regional science centers. The SDC is a unique and small interdisciplinary center which conducts integrated physical, biological, socioeconomic, and information science, advances decision-analytic methods in USGS and investigates innovative data collection and analysis methods with a goal of increasing the use and value of USGS science in decision making. In addition, USGS provides high-performance computing services (i.e., machine access, training, model tuning) to better enable the analysis and delivery of science results to key stakeholders. *Capital Investments*. The USGS has a standard Business Case Analysis (BCA) template that it is required for all major capital investments. This BCA template has a risk analysis section that includes "Climate Change Adaptation Risk." This helps to ensure that climate risk is considered and woven into planning and decision making for large capital investments for the Bureau.

Bureau/Office	*Approach to using climate risk assessments in planning and decision-making*
Bureau of Indian Affairs	The BIA uses climate risk assessments to inform implementation of some of its programs. *Tribal Climate Resilience*. Risk registers have been completed for the Branch of Tribal Climate Resilience's assessable units. Risk registers have been completed (and are ongoing) for the Annual Awards Program funding opportunity, the Voluntary Community Driven Relocation Program, and the co-planned/co-convened Native Youth Climate Adaptation Congress. *Safety of Dams (SOD) Program*. Funding for rehabilitation, replacement and/or improvement for dams managed by the SOD Program is prioritized using a risk-informed approach that includes consideration of climate hazard (flooding) risks.
Office of Surface Mining Regulation and Enforcement	The OSMRE does not currently incorporate climate risk assessments related to adaptation in their decision-making processes. The OSMRE is awaiting Departmental implementation guidance on NBS and climate adaptation/resilience before evaluating any policy modification, such as to its BIL Abandoned Mine Lands Guidance. Recognizing that OSMRE authority under the Surface Mining Control and Reclamation Act is limited, OSMRE may rely on mine operators/grantees for voluntary NBS policy implementation.
Bureau of Land Management	The BLM programs have flexibility to incorporate climate risk into their decisions. For example, BLM's Land and Water Conservation Fund criteria have flexibility to address climate hazard risks. The BLM will use Departmental guidance, once available, to develop its own guidance on incorporating climate risk into land management decisions. The BLM anticipates that it will need to develop tools, procedures, and training for specific programs and geographies.
Bureau of Safety and Environmental Enforcement	The BSEE does not currently incorporate climate risk into decisions. The BSEE uses various approaches to improve safety and environmental performance during design, installation, operation, and decommissioning of offshore operations, including wind energy. However, BSEE's actions have to-date not necessitated using climate risk assessments in its planning and decision-making. The BSEE will pursue further research and data development to better understand climate exposures and risks to its mission delivery, including its field workforce
Bureau of Ocean Energy Management	The BOEM considers climate change as part of its responsibilities under NEPA. As part of its responsibilities under NEPA and to manage development of U.S. OCS energy and mineral resources in an environmentally and economically responsible way, BOEM considers climate change, and its associated hazards and risks, in its NEPA documents, as appropriate (e.g., environmental impact statements). This includes the discussion of climate change as a stressor to the environment as well as the ways in which BOEM-regulated activities may either contribute to or redress climate change and its impacts. The BOEM is evaluating climate change in accordance with the interim NEPA guidance issued by CEQ (NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change).

[1] The Inflation Reduction Act added the Exclusive Economic Zones of the U.S. territories to BOEM's responsibilities. Notice on the boundaries of the U.S. Exclusive Economic Zone is available at: https://www.federalregister.gov/documents/2023/12/21/2023-28159/continental-shelf-and-maritime-boundaries-notice-of-limits
[2] 117 P.L 103, 117 P.L. 328, President's Budget.
[3] RCPs were used in this Plan because the Governmentwide approach for creating this iteration of climate adaptation plans uses analyses based on the IPCC's AR5, which utilized CMIP5. After guidance was shared with agencies, projections from IPCC AR6, based on CMIP6, have been made available. (For more background on these protocols and scenarios, see here: https://www.climatehubs.usda.gov/hubs/northwest/topic/what-are-climate-model-phases-and-scenarios). The Department uses climate projections related to AR5 here to follow CEQ guidance and allow for comparison to other agency climate adaptation plans but recognize that other planning efforts within and outside the Department may benefit from examining AR6-associated results.
[4] USGCRP, 2023: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023
[5] Northern Climate Reports for Changing Arctic Ecosystems
[6] USGCRP, 2018: Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II [Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)]. U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.
[7] USGCRP, 2023: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023
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[11] Global climate change implications for coastal and offshore oil and gas development - ScienceDirect
[12] Climate change impacts on wind power generation | Nature Reviews Earth & Environment
[13] The Bureau of Reclamation brings water to more than 31 million people and provides 1 out of 5 Western farmers (140,000) with irrigation water for 10 million acres of farmland that produce 60 percent of the Nation's vegetables and 25 percent of its fruits and nuts.
[14] Climate Change Adaptation Strategy (usbr.gov)
[15] Tribes and Indigenous Peoples (globalchange.gov)
[16] Climate Change | U.S. Fish & Wildlife Service (fws.gov)
[17] NPS Climate Change Response Strategy 2023 Update
[18] Megaproject reclamation and climate change | Nature Climate Change
[19] Climate | U.S. Geological Survey (usgs.gov)
[20] See appendix A for a description of cooling degree days.
[21] See appendix A for a description of heating degree days.
[22] https://pubs.usgs.gov/gip/106/pdf/100-year-flood_041210web.pdf
[23] From the Federal Real Property Profile data set, accessed through SHIRA.
[24] Replacement value estimated at over $940 million and does not include the value of associated structures.
[25] Occupational Safety and Health and Climate | NIOSH | CDC
[26] Climate Change and the Health of Workers | US EPA

[27] NCA5
[28] Occupational Safety and Health and Climate | NIOSH | CDC
[29] Ibid.
[30] Ibid.
[31] USGCRP, 2023: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023
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[33] Future of Fire: Towards a National Synthesis of Wildland Fire Under a Changing Climate
[34] Cultural Resources Climate Change Strategy (nps.gov)
[35] Ibid.
[36] Translocation of imperiled fishes: Conservation introduction of threatened bull trout in Glacier National Park | U.S. Geological Survey (usgs.gov)
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U.S. Environmental Protection Agency

2024-2027 Climate Adaptation Plan

June 2024

THE ADMINISTRATOR
WASHINGTON, D.C. 20460

U.S. Environmental Protection Agency Policy Statement on Climate Change Adaptation

The devastating impacts of climate change increasingly cost lives, disrupt livelihoods and cause billions of dollars in damages across the nation. Climate change also exacerbates existing pollution problems and environmental stressors, challenging the U.S. Environmental Protection Agency's ability to accomplish its mission of protecting human health and the environment. All these impacts disproportionately affect low-income communities and communities of color, children, the elderly, Tribes and indigenous people.

The Biden-Harris Administration has taken historic steps to provide the federal support, resources and investments needed to help the nation's communities meet the climate challenges of today and prepare for the climate stressors of tomorrow. The EPA plays a central role in the Administration's efforts to tackle the climate crisis and build a climate-resilient nation.

I directed my leadership team, including assistant administrators, associate administrators, regional administrators and the general counsel, in May 2021 to proactively incorporate climate adaptation planning into the agency's programs, policies, rules and operations, while we also continue work to reduce greenhouse-gas emissions. Since that time, the EPA has made significant strides toward meeting that directive by partnering with states, Tribes, territories, local governments, community groups, businesses and other federal agencies to strengthen their adaptive capacity and increase their resilience, placing a particular focus on advancing environmental justice.

Of the many actions we have taken and will continue to pursue, several are especially noteworthy. The agency is modernizing its financial assistance programs to encourage climate-resilient investments across the nation. The immediate focus of this effort is on investments made through the Bipartisan Infrastructure Law and Inflation Reduction Act to ensure that their outcomes will be resilient to the impacts of climate change. We are equipping communities and the recipients of our financial resources with the tools, data, information and technical support they need to assess their climate risks and develop the climate-resilience solutions most appropriate for them. We are integrating climate adaptation into our rulemaking processes, including regulations, permits and National Environmental Policy Act reviews, and our agency enforcement and compliance programs are including climate adaptation and resilience in case conclusions, whenever appropriate. We also recently launched an initiative to increase the climate literacy of our staff and agency partners,

increasing people's awareness of the risks posed by climate change to human health and the environment, and the opportunities to increase the nation's resilience to climate impacts.

The EPA is implementing measures to protect our own workforce, facilities, critical infrastructure, supply chains and procurement processes from the risks posed by climate change. The agency will complete site-specific resilience assessments at all owned facilities within the next two years and continue to upgrade and increase the climate resilience of our facilities and protect our workforce.

Working with our partners, we are making strides to build a climate-resilient nation, but we are far from finished. Tackling the climate crisis requires perseverance and collaboration at all levels, and this updated Climate Adaptation Plan highlights the EPA's planned actions from 2024 to 2027. We will continue to work with our state, local, Tribal and indigenous partners to seize on opportunities to deal with the climate crisis in their communities. Together, our combined actions will make progress toward building a climate-resilient nation, mitigating pollution, improving public health, stimulating economic growth and advancing environmental justice for all.

Michael S. Regan

Contents

Section 1: Agency Profile

Agency Profile	
Mission	Protection of human health and the environment
Adaptation Plan Scope	Entire Agency, including HQ, Regions, labs, and field offices
Agency Climate Adaptation Official	Vicki Arroyo, Associate Administrator for EPA's Office of Policy, Office of the Administrator
Agency Risk Officer	Adil Gulamali, EPA's Deputy Controller, is serving as acting Agency Risk Officer
Point of Public Contact for Environmental Justice	Theresa Segovia, Principal Deputy Assistant Administrator for EPA's Office of Environmental Justice and External Civil Rights
Owned Buildings	158 owned buildings of 3,317,444 square feet *(2023 Federal Real Property Portfolio Report submitted to the General Services Administration and the Real Estate database Sunflower)*
Leased Buildings	131 leased buildings of 6,690,757 square feet *(2023 Federal Real Property Portfolio Report submitted to the General Services Administration and the Real Estate database Sunflower)*
Employees	15,932 Federal Employees 5,078 Contractors *(People Plus 2023 Employment Summary and Personnel Security System)*
Budget	FY 2022 Enacted - $9,559,485,000 (P.L. 117-103) FY 2023 Enacted - $10,135,433,000 (P.L.117-328) FY 2024 Enacted - $9,159,000,000 (P.L.118-42) FY 2025 President Budget - $10,994,000,000
Key Areas of Climate Adaptation Effort	1. Environmental Justice 2. Financial Assistance Agreements 3. Superfund Program 4. Enforcement and Compliance Assurance 5. Equitable Resilience Technical Assistance Program

Summary Statement

EPA is building resilience and adaptive capacity to climate hazards, leveraging skills and expertise across the organization.

Climate change poses significant risks to EPA's mission of protecting human health and the environment, as well as its own workforce and facilities. For over a decade, EPA has focused on ensuring it continues to fulfill its mission of protecting human health and the environment even as the climate changes. Following the release of its 2021 Climate Adaptation Action Plan, EPA significantly increased its efforts to incorporate climate adaptation planning into the agency's programs, policies, rulemaking processes, enforcement activities, and operations. Since that time, EPA has made significant advances and established innovative actions and processes described in this document. It has also partnered with states, Tribes, territories, local governments, community groups, and businesses to strengthen their adaptive capacity and increase their resilience to climate change impacts, placing a particular focus on communities with environmental justice concerns. EPA is committed to building on the many innovative actions and processes it has already established.

All the climate adaptation work conducted by the Agency is driven by the goals established in EPA's FY 2022-2026 Strategic Plan. The Plan includes an Agency-wide goal (Goal 1) focused on tackling the climate crisis. One of the three Goal 1 objectives (Objective 1.2) is to accelerate resilience and adaptation to climate change impacts. The Agency has three long-term performance goals (LTPGs) associated with this objective. The first LTPG is focused on integrating climate adaptation planning into EPA programs, policies, rulemaking processes, enforcement activities, and operations. The second and third LTPGs are focused on building the adaptive capacity and resilience of the Agency's partners across the nation.

With respect to Agency assets, EPA has conducted an Agency-wide vulnerability assessment. Each EPA program and regional office has also conducted an office-specific vulnerability assessment. Taken together, the vulnerability assessments, along with various directives and Executives Orders (e.g., related to indigenous knowledge, nature- based solutions, integrating climate adaptation into infrastructure investments), informed the development of annual priority actions each office will take to address the LTPGs in the FY 2022-2026 Strategic Plan. For example, the Office of Mission Support has annual priority actions focused on addressing the risks posed by climate change to EPA's facilities, workforce, operations, and supply chains.

EPA is using a number of strategies to engage staff and leverage skills and expertise across the Agency to build resilience and adaptive capacity. These activities are overseen by the Office of Policy and coordinated by the Cross-EPA Work Group on Climate Adaptation and its Subgroups. The Work Group is chaired by the Office of Policy and has representatives from all the program offices and all 10 regional offices. The Work Group has identified opportunities to work together on issues relevant to all EPA offices and established subgroups to address the issues. Examples of work groups and cross-EPA activities related to climate adaptation and resilience are:

- EPA's Office of Policy recently launched a new Office of Climate Adaptation and Sustainability. The new office, to be led by a member of the Senior Executive Service, will foster integration of

climate adaptation both within the Agency and with other governmental entities in a whole of government approach to addressing climate change impacts. The new office will also work with external non-governmental partners (e.g., industrial sectors) to become more resilient to climate change impacts and look for opportunities to reduce GHG emissions through climate-sustainable practices.

- As part of EPA's Climate Literacy Initiative, the Office of Policy and Office of Research and Development have launched a "Climate Conversations" webinar series to foster peer-to-peer sharing of experiences with climate adaptation and build a cross-EPA community of practice.
- The Resilient Infrastructure Subgroup on Climate (RISC) is focused on modernizing EPA financial assistance programs to encourage climate-resilient investments across the nation. The immediate focus is on the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA) to help ensure the outcomes of investments made with those funds are resilient to climate change.
- The Resilient Rules Subgroup is focused on integrating climate adaptation into rulemaking processes.
- The Tribal Subgroup is focused on helping Tribes build their adaptive capacity and implement their respective climate adaptation plans.
- The Climate Adaptation Measures Subgroup is helping EPA assess its progress in meeting the Long-Term Performance Goals for climate adaptation that appear in the Agency's FY 2022-2026 Strategic Plan.
- The Office of Policy has developed an innovative database for tracking the progress being made by every program and regional office with their priority actions as well as the progress being made by the entire Agency meeting the annual targets set for the three LTPGs in the EPA FY 2022-2026 Strategic Plan. The database, known as the Climate Adaptation Measurement Program (CAMP) is undergoing updates and Version 2.0 is expected to be ready in Summer 2024.

Through its Climate Adaptation Plan, EPA is also advancing environmental justice as part of its mission, consistent with Executive Order 14008 and with Executive Order 14096 on *Revitalizing Our Nation's Commitment to Environmental Justice for All*. As the Agency implements its Climate Adaptation Plan to increase the resilience of its programs, policies, rulemaking processes, enforcement activities, facilities and operations, the agency will strive, as appropriate and consistent with applicable law to (1) address disproportionate and adverse environmental and health effects (including risks) and hazards, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns; and (2) provide opportunities for the meaningful engagement of persons and communities with environmental justice concerns.

In addition, as a member of the White House Environmental Justice Interagency Council, EPA received recommendations on Climate Planning, Preparedness, Response, Recovery and Impacts from the White House Environmental Justice Advisory Council (WHEJAC). The report includes many recommendations that are relevant to EPA's work. The agency is reviewing the recommendations and, as appropriate and to the maximum extent permitted by law, is taking steps to address the WHEJAC's recommendations.

Section 2: Risk Assessment

EPA used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App) that was developed for federal agencies by the White House Council on Environmental Quality (CEQ) and the National Oceanic and Atmospheric Administration (NOAA) to conduct a high-level screening of climate hazard exposure for federal facilities and personnel.

EPA assessed the exposure of its buildings; employees; and lands, waters, and cultural and natural resources to five climate hazards: extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk. In addition to these five hazards, EPA used a mix of national and local data sets to obtain more specific historic and projected hazard information at each of the Agency's facility locations. This additional data allowed EPA to explore the vulnerability and likelihood of nine additional hazards.

Climate Data Used in Agency Risk Assessment

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS and AK
Sea Level Rise	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High sea level rise scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5	CONUS and PR
		RCP 8.5	CONUS and PR

Wildfire Risk	Measured as whether an asset is in a location is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR

Exposure to extreme heat, extreme precipitation, and sea level rise were evaluated at mid- (2050) and late century (2080) under two emissions scenarios, Representative Concentration Pathway (RCP) 4.5 and RCP 8.5. Exposure to flooding and wildfire risk were only evaluated for the present day due to data constraints.

Climate Scenarios Considered in Agency Risk Assessment

Scenario Descriptor		**Summary Description from 5th National Climate Assessment**
RCP 8.5	Very High Scenario	Among the scenarios described in NCA5, RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46% less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

Additional details about the data used in this assessment are provided in Appendix A.

2A. Climate Hazard Exposures and Impacts Affecting Federal Buildings

Indicators of Exposure of Buildings to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of buildings projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually) from 1976-2005	100%	100%	100%	100%
Extreme Precipitation: Percent of buildings projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually) from 1976-2005	100%	100%	100%	100%
Sea Level Rise: Percent of buildings projected to be inundated by sea level rise	7%	7%	7%	9%
	High Risk	**Very High Risk**	**Extreme Risk**	
Wildfire: Percent of buildings at highest risk to wildfire	6%	0%	0%	
	100- year and 500-year floodplain			
Flooding: Percent of buildings located within floodplains	22%			

EPA buildings are expected to have varying degrees of exposure to the five climate hazards (i.e., extreme heat, precipitation, sea level rise, flooding, and wildfire) through the projected mid- and late-century scenarios and based on historical data. One hundred percent of EPA buildings are expected to be exposed to increased intensity of heat and precipitation. Increased heat and precipitation are expected to have a major impact on the Agency's physical structures, especially those with critical components reaching the end of useful life such as mechanical and electrical systems, building envelopes and roofs. The majority of EPA's owned facility inventory consists of laboratory buildings with smaller buildings for storage and office space. EPA inherited a number of existing federal laboratory campuses from other agencies when it was founded in 1970. While some of these campuses have undergone major renovations, in several EPA locations, the buildings were constructed at least 70 years ago and are already facing challenges managing high heat and water intrusion from precipitation.

EPA also leases space from or through the General Services Administration (GSA) for its 10 regional offices and other support and field offices throughout the United States, which accounts for 38% of the Agency's total building portfolio and includes six mission-critical laboratory facilities. EPA plans to prioritize funding for climate change adaptation measures within its owned laboratory facility portfolio. The Agency intends to partner with GSA to identify vulnerabilities in the laboratories that EPA leases from or through GSA. However, EPA does not intend to spend any funds appropriated to EPA on GSA

leased facilities**.** The Agency will work with GSA and the building owners to identify and quantify the risks to the leased buildings, but any funding required for hazard mitigation should be provided by GSA or the building owner.

All of EPA's facilities are expected to experience an increase in the annual number of days with the maximum temperature greater than the 99th percentile in all future scenarios. Mission-critical functions within EPA's laboratories often require the use of multiple, robust analytic machines and immensely sensitive mesocosms that have high operational heat loads in a temperature-controlled environment. Maintaining climate control is imperative to the efficiency and accuracy of EPA's research and applied science operations. Extreme heat is expected to increase the cooling load, leading to more intensive energy usage and higher risk to equipment failure from overheating, which can cause damage to mechanical and research equipment and delay operation. More intensive energy usage might also result in an increase in greenhouse gas emissions. Given the facilities' conditions and the remaining useful life of their components, facilities may not be able to keep up with the projected heat which magnifies the stress on Heating Ventilation and Air Conditioning (HVAC) and Air Handling Units (AHUs) components.

Increased precipitation events are also projected to affect 100% of EPA's facilities across all hazard projection scenarios. Precipitation already poses a threat to EPA's older facilities, and increases in intensity, frequency and duration of these events will further expose EPA's buildings and internal equipment to damage from water intrusion. This can be costly in both time and cost to mission and research operations. Additionally, most of the EPA's drainage and stormwater management systems were sized to meet historic precipitation patterns and will face challenges meeting the projected increased volume of water without modernization. Some EPA facilities support emergency response operations, which often require large staging areas and generally consist of impervious surfaces. This mission function can exacerbate vulnerability to extreme heat and flooding.

Based on the outputs of the NOAA screening tool, EPA has 35 buildings (22%) within its portfolio that are located within the 100-year floodplain. One EPA campus is located within an inland floodplain and has high exposure to floods; however, the Agency plans to formally remove this property from its portfolio within the next two years. While there would be little consequence to the Agency's operations if this location experienced a 100-year flood event, the Agency would be financially responsible for cleanup and hazard mitigation efforts. The screening tool also included EPA's facilities in Ada, Oklahoma, and Fort Meade, Maryland, as facilities within the 100-year floodplain; however, EPA has conducted onsite climate resilience assessments at both locations using physical observations and supplemental state and local climate data sets, confirmed that at both of the facilities there is a very low risk of impact from flooding.

Of the Agency's 24 buildings in coastal locations, Port Orchard, Washington; Gulf Breeze, Florida; and Newport, Oregon, are at the greatest risk of mission disruption from flooding. Each of these facilities' missions requires regular access to marine and coastal habitats. In some cases, laboratories even pump water directly from adjacent bodies of water (direct water intake) into the facility to support aquatic animal and ecosystem research, which increases exposure and risk from 100-year flooding events along the coasts. EPA's facilities in Newport were not originally captured by the mapping tool and are

at a significant risk from flooding. Damage to these facilities would not only significantly impact coastal research operations of EPA, but also the broader operations of other federal, state and university partners on the campus who rely on shared facilities.

The greatest risk to EPA's coastal facilities is posed by sea level rise (SLR), resulting in physical damage, and affecting building access and mission operations. Across the RCP 4.5 mid- and late-century and the RCP 8.5 mid-century scenarios, 6.9% of EPA's buildings are projected to be inundated by sea level rise. The percentage of EPA's buildings inundated increases to 9.5% in the RCP 8.5 late-century scenario. Four EPA locations have projected exposure to sea level rise, including Port Orchard, Washington; Narragansett, Rhode Island; Newport, Oregon; and Gulf Breeze, Florida. These facilities collectively support all the Agency's coastal research. To support that mission, the facilities have critical buildings located on or near the shoreline, putting this portion of EPA's research operations at risk. Newport and Port Orchard have the highest exposure to sea level rise, with all of Newport's buildings projected to be inundated in each RCP scenario and the whole Port Orchard campus projected to be inundated within the RCP 8.5 late-century scenario. The current location for Gulf Breeze on the map is inaccurate, and at the actual location there are buildings that are projected to be inundated by SLR. The main causeway structure providing access to the island facility is at highest risk for sea level rise in each of the RCP scenarios.

While only 5% of EPA buildings are at a high risk for wildfires, the widespread damage caused by wildfires can have significant impacts to both EPA's facilities themselves and vital utility infrastructure such as powerlines and transformers that the facilities rely on to operate and can completely disrupt mission functions. EPA to date has not experienced direct wildfire damage at its owned facilities; however, wildfire smoke plumes have impacted laboratories, especially those that require precise indoor air quality (IAQ) conditions for research operations. Additional filtration is needed to remove smoke and particulate matter from the air, including from wildfires, to protect worker health and safety and support science IAQ needs. This results in an increased HVAC load, similar to that of high heat days, putting an additional stressor on already stressed infrastructure.

2B. Climate Hazard Exposures and Impacts Affecting Federal Employees

Indicators of Exposure of Employees to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005	100%	100%	100%	100%
Extreme Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005	100%	100%	100%	100%

Sea Level Rise: Percent of employees duty-stationed in counties projected to be inundated by sea level rise	7%	43%	7%	51%
	High Risk	**Very High Risk**	**Extreme Risk**	
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire	2%	<1%	<1%	

EPA employees are expected to have varying degrees of exposure to the five climate hazard exposures through the different mid- and late-century scenarios and based on historical data. In all Representative Concentration Pathways (RCP) scenarios, all EPA employees are expected to be located exposed to extreme heat and precipitation in all Representative Concentration Pathways (RCP) scenarios and are in areas with a projected to be exposed to an increase in the annual number of days where with both precipitation and heat exceeding the 99th percentile. In general, the impact of extreme heat on most EPA employees reporting to their duty stations (whether teleworking or working in an office building) can be ameliorated by maintaining comfortable temperatures in offices and buildings. Increased heat and precipitation can cause increases in building moisture and create conditions that affect indoor air quality for EPA employees at their workplaces. Employees and contractors at the greatest risk to impacts from extreme heat are those who are older or have pre-existing health conditions or those who spend prolonged periods of time outdoors for their job duties (e.g., field researchers and technicians to support the Agency's research and applied science endeavors; inspectors conducting compliance inspections of the regulated community; workers conducting building and grounds maintenance, upkeep, and repairs; and those who perform security rounds on EPA property).

There is a noticeable change in the difference of EPA employees' exposure to sea level rise when comparing the mid- and late-century scenarios. Both mid-century scenarios project that 7% of EPA's employees work within counties that are expected to be exposed to sea level rise. In the late-century scenarios, however, the percentage of EPA employees in counties projected to be exposed to sea level rise increases to 43% (under RCP 4.5) and 51% (under RCP 8.5). In addition to direct impacts from sea level rise on coastal communities, higher sea levels mean that storm surges push further inland than they have historically, contributing to an increase in inland flooding that can affect EPA employees' ability to safely commute to work. Storm surges may also damage infrastructure, disrupting the broader transportation network and affecting the ability of EPA employees to access work required onsite. Commuting to and from work sites may be impacted by sea level rise depending on employee locations. Also, employees may have to deal with impacts to their personal lives (*e.g.,* homes flooding, roads impassable), which would affect their ability to carry out their work mission.

Based on historical data, a very small portion of EPA's employees are projected to have high, very high or extreme risk to wildfire; however, areas that do not burn in wildfires can still be affected by poor air quality from wildfire smoke, as well as power outages and other utility disruptions in the area that result in limited services to EPA employees. Air quality impacts can be far-reaching and long-lasting in areas that have not typically experienced direct wildfire damage or indirect damage from wildfire

smoke and worsened air quality. Degraded air quality could impact all EPA employees, with the greatest risk posed to employees whose work duties require them to be outdoors, such as those conducting fieldwork, grounds and building maintenance, and security functions; and to employees with pre-existing conditions and/or respiratory illnesses. Workers may also be affected during their commutes to EPA laboratories and office, particularly if their commutes involve time outdoors walking to and waiting at public transit stations where they could be exposed to degraded air quality.

2C. Climate Hazard Exposures and Impacts Affecting Mission, Operations and Services

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure (mission factors)	**Identified Climate Hazard**	**Description (consequence)**
EPA's mission ranges from conducting research and applied science in laboratories to emergency response functions across the nation, which increases the Agency's exposure to impacts from climate hazards.	Extreme heat, wildfire, flooding and sea level rise. Increased precipitation exacerbates impacts from flooding and sea level rise.	Marine, estuarine, and hydrologic research operations and facilities along the coast and other bodies of water are at greater risk to be impacted by flooding and sea level rise, and extreme precipitation can compound these impacts. Some facilities require large laydown areas able to accommodate the deployment, staging and storing of a range of emergency response vehicles and equipment, which can create site vulnerabilities to flooding from lack of drainage and increased ambient temperatures from extreme heat.
EPA's building inventory is aging, and the facility condition index of its buildings varies widely, which increases the Agency's vulnerability to impacts from climate hazards.	Extreme heat, wildfire, flooding, sea level rise, and increased precipitation.	Climate change impacts create additional stressors for aging infrastructure and can accelerate deterioration of physical assets and the systems they rely on. Improving the envelopes of the Agency's buildings reduces vulnerability of EPA's specialized research equipment to heat and water damage and helps minimize disruptions to mission and costly equipment repairs.
HVAC and air handling units that condition air in EPA's buildings must meet the demands of an increase in the total and consecutive number of high heat days	Extreme heat, wildfire.	EPA's facilities house critical site reliability engineering, which often produce a high heat output and require intensive cooling to keep operational. Smoke and particulate matter from wildfire events will increase the need for

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure (mission factors)	**Identified Climate Hazard**	**Description (consequence)**
and increased wildfire events into the future.		filtration in the Agency's laboratories. An increase in extreme heat days and wildfire events will create additional burdens for EPA's HVACs and air handling units to meet laboratory cooling requirements that the Agency's existing infrastructure is already struggling to maintain. If cooling requirements are not met, equipment could be damaged and may require costly and time intensive repairs, disrupting EPA's operations.
EPA's workforce, particularly field researchers and contractors who spend time outside, have additional safety concerns from primary and secondary climate hazards.	Extreme heat, wildfire (including smoke).	Workers may need to limit the number of hours spent outside. Staff conducting field work may need to shift the time/duration of the fieldwork or reschedule all together.
EPA has many laboratories in more remote locations that have a limited number of routes to access the facilities, which makes the Agency more vulnerable to disruptions to the broader area's transportation network.	100- and 500-year floodplains, sea level rise (compounded with storm and precipitation events), wildfire (severity of events can be compounded by extreme heat).	Disruptions to the transportation networks surrounding EPA's facilities can impact delivery of vital equipment, building maintenance, and emergency repairs and services. Interferences to employee access to sites and facilities can result in loss of work and information, which can cause major delays. EPA's research functions require samples to be collected across the country, each with specific holding times and sometimes requiring quick turnaround shipping to ensure research quality and integrity.
About half of EPA's laboratories are isolated and outside of metropolitan areas, and due to this, the utility service provided to these laboratories is often unreliable, its infrastructure	Wildfire, extreme heat, 100- and 500-year floodplains/precipitation, sea level rise.	The Agency experiences frequent power outages and disruptions to power and water service. Much of EPA's research equipment needs continuity in power and water supply to function. EPA's laboratories have high energy use intensities because of the equipment

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure (mission factors)	**Identified Climate Hazard**	**Description (consequence)**
is older, and utility outages take longer to resolve because there are not as many customers in the areas where EPA's laboratories are located.		plug loads and single pass air requirements to maintain safe laboratories. This results in future demand for larger interruptible and emergency power systems.

EPA assesses the vulnerability and consequence from climate hazards to four asset categories in its onsite climate resilience assessments, described in Section 3, Implementation, subsection A1 of this plan. The four asset categories are mission, workforce, physical assets, and infrastructure services and utilities. Vulnerability of these four asset categories to a specific hazard varies, depending on a range of factors that are broadly described below.

- **Mission:** Redundancy of operations, flexibility in fieldwork timing, sample holding times, responsibility for living creatures, access to a direct water intake system, and reliance on expensive or sensitive equipment.
- **Workforce:** Number and types of ways to access the site, requirement for onsite work, availability of personal protective equipment, established hazard response policy, existence of exercises in response to likely hazard events, number of workspaces located in temporary spaces and in areas that are difficult to condition.
- **Physical Assets:** Construction type, date, methods, recent renovations, and materials used; current condition; maintenance regiment; specific location on the site (e.g., near the shoreline or below ground); cost and lead time of repair or replacement; ability to access replacement parts and contractors to complete repairs; function of the asset (e.g., office space, laboratory, cold storage, server room); and building occupancy.
- **Infrastructure, Services and Utilities:** Availability of transportation routes and modes to the facility; risks to transportation and utilities systems; reliance on sensitive assets such as bridges, causeways, or tunnels to access the facility; quality of current utility service; location at the end of the utility line; above or below ground power lines; sensitivity of the site to disruption from lack of transportation and delivery access; sensitivity of the site to power outages.

By considering the full scope of consequences posed by climate risk, EPA can more deeply examine how climate hazards could affect its operations and the extent of combined potential impacts from other site-specific weather patterns and conditions.

As sea level continues to rise, high tide flooding is becoming more frequent, and higher volumes of water are spreading impacts beyond coastal areas and changing flood patterns for areas not typically affected. High water from sea level rise also increases the volume and frequency of storm surge, tropical storms, and hurricanes. Changing precipitation patterns and extreme heat from climate change are creating more viable conditions for tropical storms to migrate to areas that would not

normally experience that frequency and intensity of water volume and flooding, such as in the Midwest and Northeast. Severe storms and flood events can damage critical water and power infrastructure that keep EPA facilities operational and can create major disruption to the transportation networks surrounding the facilities, impacting supply chain capabilities, and employee access to the facility and to field research sites.

Extreme heat events are also occurring more frequently and increasing in severity and duration because of climate change. These impacts are being felt nationwide, but some of the most significant impacts on public health are projected for EPA facilities and employees in the Southeast, Southwest and Northeast and areas that are heavily urbanized with limited vegetation. Employees in these areas are projected to experience extreme heat more intensely through the urban heat island effect. Extreme heat puts employees with pre-existing health conditions, field researchers, facilities maintenance teams, and other outdoor workers at risk for heat-related illnesses and injury and can be life threatening if they are exposed for too long, and this can delay mission-critical work.

Heat will create additional stressors for building envelopes and HVAC systems; however, climate control failures can have much wider mission continuity implications beyond the physical facility. Information technology (IT) infrastructure and servers within EPA facilities are critical components to the Agency's ability to process and report research, communicate internally and externally, protect privacy and security, as well as support teleworking capabilities. IT infrastructure is highly sensitive to disruptions from heat and moisture, especially in the Southeast where there is also high humidity and can have detrimental consequences to each dimension of EPA's mission.

In addition to the projected localized impacts to EPA's mission from sea level rise and extreme precipitation, a small percentage of the Agency's facilities and employees may have high exposure to wildfires. In the United States generally, climate change is causing warmer, drier conditions that result in a higher risk for wildfires. High heat and drought combine to limit water in soils and vegetation and increase the risk of ignition from both natural- (lightning) and human-caused fires. The 5.7% of EPA facilities located in areas with high exposure to wildfires are at risk from direct damage because of fire. Impacts from fires can also severely damage critical infrastructure surrounding EPA facilities and can lead to secondary hazards such as soil erosion that creates conditions for landslides, increased flooding, and severe air quality impacts.

Poor air quality created by wildfires can directly impact EPA facilities and employees and extend far beyond the affected area. Smoke and particulate matter from wildfire events will increase the need for filtration in the Agency's laboratories. Like an increase in extreme heat days, more wildfire events will create additional burdens for EPA's HVACs and air handling units to meet laboratory cooling needs required for worker safety and research integrity that the Agency's existing infrastructure is already struggling to maintain. Reduced air quality also poses serious health risks for field researchers, emergency response teams and other outdoor workers, which can cause delays and disruptions in operations to protect EPA employees.

Lastly, EPA's isolated laboratory facilities are more sensitive to disruptions in the transportation and utility systems they rely on. Unlike the EPA laboratories in more urban areas, the more remote laboratories generally only have a single route to and from the sites, which poses a greater risk for

disruption from sea level rise, flooding, and wildfire events. Road blockages in these areas make it harder to receive emergency services, repairs or other vital supplies and potentially prolong the disaster recovery time. Utility networks surrounding the remote EPA facilities already face challenges with power and signal reliability, and climate change impacts can exacerbate the sensitivities to disruption in service lines. Many of the laboratories are fed power from aboveground powerlines and can be severely affected by all the climate hazards. Utility companies in these areas often lack financial payback incentives to fund the capital expenditures to improve their power infrastructure and assets, which creates additional mitigation and operational resiliency challenges that are largely beyond the Agency's control.

2D. Impacts from and Exposure to Additional Hazards

EPA's climate resilience assessments of its owned laboratory facilities assess the likelihood of exposure, vulnerability to, and potential consequences of a wide variety of climate and other natural hazards that may be influenced by climate change. Where projections are unavailable, historical data and the best available scientific literature are used as proxies to provide an estimate of likely changes within the hazard within the next 30 years. The table below displays the full list of natural and climate hazards considered in EPA's climate resilience assessments of its owned facilities. Figure 1 in Appendix B displays an example an EPA facility hazard exposure map, showing the location of EPA facilities in relation to FEMA flood hazard areas.

EPA-Owned Facility Resilience Assessment Complete Hazard List

- Coastal flooding
  - Sea-level rise
  - High-tide flooding
  - FEMA coastal flood zones
  - Tsunamis
  - Storm surge
- Inland flooding
  - Extreme precipitation
  - FEMA inland flood zones
- Hurricanes or hurricane-influenced events
- Tornados
- Straight-line high winds
- Hail
- Landslides
- Erosion
- Lightning
- Drought
- Wildfire
- Earthquake/seismicity
- Extreme heat and cold
- Nor'easters
- Volcanoes
- Winter storms
- Warming surface waters
  - Fresh
  - Sea water

For its owned facilities, EPA considers other locally and regionally occurring natural and climate hazards and expands the scope of hazards as appropriate. Landslides, erosion, volcanoes, and nor'easters were added as additional hazards to include in future assessments after assessments were

completed where they were found relevant and consequential. This enables EPA to understand the full scope of the Agency's potential exposure to natural and climate hazards and enables the Agency to mitigate against the projected impacts more holistically. While earthquakes and volcanoes are not influenced by climate change and are a naturally occurring hazard, the downstream impacts can lead to additional facility risks from erosion, landslides, tsunamis, and degraded air quality. Nor'easters and winter storms can cause road blockages from snow and ice, reduce electrical and mechanical performance of equipment, as well as shut down wider electrical and water infrastructure, leading to complete loss of mission capabilities in some cases.

Hazards such as flooding are divided into two main categories and further analyzed in subcategories (coastal flooding as a result of sea level rise or tsunamis; inland flooding based on extreme precipitation or location in a flood zone) based on different RCP emission scenarios. Additionally, the warming surface waters hazard category is also divided into sea and freshwater surface temperatures as they can present and influence the development of other hazards. Warming temperatures of both fresh and sea water can greatly affect the quality, quantity, and availability of data within the aquatic ecosystems being researched. EPA facilities in locations projected to experience increased high heat days, also have increased likelihood of exposure to heat-related or exacerbated hazards such as increased lightning strikes, soil erosion, and drought conditions or water stress which can be consequential to the health and safety of EPA's workforce, mission capabilities and physical assets. Similarly, to warming surface temperatures, drought conditions can also affect the availability and quality of field data that the Agency is able to collect in order to continue conducting research within watershed and groundwater ecosystems.

Section 3: Implementation Plan

3A. Addressing Climate Hazard Impacts and Exposure

3A.1 Addressing Climate Hazard Exposures and Impacts Affecting Federal Buildings

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	**Priority Action**	**Timeline for implementation (2024-2027)**
Increased intensity and frequency of high heat days impacts 100% of EPA buildings, increases energy usage intensity, and creates additional strain on existing HVAC and AHU systems and components. EPA's laboratories require single-	EPA's Office of Mission Support will continue working with energy services companies and utilities to upgrade the efficiency, availability, and reliability of EPA mechanical and electrical equipment within EPA facilities, through Energy	FY 2024: EPA will release the Notice of Opportunities for energy savings performance contracts at the Manchester Environmental Laboratory in Port Orchard, Washington for a solar field and upgrades at EPA's Andrew W. Breidenbach

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	**Priority Action**	**Timeline for implementation (2024-2027)**
pass air flow for worker safety and have specific temperature requirements for critical research operations. (In laboratories that use gaseous or noxious chemicals to maintain air quality standards, air within laboratories cannot be recirculated and follows a single path into and room and is then exhausted out of the building, rather than being recirculated. Additionally other lab specifications may require single pass air flow to maintain pressure differentials during research.)	Savings Performance Contracts (ESPCs) with deep energy retrofit projects, where feasible. Increasing the efficiency and reliability of major building systems and components will better position the Agency to continue operations during extreme heat events. EPA will be completing a consolidation and infrastructure upgrade at its Athens, Georgia, and Ada, Oklahoma, facilities that will provide updated HVAC, electrical, and building envelope systems. Additional projects associated with EOs 14057 and 14008, could be reviewed, and added in the future depending on funding availability.	Environmental Research Center R&D facility in Cincinnati, Ohio. FY 2025: EPA will complete the preliminary assessments, and if feasible, the Investment Grade Audits determining if the Agency will finalize energy savings performance contracts at its laboratories in Fort Meade, Maryland, and Edison, New Jersey. FY 2026/2027: EPA will complete the preliminary assessments, and if feasible, the Investment Grade Audits determining if the Agency will finalize energy savings performance contracts at its laboratories in Manchester, Washington, and the Andrew W. Breidenbach Environmental Research Center. EPA will also work to complete the infrastructure upgrades at Athens, Georgia, and Ada, Oklahoma.

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	**Priority Action**	**Timeline for implementation (2024-2027)**
On a national scale, increased heat and precipitation are expected to impact 100% of EPA's facilities across all mid- and late- century projections. Approximately 25% (41) of EPA's buildings are located along the coast and are vulnerable to sea level rise and flooding. Only nine of EPA's buildings are at a high risk for wildfires, and none have very high or extreme risk; however, 78% of buildings are still at some degree of risk to wildfire and its impacts. In addition to the above five hazards, there are several, more regionally specific hazards that are intensified by compounding effects and conditions.	EPA's Office of Mission Support will assess the 18 laboratory facilities owned by EPA. EPA will continue conducting climate resiliency assessments at EPA-owned facilities and initiate project recommendations that are determined to be "very-high priority" within 24 months of the final project grading process; however, the Resiliency Assessment Program and project initiation capability are fully dependent on the budget availability and adequate funding year to year. EPA's Office of Mission Support will continue to support EPA offices and programs in efforts to implement project recommendations from the climate resilience assessments that were not identified as a "very-high priority."	<u>FY 2024</u>: - Complete five climate resiliency assessment reports. - Initiate the very-high priority projects identified in the FY 2022 assessment. - Identify the very-high priority projects from each of the FY 2023 assessments' recommendations. <u>FY 2025</u>: - Complete three climate resiliency assessment reports. - Initiate the very-high priority projects identified in the FY 2023 assessments. - Identify any very-high priority projects from each of the FY 2024 assessment recommendations. <u>FY 2026:</u> - Complete final three climate resiliency assessments of EPA owned facilities (with projections up to ~2050). - Initiate the very-high priority projects identified in the FY 2024 assessments. - Identify any very-high priority projects from each of the FY 2025 assessment recommendations.

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	**Priority Action**	**Timeline for implementation (2024-2027)**
		<u>FY 2027</u>: - Begin five-year reassessment cycle at owned facilities using late century projections (~2100). - Initiate the very-high priority projects identified in the FY 2025 assessments. - Identify any very-high priority projects from each of the FY 2026 assessment recommendations.
Heat and precipitation will affect all EPA buildings, causing additional stress and deterioration on the Agency's older facilities and increasing the risk of damage to research equipment and samples. Flood risk also increases with higher levels of precipitation and sea level rise, which will create additional vulnerabilities to water intrusion.	EPA will continue to address aging infrastructure through implementation of its facility master plans and will consider projected future climate hazard exposure in equipment replacement cycles.	<u>FY 2024-FY 2027:</u> - EPA will proceed with roof repairs, electrical and HVAC equipment replacements, and building envelope improvement projects identified in the facility master plans. - EPA will revise operations and maintenance contracts as they expire to include additional task orders allowing for mitigation activities and emergency repairs.
All hazards are projected to have an impact on EPA's physical assets, workforce, systems, and mission through the mid- to late-century. EPA's capacity to support specialized research functions has been a valuable	EPA will work with other federal, state, and local entities on Memoranda of Agreements and Understanding for emergency management mitigation activities and critical asset sharing.	<u>FY 2024-2027:</u> - EPA will examine its high-risk properties and begin to coordinate new agreements with co-located federal, state, and local entities that share the same campuses and risk to mission.

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	**Priority Action**	**Timeline for implementation (2024-2027)**
collaboration opportunity to other entities with overlapping research missions, such as the National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, U.S. Geological Survey, National Institutes of Health and multiple state agencies and universities across the country. Damage to EPA facilities can not only disrupt internal operations, but also disrupt the missions of other federal, state, and local entities that share research functions and spaces.		- EPA will work with its neighboring agencies to improve and develop collaborative emergency response, mitigation and maintenance plans for shared critical assets and systems.
Four of EPA's research campuses are in coastal locations, which accounts for 26% of all EPA-owned buildings. Mission dependency for proximity to these bodies of water inherently put these facilities at greater exposure to impacts from flooding and sea level rise. Through the mid- to late-century, each coastal facility is projected to have at least 50% of their campuses inundated by water, with some projected as soon as 2050.	EPA will continue to investigate the Agency's vulnerabilities and risks within its own facilities and initiate discussions among leadership about the long-term vision for certain EPA laboratories.	<u>FY 2024-2027:</u> - Agency leadership will review EPA -owned facilities in the most vulnerable locations to determine the long-term plan for those facilities. FY 2024: The agency is currently determining the appropriate stakeholders and leaders across EPA to engage in the decision process in order to make science informed and consensus-based investments.

In response to both EO 14008 and the Agency's 2021 Climate Adaptation Plan, EPA conducted a high-level Agency-wide vulnerability assessment as a baseline for each owned laboratory and leased regional office building's exposure to 17 different future hazards. The 17 initial hazards were identified through reviews of climate science, projections, historical data, and input provided by EPA staff in different climate zones, as an initial evaluation of potential risks from climate change. In 2022, the Agency expanded upon that initial high-level, Agency-wide effort to understand the likelihood of exposure and overall risk to climate hazards and began conducting detailed assessments of all owned laboratories.

EPA's climate resiliency assessments of the Agency's owned laboratories use historic and projected hazard exposure data through the mid-century; existing site-specific documentation, such as facility master plans and past safety, health and environmental management audits; and an onsite evaluation of the facilities to understand the full likelihood of exposure, vulnerability and consequences of risk to EPA's mission, physical assets, workforce, and infrastructure/utilities/services the Agency relies on. During the onsite assessments, EPA interviews the facilities' teams and key staff from all research and applied science divisions, operational and administrative functions, and other federal and state Agency partners at the site to understand their past experiences with hazards, existing mitigation strategies and actions, and potential ideas to improve resilience of their operations. Each owned-laboratory climate resilience assessment results in a report with project recommendations that range from updating planning procedures to capital improvement projects that help ensure the facility's resilience against the most likely and consequential risks associated with future climate hazards.

Once each climate resilience assessment report is finalized, a workgroup comprised of leadership and representatives from the site and associated programs or regions meets to vote and prioritize the project recommendations using a schema that EPA's OMS developed to weigh a variety of factors. The schema allows each member of the workgroup to examine the recommended projects from the assessments against the likelihood of exposure, vulnerability, and magnitude of consequences to the asset's physical structure, workforce, operations, and other internal and external connections. Each project is weighed against additional criteria such as technical and economic feasibility and availability to determine if any projects are a very-high priority to OMS. Projects that the workgroup scores as very-high priority are then shared with EPA's Office of Resources and Business Operations to determine the funding pathway and timeline. As a result of the assessments, over 108 asset specific improvements and 74 campus-wide project recommendations have been identified and prioritized by the workgroups across 10 facilities with completed assessments.

The resilience of EPA's operations to damage and disruption from climate hazards also depends on reducing the Agency's energy consumption and increasing onsite generation of power. In support of this goal and in response to EO 14057, EPA conducted additional net-zero emissions (NZE) assessments of all owned laboratory facilities to examine potential pathways for using and procuring carbon pollution-free electricity (CFE) and the feasibility of fleet and facility electrification to meet federal building performance and sustainability goals. The NZE assessments include recommendations for phased approaches to upgrading infrastructure, baseline analyses of onsite electricity generation potential, and projected scenarios of energy savings and outputs. Many of the sustainability recommendations from the NZE assessments have overlapping goals with resiliency aimed at

improving the efficiency and reliability of EPA's building systems and components through electrification. Project recommendations from both the resiliency and NZE assessments inform future considerations for the current and projected conditions of EPA's facilities, allowing for more holistic master planning efforts and driving more targeted and climate data-informed decision-making in capital improvement projects. Understanding both the current and projected building conditions, performance and vulnerabilities allows the Agency to consider the long-term plan for existing facilities and enables more prudent investments and financial risk management.

As a result of the completed resiliency assessments conducted at the Agency's coastal facilities, EPA is critically examining the long-term feasibility of continued operations in locations that are especially vulnerable to climate hazards such as sea level rise and flooding. Nearly 25% of EPA facilities are along the coast. Across both the mid- and late-century 4.5 RCP and the mid-century 8.5 RCP scenarios, each coastal campus is projected to experience inundation of at least one critical asset that either supports major operational functions, stores emergency response equipment, or allows access to and from the facility. By the late-century 8.5 RCP scenario, over 50 % of EPA's coastal research campuses will be inundated by water from sea level rise and will have significant loss of essential functions that support mission capabilities.

Project recommendations from climate resiliency assessments of coastal sites have included: small relocations of laboratory functions to less vulnerable parts of the campus, retrofitting building floors and elevations to better protect from flooding, improving site drainage, and relocating the functions to a less vulnerable site altogether. EPA is also considering additional external factors for future investments in resiliency projects, such as overall vulnerabilities in the broader transportation network and utility infrastructure that EPA sites rely on and leveraging relationships with other federal, state, and local partners who rely on EPA facilities to support critical operations within their own missions. Given the age and condition of most EPA facilities, and additional hazards that are exacerbated by precipitation and sea level rise such as landslides, high-tide flooding, high winds, hurricanes, and storm surge, the Agency is critically examining disaster recovery costs versus the financial feasibility and viability of continued operations in high-risk areas.

EPA facilities are already experiencing impacts from extreme heat, and these impacts are expected to intensify through the mid- to late-century. To address heat impacts, EPA's climate resilience assessment recommendations range from nature-based solutions, such improving canopy cover and permeable area to reduce the ambient temperatures onsite, to full-scale replacements of major building components and envelope repairs. In addition to the resiliency assessment recommendations, EPA's facility master plan also identifies many projects focused on envelope improvements and resealing to decrease water intrusion and heat loss and improve the efficiency of mechanical and electrical systems within buildings, but major construction and retrofit projects are extremely costly and can be difficult to fund.

The Agency uses Energy Savings Performance Contracts (ESPCs) to finance major infrastructure upgrade projects by entering into an agreement with local utility providers to cover the initial project costs, and the Agency incrementally pays back the loan with the energy cost savings. ESPCs have

helped fund major infrastructure upgrades for HVAC, Air Handling Units and Building Automation Systems (BAS) to improve efficiency, help conserve energy and maintain climate control for laboratory functions at EPA's facilities in Ann Arbor, Michigan; Ada, Oklahoma; and Research Triangle Park, North Carolina. EPA also has Notice of Funding Opportunities published for additional ESPCs at its Edison, New Jersey; Fort Meade, Maryland; and Manchester, Washington; laboratories. EPA uses information from facility master plans and NZE and resiliency assessments to inform scope of work requirements for the contracts to ensure that EPA can be both sustainable and resilient in the face of climate change impacts. While ESPCs have been a helpful resource to the Agency, the procurement process is often lengthy, with the full project life lasting five to seven years or longer.

Climate change impacts will continue to be a challenge for EPA's facilities as hazards intensify and the Agency's building portfolio continues to age. Continuing to assess hazard exposures and risk will better inform the Agency's ability to continue its mission in the face of climate impacts and understanding and tracking the scope of damages to facilities and structures from hazard events and the associated costs to repair or resume operations to make climate-informed investments. In 2023, the Agency analyzed the location of EPA-owned facilities and cross-referenced them against the historically underutilized business zones (HUB Zones) in the Climate & Economic Justice Screening Tool (CEJST), to identify overlap. This analysis determined that nine of the EPA facilities are in HUB Zones (Ada, Ann Arbor, Athens-ORD, Cincinnati-AWBERC, Cincinnati-Center Hill, Cincinnati-T&E, Corvallis-Main, Gaar Corner and Newport) and four are in disadvantaged communities (Ada, Cincinnati-Center Hill, Cincinnati-T&E, and Gaar Corner).

While Agency facility planning documents such as master plans, studies and evaluations are typically held as categorically exempt under the National Environmental Policy Act (NEPA) and CEQ's implementing regulations, the specific facility actions (including construction, renovation, and property excess) that are planned and developed are formally considered and evaluated for potential impacts across a wide range of environmental and social resources and areas of interest and concern. Among these are historic, cultural, and tribal resources, which have adopted considerations of ancestorial lands. If a proposed action is determined to have the potential to impact any of these resources, formal consultations with the appropriate organization(s) such as state historic preservation offices, tribal historic preservation offices or the Advisory Council on Historic Preservation, are initiated. In practice, depending on the scope of the project and its physical location, these consultations can range from simple and brief, to very extensive, requiring the development of management plans and formal memoranda of understanding between relevant parties. Likewise, consistent with NEPA and CEQ's regulations, if any project has the potential for significant effects, an Environmental Assessment will be prepared to evaluate the potential impacts more thoroughly for significance.

3A.2 Addressing Climate Hazard Exposures and Impacts Affecting Federal Employees

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL EMPLOYEES		
Climate Hazard Impact on and/or Exposure to Employees	**Priority Actions**	**Timeline for implementation (2024-2027)**
Employees who work at or rely on the work conducted at EPA's owned laboratory facilities have either 100% exposure (to extreme heat and precipitation) or varied exposure (to flooding, sea level rise and wildfires).	EPA will continue using the onsite climate resilience assessments at EPA's owned laboratories to collect information on EPA employees' past experiences with hazard events and existing emergency response and hazard mitigation resources, to better inform future hazard response and identify gaps.	By FY 2026: Complete initial climate resilience assessment of all EPA-owned laboratories.
100% of EPA employees are projected to be exposed to extreme heat and precipitation in all RCP and time scenarios.	EPA will continue developing and updating educational materials for EPA employees as part of its Occupant Emergency Plans and program.	FY 2024-2026: EPA will conduct Occupational Safety and Health Administration Heat Illness Safety and Integrated Vegetation Management trainings as part of the Agency's environmental management systems program. Annually: Send email reminders to EPA employees about the program, region, or location's Occupant Emergency Plan. By FY 2027: Add new sections to the Agency-wide Occupant Emergency Plan to address hazards such as wildfires (including smoke).
Climate change is expected to increase the severity, duration, and frequency of extreme coastal	EPA will regularly test Mass Alert and Notification System and smaller-scale	Annually: Send test alerts through the Mass Alert and Notification System and take

and inland storms across the country, including those that happen suddenly. This impacts all EPA employees.	notification systems.	corrective action as needed if the test does not perform as intended. FY 2024-FY 2027: EPA leadership will begin reviewing EPA's facilities in the most vulnerable locations to determine the long-term plan for those facilities and begin developing processes and procedures to address the facilities with a high likelihood of risk impact. FY 2024: The agency is currently determining the appropriate stakeholders and leaders to engage in the decision process to make science informed and consensus-based investments.

All EPA employees work in locations that are projected to experience an increase in the annual number of days with the maximum temperature and precipitation exceeding the 99th percentile in all RCP scenarios. Many EPA employees either work directly at an EPA-owned laboratory facility or are connected to the work conducted in EPA's laboratories that are also all located in areas expected to experience an increase in the annual number of days with the maximum temperature and precipitation amount exceeding the 99th percentile in all RCP scenarios.

EPA's onsite climate resilience assessments consider each EPA-owned laboratory location's vulnerabilities that could be exacerbated by extreme heat and precipitation. To better understand the consequences to locations that have high exposure and vulnerability to extreme heat and precipitation, among other hazards, the climate resilience assessments include interviews with key staff working in research, applied science, field work, environmental management systems (EMS), facilities and safety management, and O&M. The interviews aim to gain a better understanding of the breakdown between indoor and outdoor work; hours of operation; requirement to work onsite; past experiences with hazard events; external coordination with utilities on emergency preparedness and response planning; and the existence of internal and external emergency response exercises and drills.

This information helps identify gaps in plans, exercises and hazards considered at each EPA-owned laboratory in existing emergency response policies and procedures, as well as ways to maintain a safe working environment for EPA employees and contractors in the face of increasing extreme heat and precipitation. These gaps are addressed in each climate resilience assessment's project recommendations. One example of a project recommendation from the onsite climate resilience assessment is to update O&M contracts to include contingency plans and emergency provisions. Examples of contingency plans in future contracts could include detailing contract workforce protections and procedures during high likelihood or high consequence future hazard events. Contracts could also require that appropriate personal protective equipment is provided to those working in extreme heat or other hazardous conditions. Additionally, these assessments help incorporate potential climate impacts in employee safety plans and training for nationwide facility EMS and Safety, Health and Environmental Management Programs (SHEMP), such as Integrated Vegetation Management and Pollinator Programs that promote planting native and drought-resistant vegetation at sites and OSHA Heat Illness Safety training courses.

Beyond EPA's owned laboratories, EPA regions and locations have developed Occupant Emergency Plans (OEP) to provide information to EPA employees on a how to respond in emergency events, such as fires or earthquakes. Only 5.7% of the Agency's buildings have high risk to wildfires and less than 3% of the Agency's employees have high, very high or extreme risk to wildfires, but a wildfire can have devastating consequences to employee health and safety if one does occur in an area where the Agency is located. EPA will continue developing and updating educational materials for EPA employees as part of the OEP program to address climate hazards with a high likelihood of occurring and those with severe potential consequences. EPA already distributes "Informational Notifications" to its employees on topical hazards. Recent Informational Notification emails from 2023 included emails on wildfire smoke and extreme heat. Each email defines the hazard, shares ways that employees can prepare for the hazard at work and at home, describes the signs of related illness (if relevant) and links to other resources for more information. These notifications help raise awareness of climate hazards and mitigation actions that EPA employees can take.

The vast majority of EPA employees work in counties that are in a 100-year floodplain (99% of employees), and 88% are also located in a county that a 500-year floodplain. Additionally, 7% of EPA employees work in counties that are exposed to sea level rise in both mid-century scenarios, which increases to 43% and 51% in the RCP 4.5 and 8.5 late-century scenarios, respectively. As the severity, duration, and frequency of extreme coastal and inland storms across the country increase as a result of climate change impacts, EPA has a greater need to be able to distribute information quickly and effectively to employees in emergencies. EPA employs a nationwide Mass Alert and Notification System (MANS) to provide critical notifications to employees during events and emergencies that can also be used in response to climate hazards, such as flooding events.

To ensure that the MANS system is functioning as expected and reaching all employees, EPA will continue conducting annual tests of the MANS system and take corrective action as needed. In addition to the nationwide MANS notifications, EPA regions and programs also use their own local alert systems onsite at EPA locations and via text and email messaging to alert employees of any

emergencies, hazards, and threats. At an Agency-wide level, EPA is also considering the long-term plan for operations at its most at-risk facilities that are in coastal locations and are likely to experience severe impacts from sea level rise and extreme storms through the late century. If the Agency determines that the risk posed by climate change is too costly in the long-term for a specific facility, the EPA employees who work at that facility will be impacted. This policy decision is discussed in further detail in Section 3B Incorporating Climate Risk into Policy and Programs.

3A.3 Advancing the America the Beautiful Initiative

Under the Biden-Harris Administration's America the Beautiful (AtB) Initiative, EPA is an active participant in government-wide efforts to connect and restore 30% of the nation's lands and waters by 2030 for the benefit of our economy, our health, and our well-being. To achieve this ambitious goal, EPA and other federal agencies are committed to following key principles to guide conservation and restoration efforts, as framed by the AtB Initiative (see sidebar).

The EPA is taking a wide range of actions to achieve the goals of the AtB Initiative across several of the program's focus areas, including creating more parks and safe outdoor opportunities in nature-deprived communities; supporting Tribally-led conservation and restoration priorities; expanding collaborative conservation of fish and wildlife habitats and corridors; increasing access for outdoor recreation; incentivizing and rewarding the voluntary conservation efforts of fishers, ranchers, farmers, and forest owners; and creating jobs by investing in restoration and resilience.

Many of the efforts that the EPA is supporting as part of the America the Beautiful Initiative generate direct or indirect benefits to ecosystems and communities working to adapt to the impacts of climate change. EPA accomplishments under the first three years of the America the Beautiful Initiative, and priorities for AtB implementation in the coming years, are described below.

America the Beautiful Initiative
Key Areas of Focus

1. Pursuing a collaborative and inclusive approach to conservation
2. Conserving America's lands and waters for the benefit of all people.
3. Supporting locally led and locally designed conservation efforts.
4. Honoring Tribal sovereignty and supporting the priorities of Tribal Nations.
5. Pursuing conservation and restoration approaches that create jobs and support healthy communities.
6. Honoring private property rights and supporting the voluntary stewardship efforts of private landowners.
7. Using science as a guide.
8. Building on existing tools and strategies with an emphasis on flexibility and adaptive approaches.

National Estuary Program. Conservation, protection, and restoration of hundreds of thousands of acres across 28 nationally designated watershed-based estuarine systems. Receiving more than $130 million under the Bipartisan Infrastructure Law, and coupled with annual appropriations, the National Estuary Program's core mission is to improve water quality, protect habitats for fish and other wildlife and the people and communities who rely on them. The National Estuary Program does this through

locally led Management Conferences, implementing long-term Comprehensive Conservation Management Plans that address a range of ecosystems stressors, support environmental and outdoor education programs, monitoring, and engage a diverse range of place-based partners in long-term conservation planning and implementation.

EPA's 28 National Estuary Programs have a legacy of significantly leveraging EPA resources to invest in projects that directly conserve coastal and riparian ecosystems, which play a fundamental role in absorbing the impacts of storms and sea-level rise, and provide economic, cultural, and recreational value to surrounding communities. In its 2022 Bipartisan Infrastructure Law Implementation Memorandum for the National Estuary Program, EPA directed each program to support community efforts to adapt to climate change within their geographies, and to outline those plans in each program's Equity Strategy, connecting climate change response to environmental justice. These efforts advance America the Beautiful focus areas 1, 2, 3, 4, and 6.

Geographic Programs. Across 12 EPA-administered, watershed-based geographic partnership programs authorized under the Clean Water Act, EPA and other federal partners are working with states, other conservation partners, Tribes, and private landowners to conserve more than 400,000 acres since 2019 alone. During this period, the programs, spanning from the Chesapeake Bay to the Great Lakes to the Gulf of Mexico to Puget Sound, have restored aquatic connectivity for fish and other species, and restored water quality over more than 1,000 stream miles. Highlights include:

- Gulf of Mexico Program: Understanding the role that private lands management plays within our watersheds, the Gulf of Mexico program made $21 million available in FY22 for Farmer-to-Farmer grants to assist historically underserved farmers in the Gulf basin in supporting conservation and nutrient reduction efforts. These efforts will be augmented through nearly $50 million in Bipartisan Infrastructure Law funding.
- Great Lakes Restoration Initiative: In partnership with the Bureau of Indian Affairs, the Great Lakes Restoration Initiative provided nearly $19 million in funds to Tribal Nations and intertribal organizations to build resource management capacity, protect and restore treaty-reserved resources and culturally significant habitats and species that support Tribal self-determined priorities. The Great Lakes Restoration Initiative is investing another $1 billion in Bipartisan Infrastructure Law funding to clean up legacy pollution in remaining Areas of Concern across the region, improving the vitality and resilience of ecosystems and the aquatic life that depend on them.
- Chesapeake Bay Program: Under the America the Beautiful initiative, EPA and partner agencies in the Chesapeake Bay Program have increased protected lands by hundreds of thousands of acres, bringing the program to 75% of its protection goal of 2.5 million additional acres protected by 2025, on top of 9.3 million currently protected acres (about 23% of the watershed). The Chesapeake Bay Program is leveraging nearly $240 million in Bipartisan Infrastructure Law to invest in a broad range of conservation and resilience efforts, from urban reforestation to farmer-led nutrient reduction projects.

The EPA's 12 Geographic Programs vary in geography and structure, but all serve to increase protected lands and waters and enhance the health and vitality of land and water ecosystems in their watersheds. Many of the programs directly invest in climate resilience – from research into the effects of ocean-warming on coral and other marine life in South Florida to mitigating the impacts of sea level rise and storm surge on communities and ecosystems in the Chesapeake Bay, San Francisco Bay, and Massachusetts Bay. EPA's 2022 Bipartisan Infrastructure guidance to Geographic Programs included a direction for programs to develop detailed Equity Strategies to leverage investments to achieve equity and environmental justice goals and included incentives for programs to focus on supporting disadvantaged communities. These efforts advance all America the Beautiful focus areas.

Nonpoint Source Pollution Management Grants for State and Tribal Governments. The EPA awards Clean Water Act Section 319 grants to states and federally recognized Tribes to support state and tribally led efforts to protect and restore waters from nonpoint source pollution. The program is developing new guidelines to integrate climate change and equity considerations more broadly and directly into Section 319 grant implementation.

Climate change is causing more frequent and longer droughts, water supply shortages, wildfires, frequent and more intense storms, flooding, and sea-level rise. These events have broader effects on the Nonpoint Source program. For example, higher temperatures can affect water chemistry, which can increase eutrophic conditions. More frequent and intense storms can result in more pollutant runoff, including sewer overflows and eroded shorelines. Longer growing seasons may also increase nonpoint source pollution loadings over time. The resulting water quality impairments can threaten natural systems, affect community and economic health, and diminish or eliminate people's recreational opportunities.

The CWA Section 319 program plays an important role by supporting state, Tribal, and local government efforts to develop WBPs and implement NPS controls that provide significant climate resilience and adaptation co-benefits. The NPS program guidelines prioritize nature-based solutions to help mitigate the impacts of those natural hazards. They also include expectations that nonpoint source management practices are designed to be climate resilient and encourages states to try to quantify the climate resilience co-benefits of these practices (such as flood water retention, reduced water temperatures).

Healthy Watershed Consortium. The EPA's Healthy Watersheds Consortium Grant Program supports local watershed protection demonstration and capacity-building projects across the United States. These projects help maintain healthy, intact aquatic ecosystems that are critical to maintaining climate resiliency across the landscape. Healthy watersheds preserve base flows during periods of drought, mitigate flooding impacts, support species migration through intact riparian corridors, and enable carbon sequestration in protected natural land cover. The program helped grantees and their partners protect an estimated 1.1 million acres and 5,200 perennial stream miles between 2016-2022. In 2023, EPA also published a new resource guide, Advancing Watershed Protection through Land Conservation: A Guide for Land Trusts, aimed at reorienting the land conservation community to EPA water

programs, resources, and foundational concepts around watershed protection. This effort advances America the Beautiful focus areas 3 and 5.

Urban Waters Federal Partnership. The Urban Waters Federal Partnership works in more than 20 urban watersheds across the country with 15 federal agencies and hundreds of local partners and community-based organizations. From Puerto Rico to Denver to Atlanta to New York City, the Partnership's twin goals are to restore and protect water quality while delivering on environmental justice disadvantaged communities. The program's Framework for the Future, celebrating the first 10 years of progress, hopes to expand this partnership model to more urban locations, pending available resources, and to advance many of the goals of the America the Beautiful initiative. Urban Waters Ambassadors provide local, community-based capacity to develop priorities, coordinate with local governments and organizations, and conduct outreach with citizens and communities.

The Urban Waters Federal Partnership is helping to advance restoration efforts and to develop green and blue spaces in many communities long deprived of access to safe and clean outdoor activities. Nature-based Solutions (discussed in Section 3B.3 of this CAP) can include both green spaces (e.g., city parks, avenue and roadside trees and green roofs) and blue spaces (e.g. water channels, urban lakes, ponds, and rivers). Establishing and maintaining green and blue spaces can help manage local flooding, build resilience to drought, protect coastal areas, and reduce urban heat islands.

The UWFP supports locally led restoration, education and engagement, and access to nature, as well as supporting efforts to enhance the connectivity of river ecosystems impacted by development. This program support America the Beautiful focus areas 1, 3, and 4. On April 21, EPA, the U.S. Department of Agriculture (USDA), and DOI announced the Walnut Creek watershed as the 21st location in the Urban Waters Federal Partnership in Raleigh, North Carolina – officially serving as the inaugural event of the White House Campaign for Environmental Justice.

EPA Brownfields Program. Brownfields recovery plays an important role in revitalizing communities by cleaning up and repurposing contaminated sites. The program offers Revolving Loan Fund (RLF) Grants, providing funding for a grant recipient to capitalize a revolving loan fund and to provide loans and subgrants to carry out cleanup activities at brownfield sites. Through these grants, EPA strengthens the marketplace and encourages stakeholders to leverage resources to clean up and redevelop brownfields. When loans are repaid, the loan amount is returned to the fund and re-lent to other borrowers, providing an ongoing source of capital within a community. In FY23, the EPA Brownfields Program assessed nearly 1,900 sites and cleaned up 170 properties. This work supported more than 17,000 jobs and opened brownfield site near the Mississippi River, an area extremely vulnerable to flooding.

While the Brownfields program is an important EPA pollution cleanup program, it also makes the land safe for reuse for a range of purposes, including providing habitat for native species, offering space for outdoor recreation, and providing opportunities to build resilience to the impacts of climate change. One example of using brownfield redevelopment for building resilience to climate change impacts was

at a brownfield site near the Mississippi River, an area extremely vulnerable to flooding. The site was transformed into a stormwater park and a piece of riverbank was restored to a natural and sustainable state. The park can now absorb and clean up to seven inches of stormwater runoff in a single day, ultimately preventing stormwater from entering the river. EPA's Climate Smart Brownfields Manual offers guidance on best practices for climate change adaptation and resilience at all stages of brownfields work. EPA's Climate Smart Brownfields Manual offers guidance on best practices for climate change adaptation and resilience at all stages of brownfields work. This program supports America the Beautiful focus areas 1, 4, 6.

3B. Climate Resilient Operations

3B.1 Accounting for Climate Risk in Planning and Decision Making

As much as possible and consistent with its authorities and available resources, EPA is accounting for the risks posed by climate change and related environmental justice concerns as it designs, implements, and assesses its programs, policies, rules, enforcement and compliance assurance activities, and operations (i.e., facility operations, workforce protection, managing and protecting supply chains).

The Agency is building the climate literacy of its management and staff to integrate adaptation into decision-making processes. It is doing this through formal training processes (e.g., all new EPA employees are required to take introductory training on climate adaptation), and by building a community of practice to foster peer-to-peer sharing of experiences. EPA is also developing decision-support tools and providing technical assistance to enable staff to integrate climate adaptation into programs and to identify strategies that will also yield co-benefits, such as reducing greenhouse gases and other pollution, and advancing environmental justice. Major approaches taken by EPA to include the results of climate risk assessment in planning and decision-making processes include:

- Protecting EPA facilities: As described in Section 2, climate adaptation is now an integral component of EPA's site planning, facility support and operations.
- Protecting EPA's supply chains: Implementing the Agency's Supply Chain Risk Management Plan "Implementation Plan" that includes actions to protect against the risks posed by climate change.
- Embedding climate adaptation into rulemaking processes: EPA is integrating information about the impacts of climate change in agency rulemaking processes consistent with its authorities. EPA is considering a variety of "entry points," including the development of the rule itself; related policy and guidance development; outreach to stakeholders, especially communities with environmental justice concerns that are more vulnerable to climate impacts; post-rule permitting; and monitoring and enforcement and compliance assurance activities.
- Modernizing EPA financial assistance programs**:** EPA is modernizing its financial assistance programs to encourage climate-resilient investments across the nation.
- Provision of technical support: EPA has established an Integrated Climate Sciences Division within its Office of Research and Development that (1) supports the implementation of the 20

EPA program and regional office Climate Adaptation Implementation Plans, and (2) provides place-based technical support to all 10 regional offices and the communities they serve.

3B.2 Incorporating Climate Risk Assessment into Budget Planning

EPA's FY 2022-2026 Strategic Plan has an Agency-wide goal (Goal 1) focused on tackling the climate crisis. One of the objectives (Objective 1.2) of the goal is to accelerate resilience and adaptation to climate change impacts. The Agency has three Long-Term Performance Goals (LTPGs) associated with this objective (see side bar). Annual targets have been set for each LTPG.

The work the entire Agency does to attain the annual targets for the LTPGs informs the Agency's annual budget submission to OMB for work related to climate adaptation. The work is driven by (1) an Agency-wide climate vulnerability assessment EPA conducted, (2) more detailed office-specific vulnerability assessments every program office and all 10 regional offices developed, (3) Executive Orders and major memoranda focused on Administration priorities (e.g., focused on Indigenous Knowledge; environmental justice; nature based solutions; ensuring the outcomes of infrastructure investments are resilient to climate impacts), and (4) available staff and financial resources.

Every EPA program office and all 10 regional offices have developed Climate Adaptation Implementation Plans that contain their office-specific vulnerability assessments and the actions they will take to address the vulnerabilities and help attain the LTPGs in the EPA FY 2022-2026 Strategic Plan. Every year, the programs and regions identify the specific priority actions they will take given available resources and any "above target" resources they receive. Taken together, the annual priority actions inform the development of EPA's annual budget submission to OMB for its work on climate adaptation.

EPA's Climate Adaptation Long- Term Performance Goals (FY22-26)

1. By September 30, 2026, **implement all priority actions in EPA's Climate Adaptation Action Plan and 20 national program and regional Climate Adaptation Implementation Plans** to account for the impacts of the changing climate on human health and the environment.
2. By September 30, 2026, **assist at least 400 federally recognized Tribes to take action** to anticipate, prepare for, adapt to/recover from impacts of climate change.
3. By September 30, 2026, **assist at least 450 states, territories, local governments, and disadvantaged communities, at risk from climate change, to take action** to anticipate, prepare for, adapt to/recover from impacts of climate change.

Another important mechanism for informing budget planning is the innovative Climate Adaptation Measurement Program (CAMP) database developed by the Office of Policy (OP). The system is used for tracking the progress being made by every program and regional office with their priority actions and the outcomes each priority action is leading to. When the annual priority actions are entered into the CAMP database by the program and regional offices, they indicate for each action whether funds are already available to implement the action or whether "above target" funds are needed. This information also informs the budget request for the Agency's work on climate adaptation.

3B.3. Incorporating Climate Risk into Policy and Programs

Agency Policies Reviewed - Climate Adaptation and Resilience	
Changes already made to programs/tools	
1. **EPA's Climate Enforcement and Compliance Strategy Memo**	This memorandum, signed in September 2023 by the Assistant Administrator for the Office of Enforcement and Compliance Assurance, requires EPA's enforcement and compliance program to: (1) prioritize enforcement and compliance actions to mitigate climate change; (2) include climate adaptation and resilience in case conclusions whenever appropriate; and (3) provide technical assistance to achieve climate-related solutions and build climate change capacity among EPA staff and our state and local partners. These requirements apply across all EPA enforcement and compliance activities, including criminal, civil, federal facilities, and cleanup enforcement. Examples of climate change adaptation and resiliency efforts in EPA's enforcement and compliance programs include: • A settlement with Jersey City Municipal Utilities Authority (JCMUA) will incorporate climate change adaptation and resilience best practices for upgrades to its sewer system to be better prepared to withstand severe storms and hurricanes. • Settlements with the cities of Greenville and Hattiesburg, Mississippi require that the work to eliminate sanitary sewer overflows and maintain compliance with the Clean Water Act be performed using sound engineering practices, including practices to improve the resilience of the sewer systems. • A settlement with the U.S. Army for violations of the Safe Drinking Water Act's (SDWA) Risk and Resilience Assessment (RRA) and Emergency Response Plan (ERP) requirements at U.S Army Garrison Fort Buchanan in Puerto Rico requires the Army to assess the risks to, and resilience of, its community water system, including risk from natural hazards.

2. Incorporating Climate Change Adaptation Criteria into Applicable Financial Assistance Agreements	EPA is modernizing its financial assistance programs to encourage climate-resilient investments across the nation. On February 28, 2023, the EPA Deputy Administrator and EPA's Senior Climate Change Adaptation Official issued a memorandum entitled "Incorporating Climate Change Adaptation Criteria into Applicable Financial Assistance Agreements." It was sent to all EPA Assistance Administrators, Associate Administrators, and Regional Administrators. The memorandum called on all the Programs and Regions to integrate climate adaptation into all relevant financial assistance agreements, over time. The immediate focus is on BIL and IRA to help ensure that the outcomes of investments made with those funds are resilient to the impacts of climate change. The memorandum also established a new subgroup to the Cross-EPA Work Group on Climate Change Adaptation. The Resilient Infrastructure Subgroup on Climate is an Agency-wide team of individuals from the program and regional offices who are collectively supporting the efforts of EPA program managers to incorporate climate adaptation into financial assistance agreements, and helping recipients of funds make climate-smart investments.
3. Response to Facility Vulnerabilities	As described in Section 2 (Risk Assessment), in 2022, EPA's Office of Mission Support began conducting climate resiliency assessments at its owned laboratory facilities to further characterize the relationship between likelihood of exposure to climate hazards; vulnerability; and scope of consequences to the mission, workforce, assets, and the infrastructure and utility systems EPA relies on. To date, the Office of Mission Support has conducted 11 of the 18 owned laboratory site visits and a total of 10 climate resiliency assessment reports have been completed. Once each report is finalized, key EPA Office of Mission Support and site stakeholders meet to review the assessment's recommended projects and vote on the highest priority recommendation(s) to increase the resiliency of EPA's facilities by addressing the most likely and consequential hazards. Funding of the high priority projects and the continuity of the resiliency assessment program are dependent on budget allowances.

	In addition to its resiliency efforts, EPA has committed to incorporating energy efficiency and greenhouse gas mitigation considerations into the Agency's facility master planning process to identify opportunities for carbon-free and net-zero solutions to mitigate greenhouse gas emissions and potential negative downstream impacts to the surrounding communities. Where EPA owned facilities geographically fall within ancestral and tribal lands, facility staff will coordinate and consult as necessary with local tribes and communities. The Office of Mission Support will also appoint a Historic Preservation Officer, who will consult with local communities, tribes, and National Registries to preserve culturally significant and historic assets and sites.
4. **Wildfire Guide: Preparation and Recovery for Underground and Aboveground Storage Tank Systems**	EPA developed this guide as a resource for Underground Storage Tank and Oil Aboveground Storage Tank owners and operators in the event of a wildfire. This guide may help Underground Storage Tank and Oil Aboveground Storage Tank owners and operators prepare for and respond to the catastrophic effects and environmental harm that may occur as a result of partial or fully burned Underground Storage Tank systems or Oil Aboveground Storage Tanks and associated piping and appurtenances.
5. **Consideration of Climate Resilience in the Superfund Cleanup Process for Non-Federal NPL Sites Memorandum**	In June 2021, EPA's Office of Superfund Remediation and Technology Innovation issued a memorandum recommending the following approach for EPA regions to consider when evaluating climate resilience during the remedy selection and implementation process: (1) assess the vulnerability of a remedial action's components and evaluate the impact of climate change on the long-term protectiveness of a selected remedy; (2) identify and evaluate adaptation measures that increase the system's resilience; and (3) implement adaptation measures necessary to help maintain the long-term protectiveness of CERCLA remedial actions.

6. The State Revolving Fund Sustainability Conversation Guide (2014)	This Guide, issued in 2014, generated discussions of climate adaptation as part of the conversations regional offices have with the states about the use of State Revolving Funds. This guide was reinforced when the Office of Water received BIL funds targeted for the State Revolving Fund program.
7. Inclusion of Indigenous Knowledge in EPA Programs Training and Community of Practice	EPA's Office of International and Tribal Affairs (OITA) released to the Agency in January 2024 a new training on how to include Indigenous Knowledge in EPA's programs and will be establishing a new community of practice for EPA staff working with Indigenous Knowledge. Incorporation of Indigenous Knowledge is one of four priority actions in OITA's Climate Adaptation Implementation Plan. OITA is offering live training opportunities on Indigenous Knowledge for EPA employees. This training follows release of the White House's Guidance for Federal Departments and Agencies on Indigenous Knowledge (pdf) in December 2022. The training provides an opportunity to gain a deeper understanding of Indigenous Knowledge, learn about the new government-wide guidance, and gain insight into implementing the guidance across EPA. The training, which focuses on both adaptation and mitigation, will be recorded and will be made available to EPA employees on EPA's Indigenous Knowledge intranet site.
8. Addressing Climate Change and Environmental Justice through Reviews Conducted Pursuant to the National Environmental Policy Act and Section 309 of the Clean Air Act	The Associate Administrator for the Office of Policy issued a memo providing guidance to the EPA's National Environmental Policy Act (NEPA) and Section 309 of the Clean Air Act (CAA) review community on how to consider climate change and environmental justice in the scope of these reviews.

In-Progress	
1. Integration into Rulemakings	EPA is considering how climate change may impact its rules so the agency can continue to protect human health and the environment in the face of possible climate change impacts. While EPA accounts for natural hazard risk in its regulatory analyses, the agency is also using the best available information to understand how future conditions might affect the outcomes of regulations. In this way, EPA's four major offices (that address air quality, water quality, contaminated sites, and chemical safety) are, consistent with statutory authorities, helping communities across the country build resilience. This work will help these offices continue to meet EPA's statutory responsibilities despite changing environmental risks from increasing temperatures, wildfires, extreme weather, sea level rise, flooding, and drought.
2. Drinking Water System Infrastructure Resilience and Sustainability Program Grants	With an influx of BIL funding, this new grant program will support eligible entities with projects in underserved (a community that does not have access to household drinking water or wastewater services or is served by a public water system that violates the National Primary Drinking Water Regulations) and small (contains a population of less than 10,000 people) or disadvantaged (the service area of a public water system that meets affordability criteria established by its respective State) to increase drinking water system resilience to natural hazards. Eligible activities for funding include planning, design, construction, implementation, operation, or maintenance.
3. EPA's Office of Land and Emergency Management three memoranda related to consideration of climate change impacts on: **a.** Clean-up of polychlorinated biphenyls (Draft) **b.** Permitting under the Resource Conservation and Recovery Act (Draft) **c.** Corrective Action under the Resource Conservation and Recovery Act (Final)	These three 2023 memoranda from the Director of the Office of Resource Conservation and Recovery to the Land, Chemical and Redevelopment Division Directors in EPA Regions 1-10 convey EPA's recommendations on: a. When and how to consider potential adverse climate change impacts in the **polychlorinated biphenyl clean-up approval process**. The draft memo identifies authorities, provides interpretations of relevant TSCA provisions, and recommends approaches to ensure that controls will provide long-term effectiveness through resilience to potential adverse climate change impacts. b. When and how to consider potential adverse climate change impacts in the **hazardous waste permitting process under the Resource Conservation and Recovery**

	Act. The draft memo includes recommendations for conducting climate change vulnerability screenings and assessments for treatment, storage, and disposal facilities to determine whether there are climate vulnerabilities that hazardous waste permits should address. c. How EPA regions and authorized states should work with RCRA facility owners or operators to integrate climate change adaptation considerations into the **corrective action process under the Resource Conservation and Recovery Act.** The recently finalized memo includes recommendations for conducting climate vulnerability screenings and assessments to determine potential climate risks and impacts in remedy selection, remedy implementation, and long-term stewardship.
Nature-Based Solutions	
Policies encouraging nature-based solutions. The Agency encourages consideration of nature-based solutions (NBS) to advance resilience to the impacts of climate change across all programs, so it is difficult to provide details on the number of policies in which consideration of NBS is included.	**Examples.** EPA supported the development of the Biden-Harris Administration's Nature Based Solutions Roadmap and continues to play a leadership role by coordinating the Green Infrastructure Federal Collaborative, supporting government-wide efforts through technical assistance, training, capacity building, and best practices development.
Environmental Justice	
How EJ Considerations are Included in Climate Adaptation Policies. Environmental Justice is a central part of EPA's climate adaptation work. In his May 2021 Policy Statement on Climate Change Adaptation, the EPA Administrator directed all EPA offices to consult and partner with states, tribes, territories, local governments, environmental justice organizations, community groups, businesses, and other federal agencies to strengthen adaptive capacity and increase the resilience of the nation, with a particular focus on advancing environmental justice. Given this directive, the 2021 EPA Climate Adaptation Plan identified ways the Agency will work with	**Examples.** • Using $2 billion in IRA funds, EPA has launched the Environmental and Climate Justice Community Change Grants program to provide funds for environmental and climate justice activities to benefit disadvantaged communities through projects that reduce pollution, increase community climate resilience, and build community capacity to address environmental and climate justice challenges. • EPA used American Rescue Plan (ARP) funds to help four state and tribal governments plan projects that build resilience to impacts from climate change and natural disasters. The projects emphasized place-based, community-driven resilience strategies such as green infrastructure

overburdened and vulnerable populations to increase their resilience to climate change. Such populations include communities of color, low-income communities, children, persons with disabilities, the elderly, tribes, and indigenous people. More detailed priority actions were then identified in the Climate Adaptation Implementation Plans produced by each of EPA's program offices and all 10 regional offices. EPA's climate adaptation staff work closely with EPA's Office of Environmental Justice and External Civil Rights to consider tribal interests in developing climate adaptation policies and programs.	that offer multiple benefits for climate adaptation and for addressing environmental justice concerns, preserving livelihoods and cultures, and enhancing quality of life. • The Office of Air and Radiation's Indoor Environments Division, Office of Children's Health Protection, Office of Policy, Office of Research and Development, and EPA Regions 9 and 10 developed a new program called Schools as Community Cleaner Air and Cooling Centers. This program provided action plans for school districts and public health agencies on how to retrofit schools to create more safe spaces in vulnerable communities during wildfire smoke and extreme heat events.
Tribal Nations	
How EPA has Consulted/Coordinated with Tribal Nations. • In 2022, because of Tribal input at the National Tribal Operations Committee meeting, EPA and the National Tribal Operations Committee created a subgroup focused on Climate Change. To date, this subgroup has commented on EPA climate-related plans, hosted Town Halls to inform and receive input from Tribes and is planning on a series of climate adaptation trainings and engagements with tribal staff in 2024. • EPA regional offices and tribal governments are working together to better understand the impacts of climate change on Tribal communities and to develop targeted adaptation strategies. This includes conducting research, collecting data, and sharing information. Region 3 is conducting a project with local tribes to evaluate cumulative impacts including climate ones. Additionally, the Office of Air and Radiation's Tribal Air Quality Toolkit is co-developed with Tribes	**Examples of Tribal Input Informing Agency Actions.** • The Office of Air and Radiation, in partnership with the regional offices, is developing a Tribal Air Quality Toolkit to provide Tribes with information and resources on air quality issues, such as monitoring, permitting, emissions inventories, and health impacts. Climate change can worsen existing environmental problems and air quality, and it may also introduce new problems as the frequency or severity of adverse conditions change. Households and Tribal communities with fewer resources are less likely to have access to the systems that help keep their environments safe and healthy. The OAR resources will support Tribal resilience in the face of climate change. • The Office of Chemical Safety and Pollution Prevention is working with tribes and states to incorporate climate change considerations into pesticide risk assessments and management decisions, as well as to promote the use of integrated pest management practices that reduce pesticide use and greenhouse gas emissions. OCSPP is working with Tribes to incorporate indigenous knowledge into the assessment to build the resiliency of decisions.

to ensure the relevancy of the Toolkit. • EPA is working with Tribes to develop emergency plans for responding to climate-related disasters such as floods, wildfires, and hurricanes. These plans include strategies for evacuating vulnerable populations, providing emergency supplies, and coordinating with other agencies, especially the Federal Emergency Management Agency. • EPA developed a partnership with the Environmental Protection Network to support Tribes in conducting vulnerability assessments that identify specific climate-related risks and consider factors such as geography, infrastructure, and traditional lifeways and practices, and help Tribes develop targeted adaptation strategies. • EPA is helping tribes to develop climate adaptation plans in preparation for the impacts of climate change. These plans include strategies for protecting infrastructure, preserving traditional lifeways and, and ensuring food security. Support for climate adaptation planning is provided in several ways, including through grants, such as the Indian Environmental General Assistance Program, and partnerships such as the Memorandum of Understanding with the Environmental Protection Network to provide targeted technical assistance. EPA consulted extensively on the General Assistance Guidance which now allows more climate related activities. • Based on numerous consultations with Tribal Nations, EPA is collaborating with other federal agencies, such as Department of the Interior, Department of Energy, and the Federal Emergency Management Agency to support Tribal climate adaptation efforts. This includes sharing information, coordinating efforts,	• The Office of Enforcement and Compliance Assurance is enhancing its compliance assistance and outreach efforts to help Tribes and communities comply with environmental laws and regulations, as well as to identify and address environmental justice concerns related to climate change. This will build resilience and help ensure remedies are protective even as the climate changes. • The Office of International and Tribal Affairs is supporting the development and implementation of tribal climate adaptation plans, as well as facilitating the exchange of information and best practices among Tribes, states, local governments, and international partners. These plans include strategies for protecting infrastructure, preserving traditional lifeways and, and ensuring food security. Support for climate adaptation planning is provided in a number of ways, including through grants, such as the Indian Environmental General Assistance Program, and partnerships such as the MOU with the Environmental Protection Network to provide targeted technical assistance. • The Office of Research and Development is conducting and supporting scientific research and technical assistance to inform and improve the adaptation and resilience of Tribes and communities, such as assessing the vulnerability and exposure of tribal lands and resources, developing tools and models to project future climate scenarios and impacts, and evaluating the effectiveness and co-benefits of adaptation and mitigation strategies. • Waste management, while a RCRA program, is essential to protecting water systems from pollution during extreme weather events and, because waste is sometimes burned after disasters, protecting air quality and human health. To address this, EPA released a waste management tool for disaster debris, so tribal communities have the information they need to respond in a protective and effective way.

and providing joint technical assistance.	Historically, a lot of post-disaster waste has been mismanaged, creating health, environmental, and social impacts on communities who are being impacted by the disaster itself.
Co-Benefits of Adaptation	
How EPA Reviews Climate Mitigation Policies to Integrate Adaptation Principles and Identify Co-benefits. EPA is reviewing and revising opportunities across its capacity building and technical assistance efforts to identify and implement adaptation strategies that deliver co-benefits for mitigation of greenhouse gases and other pollution, public health, economic growth and job creation, national security, and environmental justice. EPA has revised program policies, guidance documents, and capacity building initiatives to provide co-benefits.	**Examples** • In 2022, EPA updated its program policy for the hazardous waste Superfund Program by releasing Green Remediation Best Management Practices. The green remediation practices improve existing Superfund policies by encouraging renewable energy usage through nature-based design principals using vegetation that captures carbon while also building resilience to climate change driven floods, sea level rise, and storm events. • EPA's Office of Community Revitalization has committed under the Office of Policy's Climate Adaptation Implementation Plan to integrate climate adaptation into its technical assistance projects, which help communities to revitalize downtowns and main streets. Supporting the revival of these central areas reduces greenhouse gas emissions from transportation by making it easier for people to walk, bike, take transit, or drive shorter distances. The Office of Community Revitalization also incorporated planning strategies that may help communities build resilience to extreme climatic events, achieve electrification and decarbonization goals, while stabilizing their local economies to continue to thrive as the climate changes. • EPA is incorporating adaptation and greenhouse gas mitigation considerations into its Climate Ready Water Utilities initiative which provides drinking water, wastewater, and stormwater (water sector) utilities with practical tools, training, and technical assistance to increase system resilience to climate change. For example, the Climate Ready Water Utilities initiative collaborated with federal and non-federal partners on the "Leading Practices in Climate

	Adaptation" webinar series. The series explored steps to mainstreaming climate science and adaptation considerations into the work of water utilities, including measures to lower greenhouse gas emissions and energy usage paired with climate resilience and adaptation strategies.
EPA is reviewing and revising its broad portfolio of grant programs that support the reduction of greenhouse gas emissions for opportunities to develop criteria and incentives for funding recipients to integrate adaptation into their climate mitigation projects. EPA is giving priority consideration to programs administering Bipartisan Infrastructure Law and Inflation Reduction Act funds to capture these historic investments in infrastructure, clean energy, and greenhouse gas reduction.	• EPA incorporated co-benefits into the guidance for the $27 Billion Greenhouse Gas Reduction Fund (GGRF), an Inflation Reduction Act program. In the 2023 Notice of Funding Opportunity for the GGRF's National Clean Investment Fund, the Net-Zero Emissions Buildings category included co-benefits as a critical element to be included in applications. Co-benefits include climate resilience, along with occupant health, and environmental stewardship as critical elements of a holistic building design, construction, and operations strategy. • The EPA Clean School Bus Program provides $5 billion over five years with funding from the Bipartisan Infrastructure Law to replace existing school buses with zero-emission all-electric and low-emission models, lowering greenhouse gas emissions. In 2023, EPA incorporated climate change adaptation into the 2023 Clean School Bus Program Grant program. The program now evaluates applicants on the quality and extent to which the proposed project assesses and implements resilient measures, such as ensuring that electric school buses and charging equipment are protected from climate-driven flooding, sea level rise, and storm damage.

Climate Adaptation and Resilience. Every program and regional office within the Agency has been conducting a comprehensive review of policies and regulations to integrate climate-smart approaches and these reviews will continue into the future. Listed in the table above are examples of EPA's push to encourage Agency-wide consideration of climate change impacts on Agency program missions, functions, and activities. As programs and regions continue their reviews, the list of examples will grow.

Nature-Based Solutions. Nature-based solutions (NBS) are a fundamental component of a broad range of Agency programs to advance resilience to the impacts of climate change. In particular,

through its leadership of the Green Infrastructure Federal Collaborative, EPA is helping to lead federal efforts to reduce challenges to permitting green infrastructure and nature-based solutions, and is developing several important tools, including federal permitting and policy recommendations for supporting the adoption of nature-based solutions as well as a guidebook for developing regional permitting networks for NBS implementation.

Infrastructure investment programs are a central component of EPA's strategy to support the use of nature-based solutions to achieve climate, water quality, community resilience, and other goals. EPA recommends and supports the use of nature-based solutions in a wide range of infrastructure programs, and included guidance on prioritizing NBS, where possible, through implementation of the more than $43 billion in Bipartisan Infrastructure Law State Revolving Fund resources, and as an eligible category in the Inflation Reduction Act's $2 billion Environmental and Climate Justice Community Change Grants program, supporting projects advancing environmental justice in disadvantaged communities. Many of EPA's place-based programs, including the National Estuary Programs and Geographic Programs, invest in nature-based solutions to protect water quality, restore aquatic habitats, and enhance resilience to climate change. NBS and green infrastructure priorities were specifically highlighted in BIL implementation memoranda for these programs.

Environmental Justice (EJ). EPA's FY22-26 Strategic Plan emphasizes a cross-Agency approach to facilitate the consideration of EJ in all of the Agency's work. These efforts, championed by the Agency's Office of Environmental Justice and External Civil Rights (OEJECR), include incorporating environmental justice considerations in climate adaptation policies and coordination on funding announcements, technical assistance, and policy and regulatory development. This work is consistent with recommendations from the White House Environmental Justice Advisory Council (WHEJAC) and includes, for example: (1) supporting the efforts of EJ communities to conduct vulnerability assessments to identify their vulnerabilities to environmental hazards and the risks posed by climate change; (2) actively engaging and partnering with EJ communities to develop and implement climate adaptation plans focused on their needs and the outcomes of concern to them; (3) funding resiliency hubs, such as those focused on addressing extreme heat and its impacts; (4) supporting community-led post-disaster recovery efforts, including cleanup of toxic contaminants and protection of workers from exposures to toxic substances.

A significant example from 2023 includes the updating and signing of a Memorandum of Agreement between EPA and FEMA, forging a partnership between the two agencies to encourage and foster engagement and collaboration with disadvantaged communities, with a focused outreach to support adaptation actions that follow the principles of environmental justice and equity, including providing assistance and new tools to address climate and disaster-related public health issues.

In 2023, EPA announced the new Inflation Reduction Act Environmental and Climate Justice Community Change Grants (Community Change Grants) program, providing $2 billion in grant funding for projects to benefit disadvantaged communities as part of the Justice40 Initiative, and $200 million for technical assistance in direct response to feedback from communities and environmental justice leaders who have long called for capacity building support for communities and their partners as they work to access critical federal resources. The grants, and associated technical assistance, support a

range of actions that build adaptive capacity, foster climate justice, and protect health and the environment.

For example, the program provides targeted design assistance for disaster-prone and disadvantaged communities and sets them up to compete for the more comprehensive Community Change Grants. The anticipated positive outcomes of these grants and technical assistance are expected to materialize over the next several years and EPA expects them to be transformational for communities most adversely and disproportionately impacted by climate change, legacy pollution, and historical disinvestments. Finally, EPA is supporting Community Disaster Resilience Zone (CDRZ) communities. These are communities that have been designated by the Federal Emergency Management Agency as the most at-risk and in-need communities. CDRZ designation is considered as a factor in the Community Change Grant selection process, and CDRZ communities qualify to receive free Equitable Resilience Technical Assistance.

Tribal Nations. EPA partners with Tribal governments (Tribes) in a number of ways to support their climate adaptation efforts. With the input of Tribes, EPA has identified several key areas where Tribal communities are particularly vulnerable to the impacts of climate change, including infrastructure, food sources, and traditional lifeways and practices. Particular attention is given to actions that deliver co-benefits, including curbing greenhouse gas emissions and other pollution, while promoting public health, economic growth, and climate justice. Adaptation helps reduce the need for energy-intensive infrastructure and reduces the impact of climate change on communities.

For example, by planning for climate change impacts such as sea level rise, drought, and wildfires, Tribes can take steps to reduce their vulnerability to these impacts and protect their communities and natural resources. Additionally, adaptation strategies such as land use planning can help reduce greenhouse gas emissions by promoting compact development, preserving green space, and reducing the need for automobile travel.

EPA is committed to tracking the impact of its programmatic actions with Tribal governments and communities. In its FY22-FY26 Strategic Plan, EPA pledged to increase the number of Tribes and communities that build climate resilience through EPA investments, grants, or technical assistance. By the end of FY2023, over 275 Tribes and 400 communities have built resilience to climate change, in part, because of the EPA's efforts. The EPA expects this number to increase in the years to come as the investments it is making today pay off in future Tribal and community resilience. EPA's Climate Adaptation Measurement Program (CAMP) Version 2.0 is expected to be ready in Summer 2024 and will track each action EPA took (e.g., grant, loan, technical assistance, or training) and the specific action(s) the tribe or community took.

Co-Benefits of Adaptation. In a 2021 Policy Statement, the EPA Administrator directed the Agency to incorporate climate adaptation into the Agency's programs while lowering greenhouse gas emissions and yielding other co-benefits. This commitment to climate adaptation and mitigation co-benefits is reflected throughout EPA's 2021 Climate Adaptation Plan and in the commitments found in the 20 Climate Adaptation Implementation Plans for EPA's program offices and regions. EPA has taken some important first steps to realize these co-benefits, as demonstrated in Table 3B above.

3B.4. Climate-Smart Supply Chains and Procurement

The Federal Acquisition Supply Chain Security Act of 2018 requires all Executive Branch agencies to establish a formal Supply Chain Risk Management program that includes conducting Supply Chain Risk Assessments. EPA includes an assessment of climate hazard risk as part of its overall Agency Supply Chain Risk Management. EPA plans to conduct Supply Chain Risk Assessments for Excepted, Program Management Improvement Accountability Act and Federal Information Technology Acquisition Reform Act contracts in FY 2024.

At risk supplies/services	Outline Actions to Address Hazard(s)	Identify Progress Towards Addressing Hazard(s)
Describe the acute/long-term climate hazard posed to mission critical supply chains or services.	**Outline actions to address hazards.**	**Identify any current progress to address hazards.**
Increased heat and precipitation, flooding, sea level rise, and wildfires all threaten EPA's supply chain. EPA's laboratories require consistent, reliable, and timely deliveries of samples for research, which often have specific holding time and climate-controlled requirements to preserve the sample's integrity. The laboratories also need a variety of specialized products like inert gases to maintain accurate calibrations for analytic equipment.	1. EPA is incorporating Supply Chain Risk Management considerations into the Agency's Enterprise Risk Management processes by providing guidance for governance and support in emergency and contingency planning activities. 2. EPA's Office of Mission Support will continue to conduct facility resiliency assessments to identify and make recommendations for addressing facility-specific supply chain vulnerabilities. 3. EPA will continue to conduct Supply Chain Risk Assessments for programmatic and regional offices.	EPA has initiated a tiered approach to investigate the Agency's risks in 2024, prioritizing the Supply Chain Risk Assessment of enterprise-level critical supplies and services. Upon completion of the enterprise-level Supply Chain Risk Assessments and through FY 2027, EPA will begin to assess vulnerabilities and risks within regional and programmatic offices.
In addition to disruptions or delays in receiving laboratory supplies and samples, climate change may also disrupt the supply chain production, distribution, and transportation of equipment, parts, and in-person services needed for building operation and maintenance. Some equipment in EPA laboratories is already past its useful life and it is difficult for EPA staff and operations and maintenance contractors to obtain needed replacement parts and specialized repair services.	1. EPA region and program contracting offices will begin requiring offerors to disclose their own risks and submit an internal vulnerability assessment at the time of bidding to be more proactive in addressing potential vulnerabilities. 2. Pending storage constraints, EPA laboratories will keep extra operations and maintenance parts and equipment onsite. 3. EPA will continue implementing infrastructure replacement projects to remove older mechanical and other equipment and replace with energy efficient equipment.	EPA is in the process of multiple Infrastructure Replacement Projects (IRP) at its laboratories in Duluth, Minnesota; Ada, Oklahoma; and Athens, Georgia; and has budgeted for an IRP at its laboratory in Newport, Oregon, pending an Agency-wide decision about whether to continue to invest in that laboratory given its high-risk exposure to climate hazards due to its location.

At risk supplies/services	Outline Actions to Address Hazard(s)	Identify Progress Towards Addressing Hazard(s)
As mandated by Executive Order 14057, EPA has been implementing measures to reduce greenhouse gas emissions, improve building efficiency, and procure more carbon pollution-free electricity, and tracks that progress through installation of additional advanced meters and building automation system programs. Many of these systems require the use of proprietary technology that is not already compatible with EPA security polices and requires the procurement of third-party, cloud-based services to operate the software. Additionally, many of EPA's laboratories also use highly specific research equipment that requires proprietary software to analyze samples and access results.	1. EPA will continue to integrate Supply Chain Risk Management considerations into information and communications technology procurement and the Federal Information Technology Acquisition Reform Act contract processes. 2. EPA will continue to update and integrate information and communications technology and cybersecurity policies as new regulations, legislation, and statutory guidance documents are released. 3. EPA will participate in intragovernmental processes to address cross-sector risks and cybersecurity supply chain risk management incident response to help maintain the confidentiality, integrity, and availability of EPA technical infrastructure and assets.	EPA will adopt the use of the Office of Personnel Management's Software Attestation Form for submission by current and prospective vendors once official guidance is finalized and released. In the interim, the Agency will follow and implement the Public Notification of Software Attestation requirements posted on SAM.gov.

At risk supplies/services	Outline Actions to Address Hazard(s)	Identify Progress Towards Addressing Hazard(s)
Climate change can increase risk for cyber threats, disruptions, and other opportunities for information exploitation. Risks to EPA's physical assets and the surrounding transportation networks that the Agency relies on from climate change are increasing the Agency's reliance on remote access capabilities to continue mission operations. As more mission functions are needing to adopt remote access capabilities to combat climate change impacts, there will be an increased need for information and communications technology procurement and ongoing cybersecurity risk analysis to maintain continuity of operations plans and procedures.	1. EPA will continue to conduct annual security assessments for all Federal Information Security Management Act reportable information, to monitor vulnerabilities and report threats within information technology systems. 2. EPA will include potential climate change impacts to current and future contracts and system controls as cybersecurity supply chain risk management considerations when making risk-based decisions for acquiring information and communications technology products and services. 3. EPA will continue to update and integrate information and communications technology and cybersecurity polices as new regulations, legislation and statutory requirements are released.	In 2023, EPA began updating its Information Security Risk Management Strategic and Information Security Continuous Monitoring Strategic plans to improve information security procedure guides and other templates to incorporate updated guidance and requirements from the National Institute of Standards and Technology into information and communications technology procurement. Through FY 2027, EPA will begin conducting Supply Chain Risk Assessments, starting with Federal Information Security Management Act high-value reportable assets and at-risk Information Technology systems, then transitioning to the moderate and low-risk assets and systems, ensuring that the full scope of cybersecurity supply chain risk management is assessed.
Many EPA laboratories are in remote locations and already struggle to obtain services such as specific building repairs in a timely manner. An acute extreme weather event or longer-term climatic change impacts could exacerbate this issue by creating a greater demand for these services in the broader region. EPA is also a smaller Agency and does not have the same procurement power as some other federal agencies. There may be other critical functions in the region that take priority in an acute weather event, delaying services to EPA.	1. EPA will continue with planned laboratory consolidations to reduce the Agency's number of facilities. 2. EPA will work with other federal agencies to acquire services together. 3. EPA will utilize Emergency Acquisition procedures in accordance with Federal Acquisition Regulations Part 18, in instances when excepted operation and maintenance contracts ceiling must be raised to respond to a hazard event.	EPA is continuing to look for opportunities to consolidate its laboratory footprint and is proceeding with consolidations of its Region 4 Laboratory into the Office of Research and Development Laboratory in Athens, Georgia, and its Region 6 Laboratory in Houston, Texas, to the Office of Research and Development Laboratory in Ada, Oklahoma. EPA's assessments of its owned laboratory facilities also include project recommendations to work with other federal partners and add emergency provisions to accepted operation and maintenance contracts where applicable.

EPA relies on a wide variety of supplies and services to support its mission and has been integrating climate change considerations into its supply chain management processes to improve the Agency's adaptive capacity to plan, withstand, and recover from future climate change impacts. In 2018, EPA established a supply chain risk management Executive Board comprised of high-level leadership that was tasked to prioritize, develop policies and processes, and provide oversight for Agency-wide SCRM decisions and activities. Also, as a part of the Agency's 2021 Climate Adaptation Plan, EPA initiated an enterprise-level risk assessment to begin identifying the contracts, services, and supplies that are most critical for the Agency to maintain operations across a variety of emergency and shutdown scenarios.

EPA's physical supply chain components such as contract-supplied goods and in-person services are most at risk from climate change impacts. Research and applied science in EPA's laboratories depend on reliable shipping and delivery services to transport samples with holding times as short as 12-24 hours. Flooding from SLR and increased precipitation can cause road closures and disrupt delivery of samples within a timely manner. Impacts from wildfires and increases in high heat days can also threaten the ability of climate-controlled delivery services to meet temperature requirements for laboratory samples while in transit, which can threaten the integrity and accuracy of research. Laboratory facilities additionally require frequent shipments of specialized supplies for research, such as inert gases and high-efficiency air filters, to keep equipment accurately calibrated and maintain indoor air quality safety requirements. Climate change can also impact the ability for EPA to receive contracted in-person services such as maintenance, repairs, and onsite security. High heat, wildfires, and secondary effects such as increased lighting strikes and poor air quality can limit both the days and number of hours that contractors can safely work outside. Increases in precipitation and flooding can also create challenges for grounds maintenance and improvements and disrupt overall access to the sites.

EPA's Office of Acquisition Solutions (OAS) will be conducting an in-depth Supply Chain Risk Assessment (SCRA) for all identified "excepted" contracts starting in 2024. OAS began expanding and redefining the criteria for excepted contracts in 2022 to identify mission-critical risks and allow for additional continuity of services and funding in the event of a natural and climate disaster or shutdown scenario, to protect employee safety and owned assets. This expanded definition for excepted contracts was submitted to and approved by the Acquisitions Management Council in 2023, and since then the Agency has identified over 1,400 contracts that are deemed critical to the Agency's mission. The SCRA for excepted contracts seeks to start characterizing the relationship between exposure, vulnerability, and the potential magnitude of consequences to the supply chains from climate change and will assign a risk score of either critical, high, moderate, or low to each of contract. This same process will be replicated and conducted for Program Management Improvement Accountability Act (PMIAA) contracts for major acquisitions and contracts for Information and Communication Technology (ICT) support in FY 2024.

EPA is also incorporating climate considerations into Cybersecurity Supply Chain Risk Management (C-SCRM), which is the process of identifying, assessing, preventing, and mitigating the risks associated with the distributed and interconnected nature of ICT product and service supply chains. C-SCRM covers the entire life cycle of ICT, which includes design, development, distribution, deployment, acquisition, maintenance, and destruction. This type of supply chain procurement is

critical for the Agency as it continues to modernize its operations and the potential for climate change impacts to disrupt physical access to EPA facilities increases. As directed by EO 14057, EPA has been implementing measures to reduce GHG emissions, improve building efficiency and procure more CFE, and tracks that progress through the installation of additional advanced meters and BAS controls. However, many automation systems that allow for remote building control require the use of proprietary technology that is not immediately compatible with EPA security polices and requires the procurement of third-party, cloud-based services to operate the software on EPA servers. Additionally, many of EPA's laboratories also use highly specific research equipment that requires proprietary software and cloud services to analyze samples and access results both within the laboratory and remotely, increasing the criticality of the C-SCRAs within the Federal Information Technology Acquisition Reform Act (FITARA) process.

EPA will need to conduct more ICT procurement and ongoing cybersecurity risk analysis to maintain continuity of operations. EPA is increasingly reliant on remote access capabilities for operational resilience. As more mission functions require adoption of remote capabilities, the Agency will need to conduct more ICT procurement and ongoing cybersecurity risk analysis to maintain continuity of operations plans and procedures. The Agency's 2022 ICT Supply Chain Management Strategic Plan found that EPA was deficient in all seven of the Government Accountability Office's recommended foundational practices in C-SCRM. While the specific relationship between cybersecurity and climate change can be indirect, impacts to EPA's cybersecurity infrastructure in its current state can exacerbate existing or create new vulnerabilities to sophisticated exploitation tactics to steal data and/or damage, disable or destroy the Agency's computers, networks, or systems, which would inhibit EPA's ability to fulfill its mission and safeguard its personnel and environmental data.

As directed by EOs 14008 and 14030 and the Federal Acquisition and Supply Chain Security Act, in 2023 EPA began updating its Information Security Risk Management and Information Security Continuous Monitoring strategic plans to incorporate updated guidance and requirements from the National Institute of Standards and Technology (NIST) into ICT procurement and information security procedural guides. Through FY 2027, EPA will continue conducting Cyber-SCRAs (C-SCRAs), starting with FISMA high-value reportable assets and at-risk IT systems, then transitioning to the moderate and low-risk assets and systems, ensuring that the full scope of C-SCRM is assessed. Maintaining cybersecurity and conducting ongoing C-SCRAs will be pivotal to the Agency's operational resiliency as both science needs and the IT sector continue to rapidly evolve.

3B.5. Climate Informed Funding to External Parties

EPA's 2021 Climate Adaptation Plan and the EPA Administrator's Policy Statement on Climate Change Adaptation directed all national program and regional offices (offices) to proactively incorporate climate adaptation into the Agency's programs, policies, rules, and operations; including modernizing its financial assistance programs where appropriate. The statement also directed the offices to consult and partner with states, tribes, territories, local governments, community groups, businesses, and other federal agencies to increase the adaptive capacity and resilience of the nation, with a focus on environmental justice. EPA has built upon these early directives with a Memorandum (Memo), *Incorporating Climate Change Adaptation Criteria into Applicable Financial Assistance* (February 2023), which reaffirmed EPA's long-term commitment to modernize its financial assistance programs to

encourage climate-resilient investments. It also established the Resilient Infrastructure Subgroup on Climate (or RISC, chaired by EPA's Office of Policy) to advance this commitment in partnership with over 20 offices across the Agency. RISC's initial focus is on BIL and IRA funded programs. The lessons learned from these opportunities will allow EPA to scale its efforts to other financial assistance programs over time.

The Resilient Infrastructure Subgroup on Climate goals and activities align with the priorities of EPA's FY 22-26 Strategic Plan, EPA's 2021 Climate Adaptation Plan, "Policy Statement on Climate Change Adaptation", and the 20 national program and regional office Climate Adaptation Implementation Plans. Per the Memo, RISC is performing activities to support EPA's offices with integrating adaptation and resilience into their financial assistance programs. RISC is also taking steps to help make EPA's tools, training, data, and technical assistance initiatives more accessible to funding applicants and recipients as they make climate-resilient investments. RISC's activities are achieved in collaboration with EPA's offices to leverage the best practices and expertise of the programs. For example, EPA's National Estuary Program, Geographic Programs (such as Puget Sound), Drinking Water and Clean Water State Revolving Loan Fund programs, Brownfields grant programs, and the Community Change Grant Program are models for how to incorporate adaptation and resilience requirements into funding announcements and overall program operations.

Five goals of EPA's Resilient Infrastructure Subgroup on Climate (RISC)

- ✓ Foster internal coordination and communication.
- ✓ Enable climate-resilient infrastructure investments.
- ✓ Deliver technical assistance and decision support.
- ✓ Increase access and usability of climate information.
- ✓ Equitably advance resilient investments.

Many of these programs promote climate adaptation and resilience, while also helping to advance environmental justice as part of the Justice40 Initiative, which sets a goal that 40 percent of the overall benefits of certain Federal climate and other investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution.

The RISC is developing two main projects for the Agency that align with the Agency's goals and directives for climate adaptation. The first is an internal clearinghouse to provide EPA's financial assistance staff with a general approach to address climate adaptation and resilience throughout various steps of their program processes (e.g., writing announcements, assessing climate risks to a proposed project, performing meaningful engagement.). The second is an external facing toolbox intended to supply technical assistance providers with resources to support applicants and recipients with investing in climate-resilient projects. These two projects will provide the internal and external guidance needed to support success on both sides of a federal investment decision. EPA programs will be strongly encouraged to follow the approach laid out by the internal clearinghouse to integrate adaptation and resilience into their funding announcements, as well as climate justice. RISC has also produced interim products to help EPA staff incorporate adaptation and resilience into grant and loan programs, including compiling example language for incorporating adaptation and resilience into funding announcements, innovative practices for financial assistance programs to advance EPA's

climate adaptation goals, and BIL and IRA focused priority actions that EPA's offices can adopt as part of their Climate Adaptation Implementation Plans.

RISC's two main projects prioritize the use of climate tools and information to inform funding decisions, the incorporation of climate justice into EPA's financial and technical assistance opportunities, and the adoption of common metrics that recipients can use to meet EPA's reporting requirements. RISC is packaging federal tools and information to help both financial assistance staff and applicants understand, identify, and perform a high-level evaluation of the climate risks to a proposed project.

The Resilient Infrastructure Subgroup on Climate is also centering accessibility, equity, and climate justice in the design of its projects. RISC's internal dashboard will provide direction on the inclusion of climate justice and meaningful engagement practices when developing funding opportunities, including innovative ways to reduce application burden through program design. RISC's publicly accessible toolbox will also help reduce the barrier to entry for disadvantaged communities by sharing resources to help them easily identify what funding to apply for based on their interests, in addition to the climate risk tools and information that can be used to develop their applications. It will also highlight resources to facilitate inclusive outreach and engagement as important steps for developing climate-resilient and climate-just projects. Additionally, EPA is working to develop standard output and outcome metrics for recipient (grantee) reporting that include climate adaptation, resilience, and climate risk. Once developed, these metrics will be featured as part of RISC's internal dashboard for voluntary adoption by EPA's financial assistance programs.

3C. Climate Training and Capacity Building for a Climate Informed Workforce

Training and Capacity Building		
Agency Climate Training Efforts	**Percent of EPA staff that have taken a 60+ minute introductory climate training course (e.g., Climate 101).**	63% of all employees who joined since 2018 have taken "Climate Adaptation Introductory Training."
	Percent of EPA senior leadership (e.g., Sec, Dep Sec, SES, Directors, Branch Chiefs, etc.) that have completed climate adaptation training.	37% of senior leadership (Senior Executive Service, Supervisors, and Management Officials) and 52% of (non-Senior Executive Service) team leads who joined since 2018 have taken "Climate Adaptation Introductory Training", compared to 65% of General Service employees.
	Percent of budget officials that have received climate adaptation related training.	23% have taken "Climate Adaptation Introductory Training" or similar course.
	Percent of acquisition officials that have received climate adaptation related training.	25% have taken "Climate Adaptation Introductory Training" or similar course.

	Additional efforts the Agency is taking to develop a climate informed workforce.	17 climate adaptation trainings have been facilitated across programs and regions.
Agency Capacity	**Number of full-time federal employees (FTE) across the Agency that have tasks relevant to climate adaptation in their job description.**	There are 43 positions in the Agency where the position description directly mentions climate adaptation and/or climate resilience work. They are a combination of General Schedule, Senior Executive Service, and political employees. The Agency does not have information on contractors.

3C.1 Agency-Wide Initiatives for Developing a Climate-Informed Workforce at EPA

To respond to climate change, EPA needs its personnel and partners to adopt new ways of achieving the Agency's mission. EPA is building capacity through ongoing education and training to mainstream climate adaptation into every part of the Agency. Equipped with an understanding of projected climate impacts, the vulnerability of EPA programs to these impacts, and adaptation approaches, EPA staff will be better able to incorporate climate adaptation into their programs, plans and decisions. The Agency is also supporting efforts by our stakeholders and partners to increase their climate literacy.

Goals of EPA's Climate Adaptation Training Initiatives

(1) **Increase awareness through introductory training** about the importance of climate adaptation and encourage all EPA staff and partners to consider the changing climate in their normal course of business.

(2) **Equip EPA staff with specific methods and tools for integrating climate adaptation into decision-making processes across different types of job functions**, including programmatic staff, financial assistance staff, budget staff, acquisition staff, regulatory staff, scientists and researchers, and developers of tools and technical support.

(3) **Cultivate peer learning networks within the Agency** so that staff can use avenues to share ongoing, emerging, and practice-based adaptation knowledge.

1. **Introductory Training.** As of 2018, all newly hired EPA employees are required to take an *Introduction to Climate Adaptation* training module on the Agency-wide training platform. This module equips new employees with awareness of how climate change impacts the Agency's mission areas. Additionally, since the 2021 Climate Adaptation Plan, 10 of EPA's programs and regions have developed and deployed additional program-specific Climate Adaptation trainings—28 sessions in total, 17 distinct trainings or resources, with 8 distinct training series. These trainings are tailored to specific areas of EPA's mission and/or regional

context. In addition to these more formal trainings, there are numerous smaller regional office presentations that support climate literacy.

Budget and Acquisition Staff: EPA is working to distribute climate training to staff beyond sustainability, climate, and environmental media staff to include budget and acquisition officials. To-date, 23% of budget officials and 25% of acquisition officials have taken introductory climate training. By 2027, EPA will work on expanding its reach of climate adaptation training opportunities so that more budget and acquisition staff will have taken a climate 101 training.

Reaching Senior Leadership: To-date, senior leadership and supervisory staff have taken climate or climate adaptation training at a lower rate than non-supervisory staff (37% vs. 65% GS employees who joined Agency after 2018). However, there is progress since 2018: 37% of senior leadership (SES and above) and 52% of non-SES team leads who joined the Agency after 2018 have completed introductory climate adaptation training. In the future, EPA will continue to engage senior leadership with opportunities for targeted training.

2. Equipping Staff to Integrate Climate Adaptation Across EPA Mission Areas.

Financial Assistance Staff: With the implementation of the Inflation Reduction Act and Bipartisan Infrastructure Law, EPA is taking steps to modernize its financial assistance mechanisms so that these investments are resilient to future climate risk. (See Section 3D, "Climate-Informed Funding to External Parties"). As part of the efforts of the Resilient Infrastructure Subgroup on Climate (RISC), EPA is enhancing the capacity of its financial assistance staff to take climate change considerations into account when developing and implementing financial assistance agreements.

Regulatory Staff: EPA is educating regulatory staff about the implications of a changing climate on the Agency's mission to protect human health and the environment. For example, EPA held a training event that informed Agency rule writer participants about options for considering changing weather and climate risk during rule development. The webinar was produced in 2022 and delivered to EPA's rule writing community in 2023.

Examples Across EPA Mission Areas: Programs are developing mission area-specific training and capacity building resources. For example, the Office of Air and Radiation (OAR) developed a three-part training series that provides a brief overview of climate change basics and adaptation before focusing on how OAR is considering climate adaptation in its work. The Office of Land and Emergency Management (OLEM) developed a four-part training series for OLEM staff and management about integrating climate adaptation, mitigation, and science into its core actions. In a separate training, OLEM also trained its staff on how to conduct climate vulnerability assessments. The Office of Enforcement and Compliance Assurance (OECA) developed a training to introduce and highlight compliance and enforcement efforts to address climate change consistent with administration priorities. The Office of Research and Development (ORD) delivered multiple webinars to EPA staff related to adaptation-relevant climate impacts research or the usage of climate data and information in decision-making.

EPA's Climate Change Adaptation Resource Center (ARC-X) is an interactive resource designed to support local-level adaptation and help local government officials effectively deliver services to their communities even as the climate change. Users are given an opportunity to first self-identify by indicating the region of the country in which they live and the specific issues of concern to them (*e.g.,* air quality, water management, environmental justice, contaminated site management, ecosystem protection). The system then provides them with an integrated package of information tailored specifically to their needs, based on where they live and the specific issues of concern to them. This information includes: (1) the risks posed by climate change to the issues they care about; (2) adaptation strategies they might consider implementing; (3) case studies illustrating how other communities have successfully adapted to those risks; and (4) tools to replicate the successes of the other communities. EPA will continue to improve the ARC-X system by adding new content (*e.g.,* environmental and climate justice resources) and enhancing the user experience by making it easier to access the adaptation information they need to plan for and implement adaptation strategies in their community.

3. **Cultivating Peer Learning Around Climate Adaptation:** In addition to formal training and learning opportunities, building peer learning networks is key to maintaining a climate-informed and adaptive staff, given the evolving nature of climate adaptation. As one example of an EPA-wide peer learning network, the Integrated Climate Sciences Division in ORD and the Office of Policy have partnered to co-host an internal *Climate Conversations Seminar Series* to coordinate staff peer learning and knowledge sharing activities. Launched in fall 2023, this series provides a forum in which EPA employees can exchange knowledge and experiences on climate and apply it to their work. An average of 315 employees from across the Agency attends the sessions. The series (1) informs EPA staff about emerging climate science research relevant to the work of EPA's programs and regions, (2) highlights best practices in applying climate data and information to EPA policies and practice, (3) demonstrates applicable tools and resources to support regional climate resilience, (4) facilitates interactive peer-learning activities related to certain climate topics, and (5) fosters a sense of community and collaboration among staff on EPA climate adaptation issues. Other peer learning networks and communities of practice are being cultivated across the Agency, including Regional-specific speaker series.

3C.2 Agency Climate Adaptation Capacity

Climate adaptation work takes place in every national program office and region in the Agency, and only a portion of staff who work on climate adaptation have "adaptation" or "resilience" directly mentioned in their position description. Agency climate adaptation staff capacity includes staff who have their full time dedicated to climate adaptation and those whose time is split between climate adaptation and other job functions. There are currently 43 positions in the Agency where the position description directly mentions climate adaptation and/or climate resilience work. They are a combination of GS and SES career staff, and political appointees. Many other staff in the program offices and regions who do not identify as "climate adaptation" personnel are already integrating climate adaptation into the work they are doing. Examples include staff in the RCRA program and the Superfund program.

The Cross-EPA Workgroup on Climate Change Adaptation has historically consisted of staff who lead the coordination of climate adaptation in their program or region. In the past decade, the Workgroup membership has grown to over 350 staff, reflecting the extent to which climate adaptation is being mainstreamed across the Agency beyond staff who have adaptation directly mentioned in their position description.

There are also FTEs dedicated to climate issues in general, including adaptation. One example of such staff is the new Integrated Climate Sciences Division, launched in 2023 in the Office of Research and Development. ICSD scientists deliver regionally relevant assessments, technical assistance, and capacity building to support adaptation, in addition to their work that advances climate mitigation.

3D. Summary of Major Milestones

Subsection of Section 3 in the Implementation Plan	Description of Major Milestone for Implementation	Climate Risk Addressed (sea level rise, extreme heat, extreme precipitation, or wildfire risk)	Indicators for success
3A.1 Addressing Climate Hazard Impacts on and Exposures to Federal Buildings	FY2024-2026: EPA will have completed a resiliency assessment report for all 18 owned laboratory facilities.	Increased heat and precipitation, sea level rise, flooding, and wildfire.	Number of completed reports each fiscal year.
3A.2 Addressing Climate Hazard Impacts on and Exposures to Federal Employees	FY 2024-2026: EPA will conduct Occupational Safety and Health Agency Heat Illness Safety and Integrated Vegetation Management trainings as part of the Agency's environmental management systems program.	Extreme Heat safety and Illness	Number of EMS coordinators trained each fiscal year.
3B.3. Incorporating Climate Risk into Policies and Programs	By September 30, 2026, implement all priority actions in EPA's Climate Adaptation Action Plan and the 20 national program and regional Climate Adaptation Implementation Plans.	All of the above.	Total number of actions implemented.

3B.3. Incorporating Climate Risk into Policies and Programs	By September 30, 2026, assist at least 400 federally recognized Tribes to take action to anticipate, prepare for, adapt to, or recover from the impacts of climate change.	All of the above.	Total number of tribes assisted.
3B.3. Incorporating Climate Risk into Policies and Programs	By September 30, 2026, assist at least 450 states, territories, local governments, and disadvantaged communities at risk from climate change, to take action to anticipate, prepare for, adapt to, or recover from the impacts of climate change.	All of the above.	Total number of states, territories, local governments, and communities assisted.

Section 4: Demonstrating Progress

4A. Measuring progress

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3A – Addressing Climate Hazard Impacts and Exposure	Step 1: Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. (Y/N/Partially) Step 2: Agency has a list of discrete actions that will be taken through 2027 as part of their implementation plan. (Y/N/Partially)	**Yes.** The resulting project recommendations from EPA's owned laboratory facility climate resiliency assessments align with existing documents such as the facility master plans to inform future operation and maintenance contracts and capital improvement plans. EPA has also committed to initiate projects ranked as a "very-high" priority by the Office of Mission Support Resilience Working Group and will work with the to identify funding opportunities for these recommendations. **Yes**. EPA integrates the "very-high" priority project recommendations from the climate resiliency assessments of its owned laboratory facilities into the Agency's five-year Buildings and Facilities plan once a funding source has been identified. OMS also maintains a repository of additional project recommendations and works with facilities to identify funding pathways to implement projects that did not meet the "very-high" priority designation during the project recommendation voting process.
3B.1 – Accounting for Climate Risk in Decision-making	Agency has an established method of including results of climate hazard risk exposure assessments into planning and decision-making processes. (Y/N/Partially)	**Yes.** As much as possible and consistent with its authorities and available resources, EPA is accounting for the risks posed by climate change and related environmental justice concerns as it designs, implements, and assesses its programs, policies, rules, enforcement and compliance assurance activities, and operations (i.e., facility

		operations, workforce protection, managing and protecting supply chains) to help ensure they are effective and resilient to climate change.
3B.2 – Incorporating Climate Risk Assessment into Budget Planning	Agency has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions. (Y/N/Partially)	**Yes.** The work EPA does to incorporate climate risk into planning and budget decisions is driven by EPA's FY 2022-2026 Strategic Plan. See 3B.2 for additional details.
3B.5 – Climate Informed Funding to External Parties	Step 1: By July 2025, agency will identify grants that can include consideration and/or evaluation of climate risk. Step 2: Agency modernizes all applicable funding announcements/grants to include a requirement for the grantee to consider climate hazard exposures. (Y/N/Partially)	**Partially**. While EPA is committed to modernizing all its financial assistance programs to encourage climate-resilient investments, EPA's Resilient Infrastructure Subgroup on Climate initial focus is to support the BIL and IRA-funding programs that are distributing an unprecedented amount of federal funding. EPA is also mindful that some grant programs must comply with specific or unique statutory obligations that may prevent them from fully 'embracing' certain elements of adaptation and/or resilience (including requirements for evaluating climate risk) as part of their implementation. EPA's Resilient Infrastructure Subgroup on Climate has performed a cursory accounting of the BIL and IRA-funded grant programs that have incorporated language related to climate change as of November 2023. EPA's Resilient Infrastructure Subgroup on Climate will continue to support all financial assistance programs in considering climate risks as part of their investment decisions and recipient reporting requirements, where and when appropriate. EPA's Resilient Infrastructure Subgroup on Climate, the Office of Mission Support, and the Office of the Chief Financial Officer are working together to help financial assistance programs consistently identify climate adaptation/ resilience projects funded by EPA, which may include climate risk

		analyses. See Section 3D for more information. **Partially –** While EPA is committed to encouraging climate-resilient investments and is developing guidance for programs to support climate-resilient investments through both competitive and noncompetitive grant programs, EPA currently does not require funding announcements/grants to include a criterion that applicants/grantees must consider climate hazard exposures. However, the Office of the Chief Financial Officer and the Office of Congressional and Intergovernmental Relations are currently working with EPA's national program and regional offices to identify and consistently define universal output and outcome metrics for recipient reporting purposes. The metrics that pertain to adaptation and resilience specifically (including any consideration or evaluation of related climate risk or exposures) may help to streamline the reporting requirements for grantees expressed as part of all applicable funding announcements (and their terms and conditions for funding). Those metrics are currently under Agency deliberation.
Key Performance Indicator: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3A – Addressing Climate Hazard Impacts and Exposure	Agency has identified the information systems that need to incorporate climate change data and information and will incorporate climate change information into those systems by 2027. (Y/N/Partially)	**Partially.** EPA is incorporating information on the impacts of and responses to climate change is effectively into the diverse systems and processes that support and track EPA's financial and regulatory actions. This requires: (1) identification of those systems and processes and development of consistent and guided approaches to incorporating relevant

		climate change information and data; (2) educating appropriate staff on the relevant resources and approaches for incorporating climate change information; and (3) updating, maintaining, and enhancing the tools, guidance, and systems to offer the best available information and data in readily accessible and usable format(s). EPA has identified three categories of processes that require consideration of climate change data and information: (1) funding mechanisms, including grants to states, territories, tribes, and localities; (2) rulemaking and enforcement actions; and (3) internal operations, including facility management and personnel health and safety. EPA is engaging across the Agency to develop and implement robust mechanisms to facilitate incorporation of relevant climate change information and data into these processes. The Resilient Infrastructure for Climate Subgroup, part of the Cross-EPA Work Group on Climate Adaptation, has developed multiple resources for incorporating climate information and data into Agency processes. For more on how the Resilient Infrastructure Subgroup on Climate is incorporating climate data into Agency processes, see Section 3D. Climate Informed Funding to External Parties. See Section 3A.4--Accounting for Climate Risk in Planning and Decision Making for more information on how EPA is integrating climate adaptation into rulemaking processes. One resource designed to provide on-going science support for these efforts is the establishment of the Integrated Climate Sciences Division in EPA's Office of Research and Development. One of the goals of the new

		Division is to develop and deliver scientific information and data on climate change and climate change adaptation to EPA and EPA partner users, focusing on close engagement and interaction with the users of that information and data.
Key Performance Indicator: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate nature-based solutions, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.3 – Incorporating Climate Risk into Policy and Programs	By July 2025, 100% of climate adaptation and resilience policies have been reviewed and revised to (as relevant) incorporate nature-based solutions, mitigation co-benefits, and equity principles. (Y/N/Partially)	**Partially.** Goal 1 (Tackling the Climate Crisis) of EPA's FY 2022-2026 Strategic Plan contains an Objective (Objective 1.2) to Accelerate Resilience and Adaptation to Climate Change Impacts. The Strategic Plan commits EPA to taking necessary actions to anticipate, prepare for, adapt to, and recover from the impacts of climate change while advancing the climate resilience of Tribes and indigenous peoples, states, territories, and communities across the nation. It commits EPA to ensuring its programs, policies, rulemaking processes, enforcement and compliance assurance activities, and operations consider the current and future impacts of climate change and how those impacts will disproportionately affect communities with environmental justice concerns. The 20 Climate Adaptation Implementation Plans developed by the program and regional offices contain priority actions they will take in each fiscal year to meet this commitment. The Strategic Plan has a Long-Term Performance Goal that states: "By September 30, 2026, implement all priority actions in EPA's Climate Adaptation Action Plan and the 20 national program and regional Climate Adaptation Implementation Plans to account for the

		impacts of the changing climate on human health and the environment.”
Key Performance Indicator: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.4 – Climate-Smart Supply Chains and Procurement	Step 1: Agency has assessed climate exposure to its top 5 most mission-critical supply chains. (Y/N/Partially) Step 2: By July 2026, agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards. (Y/N/Partially)	Step 1: **Partially**, the Agency is in the process of conducting a tiered Supply Chain Risk Assessment of its critical components, supplies and services to fully understand the scope of supply chain risks. Step 2: **Partially**, EPA’s Supply Chain Risk Management plan is set to complete its tiered Supply Chain Risk Assessment in FY 2026, and upon completion the Agency will begin to address the hazards identified.
	Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services. (Y/N/Partially)	**Partially.** EPA is in the process of identifying, differentiating, and defining the mission-essential contracts for services and goods that are vital to the Agency. In 2023, EPA’s Acquisition Management Council approved definitions for Excepted, Program Management Improvement Accountability Act, and Federal Information Technology Acquisition Reform Act contracts, allowing EPA to use a tiered approach to prioritize the Agency’s contracts. Now that the contract definitions have been established, as a next step the Agency’s Office of Acquisition Solutions will work with EPA’s program offices to identify these contracts, which can impact the continuity of the Agency’s mission both remotely and onsite.

Key Performance Indicator: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures.		
Section of the CAP	**Process Metric**	**Agency Response**
3C – Climate Training and Capacity Building for a Climate Informed Workforce	Step 1: By December 2024 100% of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. (Y/N/Partially) Step 2: Does the agency have a Climate 101 training for your workforce? (Y/N/Partially) If yes, what percent of staff have completed the training? Step 3: By July 2025, 100 % employees have completed climate 101 trainings. (Y/N/Partially)	**Yes.** Each year, EPA prepares an end-of-year report on climate adaptation actions and achievements that is shared widely with Agency leadership. **Yes.** The Agency has had a Climate 101 training in place since 2018. Approximately 20% of Agency employees have taken this training. **Partially.** EPA is developing an updated version of the Climate 101 training Different parts of the training will be tailored to staff working in different programs. The Agency is assessing whether the training is warranted for all EPA staff given their responsibilities.

4B. Adaptation in Action

Following publication of the 2021 Climate Adaptation Plan, every EPA program and regional office developed a Climate Adaptation Implementation Plan that contains annual priority actions that address the five Agency-wide climate adaptation priorities (see sidebar). Taken together, the programs and regions have made significant progress integrating climate adaptation into internal programs, policies, rulemaking processes, enforcement activities, and operations, and delivering external assistance to state and local governments, tribes, and territories. As of the end of FY23, the program and regional offices had taken

Through this 2024 – 2027 Climate Adaptation Plan, EPA will continue to implement its five Agencywide priorities for climate adaptation.

1. Integrate climate adaptation into EPA programs, policies, rulemaking, and enforcement.
2. Consult and partner with wide array of stakeholders to strengthen adaptive capacity and increase resilience.
3. Implement measures to protect Agency workforce, facilities, critical infrastructure, supply chains, and procurement processes from risks posed by climate change.
4. Measure and evaluate performance.
5. Identify and address climate adaptation science needs.

over 350 priority actions to integrate climate adaptation into the work that they do. All of these actions are focused on attaining the three long-term performance goals on climate resilience and adaptation in the Agency's FY 2022-2026 Strategic Plan.

Provided below are examples of actions taken by the Agency's national program offices in partnership with the regional offices and other government entities:

- EPA is equipping communities with information and resources needed to assess their climate risks and develop the climate resilience solutions most appropriate for them, with a particular focus on advancing environmental justice.
    - ✓ Thanks to IRA funding for the new Climate Pollution Reduction Grants (CPRG) program and the Environmental and Climate Justice Community Change Grant Program ($5 billion and $2 billion respectively), EPA is providing even more support for communities adapting to climate change.
    - ✓ As part of the Community Change Grant program, Office of Water's Creating Resilient Water Utilities Initiative provides water sector utilities with the practical tools, training, and technical assistance needed to increase resilience to extreme weather events.
    - ✓ With over $50 billion from Bipartisan Infrastructure Law (BIL), EPA's Clean Water and Drinking Water State Revolving Fund Programs are providing low-cost financing for water quality and infrastructure projects, including those that help address drought, wildfire, water conservation, energy efficiency, and more.
    - ✓ With almost $2 billion in BIL funding, EPA's National Estuary Program and Geographic Program grants is supporting green infrastructure projects that help address extreme heat.
    - ✓ The Office of Environmental Justice and External Civil Rights established 16 Environmental Justice Thriving Communities Technical Assistance Centers (TCTACs), in partnership with the Department of Energy, to help disadvantaged communities across the country. The TCTACs provide training and other assistance to build capacity for navigating federal grant application systems, developing strong grant proposals, and effectively managing grant funding. In addition, these centers provide guidance on community engagement, meeting facilitation, and translation and interpretation services for limited English-speaking participants.
- The Office of Research and Development established an Integrated Climate Sciences Division to (1) support the implementation of the 20 EPA program and regional office Climate Adaptation Implementation Plans, and (2) provide place-based technical support to all 10 regional offices and the communities they serve.
- EPA's American Indian Environmental Office is leading the Agency's efforts to develop approaches for integrating Indigenous Knowledge (IK) into decisions and actions taken by EPA and its partners across the nation. OITA is training EPA in the program and regional offices and building a community of practice focused on advancing the use of IK by EPA and its partners across the nation.
- EPA's Office of International Affairs is working in support of a MOU signed in March 2024 by EPA Administrator Regan and U.S. AID Administrator Samantha Power, formalizing the leaders' joint commitment to cooperate in tackling the challenges of climate change, air and water

pollution, lead poisoning, and recycling of materials from plastics and electronic waste. One area of focus will be on the impacts of climate change on the Pacific Islands.

- Administrator Regan recently conducted a Mission to Africa where he reinforced EPA's commitment to partner with leaders, young people, and advocates to address many of these same challenges.
- The Office of Land and Emergency Management's (OLEM's) RCRA program, in partnership with the regional offices, is ensuring PCB clean-up processes, RCRA permitting, and RCRA corrective action are resilient to climate change.
- OLEM's Superfund program developed an approach that raises awareness of the vulnerability of contaminated sites to the impacts of climate change and extreme weather events and integrates climate adaptation into cleanup projects. The approach involves periodic screening of Superfund remedy vulnerabilities, prioritizing the Superfund program's steps to adapt to a changing climate, and identifying measures to assure climate resilience of Superfund sites.
- EPA is advancing implementation of nature-based solutions with other federal agencies through the Green Infrastructure Federal Collaborative to promote the implementation of green infrastructure. The collaborative is supporting strategies that foster climate resilience and encourage the equitable implementation of green infrastructure in communities across the nation.
- The Office of Enforcement and Compliance Assurance is implementing its Agency-wide guidance for incorporating (where appropriate) climate change into cleanup enforcement cases.
- The Office of Acquisition Solutions within the Office of Mission Support is continuing to implement its Supply Chain Risk Management Plan "Implementation Plan" which includes actions to protect against the risks posed by climate change.
- EPA is measuring and evaluating progress. The Agency has specific metrics to track progress meeting the Long-Term Performance Goals related to climate adaptation in the EPA FY22-FY26 Strategic Plan. The Office of Policy has also developed a Climate Adaptation Measures Program database for collecting performance data from across the entire Agency.

The Agency's climate adaptation activities described in this Plan—from helping communities build climate resilience through technical assistance to integrating climate resilience considerations in EPA's financial investments-- will carry through in the 2024-2027 CAP. EPA intends to continue being a leader in building resilience and helping communities prepare for and adapt to the impacts of climate change. EPA's newly launched Office of Climate Adaptation and Sustainability, located in the Office of the Administrator's Office of Policy, will support climate adaptation and resilience capacity building across the Agency, with an emphasis on serving communities and connecting them with EPA expertise and technical assistance. The new office will also lead and manage work on emerging, cross-cutting issues of significance to the Agency, particularly those relating to development and implementation of climate policies that support progress toward a more equitable, resilient, and sustainable economy. This includes:

- Supporting climate change adaptation and resilience capacity building across the Agency,
- Facilitating development of cross-cutting climate change mitigation strategies,

- Focusing attention on climate-related impacts on vulnerable communities,
- Assuring sustainable materials management,
- Working with industrial sectors on climate-related impacts by and on the sectors,
- Advising on voluntary consensus standards related to climate and sustainability,
- Supporting financial disclosure of climate-related risks, and
- Addressing other climate change mitigation challenges and environmental issues requiring interdisciplinary expertise and cross-sector, cross-media, cross-agency, and whole of government approaches.

Conclusion

EPA remains strongly committed to taking necessary actions to anticipate, prepare for, adapt to, and recover from the impacts of climate change while advancing the climate resilience of Tribes and indigenous peoples, states, territories, and communities across the nation.

EPA program and regional offices will continue to update policies, rulemaking processes, enforcement and compliance assurance activities, and operations to consider the current and future impacts of climate change and how those impacts will disproportionately affect overburdened and underserved communities.

EPA will continue to provide targeted assistance to Tribes and indigenous peoples, states, territories, local governments, communities, and businesses to transform their environmental programs, strengthen their adaptive capacity, and increase the resilience of the nation, with a particular focus on advancing environmental justice. This includes preparing for and responding to climate-related impacts and disasters (e.g., wildfires, extreme heat, droughts, floods, sea level rise, damage to estuaries and ecosystems, health impacts, storm surge, and melting permafrost) and ensuring that infrastructure investments increase resilience to climate change.

This Climate Adaptation Plan captures the many innovative ways the Agency will continue to fulfill its mission of protecting human health and the environment even as the climate changes.

Appendix A: Risk Assessment Data

The Federal Mapping App uses the following data:

Buildings

Buildings data comes from the publicly available Federal Real Property Profile (FRPP). The General Services Administration (GSA) maintains FRPP data and federal agencies are responsible for submitting detailed asset-level data to GSA on an annual basis. Although FRPP data is limited—for example, not all agencies submit complete asset-level data to GSA, building locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures, and properties may be excluded on the basis of national security determinations— it is the best available public dataset for federal real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of federal buildings to climate hazards.

Personnel

Personnel data comes from the Office of Personnel Management's (OPM) non-public dataset of all personnel employed by the federal government that was provided in 2023. The data contains a number of adjustments, including exclusion of military or intelligence agency personnel, aggregation of personnel data to the county level, and suppression of personnel data for duty stations of less than 5 personnel. Despite these adjustments, this data is still useful for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

Climate Hazards

The climate data used in the risk assessment comes from the data in Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool. When agency climate adaptation plans were initiated in 2023, CMRA data included climate data prepared for NCA4. Additional details on this data can be found on the CMRA Assessment Tool Data Sources page. Due to limited data availability, exposure analyses using the Federal Mapping App are largely limited to the contiguous United States (CONUS). Additional information regarding Alaska, Hawaii, U.S. Territories, and marine environments has been included as available.

Consideration of Additional Hazards

In addition to these data, EPA used a mix of national and local data sets to obtain more specific historic and projected hazard information at each of the Agency's facility locations. This additional data allowed EPA to explore the vulnerability and likelihood of nine additional hazards.

Appendix B: EPA Climate Impact Map

Figure 1. Section 2D - Example EPA Facilities Hazard Vulnerability Map

U.S. DEPARTMENT OF AGRICULTURE

CLIMATE ADAPTATION PLAN

2024-2027

May 2024

CONTENTS

A MESSAGE FROM USDA SECRETARY TOM VILSACK

Dear Reader,

Since the release of USDA's Action Plan for Climate Adaptation and Resilience in 2021, the risks posed by climate change, and its impacts to USDA's mission and those we serve, have only grown. This new USDA Climate Adaptation Plan reflects the progress we have made as a Department to address these risks and identifies areas where we can strengthen the integration of climate change information into our decision-making, operations, policies, and program delivery.

In August 2023, Hurricane Idalia cut across the southeastern United States, damaging croplands and orchards and destroying equipment and facilities in Florida, Georgia, South Carolina, and North Carolina. Earlier in 2023, after working directly with farmers to improve crop insurance coverage options, USDA's Risk Management Agency released a new Tropical Storm Option for its Hurricane Insurance Protection-Wind Index. With 60 percent of policies electing for this additional coverage, producers affected by Hurricane Idalia received $71 million in tropical storm indemnities and $85 million in hurricane indemnities, in addition to individual losses paid by multi-peril policies. This is but one example of how USDA is adapting its policies and programs to help our customers face a changing climate.

Of course, the scope of USDA's mission extends beyond agricultural production to also include natural resource and land management, rural development, food security and safety, and science and innovation. This broad mission increases our exposure to a range of climate change risks but also means we have great opportunities to build more resilient food systems and communities across the country. USDA's Rural Development agencies are helping communities build more resilient housing, energy infrastructure, and water utilities which will help them manage and recover from future extreme weather events. USDA's Research, Education, and Economics agencies are growing our understanding of climate change impacts on food systems and developing response options to both the acute shocks and long-term changes we anticipate.

Climate adaptation is one element of USDA's climate-smart approach and must be balanced with efforts to sustainably increase agricultural productivity and address climate mitigation goals through the agriculture and forestry sectors. At the same time, climate change poses a risk to these efforts, requiring a holistic approach that includes climate risk management. This new Climate Adaptation Plan brings together all eight USDA Mission Areas and truly reflects our whole-of-Department approach to helping communities across the country adapt and thrive in a changing climate.

Sincerely,

Thomas J. Vilsack

Secretary

INTRODUCTION

The U.S. Department of Agriculture (USDA), with its broad mission and diverse programs and operations, is vulnerable to the current and future effects of climate change. USDA has a stewardship responsibility for federally managed forests and grasslands, which provide a variety of critical ecosystem services. The Department also supports farmers, ranchers, and other land managers in the stewardship of their own lands and operations by promoting voluntary conservation programs and stewarding the expanding portfolio of conservation easements. These natural resources are vulnerable to a range of climate change impacts which will make them harder to manage and sustain for future generations. At the same time, the people and communities we serve across the country are exposed to the effects of extreme heat and increasingly severe storms, flooding, wildfire, and drought, many of which are intensified by climate change. This Climate Adaptation Plan describes the intentional steps that USDA is taking to adapt and build resilience Department-wide so that we are poised to serve and support our stakeholders in a changing climate.

The 2024-2027 USDA Climate Adaptation Plan builds on USDA's 2021 Action Plan for Climate Adaptation and Resilience and reflects how USDA agencies and offices have matured and advanced in their consideration of climate change in their programs, policies, and operations. The 2021 Plan identified the following priority actions:

1. Build resilience across landscapes with investments in soil and forest health.
2. Increase outreach and education to promote adoption of climate-smart adaptation strategies.
3. Broaden access to and availability of climate data at regional and local scales for USDA Mission Areas, producers, land managers, and other stakeholders.
4. Increase support for research and development of climate-smart practices and technologies to inform USDA and help producers and land managers adapt to a changing climate.
5. Leverage the USDA Climate Hubs to support USDA Mission Areas in delivering adaptation science, technology, and tools.

This new Plan does not supersede the vulnerabilities and cross-cutting action areas identified in the 2021 Plan but delves deeper into how USDA is assessing climate risks and integrating

climate adaptation into its mission delivery via policies, programs, funding, facilities management, and procurement.

This Plan was prepared in accordance with guidance for Federal climate adaptation planning from the White House Council on Environmental Quality (CEQ). The information presented here aligns with adaptation and resilience requirements in section 211 of Executive Order (E.O.) 14008 *Tackling the Climate Crisis at Home and Abroad,* section 5(d) of E.O. 14030 *Climate-Related Financial Risk*, and section 503 of E.O. 14057 *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability.* This work also describes how USDA is contributing to the objectives and opportunities for action identified in the Biden-Harris Administration's National Climate Resilience Framework.

Section 1 of this Plan provides an overview of USDA's approach to climate adaptation and resilience. Section 2 describes the risk climate change poses to USDA's mission, operations, services, and lands, and for the first time begins to leverage available data to assess climate risks to USDA's facilities and employees. Section 3 lays out USDA actions to address climate risks to the delivery of our mission and to our partners and stakeholders nationwide. Section 4 responds to governmentwide climate adaptation and resilience targets established by CEQ and highlights progress towards the cross-cutting action areas from the 2021 Adaptation Plan. Appendix 1 provides information on the climate data used in the Section 2 risk assessment. Appendix 2 summarizes the adaptation actions described throughout Section 3. Finally, Appendix 3 assesses options put forth by the U.S. Government Accountability Office (GAO) on how USDA can further enhance the climate resilience of agricultural producers through our work.

SECTION 1: AGENCY PROFILE

With this 2024-2027 Climate Adaptation Plan, USDA has broadened its work on adaptation and resilience to include 17 Agencies from all 8 Mission Areas and 6 Departmental or Staff Offices (Table 1). Climate adaptation is included in USDA's Strategic Plan for Fiscal Years 2022-2026 as Objective 1.2 "Lead Efforts to Adapt to the Consequences of Climate Change in Agriculture and Forestry," and is connected to other elements of the Strategic Plan related to natural resource management, economic resilience, science and innovation, and rural development. USDA Departmental Regulation 1070-001 Policy Statement on Climate Change Adaptation lays out the mission-wide approach to adaptation and describes how USDA will "develop, prioritize, implement, and evaluate actions to minimize climate risks, and exploit new opportunities climate change may bring" via adaptation planning. DR 1070-001 recognizes how climate adaptation complements USDA's climate mitigation efforts and must align with USDA's equity and environmental justice goals.

USDA's Office of Energy and Environmental Policy (OEEP), located within the Office of the Chief Economist (OCE), carries out duties identified in the Global Change Prevention Act of 1990, which include to "coordinate policy analysis, long range planning, research, and response strategies relating to climate change issues," and to "ensure that recognition of the potential for climate change is fully integrated into the research, planning, and decision-making processes of the Department." DR 1070-001 reinforces some of these responsibilities and directs OEEP to prepare a department-level Climate Adaptation Plan and coordinate agency-level adaptation planning efforts. The work of OEEP to coordinate and advance climate adaptation across Mission Areas, Agencies, and Offices is described further in Sections 3B(1) and 3C.

As detailed in Section 2A, the effects of climate change on USDA agencies and offices are uneven; agencies like USDA's Forest Service (USFS) are uniquely exposed to climate change impacts whereas agencies like the Agricultural Marketing Service (AMS) or the Food and Nutrition Service (FNS) have opportunities through their work to address climate risks to USDA's partners and stakeholders. USDA's Research, Education, and Economics agencies, USFS Research and Development, and USDA's Climate Hubs play a critical role in advancing science and delivering information via outreach, extension, and engagement to facilitate adoption of climate-smart practices and innovation. These research and science translation enterprises also support USDA internally to ensure use of the best-available science and to build the climate literacy and capacity of USDA personnel.

Agency-level adaptation planning is a critical step down from Departmental efforts, enabling agencies to develop adaptation actions within the scope of their mission and authorities and address their unique climate risks and opportunities. Through these planning efforts, agencies are best equipped to map out from headquarters to field offices how adaptation and resilience can be integrated into their work. This internal climate adaptation planning network provided the foundation for the development of this new 2024-2027 USDA Climate Adaptation Plan.

Table 1: USDA and Climate Adaptation at a Glance

Mission	To serve all Americans by providing effective, innovative, science-based public policy leadership in agriculture, food and nutrition, natural resource protection and management, rural development, and related issues with a commitment to deliverable, equitable, and climate-smart opportunities that inspire and help America thrive.
Adaptation Plan Scope	USDA's Climate Adaptation Plan is developed in collaboration with all 8 of USDA's mission areas, including 17 agencies and 6 Departmental and Staff Offices to reflect USDA's mission-wide approach to climate adaptation.
Agency Climate Adaptation Official	William Hohenstein, Director, Office of Energy and Environmental Policy, Office of the Chief Economist
Agency Risk Officer	John Rapp, Director of the Office of Budget and Program Analysis
Points of Public Contact for Environmental Justice	Dr. Dewayne Goldmon, Senior Advisor for Racial Equity to the Secretary Sean Babington, Senior Advisor for Climate, Office of the Secretary Justice40_USDA@usda.gov
Owned Facilities	40,298 facilities of 45,342,816 square feet (Corporate Property Automated Information System (CPAIS), 2023)
Leased Facilities	3,006 leases of 14,484,893 square feet (CPAIS, 2023)
Employees	93,974 USDA Federal (December 2023) 7,709 USDA Farm Service Agency Non-Federal (December 2023)
Federal Lands	193 million acres managed by USDA's Forest Service 405,783 acres managed by USDA's Agricultural Research Service
Budget	$221.2 billion FY22 Enacted, Public Law 117–103 $240.4 billion FY23 Enacted, Public Law 117–180 $215.1 billion FY24 Enacted, Public Law 118–42 $212.7 billion FY25 President's Budget
Key Areas of Climate Adaptation Effort	Key lines of climate adaptation effort center around the challenges that climate change poses to USDA and its stakeholders, including the risks to: 1. Agricultural productivity, 2. Water quantity and quality, 3. Rural communities and others disproportionately vulnerable to the impacts of climate change, 4. Resilience to extreme weather events, and 5. Federal lands and infrastructure.

SECTION 2: CLIMATE RISK ASSESSMENT

A. Climate Hazard Impacts on and Exposure to Mission, Operations, and Services

The current and anticipated impacts of climate change challenge USDA's ability to carry out its mission. Furthermore, climate change is threatening the lives and livelihoods of those we serve in the agriculture and forestry sectors and across rural America. These risks include the threat posed by extreme heat and precipitation, sea level rise, wildfire, and flooding and are imbedded in the climate vulnerabilities identified in USDA's 2021 Action Plan for Climate Adaptation and Resilience:

Decreased agricultural productivity

Threat to water quantity and quality

Disproportionate impacts on vulnerable communities

Shocks due to extreme climate events

Stress on infrastructure and public lands

USDA's mission is:

> "To serve all Americans by providing effective, innovative, science-based public policy leadership in agriculture, food and nutrition, natural resource protection and management, rural development, and related issues with a commitment to deliverable equitable and climate-smart opportunities that inspire and help America thrive."

Climate change has the potential to threaten USDA's leadership on the issues identified in its mission statement in diverse ways (Table 2):

- **Agriculture.** Climate change will challenge USDA's Farm Production and Conservation agencies by exacerbating demand for conservation technical and financial assistance, disaster assistance programs, risk management products, and other services. The Marketing and Regulatory Program agencies will be challenged to keep apace of climate-driven changes to pests and pathogens that pose a threat to agriculture and to maintain continuity of critical grading and inspection services.
- **Food and Nutrition.** Many of the communities that depend on programs administered by the Food and Nutrition Service (FNS) are disproportionately vulnerable to the impacts of climate change. The relative importance of FNS programs that are deployed in response to disasters or that target vulnerable populations, like children, will become increasingly important in a changing climate. Climate change poses a threat to livestock and poultry production and may alter the prevalence of foodborne illnesses, which may require the Food Safety and Inspection Service to adapt its policies and operations.
- **Natural Resources Protection and Management.** Climate change is challenging the Forest Service's (USFS) ability to maintain the health, diversity, and productivity of the Nation's forests and grasslands. Acute and chronic stressors are impacting the diverse services these ecosystems provide, including carbon uptake and storage, while posing a risk to the USDA employees who work on these lands. Increasingly frequent and severe wildfires, exacerbated by climate change, also pose a significant threat to communities across the United States, including those with environmental justice concerns.
- **Rural Development.** Ongoing climate change is testing the resilience of local governments and rural communities, making Rural Development's mission more difficult and threatening its investments in infrastructure, housing, and utilities. Disadvantaged communities will be the hardest hit. The work of RD and its partners can enhance the resilience of these communities, so they can recover more quickly when the next crisis occurs.
- **Science and Innovation.** The ability of the agriculture and forestry sectors to adapt in the long term depends on investment in and prioritization of science and innovation today. Scientific questions on the effects of and response to climate change are creating new demands on USDA's research and statistical agencies. At the same time, the effects of climate change will hinder USDA's ability to fund and conduct research and gather critical survey data in a timely manner, hampering progress and discovery.
- **Equity and Environmental Justice.** Considerations of equity and environmental justice are woven throughout USDA's climate adaptation efforts to ensure that the benefits of our actions reach those who are most vulnerable to the impacts of climate change, such as communities with environmental justice concerns. Maladaptation, when actions taken inadvertently increase climate vulnerability, must be considered during decision-making and other processes so that the actions USDA takes do not increase the exposure of communities with environmental justice concerns to further climate-related risks.

Table 2: Summary of climate change effects on USDA's mission, operations, and services

	Mission Impacts	Operational Impacts
DEPARTMENTAL ADMINISTRATION (DA)		
Office of Property & Environmental Management (OPEM), Office of Homeland Security (OHS), etc.	Impacts to continuity of operations planning, policy development, and emergency response and recovery.	Increased interagency coordination and workload of 24/7/365 OPSCENTER, demand for new staff expertise. Infrastructure and facilities damage, threat to continuity of operations
FARM PRODUCTION & CONSERVATION (FPAC, including the FPAC-Business Center)		
Natural Resources Conservation Service (NRCS)	Increased demand for technical and financial assistance from producers, increased training needs for field staff.	Impacts to local service center infrastructure and service delivery.
Farm Service Agency (FSA)	Increased demand for disaster assistance and other FSA programs.	Impacts to local service center infrastructure and service delivery.
Risk Management Agency (RMA)	Increased demand for risk management products.	
FOOD, NUTRITION, & CONSUMER SERVICES (FNCS)		
Food & Nutrition Service (FNS)	Increased demand for Supplemental Nutrition Assistance Program (SNAP), Disaster SNAP, and USDA Foods, challenges administering Child Nutrition Programs.	Threats to emergency response due to infrastructure and communication impacts.
FOOD SAFETY (FS)		
Food Safety and Inspection Service (FSIS)	Threats to animal welfare. Changes in levels of foodborne pathogens may impact food safety.	Risks to FSIS employee health and safety, changing workloads due to changing conditions.
MARKETING & REGULATORY PROGRAMS (MRP)		
Agricultural Marketing Service (AMS)	Difficulty procuring and distributing food and providing developmental assistance to local and regional food markets.	Disruptions to grading and inspection services.
Animal & Plant Health Inspection Service (APHIS)	Increased demands on agency capacity to monitor for, respond to, and manage pest, pathogen, and other threats.	Increased staff workload and deployments, exposure to extreme conditions.
NATURAL RESOURCES & ENVIRONMENT (NRE)		
Forest Service (USFS)	Increasingly challenging to manage the health, diversity, and productivity of Nation's forests and grasslands.	Employee exposure to extreme heat, wildfire, and other hazards; physical and mental strain; damage to infrastructure and recreation facilities.
RURAL DEVELOPMENT (RD)		
Rural Housing Service **Rural Utilities Service** **Rural Business Cooperative Service**	Threats to development efforts; property destruction; construction delays; revenue disruption for existing loans; stress on vulnerable communities.	Increased interagency recovery coordination, demand for new staff expertise.

	Mission Impacts	Operational Impacts
RESEARCH, EDUCATION, & ECONOMICS (REE)		
Agricultural Research Service (ARS)	Shifting demands on research priorities, increased need for innovation adoption.	Threat to research facilities and animals, continuity of field studies.
National Institute of Food and Agriculture (NIFA)	Shifting demands on research priorities, increased need for innovation adoption, disproportionate impacts to disadvantaged communities.	Delays in funding delivery, disruptions to funded research.
Economic Research Service (ERS)	Increased demand for staff and resources to provide decision-relevant analyses without diminishing other critical agency functions.	Ability to deliver timely, relevant analysis and information
National Agricultural Statistics Service (NASS)	Increased demand for climate-related data and analyses.	Ability to gather survey information impeded by climate-related hazards.
TRADE AND FOREIGN AGRICULTURAL AFFAIRS (TFAA)		
Foreign Agricultural Service (FAS)	Shifting global trade patterns, stress on trade infrastructure, and diminished food security globally.	Changing demands for international data and analyses

B. Climate Hazard Exposures and Impacts Affecting USDA Facilities

USDA has a total of 42,673 facilities reported in the Federal Real Property Profile Management System on which the Federal Mapping App draws (Figure 1). This inventory encompasses buildings, structures, and the land on which facilities are located, whose mission-critical uses include laboratories and field study sites, roads, housing, recreation, and communications systems, as well as office space. The analysis presented in this section includes all USDA facilities as they are all key components of USDA operations and non-building facilities represent almost half of all assets. USDA Forest Service facilities and structures account for 82 percent of USDA's asset portfolio, with the Agricultural Research Service managing another 12 percent of the assets. Facilities in California, Oregon, Idaho, Montana, Washington, Colorado, and Arizona make up 60 percent of the portfolio.

We present here a high-level summary of the exposure of these assets to climate-change related hazards including extreme heat, extreme precipitation, sea level rise, wildfire, and flooding, based on the data available in the Federal Mapping App (Box 1). Some hazards, like drought, are not yet able to be assessed with the available data at this time but may be addressed on a site-by-site basis. Efforts to address these hazards are presented in Section 3 of this Plan.

Extreme Heat

Under mid- and high-emissions scenarios, at mid- and late-century time horizons, all USDA facilities in the continental United States will experience an increase in the annual number of hottest days relative to the average of the four hottest days per year from 1976 to 2005 (days >99th percentile, Table 3). Under RCP 4.5, by 2050, 1 percent of USDA facilities would be expected to experience 30 or more extreme heat days and by 2080, 9 percent of facilities would experience 30 or more extreme heat days, with 0.5 percent of facilities experiencing 60 or more extreme heat days. Under RCP 8.5, by 2050, 8 percent of USDA facilities would have 30 or more extreme heat days, and 0.3 percent facilities could expect 60 or more extreme heat days. Under

this same scenario, by 2080, the vast majority of the continental United States would have over 30 days of extreme heat; 96 percent of USDA facilities would have at least 30 extreme heat days, and 24 percent would experience at least 60 extreme heat days. The impacts of extreme heat would be felt first and worst at facilities in Florida, followed by facilities throughout the Southwest, West, and Midwest. With prolonged severe heat, facility heating, ventilating, and air conditioning (HVAC) systems may be strained or inadequate.

Figure 1: Exposure of USDA facilities to climate change-related hazards, clockwise from top left, geographic distribution of USDA facilities and structures (n=42,673); projected increase in exposure to extreme heat; projected inundation due to sea level rise; current exposure to flood risk; current exposure to wildfire risk; and projected increase in extreme precipitation.

Table 3: Indicators of exposure of USDA facilities to climate-related hazards

	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Heat: Percent of facilities projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually) from 1976 to 2005	100%	100%	100%	100%
Precipitation: Percent of facilities projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually) from 1976-2005	99%	100%	100%	100%
Sea Level Rise: Percent of facilities projected to be inundated by sea level rise	0.7%	0.8%	0.7%	0.8%
	High Risk	**Very High Risk**	**Extreme Risk**	
Wildfire: Percent of facilities at highest risk to wildfire	22%	9%	11%	
	100- or 500-year floodplain			
Flooding: Percent of facilities located within floodplains	6%			

Extreme Precipitation

Under mid- and high-emissions scenarios, at mid- and late-century time horizons, the majority of USDA facilities in the United States will experience an increase in the annual number of wettest days relative to 1976-2005 (days >99th percentile, Table 3). By 2050, under RCP 4.5, most facilities would see an increase of ≤ 40% in the number of individual wettest days. By 2080 however, facilities experiencing a growing number of wettest days would increase, with those in areas of New England experiencing the most significant changes. Under RCP 8.5, these increases in extreme precipitation would occur more quickly and intensely and be more widespread. By 2050, facilities in Alaska, New Hampshire, Pennsylvania, and Vermont would be most affected, and by 2080, significant impacts would be felt across 32 States in the Northwest, West, Midwest, East, and Alaska. Extreme precipitation can cause localized flooding and subsequently damage property, buildings, dams, bridges, and roads.

While these data capture changes in precipitation, expected changes in the severity of drought are not quantifiable using the Federal Mapping App at this time. However, projected changes in drought intensity, per the Fifth National Climate Assessment (2023), are anticipated to impact USDA facilities across the Southwest and Great Plains.

Sea Level Rise

Sea level rise is expected to impact 0.7 to 0.8% of USDA facilities across both climate scenarios and time horizons. The areas with the most USDA facilities likely to be impacted are Humboldt County in California, Broward and Miami-Dade Counties in Florida, Terrebonne Parish in Louisiana, and Charleston County in South Carolina. Facilities in eight additional States and the District of Columbia are also vulnerable to sea level rise. Sea level rise can cause erosion around the foundations of buildings and disrupt operations and services.

Wildfire

Wildfire risk to USDA facilities is most significant across the western United States, but some facilities in the South, East, and Midwest also face wildfire risk. Overall, 42 percent of USDA facilities are in the high to extreme risk categories. The data available for this analysis only reflects wildfire risk based on historical information. Climate change, in combination with other stressors, is expected to alter natural fire regimes, creating increasingly frequent and severe wildfires, increasing the risk to USDA facilities. Wildfires can cause extensive damage to buildings and property and potentially lead to long-term disruption of operations. Campgrounds and other recreational facilities, as well as public safety, could be impacted.

Flooding

Based on FEMA's National Flood Hazard Layer, 6 percent of USDA facilities lie within the 100- or 500-year flood plain. Facilities vulnerable to flooding span 41 States and Puerto Rico, and while many are in coastal areas, many are also inland. With climate change-induced increases in precipitation, as described above, and changes in the intensity and behavior of severe storms, flooding risk is likely to further increase in many of these areas. As with sea level rise, flooding can cause damage to structure and contents of facilities and disrupt operations and services.

Data Sources for Climate Risk Assessment of Federal Facilities and Employees*

- USDA used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App), developed for Federal agencies by CEQ and the National Oceanic and Atmospheric Administration (NOAA) to conduct a high-level screening of climate hazard exposure for Federal facilities and personnel.
- Asset data in this tool come from the Federal Real Property Profile Management System (FRPP MS), and employee data come from the Office of Personnel Management.
- Projected climate data is available for the heat, precipitation, and sea level rise indicators for two Representative Concentration Pathways (RCP), 4.5 (middle) and 8.5 (high) emissions scenarios, and for two time horizons, 2050 (mid-century) and 2080 (late-century).
- Heat and precipitation data come from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset as prepared by NOAA for the 4th National Climate Assessment.
- Sea level rise data comes from NOAA Coastal Digital Elevation Models and 2022 Interagency Sea Level Rise Technical Report Data Files.
- Wildfire and flood data are based on historical information and come from USDA Forest Service Fire Sciences Laboratory and Federal Emergency Management Agency (FEMA) data sources, respectively.
- All data sources cover the continental United States. Coverage for Alaska, Hawaii, and U.S. territories is more limited and shown when available.

**See Appendix 1 for more detail.*

C. Climate Hazard Exposures and Impacts Affecting USDA Employees

USDA has 93,974 Federal employees located in every State, some U.S. Territories, and at U.S. embassies and consulates around the world. A subset of this total, 70,537 employees, were provided by the Office of Personal Management for analysis within the Federal Mapping App, aggregated to the county-level for security and privacy reasons. Thus, the assessment below should be considered a high-level overview only and may not be representative of all climate-related risks to individual employees. Efforts to address climate-related risks to employee welfare and working environment are addressed in Section 3 of this Plan.

Figure 2: Exposure of USDA employees to climate change-related hazards, clockwise from top, geographic distribution of USDA employees (n=70,537); projected increase in extreme precipitation; projected inundation due to sea level rise; current exposure to wildfire risk; and projected increase in exposure to extreme heat.

Table 4: Indicators of exposure of USDA employees to climate-related hazards

	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005	97%	97%	97%	97%
Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005	97%	97%	97%	96%
Sea Level Rise: Percent of employees duty-stationed in counties projected to be inundated by sea level rise	11%	19%	11%	20%
	High Risk	**Very High Risk**		**Extreme Risk**
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire	22%	8%		4%

Extreme Heat

Under mid- and high-emissions scenarios, at mid- and late-century time horizons, most USDA employees will be exposed to more hot days, respective to their given location (Table 4, Figure 2). Employees in Texas and Florida will likely be impacted first, but later in the century, this increase in hottest temperatures will be felt throughout the West and Midwest. USDA employees who are required to work outside or in poorly ventilated areas will be particularly vulnerable to the effects of rising temperatures, including heat-related fatigue, heat stroke, and exhaustion.

Extreme Precipitation

Similarly, under mid- and high-emissions scenarios, at mid- and late-century time horizons, the majority of USDA employees will experience an increase in the annual number of wettest days relative to 1976-2005 (days >99th percentile). The largest changes will occur in California, the Pacific Northwest, the Southeast, and the Northeast and will become more intense later in the century and under the high-emissions scenario. Increasingly intense rain events will make the work of employees who must work outside more challenging and, in instances of flooding, potentially more dangerous.

Sea Level Rise

Approximately 10 percent of USDA employees work in counties that will experience some degree of sea level rise by 2050 for both RCP 4.5 and 8.5. By 2080, under both scenarios, 19-20 percent of employees will be working in counties experiencing sea level rise that is increasing in its extent. USDA employs approximately 550 employees at the facilities most at risk for sea level rise, described above. Total vulnerability of USDA employees to sea level rise in other locations may be an overestimate due to the aggregation of employee data at the county level. Regardless, increased sea level rise as a result of climate change could make working and getting to work more challenging for many USDA employees.

Wildfire

Over a third of USDA employees work in counties most at risk of wildfire in the United States. Wildfire particularly affects the Forest Service workforce, especially the wildland firefighters, many of whom are hired on a seasonal basis. As of late July 2023, the Forest Service had 11,187 wildland firefighters onboarded, ahead of the typical wildfire season. With climate change, the active fire season is expected to become longer and more active, increasing the demands, stresses, and health impacts to wildland firefighters and other USDA employees.

D. Climate Hazard Exposures and Impacts Affecting Federal Lands, Waters, and Cultural Resources

Climate change threatens the ability of USDA to effectively manage the Federal lands, waters, and cultural resources it stewards. With the 193-million-acre National Forest System, the Forest Service is the primary land management agency within USDA. Climate change threatens the ability of the Forest Service to fulfill its mission, by undermining the health, diversity, and productivity of the Nation's forests and grasslands (Table 5).

The USDA Forest Service Climate Adaptation Plan, released in 2022, identifies six themes that encompass the physical and ecological risks to the Nation's forests, grasslands, and waters, as well as the social, economic, and organizational implications of those threats. The key risks include:

1. **Shifting fire regimes.**

   As fire regimes shift in a warmer and potentially drier climate, USDA will face challenges in reducing risks and realizing benefits from fire. Fire season length and area burned have increased in recent decades, and these trends will continue as the climate further warms. Potential future increases in both area burned and high severity fires, from changes in fire weather conditions and fuel loads, will present challenges to ecosystems and communities. In dry forest types that historically experienced frequent fires, over a century of fire exclusion and other land management practices have contributed to increased forest stand densities and higher fuel levels, making them vulnerable to larger and uncharacteristically severe fires. While fire is an important ecological process and management tool, warmer and drier conditions may hinder the ability of USDA to manage fire for its social and ecological benefits in some areas.

2. **Extreme events and disturbances.**

   Climate change will contribute to more frequent and intense extreme events and disturbances in addition to wildfire, including floods, drought, hurricanes, insect and disease outbreaks, and the spread of invasive species. These disturbances already affect the Nation's lands and waters but will likely increase in intensity and frequency because of climate change. Flooding may increase in many of the Nation's watersheds due to changes in precipitation patterns and hydrologic processes. Increased warming may result in more intense hurricanes and other storms and increase the likelihood of extreme droughts in many parts of the United States. Climate-induced changes to insects, pathogens, invasive plants, and other species will contribute to the loss of ecological integrity through increased mortality and competition with native species. These extreme events and disturbances, including increasingly frequent and severe wildfire, can interact and be compounded by one another.

3. Chronic stressors to watersheds and ecosystems.

The Nation's lands and waters are already experiencing long-term changes in mean annual temperature and precipitation, and these changes will likely accelerate in the coming decades. Long-term shifts in seasonal precipitation, growing season length, and annual minimum and maximum temperatures are creating chronic stress on watersheds and ecosystems. Atmospheric carbon dioxide also continues to rise, affecting forest and rangeland productivity and function. Chronic stressors will likely alter the diversity, structure, function, and productivity of ecosystems and watersheds, creating new challenges for land management.

4. Disruption in the delivery of ecosystem products and services.

Climate change will affect the ability of the Nation's forests and grasslands to furnish important services to the public, including clean water and air, carbon storage and uptake, timber and nontimber forest products, productive grazing land, and recreation opportunities. These benefits may be lost or altered due to changes in wildfire regimes, extreme events, and chronic stresses on watersheds and ecosystems. These impacts of climate change will interact with changes in demands for products and services resulting from shifts in human population and economic growth.

5. Disproportionate impacts on disadvantaged communities and Tribal Nations.

The adverse impacts of climate change on forests and grasslands disproportionately affect Tribal Nations and disadvantaged communities, undermining their ability to manage risks, respond to hazards, and minimize loss from disturbances. Climate change threatens ecosystem services important to human health, infrastructure, economic prosperity, and culture. Tribal Nations and other Indigenous peoples also face disproportionate impacts on their ancestral homelands, threatening cultural survival.

6. Threats to the agency mission, infrastructure, and operations.

The impacts of climate change affect the ability of the Forest Service to fulfill its mission, sometimes generating direct threats to its workforce and operations. Climate change may create new challenges for public engagement as well as place additional stress on an understaffed workforce. Extreme events may damage or destroy critical infrastructure, disrupting operations and elevating health and safety risks to the workforce.

Table 5: Exposure to and effects of climate change on the National Forest System

Hazard/Resource	Current Effects/Exposure	Future Effects/Consequences
Wildfire	Doubling of average annual area burned by large wildfires in the U.S. since 2000. Impacts public and employee health, natural fire regimes and ecosystem health, water quality, erosion, and infrastructure.	Increase in volume of trees killed by fire expected by 2070. Increases in annual area of moderate-severity fire in all Resource Planning Act Assessment regions. Variable changes in area of high severity fires.
Flooding	Increases in heavy rainfall apparent across most of the U.S. Impacts erosion, water quality, infrastructure. Burned areas are particularly vulnerable to landslides and other hazards.	Continued damage to Forest Service roads and infrastructure; impacts on watershed function, downstream communities, and ecosystems.
Severe Storms	More frequent or severe storms, particularly in Eastern U.S.	Continued change to the intensity and behavior of storms; increased needs for post-disaster support.
Drought	Decrease in water availability originating from forested lands. Harm to forest and rangeland health.	Increasing forest exposure to drought will decrease water storage and availability, harm forest and rangeland productivity, and increase severity and likelihood of wildfire.
Insects & Disease	Increased damage and mortality from insects, disease, and invasive species.	Future conditions increase potential for insect and disease outbreaks and expansion of invasive species distribution.
Habitat Shifts	Decrease in extent of certain forest types, caused in part by climate change, including commercially important trees.	Increased need for adapted forestry practices to manage pace of climate change.
Recreation	Increased demand for summer recreation activities and reduced opportunities for winter recreation. Impacts due to diminished air and water quality and on facilities and public safety.	Intersection of human population changes with climate change will alter recreation opportunities.
Sensitive & At-risk Species	Threat to biodiversity, migration patterns, and landscape connectivity.	Decreased ability of forests and grasslands to serve as climate refugia.
Ecosystem Services & Local Economies	Changes to forest product supply, exacerbation of changing use trends, and changes to wood products industry.	Challenges in simultaneously managing for ecosystem services and adapting management approaches.
Old Growth Forests	Increased risk from acute and chronic disturbances.	Climate-amplified damages continue to be the primary threat to these systems.
Cultural Resources	Direct (heat, precipitation) and indirect (wildfire, sea level rise, flooding, erosion) threats.	Increased risk depending on location and degree of future change.
Treaty Rights, Reserved Rights, Other Tribal Rights	Diminished ability to advance protection of Tribal rights.	Exacerbation of ability to advance protection of Tribal rights.
Sacred Sites	Threats to physical integrity, access, and protection of Sacred Sites	Exacerbation of threat to Sacred Sites.

SECTION 3: IMPLEMENTATION PLAN

Refer to Appendix 2 for a summary of key actions highlighted throughout Section 3.

A. Addressing Climate Hazard Impacts and Exposure

1. Addressing Climate Hazard Exposures and Impacts Affecting USDA Facilities

Summarizing Section 2B, the most widespread risk to USDA facilities is extreme heat, which will affect all facilities under all scenarios. This is followed by extreme precipitation, which will affect over 95 percent of USDA facilities in all scenarios, and wildfire, which poses a high to extreme degree of risk to 42 percent of USDA facilities.

Extreme temperatures can stress the U.S. energy system and place USDA facilities at risk, as cooling systems are overcome by the added burden, especially in the Southwest, Southeast, Puerto Rico, and the U.S. Virgin Islands. In Alaska, thawing permafrost associated with higher temperatures is expected to continue, leading to drier landscapes, more wildfires, and increased costs of maintaining infrastructure. Increased spread of invasive species such as termites will also pose a higher risk to USDA facilities.

In addition to buildings, other USDA facilities such as dams, bridges, and roads are at increased risk of flooding, washouts, and mudslides as the frequency and intensity of extreme weather events increase. Agency-owned dams are directly impacted by climate change. Dams are designed to withstand engineering average conditions but are not necessarily capable of handling the extreme events due to climate variations. Risks to the safety of dam assets are exacerbated by fire, drought, and flood conditions. Drought and flood conditions, along with wildland fire areas over dam assets, decrease safety and stability of structures, increasing the risk to land and communities downstream of the dams.

Forest Service buildings in the wildland-urban interface are at substantial risk for increased damage from wildfire, particularly in the West. Forest Service heritage sites, recreation facilities, and buildings throughout the National Forest System, such as visitor and welcome centers, comfort stations, offices, and warehouses are increasingly compromised by threats from climate change such as hurricanes, wildfire, flooding, and invasive species, which can threaten wood construction.

Department-level Priority Actions

USDA is committed to improving the climate resilience of sites, fleet, and facilities and implementing its Departmental Regulations and Directives for sustainable and climate adaptive operations of these assets (Table 6).

To increase understanding of climate vulnerabilities and better integrate climate considerations into project prioritization, USDA is re-launching the Sustainable Operations Council (SOC). The SOC will provide Department-wide senior management engagement in sustainable operations programs and real property management. The council will advise the Assistant Secretary for Administration (ASA) and develop and implement policies, procedures, processes, reporting mechanisms, and required actions related to USDA sustainable operations, including climate adaptation at USDA facilities. Within the framework of the SOC, subject matter experts and other stakeholders will work collaboratively to identify the Council's goals and objectives.

USDA is working with the Department of Transportation's Volpe Center to develop the Climate Hazard Exposure and Resilience (CHER) Tool for USDA property and infrastructure. The tool will be used to identify facility-level climate vulnerabilities and develop actions to address these risks, with the aim to increase USDA operational resilience. This effort will inform development of policy and guidance, as well as prioritization of project funding. This activity includes developing and deploying tools, guidance, and training to complete climate resilience assessments of 1,000 mission-critical USDA facilities, in accordance with the USDA 2021 Climate Action Plan. Climate risks to 2,000 of USDA's contaminated sites will also be assessed to inform decision making around project funding and environmental cleanup options to protect USDA managed lands. When possible, analyses will incorporate data, such as the Climate and Economic Justice Screening Tool (CEJST). The project includes the development of a template for presenting the business case for implementing resilience-building projects. Upon completion, USDA will have a dashboard to present the results of the completed resilience assessments.

The Federal Flood Risk Management Standard requires agencies to prepare for and protect federally funded buildings and projects from flood risks. USDA's real property leasing program will continue to ensure that floodplain impacts are identified for projects, and that alternatives that avoid the floodplain are identified and evaluated.

Agency-level Priority Actions

Office of Operations (OO). OO, which manages USDA facilities in the National Capital Region, is undertaking building modernization projects that include provisions to increase the resilience of real property. Examples include replacing roof components, adding storm windows and emergency generators, and installing air conditioning systems able to cope with changing temperatures. Future modernization projects will follow similar paths and add other appropriate provisions in response to future climate change.

Agricultural Marketing Service (AMS). To enhance resilience to climate impacts, AMS is building robust contingency operation (ConOps) plans by reviewing existing plans and assessing the need for new ConOps plans, ensuring that climate change vulnerabilities are assessed and incorporated. This action will be done in consultation with industry partners to identify plans that allow AMS to continue service delivery to their customers and to grant flexibilities during extreme weather events and other disasters. In coordination with the AMS real property plan,

Sustainability Plan, and related risk management factors, this process will inform AMS' future facility project prioritization.

Agricultural Research Service (ARS). ARS maintains continuity of operations plans (COOPs) to continue critical operations at ARS locations under a range of circumstances, including extreme weather impacts. ARS locations perform regular and preventative maintenance to keep buildings and equipment in optimal condition to resist severe weather. This is coordinated through the Environmental Management System (EMS), which is maintained by the ARS Facilities Division.

Farm Production & Conservation Mission Area (FPAC). FPAC employs a Climate Change Action Strategic Framework to underscore its commitment to a holistic approach to climate change. This approach explicitly addresses climate change risks to FPAC's owned real property assets: land, buildings, and structures. FPAC remains dedicated to consistently identifying and incorporating climate resilience criteria across its real property portfolio and other relevant initiatives, ensuring a proactive and adaptive stance against the evolving challenges of climate change.

Forest Service. The Forest Service Climate Adaptation Plan includes a priority action to reduce risks and improve capacity in agency operations and infrastructure. Risks from climate exposure and hazards to Forest Service buildings are addressed through the National Asset Management Program, which incorporates climate resilience criteria to inform infrastructure spending decisions.

Table 6: Prioritized actions to address climate hazard exposures and impacts affecting USDA facilities

Agency/ Office	Climate Risk	Priority Action	Implementation Timeline
OPEM	Need for additional high-level coordination	Re-launch USDA Sustainable Operations Council	2024 Q1 Ongoing, quarterly
OPEM	Need for facility-level assessments of climate-related hazards	Continue development of Climate Hazard Exposure and Resilience (CHER) Tool with DOT's Volpe Center to assess climate-related risks to facilities. Outputs to include a contaminated site report, final tool & guidance, completed facility assessments, and dashboard.	2024-2025
OPEM	Flood risk at leased facilities	Continue to ensure that floodplain impacts are identified for leases and identify and evaluate alternatives that avoid the floodplain.	2024, ongoing
OO	Hazards in the National Capital Region	Integrate resilience-building provisions into building modernization projects in the National Capital Region	2024, ongoing
AMS	Interruption to AMS mission critical services, including facilities.	As part of the contingency operations planning process, identify climate risks (Phase 1), implement targeted initiatives with metrics (Phase 2), and examine lessons learned and redesign as needed (Phase 3).	2025 (Phase 1)

Agency/ Office	Climate Risk	Priority Action	Implementation Timeline
ARS	Risk of extreme weather impacts to ARS facilities	Maintain COOPs and perform regular and preventative maintenance to buildings and equipment.	2024, ongoing
FPAC-BC	General facilities risk due to climate hazards	Develop a new space management policy to optimize workforce and operational footprint, integrate climate resilience and mitigation goals.	FY24
FPAC-BC	General facilities risk due to climate hazards	Develop a Facilities Program Manual to include planning guidance for environmental justice, climate adaptation, and resilience.	FY24
FPAC-BC	General facilities risk due to climate hazards	Conduct facility condition assessments to determine mission critical facility condition index and replacement value and identify retrofit opportunities to increase resilience.	FY24-27
USFS	Wildfire risk in wildland-urban interface	Continue to implement of 2021-2022 pilot program for USFS facilities at risk of wildfire to assesses fire resilience of structures and identifies changes to increase survivability.	2024-2027
USFS	Flooding	Quantify flooding risk, including due to climate change, using the USFS Flood Potential Portal (https://floodpotential.erams.com/).	Ongoing
USFS	Threats to historic building and facilities	Remotely train USFS recreation professionals and line officers using improved tools and strategies, embrace facility improvements when addressing deferred maintenance, and update web resources that help decision-makers assess a site or facility's climate vulnerability.	2024
USFS	Threat to dams due to extreme precipitation and flooding	Continue evaluation and analysis of high and significant hazard dam spillway capacities to understand how climate extremes may affect the safety of dam assets and communities and land downstream. Use results to inform prioritization of dam repairs, upgrades, and decommissioning.	Ongoing
USFS	Threat to dams due to wildfire	Work with the Burned Area Emergency Response (BAER) teams to identify assets affected by wildfire. Use results to inform prioritization of dam repairs and decommissioning.	Ongoing

2. Addressing Climate Hazard Exposures and Impacts Affecting USDA Employees

USDA employees are located throughout the United States, its Territories, and U.S. embassies and consulates around the world. Employees work in rural and urban areas, many in headquarters or field offices, some in laboratories, while many others spend significant amounts of time working outdoors or in privately owned facilities. The work environments of USDA employees are as diverse as the climate change risks that they face. As described in Section 2C, exposure to extreme heat will become an increasing concern for many USDA agencies. Physical disruptions and health risks will be an acute concern with more intense or impactful extreme weather events, including increased risk of flooding. Finally, firefighters in USDA's Forest Service are already feeling the burden of longer and more intense wildfire seasons that are associated in part with higher temperatures and intense drought.

Climate-related risks to employees should be identified through Enterprise Risk Management (ERM) activities conducted at the Mission Area- and Agency-level. The Office of Budget and Program Analysis (OBPA) leads ERM efforts for USDA and will continue to partner with the Office of Energy and Environmental Policy (OEEP) to strengthen connections between employees working on risk management and climate adaptation to ensure these risks are elevated, when appropriate.

The Emergency Programs Division and the Continuity Planning Division within USDA's Office of Homeland Security (OHS) are critical to preparing for and responding to natural disasters and other events that threaten USDA's mission or personnel. To account for longer seasons in which climate-related hazards are prevalent or increasingly frequent, OHS may have to adjust the staffing patterns of their 24/7 Operations Center. OHS aims to integrate GIS software into their workflows to allow for quicker analysis and response to disasters and extreme weather events. Finally, in continuity planning, OHS will ensure that agency alternative sites have appropriately accounted for potential climate change risks, especially those that may not have been prevalent when a site was originally chosen.

USDA Mission Areas and agencies are addressing climate-related risks to their employees in multiple ways, including (Table 7):

- Assessing workforce-specific climate vulnerabilities and reviewing personnel safety policies and guidance.
- Updating and maintaining Continuity of Operations Plans (COOPs) and leveraging telework flexibilities to enable critical work to continue.
- Building workforce capacity to address climate-related impacts and demands on employees.
- Bolstering critical communications infrastructure and enhancing lines of communication to employees.
- Recognizing the importance of fleet preparedness to employee resilience.
- Addressing the challenges to wildland firefighters.

New actions identified here will be integrated into future USDA agency-level climate adaptation planning, monitoring, and reporting efforts.

Table 7: Prioritized actions to address climate hazard exposure and impacts affecting USDA employees

Action Areas	Priority Actions	Agency/ Office	Timeline
Enterprise Risk Management	Strengthen identification of climate-related risks, when appropriate, during enterprise-risk management.	OBPA	Ongoing
Continuity of Operations Plans (COOPs)	Adapt emergency planning, preparation, and operations.	OHS	Ongoing
	Follow-up on efforts identified in COOP update.	NRCS	Ongoing
	Maintain and adjust COOP as needed.	FSA	Ongoing
	Use telework/remote work flexibilities to enhance mission resilience when COOPs are activated.	All	Ongoing
Personnel safety policies and guidance	Develop new Disaster Preparedness Template.	FPAC-BC	Ongoing
	Develop plan to manage employee-related climate risks.	AMS	2025
	Review safety and hazard reporting (Directives 4791.12 & 4791.13) to ensure safe and healthy working conditions.	FSIS	Ongoing
	Continue to issue guidance to inspection program personnel on preventing heat-stress illness and acquire and distribute items to avert heat stress in IPP. Evaluate new products to make available as needed	FSIS	Ongoing
	Create data dashboard to evaluate employee-related climate risks to inform development of emergency guidance and communication system for RD duty stations.	RD	FY24-26
Workforce Capacity Building	Continue to operationalize 'jump teams' to add personnel and resources to county offices during disasters.	FSA	Ongoing
	Invest in training and support for employees to maintain mission-delivery through disasters.	FSA	Ongoing
	Implement agreement with AmeriCorps, The Corps Network (TCN), and the National Association of Conservation Districts (NACD), to establish a Working Lands Climate Corps.	NRCS	Ongoing
	Implement 5-year interagency agreement with AmeriCorps NCCC to establish the NCCC Forest Corps.	USFS	Through 2028
	Implement 5-year participating agreement with Student Conservation Association.	USFS	Through 2028
	Implement 3-year national participating agreement with Conservation Legacy Ancestral Lands Conservation Corps.	USFS	Ongoing
	Offer training sessions on disaster and emergency response	FNS	FY24
	Continue to provide Workplace Safety & Health Hazards training.	FSIS	Ongoing
Communications	Monitor emergency communications needs and consider embedding within COOP and disaster planning.	NRCS	Ongoing
	Review and identify alternatives and redundancies to ensure continuity of communications during disasters.	FSA	Ongoing
	Maintain emergency contact information and implement and review its emergency contact protocols.	NIFA	Ongoing

Action Areas	Priority Actions	Agency/ Office	Timeline
	Integrate health and safety information into employee newsletters, internal webpages, and other platforms.	All	Ongoing
Fleet preparedness	Consider transportation and fleet preparedness during disaster response. Identify at-risk vehicles and garages using decision-support layer in the Fleet Utilization Dashboard.	FPAC-BC	Ongoing
Wildfire	Continue implementing BIL-supported temporary pay increase for wildland firefighters. Continue work with Department of the Interior, through direction from BIL and FY23 National Defense Authorization Act (NDAA), within the Federal Firefighter Health and Wellbeing Program to develop an approach for measuring and managing hazardous exposures from the wildland fire environment with the potential for short- and long-term health effects.	USFS	Ongoing

3. Addressing Climate Hazard Exposures and Impacts Affecting Federal Lands, Waters, and Cultural Resources

Managing Climate Risks to the National Forest System

Climate change threatens USDA's ability to effectively manage its lands and waters, which primarily consist of the 193 million acres within the National Forest System, managed by USDA's Forest Service (USFS). The Forest Service is focusing on finding solutions to its climate challenges and greatly accelerating the integration of climate change considerations into all aspects of agency planning and operations. The Forest Service Climate Change Adaptation Plan (USFS CAP), released in July of 2022, provides an overarching vision for key actions that must be taken to reduce risks to lands and waters within the National Forest System, as well as state, private, and Tribal lands.

The Forest Service is seeking to reduce climate-driven wildfire risk through the implementation of the Wildfire Crisis Strategy (WCS) and support post-wildfire recovery through implementing climate-informed actions in its Reforestation Strategy. National programs are identifying key changes that need to be made to policy and guidance in response to USDA Secretarial Memorandum 1077-004 on Carbon Stewardship and Climate Resilience and based on input received from the recent Advance Notice on Proposed Rulemaking (ANPR) on Climate Resilient Forests and Grasslands. In addition, Regional Climate Action Plans, finalized in December 2023, identify key regional goals and climate challenges, and detail local programs, actions, and partners to address those challenges. These actions, investments, and policy reforms aim to sustainably manage and adapt our nation's lands and waters in ways that provide for ecological integrity and support social and economic sustainability in a changing climate.

Preparing for and responding to these changes will require clear performance and accountability measures that prioritize climate action. The Climate Action Tracker (CAT) is the primary tool used by the Forest Service for reporting and monitoring climate change actions, including those described in the USFS CAP, Secretarial Memorandum 1077-004, and Executive Orders 14008 and 14057. The CAT collects information about climate actions from 149 national forests and offices to quantitatively track progress on climate goals at all levels of the agency. In early 2024, the Forest Service plans to share a public progress report on the first two years of CAT reporting, including highlights of national and regional-level climate plans and actions.

Key action areas outlined in the USFS CAP to address the effects of climate change on Federal lands, waters, and cultural resources include (Table 8):

Implement the Wildfire Crisis Strategy through climate-informed actions. In early 2022, the Forest Service released its Wildfire Crisis Strategy (WCS), with the 10-year goal of treating an additional 20 million acres on the National Forest System and an additional 30 million acres on other lands to make landscapes more resilient to wildfire and other disturbances that are driven in large part by climate change. This strategy responds to the effects of climate change in degrading forest health and elevating wildfire risk, especially in the Western United States, by funding activities on 21 high-risk landscapes. Using funds from the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA), over a million acres were treated in FY 2022 and 2023. In February 2024, an additional $500 million from both BIL and IRA investment to further expand the WCS was announced, bringing the total investment in this comprehensive strategy to over $2.4 billion. The Forest Service is collaborating with the Intertribal Timber Council to support Tribal collaboration and workforce capacity in implementing the WCS. BIL funding is also being

used to support the Joint Chiefs' Landscape Restoration Partnership program that aims to improve forest health on public and private lands. FY 2023 investments built on the more than $48 million invested in FY 2022 to fund projects to mitigate wildfire risk, protect water quality, improve wildlife habitat, and enhance forest ecosystems, fostering resilience to climate stressors.

Help watersheds adapt to changing conditions, drought, and flooding. Climate adaptation efforts will target streams, rivers, lakes, and reservoirs to ensure that the Nation's forests and grasslands continue to provide clean and abundant water to downstream communities, even after extreme events. Functioning watersheds can absorb large pulses of water from heavy rain and rapid snowmelt while also weathering the effects of intense droughts. In 2023, the Forest Service signed a $33 million, IRA-funded agreement with Trout Unlimited (TU) as part of the National Watershed and Aquatic Restoration Initiative. This agreement will fund TU to collaborate with USFS personnel to implement approximately 130 projects that benefit USFS priority watersheds under the Watershed Condition Framework and Source Water Protection Areas through 2027. TU will also hire a Tribal projects coordinator to support Tribal Nations and communities in project development.

Help ecosystems adapt to intensifying disturbances and extreme events. Forest Service land managers are helping ecosystems resist the effects of and build resilience to disturbances. In some forests, this includes treatments to reduce tree densities, maintain species diversity, or create heterogeneous landscapes that can withstand droughts and insect outbreaks. In rangelands, managing for diverse native plant communities may help prepare ecosystems for drought and intensifying disturbances, like the spread of invasive species. In late 2023, American Forests and USFS announced a $20 million keystone agreement to help the agency organize and rapidly scale climate-adapted reforestation across millions of burned and degraded acres over the next five years.

Fully integrate climate considerations into guidance and directives. The Forest Service directive system serves as the primary basis for managing programs and the primary source of administrative direction for employees. The Forest Service is developing changes to its directives that better integrate climate resilience, carbon stewardship, and Indigenous Knowledge into planning and ecosystem management. For example, the Forest Service Silviculture Manual (FSM 2470) is undergoing revision to incorporate climate adaptation considerations. Language regarding the use of assisted migration is being added, providing explicit direction on when different forms of assisted migration may be appropriate, and the term "climate-informed reforestation" is being clearly defined. As part of the Secretary's Memo on Climate Resilience and Carbon Stewardship, the Forest Service prepared a set of 45 recommendations, including recommendations for 29 directives revisions. These recommendations were approved by the Secretary on February 29, 2024, for implementation in a phased approach from 2024 to 2026.

Plan for future conditions across boundaries. The pace and scale of climate change require the Forest Service to think at broader spatial scales and longer time horizons. Extending beyond jurisdictional and ecological boundaries, climate change will require planning to account for landscape-scale changes. Planning for desired future conditions that accounts only for past climatic conditions puts forests and grasslands at risk of being unable to sustain ecological integrity and provide multiple benefits to the public. The Forest Service is developing tools and information to help staff integrate climate vulnerability assessments and adaptation more effectively into the plan revision process, in accordance with the 2012 Planning Rule. State forest assessments and state wildlife action plans also are integrating climate change into strategic goals across ownership regimes. The agency is prioritizing investments in co-stewardship with Tribes to protect both Tribal lands and communities and National Forest System lands from climate risks.

Manage ecosystems for long-term change. On-the-ground management will require a range of actions to protect at-risk plant and animal species and ecosystems, improve ecosystem resilience, and in some cases facilitate transitions to more climate-adapted conditions. The Forest Service will employ evidence-based adaptation actions (derived from demonstration projects, the Adaptive Silviculture for Climate Change network, and other efforts) to maintain ecosystem function in balance with other social, economic, and cultural values; not all actions will be appropriate everywhere. Actions will ultimately depend on local goals and objectives and will be guided by local expertise, Indigenous Knowledge, and scientific research.

Table 8: Prioritized actions to address climate change hazard exposures and impacts affecting the National Forest System (see Appendix 2 for action timelines)

Hazard/Resource	Priority Actions
Wildfire	**Implement the Wildfire Crisis Strategy (WCS).** Project activities include fuel removal, including through thinning and prescribed fire, across 21 landscapes to reduce climate-related risks. Over a million acres treated in FY22 and 23, and with a plan to treat another half-million acres in FY24 within these high-risk landscapes. **Implement the National Prescribed Fire Resource Mobilization Strategy**. Aligns prescribed fire implementation, support, and coordination agency-wide to increase the pace and scale of prescribed fire use and successfully implement the Wildfire Crisis Strategy **Joint Chiefs' Landscape Restoration Partnership Program.** Three-year collaborative projects with agricultural producers, forest landowners, Tribes, and public land managers to enhance forest health and climate resilience. Implement FY 2023 and 2024 funding. **Implement the National Reforestation Strategy.** A framework to increase the pace and scale of reforestation to address existing needs, anticipate future events including climate change, and meet the provisions of the recently passed REPLANT Act (Public Law 117–58), with a 2030 target of reforesting 1.8 million acres.
Flooding	**Modernization of the Watershed Condition Framework.** Incorporation of climate change, drought, fire, and flood threats into prioritization of 6th level (HUC12) sub-watersheds and implementation of watershed restoration activities. **Updates to water resources directives.** Propose updates to the water resources directives to include climate adaptation considerations in Best Management Practices program policy, watershed planning, and watershed restoration prioritization. **Implementation of restoration programs to build resilience.** Leverage BIL and IRA investments towards the Collaborative Aquatic Landscape Restoration (CLAR) and Joint Chiefs' Landscape Restoration Partnership programs which will improve ecosystem health and wildlife habitat, making them better able to withstand climate stressors. **Avoid maladaptation in project implementation.** Continue to promote use of the categorical exclusions found in 36 CFR 220.6 (e) 18 and 19 for efficient project planning of hydrological restoration and post-disturbance remediation activities without potential for significant adverse impacts.
Severe Storms	**Forest Service National Post-Disaster Recovery (NPDR) Team.** Established in August 2023 to lead innovative approaches to post-disaster recovery to support the field, and coordinate efforts with Tribes, Federal and State agencies, and local partners. **Establish an Enterprise Emergency Management Council.** This cross-Forest Service senior-level team will facilitate timely information sharing on preparedness, response, recovery, and mitigation efforts in the event of large-scale emergencies or disasters affecting National Forest System lands. **Applying data and tools for preparedness and response.** Continue to use predictive technology and services to increase preparedness for major storm events and increase pre-emptive response to setup recovery efforts. **Center equity in recovery efforts.** Ensure guidance for recovery efforts thoroughly integrates Tribal and equity considerations.
Drought	**Apply geospatial analysis to assess drought impacts and vulnerability.** The Forest Service Climate Risk Viewer already includes drought-related geospatial layers to help land managers consider drought in strategic planning and other applications. In FY24, the USFS Geospatial Technology and Applications Steering Committee (GeoTASC) is funding design of a drought vulnerability assessment (DVA) that uses remotely sensed data and machine learning techniques and will be applied to inform forest and rangeland management in

Hazard/Resource	Priority Actions
	drought-stressed areas. Pilot DVAs and drought adaptation workshops will be conducted in Eldorado National Forest (R5) and the Ashley National Forest (R4).
Insects & Disease	**Address risk of invasive species across landscapes.** In FY23, the Forest Service announced investments in 60 projects totaling $18.7 million to address invasive species on Federal, State, private, and Tribal lands. In FY24, the Forest Service will allocate $7.7 million available from the BIL for invasive species prevention, detection, and eradication on National Forests and National Grasslands, which will help reduce the climate-driven impacts of invasive species.
Habitat Shifts	**Revise Silviculture Manual (FSM 2470).** This Manual is undergoing revision to incorporate climate adaptation into all aspects of silviculture and reforestation, including added language on assisted migration and climate-informed reforestation.
Recreation	**Reimagine Recreation.** Leverage Reimagine Recreation strategic planning initiative to enhance delivery of public benefits through recreation, including in the context of adapting to new environmental conditions. **Enhancing integration of climate adaptation into recreation planning.** Develop additional guidance, instruction, and procedural direction to integrate climate adaptation, wildfire risk reduction, and equity considerations into recreation planning; wilderness and wild and scenic river planning; facility improvement projects; special uses; and national level project prioritization and funding decisions.
Sensitive & At-risk Species	**Adapt policies and guidance for at-risk species.** Develop new data standards and data management policies for watershed conservation and wildlife connectivity. Develop informational guidance on incorporating climate risk and adaptation into the land management planning process. Prepare informational guidance for increased intra-agency, Tribal, State, and partner cooperation and coordination to promote biodiversity, habitat connectivity, and ecological integrity and resilience.
Ecosystem Services & Local Economies	**Integrate climate adaptation and mitigation into policies and guidance.** Prepare policy revisions, guidance, and additional research to encourage beneficial utilization of forest restoration byproducts as a result of adaptation-related activities while considering climate mitigation and carbon stewardship implications.
Old Growth Forests	**Climate-informed amendment of land management plans.** In amending all 128 land management plans to ensure consistent management strategies for old-growth forest conservation and management, integrate climate vulnerabilities and adaptation to enable flexibility in responding to rapid changes in wildfire behavior, drought, insects and disease.
Cultural Resources **Treaty Rights, Reserved Rights, Other Tribal Rights** **Sacred Sites**	**Strengthening Tribal Consultations and Nation-to-Nation Relationships.** Climate adaptation will be mainstreamed into elements of this Forest Service Action Plan, including into consultation, coordination, and collaboration on projects that affect Tribal interests and efforts to improve the protection of sacred sites. **Tribal Forest Protection Act workshops.** In FY24, the Tribal Climate Adaptation Menu team is leading a 'train the trainer' workshop to train facilitators to lead groups through using the menu, with the intent of promoting the consideration of Tribal perspectives in adaptation projects in multiple communities and locations.

Advancing the America the Beautiful Initiative

Launched in 2021, the Biden-Harris Administration's America the Beautiful Initiative seeks to support and advance locally led conservation and restoration efforts across the Nation. USDA contributes uniquely through its work to incentivize voluntary conservation on working lands and its partnerships with rural, urban, and Tribal communities across the country. Many of these conservation efforts simultaneously address climate change risks to soil health and agricultural production, biodiversity, recreation, and public health. We offer here recent examples of USDA activities at this intersection of conservation and climate adaptation that are elevating locally led conservation efforts and strengthening local economies (Table 9). Conservation and restoration efforts are inherent to many of the USDA programs highlighted below and integration of adaptation and resilience into these efforts will continue as these programs are implemented over the timeframe of this Adaptation Plan.

Table 9: Examples of USDA actions towards America the Beautiful focal areas

Incentivizing the voluntary conservation efforts of ranchers, farmers, and forest landowners
Voluntary and incentive-based conservation is key to USDA's approach to addressing climate change. NRCS works with producers and communities to achieve their individual conservation and business goals, while helping to ensure the long-term sustainability of U.S. agriculture. Through its Conservation Stewardship Program (CSP), NRCS helps producers build on existing conservation efforts, incentivizing them to further enhance their operation, building climate resilience and rewarding those efforts. In FY23, the CSP provided funding to 2,406 landowners for climate-focused contracts on 3,312,492 acres of land. Similarly, FSA conservation programs address conservation and climate goals on working lands. The Conservation Reserve Program (CRP) encourages farmers to remove environmentally sensitive land from agricultural production for 10- to 15-year periods. In FY23, FSA issued $1.77 billion in payments to 667,000 participants for conservation of more than 23 million acres of private land, 3.9 million of which was newly enrolled. FSA continues to adapt CRP to meet the needs of producers and the environment, including by adjusting payments to incentivize climate-smart farming practices as well as those that improve water quality. The Conservation Reserve Enhancement Program (CREP), a subset of CRP, has been adapted to incentivize additional conservation efforts, for example by allowing flexibility in how matching funds are provided. The Colorado Republican River CREP is one example where producers are incentivized to adopt dryland crop production practices which will help them work toward permanently retiring water rights and conserving the Ogallala Aquifer for future generations.
Creating jobs by investing in restoration and resilience
USDA's Rural Development (RD) supports efforts to bolster rural economies, including by working with partners to invest in restoration and resilience. In one example, joint support from RD and the U.S. Endowment for Forestry and Communities helped communities in Eastern Oregon and Northern California steward forest resources, create jobs, and plan for the future through organized community forestry. Using the funding, multiple regional and local organizations created and carried out plans to treat large swaths of public and private forests and implement policies to support sustainable forest stewardship. Supporting community investment in forest stewardship will help communities manage wildfire risk and foster forest health in a future changing climate.

Supporting Tribally led conservation and restoration priorities

Tribes are an important partner in conservation and contribute valuable traditional knowledge to conservation efforts. At the same time, Tribal livelihoods, health, nutrition, and cultural practices, as well as the ecological resilience of their territories, are vulnerable to the effects of climate change. USDA agencies partner with Tribal Nations to support them in addressing conservation and climate goals. NRCS's Regional Conservation Partnership Program (RCPP) promotes coordination of conservation activities with partners that offer value-added contributions, to expand the collective ability to address on-farm, watershed, and regional natural resource concerns. In 2023, three projects led by Tribes were funded, totaling more than $58 million: a project with the Gila River Indian Community to build drought resilience, the Headwaters Restoration project with the Penobscot Indian Nation and the US Fish and Wildlife Service to improve habitat and wildlife conditions, and the Tribal Stream and Michigan Fruitbelt Collaborative to preserve and restore the fragmented multi-tribal fisheries and wildlife populations in northwest Lower Michigan.

NRCS also uses authority granted in the 2018 Farm Bill to enter into Alternative Funding Arrangement Programmatic Agreements (PA) with Federally recognized Tribal Nations, giving NRCS greater program flexibility to work with Tribes to help them achieve their conservation goals.

FSA has worked to increase its engagement with a broader range of communities and expand access to its programs. In 2022, FSA entered into the first-ever Tribal Nations CREP agreements with the Cheyenne River, Rosebud and Oglala Sioux Tribes. FSA entered into the Big Sioux River Watershed CREP agreement with the South Dakota Department of Game, Fish & Parks to assist farmers, ranchers, and agricultural landowners to improve water quality, reduce soil erosion, enhance wildlife habitat, and create public hunting and fishing access. FSA's Safety Net Division (SND) worked extensively with Tribal Communities after the winter storms of 2022 to educate all members of available disaster recovery programs and requirements.

Expanding collaborative conservation of fish and wildlife habitats and corridors

In 2023, NRCS and FSA announced new coordinated conservation work through the Working Lands for Wildlife (WLFW) framework, which focuses on voluntary, locally led efforts that benefit wildlife and agricultural communities. This framework is actively being used in 48 states, helping guide 8 national and 14 state-identified initiatives that meet both the needs of the species as well as those of the agricultural operations. USDA is working with partners to develop four new frameworks to be released in 2024-25 for Western Migratory Big Game, Eastern Deciduous Forests, Eastern Aquatic Connectivity, and Southern Pine Ecosystems.

The Forest Service has recently established new keystone agreements using BIL and IRA funding that work to simultaneously address the wildfire crisis in the Western U.S. while enhancing fish and wildlife habitats and corridors. Examples include a $40 million agreement with Trout Unlimited to fund watershed restoration treatments, a $60 million agreement with the Mule Deer Foundation to carry out ecological restoration work, and a $50 million agreement with the National Wild Turkey Federation in support of the 20-year national master stewardship agreement.

Through the Collaborative Aquatic Landscape Restoration Program (CALR), the Forest Service has invested $25.5 million of BIL funding in 11 projects for fish passage and aquatic restoration in collaboration with the Department of the Interior, Tribes, and local partners. These projects enhance the resilience of aquatic systems to withstand increased visitation pressure and climate change effects. In FY24 $28 million will be allocated to fund 11 additional projects.

Creating jobs by investing in restoration and resilience

USDA's Rural Development (RD) supports efforts to bolster rural economies, including by working with partners to invest in restoration and resilience. In one example, joint support from RD and the U.S. Endowment for Forestry and Communities helped communities in Eastern Oregon and Northern California steward forest resources, create jobs, and plan for the future through organized community forestry. Using the funding, multiple regional and local organizations created and carried out plans to treat large swaths of public and private forests and implement policies to support sustainable forest stewardship. Supporting community investment in forest stewardship will help communities manage wildfire risk and foster forest health in a future changing climate.

Increasing access for outdoor recreation

USDA's RD recently supported work in Oakridge, Oregon to develop local trails into a hub for mountain biking recreation after this community lost 1,600 jobs to sawmill closures. With investments through its Water and Waste Disposal Loan Program, Business and Industry Guaranteed Loan Program, and Intermediary Relending Program, RD helped to support regional infrastructure and business development to aid this transition. The community was equipped with the resources to both steward the local environment, help small businesses, and transition its economy towards the outdoor recreation industry. Strengthening the recreation economy within this community will create more diverse job and income streams, increasing overall community resilience, while also fostering a renewed interest in conserving natural resources and ecosystem services for the future.

Creating more parks and safe outdoor opportunities

Through its Urban and Community Forestry (UCF) program, the Forest Service is delivering IRA investments that support disadvantaged communities experiencing low tree canopy through established partnerships with local organizations. Urban trees are a natural climate solution that help reduce the impacts of heat on urban communities while also directly storing carbon and reducing cooling energy use. In April 2023, USDA announced the availability of $1 billion in grants to increase equitable access to trees and green spaces in urban and community forests. Awards were announced in September 2023 and are being managed by the Washington Office, Regional Offices, and 12 National Pass-Through Partners. A significant number of these projects include climate resilience as a priority. In 2024, the UCF program will support 385 IRA awardees in their efforts to enhance access to tree canopy for communities in need, deliver an anticipated $40 million core program in collaboration with state forestry agencies, provide cost share grants to develop climate-resilient tree nurseries, and coordinate activities of the National Urban & Community Forestry Advisory Council.

B. Climate-Resilient Operations and Management

1. Accounting for Climate Risk in Planning and Decision Making

As described in Section 2A, climate change has the potential to impact many aspects of USDA's mission and operations. For this reason, climate change adaptation efforts are coordinated at the Department level, via the Office of the Chief Economist's (OCE) Office of Energy and Environmental Policy (OEEP). OEEP works closely with the Office of Budget and Program Analysis (OBPA), the office responsible for USDA's strategic planning; enterprise risk management; performance management and reporting; budget analysis, justification, and control; and legislative and regulatory actions. Section 3B(2) of this plan describes in greater detail how OBPA is working to integrate climate change into risk management processes which subsequently feed into strategic planning and budget formulation.

USDA Departmental Regulation (DR) 1070-001 reinforces the need "to integrate climate change adaptation planning, implementing actions, and performance metrics into USDA programs, policies, and operations." DR 1070-001 directs OEEP to issue guidance for USDA Mission Areas, Agencies, and Offices to prepare climate adaptation plans that identify how climate change may affect their ability to achieve their mission and policy, program, and operational objectives. The guidance prepared by OEEP follows the model of *The Adaptation Workbook*, a product of the Northern Institute of Applied Climate Science and USDA's Northern Forests Climate Hub. The guidance directs Mission Areas, Agencies, and Offices to (1) define their goals and objectives, (2) assess climate change impacts and vulnerabilities, (3) evaluate goals and objectives given the identified climate risks, (4) identify adaptation approaches and tactics for implementation, and (5) monitor and evaluate the effectiveness of implementation.

In July 2022, USDA released 13 Agency-level Climate Adaptation Plans; these plans build off the themes identified in USDA's 2021 Climate Adaptation Plan and put them into practice via climate adaptation implementation at the agency-level. OEEP is currently working with additional agencies and staff offices to prepare and release their plans later in 2024. Through their Climate Adaptation Plans and development of this Plan, agencies are assessing the types of climate data and assessments their agencies already use in planning and decision making, and where are there gaps and opportunities to develop this capacity further (Table 10). In FY 2024, OEEP aims to organize a series of capacity-building sessions for USDA agencies that will support them in identifying and applying climate change data appropriate to their missions, climate vulnerabilities, and adaptation actions. Beginning in late FY 2025, OEEP will work with USDA agencies to update their agency-level plans to reflect progress to date and identify areas where climate data and assessments can be used more rigorously to inform planning and decision making.

As described in Action 5 of USDA's 2021 Climate Adaptation Plan, USDA's Climate Hubs play a role in supporting agencies in using climate change-related data and assessments and developing tools that are useful both internally and externally to USDA. Examples of such tools include the AgRisk Viewer, which provides an accessible platform for crop insurance loss data, the Climate Quick Reference Guides, which provides basic climatic information at the county level, Grass-Cast, a predictive tool that estimates how much grass will be available during a growing season, and the Soil Temperature Climatology and Freeze Date Tools. These tools look at historical data that provide producers and technical service providers with predictive information to support livestock and crop production.

Table 10: Integration of climate risk information into USDA planning and decision making

How climate data and risk assessments are already applied in planning and decision making:	
OBPA	Directs agencies to consider climate-related risks during enterprise risk management process.
OEEP	Encourages use of resources, like the Fifth National Climate Assessment and The Adaptation Workbook framework, during adaptation planning.
AMS	Incorporates climate risk assessments and risk-benefit analyses into annual budgets, strategic planning processes, and other efforts like USDA's Food & Agriculture Sector Risk Mitigation and Resiliency Plan for National Security Memorandum #16.
APHIS	Uses climate suitability maps, based on the Spatial Analytic Framework for Advanced Risk Information Systems (SAFARIS), for plant pests to inform operational and policy decisions like surveys and agricultural trade policy.
ERS	Annually considers adequacy of agency resources in response to anticipated demands for information and analyses. In recent years, facilitating climate adaptation to changing risks has emerged as an increasingly important priority. This is reflected in recent increases in investments in expanding data collection and development efforts and improving the capabilities of in-house models to better identify and evaluate climate hazards and their implications for agriculture, forestry, the environment, and rural communities.
FAS	Uses a Planning Quality Checklist for FAS Programs, Projects, and Activities, which includes best practices for risk management and evidence-based decision making. Administers the Global Agricultural and Disaster Assessment System (GADAS) which assists the agricultural community in monitoring global crop conditions and assessing extreme events. Manages the Global Agricultural Information Network (GAIN) which reports on climate-related issues and developments that impact international trade and U.S. export opportunities.
FNS	Maintains the FNS Disaster Resiliency and Recovery Tool to identify areas of highest need and determine communities that may contain underserved populations which could be adversely affected by climate change. Uses the tool and NOAA/NWS Prediction Center data to estimate how many households, schools, and SNAP retailers are in a disaster area. Works with Regional Disaster Coordinators to increase awareness of climate risks and educate stakeholders. Exploring the use of weather data to improve the disaster response waiver process.
FSA	Uses the National Drought Monitor to identify areas in need of relief for the Livestock Forage Disaster Program (LFP), the Emergency Assistance for Livestock, Honeybees, and Farm Raised Fish Program (ELAP), and CRP for emergency haying and grazing. Also uses the Drought Monitor to verify drought loss claims with the Emergency Conservation Program (ECP) and the Noninsured Crop Disaster Assistance Program (NAP). Applies weather station data, including the NOAA-supported Parameter-elevation Regressions on Independent Slopes Model (PRISM), to verify qualifying extreme weather events for NAP. Employs additional tools at State-level to update planting and harvest dates for the National Crop Table.
NASS	Use Google Earth Engine to estimate crops impacted by flooding, tornadoes, hurricanes, and wildfire. Use a climate information system to inform the Agricultural Statistics Board about climate anomalies and extreme weather that could impact agricultural production.
NRCS	Incorporates local observed and historical climate data into planning tools and databases like the Conservation Assessment Ranking Tool (CART), the Water Erosion Prediction Program (WEPP), the Wind Erosion Prediction System (WEPS), and others. Developed NRCS County Drought Dashboard.

How climate data and risk assessments are already applied in planning and decision making:	
RMA	Combines recent program information (20 years) with adjustments for longer-term climate data for insurance ratemaking. Some programs use rainfall and hurricane datasets that are 70 and 170 years long, respectively.
USFS	For project development, agency guidance encourages the use of (1) The Climate Risk Viewer for considering climate change risks in the development and analysis of a proposed action, (2) The Adaptation Workbook (and accompanying NEPA-specific guide) to assist with designing projects, and (3) forest carbon NEPA templates, carbon white papers, and other resources.
Future plans and/or needs to further incorporate climate data into planning and decision making:	
OPEM	Developing CHER tool for USDA facilities with DOT Volpe Center, to identify climate vulnerabilities, which will be used to inform prioritization of capital planning and space management projects.
FSA	Forward-looking data would help programs like ECP anticipate geographic areas in need of assistance along with budgetary and staff capacity needs. Programs relying on disaster declarations could incorporate analyses of impacts to commodities in long-term planning. FSA (and NRCS) could work with programmers to update climate years used in erosion models, (RUSLE2 and WEPS).
FSIS	Evaluating climate risks in development of forthcoming FSIS Climate Adaptation Plan. Could consider adapting sampling plans to increase sampling frequency or scope following extreme weather events.
NRCS	Conducted a survey of state and local climate data needs, which will be used to inform efforts to increase access to and use of climate change data. NRCS Science and Strategic Planning workgroup originating from the NRCS Adaptation Plan will finalize recommendations to integrate climate change into NRCS tools by the end of FY24.
RD	Continued development and implementation of tools, including a Loan Portfolio Disaster Dashboard and a Weather-Adjusted Economic Risk Dashboard, to inform decision making on underwriting and servicing by identifying areas with a history of and at risk of extreme weather events, including communities with environmental justice concerns.
USFS	In 2024 the agency will develop informational guidance and training to implement existing Planning policy and directives in the context of climate change. The guidance will clarify how to explicitly consider climate adaptation and carbon stewardship in each phase of land management planning and will be a framework for future Land Management Plan revisions. The guidance will discuss how to integrate climate risk data sources and tools such as the Forest Service Climate Risk Viewer, the Resources Planning Act Assessment (RPA), and existing climate change vulnerability assessments.

2. Incorporating Climate Risk Assessment into Budget Planning

As climate change-related economic damages grow, the climate-related financial risk to the Federal budget is also projected to increase. To address this risk, Executive Order 14030, *Climate-Related Financial Risk* (Section 6b) directs "[t]he Director of Office of Management and Budget (OMB) and the Chair of the Council of Economic Advisers, in consultation with the Director of the National Economic Council, the National Climate Advisor, and the heads of other agencies as appropriate, [to] develop and publish annually, within the President's Budget, an assessment of the Federal Government's climate risk exposure."

To support this directive, OMB is engaging with agencies annually to conduct assessments of federal climate risk exposure to specific programs, that are then compiled into a white paper that accompanies the President's Budget. The first of these analyses were published in 2022 and 2023 and, relevant to USDA, included assessments of the potential effects of climate change on crop insurance expenditures, federal wildland fire suppression expenditures, and federal facility flood risk. The assessments released with the FY 2025 President's Budget include an evaluation of the financial risk to USDA's Livestock Forage Disaster Program (LFP), based on recent work by the Economic Research Service (ERS), and an updated assessment of Wildland Fire Suppressions Costs.

These assessments of climate risk to USDA programs have been supported by the technical capacity of multiple USDA agencies. USDA's ERS has research capacity in both climate impacts and climate adaptation and resilience that is supported through statistical analysis as well as simulation models. The USDA Forest Service has extensive modeling capacity supporting its periodic Resources Planning Act (RPA) Assessment that provides snapshots of current agency forest and rangeland conditions and projected impacts 50 years into the future, incorporating drivers of socioeconomic and climatic change. These analyses and others rely heavily on data collection through efforts such as the Forest Inventory and Analysis (FIA) program, the Natural Resource Inventory (NRI), ERS's Agricultural Resource Management Survey (ARMS), and other National Agricultural Statistics Service (NASS) surveys of the agricultural sector.

Section 6c of E.O. 14030 directs that the Federal Government's long-term fiscal exposure to climate-related fiscal risk be addressed via the formulation of the President's budget and through oversight of budget execution. Moving towards this goal, USDA will be implementing a new process for FY 2026 budget development to include results of climate hazard risk exposure assessments in planning and decision-making processes. USDA systematically considers risk in planning and decision-making at the Departmental level via the Enterprise Risk Management (ERM) Program. Through the ERM process, Mission Areas, Agencies, and Staff Offices identify risks that may impede achievement of Agency objectives and Departmental strategic objectives. As part of the guidance, OBPA will direct Mission Areas/Agencies to explicitly consider the climate risk exposure assessments in their ERM risk assessment process. Then, during the budget planning and formulation process, Mission Areas, Agencies, and Staff Offices are required to identify their top enterprise risks and integrate discussion of these risks into their budget justifications.

3. Incorporating Climate Risk into Policy and Programs

Adaptation planning at multiple levels creates an enabling environment for agencies and offices to adapt policies and programs to current and anticipated effects of climate change. Adaptation can address climate impacts to programs and operations or can be a means to address the effects of climate change on the people, sectors, and communities that USDA serves. As documented in their Agency-level climate adaptation plans, and re-affirmed through the development of this Plan, USDA agencies are committed to reviewing policies and programs through a climate adaptation lens, when relevant and appropriate (Table 11).

Table 11: Adaptation of USDA policies and programs to climate change (see also Appendix 2)

Who across USDA is engaged in climate adaptation?
▪ Agency-level adaptation plans have been completed by 6 Mission Areas/14 Agencies, and 4 Offices. ▪ More than 18 Agencies and Offices provided input to and reviewed this Plan.
How is climate adaptation coordinated within USDA?
▪ OEEP coordinates across USDA and the Director of OEEP is USDA's Climate Adaptation Official (Table 1). ▪ OEEP engages with Agencies and offices via monthly meetings of USDA's Global Change Task Force and quarterly meetings of USDA's Climate Adaptation Community of Practice. ▪ OEEP manages development of USDA's Adaptation Plan, coordinates development of Agency-level plans, and solicits feedback on Agency-level adaptation implementation to inform Department-level reporting. ▪ OEEP works with OBPA to enhance integration of climate adaptation into planning and risk management.
How have policies and programs been adapted to account for the effects of climate change?
▪ Incentivizing climate-smart agricultural practices via conservation and risk management programs ▪ Integration of climate adaptation into USFS policies and programs ▪ Anticipating effects of extreme weather by offering new crop insurance products, streamlining access to post-disaster assistance, enhancing housing and energy resilience, and adapting nutrition policy and programs. ▪ Via regional efforts like NRCS State Technical Committees and USFS Regional Climate Adaptation Plans. ▪ Adapting USDA research, analytical capabilities, and survey priorities to reflect changing needs. ▪ Leveraging international diplomacy and engagement to advance climate adaptation. ▪ Prioritizing climate adaptation in strategic planning and enterprise risk management. ▪ Updating Departmental directives and guidance.

Planned policy changes or revisions to advance climate adaptation:		
1	Issue directions to consider climate risk exposure assessments in Enterprise Risk Management.	OBPA
2	Complete additional Agency/Staff Office Adaptation Plans.	OEEP
3	Include climate change effects and precautions in USDA Continuity of Operations Plan.	OHS
4	Include climate risks in USDA response to National Security Memorandum-16 on Strengthening the Security and Resilience of United States Food and Agriculture.	OHS
5	Incorporate real property resilience in USDA Departmental Manual on Sustainable Operations.	OPEM
6	Implement new predictive imputation methods for the June Area Survey, in part to help manage for climate-related disruptions.	NASS
7	Review and revise policy and guidance for stewardship of perpetual easements, including assessing potential for future ecological monitoring procedures to include climate change effects prior to and during habitat restoration.	NRCS
8	Revise the USDA Foods disaster response regulations (7 CFR 250.69 and 250.70) to better support the response to Presidentially declared disasters and emergencies.	FNS
9	Revise 7 CFR Part 1924 Subpart A to include climate resilient building practices.	RD
10	Update the USFS Silviculture Manual to ensure use of climate-informed silvicultural practices in the National Forest System.	USFS
11	Develop proposal for policy revisions, guidance, and additional research to encourage beneficial use of forest restoration byproducts.	USFS
12	Prepare additional procedural direction to integrate climate adaptation, wildfire risk reduction, and equity considerations into recreation, recreation facility, and designated areas planning.	USFS
13	Develop proposal to update Wildlife, Fish, and Sensitive Plant Habitat Management directives in context of current needs and future climactic conditions.	USFS
14	Include climate change in proposal to update the Water Resource Management directives (FSM 2532).	USFS

Agricultural production and conservation. The Farm Production and Conservation agencies are working to encourage adoption of climate-adapted farming practices and risk management strategies to enhance the climate resilience of farmers and land managers. NRCS's Easement Programs Division is reviewing and revising policy and guidance for stewardship of perpetual easements, including evaluating the potential for future monitoring procedures to assess climate impacts prior to and throughout habitat restoration. FSA's CREP for the Colorado Republican River has been revised to offer producers a dryland crop production practice to support producers in reducing consumptive water use and conserving the Ogallala Aquifer. This change enables producers to keep their land in production and continue earning income while implementing conservation practices. Finally, RMA continues to offer new products and adapt existing products to reflect changing farming practices as a result of changing conditions or new climate-smart approaches.

Natural resources management. As described in greater detail in Section 3A(3), the Forest Service is working to integrate climate adaptation into all aspects of its planning and operations. In 2023, USFS National Offices conducted a climate-oriented review of their directives and procedures to inform recommendations to the Secretary for adjustments to policy, guidance, training, and investment. At the same time, USFS issued the Forest and Grassland Climate Resilience Advanced Notice of Proposed Rulemaking (ANPR), which included public feedback

and Tribal consultation, on how USFS should adapt current policies to protect, conserve, and manage National Forests and Grasslands for climate resilience. Finally, in late 2023, USFS issued guidance for project-level consideration of climate change in NEPA. The establishment of a new Policy Office within the Forest Service has enhanced the agency's capacity for policy analysis and climate adaptive policy reforms. In 2024 and beyond, the USFS intends to update or propose climate-informed revisions to guidance and policies related to silviculture practices, beneficial uses of forest restoration byproducts, recreation and designated areas planning, habitat and water resource management, and forest-level land management planning. USFS will continue to use its Climate Action Tracker to collect agency-wide information to quantitatively track progress towards its climate goals.

Managing for extreme weather impacts. Adjustments to policies and programs are being made to account for changing intensity and severity of extreme weather events. Rural Development (RD) plans to revise 7 CFR Part 1924 Subpart A to include climate resilient building practices. Through its Rural Energy for America Program (REAP), RD is bolstering the energy resilience of farmers and rural small business owners. RMA has created new insurance products to help producers manage their risk from hurricanes, tropical storms, smoke, and excessively wet conditions that can prevent them from applying fertilizer. FSA has adjusted requirements for the 2023 Emergency Assistance for Livestock, Honeybees, and Farm-raised fish (ELAP) and the Livestock Indemnity (LIP) Programs to allow producers more time to apply for this disaster assistance. USDA's Food and Nutrition Service (FNS) is revising the USDA Foods disaster response regulations (7 CFR 250.69 and 250.70) to better support the response to Presidentially declared disasters and emergencies without impeding regular operations. FNS is also identifying opportunities through their Childhood Nutrition programs to minimize exposure to extreme heat during summertime and continue to get meals in the hands of children in spite of extreme weather events.

Science, research, and innovation. USDA's research and statistical agencies are adapting their programs to support the science and innovation needed to address the challenges climate change poses, while adjusting their operations to ensure reliability of the critical information they supply. The Economic Research Service has been expanding the resources it allocates to developing data products, enhancing modeling capabilities, and producing new research products that inform discussions of how to facilitate farm- and sector-level adaptation to changing climate conditions and risks. ERS has published three reports using 2019 Survey of Irrigation Organizations data to assess how irrigation organizations plan and respond to drought, how policies and new technologies have expanded lands under irrigation, and an assessment of the water infrastructure that irrigation organizations use. In recent years, ERS has also added new questions to the USDA Agricultural Resources Management Survey (ARMS) to improve understanding of the nature and extent of climate-smart farming practices, such as adoption of digital farming practices, cover crops, rotational grazing, and adoption of drought-tolerant corn. NASS is modernizing its data collection methods, strategies, and tools to minimize disruption to their operations. In FY 2024, NASS will implement new predictive imputation methods that use crop acreage forecasts, and geospatial and administrative data for NASS's largest annual survey, the June Area Survey. The Agricultural Research Service (ARS) is integrating climate change priorities into its programs via its 5-year Action Plan cycles that set research priorities and identify anticipated products. ARS scientists develop research projects to align with these Action Plans and ARS documents progress towards the objectives annually. At the end of each 5-year cycle, ARS conducts a retrospective analysis to see how well priorities are met. Section 3B(5)

discusses in greater detail how the National Institute of Food and Agriculture (NIFA) is elevating climate adaptation in the research and programs it funds.

At the intersection of USDA's science and program agencies, the USDA Climate Hubs provide climate change expertise to support USDA agencies in adapting their policies and programs. Activities can include dissemination of climate change information and resources, development of tools to support climate-informed decision-making, and capacity building and training for USDA employees to equip them with the knowledge and skills to make these decisions. NRCS has strengthened their connectivity to each of the 10 domestic Climate Hubs by establishing NRCS Climate Hub Co-Leads to work with each Hub, represent NRCS needs to the Hubs, and serve as a conduit of information between the Hubs and NRCS.

International activities. Internationally, USDA's Foreign Agricultural Service (FAS) is integrating climate adaptation into its programs and international engagements. In 2023, FAS launched a new International Climate Hub, growing USDA's network of Climate Hubs. This new Hub will share research and approaches developed domestically with our international partners and connect the other Climate Hubs to relevant research and approaches produced internationally. The Coalition on Sustainable Productivity Growth for Food Security and Resource Conservation, co-led by FAS and the Office of the Chief Economist, will work to highlight practices and approaches that help producers adapt and build resilience to the effects of climate change. FAS has already made climate-smart agriculture a key theme within the Food for Progress program, as well as its fellowship and exchange programs, and will work to expand the emphasis on climate adaptation into its activities on sanitary and phytosanitary systems. FAS is also leading USDA's engagement in the Global Framework on Water Scarcity in Agriculture, (WASAG), a multilateral initiative led by the Food and Agriculture Organization of the United Nations (FAO), to promote international cooperation on agricultural water conservation and sustainable food security in the context of climate change. Finally, FAS's efforts on climate adaptation align with many of the priorities identified in the President's Emergency Plan for Adaptation and Resilience (PREPARE), and FAS is working to align its metrics to track climate adaptation progress with PREPARE's Monitoring, Evaluation, and Learning framework.

In managing the effects of climate change, USDA strives to integrate and consider other related Departmental and Administration priorities, including addressing environmental justice, supporting and partnering with Tribal Nations, identifying areas of potential climate mitigation and adaptation co-benefits, and using nature-based solutions where possible. Planned actions to adapt policies or programs that also address these crosscutting priorities are included in Table 14.

Environmental justice. Through its Climate Adaptation Plan, USDA is able to advance environmental justice as part of its mission, consistent with Executive Order 14008 and with E.O. 14096 *Revitalizing Our Nation's Commitment to Environmental Justice for All*. In implementing this Climate Adaptation Plan, USDA will, as appropriate and consistent with applicable law, address disproportionate and adverse environmental and health effects and hazards, including those related to climate change. The Department will address cumulative impacts of environmental and other burdens on communities with environmental justice concerns and provide opportunities for the meaningful engagement of persons and communities with environmental justice concerns.

In addition, as a member of the White House Environmental Justice Interagency Council, USDA received recommendations on Climate Planning, Preparedness, Response, Recovery and Impacts

from the White House Environmental Justice Advisory Council (WHEJAC). The report includes many recommendations that are relevant to the work of USDA. The Department is reviewing the recommendations and, as appropriate, and to the maximum extent permitted by law, is taking steps to address the WHEJAC's recommendations.

OEEP collaborates closely with USDA's Environmental Justice Lead in OBPA, including in developing and reviewing this Plan. Together they work to ensure that communities with environmental justice concerns, and the effects of climate change on these communities, are considered in the work of the Department. Each Agency-level Adaptation Plan is directed to consider the unique vulnerabilities of communities with environmental justice concerns and how to ensure maladaptation is not perpetuated through USDA programs and operations. This work is continual, however recent examples of USDA actions to advance understanding and action on environmental justice include:

- Forest Service leveraging its Climate Action Tracker to track engagement with communities with environmental justice concerns to inform future strategies to reduce disproportionate, negative impacts and ensure equal distribution of the benefits of climate change activities.
- FSA's expansion of eligibility and access to Noninsured Crop Disaster Assistance (NAP) for underserved producers and investments in relief for distressed borrowers with certain direct and guaranteed loans.
- RMA's support for risk management education initiatives for underserved producers, a nationwide outreach effort to encourage enrollment in whole farm and micro-farm products, and engagement with specialty crop producers to address gaps in current crop insurance offerings.
- USDA Northeast Climate Hub's Climate Equity project, which seeks to identify and support stakeholders involved in agriculture, aquaculture, and forestry who are engaged with climate equity and social justice issues.
- NIFA's efforts to work with partner institutions who have relationships with disadvantaged communities, such as Hispanic-serving Institutions, Alaska Native-Serving and Native Hawaiian-Serving Institutions, 1890 Land-grant Institutions, and 1994 Land-grant Tribal Colleges and Universities. Within the Agriculture and Food Research Initiative's (AFRI) Foundational and Applied Sciences (FAS) program, there is a new program area priority on Environmental Justice (A1461), which in FY 2023 funded one award to an 1890 Land-grant institution to determine the impact of NIFA programs on underserved communities. This priority area is being expanded in FY 2024 to include work that will increase our understanding of community-level climate resilience and thresholds and will include a component on positive youth development.
- ERS's research on topics related to rural resilience, including improving understanding around broadband access and heirs' property rights.
- RD's development of priority scoring points for projects located in vulnerable areas and their incorporation into NOFAs for construction of new housing, buildings, and infrastructure. Ensuring that these investments are climate resilient will help decrease exposure of these communities to climate hazards, while reducing energy burden and carbon emissions.

Tribal Nations. USDA's Office of Tribal Relations (OTR) works across USDA to ensure that policies and programs are efficient, easy to understand, accessible, and developed in consultation with Tribal Nations. The Director of OTR represents USDA to the White House Council on Native American Affairs and co-leads the Committee on Climate Change, Tribal Homelands, and Treaties. OTR and OEEP are committed to working together on implementation of this Plan and will work to strengthen engagement with Tribes when developing policies and programs that address climate-related risks to Tribal communities.

Within USDA, for many of the initiatives described above, agencies are inviting consultations and engaging in collaborations with Tribal Nations to inform policy and program development. As part of the Advance Notice on Proposed Rulemaking (ANPR) on Climate Resilient Forests and Grasslands process, USFS held a collaborative national Tribal Forum in July 2023, issued invitations to Tribal leaders to consult on the ANPR in September 2023, for which one request has been received, and provided updates on the process at a December 2023 Tribal Forum. Feedback received in this Forum and from ongoing consultation will inform a range of policy decisions and programmatic actions to address climate resilience on national forests and grasslands. In another example, FSA's Safety Net Division worked extensively with Tribal communities following winter storms in 2022 to educate Tribal members of available disaster recovery programs and requirements to increase access to these programs.

USDA agencies are advancing efforts to integrate Indigenous Knowledge (IK) into their activities, including those related to climate adaptation and resilience. Based on stakeholder engagement conducted in FY 2022, NIFA created an internal IK task force and has since integrated IK into Requests for Applications for AFRI FAS, AFRI Sustainable Agricultural Systems (SAS), From Learning to Leading: Cultivating the Next Generation of Diverse Food and Agriculture Professionals (NextGen), New Beginning for Tribal Students (NBTS), Tribal College Extension Program (TCEP), and Alaska Native-Serving and Native Hawaiian-Serving Institutions (ANNH) Education Competitive Grants programs. Incorporation of IK into NIFA funded projects will enhance climate resilience and nutrition security of communities through culturally relevant management of their natural resources and agricultural systems. NRCS is collaborating with Tribal subject matter experts on climate adaptation strategies already employed on Tribal Lands and has created an Indigenous Practices Team under the Science & Technology Deputy Area focused on the creation of interim practice standards. Finally, NRCS has established a new funding priority focused on strengthening conservation through IK within the National Classic Conservation Innovation Grants program. This effort will further expand the opportunities for NRCS to learn more about innovative climate adaptation and resilience strategies unique or applicable to Tribal and indigenous communities that may be appropriate for integrating into NRCS's own conservation planning and practices.

The USDA Climate Hubs have future activities planned that address Tribal concerns and aim to strengthen partnerships with Tribal Nations. One example is the planned re-establishment of a Memorandum of Understanding (MOU) between the Climate Hubs and the Cooperative Extension Section (CES) and Experiment Station Section (ESS) of the Association of Public and Land-grant Universities (APLU) Board on Agricultural Assembly. The new MOU places additional emphasis on working with Tribal Extension and developing greater understanding of IK. These activities will help USDA better understand the scope and scale of Tribal climate

equity issues in agriculture and forestry and enhance consideration of these issues in the work of the Climate Hubs.

Climate change poses a threat to Tribal subsistence practices and food security. Many USDA efforts to build the resilience of these systems will also enhance their resilience to the effects of climate change. RMA has worked with several Tribal Nations to target risk management products for Indigenous food sources, like wild rice. Investments through AMS's Indigenous Animals Harvesting and Meat Processing Grant Program (IAG) are working to boost supply chain resilience and expand local capacity to process and distribute culturally appropriate food sources to build food security in Tribal communities. Finally, in developing proposed changes to the USDA Foods disaster response regulations, FNS has considered input received via Tribal consultation during the development of the rule.

Climate mitigation and adaptation co-benefits. Climate adaptation and mitigation are often inextricably linked in agriculture because of the potential for many farming practices with carbon sequestration potential to also build resilience to the effects of drought, floods, and other hazards. The long term carbon sequestration potential of forests is threatened by climate change and other stressors, and larger, more severe wildfires have the potential to increase greenhouse gas emissions. Healthy soils and forests are essential to ensuring the sustainability of these resources for future generations, while also leveraging their full potential to be solutions to the climate crisis. For these reasons, USDA identified investments in soil and forest health as a critical need in its 2021 Climate Adaptation Plan.

The almost $19 billion provided by the IRA for NRCS conservation programs is targeted towards climate mitigating conservation practices. To the extent possible within the authorities of the IRA, NRCS is identifying opportunities for adaptation and mitigation co-benefits. The USDA Climate Hubs are supporting this work by helping to increase awareness and implementation of agriculture and agroforestry climate-smart practices. The Hubs will provide outreach and educational support for field planners and partners, address the near-term needs for relevant decision support tools and information, and address ongoing needs to evaluate practices, reduce uncertainty, and increase the connection of scientific knowledge to the implementation of climate change mitigation practices.

The USFS ANPR sought input on how National forests and grasslands should be managed for carbon stewardship as well as to foster climate resilience. The USFS is taking an intentional approach to carbon stewardship in ecosystem and watershed management on National Forest System lands, that considers carbon within the context of multiple uses, ecosystem integrity, and climate adaptation, not at the expense of forest health or habitat.

OPEM is weaving adaptation into its sustainability activities, prioritizing energy resilience in anticipation of utility disruptions, and integrating climate risk into building sustainability criteria. To increase the electric vehicle fleet and electric vehicle supply equipment (EVSE), USDA uses the Climate and Economic Justice Screening Tool to identify and prioritize sites for EVSE installation. Increased use of electric vehicles and implementation of onsite EVSE can provide continuity of fleet operations in the event extreme weather disrupts petroleum fuel supplies.

Nature-based solutions (NBS). NBS are woven into the fabric of many of USDA's existing farm conservation efforts and overlap with many of the activities described in Section 3A(3). An additional example from NRCS not already highlighted, is the Agricultural Conservation Easement Program (ACEP), which helps producers protect sensitive landscapes, including

wetlands, grasslands, and prime farmlands. In FY 2023, over 35,000 acres were enrolled in ACEP Wetland Reserve Easements and over 143,000 acres were enrolled in ACEP Agricultural Land Easements. The ACEP Wetland Reserve Easements program preserves, protects, and restores wetlands, which are key to floodwater containment in many areas and can be essential to climate resilience. Within FSA's work, the Conservation Reserve Program (CRP) is the most prominent example of NBS, where NBS and CRP support efforts to mitigate climate change, improve water quality, prevent soil erosion, and reduce the loss of wildlife habitat. Grassland CRP is one such example, which allows producers to continue haying and grazing practices, while protecting grasslands from conversion. In 2023, the Grassland CRP signup received a record 4.6 million acres in offers, of which nearly 2.7 million acres were enrolled. Similar to other cross-cutting priorities, NBS are woven into many of NIFA's funding opportunities as well. Finally, where possible and appropriate, RD building programs will incentivize the use of NBS via scoring points in future funding opportunities.

4. Climate-Smart Supply Chains and Procurement

USDA's Office of Contracting and Procurement (OCP) provides Department-wide leadership, management, and oversight in contracts and procurement. OCP is responsible for Department-wide procurement policy, Enterprise-wide procurement systems including purchase charge cards, and procurement operations servicing several USDA agencies and staff offices. Given the breadth of USDA's mission, procurements can range from software and routine supplies to scientific equipment or food commodities. With this diversity in procurement needs, the potential climate risks are diverse.

In developing this Plan, OCP worked with Mission Areas and Agencies to identify potential risks or increased demands to suppliers that could disrupt USDA mission delivery and operations (Table 12). These risks and others will be considered as OCP carries out risk management activities described below.

Table 12: Potential suppliers at risk of climate-related disruptions

At-risk supplies/services	Causes of risk	Future actions or progress towards addressing risks
HVAC (Acquisition, maintenance, and repair)	Extreme heat, flooding, wildfire	These long-term, risks, may require: • Adapting budgets to account for increased costs. • Increased coordination with other Federal agencies, e.g. FEMA • Adjustments to program demands (e.g., for aerial imagery) • Planning for and anticipating delays • Alternate sourcing with longer lead-times
Supplies and services required after natural disasters (food, construction materials, etc.)	All hazards	
Geospatial aerial imagery acquisition	Longer growing seasons, more storm events	
Construction contracts	Flooding, wildfire	
Information technology (IT) materials, including silicon chips	Any hazards that may impact international trade	

To better understand overall and climate-related risks to mission critical acquisitions, OCP has the following activities planned for 2024-2027:

- Inclusion of climate hazard risk in Acquisition Mission Area Annual Reviews in FY24, which will promote collaborative identification of supply chain risks and best practices for risk management.
- Planned research (and potential acquisition) of supply chain risk management software.
- Process mapping and policy infrastructure creation to support readiness of Agriculture Priorities & Allocation Systems (APAS) ratings. APAS is a USDA program that supports national defense and emergency preparedness initiatives by addressing essential civilian needs (food and food resources) through the placement of priorities or allocations on contracts for items and services.
- Expanded use of the USDA's Procurement Forecasting Tool to identify mission critical procurement requirements and expand the vendor visibility and assist in market research.

- Include identification of climate-smart sourcing items/providers when the acquisition workforce uses Government Purchase Card (GPC) platforms and develop goals for climate-smart sourcing using the GPC.
- Explore use of the NIST Manufacturing Extension Partnership (MEP). The MEP partners with Federal agencies to assist potential vendors to reduce costs, improve efficiencies, develop the next generation workforce, create new products, and find new markets. The manufacturing innovations could be used to assist USDA in addressing climate hazard and supply chain vulnerabilities.

In addition to leveraging the risk assessment actions, described above, OCP plans to integrate climate hazards and vulnerabilities into its under-development Program Management Deskbook. The Deskbook will serve as policy, guidance, and instruction to Mission Area Program and Project Managers across USDA. Specifically, the Deskbook will have a subsection devoted to drafting climate exposure management considerations during the requirement formation and market research steps of USDA acquisitions. In addition, OCP plans to require that Mission Area Senior Contracting Officers submit action plans to address identified climate hazards within the supply chain. These submissions are planned in FY 2025 based on the FY 2024 AMRs.

To implement efforts to address potential supply chain disruptions due to climate hazards, OCP will leverage its existing Pillars of Sustainable and Innovative Acquisition program. Initiated in FY 2022, this program is delivering sustainable Federal acquisition solutions in four focal areas: procurement equity, worker well-being, climate-smart acquisition, and supply chain resilience. Annually, the program lead works with stakeholders across the Department to establish projects, set goals, and track accomplishments associated with each of the Pillars' focal areas. The goals and accomplishments related to acquisition within this Plan will be tracked accordingly, including the identification of key milestones.

To build capacity for this work within USDA, in FY 2024 OCP is establishing and staffing the Acquisition Project Management Office (APMO). The APMO will assist USDA Mission Areas with all aspects of acquisition program and project management including the appropriate inclusion of climate hazard risk management aspects. Finally, as described in Section 3C, OCP is working in partnership with OPEM to build employee climate literacy and engagement on climate risk to supply chains and procurement.

5. Climate Informed Funding to External Parties

USDA agencies provide funding to diverse stakeholders in the form of grants, loans, and other mechanisms to support their respective missions. Improved integration of climate adaptation into many of these programs was considered during adaptation planning efforts at the agency-level in 2022. Examples of USDA programs where climate adaptation is a funding consideration or priority include:

Agricultural Marketing Service. AMS works to improve domestic and international opportunities for U.S. growers and producers and build more resilient food systems by offering Federal funding opportunities to organizations across rural America and the Nation's agricultural sector. In FY 2023, AMS published 12 funding opportunities for grants and cooperative agreements totaling over $1 billion to support market development for U.S. agricultural producers. The following language was included in each of those funding opportunities and will continue to be used for relevant opportunities in the future:

> "USDA promotes climate-resilient landscapes and rural economic systems, including tools to support agriculture, forests, grazing lands, and rural communities. AMS encourages applicants to consider including goals and activities related to reducing and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere or adapting to the already occurring climate change in their project's design and implementation."

Farm Service Agency. FSA administers programs to agricultural producers, many of which enable producers to be more financially resilient and as a consequence, more climate resilient.

- FSA offers:
    - Emergency loans to help producers recover from production and physical losses due to drought, flooding, and other natural disasters or quarantines,
    - Low-interest financing to build or upgrade on-farm storage facilities and purchase handling equipment, and
    - Loans to provide interim financing that helps producers meet cash flow needs, without having to sell their commodities when market prices are low.
- Using IRA funds, FSA has so far provided $1.7 billion of disaster relief to more than 30,000 distressed borrowers with certain FSA loans to expedite assistance to agricultural operations at financial risk.
- FSA's Farm Loan Programs recently developed a climate-smart toolkit and factsheet to help producers implement climate-smart agriculture practices or to purchase related equipment for their operations.
- The Farm Storage Facility Loan (FSFL) Program loan application has been updated to ask the applicant if the project will use clean energy or energy efficient equipment, which as a co-benefit, can make the facility more energy resilient.
- FSFL launched the Emergency Grain Storage Facility Assistance Program to deliver assistance to producers who lost critical facilities during the devastating tornadoes and derechos of 2021, to which USDA committed $120 million to meet the large demand for assistance.
- Through its Monitoring, Assessment, and Evaluation program, FSA is working to evaluate the effects of land enrollment in the Conservation Reserve Program (CRP) on soil health, wildlife habitat, water quality, and carbon sequestration. Data collected from these projects will improve understanding of the links between these outcomes and direct future practices offered under CRP.

Foreign Agricultural Service. FAS's Food for Progress Program donates U.S. agricultural commodities to recipient countries to be sold on the local market and then uses the proceeds to support agricultural, economic, or infrastructure development programs in-country. FAS includes climate-smart agriculture as a programmatic theme in its annual Notice of Funding Opportunity (NOFO) and is currently funding projects in Colombia, Cote d'Ivoire, Malawi, Mauritania, and Thailand that will have adaptation and resilience benefits for the farmers.

In FY 2023, FAS included the following adaptation-related language in its NOFO for the McGovern-Dole International Food for Education and Child Nutrition program:

> "Applicants must include information on climate change's current impacts on food security and food systems in the country, especially its impact on school-age children…Climate: FAS encourages Applicants to include information on how proposed activities will account for climate change vulnerabilities. FAS encourages Applicants to propose climate informed interventions, such as fuel-efficient stoves, climate-smart agriculture adaptations to school gardens, adapted WASH infrastructure, and climate resilience committees."

Funded projects are encouraging adaptation through their work by training producers to use climate smart growing techniques, planting trees to reduce soil erosion, installing solar powered water pump systems and stoves, and considering resilience in construction of school kitchens.

Forest Service. At least 38 internal and external competitive funding programs in the Forest Service include criteria related to climate resilience in their guidance. The Forest Legacy Program, a program administered in partnership with State agencies, aims to protect privately owned forest lands from the threat of conversion to non-forest uses. The Scoring Guidance for the National grant funding component of the process prioritizes climate resilient landscapes based on attributes that enhance resilience and support adaptation, including landscape connectivity, forest health, ecosystem diversity, soil productivity, species presence and range, wildlife habitat, and water resources. Another program, the IRA-Forest Landowner Support (FLS) program, incorporates IRA provisions that support the participation of underserved and small-acreage forest landowners in emerging private markets for climate mitigation or forest resilience and establish cost share for climate mitigation or forest resilience practices through competitive grant programs. IRA-FLS released a NOFO in August 2023 related to market participation, with guiding principles and evaluation criteria emphasizing adaptation and resilience. A NOFO related to cost share programs will be released in FY 2024. Finally, in FY 2023, the Forest Service began accepting applications for a second round of investments in wildfire protection for communities through the Community Wildfire Defense Grants program. Individual grants fund up to $250,000 to update community wildfire protection plans and up to $10 million for associated wildfire resilience projects, with total number funded determined by available funding, which is up to $250 million.

National Institute of Food and Agriculture. NIFA, USDA's extramural research funding body, applies an integrated approach to ensure that the outcomes of agriculture-related science and innovation reach the people who can put them into practice. NIFA is integrating climate change-related research, extension, and education into its funding programs, when appropriate, and creating new opportunities to support agriculture, forestry, and rural communities in tackling climate change. In FY 2022, NIFA awarded a total of $35 million across the agency to support climate adaptation; this level increased to $105 million in FY 2023.

- NIFA includes an emphasis on proposals that address climate smart agriculture and forestry in the Request for Applications (RFAs) for all three AFRI programs: FAS, SAS, and Education and Workforce Development (EWD).
- NIFA created a new program area priority, Rapid Response to Extreme Weather Events across Food and Agricultural Systems in its AFRI FAS program for FY 2022 and 2023. The new rapid response program allows for rolling submission of applications and awards funding in response to climate change-relevant natural disasters. This program supports Extension and research on three themes, (1) agroecosystem resilience, (2) food safety, food and nutrition security, and agricultural commodity security, and (3) health, well-being, and safety. FY2022 and 2023 funding totaling $5.7 million supported 20 projects in response to extreme events including drought, flooding, wildfire, and hurricanes.
- Beyond AFRI, there are over 30 programs at NIFA such as the 1890 Capacity Building Grants Program, Beginning Farmer and Rancher Development Program, Community Food Projects, Sustainable Agriculture Research and Education, etc. that support projects that address climate-smart agriculture and forestry.
- In FY 2023, new language was added to the USDA-wide Small Business Innovation Research (SBIR) Phase I RFA to emphasize projects that address climate adaptation to build resilient systems and communities.

Natural Resources Conservation Service. NRCS delivers financial assistance via grants and cooperative agreements to address conservation and environmental challenges. Examples where climate adaptation and resilience are being considered, include:

- Conservation Innovation Grants (CIG) are competitive grants to support partners in addressing water quality, water quantity air quality, soil health, and wildlife habitat challenges, all while improving agricultural operations. Climate adaptation-relevant priorities for CIG's On-Farm trials in FY 2024 include irrigation water management technologies, nutrient management, grazing lands, and soil health demonstration trials. For CIG Classic, adaptation-relevant priorities include forestry, habitat conservation and restoration for wildlife and invertebrates, managing agricultural lands to improve local water quality, energy conservation, economics, and strengthening conservation through Indigenous Knowledge.
- As described in prior sections, the Regional Conservation Partnership Program (RCPP) is a partner-driven approach to conservation that funds solutions to natural resource challenges on agricultural land. In 2023, out of 81 projects and $1.1 billion of investment, 22 projects are focused on water quantity and conservation, 3 are led by Tribes, 16 support protection and restoration of wildlife corridors, and 10 focus on urban agriculture.
- NRCS supports dam and flood prevention projects and repairing existing watershed infrastructure through the Watershed and Flood Prevention Operations (WFPO) Program, Watershed Rehabilitation Program (REHAB), and Emergency Watershed Protection (EWP) Program, which can help project sponsors rehabilitate aging dams that are reaching the end of their design lives or no longer meet Federal or state standards.
- Equity Conservation Agreements support outreach activities that encourage diverse and inclusive participation in NRCS programs. Working in conjunction with non-governmental organizations (NGOs), projects introduce conservation planning and climate smart practices to protect farmland ecosystems, watersheds, and wildlife habitat in areas of disadvantaged communities. In FY23, NRCS selected 139 projects, investing $70 million to expand access to conservation assistance and career opportunities.

Rural Development. Where appropriate and possible, RD integrates climate and energy resilience into its programs, for example:

- The Rural Energy for America Program (REAP) enhances climate resilience through investment in energy efficiency improvement projects.
- The Powering Affordable Clean Energy (PACE) program asks applicants to demonstrate that a proposed project is reliable and resilient.
- Rural Housing Service disaster response programs incorporate resilience into Single-Family Housing and Community Facilities programs. The Community Facilities Technical Assistance and Training Program and the Rural Community Development Initiative support resilience-building through technical assistance.
- Electric programs within the Rural Utilities Service fund energy efficiency improvements and conservation measures that can enhance resilience.

USDA agencies will continue to create and review funding opportunities through the lens of climate adaptation and resilience to ensure that, as applicable, these programs have the maximum opportunity to provide these benefits directly or as a co-benefit. Additional planned changes to funding opportunities include:

- FSA is reviewing FSFL policies to determine whether certain flexibilities can be made, or waivers granted, to further reduce FSFL financial obligations for producers in immediate need of grain storage following extreme weather events.
- FSA is undertaking a major initiative to streamline and automate Farm Loan Program processes, which will improve customer service and expand credit access. Though not climate-specific, these changes will reduce the burden for producers seeking financing and make them more economically resilient to the effects of climate change on their farms.
- USFS is broadly seeking to integrate climate adaptation and resilience into all relevant competitive funding, in accordance with recommendations prepared in response to the USDA Secretary's Memo on Climate Resilience and Carbon Stewardship, including continuing efforts related to the Forest Legacy Program and IRA-FLS, described above.
- NIFA is continuing to review RFAs and programs to identify additional opportunities to integrate climate adaptation into funding streams. NIFA will continue to offer webinars to highlight funding opportunities relevant to climate adaptation and resilience.
- FAS is drafting an update to the climate-related language in the FY24 McGovern-Dole NOFO.

Ensuring that all applicants, whether they are individuals, communities, or organizations, have equitable access to these fundings streams is a priority for USDA. NRCS is prioritizing projects focused on underserved producers and climate smart agriculture and forestry, offering enhanced payment rates to program participants, and revising the minimum annual payment for FY24 CSP to recognize operational size and efficiency differences. FSA's Increasing Land, Capital, and Market Access Program is working to increase access to farm ownership opportunities, improve results for those with heirs' property or fractionated land, increase access to markets and capital that affect the ability to access land, and improve land ownership, land succession, and agricultural business planning. Rural Development and the Forest Service use the Climate and Economic Justice Screening tool (CEJST) to identify disadvantaged communities and incorporate this information into scoring criteria for funding opportunities. The Forest Service is expanding its Community Navigator Initiative in 2024 to support disadvantaged communities in accessing Forest Service programs, services, and competitive funding opportunities. These populations include Tribes, rural communities at high risk of wildfire and/or climate extremes, small acreage landowners, and new partners that have not previously worked with the agency. Finally, many of the programs described in this section are part of the Biden-Harris Administration's Justice40 Initiative, which set the goal of 40 percent of overall benefits of certain Federal investments in climate, clean energy, affordable and sustainable housing, clean water, and other areas flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution.

C. Climate Training and Capacity Building for a Climate Informed Workforce

Enhancing the climate literacy and capacity of USDA's workforce is critical to ensuring that the Department can best serve our stakeholders in a changing climate. A common understanding of what climate change is and its effects on agriculture, forestry, and rural communities is a useful foundation. However, the diversity of USDA's mission requires also educational resources and engagement that is unique to the work of specific agencies and job series.

The most significant Department-level climate literacy effort since USDA's 2021 Climate Adaptation Plan was a monthly, year-long Climate Science Seminar Series. The series looked across agricultural, forested, grassland, food-, and forest-product systems, and included the biophysical and social sciences to understand the impacts of climate change, options for adaptation and mitigation, the variable impacts on communities of people, and interactions with economic and social systems. Each hour-long seminar featured a 40-minute presentation by scientists from USDA, other Federal agencies, universities, non-governmental organizations, and private industry followed by 15-20 minutes for questions. Live participation was limited to USDA staff and a few Extension professionals, to create an environment where a range of questions could be asked, and afterwards the recordings were made widely available. Personnel from 24 of 29 USDA agencies and offices attended at least one seminar and attendance ranged from 246 to 1339 attendees (average 738/seminar, Table 13). Attendance was broad across position types and job descriptions, including scientific, technical, and administrative staff as well as some senior executives. This series has provided a strong scientific foundation upon which agencies are building more specialized training.

Table 13: USDA Climate Employee Climate Training and Capacity

Climate Training Efforts	~ 3% of USDA employees viewed Climate Science Seminar Series (2973 unique participants)
	~ 130 Senior Leadership individuals (primarily within NRCS and FSA) have received training that included climate change effects and adaptation responses
	~ 65% of certified USDA contracting professionals completed a climate training course
Agency Capacity	25 – 12,000 number of full- time USDA employees (FTE) with climate adaptation-related duties (range includes employees for whom climate change is integrated into at least 20% of their work, representing somewhere between 0.03 to 13% of the total USDA workforce)
	≥ 228 contractors, interns, fellows, and other non-FTEs with climate adaptation-related duties

Within agencies, an array of climate literacy and capacity building efforts are taking place, a few examples of which include:

- NRCS is engaging employees through a range of formats including regional NRCS Climate Town Halls, 1-hour basic climate and conservation sessions for State office and technical specialists, and thematic webinars hosted by the Office of the Regional Conservationists. USDA's Climate Hubs have provided Climate Conversation sessions to over 3,000 NRCS staff in 24 States and 4 above-State/regional groups. These 1-2 hour sessions are tailored to each location to describe climate change impacts and how climate-smart agriculture and forestry-related practices can support adaptation.

- During disaster program training for all employees in 2023, FSA provided a climate 101 presentation, which included FSA's Adaptation Plan and what it means for the FSA workforce. The Midwest Climate Hub has established a collaboration with Iowa FSA leadership to provide climate training to their staff.
- From August to November 2023, FAS hosted a 13-part, agency-wide Climate Change Literacy Series with subject-matter experts speaking on different climate change topics, while tying them to FAS' overall mission. Each session had a weekly average of 80 attendees from FAS Washington and Overseas posts, with the most popular session reaching a capacity of 168 live attendees.
- RD has developed training to support their field staff in implementing and ensuring compliance with the new Federal Flood Risk Management Standard (FFRMS).
- Approximately 200 members of USDA's acquisition workforce received training on Climate Risk and Procurement as part of its regular training series.

Intra-agency coordination and engagement occurs via regular meetings with different levels of leadership from the Office of the Secretary, Mission Area, Agencies, and staff and Departmental offices. OEEP hosts a monthly meeting of USDA's Global Change Task Force, providing Department-level updates and hearing updates from Agencies and offices on recent accomplishments and upcoming activities. In late 2022, OEEP began convening quarterly meetings with climate adaptation leads from across the Department as a platform for sharing lessons learned, building intra-agency partnerships, and identifying data and other climate adaptation-related needs.

Many USDA agencies (e.g., APHIS, NIFA, NRCS, and ERS) have formed internal climate teams to coordinate within their agencies on issues related to climate change and ensure they are responsive to climate-related demands from both the top-down and bottom-up. Internal SharePoint platforms have become a common means of sharing climate change information with a wider number of agency staff. NRCS and FSA have been particularly effective at engaging leadership within their agencies in climate literacy activities. For example, climate change sessions at each of the NRCS National Leadership Team Meetings in FY 2023 and 2024 have engaged 97-104 national and State-level leaders each meeting.

One means of building the climate capacity of USDA's staff has been the establishment of USDA's Climate Change Fellows Program (CCFP), through which Fellows are hired to time-limited appointments in the Excepted Service under "Schedule A" hiring authority, as specified in 5 CFR 213.3102(r). NRCS has used workforce analysis and planning to identify key disciplines needed to support climate adaptation and mitigation activities and is using the CCFP to fill some of this need. The Forest Service is also increasing climate change workforce capacity through climate-focused cohorts of the Resource Assistants Program, using BIL funding. Beginning in February 2023, a new cohort of approximately 20 recent graduates has been onboarded every 6 months. These individuals are placed in 8-12 month internships where they work on climate change adaptation, carbon analysis, and sustainability before converting into permanent positions. NIFA has recently filled permanent positions, including a new division director to lead the Global Climate Change Division and a National Program Leader focused on climate data systems and analysis, and is also using the CCFP to support climate-related programs and reporting.

In the immediate future, agencies and offices plan to advance climate literacy and engagement in the following ways:

- NRCS will continue to inventory existing training and identify modules where climate information could be easily integrated to meet training needs as well as encourage the use of Climate Quick Reference Guides, developed by the Southwest Climate Hub, to support the work of NRCS field staff.
- OCP and OPEM will survey USDA's acquisition workforce in FY 2024 to assess existing knowledge and skills related to climate smart acquisition and identify areas of focus for future communications and training.
- FSA will continue to broaden collaborations with the Climate Hubs to provide training to FSA staff when feasible. FSA is also considering developing materials and training to help staff understand climate issues and how program and loan products can be used to achieve a customer's environmental and conservation goals.
- The Forest Service will continue its work with the American Society of Adaptation Professionals (ASAP) to identify and address gaps in workforce climate literacy. Existing resources have already been catalogued, a gap analysis has been completed, and learning programs for certain job categories have been outlined. The next step is to develop full learning programs for line officers, climate change coordinators, and resource specialists that will consist of existing and to-be-developed resources.

Over the lifespan of this Adaptation Plan, USDA will continue to identify new ways to enhance climate literacy to ensure the Department is equipped to meet its climate goals and respond to the effects of climate change.

SECTION 4: DEMONSTRATING PROGRESS

A. Measuring Progress

To better capture adaptation and resilience outcomes across the Federal Government CEQ has developed process metrics that aim to demonstrate progress towards these outcomes. Below are USDA's responses for 6 process metrics which will serve as a benchmark to grow from as we advance our efforts on climate adaptation and resilience.

Outcome	**Climate adaptation and resilience objectives and performance measures are incorporated in planning and budgeting of USDA programs by 2027.**
Process Metric	**Step 1: USDA has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken.** Yes **Step 2: USDA has a list of discrete actions that will be taken through 2027 as part of our implementation plan.** Yes
USDA Response	This updated USDA Climate Adaptation Plan, in combination with Agency and Office Climate Adaptation Plans, will direct implementation of climate adaptation actions for 2024 and beyond. In late 2025, OEEP will initiate a process to update the Agency and Office Adaptation Plans, which will include folding in the actions described here, if not already included in prior Plans. Climate adaptation is a stated objective (1.2) in USDA's 2022-2026 Strategic Plan and has been incorporated into several Agency Strategic Plans, also.
Process Metric	**USDA has an established method of including results of climate hazard risk exposure assessments into planning and decision-- making processes.** Partially
USDA Response	Due to the diversity of USDA's mission across its 29 Agencies and Departmental offices, there is no single type or method for using climate risk assessments that would be suitable across these many organizations. At the Department-level, the Office of Budget and Program Analysis is working to better integrate climate change risks into the Enterprise Risk Management process and the Office of Energy and Environmental Policy is supporting Agencies and offices in developing and implementing agency-level Climate Adaptation Plans. Both of these efforts will position agencies and offices to make more climate-informed decisions.

Process Metric	**USDA has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions.** Partially, ongoing
USDA Response	As described in Section 3B(2), in developing the FY 2026 budget, OBPA will direct USDA Mission Areas and Agencies to consider results of climate risk exposure assessments during Enterprise Risk Management. Then during budget planning and formulation, these entities will be required to identify their top enterprise risks and integrate discussion of these risks into their budget justification. Assessments of climate-related financial risk to USDA programs is supported by technical capacity across multiple USDA agencies, including the ERS, RMA, and USFS.
Process Metric	**Step 1: By July 2025, USDA will identify grants that can include consideration and/or evaluation of climate risk.** Complete, ongoing **Step 2: USDA modernizes all applicable funding announcements/grants to include a requirement for grantees to consider climate hazard exposures.** Partially, ongoing
USDA Response	Per Section 3B(5), grant programs across USDA have been identified where climate adaptation language can and has been incorporated. As part of ongoing and iterative climate adaptation, USDA will continue to identify opportunities to address climate risks and support adaptation through funding opportunities, where appropriate.

Outcome	**Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.**
Process Metric	**Agency has identified the information systems that need to incorporate climate change data and information and will incorporate climate change information into those systems by 2027.** Partially, ongoing
USDA Response	Through adaptation planning and coordination efforts, USDA Agencies and offices have identified systems that already use climate-related information and other areas where climate information and data could be used to enable climate-informed decision-making. As described in Section 3B(1), USDA Agencies and offices are committed to improving USDA's capacity to use climate information and data and apply it, where appropriate, to support delivery of USDA's mission.

Outcome	**Agency Climate Adaptation Plans address multiple climate hazard impacts and other stressors and demonstrate nature-based solutions, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives.**
Process Metric	**By July 2025, 100% of climate adaptation and resilience policies have been reviewed and revised to, as relevant, incorporate nature-based solutions, mitigation co-benefits, and equity principles.** Yes, ongoing
USDA Response	Adaptation planning at the Agency and office level has provided the framework for assessment of policies and programs relevant to climate adaptation. Where relevant, these policies and programs are considering climate adaptation as well as other cross-cutting themes and priorities, including equity, environmental justice, nature-based solutions and climate mitigation. USDA will continue this work to mainstream climate adaptation so that it is an integral consideration, when relevant, in the early phases of policy and program development.

Outcome	**Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.**
Process Metric	**Step 1: Agency has assessed climate exposure to its top 5 most mission-critical supply chains.** Yes **Step 2: By July 2026, agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards.** Partially, ongoing
USDA Response	In preparing this Plan, OCP has taken strides to identify mission critical acquisitions, and the general and climate-related vulnerabilities to their supply chain. This effort will serve as a foundation to develop and implement plans to minimize climate-related supply chain disruptions.
Process Metric	**Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services.** Partially
USDA Response	OCP will include a subsection devoted to managing climate change vulnerabilities and exposure within the acquisition process into the USDA Program Management Deskbook that is currently under development. OCP also plans to require that Mission Area Senior Contracting Officers submit action plans to address identified climate hazards within the supply chain.

Outcome	**By 2027, USDA staff are trained in climate adaptation and resilience and related agency protocols and procedures.**
Process Metric	**Step 1: By December 2024, 100% of USDA leadership has been briefed on current climate adaptation efforts and actions outlined in this Plan.** Planned **Step 2: Does the agency have a Climate 101 training for your workforce?** Yes, ≥ 3% USDA staff have completed **Step 3: By July 2025, 100% of employees have completed climate 101 trainings.** Partially
USDA Response	As appropriate, USDA leadership will be briefed on the current state of climate adaptation efforts and the actions outlined in this Plan. The USDA Climate Science Seminar Series currently serves as the most comprehensive, foundational, and accessible resource for climate literacy across USDA. Agencies and Offices are building off this work and developing their own mission- and workforce-specific trainings. USDA employees will complete climate training as relevant and needed for their individual roles. Given the diversity of USDA's mission, basic climate literacy, and the format in which it is delivered, varies widely between agencies.

B. Adaptation in Action

USDA's 2021 Climate Adaptation Plan identified five Adaptation Actions that articulate how USDA can help the agriculture and forestry sectors, and rural communities, build resilience and adapt to the effects of climate change. These Actions are still relevant and provide a context for this 2024-2027 Climate Adaptation Plan. Below we highlight a selection of USDA efforts in support of these Actions to demonstrate our progress.

Action 1: Build resilience across landscapes with investments in soil and forest health.

USDA's Natural Resources Conservation Service (NRCS) is leveraging the Regional Conservation Partnership Program (RCPP) to collaborate with partners to support innovative projects that address climate change, enhance water quality, and address other critical challenges on agricultural land. In 2023, NRCS announced $1.1 billion for 81 RCPP projects, made possible by the Inflation Reduction Act. Either as a direct benefit or co-benefit, many of these projects will enhance soil health and increase the climate resilience of the agricultural producers. Examples of such projects in 2023 include:

- A project in California to implement high-efficiency irrigation systems that will reduce water consumption, manage erosion, improve soil health, foster enriched habitats, and reduce greenhouse gas emissions.
- A project in Scott County, Iowa to implement climate-smart conservation practices that will help manage for flood and drought risk, water quality, soil health and wildlife habitat.
- A project in the northern Great Plains to increase adoption of soil health practices, including no-till and cover crops, which will include outreach to underserved producers and partner with Tribal communities.

Action 2: Increase outreach and education to promote adoption of climate-smart adaptation strategies.

The National Institute of Food and Agriculture (NIFA) established a program area priority within one of its flagship funding programs to forge stronger regional partnerships between USDA's Climate Hubs and the Cooperative Extension Service. These projects leverage the combined capacity of Extension and the Hubs to reach agricultural producers, land managers, and diverse communities across the country. Through the A1721 Extension, Education and USDA Climate Hubs Partnership program area priority of the Agriculture and Food Research Initiative's Foundational and Applied Science Program, NIFA invested $18 million in 12 projects in FY22 and FY23. Examples of these projects that aim to enhance climate adaptation and resilience, include:

- A project with the Northern and Southern Plains Climate Hubs to develop and implement educational and outreach resources that promote the adoption of climate-smart practices to reduce the risk of drought, wildfire, and woody encroachment on livestock production.
- A project with the Southeast Climate Hub to develop and deliver science-based climate-smart forestry Extension education to landowners, professionals, and natural resource managers.
- A collaboration with the Northwest and California Climate Hubs to build stronger regional networks of agricultural organizations and peer-to-peer producer communities of practice to advance resilience to drought and other climate risks, particularly for small and mid-scale underserved producers.
- A partnership with the Caribbean Climate Hub to build the capacity of community health centers in Puerto Rico and the U.S. Virgin Islands to prepare for and manage climate change impacts to agricultural workers.

Action 3: Broaden access to and availability of climate data at regional and local scales for USDA Mission Areas, producers, land managers, and other stakeholders.

USDA's Forest Service (USFS) developed the Climate Risk Viewer, a new tool to assess climate risks and vulnerabilities and identify gaps between management plans and climate pressures. The Climate Risk Viewer brings together spatial information from 131 high-quality datasets about wildfire and firesheds, ecological trends, climate risks, and Forest Service management intention. USFS continues to develop, improve, and provide guidance for the application of the Climate Risk Viewer to National Forest System management. To build on this work, USFS is supporting a collaborative effort with a range of stakeholders and technology service providers to advance innovation and technology to support climate-informed forest management for the broader land management community, that encompasses landscapes beyond the National Forest System.

Action 4: Increase support for research and development of climate-smart practices and technologies to inform USDA and help producers and land managers adapt to a changing climate.

Science to understand the effects of climate change and advance climate adaptation and resilience cuts across many priority areas of USDA's Agricultural Research Service (ARS), from plant genetics and diseases to human nutrition and sustainable agricultural systems. In one example of adaptation-related research, ARS scientists in North Dakota are collaborating with partners at the University of Alaska Fairbanks to explore the impacts of climate change on Alaskan

agriculture and develop effective adaptation strategies. This includes identification of crops that may be better suited to the changing conditions and considering growing areas within Alaska. In the long run, this work hopes to foster a sustainable approach to agriculture in Alaska that minimizes soil degradation and other negative impacts, while fostering more economically resilient and food secure local communities.

Action 5: Leverage the USDA Climate Hubs to support USDA Mission Areas in delivering adaptation science, technology, and tools.

USDA's Climate Hubs and Agencies are working together to build workforce climate literacy, improve access to and use of climate change-related information, and translate science for application in USDA conservation and land management activities. Recent examples of supporting activities include:

- The Northwest Climate Hub co-hosted two workshops to build peer-to-peer learning and share information on drought, the U.S. Drought Monitor, and climate adaptation options for producers and staff from NRCS, FSA, and Extension.
- NRCS has established 10 NRCS Climate Hub Co-Leads to work with each of the 10 regional Hubs, to represent NRCS needs to the Hubs, oversee collaborative activities, and serve as a conduit of information.
- The Forest Service Rocky Mountain Research Station, in collaboration with the Northern Plains Climate Hub and other USFS staff, is developing templates and guidance to incorporate climate and related data into rangeland National Environmental Policy Act (NEPA) analysis.
- The Caribbean Climate Hub is building on its ADAPTA project and working with NRCS, USFS, and Extension to create bilingual, sector-specific adaptation guides for tropical forestry and agriculture.

ABBREVIATIONS

AMS	Agricultural Marketing Service
APHIS	Animal and Plant Health Inspection Service
ARS	Agricultural Research Service
AFRI	Agriculture and Food Research Initiative
BIL	Bipartisan Infrastructure Law
CEJST	Climate & Economic Justice Screening Tool
CEQ	White House Council on Environmental Quality
COOP	Continuity of Operations Plan
CRP	Conservation Reserve Program
EO	Executive Order
ERM	Enterprise Risk Management
ERS	Economic Research Service
FAS	Foreign Agricultural Service
FNS	Food and Nutrition Service
FPAC	Farm Production & Conservation
FSA	Farm Service Agency
FSIS	Food Safety and Inspection Service
FTE	Full-time equivalent
FY	Fiscal year
GAO	U.S. Government Accountability Office
IRA	Inflation Reduction Act
NASS	National Agricultural Statistics Service
NBS	Nature-based solutions
NCA	National Climate Assessment
NIFA	National Institute of Food and Agriculture
NRCS	Natural Resources Conservation Service
OBPA	Office of Budget & Program Analysis
OCE	Office of the Chief Economist
OCP	Office of Contracting & Procurement
OEEP	Office of Energy and Environmental Policy
OHS	Office of Homeland Security
OMB	White House Office of Management and Budget
OPEM	Office of Property and Environmental Management
OTR	Office of Tribal Relations
RD	Rural Development
RCP	Representative concentration pathway
RCPP	Regional Conservation Partnership Program
REE	Research, Education, & Economics
RMA	Risk Management Agency
USDA	United States Department of Agriculture
USFS	United States Forest Service
WCS	Wildfire Crisis Strategy

APPENDIX 1: DATA SOURCES FOR CLIMATE RISK ASSESSMENT

USDA used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App), which was developed for Federal agencies by the White House Council on Environmental Quality (CEQ) and the National Oceanic and Atmospheric Administration (NOAA) to conduct a high-level screening of climate hazard exposure for Federal facilities and personnel.

Facilities

Facility data comes from the publicly available Federal Real Property Profile (FRPP). The General Services Administration (GSA) maintains FRPP data and Federal agencies are responsible for submitting detailed asset-level data to GSA on an annual basis. Although FRPP data is limited—for example, not all agencies submit complete asset-level data to GSA, facility locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures, and properties may be excluded on the basis of national security determinations— it is the best available public dataset for Federal real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of Federal facilities to climate hazards.

Personnel

Personnel data comes from the Office of Personnel Management's (OPM) non-public dataset of all personnel employed by the Federal Government that was provided in 2023. The data contains a number of adjustments, including exclusion of military or intelligence agency personnel, aggregation of personnel data to the county level, and suppression of personnel data for duty stations of less than 5 personnel. Despite these adjustments, this data is still useful for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

Climate Hazards (Tables 1 and 2)

The climate data used in the risk assessment comes from the data in Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool. When agency climate adaptation plans were initiated in 2023, CMRA data included climate data prepared for the Fourth National Climate Assessment (NCA4). Additional details on this data can be found on the CMRA Assessment Tool Data Sources page. Due to limited data availability, exposure analyses using the Federal Mapping App are largely limited to the contiguous United States (CONUS). Additional information regarding Alaska, Hawai'i, U.S. Territories, and marine environments has been included as available.

Table 1: Climate data used in USDA risk assessment

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for NCA4.	RCP 4.5	CONUS
		RCP 8.5	CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for NCA4.	RCP 4.5	CONUS
		RCP 8.5	CONUS and AK
Sea Level Rise	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High sea level rise scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5	CONUS and PR
		RCP 8.5	CONUS and PR
Wildfire Risk	Measured as whether an asset is in a location that is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR

Table 2: Climate scenarios considered in USDA risk assessment

Scenario Descriptor		Summary Description (taken from 5th National Climate Assessment)
RCP 8.5	Very High Scenario	RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46% less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

APPENDIX 2: SUMMARY OF MAJOR MILESTONES

The following is a summary of ongoing and new actions described throughout Section 3. Effort has been made to avoid duplication, however where there is crossover between purposes or aims, actions may be repeated.

Agency/ Office	Hazard	Action	Timing	Indicators of success
3A(1) Addressing Climate Hazard Impacts on and Exposures to Federal Buildings				
OPEM	All	Re-launch USDA Sustainable Operations Council	Ongoing	Regular meetings
OPEM	All	Develop CHER Tool	2024-2025	Application of tool
OPEM	Flooding	Identify flood risks and evaluate alternatives in leasing processes	Ongoing	Fewer flood incidences
OO	All	Integrate resilience provisions into building modernization projects	Ongoing	Provisions into project plans
AMS	All	Integrate climate risks into COOP development	2025	Completed COOP
ARS	All	Maintain COOPs. Building and equipment maintenance for extreme weather resilience.	Ongoing	Updated COOPs Fewer post-disaster expenses
FPAC-BC	All	Integrate climate goals into space management policy	FY24	Completed policy
FPAC-BC	All	Integrate climate goals into Facilities Program Manual	FY24	Completed manual
FPAC-BC	All	Conduct facility condition assessments	FY24-27	Resilience in assessments
USFS	Wildfire	USFS facilities assessment for wildfire risk	2024-2027	# facilities assessed
USFS	Flooding	Quantify facility flooding risk	Ongoing	# facilities assessed
USFS	All	Train USFS recreation professionals and line officers	2024	# employees trained
USFS	Precip. Flooding	Evaluate at-risk dam spillway capacities	Ongoing	# dams evaluated
USFS	Wildfire	Work with BAER team to identify damaged assets	Ongoing	# assets assessed
3A(2) Addressing Climate Hazard Impacts on and Exposures to Federal Employees				
OBPA	All	Integrate climate risk into enterprise risk management	Ongoing	Climate risk in ERM
OHS	All	Adapt emergency planning, preparation, & operations	Ongoing	Future risk considered
Multiple	All	Review communication needs and redundancies	Ongoing	Resilient comms plan
Multiple	All	Communicate climate-related risks to employees	Ongoing	# of articles/items
AMS	All	Develop plan to manage climate risks to employees	2025	Plan complete
FNS	All	Staff disaster and emergency response training	FY24	# employees trained
FPAC-BC	All	Complete development of Disaster Preparedness Template	Ongoing	Deliver to agencies
FPAC-BC	All	Consideration of fleet preparedness for disaster response	Ongoing	Resilient fleet plan
FSA	All	Continue to operationalize ‘jump teams’	Ongoing	# events responded to
FSA	All	Train and support employees to maintain mission-delivery	Ongoing	# employees trained

Agency/ Office	Hazard	Action	Timing	Indicators of success
FSIS	All	Review safety and hazard reporting	Ongoing	Data submitted and review complete
FSIS	Heat	Maintain heat-stress guidance and products for IPP	Ongoing	# heat stress illness prevention items distributed
FSIS	All	Continue annual Workplace Safety & Health Hazards training	Ongoing	% employees trained
NRCS	All	Follow through on efforts originating from COOP update	Ongoing	COOP tasks complete
NRCS	All	Interagency agreement to establish Working Lands Climate Corps	Ongoing	# of people employed
RD	All	Create and use dashboard for climate risks to employees	FY24-26	Dashboard complete
USFS	All	Interagency agreement to establish the NCCC Forest Corps	2023-2028	# of people employed
USFS	All	Implement agreement with Student Conservation Association	2023-2028	# of people employed
USFS	All	Implement agreement with Conservation Legacy Ancestral Lands Conservation Corps	2023-2026	# of people employed
USFS	Fire	Implement BIL-supported temporary pay increase for wildland firefighters	Ongoing	# employees w/higher pay
3A(3) Addressing Climate Hazard Impacts/Exposures to Federal Lands, Waters, and Cultural Resources				
USFS	Wildfire	Implement Wildfire Crisis Strategy	Ongoing	Meet FY24 goal
USFS	Wildfire	Implement the National Prescribed Fire Resource Mobilization Strategy	Ongoing	Prescribed fire usage by USFS
USFS	All	Implement Joint Chiefs' Landscape Restoration Partnership Program projects with adaptation benefits	Ongoing	$ invested
USFS	All	Implement National Reforestation Strategy	2022-2030	Meet 2030 target
USFS	All	Modernization of Watershed Condition Framework	Ongoing	Climate risks incorporated
USFS	All	Update water resources directives	2024-2027	Update complete
USFS	All	Allocate $28 million to fund 11 additional Collaborative Aquatic Landscape Restoration (CALR) projects	FY24	$ invested
USFS	All	Forest Service National Post-Disaster Recovery Team	Ongoing	Regular meetings
USFS	All	Establish an Enterprise Emergency Management Council	2024	# events responded to
USFS	Drought	Design & deploy a drought vulnerability assessment	FY24	# workshops held
USFS	All	Allocate $7.7 million available FY24 invasive species prevention, detection, and eradication in NFS	FY24	Acres treated
USFS	All	Revise Silviculture Manual (FSM 2470)	Ongoing	Revision complete
USFS	All	Continue to integrate adaptation into recreation planning	Ongoing	# Facilities assessed
USFS	All	Integrate adaptation into land management plan amendments	Ongoing	# plans revised/128

Agency/ Office	Hazard	Action	Timing	Indicators of success
USFS	All	Integrate adaptation into "Strengthening Tribal Consultations and Nation to Nation Relationships" implementation	Ongoing	Climate in consultations
USFS	All	Hold Tribal Forest Protection Act workshop	FY24	# trainers trained
3B(1) Accounting for Climate Risk in Planning and Decision Making				
OEEP	All	Finalize additional agency & office adaptation plans	2023-2024	Plans complete
OEEP	All	Develop and hold briefing sessions on application of climate data in agency processes	2024	# attendees & sessions held
OEEP	All	Update agency-level climate adaptation plans	FY25-26	Plans revised
OPEM	All	Use CHER tool to prioritize capital planning and space management projects	2026	Tool applied to planning
APHIS	All	Apply climate suitability maps in decisions on survey design and trade policy development	Ongoing	Maps used in planning
NASS	All	Use Google Earth Engine to estimate crops impacted by climate-related extreme weather events	Ongoing	Methods implemented
NASS	All	Use climate information system to inform NASS Agricultural Statistics Board about climate change-related impacts to agricultural production	Ongoing	Methods implemented
NRCS	All	Finalize recommendations on integration of climate change into NRCS tools	FY24	Rec's delivered
RD	All	Development of Loan Portfolio Disaster Dashboard	Ongoing	Dashboard applied
RD	All	Development of Weather-Adjusted Economic Risk Dashboard	Ongoing	Dashboard used
USFS	All	Adapt informational guidance and training on Planning policy for climate change	2024	# resources w/ climate
3B(2) Incorporating Climate Risk Assessment into Budget Planning				
OBPA	All	Implement new process for FY26 budget development to include results of climate hazard risk exposure assessments	FY24	ERM guidance updated
ERS/All	All	As needed, support development of financial-related climate risk assessments	Ongoing	Analyses complete
3B(3) Incorporating Climate Risk into Policy and Programs				
OBPA	All	Integrate adaptation considerations into the development of USDA's Environmental Justice Strategic Plan	2024	Adaptation language included
OPEM	All	Real property resilience incorporated into Departmental Manual on Sustainable Operations	2024-2027	DM complete
OHS	All	Include language on climate effects and precautions in USDA COOP	Ongoing	COOP complete
OHS	All	Include climate risks in USDA response to National Security Memorandum-16	Ongoing	USDA response submitted
OTR/OEEP	All	Incorporate climate adaptation into planned Tribal Consultations when appropriate	FY24	Include climate adaptation in framing papers when applicable

Agency/ Office	Hazard	Action	Timing	Indicators of success
ARS	All	Use internal ARSx and Grand Challenges Synergies programs to promote innovative and cross-disciplinary climate research	Ongoing	# projects advancing climate adaptation science
ARS	All	Use LTAR and GRACEnet science networks to conduct cutting edge climate research	Ongoing	# projects advancing climate adaptation science
FAS/OCE	All	Highlight climate adaptation and resilience practices within the SPG Coalition	2024-2027	Inclusion of adaptation
FAS	All	Grow the work of the new International Climate Hub	2024-2027	# international partners engaged
FAS	All	Implement climate-smart agriculture fellowship and exchange programs	2024-2027	# participants
FAS	All	Integrate adaptation into sanitary and phytosanitary systems activities	2024-2027	Climate effects on SPS considered
FNS	All	Revise USDA Foods disaster response regulations (7 CFR 250.69 and 250.70)	Ongoing	Regulations revised
NASS	All	Implement new methods for June Area Survey	FY24	Methods implemented
NIFA	All	Expansion of AFRI FAS A1461 to support research and Extension focused on environmental justice	FY24	Projects funded
NRCS	All	Review and revise policy and guidance for stewardship of perpetual easements	Ongoing	Climate included in revisions
NRCS	All	Include environmental justice in equity training	2024-2027	# employees receiving training
RD	All	Revise 7 CFR Part 1924 Subpart A to include climate resilient building practices	2024-2027	Revision complete
RMA	All	Develop new risk management products for specialty crop producers	Ongoing	# new products offered
USFS	All	Integrate climate change into guidance for forest-level management planning, consistent with 2012 Planning Rule	2024	Guidance issued
USFS	All	Update USFS Silviculture Manual	2024-2027	Update complete
USFS	All	Develop policy and guidance to encourage beneficial use of forest restoration byproducts	2024-2027	Policy/guidance finalized
USFS	All	Prepare additional direction to integrate adaptation into recreation and designated areas planning	2024-2027	Guidance finalized
USFS	All	Develop proposal to update Wildlife, Fish, and Sensitive Plant Habitat Management directives	2024-2027	Proposal completed/adopted
USFS	All	Develop proposal to update the Water Resource Management Directives	2024-2027	Proposal completed/adopted
3B(4) Climate-Smart Supply Chains and Procurement				
OCP	All	Include climate risks in Acquisition MASCO Reviews (AMR)	FY24	AMRs complete
OCP	All	Research (and potentially acquire) supply chain risk management software	2024-2027	Software acquired

Agency/ Office	Hazard	Action	Timing	Indicators of success
OCP	All	Conduct process mapping and policy creation to support Agriculture Priorities & Allocation Systems ratings	2024-2027	Ratings adapted
OCP	All	Expand use of Procurement Forecasting Tool	2024-2027	# of tool uses
OCP	All	Integrate climate goals into Government Purchase Card (GPC) use and platforms	2024-2027	GPC policies updated
OCP	All	Integrate climate vulnerabilities into Project Management Deskbook	Ongoing	Deskbook complete
OCP	All	Require Senior Contracting Officers to submit action plans that account for supply chain climate risks	FY25	Plans submitted
OCP	All	Establish and staff Acquisition Project Management Office	FY24	Staff onboarded
3B(5) Climate Informed Funding to External Parties				
AMS	All	Include climate resilience language in RFAs, when appropriate	Continuous	# NOFOs with adaptation
FAS	All	Update language in McGovern-Dole NOFO	FY24	# projects received with adaptation
FSA	Storms	Review Farm Storage Facility Loan policies for flexibilities to speed up assistance	Ongoing	Policies changed
FSA	All	Streamline and automate Farm Loan Program processes	Ongoing	# loans/time period
NIFA	All	Review RFAs and programs for climate adaptation opportunities	Continuous	# RFAs with adaptation
NIFA	All	Webinar to share agency-wide climate adaptation funding opportunities	FY24	Annual climate adaptation funding level
NRCS	All	Review funding opportunities for adaptation and resilience	Continuous	# of NOFOs with adaptation
USFS	All	Integrate climate adaptation and resilience into all relevant competitive funding	Continuous	# programs with adaptation criteria
USFS	All	Update National Forest Carbon Monitoring dataset to support Forest Legacy project development	Ongoing	Dataset updated
USFS	All	Issue NOFO for Forest Landowner Support cost-share programs	FY24	NOFO issued
USFS	All	Invest additional $44 million in Community Navigators	FY24	# individuals served
3C Climate Training and Capacity Building for a Climate Informed Workforce				
OCP/OPEM	All	Survey USDA acquisition personal for knowledge and skill gaps	FY24	Training plan developed
FSA/ Climate Hubs	All	Expand work with USDA Climate Hubs to support FSA training	2024-2027	# employees trained
NRCS	All	Identify and adapt training materials to meet needs	Ongoing	# employees trained
USFS	All	Develop and deploy learning programs with ASAP	Ongoing	Learning programs ready

APPENDIX 3: ASSESSMENT OF OPTIONS TO ENHANCE THE RESILIENCE OF AGRICULTURAL PRODUCERS TO THE IMPACTS OF CLIMATE CHANGE (RESPONSE TO GAO 23-104557)

A. Introduction

This Appendix to USDA's 2024-2027 Climate Adaptation Plan addresses the Recommendation for Executive Action from the January 2023 U.S. Government Accountability Office (GAO) report titled "CLIMATE CHANGE: Options to Enhance the Resilience of Agricultural Producers and Reduce Federal Fiscal Exposure (GAO-23-104557)." Within the context of increasing climate change impacts and growing Federal fiscal exposure, the aims of this report were to (1) examine USDA efforts to enhance the climate resilience of agricultural producers and (2) identify potential options to further enhance these activities (Table 1).

GAO's Recommendation for Executive Action for USDA was to further analyze the options identified within the report and integrate them into ongoing climate adaptation and resilience planning, as appropriate. In response to GAO's recommendation, USDA committed to integrating consideration of these options into its departmental adaptation planning process. This appendix to USDA's 2024-2027 Climate Adaptation Plan represents that consideration, with input from USDA's Office of Energy and Environmental Policy (OEEP), the Natural Resources Conservation Service (NRCS), the Farm Service Agency (FSA), the Risk Management Agency (RMA), and USDA's Climate Hubs. In addition to the discussion of each option below, these agencies and programs will continue to consider these options in future adaptation and strategic planning processes.

GAO used their *Disaster Resilience Framework* to structure the study, sorting the thirteen identified options among the Information, Integration, and Incentive principles of the Framework. The recommendations primarily focus on policies and programs within NRCS, FSA, and RMA, as well as USDA's Climate Hubs, a multiagency program. USDA engaged with GAO during the development of the study and some of the feedback provided during that process is available in Appendix IV of the report. This appendix, a supplement to USDA's 2024-2027 Climate Adaptation Plan, expands on that initial feedback and reflects the most up-to-date thinking on the relative strengths and weaknesses of each of the GAO options. For each option, we discuss the extent to which USDA is already advancing certain measures and if not, the barriers or limitations that may make an option challenging to implement. Many of the options are complementary so there may be some overlap in how USDA is addressing multiple options. As noted by GAO, USDA's work is likely strengthened by pursuing a selection of the options presented here.

Table 1: Potential policy options identified by GAO for USDA to enhance the climate resilience of agricultural producers, using the principles of GAO's *Disaster Resilience Framework*

Information	Options to help producers further enhance their climate resilience by improving producer access to information that is authoritative and understandable.
1.	Collect data on practices that enhance climate resilience.
2.	Expand technical assistance to prioritize and promote practices that enhance climate resilience.
3.	Prioritize climate resilience in whole-farm conservation planning.
4.	Expand the capacity and expertise of USDA's Climate Hubs.
Integration	Options to help producers enhance their climate resilience through integration of agency planning to help decision makers take coherent and coordinated resilience actions.
5.	Develop an agricultural climate resilience plan that addresses regionally specific needs.
Incentives	Options to help producers enhance their climate resilience by providing additional incentives through the Department's agricultural risk management and conservation programs.
6.	Establish standards for climate-resilient agricultural operations.
7.	Revise the Natural Resources Conservation Service's Conservation Practice Standards to include practices that enhance climate resilience.
8.	Expand conservation program eligibility to include and prioritize practices that enhance climate resilience.
9.	Expand the capacity of USDA's conservation programs to help producers enhance their climate resilience.
10.	Research the feasibility of incorporating climate resilience into crop insurance rates.
11.	Require the adoption of relevant climate-resilient practices to receive premium subsidies.
12.	Offer crop insurance premium subsidies for agricultural producers who use practices that enhance their climate resilience.
13.	Require that producers adopt practices that enhance climate resilience to be eligible for certain Farm Bill Title I programs.

B. Assessment of GAO Options to Help Enhance Producers' Climate Resilience

Option 1: Collect data on practices that enhance climate resilience to demonstrate the benefits of those practices and ensure that data are accessible to a variety of stakeholders.

GAO Option 1 encourages USDA to leverage data about conservation practice outcomes to demonstrate and communicate the climate resilience benefits of those practices to producers. This Option aligns with USDA and Agency-level Climate Adaptation Plan actions that aim to help farmers and land managers manage their unique climate risks by providing decision support tools and information.

NRCS's Conservation Effects Assessment Project (CEAP) is one way in which USDA is already working to quantify the effects of conservation practices across the Nation's working lands. CEAP uses natural resource and farmer survey data and physical process modeling to estimate the environmental effects of conservation practices on five different focus areas: cropland, grazing land, wetland, wildlife, and watersheds. These assessments include practices that span many land uses and resource concerns and of which climate adaptation and resilience is a direct or co-benefit (e.g. wetland assessments to contain floodwaters, ecosystem services from key rangeland practices – brush management, herbaceous weed treatment, and prescribed grazing,

and the impact of cover crops and reduced tillage practices on nitrogen and phosphorus dynamics on cropland).

NRCS shares data on conservation practice implementation via NRCS programs publicly using the Soil and Water Resources Conservation Act (RCA) Data Viewer. This information alone however is not sufficient to communicate to producers the benefits of risk-reducing practices. In the context of NRCS's Climate Adaptation Plan, NRCS has established a working group dedicated to improving data management and outcomes for climate adaptation. This group also aims to produce useful data and tools to support climate change adaptation decision-making by the agency. Equipping NRCS staff with resources and data about climate risks and adaptation responses will strengthen the technical assistance they are able to provide to producers. As part of ongoing climate adaptation, NRCS will consider actions such as:

- Improving practice implementation data collection and reporting with greater detail and more results.
- Expanding CEAP to include assessment of practices for climate change benefits.
- Strengthening internal and external collaborations with research organizations to support evaluation of conservation practice benefits.

Like NRCS, FSA is also taking steps to better quantify the benefits of conservation practices delivered through their programs. Many of the Monitoring, Assessment, and Evaluation (MAE) projects that work to address soil and forest health of land enrolled in Conservation Reserve Program (CRP) have climate resilience benefits in addition to the climate mitigation benefits they primarily target. MAE could be further leveraged to determine if sufficient climate resilient practices exist within the current suit of conservation practices or if new practices need to be added in response to a wider range of climate stressors across diverse farming operations.

Both FSA and NRCS identified the critical need for continued partnership with USDA's Research, Education, and Economics (REE) agencies to leverage the research they conduct and support to better understand the climate resilience benefits of different agricultural practices. Also essential is an understanding of the co-benefits or tradeoffs with these practices and the need to balance adaptation and resilience with sustainably increasing agricultural production and achieving climate mitigation goals. The Agricultural Research Service (ARS) supports this work through its National Programs (NP), including NP 305: Crop Production, NP 211: Water Availability & Watershed Management, NP 212: Soil and Air, and NP 216: Sustainable Agricultural Systems. ARS also manages the Long-Term Agroecosystem Research (LTAR) Network, a series of 18 research locations across the United States that develop strategies to sustainably intensify agricultural production, which includes managing for the effects of climate change. The National Institute of Food and Agriculture (NIFA) supports proposals that address the need to better understand conservation practices through efforts like the Agriculture and Food Research Initiative's (AFRI) Foundational and Applied Sciences (FAS) and Sustainable Agricultural Systems (SAS) programs. The Economic Research Service (ERS) and National Agricultural Statistics Service are working to improve the timeliness of data collection and release, including developing a national-level conservation data platform. While much of this work is being undertaken to improve quantification of greenhouse gas benefits, with support from the Inflation Reduction Act, many of these practices have climate adaptation co-benefits and will contribute to the goals of Option 1. Finally, USDA's Climate Hubs can play a key role in translating scientific outcomes into useable information and tools for USDA field staff delivering conservation technical assistance.

Option 2: Expand the technical assistance provided by USDA and other key partners to prioritize and promote practices that enhance climate resilience.

Option 2 identifies the important role that conservation technical assistance, through USDA's NRCS, can play in helping producers adapt and be more resilient to the impacts of climate change. NRCS's Climate Adaptation Plan recognizes the need to not only expand technical assistance, but to also strengthen NRCS's consideration of climate change effects and responses in its existing business practices and programs.

To advance implementation of their Climate Adaptation Plan, NRCS stood up a short-term Climate Change Adaptation Technical Team (CCATT). The CCATT provided foundational recommendations for how NRCS should integrate information on climate impacts and adaptation into the NRCS conservation planning process. Some of these recommendations are still being considered by agency leadership, while others have already been incorporated (see Option 7).

NRCS is dedicating significant effort to improve the climate literacy of its professional conservation planners to enhance technical assistance for climate-smart agriculture, which includes climate adaptation. Examples of recent and ongoing efforts include:

- Developing a Climate-Smart Agriculture and Forestry Toolkit for use by staff at the State and county level.
- Integrating climate science and resource impacts into NRCS State Technical Committees.
- Enhancing cross-agency coordination by identifying State- and national-level climate points of contact.
- Enhancing cross-agency communication by establishing an internal, online climate change resource center, publishing a monthly internal climate newsletter, and initiating bimonthly virtual meetings on issues related to climate change.
- Collaborating with USDA's Climate Hubs to develop tools, curricula, webinars, and other resources.

NRCS is also leveraging programs and initiatives like the Regional Conservation Partnership Program and the NRCS Plant Materials Centers (PMCs) to support innovative projects to address climate change and other critical challenges to agricultural producers. A recent progress report on climate-smart agriculture activities from the Plant Materials Program describes how the PMCs are helping conservation planners choose appropriate plant species and varieties for a changing climate.

Looking ahead, depending on capacity and resources, NRCS will continue to partner in new ways with USDA's Climate Hubs, particularly on workforce climate literacy, to ensure that NRCS's field staff is equipped to help producers manage climate change-related challenges. NRCS could also potentially expand the work of the PMCs on climate adaptation and resilience. Looking beyond NRCS conservation technical assistance, the National Cooperative Extension Service will be a critical partner in helping producers assess and manage for climate change effects on their lands. Through AFRI FAS funding, NIFA is currently supporting the development of a climate action plan for Extension that will direct efforts to help producers, land managers, and rural communities address the causes and consequences of climate change.

Option 3: Prioritize climate resilience in whole-farm conservation planning and incentivize it through USDA's conservation programs to enhance producers' climate resilience.

Option 3 suggests that USDA prioritize climate resilience in "whole-farm conservation planning" and incentivize "whole-farm planning" through its conservation programs. Taking a whole-farm view aligns with a climate-smart agricultural approach that prioritizes and balances sustainably increasing agricultural production, adapting to climate impacts, and opportunities to reduce greenhouse gas emission and increase carbon sequestration.

As described in response to Option 2, NRCS stood up a Climate Change Adaptation Technical Team (CCATT) to develop recommendations for how NRCS should integrate information on climate impacts and adaptation into the NRCS conservation planning process. The initial steps of this process take a holistic view of a producer's operation and include:

1. *Identify problems and opportunities.* Initial opportunities and problems are first identified while working with the customer.
2. *Determine objectives.* The customer identifies their objectives, while the planner guides the process so that it includes the customer's needs and values, the resource uses, and on-site and off-site ecological protection
3. *Inventory resources.* Natural resource, economic, and social information for the planning area is collected to further define problems and opportunities, develop alternatives, and evaluate the plan.
4. *Analyze resource data.* The planner studies the resource data and defines existing conditions for all the identified natural resources, including limitations and potentials for desired use.

NRCS conservation planners will help producers define the scope of their conservation planning efforts, but at their core, NRCS's conservation programs are voluntary and locally led. Prioritizing whole-farm planning may dissuade participation by producers who want to initially address a specific resource concern or test a single conservation practice on one part of their operation.

As described in Option 2, NRCS is taking significant steps to increase the capacity of its field staff to understand climate change risks and identify response options, in particular during conservation planning. NRCS is curating data and developing tools to support NRCS decision-making at the State and local level; a drought dashboard has already been developed and deployed, a wildfire dashboard is in development, and flood risk data have been collected and evaluated. Through its Resource Inventory Assessment Division (RIAD), NRCS has updated its Priority Data Layers Project to visualize past treatment and future opportunities for (1) mitigating climate change, (2) advancing equity in program delivery, and (3) promoting conservation in urban and peri-urban areas. Dependent on capacity and resources, future updates could consider how to overlay climate change-related risks with these existing indicators.

Option 4: Expand capacity and expertise of USDA's Climate Hubs to help producers make informed decisions on climate resilience.

GAO Option 4 proposes to grow the technical capacity and expertise of the Climate Hubs to expand their reach and impact. This option is consistent with the prominent role of the Climate Hubs identified in USDA's 2021 Action Plan for Climate Adaptation and Resilience and Climate-Smart Agriculture and Forestry Strategy: 90-Day Progress Report (2021).

USDA's Climate Hubs develop and deliver science-based information and technologies to farmers and other natural resource managers to enable climate-informed decision-making, reduce agricultural risk, and build resilience to the effects of climate change. The ten regional domestic Hubs and one international Hub achieve this through assessment and synthesis of scientific information, development of tools and technology paired with technical assistance, and stakeholder education, outreach, and engagement. While a significant portion of the Hubs' work is outward-facing, working with external partners, the Hubs also play a crucial inward-facing role, strengthening the capacity of USDA agencies to mitigate and adapt to climate change.

Established in 2014, the Hubs are hosted and funded by USDA's Agricultural Research Service (ARS), Forest Service (USFS), Natural Resources Conservation Service (NRCS), and Foreign Agricultural Service (FAS), with contributions from other USDA research and program agencies. At the national level, the Hubs are overseen by an Executive Committee comprised of senior program leaders from across USDA, led by a National Lead that rotates biennially between ARS, FS, and NRCS, and supported by a National Coordinator, a permanent position located within USDA's Office of Energy and Environmental Policy.

Each Hub is led by a director, who oversees the regional implementation of the Hub's mission, including regional program priorities, staffing, budgeting, and evaluation. Each Hub is supported by a Coordinator, who manages and supports science synthesis, tool development, communication, and education efforts, and provides connection and cohesion within each Hub and with external partners. Climate Hubs Co-Leads from ARS, NRCS, and FS ensure collaboration between the Hubs and their home agencies at the regional level and provide advisory support to the Director. Additional staffing levels are dependent on the priorities of each Hub and can include fellows, early-career individuals that assist in implementing Hub strategies and projects, and liaisons, temporary detailees who work with Hubs to develop and deliver projects that are beneficial to their host agency and act as subject matter experts.

In the past 2-3 years, there has been a significant increase in funds, including through the Inflation Reduction Act, for the Climate Hubs to carry out additional projects and activities. This is enabling the Climate Hubs to hire term Climate Fellows and other staff that can support specific networking and training for field and leadership staff within USDA and for external partners, as well as climate-related tool development and science synthesis. Despite the influx of funds, the limited number of full-time equivalent (FTE) staff for the Climate Hubs has remained relatively static over its 10-year lifespan. Additional resources had been dedicated to contractors or fellows in temporary positions to carry out focused projects. The lack of growth in FTE positions has made it challenging to build expertise and foster lasting stakeholder relationships at the regional and national level. One challenge is that funding from the USDA agencies that contribute to the Climate Hubs can be variable and uneven depending upon the prioritization of the Hubs by each agency. This limits the ability for the Hubs to hire permanent staff necessary for program continuity. Another challenge is that as funding and term positions have grown at the regional level, national support has remained limited to two positions, one permanent and one term. These, and other concerns will be identified during this year's Hub 5-year review process, beginning in 2024, and may be addressed in the next Hub Strategic Plan.

In the future, expanded support of the Climate Hubs could allow the program to broaden its reach, diversify projects, and ensure stability and consistent expertise. In the context of this Adaptation Plan, increased capacity and expertise of the Hubs would strengthen the Hubs' ability to help USDA agencies aid producers in preparing and responding to the effects of climate

change. Challenges arise when funding is transient and inconsistent, making it difficult to build permanent capacity and sustain long-term projects and engagements.

Option 5: Develop an agricultural climate resilience plan that addresses regionally specific needs by coordinating within USDA, across relevant Federal agencies, with producers, and with other key stakeholders.

Option 5 proposes that USDA develop and implement a strategic plan focused on adapting and building resilience of agricultural production and producers to the impacts of climate change. This plan would place an emphasis on regional climate risks and opportunities and be informed by engagement and input from Federal agencies and diverse agricultural stakeholders.

USDA regularly prepares a department-wide Climate Adaptation Plan and carries out annual progress reporting based on the White House Council on Environmental Quality's guidance for Federal climate adaptation planning. USDA's Office of Energy and Environmental Policy (OEEP) leads these activities, in accordance with USDA Departmental Regulation 1070-001: USDA Policy Statement on Climate Change Adaptation, to integrate climate change adaptation into USDA's mission, operations, and assets. To account for the diverse risks and opportunities that climate change poses to USDA's 28 agencies and offices, USDA released agency-level climate adaptation plans in 2022 that build on the Department-level plan and further integrate adaptation into agency-level management. Through these efforts, USDA is working to manage the effects of climate change on its mission delivery and support the Nation's agricultural producers, forest land managers, rural communities, and food systems in adapting and building resilience to climate change.

Overlaying a separate adaptation planning process on this existing framework would likely be duplicative. However, the underlying principles of Option 5, a regional emphasis on addressing climate risks to producers, have merit and in some ways are already integrated into USDA's climate adaptation efforts. USDA's Farm Production and Conservation agencies (NRCS, FSA, and RMA), Research, Education, and Economics agencies (ARS, NIFA, ERS, and NASS), and Marketing and Regulatory Program agencies (APHIS and AMS) are all already working to manage the diverse threats climate change poses to agricultural production across the United States. NRCS is supporting practices and projects that enhance the adoption of climate-smart farming practices through its conservation programs, while USDA's research agencies are supporting development of crop and livestock varieties that are adapted to changing climate conditions. USDA's Climate Hubs address regional climate change challenges to agriculture, both by working with external partners and with USDA agencies. Individual Hubs work with USDA agency staff in their region to train them on regional climate risks, adaptation options, and ways to use tools and data to manage those risks and assess options.

In terms of elevating regional climate risks and opportunities, much of this is borne out at the agency-level when acute or chronic climate hazards are addressed through existing programs. Taking NRCS as an example, many of the projects funded by the Regional Conservation Partnership Program address regional climate challenges via Critical Conservation Areas designated by the Secretary of Agriculture. NRCS maximizes local flexibility for using conservation practice standards to address natural resource issues by sharing examples, integrating new technologies, and prioritizing national review of practices that will have the most impact helping producers adapt to climate changes. NRCS has taken initial steps to review and provide updates to policy where needed to maximize local flexibility. NRCS has provided

guidance to States on how to create geographically specific payment scenarios. This new guidance addresses, among other issues, the inability to add or change scenarios in response to emergency needs such as droughts, flooding, fire, and industry supply disruptions.

Moving forward, as the challenges climate change poses to agriculture grow, USDA will strive to maintain momentum its mainstreaming of climate adaptation throughout its mission. This will include enhancing the use of climate change data and information in planning and decision-making and bolstering the capacity of customer-facing programs to provide support to producers dealing with climate impacts. This will be underpinned by the critical work of USDA research agencies to develop regionally appropriate technologies and approaches to ensure farmers can keep farming well into the future.

Option 6: Establish standards for climate-resilient agricultural operations to help create incentives for practices that enhance climate resilience and improve marketability.

With Option 6, GAO proposes that USDA establish standards for climate resilient farming operations, potentially akin to USDA's National Organic Program, with the intent to incentivize adoption of practices that enhance producers' climate resilience and product marketability.

Creation of standards for climate-resilient agriculture operations has the potential to be duplicative of ongoing government programs and private industry efforts to incentivize the adoption of agricultural practices with climate mitigation benefits. For example, USDA is investing $3.1 billion in its Partnerships for Climate-Smart Commodities Program to expand markets for climate-smart commodities. The 141 projects through this effort are pilots, meant to inform approaches related to implementing climate-smart practices, measuring their climate benefits, and creating markets for the associated commodities. Many of the approaches and practices that are being tested by Partnerships projects have adaptation and resilience co-benefits. It will be important to learn from these approaches before developing a "climate-smart" standard, which could include both mitigation and adaptation benefits.

GAO notes that developing agricultural climate resilience standards would require significant stakeholder coordination and collaboration. USDA agrees that coordination with stakeholders would be essential and offers anecdotal evidence to suggest that stakeholders are not yet interested in USDA climate-resilient standards. To understand and share the most successful climate mitigation and marketing strategies arising from Partnerships for Climate-Smart Commodities projects, USDA is engaging Partnership grant recipients in a Learning Network. Through frequent engagement with grant recipients, USDA is learning that recipients do not have consensus on whether USDA standards for climate mitigation would advance climate-smart market development. Some grant recipients have expressed an interest in USDA standards, while many others are not interested in standards-based incentives. Further, there are divergent opinions on what such standards should reflect, how they could be measured or verified, and whether it is possible to generate one set of standards applicable to a wide range of agricultural products. Therefore, reaching consensus to generate such standards for climate resilient practices is unlikely, especially given the outstanding need to quantify their benefits (Option 1), and presents a high barrier to pursuing this strategy.

Lack of Congressional authority is another barrier to implementing Option 6. The USDA National Organic Program (NOP) offers an example of a successful federally regulated labeling program. It is important to note however that establishment of NOP and organic farming

standards was authorized via passage of the Organic Foods Production Act of 1990. No such authority yet exists to support USDA establishment of climate-resilient farming standards.

Beyond USDA, there already several certification schemes for ecological or regenerative agriculture, for example Savory Institute's Land to Market Initiative, A Greener World's "Certified Regenerative" label, and others. These initiatives typically include a focus on soil health, holistic management, and natural resource conservation that may already fill the niche for climate-resilient agricultural standards. Regenerative labels already appear in retail markets, and many standards developers are spearheading initiatives with consumer packaged goods companies that have broad supply chains and market influence. An additional challenge that standard setting creates is determining whether to make the standards outcome-based or practice-based. Existing regenerative agriculture standards are split on if they require the adoption of practices (practice-based) or are focused on measurable outcomes (outcome-based), and there is no consensus on which approach is better.

USDA can incentivize adoption of climate resilient practices without creating accompanying standards which would likely be costly to develop and potentially outweigh the marketing benefits. As described in other options, NRCS is working to integrate climate resilient agricultural practices through their conservation planning process and existing conservation programs.

Option 7: Revise the Natural Resources Conservation Service's Conservation Practice Standards to include the identification and evaluation of existing and new conservation practices that enhance producers' climate resilience.

With Option 7, GAO suggests that NRCS revise its Conservation Practice Standards to better identify and evaluate existing and new practices that can enhance the climate resilience of producers. In the NRCS Climate Adaptation Plan, Action Area 4 proposes to address this need through maximizing "local flexibility for using Conservation Practices to address natural resource issues by sharing examples, integrating new technologies, and prioritizing national review of practices that will have the most impact helping producers adapt to climate changes."

The NRCS Climate Change Adaptation Technical Team (CCATT), introduced in the discussion of prior Options, was staffed by 7 full-time NRCS technical staff on a 120-day detail with the goal to provide recommendations to NRCS on how to integrate climate impact and adaptation information into NRCS conservation planning. Recommendations made by the CCATT included those related to:

- Natural resource concerns that may be associated with climate change stressors.
- Conservation planning criteria, assessment procedures, tools, and considerations that can be adjusted to better address climate change-related resource concerns.
- Conservation practices and activities that may support adaptation or can be updated to better address adaptation needs.

Some of these recommendations included, for example, proposed revisions to the existing natural resource concern framework used to assess and identify conservation opportunities, the integration of additional climate data layers and information into agency conservation planning tools, and the development of draft fact sheets that can help conservation planners understand and plan for projected resource concerns caused by climate change. While these

recommendations are currently under review, NRCS is working to implement them, as appropriate.

As NRCS continues to implement this and other priority actions identified in its Adaptation Plan, NRCS will continue to look for opportunities to improve the Conservation Practice Standards with available resources. Option 7 is closely linked with Options 1-3 and will be dependent on many of the enabling conditions previously raised, including climate literacy of the NRCS workforce, sufficient technical expertise within NRCS, and collaboration with USDA's research agencies and Climate Hubs.

Option 8: Expand eligibility to include and prioritize climate-resilient practices in the administration of USDA's conservation programs.

With Option 8, GAO suggests that USDA could expand conservation program eligibility by prioritizing applications from:

- Producers' seeking to apply climate resilience-building practices,
- Regions at higher risk of climate change-related impacts, or
- Lands with climate adaptive and resilient qualities at risk for conversion to non-agricultural uses.

Both NRCS and FSA have taken actions in the past or have ongoing efforts to expand eligibility and prioritize climate-resilient practices through USDA conservation programs.

NRCS's approach has been to expand eligibility at the funding or allocation level by having focus areas within programs and program rankings, such as special initiatives or funding pools. A prior example is the Environmental Quality Incentives Program (EQIP) Cover Crop Initiative, where NRCS made $38 million in additional assistance available in 11 States to help producers mitigate climate change through widespread adoption of cover crops. While the focus was on the potential of this natural and inexpensive solution in increase carbon sequestration in soils, the soil health benefits from cover crops can improve resilience of the soils to climate impacts. Climate change factors continue to be a consideration within NRCS allocation processes; however, additional work is needed to further integrate climate adaptation needs and priorities.

FSA has been working to update its programs to integrate climate-resilience co-benefits within existing conservation programs. For example, FSA has expanded Conservation Reserve Program (CRP) eligibility by:

- Moving State Acres for Wildfire (SAFE) back into Continuous CRP to allow for year-round sign-up.
- Making the Highly Erodible Land Initiative (HELI) eligible for both General CRP and Continuous CRP.
- Expanding the Clean Lakes, Estuaries, and River 30 (CLEAR30) pilot program nationwide.

FSA is always considering improvements to its programs and will continue to look for ways to include climate-resilient practices. One action FSA is considering taking is updating the environmental benefits index (EBI), which is used to rank general CRP offers. The EBI could be updated to increase the weight of the climate ranking factor. FSA would need to determine how that would affect the other ranking factors that make up the EBI score. FSA will continue to

partner with NRCS to ensure that conservation practice standards that meet the definition of climate resilient can be reviewed and considered for FSA conservation programs.

Option 9: Expand the capacity of USDA's conservation programs to prioritize enrollment of acreage that helps producers enhance their resilience to climate change.

Option 9 encourages USDA to expand the capacity of its conservation programs administered by NRCS and FSA to prioritize enrollment of acreage that helps producers enhance their climate resilience. Helping producers adapt to the effects of climate change and build resilience on their farms is important but must be balanced with other economic and environmental interests, including but not limited to, sustainably enhancing agricultural productivity. While this Option appears to focus on financial assistance from USDA's conservation programs, technical assistance, as discussed in Option 2, is a critical component to ensure appropriate and effective conservation decision-making. This Option is also closely linked to Option 1 in that the benefits of climate resilient farming practices need to be better understood to appropriately match farm acreage to potential climate risks and conservation options.

FSA has already created a Climate-Smart Incentive within CRP that provides additional payments for CRP practices "that will increase carbon sequestration, reduce greenhouse gas emissions, and otherwise are climate-smart practices," many which have climate adaptation co-benefits. The payments support establishment of trees, grasses, wildfire habitat, and wetland restoration. FSA could review the Climate-Smart Incentive and the environmental benefits index (EBI) to ensure they adequately incentivize climate-smart practices, which would help FSA prioritize enrollment of CRP acres that enhance producers' climate resilience. Congressional action would be required to increase the total acres enrolled in CRP programs beyond those authorized in the Farm Bill. Another potential action FSA could take is to explore expanding pilot programs like the Soil Health and Income Protection Program (SHIPP). The program allows producers up to 5 years to develop a systems approach with multiple practices as part of a production crop rotation, which could increase conservation program capacity for climate resilient practice implementation.

NRCS has ongoing work dedicated to increasing the acreage on which climate adaptive and resilience-building practices are implemented, including by improving data management and quantification of conservation outcomes (Option 1). NRCS has collected and evaluated data for priority climate stressors (drought, wildfire, and flooding) and has developed or initiated development of decision-support tools to support decision-making and prioritization. Conservation easements are an important part of NRCS's portfolio of conservation programs. Easements can be used to protect critical landscapes such as wetlands, helping to maintain ecosystems services like water regulation and retention that can buffer the impacts of extreme weather events and other climate change effects. The Agricultural Conservation Easements Program (ACEP) aids landowners and eligible entities with conserving, restoring, and protecting wetlands, productive agricultural lands, and grasslands at risk of conversion to non-grassland uses. Landowners voluntarily offer to sell an easement to NRCS that provides the agency with the full authority to restore and enhance the floodplain's functions and values through the Emergency Watershed Protections Programs Floodplain Easement Option.

Finally, with resources from the Inflation Reduction Act, NRCS will be investing $19.5 billion over 5 years in conservation practices, activities, and projects that support climate change

mitigation. While this funding is directed toward climate change mitigation, several of the supported Climate-Smart Mitigation Activities may also provide adaptation and resilience co-benefits. For example, while cover crops help to increase carbon sequestration in soils, the increased soil cover and organic matter can also help increase soil moisture-holding capacity and prevent soil erosion, which may increase resilience to climate change impacts such as increased drought and changing precipitation patterns.

Option 10: Research the feasibility of incorporating data on the projected impacts of climate change on agriculture and data on the effects of climate-resilient practices into crop insurance rates.

Option 10 suggests that USDA's Risk Management Agency, RMA, which manages the Federal Crop Insurance Corporation (FCIC) consider how to incorporate projections of climate impacts on agriculture and adaptation response into crop insurance rates. As required by law, Federal crop insurance is an actuarially sound insurance program, meaning that the premium charged should be equal to expected indemnities, plus a reasonable reserve. This means that, to the extent that climate change affects the risk profile of a given commodity, and thus the expected indemnities, the premium charged should change accordingly. Option 10 suggests that RMA should consider integrating additional data on climate impacts or implementation of climate-resilient farming practices into the insurance rating methodology to improve the accuracy of premium rates.

USDA regularly reviews its rating methodology and incorporates historical loss data into updating premium rates. For example, RMA shortened the historical time horizon used to establish premium rates from around 45 years down to a rolling 20-year period, which makes premium rates more responsive to changes in risk. These regular and timely updates incorporate recent climate change-related impacts and adoption of existing climate-resilient practices by producers. Furthermore, RMA's premium rating methodology includes a self-adjusting mechanism whereby yield guarantee changes with a producer's productivity. Considerations of future climate change projections would likely impact the overall risk assessment and would have to be considered alongside potential changes in technology and improvements in farming practices that may mitigate risk.

Nonetheless, inquiry into the impacts of climate change on crop insurance is vital, as increasing climatic variability will place demands on RMA's programs. RMA's Climate Adaptation Plan highlights the need for this research on an ongoing basis. RMA also encourages private individuals and the private sector to engage with the FCIC by proposing specific insurance products or other revisions. The Post Application Coverage Endorsement is a recent example of a programmatic change that was developed via stakeholder contributions.

Option 11: Require the adoption of relevant climate-resilient practices to receive crop insurance premium subsidies.

Option 11 suggests that RMA should require farmers to implement climate risk-reducing agricultural practices to receive Federal crop insurance premium subsidies. USDA's approach to agricultural conservation and risk management is voluntary and incentive-based, however, the approach this option proposes is more prescriptive. Implementing requirements such as this would likely require Congressional authorization. Putting in place this option would require a strong response to Option 1 to ensure that conservation practice requirements were applied in the right contexts and had clear climate resilience benefits. Furthermore, there is a mismatch

between the annual timescale on which farmers purchase crop insurance and the multiple years it often takes to realize climate resilience benefits of ongoing conservation practice implementation.

Crop insurance is a key pillar of farm support within USDA's safety net programs. Its adoption is extremely high, with well over 90 percent of principle crops covered in the United States. Already, requirements exist for participants in the program to follow good farming practices (GFPs) to maintain their crop insurance coverage. The Highly Erodible Land Conservation (HELC) and Wetland Conservation (WC) provisions are examples of a more prescriptive incentive structure already in place. These provisions require certain conservation actions be taken by farmers to receive financial support from Federal farm programs. The 2014 Farm Bill made certification of and adherence to HELC and WC a condition for receiving crop insurance premium subsidies. As a result, 99.9 percent of crop insurance customers are compliant (those out of compliance must pay the full premium cost without subsidy or do not purchase insurance at all). Program participation has continued to grow since passage of 2014 Farm Bill; thus, it does not appear that the HELC and WC provisions are significant barriers to wider adoption of crop insurance by farmers and ranchers.

Option 12: Offer crop insurance premium subsidies for agricultural producers who use practices that enhance their climate resilience.

Option 12 is similar in its aim to Option 11, but less prescriptive in its approach to encourage adoption of climate-smart practices by increasing the amount of crop insurance subsidies. This Option aligns well with part of USDA's approach, described in RMA's Climate Adaptation Plan, to incentivize climate-smart practices like cover crops. There is an existing authority that allows States to provide additional subsidy to producers with crop insurance policies. Iowa, Illinois, Indiana, and Wisconsin have used this authority to provide an additional premium subsidy to producers who used cover crops prior to their insured crops. The aforementioned States identified eligible producers and land and provided this information to USDA to administer the additional subsidy. USDA used this early effort as a model for its national Pandemic Cover Crop Program. These programs have been successful in promoting the link between cover crops and crop insurance and demonstrating the compatibility of cover crops and crop insurance coverage.

Beyond the State authority and the temporary authority during the pandemic, USDA cannot continue to implement incentive programs structured this way, as subsidy levels are determined legislatively. If addressed legislatively, Congress would need to provide authority, funding, and a mechanism for identifying eligible producers and land. Also, whereas cover crops have an existing reporting infrastructure for identification, most climate-resilient practices are not reported uniformly or in a way that is conducive to integrating with crop insurance operations. RMA's Climate Adaptation Plan does address the possibility of continuing these State and national programs in the future, should such authorities exist, especially in regard to cover crops and climate-smart water use.

Option 13: Expand conservation compliance requirements to include the adoption of certain climate-resilient practices for producers to be eligible for certain Farm Bill Title I programs.

Option 13 suggests that USDA consider expanding conservation compliance requirements to include the adoption of climate-resilient practices for producers to be eligible for certain Farm Bill Title I programs. As described in Option 11, the HELC and WC provisions are examples of

where conservation compliance is already a requirement. These provisions require producers participating in most programs administered by FSA and NRCS to abide by certain conditions on any land owned or farmed that is highly erodible or that is considered a wetland. Producers must certify that they will not:

- Plant or produce any agricultural commodity on highly erodible land without following an NRCS-approved conservation plan or system.
- Plant or produce an agricultural commodity on a converted wetland.
- Convert a wetland to make possible the production of an agricultural commodity.

Commodity programs have historically been an essential part of U.S. farm policy by virtue of their history of providing various forms of revenue support. Provisions of Title I, the "Commodity Title," of the 2018 Farm Bill, Agricultural Improvement Act of 2018, Pub. L. No. 115-334, 132 Stat. 4490, authorize current commodity revenue support programs for crop years 2019 to 2023. These programs include marketing assistance loans (MALs), Price Loss Coverage (PLC), and Agricultural Risk Coverage (ARC). MALs provide both a floor price and interim financing for certain commodities. The PLC and the ARC programs provide income support at levels above the price protection offered by MALs. Title I also authorizes four programs that provide Federal assistance to help farmers recover financially from natural disasters, including drought and floods. These programs are (1) the Livestock Indemnity Program; (2) the Livestock Forage Disaster Program; (3) the Emergency Assistance for Livestock, Honey Bees, and Farm-Raised Fish Program; and (4) the Tree Assistance Program.

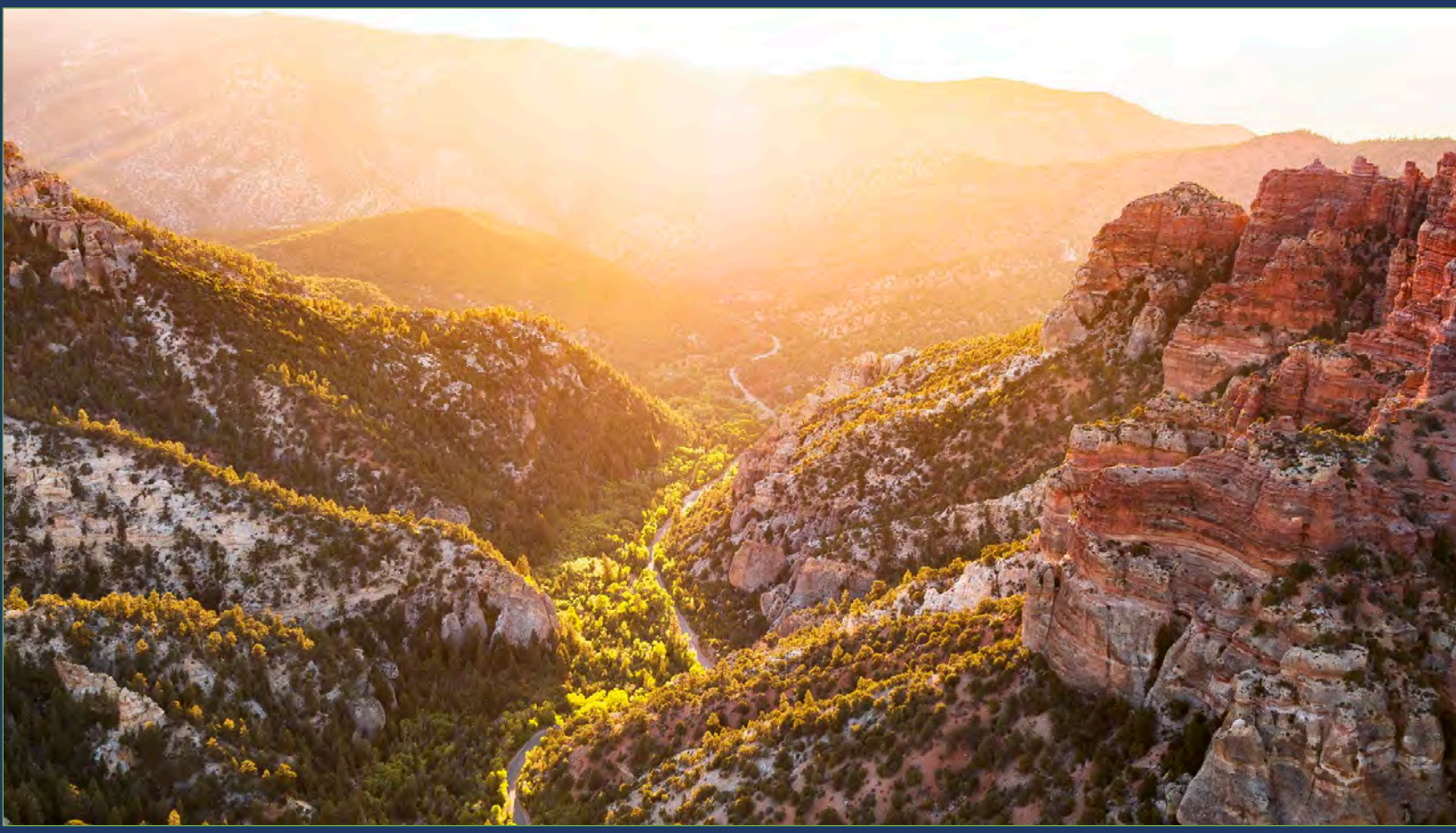
Adding additional eligibility requirements for these programs may impede access for the producers most in need of them. They might also disincentivize producers from participating in voluntary conservation programs due to concerns about the cost or difficulty of implementing climate resilient practices as a prerequisite. Cost effective implementation of climate-resilient practices such as no-till residue management, cover crops, conservation crop rotation, and nutrient and pest management can take years to establish and produce climate-resilient benefits. Producers may not have the equipment and labor necessary to readily transition to and implement these practices if new requirements were put in place. Similar to many of the other options discussed here and as acknowledged in Option 1, there is not yet sufficient data to determine when a return on investment is reached for a range of agricultural operations and regions. These requirements would likely place disproportionate stress on underserved and limited resource producers trying to comply with eligibility requirements to receive USDA benefits.

Requiring adoption of climate smart practices for Farm Bill Title 1 programs might improve climate resilience; however, it is likely not feasible without additional resources to enhance financial and technical assistance to producers to assist in the transition.

C. Conclusion

USDA welcomed this GAO report which identified key policies and programs that USDA can leverage to help farmers adapt and build resilience to the effects of climate change on their operations. In developing the responses presented here, Option 1 stands out as particularly important, that if not addressed could undermine other efforts to enhance the climate resilience of producers. Improving understanding of the costs and benefits of conservation practices that provide adaptation and resilience benefits or co-benefits will enhance conservation planning and

help producers make more informed decisions in a changing climate. Many of the identified options align with ongoing efforts, however some may require additional authorities or resources to implement to the extent envisioned by GAO. The GAO report and the assessment presented here will be useful resources to USDA as it continues to engage in the iterative process of climate adaptation planning and implementation at various levels of the Department.



U.S. Department of Health & Human Services
2024 - 2027 Climate Adaptation Plan

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Xavier Becerra
Secretary of Health and Human Services

U.S. Department of Health and Human Services

2024-2027 Climate Adaptation Plan

Table of Contents

Section 1: Agency Profile

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Mission	To enhance the health and well-being of all Americans, by providing for effective health and human services and by fostering sound, sustained advances in the sciences underlying medicine, public health, and social services.
Adaptation Plan Scope	Assistant Secretary for Financial Resources (ASFR), Administration for Strategic Preparedness and Response (ASPR), Centers for Disease Control and Prevention (CDC), Food and Drug Administration (FDA), Indian Health Services (IHS), and National Institutes of Health (NIH), OASH/Office of Climate Change and Health Equity (OCCHE), Substance Abuse and Mental Health Services Administration (SAMHSA)
Agency Climate Adaptation Official	Reginald Taylor, M.S., PE, PMP
Agency Risk Officer	Christine Jones, PMP
Point of Public Contact for Environmental Justice	Sharunda Buchanan, M.S., Ph.D.
Owned Buildings	2,714 Buildings of 34.3 million gross square feet *(U.S. Department of Health and Human Services (HHS) Automated Real Property Inventory System (ARIS)[1]; Data Snapshot Date: 10/3/2023)*
Leased Buildings	1,420 Buildings of 31.4 million square feet *(ARIS, Data Snapshot Date: 10/3/2023)*
Employees	65,761 Agency Staff Full Time 15,011 Agency Staff non-Full Time *(Federal Climate Adaptation Plan Mapping 2024)*
Federal Lands and Waters	4,322 acres *(ARIS, Data Snapshot Date: 10/3/2023)*
Budget	FY 2022: $108.6 billion FY 2023: $115.4 billion FY 2024 Enacted: $117 billion (P.L. citation 118-47) FY 2025 Budgeted: $130.7 billion (President's Budget)
Key Areas of Climate Adaptation Effort	1. Expanding health program implementation for climate adaptation 2. Optimizing workforce and operational footprint through space management. 3. Enhancing climate literacy in the HHS management workforce 4. Promoting sustainable and climate-resilient operations at HHS Facilities. 5. Ensuring a climate-ready supply of products and services

[1] The Automated Real Property Inventory System (ARIS) is a database of all HHS real property data that is used to help develop and direct real property strategies to support the Department's diverse missions. ARIS data is submitted to the Federal Real Property Management System reporting annually.

Climate change poses a serious current and future threat to the health and well-being of all Americans. The Fifth National Climate Assessments concludes:

> "*It is an established fact that climate change is harming physical, mental, spiritual, and community health and well-being through the increasing frequency and intensity of extreme events, increasing cases of infectious and vector-borne diseases, and declines in food and water quality and security. Climate-related hazards will continue to grow, increasing morbidity and mortality across all regions of the US*[2]"

The health and well-being threats from climate change result from a large number of environmental changes and human exposures that are occurring because of climate change. These include:

- Increased frequency and severity of extreme heat
- Increased air pollution, including wildfire smoke and ozone
- Changes in pollens and allergens
- Increases in range and season length of a variety of vector-borne diseases, including West Nile Virus and Lyme Disease
- Increased risks to food and water safety
- Multiple health risks associated with increased extreme weather events, including severe hurricanes and flooding
- Increased mental and behavioral health stressors, including threats to spiritual well-being, especially for indigenous populations
- Threats to livelihood and economic well-being from increased heat and extreme weather, as well as coastal changes, including sea level rise

The threats to health do not affect all populations equally. The Fifth National Climate Assessment highlights the communities throughout the United States that face greater health risks from climate change associated with historic discrimination and marginalization. These include BIPOC (Black, Indigenous, and People of Color), individuals and communities with low wealth, women, people with disabilities or chronic diseases, sexual and gender minorities, and children[3]. In addition, elderly populations are at higher risk of many climate-related adverse health and well-being outcomes.

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[2] Hayden, M.H., P.J. Schramm, C.B. Beard, J.E. Bell, A.S. Bernstein, A. Bieniek-Tobasco, N. Cooley, M. Diuk-Wasser, Michael K. Dorsey, K.L. Ebi, K.C. Ernst, M.E. Gorris, P.D. Howe, A.S. Khan, C. Lefthand-Begay, J. Maldonado, S. Saha, F. Shafiei, A. Vaidyanathan, and O.V. Wilhelmi, 2023: Ch. 15. Human health. In: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023.CH15

[3] Hayden, M.H., P.J. Schramm, C.B. Beard, J.E. Bell, A.S. Bernstein, A. Bieniek-Tobasco, N. Cooley, M. Diuk-Wasser, Michael K. Dorsey, K.L. Ebi, K.C. Ernst, M.E. Gorris, P.D. Howe, A.S. Khan, C. Lefthand-Begay, J. Maldonado, S. Saha, F. Shafiei, A. Vaidyanathan, and O.V. Wilhelmi, 2023: Ch. 15. Human health. In: *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023.CH15

The complex and myriad nature of threats to health and well-being and the many communities at higher risk from climate change-related health and wellbeing outcomes means that all HHS Divisions are affected by climate change, and that all Divisions have important roles to play in protecting people in the United States from the adverse impacts.

Estimates of the financial risk to HHS programs and services are very few and partial. The most directly applicable analysis comes from the Office of Management and Budget, which published "Climate Risk Exposure: An Assessment of the Federal Government's Financial Risks to Climate Change" in April 2022. This analysis estimated that federal healthcare expenditures associated just with climate change could range between $824 million and $22 billion by the end of the century. The authors note, however, that "this may only be a small portion of the increased Federal costs of health care brought on by climate change." The analysis only includes the costs of illness from ozone and fine inhalable particulate matter with a diameter generally less than 2.5 micrometers ($PM_{2.5}$) air pollution, Valley Fever, Southwest Dust, and wildfire smoke. It did not include vector-, food-, or water-borne illnesses, heat-related morbidity, or mental and behavioral health impacts, among other omissions.

The HHS mission is to enhance the health and well-being of all Americans by providing effective health and human services and by fostering sound, sustained advances in the sciences underlying medicine, public health, and social services. The Department is comprised of twelve Operating Divisions (OpDiv), which administer a wide variety of health and human services and conduct life-saving research for the nation, protecting and serving all Americans, and fourteen staff divisions, which provide coordination, enforcement, management, and policy formulation functions for the Department.

The title of the HHS Sustainability Program is "Go Green Get Healthy HHS," which aims to introduce sustainable practices and build resilience and adaptive capacity in every area of HHS' mission activities and operation. HHS advances sustainable practices, resilience, and adaptive capacity through nine (9) Go Green Get Healthy HHS coordinators, whom HHS' Chief Sustainability Officer leads. The nine (9) HHS Go Green Get Healthy workgroups are OpDiv Chief Sustainability Officer (CSO), Sustainability Outreach Managers, Environmental Managers, Pollution Prevention/Waste Managers, Green Procurement Managers, Energy/Water Managers, Fleet Managers, Electronic Stewardship/Data Center Consolidation Managers, and High-Performance Sustainable Building Managers. Go Green Get Healthy HHS workgroups meet regularly to develop plans, implement strategies, and respond to HHS Chief Sustainability Officer data calls to meet the goals of Executive Orders (EO) 14008 and 14057. HHS' adaptation and resilience efforts are embedded within the HHS' Go Green Get Healthy workgroup leads. The Sustainability Outreach Managers are focused on carbon mitigation as climate vulnerability assessments are progressing. HHS is currently drafting a Sustainability and Climate Adaptation Portfolio Charter, which defines an HHS organizational structure, key roles, and responsibilities to systematically distribute climate adaptation/resilience and carbon mitigation workload across the Department. HHS is planning to issue is Sustainability and Climate Adaptation Portfolio Charter by end of Fiscal Year 2024.

In August of 2021, the HHS Office of the Assistant Secretary for Health (OASH) | Office of

Climate Change and Health Equity (OCCHE) was established with the mission to protect the health of people throughout the U.S. in the face of climate change, especially those experiencing a higher share of exposures and impacts. OCCHE provides expertise and coordination related to climate change and health equity to all Department of Health and Human Services divisions, other federal agencies, and the White House. OCCHE also develops and coordinates numerous deliverables and activities, including implementing several EOs, such as EO 14008 and 14057. OCCHE provides climate and health messaging, training, and initiatives within HHS, the federal government, and the public sector. In addition, OCCHE convenes the HHS Climate Change and Health Equity workgroup, which comprises individuals from all HHS Divisions and serves as the primary HHS coordinating platform for programmatic climate change actions.

In 2022, HHS formalized the HHS Climate Literacy Team, comprised of subject matter experts from the HHS Sustainability Office, OCCHE, HHS Office of Human Resources, and OpDiv representatives. The Team works to coordinate climate training, outreach, and messaging for the Department. The HHS Climate Literacy Team developed climate language for incorporation into employee Performance Management Appraisal Programs (PMAPs) and a strategy for implementation. HHS Human Resources staff worked quickly to ensure that the Department-wide executive performance requirements for the appraisal cycle of Senior Executive Service (SES), Senior Level/Scientific or Professional (SL/ST), and Title 42(f) executive equivalents beginning October 1, 2022 included Critical Element 1 – Leading Change to address Executive Order 14008 – *Tackling the Climate Crisis at Home and Abroad,* with the following language added: Performance Requirement – Promote efforts to improve climate literacy across the HHS workforce, emphasizing education for sustainability. As we advance, the Team will continue to organize awareness events and materials and work to develop training.

Through its Climate Adaptation Plan, HHS is also able to advance environmental justice as part of its mission, consistent with EO 14008 and with EO 14096 on *Revitalizing Our Nation's Commitment to Environmental Justice for All*. As HHS implements its Climate Adaptation Plan to increase the resilience of its facilities and operations, the agency will use its best efforts, as appropriate and consistent with applicable law: to address disproportionate and adverse environmental and health effects (including risks) and hazards, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns; and, provide opportunities for the meaningful engagement of persons and communities with environmental justice concerns. The Office of Environmental Justice (OEJ) within OCCHE coordinates the department's work to protect the health of disadvantaged communities and vulnerable populations on the frontlines of pollution, and other environmental hazards that affect health.

In addition, as a member of the White House Environmental Justice Interagency Council (WHEJAC), HHS received recommendations on Climate Planning, Preparedness, Response, Recovery and Impacts from the WHEJAC. The report includes many recommendations that are relevant to the HHS' work. HHS is reviewing the recommendations and, as appropriate and to the maximum extent permitted by law, is taking steps to address the WHEJAC's recommendations.

Section 2: Risk Assessment

HHS used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App)— which was developed for federal agencies by the White House Council on Environmental Quality (CEQ) and the National Oceanic and Atmospheric Administration (NOAA) to conduct a high-level screening of climate hazard exposure for federal facilities and personnel.

When considering extreme heat and precipitation, HHS only included buildings that could see more than zero days per year above the 99th percentile. HHS assessed the exposure of its buildings; employees; and lands, waters, and cultural and natural resources to five climate hazards: extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk.

2.1 Climate Data Used in Agency Risk Assessment

Table 2 Climate Data Used in Agency Risk Assessment

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS and AK
Sea Level Rise	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High sea level rise scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5	CONUS and PR
		RCP 8.5	CONUS and PR
Wildfire Risk	Measured as whether an asset is in a location is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR

Exposure to extreme heat, extreme precipitation, and sea level rise were evaluated at mid- (2050) and late-century (2080) under two emissions scenarios, Representative Concentration Pathway (RCP) 4.5 and RCP 8.5. Exposure to flooding and wildfire risk were only evaluated for the present day due to data constraints.

2.2 Climate Scenarios Considered in Agency Risk Assessment

Table 3 Climate Scenarios Considered in Agency Risk Assessment

Scenario Descriptor		Summary Description from 5th National Climate Assessment
RCP 8.5	Very High Scenario	Among the scenarios described in NCA5, RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46% less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

2.3 Climate Hazard Exposures and Impacts Affecting Federal Buildings

Table 4: Climate Hazard Exposure to Buildings for Heat, Precipitation, and Sea Level Rise

Indicators of Exposure of Buildings to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of buildings projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually) from 1976-2005	100%	100%	100%	100%
Extreme Precipitation: Percent of buildings projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually) from 1976-2005	99%	100%	100%	99%
Sea Level Rise: Percent of buildings projected to be inundated by sea level rise	1%	1%	1%	1%
	High Risk	**Very High Risk**	**Extreme Risk**	
Wildfire: Percent of buildings at highest risk to wildfire	11%	1%	3%	
	100- or 500- year floodplain			
Flooding: Percent of buildings located within floodplains	2%			

HHS owns and leases a considerable number of buildings, over 4,000, spread across the United States (U.S.) and its territories, each facing varying degrees of exposure to climate hazards. This section pertains to the HHS owned buildings and provides an overview of exposures for Representative Concentration Pathway (RCP) 4.5 in the late century where data exists.

Out of the total HHS-owned buildings that have climate exposure data, 100% will experience a rise in temperature due to global warming. High temperatures can strain building cooling systems, leading to elevated indoor temperatures that pose risks to workers' health and hinder productivity. Moreover, buildings can contribute to heat islands during heatwaves, increasing health hazards for outdoor personnel.

100% of HHS-owned buildings are expected to encounter increased precipitation exposure for up to 2 days more on average. Heightened precipitation can infiltrate buildings and damage subsurface utilities, potentially causing operational disruptions and irreversible losses. It can also introduce waterborne illnesses through runoff.

The rising sea level can have several detrimental impacts on infrastructure, including flooding, erosion of supporting soils, building collapses, saltwater surges into waterways, and transportation delays. Flooding can result in property damage, operational disruptions, and transportation delays. In HHS, 2% (46) of buildings are located in either 100-year or 500-year floodplain maps for where we have data. 1% (27) of HHS buildings are projected to be inundated by rising sea levels. Dauphin Island is particularly vulnerable to rising sea levels. The FDA Gulf Coast Seafood Laboratory Site is in Dauphin Island, Alabama. Dauphin Island is a low-lying barrier island with an average elevation of only 7.2 feet, and it has been in a net erosional phase since the 1950s. In 2007, Dauphin Island was 16% smaller than in 1958. The rise in sea level will make Dauphin Island more susceptible to coastal storm surges, including weaker, seasonal storms. These factors could have a substantial impact by increasing erosion, permanently inundating some areas, and leading to higher salinity levels in estuaries and freshwater aquifers.

The FDA is addressing flooding from sea-level rise and storm surges at both the current Dauphin Island laboratory in Dauphin Island, Alabama, and the future site for a new laboratory. Both locations have not historically, nor expected for the foreseeable future, experienced flooding. The existing laboratory is protected by a 25’ sheet-pile seawall which in turn protects numerous Indigenous Historical Shell Mounds that also act as a natural barrier against tidal flooding, and the fact that all buildings have been constructed on elevated piers. Additionally, the facility grounds are intentionally graded to allow for maximum water surge drainage back into the canal and Bay. However, multiple large-capacity pumps are maintained on-site should an unforeseeable flood occur and two, elevated, fully redundant 300-kW Tier 4+ generators and an elevated fuel supply are maintained to provide full-power for up to two weeks after tropical events. FDA is working closely with the design firm for the new laboratory to address current climate risks and prepare for increasing future risks at that site.

HHS has identified 359 HHS-owned buildings, accounting for 14% of the total, with a high, very high, or extreme probability of wildfire exposure. Wildfires have the potential not only to damage or destroy these buildings but also to disrupt critical services such as power, gas, communications, transportation, and water supply. Smoke from wildfires can impact health hundreds of miles from site of the fire. Wildfire smoke can cause respiratory, cardiovascular, and eye issues, along with sinus irritation, fatigue, increased heartbeat, and inflammation.

HHS has 4,214 acres of land predominantly used for institutional work, office building locations, and research and development. HHS is not a federal land management agency, meaning HHS land is generally closed to the public. However, conserving and restoring lands may increase climate adaptation and resilience, including preserving water and restoring ecosystems that support water supply reliability, resiliency to drought, and resistance to flooding. HHS will review existing and planned land conservation activities to discover opportunities for increasing climate adaptation and resilience based on the lands that surround its buildings

2.4 Climate Hazard Exposures and Impacts Affecting Federal Employees

Table 5: Climate Hazard Exposure to Federal Employees for Extreme Heat, Extreme Precipitation, and Sea Level Rise

Indicators of Exposure of Employees to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005	100%	100%	100%	100%
Extreme Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005	99%	100%	99%	99%
Sea Level Rise: Percent of employees duty-stationed in counties projected to be inundated by sea level rise	8%	14%	8%	16%
	High Risk	**Very High Risk**		**Extreme Risk**
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire	6%	1%		1%

HHS has a diverse portfolio of owned and leased buildings, such as hospitals, laboratories, offices, and outpatient healthcare facilities where employees may be exposed to climate hazards. Tables 5 above provide an overview of HHS employee exposure to climate hazards. This section will only expound on projection data related to RCP 4.5 in the late century to provide a general understanding of climate hazard exposure to Federal personnel at HHS.

As indicated in the Federal Mapping App, 100% of personnel will be exposed to extreme heat. HHS projects that as the global temperature continues to rise, 99% of personnel will experience increases of at least 5 to 68 more annual days of temperature surpassing the 99th percentile. These warmer temperatures pose a greater risk for various issues such as heart disease hospitalization, worsening asthma, and chronic obstructive pulmonary disease due to heat exhaustion, leading to heat stroke, dehydration, and kidney injury. Climate projections reveal that heat will remain a future climate hazard for NIH campuses. The number of cooling degree days and days with a heat index above 90ºF will continue to increase significantly, impacting building cooling systems, electrical systems, research quality, employee and patient safety, and healthcare services capacity. Increased temperatures and droughts would lead to more significant occurrence, severity, and variability of wildfires, potentially damaging or destroying facilities and critical infrastructure such as electrical utilities and access roads.

Heat is the most significant climate hazard projected to impact HHS's facilities in the Southwest of CONUS. Increased heat in the Southwest region can lead to droughts and decreased vegetation, making the land vulnerable to soil erosion during precipitation events. Soil erosion from extreme precipitation can expose and damage infrastructure such as utilities and roads, causing unplanned outages and rendering many land areas inaccessible.

Moreover, rising temperatures also lead to an increase in precipitation. As indicated in the Federal Mapping App, 100% of personnel will be exposed to extreme precipitation. HHS projects at least 62% of HHS personnel will experience one or more additional days of annual rainfall surpassing the 99th percentile at various locations. Planting trees to cool HHS facilities during sweltering days offers a nature-based solution that protects human health and reduce energy and carbon emissions.

Flood waters can be hazardous and contain contaminants, germs, physical objects, and wild or stray animals, which may result in health issues such as wound infections, gastrointestinal illness, and tetanus. It is worth noting that over half, on a facility count basis, and comprising of 10% of HHS' direct owned square footage, is HHS family housing real property situated in Tribal areas without floodplain maps. Therefore, HHS is actively working towards obtaining more floodplain map data to assess personnel working in flood-prone areas. Climate data also reveals that the NIH campuses are expected to continue experiencing an increase in the intensity and frequency of precipitation events in the future, which is compromising near end-of-life stormwater management systems. These events will lead to more significant flooding and erosion issues.

Extreme precipitation is projected to increase on HHS's lands in the East. The increased precipitation may result in major flooding in and around land near floodways, low-lying areas, or bodies of water. Flooding may also occur from rainfall, and debris from extreme precipitation runoff can overburden sewer systems.

The rise in sea level is projected to affect a small percentage of HHS land. For example, HHS land on Dauphin Island, Alabama, is particularly vulnerable to rising sea levels and will make Dauphin Island more susceptible to coastal storm surges, including weaker, seasonal storms. HHS land on Dauphin Island is also a National Register Listed property, which has evidence of prehistoric subsistence and settlement patterns during the early colonial period and potential Native American occupation during the early French colonial period. The rising sea level could have a strong impact by increasing erosion and carrying away historical evidence that should be preserved. The rising sea level could also permanently inundate some areas, leading to higher salinity levels in estuaries and freshwater aquifers.

2.5 Climate Hazard Exposures and Impacts Affecting Mission, Operations and Services

Table 6: Climate Hazard Impacts on and Exposures to Mission, Operations and Services

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	Identified Climate Hazard	Description
Worker Health	Extreme Heat	Greater than 99% of the HHS workforce will be exposed to an annual increase in days with a maximum temperature greater than the 99th percentile. According to the Occupational Safety and Health Administration (OSHA), extreme heat is a well-known and recognized occupational hazard for outdoor and indoor workers. It can cause severe or fatal illness when workers are not provided the necessary protections or training.
Providing healthcare services to Southwest and Northeast IHS facilities, including Arizona, California, Massachusetts, and Nevada.	The severity of heat hazards (low to high) varies in each state and region. It is related to a rise in the impacts associated with the increase in average temperatures and the occurrence and severity of heat waves.	IHS healthcare services could reach maximum capacity sooner and more frequently due to increased cases of heat-related illnesses and could overburden staff. With severe heat, facility heating, ventilating, and air conditioning (HVAC) systems may be overused or inadequate, negatively impacting healthcare services.
Providing healthcare services to Northeast IHS facilities, including Massachusetts.	High wind hazards in Massachusetts are related to increased low-pressure systems or storm cycles and the resulting impacts from associated gusts.	IHS healthcare services may experience direct property destruction, resulting in the temporary closure of facilities and services. Wind may cause power outages and cause difficulty accessing facilities due to debris. Loss of power and access to healthcare facilities would reduce people's access to essential resources.
Providing healthcare services to Southwest and Great Plains IHS facilities, including Arizona, California, Nevada, and South Dakota.	Wildfire hazards vary by State and result from extended periods of drought or heat and ignition sources from human or environmental causes.	Like impacts from wind hazards, wildfires could lead to direct property destruction, resulting in the temporary closure of facilities and services and loss of power and access to facilities. Wildfire hazards could also lead to IHS facilities reaching maximum capacity sooner and more frequently due to increased cases of smoke-related illnesses.
NIH Campuses' Stormwater Management System	Flood – Increasing intensity and frequency of precipitation.	Several campus stormwater management systems are near the end of life. These systems need to be replaced with greater capacity to accommodate an expected increased frequency and severity of precipitation events. One potential impact from compromised several water management systems is on the NIH Bethesda Campus where a trans-shared

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	Identified Climate Hazard	Description
		resource on Electron Microscopy was affected from an increased intensity precipitation event in September 2020.
NIH Campuses' Buildings Cooling Systems	Heat – Increasing number of cooling degree days.	Campus building cooling systems are expected to experience an increased demand due to the increasing number of cooling degree days, which can strain power grid and water infrastructure.
NIH Campus Facilities Power/Communication System Disruption	Wind - Increasing frequency of hurricanes/strong storms.	All NIH campus facilities are expected to experience an annual increase in intense storms. These storms can potentially affect campus access and disrupt operations.
NIH Rocky Mountain Laboratories Campus air quality CDC Fort Collins Campus air quality	Wildfires – Increasing frequency of wildfire events	The Rocky Mountain Laboratories campus in Montana, has experienced poor air quality due to smoke from regional and non-regional wildfires that have increased in frequency from rising temperatures and drought. The Fort Collins Campus experienced a wildfire event in recent years where staff were forced to work remotely due to extremely poor air quality.

This part explores the ways in which shifts in climate and natural phenomena such as heatwaves, strong wind gusts, wildfires, and intense rainfall can influence our missions, operations, and healthcare provisions. HHS will investigate how these occurrences might affect its employees and the services it delivers to the public.

HHS' aim is to gain a deeper comprehension of these hazards and to consider measures for enhanced preparedness. This initiative will ensure the safety of HHS personnel and the continuous availability of healthcare services and biomedical research during such events.

Employees will encounter an increased number of extremely hot days annually. Exposure to such conditions can lead to severe health issues, including fatalities, without appropriate safeguards or education. The prevalence of heat may also escalate the incidence of illnesses related to high temperatures, potentially overwhelming HHS hospitals and exerting excessive stress on the staff. Moreover, excessive temperatures could impair the function of cooling systems in these facilities, complicating the delivery of healthcare services. The anticipated higher utilization of cooling systems due to the rise in hot days will burden HHS' energy and water resources.

Powerful gusts from extreme weather such as hurricanes or tornadoes can inflict damage on HHS buildings, cause utility outages, and obstruct facility access, which compromises HHS from achieving its various missions. Similarly, wildfires can not only cause physical damage to HHS

structures but also complicate service delivery. The increase in individuals requiring medical attention due to smoke inhalation affects facility operations and healthcare services capacity especially in the Northeast and Northwest regions of the CONUS.

The infrastructure of HHS for managing substantial rainfall from its near end-of-life stormwater management systems may be inadequate, as it was not designed to cope with the more frequent and intense rainfalls. This deficiency was evident in the disruptions experienced at the NIH Bethesda Campus in 2020. An uptick in rain could mean that HHS buildings and services may face more disruptions from storms. Anticipated are more severe storms that could challenge the ability for HHS to provide healthcare services and biomedical research reliably.

To navigate these challenges, HHS is planning mitigations to climate hazards and building adaptive capacity modifications to safeguard its workforce and guarantee the persistent provision of healthcare services and biomedical research amidst extreme weather conditions. These adjustments will position HHS to remain proactive and uphold its dedication to serving the American public.

Section 3: Implementation Plan

3.1 Address Climate Hazard Exposures and Impacts Affecting Federal Buildings

Table 7: Prioritized Actions to Address Climate Hazard Impacts on and Exposure to Federal Buildings

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	Priority Action	Timeline for implementation (2024-2027)
Heat 100% of HHS-owned buildings may be exposed to an increase in annual days with a maximum temperature greater than the 99th percentile.	Revise HHS internal climate adaptation processes with the following guidance: • Minimize heat gain in buildings • Right-size emergency cooling • Maximize clean energy backup power for emergency cooling.	• Revise HHS internal climate adaptation process, which includes climate vulnerability assessments, prioritizations, response planning, budget submissions, tracking, and reporting progress (April 2025) • Stakeholder review period (May 2025) • Finalize HHS internal climate adaptation process (June 2025) • HHS Chief Sustainability Officer approval (August 2025)
Wildfire 14% of buildings have a high, very high, and extreme risk of wildfire exposure.	Revise HHS internal climate adaptation processes with the following guidance: • Use fire-resistant materials • Ensure there is a sufficient defensible area around buildings	• Revise HHS internal climate adaptation process, which includes climate vulnerability assessments, prioritizations, response planning, budget submissions, tracking, and

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	Priority Action	Timeline for implementation (2024-2027)
	• Give special care and protection to fire-prone areas • Maintain clean indoor air quality	reporting progress (April 2025) • Stakeholder review period (May 2025) • Finalize climate adaptation process (June 2025) • HHS Chief Sustainability Officer approval (August 2025)
Flooding 2% Facilities within 100-year floodplain or within a 500-year floodplain	Update HHS Floodplain Management procedures to implement the Federal Flood Risk Management Standard (FFRMS) Procedures	May 2024 – Publish final HHS Floodplain Management Procedures.

This strategy aims to tackle and enhance the way HHS facilities mitigate their risk and the effects experienced due to climate-related threats. HHS will revise its climate adaptation methodology internally, incorporating guidance for key areas such as reducing heat gain, ensuring emergency cooling, enhancing fire resistance, utilizing renewable energy sources, and mitigating flooding.

The term heat gain describes the temperature rise within a structure, causing discomfort to HHS employees and visitors and increased utility costs. Methods to lower heat gain involve but are not limited to the following: applying reflective materials to roofs, surrounding structures with trees for shade, and fitting windows with insulation.

Emergency cooling is vital to maintain internal temperatures of structures safe during electricity failures or periods of extreme heat. Viable strategies to achieve emergency cooling but are not limited to the following include performing energy evaluations to assess the needed capacity and adopting energy-efficient cooling systems. Employing renewable energy sources can offer dependable backup energy source for emergency cooling without adding to global warming. Installing photovoltaic panels and utilizing battery storage solutions to guarantee power availability during crises.

Constructing facilities with fire resistant materials such as treated lumber, stone, or metallic materials, and apply fire-resistant paints to fire prone areas can markedly lessen the threat of damage from wildfires. Creating a defensible area around structures is crucial for their protection against wildfire. This involves the routine clearing of combustible vegetation and the creation of zones with varying types of flora that serve as fire barriers. Zones that regularly experience high temperatures, dryness, and have combustible vegetation are deemed high-risk for fires. Defensive strategies for areas at risk of fire include the establishment of firebreaks and regular fire safety drills and readiness training for residents. Preserving superior indoor air quality is vital for the health and comfort of individuals within the building. Methods for

purifying indoor air include ensuring ventilation systems are functioning correctly and utilizing air filters to eliminate pollutants.

Revamping procedures for managing floodplains is also vital as floods can cause extensive harm to structures and interrupt their operations. HHS' current floodplain management procedures are outlined in the HHS General Administration Manual Part 30-40-40. HHS published its draft FFRMS procedures in accordance with EO 13690 and EO 14030 on the Federal Register on November 6, 2023, to allow the public to the Federal Register for a 30-day comment period. HHS' FFRMS procedures were viewed 128 times with no comments received over the 30-day comment period. HHS finalized its FFRMS procedures on the Federal Register on May 1, 2024, and HHS will apply the FFRMS to minimize risk to flooding damage and ensure critical infrastructure is water resistant.

Implementing these strategies will safeguard not only the HHS buildings but also promote the safety and comfort of the individuals inside them. HHS is set to integrate these approaches into its guidance for internal climate adaptation planning by April 2025. The plan's amendments will be examined by key HHS stakeholders in May 2025, with the expectation that the revised strategy will be completed within the year and receive endorsement from the HHS Chief Sustainability Officer by August 2025.

3.2 Addressing Climate Hazard Exposures and Impacts Affecting Federal Employees

Table 8: Prioritized Actions to Address Climate Hazard Impacts on and Exposure to Federal Employees

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL EMPLOYEES		
Climate Hazard Impact on and/or Exposure to Employees	Priority Actions	Timeline for implementation (2024-2027)
Heat 100% of HHS employees are located in areas projected to be exposed to an increase in the annual number of days with a maximum temperature greater than the 99th percentile for RCP 4.5 Late Century. Precipitation 100% of HHS employees are located in areas projected to be exposed to an increase in the annual number of days with precipitation exceeding the 99th percentile for RCP 4.5 Late Century. Wildfire 8% of HHS employees may be exposed to very high and extreme wildfire risks.	Revise HHS internal climate adaptation process, which includes climate vulnerability assessment, prioritizations, response planning, budget submissions, tracking, and reporting guidance and resources to foster mission-essential personnel engagement. Create policies that encourage divisions to share workspace and develop space reservation systems.	• Revise HHS Internal HHS internal Climate Adaptation Process (June 2025) • Facilities Program Manual Update (March 2026)

Climate hazards risks not only affect the general population but also specifically to the HHS workforce. This part outlines a comprehensive strategy to protect HHS personnel from the threats posed by extreme temperatures, intense precipitation, and wildfires. The staff of the Health and Human Services department is particularly vulnerable as they are situated in regions prone to notably higher temperatures than previously recorded. Furthermore, there's an anticipation that areas with HHS employees will experience a significant rise in days with severe rainfall. A smaller subset of the workforce, comprising roughly 8% of HHS staff, faces a substantial risk of wildfires.

To address these challenges, HHS is committed to revising and enhancing its approach to preparing for the impacts of climate change. This entails assessing potential risks, prioritizing them, formulating strategies for mitigation, optimizing financial allocation, and regularly monitoring progress. Immediate steps will be taken to initiate these adjustments. As mentioned in the previous part in Section 3A, by August 2025, HHS aims to have refined its climate preparedness strategies.

The plan includes fostering a more collaborative environment by facilitating office space sharing among different HHS divisions and augmenting the flexibility of work locations for employees to mitigate operational disruptions. Further, HHS is implementing reservation systems for office spaces facilitate 21st Century Workplace Policy implementation.

HHS recently updated its Facility Program Manual in August 2022, drafted a new section in April 2023, and updated sections 3.3.2.4 Paragraph 7, 4.1, and 5.8.3 Paragraph 3 in January 2024. HHS is planning to update its Facility Program Manual to incorporate revised guidance associated with Pre-Project Planning to try and mitigate planning and financial risks associated with facility projects. In addition, HHS will update its Facility Project Approval Agreements submission requirements to align said submission with specific industry standard milestones, as well as the chosen project delivery and contract strategies applicable to each project. Finally, HHS will be updating Chapter 8 to include aspects for net zero emission requirements, high energy and water efficiency, low embodied carbon, climate resilience, and environmental justice.

3.3 Accounting for Climate Risk in Planning and Decision Making

HHS maintains a climate vulnerability assessment database of land, structure, and building assets leased or owned. The climate vulnerability assessment database includes heat, flood, wildfire, and wind likelihood of exposure levels at the county level for each asset and other information relative to performing evaluations such as replacement value, condition index, predominant use, environmental justice index, etc. Each asset receives a priority number on a scale of 1 to 5, with one being the highest priority, based on the asset's mission criticality and likelihood of exposure to the climate hazard. HHS climate vulnerability assessment process guides HHS divisions to evaluate assets in order of priority to determine risk levels based on steps 1 & 2 of the U.S. Climate Resilience Toolkit steps to resilience. After obtaining risk levels from the climate vulnerability assessment, HHS divisions will begin planning projects or activities to address climate risks in order of risk level, i.e., high, medium, or low, and associated financial risk. HHS

divisions develop climate adaptation and sustainability plans in a plan activities database, including an estimated scope, schedule, and cost for each planned activity. The estimated costs with the climate and sustainability plan database are aggregated by each HHS division for the upcoming budget cycle.

3.4 Incorporating Climate Risk Assessment into Budget Planning

The HHS Chief Sustainability Officer (CSO) has collaborated with the Chief Financial Officer to update the instructions for preparing budget justification for HHS (HHSJ) and instructions for preparing budget justifications for the Office of Management and Budget (OMBJ). The instructions require each OpDivs' CSO (i.e., CDC, FDA, IHS, and NIH CSOs) to provide their budget office with funding estimates to meet climate and sustainability goals. The instructions reference the HHS CSO's guidance for the OpDivs' CSO to prepare budgets based on their Climate Adaptation and Resilience Plan (CARP) and Sustainability Plan on the HHS Sustainability Program internal tracking system. Each planned activity includes the scope, schedule, budget, fiscal year, deliverables, and primary goal aligned with federal laws, regulations, and executive orders (e.g., Climate Resilient Infrastructure and Operations, Develop Climate- and Sustainability-Focused Workforce, etc.). Divisions must also include facility-related climate and sustainability activities for projects above the HHS approval thresholds in their Real Property Capital Plan, subject to approval from the Senior Real Property Officer (SRPO) and Capital Investment Review Board (CIRB).

3.5 Incorporating Climate Risk into Policy and Programs

Climate Adaptation and Resilience Policies Reviewed

The following HHS divisions have enhanced policies, methodologies, regulations, tactics, agendas, guides, or directives to integrate abilities more effectively for adapting to climate change and bolstering resilience:

- Assistant Secretary for Administration (ASA)
- Assistant Secretary for Financial Resources (ASFR)
- Administration for Strategic Preparedness and Response (ASPR)
- Centers for Disease Control and Prevention (CDC)
- Centers For Medicare and Medicaid Services (CMS)
- Food and Drug Administration (FDA)
- Office of Assistant Secretary for Health (OASH)
- Program Support Center (PSC)
- National Institutes of Health (NIH)
- Indian Health Service (IHS)

The illustrated examples include:

- National Health Security Strategy offers strategic direction and implementation actions to strengthen the nation's capabilities to respond to and recover from climate disasters and emergencies.

- Hospital Preparedness Program (HPP) provides leadership and funding through cooperative agreements to states, territories, and eligible metropolitan areas to improve the capacity of the health care system to plan for and respond to large-scale emergencies and disasters.
- Public Health Emergency Preparedness Program supports health agencies in augmenting their capacities to efficiently tackle a variety of public health dangers, such as infectious illnesses, natural calamities, and events involving biological, chemical, nuclear, and radiological hazards.
- CMS Emergency Preparedness Rule mandates sufficient planning for all disasters, both natural and human-made, ensuring collaboration with emergency preparedness frameworks at the federal, state, Tribal, regional, and local levels.
- HHS National Environmental Policy Act Procedures incorporates climate knowledge within its floodplain administration practices should any action occur within a floodplain.
- HHS Policy for Electronic Stewardship (Pending), updating the policy with the aim at fostering climate-resilient investments that further climate adaptation while safeguarding HHS information technology systems.
- HHS Facility Program Manual provides guidance to incorporate sustainable design protocol aiming for net-zero emissions structures by 2050, assess climate risks, and to adapt HHS facilities subject to climate hazard risks to ensure operational continuity.
- HHS Occupant Emergency Plans outlines alert procedures for occupants concerning imminent severe weather events.
- HHS Guiding Principles for Sustainable Buildings (pending) builds on the CEQ's Guidelines for Sustainable Federal Building as of December 2020, in alignment with EO 14008 and 14057 to enhance facility energy and water efficiency, reduce carbon footprint, and increase resilience to extreme weather, particularly benefitting marginalized communities.
- HHS Sustainable Acquisitions and Climate Resilience Directive primarily focuses on maximizing the procurement of sustainable goods and services, backing the objective to 'Achieve Net-Zero Procurement by 2050' as outlined in EO 14057 and the Federal Sustainability Plan, which looks towards catalyzing clean energy industries and jobs via federal sustainability efforts.
- FDA Staff Manual Guidance (SMG) Policy encourages ongoing enhancements across all environmental responsibilities and sustainability goals, reflecting the commitments set by federal, state, local, and Tribal directives, Executive Orders, and statutes.
- The NIH and IHS present a design guide and criteria promoting the use of nature-based solutions.
    - The 2022 IHS Architect/Engineer Design Guide, showcasing strategies to improve indoor environments by employing elements of nature to bolster health, well-being, and employee productivity. This initiative is part of leveraging Biophilic Design capabilities for the project, connecting humans to the natural surroundings based on evidence-based design, supported by scientific studies highlighting the comprehensive mental and physical health benefits derived from nature exposure.
    - The NIH Design Requirements Manual (DRM) specifies the use of nature-based solutions, including the conservation, safeguarding, and replenishment of

vegetation in coordination with the NIH Landscape Architect. A notable part of the DRM, Section 3.5.4, stipulates a mandatory one-to-one replacement for any tree removal and proposes up to eight replacements for trees exceeding 40 inches in diameter.

- Policies for climate mitigation established by IHS yield additional advantages for both new and existing facilities. An exemplar is the new Pueblo Pintado Health Center in New Mexico, which utilizes sustainability criteria from the 2022 IHS A/E Design Guide, Chapter 5 during its design phase. The design team sought insight from the 2018 Climate Adaptation Plan for the Navajo Nation to better align the facility's long-term essential functions and Risk Assessment strategies throughout its operation.
- The CMS Innovation Center's proposed Transforming Episode Accountability Model (TEAM) is a five-year mandatory model for select acute care hospitals that includes a voluntary Decarbonization and Climate Resilience Initiative comprised of an emissions reporting element, and technical assistance and learning system supports for participants seeking to improve their climate impact and resiliency. If finalized, the model will be the first time HHS proposes to collect data on health care greenhouse gas emissions.

Environmental Justice Policies Reviewed

HHS supplemented its 2021 Climate Action Plan through issuing the Climate Change and Health Equity Strategy (CCHE) Supplement to describe HHS outward-facing programmatic activities from HHS Divisions. The CCHE supplement further outlines HHS' strategy for meeting EO 14096.

HHS has updated its NEPA procedures, which are outlined in Chapter 10 of its Facility Program Manual to identify and address the human health and environmental effects of HHS programs, policies, and activities on disadvantaged populations.

The CDC, in collaboration with the HHS Office of Environmental Justice, created the Environmental Justice Index (EJI)), a comprehensive, location-specific instrument designed to evaluate the collective impact of environmental burdens through a lens focused on human health and equity. The EJI provides a singular rating for each community, enabling public health authorities to pinpoint and visualize areas at heightened risk for the health repercussions of environmental strain.

HHS has included EJI as part of its Climate Vulnerability Assessment Procedure where it is mandatory for HHS divisions to prioritize evaluations for developing a climate risk strategy. This ensures the influences on underprivileged and environmentally burdened communities are considered in the initial stages of climate adaptation and resilience planning. For communities identified by an EJI rating of 0.70 to 1.0, HHS Divisions are obligated to:

- Forge effective public engagement strategies with disadvantaged communities to delineate a planned agency action.
- Examine the environment influenced, such as living conditions, subsistence, and demographic profiles of disadvantaged populations.
- Propose alternatives that disadvantaged communities prefer.

IHS maintains a close collaboration with Tribal Nations concerning both new and existing facilities – making Tribal consultation a cornerstone of IHS climate adaptation efforts. IHS consistently interacts with Tribal governments as much as feasible and permitted by law to gather feedback on initiatives impacting Tribal Nations. This includes involving Tribes in the NEPA process for facility building, where the public is invited to comment on the project scope, location, and methodology. Responses are considered and integrated into the planning and design phases as necessary.

Climate Change and Health Equity Policies, Tools, and Resources

In response to a specific mandate in Executive Order 14008, the Secretary of Health and Human Services established the Office of Climate Change and Health Equity (OCCHE) on August 31, 2021. OCCHE is building climate adaptation and resilience capacity across all the HHS Divisions and supporting those divisions in introducing climate-related programs and policies that improve resilience and sustainability in communities and facilities across the country outside of HHS' real property portfolio. To that end, OCCHE convenes the HHS CCHE Working Group, which meets quarterly to provide department-wide updates and coordinate new climate change-related initiatives. OCCHE staff also regularly meet one-on-one with staff from other Divisions to promote the development of climate adaptation and resilience.

- Launching the OCCHE Health Sector Resource Hub, a one-stop web destination with support for organizations working on climate resilience and sustainability with tools including a referral guide for providers, a compendium of federal funding resources for work in this area, the Inflation Reduction Act (IRA) Quickfinder and a related webinar series.
- Launching an OCCHE Climate and Health Outlook Portal and other tools to help forecast and document climate-related threats, including an OCCHE and Department of Transportation EMS Heat Tracker, mapping local emergency responses to heat-related illness.
- Supporting individuals, families, and communities as they manage the challenge presented by climate change, including $3.7 billion in Low Income Home Energy Assistance Program (LIHEAP) funds announced by the Administration for Children and Families in October 2023.
- Issuing a categorical waiver from the Centers for Medicare and Medicaid Services to allow many healthcare providers to supply emergency backup power through healthcare microgrid systems (e.g., clean energy technologies like wind, solar, and fuel cells).
- Broadening research on climate health through the National Institutes of Health Climate Change and Health Initiative Strategic Framework - PDF and providing support to states and cities to protect at-risk populations from climate impacts through initiatives like the Centers for Disease Control and Prevention Climate-Ready States and Cities Initiative.

Releasing the newest version of the CDC Heat & Health Tracker. The Heat and Health Tracker provides real-time, local heat and health information so communities can better prepare for and respond to extreme heat events. With the latest update, you can track the annual rate of work-related injuries, illnesses, and deaths due to heat per 10,000 full-time workers by state. Looking ahead to 2024 and beyond, HHS Divisions plan many activities to advance climate health and

equity through their programs and policies (as documented in the strategy supplement). These include a Catalytic Program to help healthcare organizations (and particularly safety net providers) take advantage of the tax credits, grants, and other supports made available by the Inflation Reduction Act (IRA); packaging tools and resources to help states, communities, and other stakeholders prepare for the extreme heat and other catastrophic events of the next summer season; and climate-related updates to the CMS Emergency Preparedness Rule and the Sustainable and Climate-Resilient Healthcare Facilities Toolkit.

3.6 Climate-Smart Supply Chains and Procurement

As mentioned in exposures **Error! Reference source not found.** Part **Error! Reference source not found.**. Addressing Climate Hazard Exposures and Impacts Affecting Federal Employees, HHS is planning to update its Chapter 8 of the HHS Facility Program Manual to include updating aspects for net zero emission requirements, high energy and water efficiency, low embodied carbon, climate resilience, and environmental justice. Utilizing high energy and water efficiency systems and low embodied carbon products support HHS' adaptation and/or resilience strategies.

In consultation with the Environmental Protection Agency (EPA) and the Department of Energy (DOE), HHS will promote environmentally sustainable manufacturing practices that protect the environment and public health, including for communities adjacent to manufacturing facilities. This effort will draw on COVID-19 lessons learned to strengthen the public health industrial base and address the interests and needs of communities with environmental justice concerns.

HHS is investing in research and development efforts to deliver safe and effective long-term waste management strategies to protect human health and the environment. These efforts involve engagement with the medical countermeasure (MCM) industry to promote manufacturing and distribution processes that protect climate sustainability and health equity (e.g., introduce biodegradable products, reduce emissions and other harmful community impacts of the supply chain, and domestic industrial base expansion). Sterilization of medical devices can reduce the need for single-use medical devices, thereby decreasing the overall impact of climate change on the medical supply chain. For example, ethylene oxide (EtO) a commonly used sterilizer for medical devices poses a significant risk to human health and environment, especially for disadvantaged communities. HHS is taking steps through organizing a series of town halls aimed at raising awareness, informing, and providing a future vision to reduce the overall EtO reliance while maintaining a resilient supply of sterilized medical devices.

The National Strategy for a Resilient Public Health Supply Chain aims to "Achieve ethical, sustainable sourcing that includes high standards on labor and environment while combatting unfair trade." Specifically, the Strategy calls for promoting "environmentally sustainable manufacturing practices to limit environmental impacts to the planet and communities located near manufacturing facilities."

HHS has partially developed an implementation plan to address supplies and/or services disruption from climate hazards.

- HHS has issued its Sustainable Acquisitions and Climate Adaptation Directive and Affirmative Procurement Plan as an HHS internal facing documents to incorporate current regulatory guidance and to reduce the adverse impacts of the Department's decisions to acquire goods and services on the environment and human health. The primary focus of this directive is to maximize the procurement of sustainable products and services in support of the goal to 'Achieve Net-Zero Procurement by 2050' laid out in EO 14057, *Catalyzing Clean Energy Industries and Jobs through Federal Sustainability* and the Federal Sustainability Plan. Through this directive, the HHS Sustainable Acquisition Program aims to:
    - Reduce greenhouse gas emissions and pollution,
    - Promote energy efficiency and water conservation,
    - Eliminate or reduce the generation of hazardous waste and the need for special material processing (including special handling, storage, treatment, and disposal)
    - Promote environmental stewardship,
    - Support climate-resilient supply chains,
    - Drive innovation,
    - Divert waste from landfills and drive cost-effective waste reduction, and
    - Incentivize markets for sustainable products and services.
- HHS developed targeted training for the Acquisition Workforce, "Greening HHS Procurements," which provides the activity/program offices with tools and awareness to promote and locate sustainable and climate-friendly products and services.
- HHS' 2021 Climate Action Plan designated medical supplies, utilities (refrigerated sample storage, data collection, surveillance back up services, and IT services), vivarium support services, medical supplies and stockpile warehouse, and vaccines (Policies and Production) categories as critical supplies and services.

Table 9: At Risk Supplies/Services

At risk supplies/services	Outline Actions to Address Hazard(s)	Identify Progress Towards Addressing Hazard(s)
Extreme weather events driven by climate change can disrupt the production, stockpiling, and distribution of medical supplies. This includes disruption of raw material production and manufacturing/distribution of personal protective equipment, depletion of medical supply and vaccine stockpiles, and impeding the movement of goods. Extreme weather events can also increase the demand for medical supplies, further stressing supply chains.	Using the Critical Infrastructure Partnership Advisory Council framework.	HHS carries out multiple activities through the HPH Sector supply chain task groups. HHS gathers input from across industry and government stakeholders to develop strategies and conduct studies to inform and support changes in policies affecting HPH Sector supply chains.

3.7 Climate Informed Funding to External Parties

HHS drafted its National Initiative to Advance Building Code (NIABC) plan and submitted it to the Federal Emergency Management Agency Mitigation Framework Leadership Group (MitFLG) Building Code Task Force (BCTF) on September 25, 2023. HHS' NIABC plan is a viable strategy to increase climate adaptation and resilience in its funding announcements by adopting the latest building codes. HHS' NIABC plan outlines fourteen (14) programs that fund, finance, or provide technical assistance for the construction or transfer of federal real property for public health or homeless assistance conveyance. Half of the HHS programs have been evaluated as either meeting the local building code or the latest state or local code. For the remainder of the programs with just meeting local code or no building code or standard specified, the HHS Office of Climate Change and Health Equity is drafting FY 2025 Notice of Funding Opportunity guidance for HHS programs that fund construction by the end of Fiscal Year 2024 as outlined in Office Management and Budget (OMB) Memo M-24-03: Advancing Climate Resilience through Climate-Smart Infrastructure Investments and Implementation Guidance for the Disaster Resiliency Planning Act.

HHS recognizes that communities are the best resource to immediately respond to the impacts of climate hazards at HHS facilities. Investing in disadvantaged communities where HHS facilities are located not only fulfills HHS's mission but also increases HHS's adaptive capacity to recover from climate disasters because HHS can employ the developed strength and services the local community offers. Many of HHS programs promote climate adaptation and resilience, while also helping to advance environmental justice because they are covered programs within the Justice40 Initiative, which sets a goal that 40 percent of the overall benefits of certain Federal climate and other investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution. For reference, M-29-03 on "Addendum to the Interim Implementation Guidance for the Justice40 Initiative, M-21-28, on using the Climate and Economic Justice Screening Tool (CEJST)," directs agencies to use CEJST to identify geographically defined disadvantaged communities for any covered programs under the Justice40 Initiative and for programs where a statute directs resources to disadvantaged communities, to the maximum extent possible and permitted by law. HHS developed updated Notice of Funding Opportunity guidance to promote equity and environmental justice to serve disadvantaged communities in HHS financial assistance programs, processes, and policies on October 26, 2022. This guidance is annually distributed.

3.8 Climate Training and Capacity Building for a Climate Informed Workforce

Table 10: Training and Capacity Building

Training and Capacity Building	
	Identify the percentage of the agency's Federal staff that have taken a 60+ minute introductory climate training course
Agency Climate Training Efforts	HHS does not offer an introductory training course, so it does not have figures to report. Staff may take climate training through on-HHS offerings, but HHS does not rack participation in these external trainings.

Training and Capacity Building	
	Detail the percent of the agency's senior leadership (e.g., Sec, Dep Sec, SES, Directors, Branch Chiefs, etc.) that have completed climate adaptation training. 100% of Senior Executive Service (SES) staff have received climate training in FY2023.
	Detail the percent of budget officials that have received climate adaptation related training. HHS is developing its budget official training and does not have figures to report.
	Detail the percent acquisition officials that have received climate adaptation related training. 60% of acquisition officials have completed the FAC 093 Introduction to Supply Chain Risk Management training. The acquisition officials include certified Contracting Officers, Contracting Officer Representatives, Program Managers, and Project Managers.
	Detail additional efforts the agency is taking to develop a climate informed workforce. Developing training and workflows to track training and making training mandatory.
Agency Capacity	***Detail the number of full time Federal staff (FTE) across the agency that have tasks relevant to climate adaptation in their job description. Detail if the agency has contracting staff with tasks relevant to climate adaptation in their job description. Additionally, the agency may include information on climate adaptation staffing approaches in the narrative.*** Over 300 federal full-time employees across the agency have tasks relevant to climate adaptation in their job description, and they report their accomplishments and impact quarterly on HHS' SharePoint site. HHS advances sustainable practices, resilience, and adaptive capacity through nine (9) Go Green Get Healthy HHS coordinators as indicated in section 1.

HHS is committed to advancing climate literacy among its workforce. In alignment with Executive Order 14057, Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, and the HHS Climate Action Plan, the HHS Climate Literacy Team developed a comprehensive approach to increase climate literacy called the HHS Earth AIR framework: Attention, Intention, and Results. The AIR framework is a systematic approach to change that has been effective in a variety of settings and includes increasing literacy through policies and procedures such as climate requirements in Senior Executive Service Performance Management Appraisals, numerous outreach initiatives to raise climate awareness in the organization, and utilization and monitoring of the Federal Employee Viewpoint Survey (FEVS). In FY 2022, the HHS FEVS scores on a sustainability question increased favorably by nearly 4% in one year. The question specifically was, "My organization promotes sustainability initiatives designed to reduce our impact on the environment and build climate resilience. (Examples include commuting/carpooling programs, using environmentally preferred products, minimizing generation of waste, and minimizing energy and water use)." The survey provided evidence of a

positive shift towards the HHS workforce recognizing that HHS considers sustainability and climate a priority.

HHS updated the instructions for preparing the discretionary budget justification. The instructions require each division's Chief Sustainability Officer to provide their budget office with funding estimates based on their CARP and Sustainability Plan and includes a video tutorial. Climate training for budget officials began in March 2024, and the training model included group discussions and activities.

HHS recognizes that some agencies may create climate adaptation training more relevant to an audience's job function due to the agency's mission. For example, the HHS Climate Change and Health Equity 101 training is more relevant to health professionals in other federal agencies than a general climate 101 training for all employees. Another example is the General Services Administration (GSA) training, FAC 095 Climate Adaptation for Program Managers, offered through their Federal Acquisitions Institutes learning portal. As such, HHS will work through the Climate Engagement and Capacity Building Interagency Group to share mission-specific training with other Federal agencies and identify existing or forthcoming climate adaptation training from other Federal agencies more relevant to job functions such as acquisitions, budgeting, construction, security, etc.

3.9 Summary of Major Milestones

Table 11: Timeline Summary of Major Milestones

Section of the Implementation Plan	Description of Milestone	Climate Risk Addressed	Indicators for success
Sections 2A, 2B, 2C	Complete Climate Vulnerability Assessments for Assets	Heat, wildfire, wind, and flood (due to precipitation and sea level rise)	• Priority 1 assessment completed for all major assets (i.e., buildings, structures, land, and personnel) by 2026 • Essential personnel data integrated with climate exposure data by 2025
Sections 3A.1, 3A.2, and 3A.3	Discrete Climate Adaptation Plans for Assets	Heat, wildfire, wind, and flood (due to precipitation and sea level rise)	Discrete plans for each asset that addresses priority 1 climate risks identified in climate vulnerability assessments by 2027.
Sections 3A.1, 3A.2, 3B	Update Policies, Processes, and Procedures	Heat, wildfire, wind, and flood (due to precipitation and sea level rise)	• Update climate adaption processes with heat and wildfire guidance by 2025 • Update HHS Floodplain Management Procedures by 2024. • Incorporate nature-based solutions and mitigation co-benefits into manuals, policies, or guidance by 2025.

Section of the Implementation Plan	Description of Milestone	Climate Risk Addressed	Indicators for success
Section 3C	Complete Climate Vulnerability Assessments for critical supplies	Heat, wildfire, wind, and flood (due to precipitation and sea level rise)	Top 5 critical supplies assessed for vulnerabilities and risks by 2026
Section 3C	Discrete Climate Adaptation Plan for Critical Supplies	Heat, wildfire, wind, and flood (due to precipitation and sea level rise)	A climate adaptation plan for each of the five critical supplies that address the risk identified in the climate vulnerability assessments by 2027.
Section 3D	Climate financial risk reduction measures incorporated into construction grants	Heat, wildfire, wind, and flood (due to precipitation and sea level rise)	• Update Notice of Funding Opportunity (NOFO) guidance to address climate financial risk in construction grants by 2026. • Centrally pull together data from SF-429 to assess HHS' implementation of climate adaptation for construction grants by 2026.
Section 3E	Workforce completes Climate Change and Health Equity 101 Training	Heat, wildfire, wind, and flood (due to precipitation and sea level rise)	• Post Climate Change and Health Equity 101 Training on Learning Management System by 2025. • The workforce will complete climate change and health equity 101 training by 2025.

Section 4: Demonstrating Progress

4.1 Measuring progress

Table 12: Demonstrating Progress

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3A –Addressing Climate Hazard Impacts and Exposure	Step 1: Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. (Y/N/Partially) Step 2: Agency has a list of discrete actions that will be taken through 2027 as part of their implementation plan. (Y/N/Partially)	Step 1 (Partially): HHS has a system that connects hazard impacts to discrete actions within plans. Step 2 (Partially): Discrete actions will be generated in plans as climate

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.		
		vulnerability assessments are completed.
3B.1 – Accounting for Climate Risk in Decision-making	Agency has an established method of including results of climate hazard risk exposure assessments into planning and decision-making processes. (Y/N/Partially)	(Yes) HHS has a climate budget process that guides divisions in sourcing climate adaptation plans from risks identified in climate vulnerability assessments.
3B.2 –Incorporating Climate Risk Assessment into Budget Planning	Agency has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions. (Y/N/Partially)	(Yes) HHS has updated its instructions for preparing budget justifications of HHS (HHSJ) and instructions for preparing justifications for Office of Management and Budget (OMBJ) for HHS Divisions to submit to their respective budget office's funding estimates to meet climate and sustainability goals.
3B.5 – Climate Informed Funding to External Parties	Step 1: By July 2025, agency will identify grants that can include consideration and/or evaluation of climate risk. Step 2: Agency modernizes all applicable funding announcements/grants to include a requirement for the grantee to consider climate hazard exposures. (Y/N/Partially)	Step 1 (Yes): HHS has identified several construction grants for climate risk evaluations. Step 2 (Partially): HHS is updating announcement language for applicants to consider climate hazard exposures for certain construction grants. HHS is taking steps to prioritize climate-related hazards and sustainability in grant-funded work.
Key Performance Indicator: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3A –Addressing Climate Hazard Impacts and Exposure	Agency has identified the information systems that need to incorporate climate change data and information and will incorporate climate change information into those systems by 2027. (Y/N/Partially)	(Yes) HHS has identified information systems that need climate change data and will integrate with those information systems by 2027.
Key Performance Indicator: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate nature-based solutions, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives.		

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.3 – Incorporating Climate Risk into Policy and Programs	By July 2025, 100% of climate adaptation and resilience policies have been reviewed and revised to (as relevant) incorporate nature-based solutions, mitigation co-benefits, and equity principles. (Y/N/Partially)	(Partially) Policies have been reviewed and revised to incorporate climate adaptation and equity principles. Nature-based solutions and mitigation co-benefits are forthcoming.
Key Performance Indicator: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.4 – Climate-Smart Supply Chains and Procurement	Step 1: Agency has assessed climate exposure to its top 5 most mission-critical supply chains. (Y/N/Partially) Step 2: By July 2026, agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards. (Y/N/Partially)	Step 1 (Partially): Climate exposure assessments are in varying stages of completion for the top 5 mission-critical supply chains. Step 2 (Partially): HHS developed plans to maintain supply chain visibility and public health emergency response capabilities even during extreme weather events.
	The agency has examined how different climate dangers could affect essential services and goods needed. After discovering the risks, the agency planned and set goals to keep everything safe and running smoothly. (Y/N/Partially)	(Partially) • The National Strategy for a Resilient Public Health Supply Chain aims to "Achieve ethical, sustainable sourcing that includes high standards on labor and environment while combatting unfair trade." Specifically, the Strategy calls for promoting "environmentally sustainable manufacturing practices to limit environmental impacts to the planet and communities located near manufacturing facilities."
Key Performance Indicator: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures.		
Section of the CAP	**Process Metric**	**Agency Response**

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.		
3C – Climate Training and Capacity Building for a Climate Informed Workforce	Step 1: By December 2024 100% of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. (Y/N/Partially) Step 2: Does the agency have a Climate 101 training for your workforce? (Y/N/Partially) If yes, what percent of staff have completed the training? Step 3: By July 2025, 100 % employees have completed climate 101 trainings. (Y/N/Partially)	Step 1 (Yes): 100% of HHS leadership will be briefed on current climate adaptation efforts and actions outlined in this CAP by December 2024. Step 2 (Partially): HHS is developing a climate change and health equity 101 training crafted for HHS staff. Step 3 (Partially): HHS will work to have the climate change and health equity 101 training available in the Learning Management System with sufficient time for 100% of employees to complete it by July 2025.

4.2 Adaptation in Action

The climate crisis was decades in the making and will require significant momentum to tackle and overcome. Namely, it will require everyone worldwide to participate and celebrate their positive contributions towards climate adaptation, great and small. Below are examples of adaptation in actions from various divisions within HHS:

- The NIH has set up a Forest Service contract to manage the forest and reduce wildfire risk. A climate vulnerability assessment of the Research Triangle Park Campus has determined a wildfire risk at Research Triangle Park due to a large section of pines at the same age. Trees that are the same age are expected to die around the same time, which will result in fallen trees and branches that increase the risk of wildfires. The Forest Service contract will evaluate and remove trees to mitigate wildfire risks.
- The NIH is in the final stages of a $10 million Multi-building Utility Energy Service Contract (UESC) at the Poolesville Campus to produce clean energy and reduce energy and water consumption. Thus, making the campus more resilient to energy and water disruptions/limitations while mitigating climate change by reducing greenhouse gas emissions.
- The FDA is implementing climate resiliency projects at the San Juan District Office in San Juan, Puerto Rico, as that site is consistently affected by severe weather. The resiliency projects include a 13.7-kilowatt roof-mounted solar system that can provide enough power for a natural disaster command center, a domestic solar hot water heater, a new 20,000-gallon water storage tank that increased capacity by 120% to enhance preparedness, and a rainwater harvesting system that collects 3,000 gallons per week of condensate water from chillers. Additional energy and water conservation measures have

been implemented to reduce the overall energy and water use intensity to support climate adaptation, mitigation, and resiliency.

HHS believes the most notable outcome is from HHS Earth AIR framework which took steps to include climate language in the SES PMAPs. In fact, because of the PMAP requirement, SES staff have been asking for more information on climate change, mitigation, and adaption. They are asking "What can I do?" Therefore, the Climate Literacy Team is working on an SES Climate Action Toolkit of information for the SES staff to refer to and use with their staff. Attention has been captured and intention of efforts is underway, which will lead to results as more employees learn and integrate actions into their workplace. Additionally, HR is now working on getting the climate-related language included in supervisor and employee PMAPs to ensure that climate literacy is a priority for all HHS employees.

As previously mentioned, the FEVS is used to help measure impact of the HHS AIR Framework. The results of the HHS 2022 FEVS sustainability question show that 48% of respondents agree that their organization promotes sustainability initiatives designed to reduce our impact on the environment and build climate resilience while 39.8% were neutral and 12.3% disagree. This is a positive increase from the 2021 results where 44.2% agreed, 41.4% were neutral, and 14.4% disagreed. These results show the positive impact the program is achieving and portrays the large number of employees who are neutral to the comment. The additional emphasis on the climate that will start at the SES level and trickle down will engage more of these employees who feel neutral to their organization's promotion of sustainability.

The HHS climate and sustainability outreach efforts reach tens of thousands of individual employees quarterly, and often more frequently. The 2022 HHS Earth Day Speaker Series presentations had roughly 850 live viewers in April 2022, and today have a total of nearly 25,000 views on YouTube. Annually, the HHS Climate Literacy Team sends out 6 to 8 agency-wide emails on sustainability programs or initiatives. With a workforce of roughly 80,000 people, this equates to 480,000 to 640,000 potential viewing impressions. The 2023 HHS Kids' Earth Day Poster Contest had nearly 100 participants. As previously mentioned, the OpDivs also disseminate outreach material to their employees such as the monthly NIH Green Zone Newsletter sent to more than 300 NIH staff.

The HHS Earth AIR framework specifically addresses the EO 14057 requirement of increasing climate literacy of the HHS workforce, but it also impacts every other goal of EO 14057. Increasing climate literacy means educating and raising the awareness of HHS employees on how every aspect of their job and everyday life impacts our climate. It means helping our employees understand their climate impact and carbon footprint, and how they can lessen that footprint at their office and home. HHS outreach covers everything from the health impacts of climate change to energy and water efficiency, to waste prevention, to green purchasing, to reducing plastic use, to food, and the environment. HHS also believes that outreach should not only center on the workplace, but also employees' lifestyle, offering tips and actions for both.

Future efforts for the HHS Climate Literacy team include developing an information video for employees addressing how to implement sustainability and climate mitigation or resiliency strategies into their work, mandating agency-wide employee acknowledgement of the HHS Climate Action Plan and outlining available training on climate and sustainability related topics.

The HHS Climate Literacy Team is committed to advancing climate literacy among its workforce. By taking these actions, the HHS Climate Literacy Team will help ensure that all HHS employees have the knowledge and skills they need to address the climate crisis.

Appendix A: Risk Assessment Data

The Federal Mapping App uses the following data:

Buildings
Buildings data comes from the publicly available Federal Real Property Profile (FRPP). The GSA maintains FRPP data and federal agencies are responsible for submitting detailed asset-level data to GSA on an annual basis. Although FRPP data is limited—for example, not all agencies submit complete asset-level data to GSA, building locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures, and properties may be excluded on the basis of national security determinations— it is the best available public dataset for federal real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of federal buildings to climate hazards.

Personnel
Personnel data comes from the Office of Personnel Management's (OPM) non-public dataset of all personnel employed by the federal government that was provided in 2023. The data contains a number of adjustments, including exclusion of military or intelligence agency personnel, aggregation of personnel data to the county level, and suppression of personnel data for duty stations of less than 5 personnel. Despite these adjustments, this data is still useful for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

Climate Hazards
The climate data used in the risk assessment comes from the data in Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool. When agency climate adaptation plans were initiated in 2023, CMRA data included climate data prepared for NCA4. Additional details on this data can be found on the CMRA Assessment Tool Data Sources page. Due to limited data availability, exposure analyses using the Federal Mapping App are largely limited to the contiguous United States (CONUS). Additional information regarding Alaska, Hawaii, U.S. Territories, and marine environments has been included as available.

U.S. Department of
Health and Human Services

Climate Change and Health Equity Strategy Supplement

DECEMBER 2023

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I. Message from the Assistant Secretary for Health

Dear Health Sector and Human Services Leaders,

At the start of the Biden Administration, the President issued an executive order (Executive Order 14008, Tackling the Climate Crisis at Home and Abroad) in which he directed the Department of Health and Human Services (HHS) to create a new office to address the unprecedented threats to human health presented by climate change. Recognizing the particular risk that the climate crisis presents for at-risk populations, we established the new Office of Climate Change and Health Equity (OCCHE) within the HHS Office of the Assistant Secretary for Health on August 31, 2021.

Since that time, HHS and OCCHE have operated on several fronts to advance this critical work. The Department has set a vision for national health sector action on climate change through a component of the HHS Strategic Plan (FY 2022-2026), through participation in the World Health Organization's (WHO) Alliance for Transformative Action on Climate and Health and through engagement in the National Academy of Medicine's (NAM) Climate Collaborative, a public-private collaboration of health system stakeholders interested in advancing decarbonization which I co-chair. In addition, HHS continues to play a leadership role in several different interagency councils, including the Extreme Heat Interagency Working Group and the White House Environmental Justice Interagency Council.

In partnership with the White House, OCCHE also launched the Health Sector Climate Pledge, which has secured commitments from hundreds of private sector organizations to enhance their resilience, reduce their emissions and be transparent about their progress. To support those commitments and the sector more broadly, OCCHE has expanded awareness of direct supports to communities and care providers as they seek to manage the acute and chronic challenges that climate change introduces. Working across the federal government, OCCHE has in addition convened federal health systems, including the Veterans Health Administration (VHA), the Indian Health Service (IHS), and the Defense Health Agency (DHA), to collaborate on emissions reduction and facility resilience.

OCCHE has also served as a convener and technical support to HHS itself. This strategy document lays out for the first time in one place the accomplishments of all HHS agencies in recent years and their aims and plans for the near future.

Since the threats associated with climate change are unfolding rapidly, our view is that any resource we create will necessarily be a "living" one. We will make updates to our strategy and key actions from HHS agencies on a regular basis, and broadly communicate these.

We appreciate your time and interest in this work, and we are deeply grateful for energetic action of leaders across the health and human services sectors in addressing the unprecedented health challenges of climate change.

Sincerely,

Admiral Rachel Levine
Assistant Secretary for Health
U.S. Department of Health and Human Services

II. Introduction

HHS has played an important role in anticipating and addressing the health impacts of climate change for many decades, including through the formal creation of the Climate and Health Program at the Centers for Disease Control and Prevention (CDC) in 2009. In addition to the efforts of the CDC, the National Institutes of Health (NIH) and the Administration for Strategic Preparedness and Response (ASPR) have studied climate-related threats to health and health systems and introduced research and tools to support states, communities and health and human services providers in their efforts to respond.

Since the beginning of the Biden Administration, HHS has significantly accelerated and expanded its work in this area. Executive Order 14008, *Tackling the Climate Crisis at Home and Abroad*, instructed HHS to create OCCHE and to stand up a new interagency working group and advisory committee related to protecting at-risk populations from the health impacts of climate change and preparing the health sector for climate impacts. Additional executive orders have climate mandates relevant to HHS, including Executive Order 14030 (*Climate-Related Financial Risk*), Executive Order 14057 (*Catalyzing Clean Energy and Jobs Through Federal Sustainability*) and Executive Order 14096 (*Revitalizing Our Nation's Commitment to Environmental Justice*).

Demonstrating a new level of commitment to addressing climate-related threats to health and well-being, the Department has responded to these directives. In addition to formally launching OCCHE on August 31, 2021, it has included climate change in its new Strategic Plan through Strategic Objective 2.4 (*Mitigate the impacts of environmental factors, including climate change, on health outcomes*) and Strategic Objective 5.4 *(Ensure the security and climate resiliency of HHS facilities, technology, data, and information, while advancing environment-friendly practices).* In September 2021, HHS published an agency Climate Action Plan that for the first time committed to climate actions across all its relevant Operating and Staff Divisions. And in November 2021, the first-ever HHS delegation to a United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) supported the United States' commitment to the COP26 Health Program, committing to setting and achieving health system greenhouse gas emission reduction and resilience goals. Among the steps included in the COP26 Program was the development of a National Adaptation Plan for Health. Such actions constitute meaningful direction setting and they also set the stage for the development and publication of this document.

This document describes both the specific challenges the health and human services sectors face with respect to climate change and the specific planned responses of relevant HHS Operating and Staff Divisions to prevent harm across communities and facilities in the U.S. It is a supplement to the existing HHS Climate Action Plan (U.S. HHS, 2021), a document which captures both inward-facing HHS efforts to become more resilient and sustainable in the Department's own facilities and services (as required by Executive Orders 14008 and 14057) and the outward-facing, programmatic activities from agencies enumerated in more detail here. It is also distinct from an HHS Environmental Justice Strategic Plan which will be introduced in the coming months, pursuant to Executive Order 14096.

III. Problem Statement (Current Assessment of Climate-Related Threats to U.S. Healthcare, Public Health and Human Services)

The 4th National Climate Assessment concluded that "Impacts from climate change on extreme weather and climate-related events, air quality and the transmission of disease through insects and pests, food, and water increasingly threaten the health and well-being of the American people, particularly populations that are already vulnerable," (U.S. Global Change Research Program, 2018), and the recently-released 5th National Climate Assessment only amplifies this concern (U.S. Global Change Research Program, 2023). The 2009 Lancet Commission on Health and Climate Change described climate change as "the biggest global health threat of the 21st century," (Costello et al., 2009) while the second Lancet commission, in 2015, asserted that "tackling climate change could be the greatest global health opportunity of the 21st century." (Watts et al., 2015). In 2021, over 200 health journals around the world published a consensus statement calling for urgent action to keep average global temperature increase below 1.5 degrees Celsius, acknowledging that climate change is already causing a host of global health harms, and that the ecologic and public health consequences of exceeding this threshold would be catastrophic (Atwoli et al., 2021).

These harms to health caused by climate change are also inequitably distributed. People with lower incomes, indigenous communities and communities of color are disproportionately harmed because of systemic inequities that affect climate exposures, sensitivity, and adaptive capacity (EPA, 2021). Children, because of their physiology, developmental needs, and cumulative exposure risk, are uniquely vulnerable to climate-related hazards (American Academy of Pediatrics Council on Environmental Health, 2015) while populations with underlying medical conditions, people with disabilities, older adults, and pregnant women are also at increased risk. Due to the nature of many work environments, various worker populations are at greater risk for climate-related impacts, as well, particularly as employers may not be sufficiently prepared or have adequate resources to implement risk management plans (Shulte et al., 2023).

Moreover, inequitable threats to health from climate change interact with inequitable threats to health from all toxic environmental exposures related to air and water pollution, unhealthy housing, and other environmental hazards. The mission of the HHS Office of Environmental Justice (OEJ), which sits within OCCHE, is to protect the health of communities with environmental justice concerns, disadvantaged communities, and other vulnerable populations on the frontlines of pollution, and other environmental hazards that affect health. OEJ is leading the development of an HHS Environmental Justice Strategic Plan and its elements will interact with and complement those in this document.

Health consequences of climate change are wide ranging — including but not limited to the impacts of increasing frequency and severity of wildfires and extreme weather events such as heatwaves and storms, changing patterns of infectious disease, decreased air and water quality, and disruptions in access to food and water (U.S. Global Change Research Program, 2016). Beyond acute challenges of this kind, climate change exacerbates a variety of chronic health conditions like cardiovascular disease, asthma and allergies, causing more vector-borne illness, water-borne illness and mental health stressors, as well.

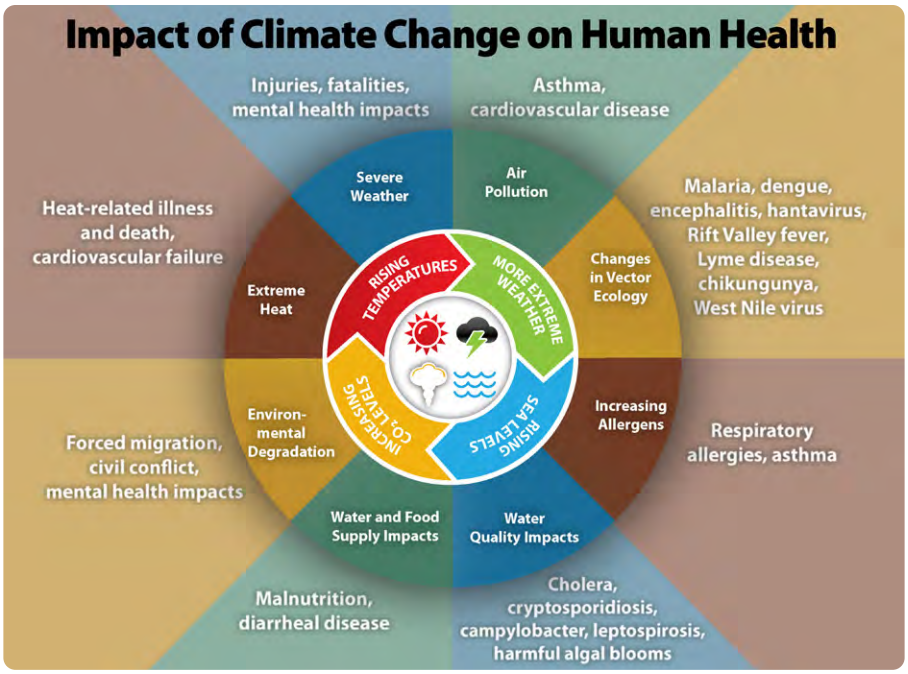

Figure 1: Impact of Climate Change on Human Health (CDC, 2022) https://www.cdc.gov/climateandhealth/effects/default.htm

For the healthcare sector, climate change not only affects the well-being of populations served; it also represents a costly threat to operational continuity. For example, between 2000-2017, 72% of hospital evacuations were due to climate-sensitive disasters (Mace, SE & Sharma, A, 2020). In 2022 alone, there were 18 extreme weather and climate disasters in the U.S. whose cost exceeded $1 billion each (Smith, 2023). Of note, these disaster cost estimates do not include healthcare related costs although the Office of Management and Budget (OMB) also estimates tens of billions in additional climate-related federal healthcare spending in coming decades (OMB, 2022).

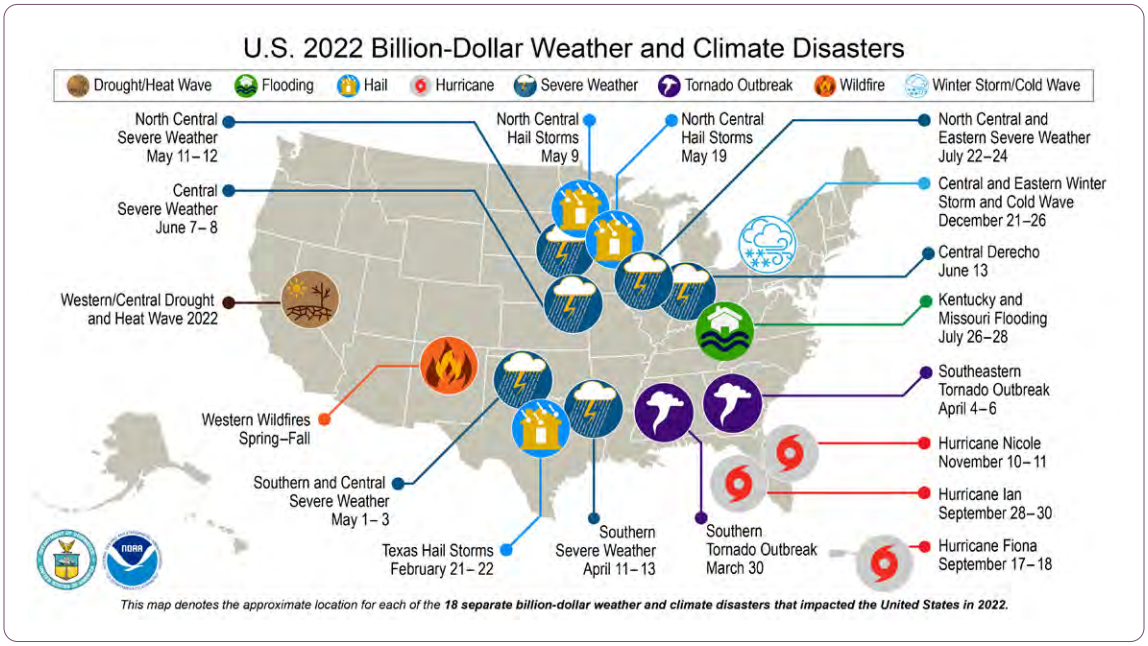

Figure 2: In 2022, the U.S. experienced 18 separate weather or climate disasters that each resulted in at least $1 billion in damages. National Oceanic and Atmospheric Administration (NOAA) map by National Centers for Environmental Information (NCEI) https://www.climate.gov/media/14987.

Climate-fueled disasters can also disrupt human service operations that are essential to protecting high-risk populations from climate hazards. For example, utility assistance programs and home weatherization interventions can protect at-risk individuals from exposure to both extreme heat and cold, and income support programs can provide critical help to households displaced by disaster.

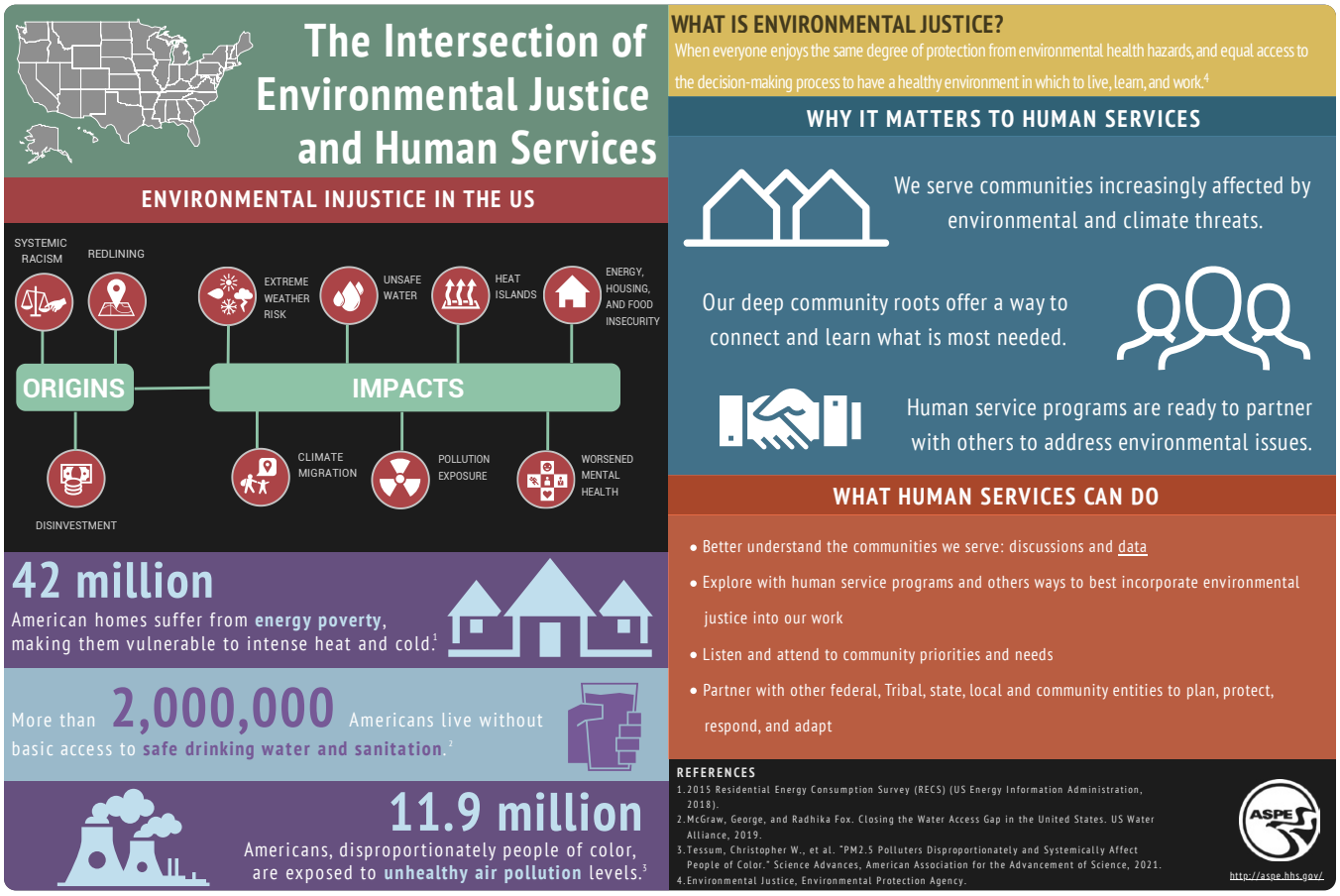

Figure 3: The intersection of environmental justice with human services policies and programs (ASPE, 2021) https://aspe.hhs.gov/reports/ej-human-services

In addition, the U.S. health sector contributes 8.5% of total U.S. greenhouse gas emissions (Eckelman et al., 2020) through direct, on-site emissions, purchased energy and emissions associated with its value chain. Increasing operating efficiency and decreasing greenhouse gas emissions in healthcare facilities aligns with the mission of protecting population health.

Cumulatively, climate change represents a challenge to community health and health care that is truly unprecedented in its scope and scale. While all HHS Operating and Staff Divisions must take internal actions to ensure preparedness for climate-related events and contribute to mitigation, many also have major programmatic opportunities to bolster the climate-related efforts of the populations and organizations they serve.

IV. Stakeholder Recommendations for HHS Action

In recent years, numerous professional societies, advocacy groups, academic experts and congressional witnesses have offered their views on the actions HHS can take to address climate-related threats and more rapidly advance resilience and decarbonization across the country. In a major statement from 2021, for instance, more than 50 health and medical organizations outlined possible actions from HHS Operating and Staff Divisions, suggesting both programmatic and regulatory steps that agencies could take to best meet the needs of the populations they serve (Health Voices for Climate Action, 2021).

In addition, HHS has since 2021 conducted numerous regional listening sessions and issued five Requests for Information (RFIs) from different agencies — two from the Centers for Medicare & Medicaid Services (CMS) and one each from the Agency for Healthcare Research and Quality (AHRQ), NIH and the Substance Abuse and Mental Health Services Administration (SAMHSA) — to more fully understand how HHS programs can have the greatest impact in preparing for and addressing the impacts of climate change on health and well-being (this document's Appendix summarizes learning from these RFIs).

Looking across this feedback, organizations and individuals providing recommendations have broadly embraced the importance of setting goals for reduced emissions and increased climate resilience, but also repeatedly requested the following to support health and human services stakeholders in this regard:

- Increased research on resilience, decarbonization, and the cost impacts of climate change for care providers;
- More timely data to understand the threats and health impacts associated with climate change, especially for populations at highest risk;
- Increased information to support life cycle assessment of healthcare products;
- Increased funding, including grants, incentives and tax-related supports, to help deepen climate resilience and decarbonization work, such as investments in renewable energy projects;
- Provision of technical assistance tools and learning collaboratives to assist operational and clinical improvements in this area;
- Education for clinicians, patients, health care institutions, and members of the public on climate change and environment-related health impacts and social determinants of health (SDOH);
- Standardized measures and measurement frameworks to help with progress tracking and emissions reporting (with mixed views on whether such reporting be mandatory or voluntary);
- Development of quality measures and metrics tied to climate-related health impacts;
- Updates to and simplification of emergency preparedness requirements, conditions of participation, and other regulations to help all provider and supplier types to be more responsive to climate-related challenges;
- Attention to the challenges different provider types, already under strain from the pandemic, must address to take on this work and ensure no compromise in the quality of care delivery;
- Increased collaboration among federal agencies, as well as government and non-governmental entities, to make certain that supports and requirements are aligned.

These recommendations reflect growing acknowledgement of the unprecedented threats to health presented by climate change and a strong interest among individuals, medical and professional associations, health care providers, public health and human services institutions and others to reduce emissions and enhance resilience and emergency preparedness efforts in response.

Ongoing listening — through additional RFIs, regional listening sessions and other interactions — will be essential to make certain that resources are applied efficiently to address the most urgent climate-related problems. External reports also have the potential to be informative; in 2022, for example, the House of Representatives Ways and Means Committee issued their own RFI, canvassing large industry associations, large health systems, and other sector stakeholders for written feedback on climate-related threats to health, and it also held public hearings on national climate resilience (U.S. House Ways and Means Committee, 2023).

V. Accomplishments to Date

HHS has for several decades sought to understand climate-related challenges and taken actions to address them. These include regional initiatives like CDC's Climate-Ready States and Cities Initiative — and its associated Building Resilience Against Climate Events (BRACE) framework — along with relevant emergency responses coordinated by ASPR.

Since the start of the Biden Administration, HHS investments of time and resources for work on climate-related challenges have increased significantly. This started with the creation of OCCHE, called for by Executive Order 14008, and was reinforced when HHS introduced for the first time an explicit aim in its strategy to address environmental health and specifically climate change. Since that time, the Department has taken several other actions to create more formal structures to coordinate and expand this work within HHS, engaging all agencies. These include the following:

Recent Actions to Formalize Efforts on Climate Change and Environmental Justice within HHS

- Establishment of OCCHE to address the impact of climate change on the health of people living in the U.S. (August 2021)
- Entry of HHS into the United Nations Health Programme in conjunction with the 2021 UN Climate Change Conference (November 2021)
- Inclusion of a goal to mitigate the impacts of environmental factors (including climate change) in HHS Strategy (December 2021)
- Creation of the HHS Climate Change and Health Equity Working Group, consisting of all HHS Operating Divisions, to coordinate efforts to enhance health systems resilience and sustainability through the activities of HHS (February 2022)
- Establishment of OEJ to protect the health of disadvantaged communities and at-risk populations on the frontlines of pollution and other environmental hazards that affect health (May 2022)
- Announcement of the HHS Justice40-covered programs, with the goal of ensuring that 40% of the overall benefits of climate, clean energy and other covered federal investments flow to disadvantaged communities (using the Climate and Economic Justice Screening Tool to identify those communities) (June 2022)
- Issuance of five requests for information on climate and health from four HHS Operating Divisions, including one each from AHRQ, NIH, and SAMHSA, and two from CMS (September 2021–August 2022)

With these foundational structures in place, HHS has turned its attention to enhancing both facility and community resilience and accelerating decarbonization across health and human services. Major initiatives have included the White House-HHS Health Sector Climate Pledge, a campaign that invites private sector organizations to enhance resilience, reduce emissions and transparently share their progress in keeping with the administration's goals, as well as efforts to enumerate all available federal resources to support industry work in this area, including significant resources made available by the Inflation Reduction Act (IRA). In addition, OCCHE is now also collaborating with England's National Health Service (NHS) and health systems of other nations to provide aligned guidance for health

sector suppliers on emissions reporting and target-setting (given the disproportionate impact that emissions related to the value chain have on the sector's overall footprint).

Major HHS actions from the last two years include the following:

Actions to Accelerate Community Resilience

- Ongoing utilization of the emPOWER program from ASPR and CMS to use data and mapping technology to proactively identify Medicare beneficiaries at risk during disasters (including climate-related disasters)
- Creation of the Extreme Heat Interagency Working Group, co-led by HHS, NOAA and the Environmental Protection Agency (EPA), convening agencies to communicate, coordinate and improve federal response to extreme heat and continuously add health-related updates to the National Integrated Heat Health Information System (https://www.heat.gov/). (August 2021)
- Expansion through the American Rescue Plan of the Administration for Children and Families (ACF) Low Income Home Energy Assistance Program (LIHEAP) to keep families safe and healthy by providing assistance on reducing costs associated with home energy bills, energy crises, weatherization and energy-related home repairs (April 2022)
- Creation of the Climate Change and Health Equity Playbook: Adaptation Planning for Justice, Equity, Diversity, and Inclusion by CDC and the American Public Health Association (APHA) (April 2022)
- Launch of the OCCHE Climate and Health Outlook (CHO), which provides information to health professionals and the public on how health may be affected by climate events in the coming months, as well as resources to take proactive action (May 2022)
- Release of ACF guidance on the flexibilities associated with the use of Community Services Block Grant funding for summer crisis assistance and disaster response to mitigate heat stress (July 2022)
- HHS/Department of Energy (DOE) partnership to develop and pilot the Low-Income Clean Energy Connector, which makes community solar more accessible to households participating in LIHEAP (July 2022)
- Launch by CDC/Agency for Toxic Substances and Disease Registry (ATSDR) and OEJ of the Environmental Justice Index (EJI) to rank the cumulative impacts of environmental injustice on health for every census tract in the U.S. (August 2022)
- CMS approval of the Oregon Health Plan Medicaid 1115 Demonstration Project, which includes allowance for coverage of medically necessary air conditioners, heaters, humidifiers, air filtration devices, generators, and refrigeration units when certain requirements are met (October 2022)
- ASPR publication of the National Health Security Strategy (NHSS) 2023-2026, which describes climate change and health disparities as threats to national health security and offers strategic direction and implementation actions to improve community resilience before, during, and after disasters (February 2023)
- Launch by OCCHE and the National Highway Traffic Safety Administration (NHTSA) of the EMS HeatTracker, a dashboard that maps local emergency medical service (EMS) utilization for heat-related illness in the U.S. (August 2023)
- Launch by ASPR's Division of Community Mitigation and Recovery (CMR) of a pilot project in HHS Region 5 to address post-disaster equity issues (in terms of race/ethnicity, gender, and LGBTQ+ identity) through the disaster recovery process, resulting in the Equity Guide and Checklist (August 2023)

- ACF, the Assistant Secretary for Planning and Evaluation (ASPE), the Office of Regional Health Operations (ORHO) and OCCHE convening of regional community conversations across the country with local service providers, government and community members in locations with exposure to environmental and climate threats, culminating in an event on Strengthening Partnerships for Healthy, Climate Resilient, and Thriving Communities (February-August 2023)
- Launch by OCCHE and ASPR of the Climate and Health Outlook Portal, an interactive companion to the Climate and Health Outlook that is hosted on ASPR's GeoHEALTH Platform and maps county-level heat, wildfire, and drought forecasts in the U.S. for the current month, as well as county-level individual risk factors that may increase the risk of negative health outcomes from these climate-related hazards (September 2023)
- HHS contributions of health considerations in the Biden Administration's National Climate Resilience Framework (September 2023)
- Ongoing expansion of NIH programmatic work, including the Climate Change and Health Initiative, which is an effort to reduce health threats from climate change across the lifespan and build health resilience in individuals, communities, and nations around the world, especially those at highest risk (includes NIH launch of a Climate Change and Health Research Coordinating Center at Boston University School of Public Health (SPH) and TH Chan Harvard SPH to support these efforts by creating a community of practice of active researchers in Climate and Health, considering data management and integration issues and developing partnerships to create a global health component of the initiative)

Actions to Accelerate Healthcare Facility Resilience and Climate-Sensitive Clinical Care

- Publication of ASPR's Technical Resources, Assistance Center and Information Exchange (TRACIE) *Climate Change Resilience and Healthcare System Considerations*, providing an overview of climate trends in the U.S. and outlining the impacts of climate-related illness and injury on health system operations, care delivery, and patient surge (April 2022)
- Delivery of OCCHE/CDC Collaborative on Climate Change and Cardiovascular Health to provide a national forum for health professionals and organizations to learn more about the impacts of air pollution and extreme heat on cardiovascular health with interventions to address these threats (November 2022-April 2023)
- Release of AHRQ analyses of Healthcare Cost and Utilization Project data to study the impact of climate change on hospital and emergency department (ED) utilization during extreme heat (December 2022)
- AHRQ convening of an expert roundtable on identifying and creating climate resilience measures for healthcare delivery organizations with attention to current state of knowledge and required research (February 2023)
- OCCHE release of the Protecting Vulnerable Patient Populations from Climate Hazards Referral Guide for Health Professionals to inform education and referrals in clinical settings for patients who are vulnerable to the health impacts of climate change (May 2023)
- OCCHE release of Climate Resilience Plan Elements for Healthcare Organizations to help healthcare facilities think through the best approach for assessing organizational risk and addressing facility vulnerabilities (July 2023)
- HRSA convening of Federally Qualified Health Center (FQHC) focus groups to address

preparedness, recovery and resilience and to inform development of technical assistance on climate change resilience action for health centers (July 2023)

- ASPR release of Heat Hazards dashboard and Summer Weather Assessment dashboard on the HHS GeoHEALTH Platform
- Ongoing expansion of CDC programmatic work, including the CDC Climate and Health Program, which supports state, tribal, local, and territorial public health agencies to prepare for the health impacts of climate change

Actions to Accelerate Health Sector Decarbonization

- Launch of the NAM's Action Collaborative on Decarbonizing the U.S. Health Sector, co-chaired by the HHS Assistant Secretary for Health (September 2021)
- Launch of the WH-HHS Healthcare Sector Climate Pledge inviting private sector stakeholders to voluntarily commit to reduce greenhouse gas emissions by 50 percent by 2030 and achieve net zero emissions by 2050 with 116 organizations representing more than 870 hospitals signing on so far (April 2022)
- Launch by OCCHE and federal health systems partners of the Federal Health Systems Learning Network (FHSLN) to support the VHA, DHA, and the IHS in meeting the emissions reduction goals of Executive Order 14057 (June 2022)
- HHS collaboration with NHS England (and, increasingly, other nations) to align procurement requirements and guidance for health sector suppliers (November 2022)
- Release of the OCCHE Compendium of Federal Resources for Health Sector Emissions Reduction and Resilience and an associated webinar series on Accelerating Healthcare Sector Action on Climate Change and Health Equity (July-November 2022)
- Release of the AHRQ Primer on Measures and Actions for Healthcare Organizations to Mitigate Climate Change to support healthcare organizations in advancing decarbonization efforts (September 2022)
- Release of the CMS Health Systems Microgrid Waiver permitting new and existing health care facilities subject to CMS requirements to utilize alternative sources of power other than a generator set or battery system, including a health care microgrid system (March 2023)
- Launch of the OCCHE IRA "Quickfinder" to help health sector stakeholders take advantage of the investment opportunities for work on resilient infrastructure and renewable energy made available by IRA, as well as the Health Sector Resource Hub where organizations can find helpful resources and supports related to emissions reduction and climate resilience (April 2023)
- Release of the HHS/Environmental Protection Agency (EPA) Energy Star Portfolio Manager Guide on how different healthcare provider types can use the Energy Star Portfolio Manager to track energy use and greenhouse gas reductions (April 2023)
- Co-hosting of a White House Roundtable to bring together health sector stakeholders, financial institutions and philanthropies to discuss financing challenges and opportunities associated with the IRA for safety net care providers and the healthcare sector more broadly. (October 2023)

Building on these initial actions, OCCHE now seeks to articulate an HHS-wide vision for transformation of the U.S. health and human services sectors, securing specific contributions from every HHS Operating Division to support their programs and stakeholders in mitigating the health effects of climate change and promoting resilience.

VI. Planned Actions for the Near Term

Going forward HHS will organize itself to assist communities, healthcare facilities, public health agencies, human services providers and other stakeholders across the country in addressing the challenges that climate change presents. Specifically, HHS Operating Divisions will pursue the following vision for national transformation:

- Every community, health system and provider in every U.S. location is prepared for both disruptive and chronic climate impacts on its most at-risk patient populations.
- Every healthcare institution is prepared for long-term operation — and can support community resilience — in the face of climate catastrophes.
- Every hospital and health system in the U.S. is publicly tracking its greenhouse gas emissions and is on a path to net zero by tackling Scope 1 emissions (direct on-site emissions), Scope 2 emissions (emissions associated with purchased energy) and Scope 3 emissions (emissions associated with the value chain).
- Public sector investments to reduce greenhouse gas emissions and fossil fuel dependence consider implications for health and health equity.

To make this possible, HHS will take advantage of the many policy levers at its disposal through its Operating Divisions, including technical assistance, tool development, funding opportunities, measurement, reimbursement and regulation, among others. The Department will also invest more heavily in building capacity across all agencies to understand and address climate-related challenges, which has started in 2023 through creating focused learning requirements for the HHS Senior Executive Service (SES) and identifying climate health points of contact in HHS Operating and Staff Divisions and regional offices.

Some key planned HHS actions for the next two years are organized below by Operating Division and include research and analysis activities (i.e., activities to study, analyze and summarize challenges and opportunities related to climate health across the country), resilience activities (i.e., activities to support health systems—and the communities they serve—in becoming more resilient to climate threats) and emissions reduction activities (i.e., activities to support healthcare organizations in reducing their carbon footprint).

Administration for Children and Families (ACF)

ACF promotes the economic and social well-being of families, children, individuals and communities. It does this mainly through programs that connect these groups — and particularly at-risk populations — to services that put them on a path to stability and help them recover from crises and stressors. Its planned climate-related activities over the next two years include:

- Expanding the reach and impact of the LIHEAP program to allow more families to reduce energy costs by accessing its benefits
- Initiating LIHEAP demographic data collection from program service information and developing a Community Economic Development (CED) mapping capability to assess how CED projects may align with the Justice40 Initiative

Administration for Community Living (ACL)

ACL increases access to community support and resources for the unique needs of older Americans and people with disabilities by funding services and supports provided primarily by networks of community-based organizations, and by investing in research, education, and innovation. Its planned climate-related activities include:

- Engaging Aging & Disability Networks to supply information on access to cooling centers for older adults and people living with disabilities during extreme heat events
- Directing State Assistive Technology programs to help people with disabilities access re-used durable medical equipment and other assistive technologies during heat waves, power outages and displacement due to wildfires
- Updating the Emergency Preparedness module in National Survey of Older Americans Act Participants (NSOAAP) to collect information on climate vulnerability

Administration for Strategic Preparedness and Response (ASPR)

ASPR leads the nation's medical and public health preparedness for, response to, and recovery from disasters and public health emergencies. It accomplishes this through programs such as the Hospital Preparedness Program (HPP), which is the primary source of federal funding for health care system preparedness and response, and the Technical Resources, Assistance Center, and Information Exchange (TRACIE), which provides information and technical assistance to those working in disaster medicine, healthcare system preparedness, and public health emergency preparedness. Its planned climate-related activities include:

- Developing a Tribal engagement strategy for health and social services disaster recovery
- Launching the Healthcare and Public Health Risk Identification and Site Criticality 2.0 (RISC 2.0) toolkit, including climate change and health equity considerations and links to the Sustainable and Climate-Resilient Health Care Facilities Toolkit (SCRHCFT)
- Continuing to maintain existing ASPR TRACIE resources focused on climate change and health equity and develop new resources to advance health equity, filling gaps in health care system preparedness for climate change
- Continuing to incorporate climate resilience and health equity capabilities to strengthen health care system readiness in relevant technical assistance programming
- Developing and promoting methods to ensure climate change resilience, mitigation and health equity concerns are identified and addressed in after-action and evaluation activities
- Conducting exercises and trainings that emphasize climate resilience, mitigation and health equity during disaster response and recovery operations

Agency for Healthcare Research and Quality (AHRQ)

AHRQ produces evidence to make health care safer, higher quality, more accessible, equitable, and affordable, and works within HHS and with other partners to make sure that the evidence is understood and used in healthcare delivery. Its planned climate-related activities include:

- Continuing to spread its Decarbonization Primer to healthcare sector stakeholders
- Continuing to promote its Special Emphasis Notice encouraging health services research grant applications on climate change and healthcare
- Producing a technical brief on the use of environmental life cycle analysis (LCA) in healthcare
- Continuing to conduct intramural research on the impacts of heat on health and healthcare delivery
- Continuing collaborations, as noted below on page 20, that use AHRQ data to deepen understanding of climate change's impact on health and healthcare delivery

Centers for Disease Control and Prevention (CDC)

CDC protects the public health of the nation by providing leadership and direction in the prevention and control of diseases and other preventable conditions, and by responding to public health emergencies. CDC's Climate and Health Program supports state, tribal, local, and territorial public health agencies as they prepare for the health impacts of a changing climate. CDC's National Institute for Occupational Safety and Health (NIOSH) also supports research related to the occupational impacts of climate that can be used for risk management programs and for development of prevention and mitigation measures. In addition to the ongoing work of these programs, specific planned climate-related activities across CDC include:

- Incorporating climate and health equity in the Public Health Emergency Preparedness (PHEP) program and guidance
- Including climate and equity in Preventative Health and Health Services (PHHS) Block Grant Program
- Incorporating health equity into climate-related objectives/products through the Interagency Council for Advancing Meteorological Services (ICAMS) particularly through their new working group on social equity
- Updating the Building Resilience Against Climate Effects (BRACE) framework to include an explicit focus on equity, guidance on both adaptation and mitigation efforts, and increased flexibility to accommodate diverse contexts and capacity.

Centers for Medicare & Medicaid Services (CMS)

CMS combines the oversight of the Medicare program, the federal portion of the Medicaid program and State Children's Health Insurance Program (CHIP), the Health Insurance Marketplace, and related quality assurance and improvement activities. Its planned climate-related activities include:

- Updating emergency preparedness regulations and associated guidance to reflect more explicit climate resilience considerations
- Exploring the incorporation of climate resilience considerations in forthcoming CMS technical assistance programs (e.g., Quality Innovation Network-Quality Improvement Organizations (QIN-QIO) Statement of Work (SOW), American Indian Alaska Native (AIAN) Statement of Work)
- Advising states about opportunities to better address climate change as a SDOH using Medicaid and CHIP authorities (e.g., highlight and share examples of how specific states are implementing optional services through demonstration projects to address the health impacts of climate change for vulnerable beneficiaries)
- Responding in a timely way to climate-related crises and health emergencies to grant necessary waivers and support the undisrupted delivery of care in facilities across the country
- Exploring CMS authorities to support and incentivize healthcare facility action on emissions reduction

Food and Drug Administration (FDA)

FDA is responsible for protecting the public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, and medical devices; and by ensuring the safety of our nation's food supply, cosmetics, and products that emit radiation. FDA also has responsibility for regulating the manufacturing, marketing, and distribution of tobacco products to protect the public health and to reduce tobacco use by minors. Its planned climate-related activities include:

- Building on assessments of the scientific need and regulatory path for a potential transition from Hydrofluoroalkane (HFA) to new propellants (Center for Drug Evaluation and Research/Office of Pharmaceutical Quality)

- Providing ongoing feedback to the Environmental Protection Agency on proposed rules to reduce emission of ethylene oxide from sterilization facilities in the drug supply chain (Center for Drug Evaluation and Research/ Office of Pharmaceutical Quality)
- Building on the approval of a drug to reduce ammonia gas emissions from beef cattle in 2018 (Experior), continuing exploration of additives and drugs that can reduce animal-based emissions (Center for Veterinary Medicine)
- Participating in the interagency plastic pollution working group, helping to identify potential implications of new mandates regarding plastics used in drug packaging (Office of Policy, Legislation and International Affairs and Office of Pharmaceutical Quality)
- Continuing to contribute to global regulatory conversations regarding expectations for drug substance and drug product storage conditions across all climactic zones (Office of Pharmaceutical Quality)
- Continuing to study climate change's impact on food producers (Center for Food Safety and Nutrition)
- Continuing to take climate change into consideration as part of the FDA's One Health Initiative to bring human, animal and environmental concerns into alignment
- Considering climate change in future health equity innovation and grant programs (FDA Office of Minority Health and Health Equity issued a health equity innovation award in FY23 which included a request for proposals related to climate change)
- Expanding educational programming for office directors and associated staff education from OCCHE, CDC and other departmental experts (building on multiple sessions in 2023)

Health Resources and Services Administration (HRSA)

HRSA provides health care to the nation's highest-need communities, serving people who are geographically isolated and economically or medically vulnerable. HRSA programs support people with low incomes, people with HIV, pregnant women, children, parents, rural communities, transplant patients and other communities in need, as well as the health workforce, health systems and facilities that care for them. Its planned climate-related activities include:

- Establishing partnerships to provide training and technical assistance related to climate and emergency preparedness to raise awareness and facilitate knowledge transfer among clinicians, support staff, and the public health workforce
- Assisting with building organizational awareness and capacity to mitigate, prepare for, respond to, and recover from public health emergencies, natural disasters and other emergencies, and/or potential health effects associated with a changing climate

Indian Health Service (IHS)

IHS provides federal health services to American Indians and Alaska Natives. It is their principal federal health care provider and health advocate, with the mission of raising the physical, mental, social, and spiritual health of American Indians and Alaska Natives to the highest level. Its planned climate-related activities include:

- Delivering on the decarbonization goals of Executive Order 14057 (includes conducting sustainability audits on existing HHS/IHS facilities)
- Contributing to the Federal Health System Learning Network to advance joint work on clinical decarbonization and meet the decarbonization goals of Executive Order 14057
- Exploring construction of a net zero medical facility, partnering with Tohono O'odham Nation to conduct a planning study to project the cost differential associated with a Net Zero facility

National Institutes of Health (NIH)

NIH supports biomedical and behavioral research within the U.S. and abroad, conducts research in its own laboratories and clinics, trains promising young researchers, and promotes collecting and sharing medical knowledge. Its planned climate-related activities include:

- Expanding the NIH portfolio on the health impacts of climate change across many climate factors, including extreme weather events (this will be accomplished by funding investigator-initiated research grants and providing supplements to existing grants to expand capacity and leverage existing investments to study many health outcomes)
- Further establishing the NIH Climate Change and Health Research Coordinating Center and funding four Alliance for Community Engagement — Climate and Health (ACE-CH) "hubs" that will explore local climate-related challenges with impacted communities and prepare to conduct translational research
- Supporting a Climate and Health Scholars Program to increase climate and health-related research capacity at the NIH
- Forming partnerships with other federal agencies, including the National Science Foundation, to support timely health research in response to climate related disasters
- Providing additional research funding and training opportunities for grantees interested in studying the intersection of climate and health
- Disseminating a knowledge management tool (NIEHS Climate Change and Health Glossary) with the intent to help guide discussions and research with common and cohesive language across disciplines working on climate change and human health
- Building infrastructure for a climate change and health data ecosystem through curation, creation, and evaluation of data sources, methods, tools, and other resources to explore potential relationships between wildfire exposures and health outcomes (funded by the Office of the Secretary Patient-Centered Outcomes Research Trust Fund)

Office of the Assistant Secretary for Health (through the Office of Climate Change and Health Equity)

The Office of the Assistant Secretary for Health leads the Department's public health initiatives and programs. Its work on climate change is carried out by the Office of Climate Change and Health Equity (described in prior sections), which also plays a coordinating role in climate-related activities across the Department. OCCHE's planned climate-related activities include:

- Producing the Climate and Health Outlook each month to support healthcare stakeholders in anticipating and responding to climate-related threats
- Developing plans for continued regional and tribal engagement following the August 2023 "Strengthening Partnerships for Healthy, Climate Resilient, and Thriving Communities" event
- Developing and disseminating a heat-related tool using the EJI
- Updating and re-launching the Sustainable and Climate Resilient Healthcare Facilities Toolkit and packaging supports to prepare for common climate-related threats
- Increasing health sector stakeholder participation in the White House-HHS Climate Pledge
- Identifying relevant programs from the IRA to support transformative industry investments in renewable energy, building efficiency and resilience (through the IRA Quickfinder) and actively disseminating this information through other agencies, associations and partners

- Catalyzing solarization of health centers and investment in renewables by other safety net providers through available IRA resources
- Supporting HHS in collaborating on procurement guidance with NHS England, producing shared information for suppliers on expected climate disclosures and involving other nations to the degree possible
- Operating the Federal Health Systems Learning Network to help federal care providers meet the decarbonization goals of Executive Order 14057
- Clarifying statutory limitations and flexibilities for HHS and HHS Operating Division work on emissions reduction
- Building on climate-related training for HHS Senior Executive Service members and for individuals in all Staff and Operating Divisions

Substance Abuse and Mental Health Services Administration (SAMHSA)

SAMHSA recently announced its updated mission and vision as part of its 2023-2026 Strategic Plan, which is to lead public health and service delivery efforts that promote mental health, prevent substance misuse and provide treatments and supports to foster recovery while ensuring equitable access and better outcomes. SAMHSA envisions that people with, affected by, or at risk for mental health and substance use conditions receive care, achieve well-being, and thrive. Its planned climate-related activities include:

- Building on information received through SAMHSA's 2022 Request for Information and conducting regional "climate conversations" with SAMHSA stakeholders across the 10-SAMHSA regions, along with Tribal nations and territories
- Educating behavioral health providers on the disproportionate impact of extreme heat on people with serious mental illness and/or substance use disorders (behavioral health providers and people with mental health and substance use conditions will be advised on the physiological effects of extreme heat on people who have mental health and substance use conditions and related actions they can take to mitigate risks for heat-related health problems)
- Supporting incorporation of climate-informed behavioral health services across a continuum of behavioral health service provider types, including integrating climate related health information into existing behavioral health and wellness curriculums
- Addressing the mental health impacts of climate change through SAMHSA block grants

There are also several potential collaborations across Operating Divisions that could include:

- Exploring the addition of more climate-related variables to HHS SDOH databases (e.g., AHRQ) and data inventories in order to accelerate collection of information on climate change as a social determinant, particularly for at-risk populations
- Exploring additional inter and intra-Department data analysis collaborations, building on efforts like the AHRQ-OCCHE collaboration using Healthcare Cost and Utilization Project (HCUP) data to better understand extreme heat impacts on healthcare services
- Creating an HHS compendium of "success stories" on climate resilience and health equity both as a communication tool and to inform policy

In addition, OCCHE and HHS Operating Divisions will interact closely with other federal departments to carry out necessary work. This happens regularly through the Federal Health System Learning Network and through exchanges with agencies whose work has a close relationship to climate change and health. This happened in the spring of 2023, for example, when OCCHE and EPA collaborated to develop shared guidance for all healthcare provider types on use of the EPA Portfolio Manager platform for emissions tracking.

The HHS Climate Change and Health Equity Working Group will be the venue for regular review of progress and annual updates on the planned actions outlined above.

VII. Framework for Future Action

While the activities outlined in the preceding sections suggest good progress and promising near-term plans from HHS Operating and Staff Divisions, much more action is required to truly transform the Department and the health and human services sectors such that they are fully prepared for climate impacts on at-risk populations and truly sustainable. Organizing frameworks for health system resilience and sustainability, such as the WHO Operational Framework for Building Climate Resilient and Low Carbon Health Systems, offer a helpful starting point in defining what is required to transform the sector in service of both resilience and emissions reduction. The framework's categories suggest key areas of focus against which we can assess the sector's current strengths and needs.

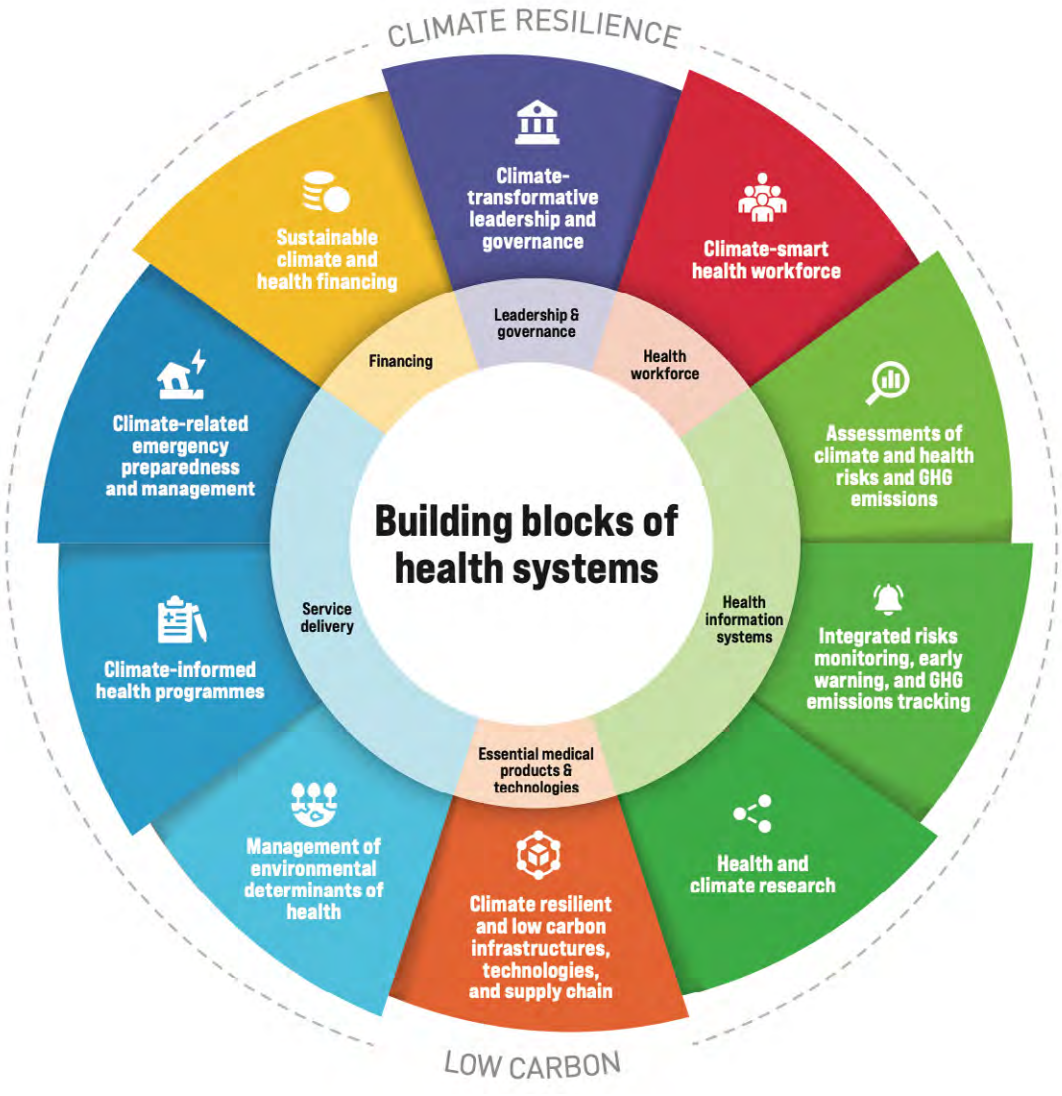

Figure 4: Ten components comprising the WHO operational framework for building climate resilient and low carbon health systems, and the main connections to the building blocks of health systems (WHO, 2023) https://www.who.int/publications/i/item/9789240081888

Specifically, HHS has identified eight components of an integrated strategy to address the challenges of climate change and advance equitable outcomes for the department and the health sector. The first two components (data collection, research) are foundational activities that will help establish the evidence base and tracking mechanisms for action; the balance of the components relate to catalyzing change in healthcare and public health sector stakeholder organizations to allow them to more rapidly become resilient and sustainable. Achieving the vision of a resilient, sustainable health system and resilient, thriving communities in the face of climate change cannot be achieved without implementing all eight components. All are essential to drive the needed transformation.

This section describes examples of necessary advances in each of the components of the strategy. At present, several of these are contingent on legislative commitments.

1. **Data collection and data system integration for climate health surveillance, research, health risk screening and diagnosis.** While there have been recent advances in surveillance of heat-related morbidity and mortality, the nation currently does not have robust surveillance systems for morbidity and mortality attributable to other climate-related phenomena such as wildfire smoke, flooding and hurricanes. Data collection systems are also needed to track greenhouse gas emissions and resilience status of the health sector. More robust data collection will directly support research as well as the consensus development of indicators and measures noted below.

    a. ***Examples of Needed Data Collection Actions***
        i. Development of tracking systems for heat, wildfire and extreme weather event-related morbidity and mortality.
        ii. Development of an HHS emissions tracker to estimate industry-wide emissions through aggregate (submitted) information, possibly drawing upon data submitted to the EPA Portfolio Manager platform

2. **Multidisciplinary climate health research, including health services research and biomedical research and development.** As previously documented, historical investment in research on climate change and health has been very small compared to other health issues, resulting in a limited evidence base (Sorensen et al., 2023). This is especially true of health services research related to climate resilience and sustainability. Recent increases in research funding at the NIH will help close the gap in community-based and implementation science research results over time, but a great deal of additional research (ranging from research and development for more sustainable biomedical devices to health services research to evaluate new climate-friendly models of care) is required to address sustainability and resilience needs of systems and communities.

    a. ***Example Research Topics on Health System Resilience***
        i. "Tipping points" for healthcare facility failure during and after extreme weather events and climate-related disasters
        ii. Return on specific investments related to healthcare facility resilience
        iii. Climate-related complications in priority areas for administration and HHS (e.g., maternal health).

    b. ***Example Research Topics on Decarbonization***
        i. Optimal approaches to on-site decarbonization, including through innovations in operations and care delivery (building on AHRQ Decarbonization Primer and identification of bright spot performers)
        ii. Comprehensive Life Cycle Assessment of healthcare products and services for all provider types to identify products and services with highest emissions impact for targeted reduction
        iii. Impact and distribution of Scope 3 emissions for different components of health sector

3. **Consensus development of climate health risk, outcome, resilience and quality indicators and measures:** Climate change-related risk, resilience and performance need to be measured and tracked at all levels of the healthcare and public health sector. At the individual level, indicators of health vulnerability can help identify patients in need of interventions when extreme weather events are anticipated. At the facility level, measures of

health system resilience and performance in addressing health risks of climate change need to be developed through standard consensus processes and incorporated into healthcare quality improvement in much the same way that patient safety and infection control imperatives have been translated into quality measures. At a national scale, indicators of health outcomes associated with climate change are needed to assess progress in health system resilience in the face of escalating exposures to climate-related hazards and health system sustainability.

a. Examples at the individual scale

i. Electronic Health Record (EHR) flags to prompt identification of patients at risk for climate-related hazards (e.g., extreme heat exposure), with suggested interventions for referral and anticipatory guidance

b. Examples at the facility or organization scale

i. Development of screening and diagnosis quality targets for climate-related exposure and risk
ii. Development of new standardized measures of facility resilience, as well as sustainability and energy efficiency, through consensus processes (e.g., National Quality Forum)
iii. Development of new measures that treat harm associated with facility carbon emissions as a dimension of quality

c. Examples at the national and sub-national scale

i. Aggregations of the above (e.g., facility greenhouse gas emissions) for tracking progress at the city, county, state and national level
ii. Development of national indicators of climate change-related health outcomes to track progress in public health, community resilience and well-being

4. Workforce training and capacity building: Meeting the health and human services challenges of climate change will require a workforce with appropriate skills and support for attaining them. This entails both enhancing the skills of existing healthcare, public health and human services professionals and training new groups of workers in specialties and skills specific to the challenges of climate change. This will include healthcare engineers with specialized skills in resilient and renewable energy, community health workers with specialized skills in climate-related patient risk assessment and interventions, clinicians with expertise in providing climate-informed care, and others.

a. Example training initiatives for existing workers:

i. Mandatory training on climate health and equity for all HHS SES, HHS Staff, and Public Health Officers with customized materials relating to the constituents of each agency
ii. Creation of dedicated climate-related positions in HHS agencies and organizations across the country
iii. Training of safety net providers in climate-informed primary care delivery

b. Example training initiatives for a new workforce:

i. Incentives for inclusion of climate health and equity curricula in all HHS-funded Graduate Medical Education

5. Innovation and enhancement in delivery of health care, public health, human services and health emergency preparedness and response: The increasing frequency and severity of climate change-related health threats drives the need for innovation in the delivery of healthcare, public health and human services. Ensuring continuity of operations and community well-being while reducing greenhouse gas emissions requires significant changes in how the sectors operate. The industry should have access to a continuously updated compendium of successful innovations and case examples from across the country and around the world. Building on a growing evidence base, additional innovations must be piloted, evaluated and disseminated in order to meet the climate

change challenges before the Department. Importantly, any innovations must be introduced in such a way that patient safety and outcomes are enhanced and never worsened.

a. Potential Innovations:

i. Care coordination models to protect at-risk patients from climate-related hazards, incorporating climate-related exposures in SDOH screening and referral
ii. Renewable energy innovations (e.g., community solar subscription programs for health centers and safety net hospitals)
iii. Innovative approaches to enhance climate resilience across public health, healthcare, and human services (e.g., incentives for healthcare organizations' upstream investments in community resilience, such as investments in affordable housing and greenspace; novel partnerships to enhance coordination between health, human services, and community organizations to improve climate resilience)
iv. Incorporation of climate action and outcomes related to climate-sensitive health conditions in healthcare quality improvement initiatives

6. Technical assistance and tool development: Healthcare, public health and human services organizations have varying levels of understanding and skill in addressing the threats presented by climate change. Climate change challenges also occur in a context of severe stresses and competing priorities for healthcare, public health and human services stakeholders. Substantial technical assistance and development of user-friendly tools and guidance are needed to assist organizations and professionals on a path towards climate resilience and sustainability. Additional technical assistance and tool development will be required as the innovations and enhancements described above are introduced.

a. Examples of Technical Assistance and Tools for Health System Resilience

i. Support for different provider types through preparedness components of the next CMS QIO Statement of Work
ii. Support associated with the planned launch of the Sustainable and Climate-Resilient Health Care Facilities Toolkit update and RISC 2.0 Vulnerability Assessment
iii. Support for FQHCs on climate resilience and resilient infrastructure through technical assistance, and partnerships to enhance primary care providers' protection of vulnerable patients from climate-sensitive hazards (including referrals to LIHEAP and the Low Income Home Water Assistance Program (LIHWAP))

b. Examples of Technical Assistance and Tools for Decarbonization

i. Development tools and resources to support organizations in developing inventories of Scope 3 emissions (i.e., emissions associated with the supply chain)
ii. Support to providers on enhanced greenhouse gas emissions tracking in partnership with EPA
iii. Support for expansion of Federal Health Systems Learning Network to facilitate dissemination of its insights and tools to private sector

7. Policies to sustain progress and heighten accountability: As consensus grows on effective, safe and affordable interventions to address climate change challenges, updates and revisions to existing authorities and policies will help ensure widespread adoption of necessary actions and measures. Existing evidence already supports revisions to emergency preparedness and resilience programs and policies. Expanded understanding and pilot testing will help support additional revisions and updates in the future.

a. Example policies, governance and structures to reinforce community and facility resilience:

i. Revision of CMS emergency preparedness regulations to more fully account for unprecedented climate-related challenges and threats to at-risk populations
ii. Inclusion of investments in sustainable operations, community climate resilience in community benefit reporting

b. Example policies, governance and structures to reinforce decarbonization:

i. Revision of EP Rule and building codes to support resilient health facility microgrids with renewable production and battery backups
ii. Exploration of greenhouse gas (GHG) accounting — and then reduction — as a CMS condition of participation or quality improvement measure
iii. Exploration of statutory authority for FDA to address emissions in production of drugs, technology, equipment

8. Funding and finance mechanisms for healthcare system resilience and decarbonization: While many investments in decarbonization and resilience ultimately save money, most require some degree of upfront capital expenditure. Existing federal programs and legislation like the IRA can help meet healthcare and public health sector needs and must be broadly accessed by organizations serving at-risk populations if transformative changes to energy infrastructure, health facility resilience and community resilience are to occur. Additional dedicated funding specifically designed for the healthcare, public health and human services sectors would facilitate more rapid and effective transformation and dedicated funding for staffing and programming within HHS could also help accelerate the Department's work on urgent climate-related challenges.

VIII. Management of HHS Work on Climate Change and Health Equity

To successfully carry out this document's vision, HHS has management structures to ensure department-wide attention to climate change and incorporate climate considerations into as much of its operations as possible.

As noted above, the Department's work on climate change and health equity originates through Executive Order 14008 and the mandate for each agency to develop a Climate Adaptation and Resilience Plan. The Director of the HHS Program Support Center (PSC) serves as HHS Chief Sustainability Officer and is responsible for full implementation of EO 14008 including agency planning, reporting requirements, and accountability. The Office of Climate Change and Health Equity has partnered closely with PSC and shares accountability for implementation of those aspects of the HHS Climate Adaptation and Resilience Plan that pertain to public health protection and health sector decarbonization and resilience.

HHS work on climate change and health equity also relates to specific components of the HHS 2022-2026 Strategic Plan, including:

- **Strategic Objective 1.2:** Reduce costs, improve quality of healthcare services, and ensure access to safe medical devices and drugs
- **Strategic Objective 1.3:** Expand equitable access to comprehensive, community-based, innovative, and culturally competent healthcare services while addressing social determinants of health
- **Strategic Objective 2.1:** Improve capabilities to predict, prevent, prepare for, respond to, and recover from disasters, public health and medical emergencies, and threats across the nation and globe
- **Strategic Objective 2.4:** Mitigate the impacts of environmental factors, including climate change, on health outcomes
- **Strategic Goal 3:** Strengthen Social Well-being, Equity, and Economic Resilience to capture human services goals and objectives
- **Strategic Objective 5.4:** Ensure the security and climate resiliency of HHS facilities, technology, data, and information, while advancing environment-friendly practices

Thus, the activities in this document also fall under the governance mechanisms of the HHS Strategic Plan, creating both programmatic and operational expectations for HHS divisions. For example, Senior Executive Staff at HHS have a specific element of their performance criteria related to training on climate change issues, as noted above, and explorations of how climate considerations should be incorporated into department funding opportunities are underway, as well.

The Office of Climate Change and Health Equity plays a central role across HHS in the implementation and accountability for both the HHS Climate Adaptation and Resilience Plan and the HHS 2022-2026 Strategic Plan. The Office convenes the HHS Climate Change and Health Equity Workgroup, which comprises individuals from all divisions of the Department and serves as the primary coordinating platform for programmatic climate change actions. This work on climate change and health equity is accomplished in close coordination with the CSO and with the HHS Office of Environmental Justice and HHS Environmental Justice Working Group, under the governance structures associated with that Working Group and relevant Executive Orders, such as E.O. 14096.

IX. Conclusion

As climate change progresses and its impacts become more apparent and severe, the Department of Health and Human Services has essential roles to play in protecting the health of all people in the U.S. and assuring the resilience of the nation's health systems. In addition, the Department, through its social supports and poverty alleviation programs, is an essential safety net and support to at-risk families as they face a disproportionate burden of impacts from climate change. Lastly, because the health sector in the U.S. is a significant source of greenhouse gas and other pollution, the Department has a critical role in supporting the reductions of those pollutants from the health sector.

This strategy represents a watershed moment in the history of the Department of Health and Human Services' efforts to address the threats associated with climate change. It demonstrates an unprecedented level of effort and engagement across the entire Department to identify viable and effective steps that can be taken now to start to address the climate crisis. And it is also just a beginning. As more and more components of HHS address the challenges climate change poses for human health and well-being, it is certain that more widespread and robust programming will develop. With climate change posing the greatest global threat to human health this century, addressing climate change is essential to achieving the overarching HHS mission to enhance the health and well-being of all Americans.

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Appendix: Summary of Findings from HHS Requests for Information on Climate Change and Health Equity

Since 2021, several HHS agencies have issued requests for information (RFIs) regarding climate change and its impacts on the health and well-being of people living in the U.S., giving particular attention to the needs of vulnerable populations. This has included two RFIs from the Centers for Medicare & Medicaid Services (CMS) and one each from the Agency for Healthcare Research and Quality (AHRQ), the Substance Abuse and Mental Health Services Administration (SAMSHA), and the National Institutes of Health (NIH). The HHS Office of Climate Change and Health Equity (OCCHE) contributed to several of these, working together with CMS to craft and summarize its RFI materials and consulting on the AHRQ and SAMHSA solicitations.

Roughly 250 comments were reviewed by OCCHE staff and detailees, which included feedback from health systems, healthcare providers, professional associations, trade associations, community organizations, private businesses, government agencies, academic institutions and unaffiliated individuals, among others. Most comments were supportive of HHS efforts to both address the negative effects of climate change on health and support American public health, health care and human service organizations in becoming more resilient and sustainable. Stakeholders consistently identified climate change as a major concern and a serious threat to the well-being of communities across the U.S. and requested that HHS strengthen programmatic and policy responses and offer financial support to nongovernmental organizations seeking to take action in this area.

The first RFI issued by CMS was part of its 2023 Notice of Benefit and Payment Parameters for health insurance exchanges and received 52 comments. Commenters universally acknowledged the threats climate change presents to human health and broadly recommended that healthcare stakeholders consider the impact of climate change on their enrollees, providers, and employees. Nearly half of the commenters supported the collection and public reporting of greenhouse gas emissions data by providers and some urged development of performance and quality measures tied to climate-related outcomes. Commenters also noted the importance of preparing health care systems for climate health threats by identifying at-risk enrollees prior to climate change events to better assist them with access to cooling and clean air resources. Some commenters suggested tying healthcare system and provider reimbursement to action on climate change and emissions reduction. Commenters frequently discussed the relationship between climate change and social determinants of health, noting the importance of anticipating and managing climate change's impact on the health of certain marginalized and high-risk populations.

The second CMS RFI was issued as part of the Medicare Inpatient Prospective Payment Systems Notice of Proposed Rulemaking for 2023 and the comments it contained were generally consistent with those from the agency's prior RFI. Commenters also requested more timely data to understand threats and health impacts associated with climate change, especially for vulnerable and marginalized populations, as well as information on cost impacts of climate-related conditions for care providers. In addition, several comments requested funding, financing supports and incentives to help deepen work in this area (with attention to the needs of different provider types), as well as technical assistance resources to assist operational and clinical improvements in this area (with attention to frontline specialties whose work intersects with climate health) and standardized measures and measurement frameworks to help with progress tracking and reporting (with mixed views on whether such reporting be mandatory or voluntary). Stakeholders also raised the need for updates to emergency preparedness requirements, conditions of participation, and other regulations to help all provider and supplier types be more responsive to climate-related challenges and better support the needs of at-risk populations.

AHRQ solicited feedback on how the agency can have the greatest impact in addressing climate change through its core competencies of health services research, practice improvement, and data and analytics. AHRQ received comments and suggestions from 51 organizations and individuals, representing large healthcare systems, solo practitioners, environmental advocacy groups, medical device manufacturers, legal scholars and others. Most responses supported AHRQ's efforts to help tackle climate change, urging the agency to support additional health services research related to climate and health. Commenters also suggested AHRQ provide education on such topics as facility resilience, the interaction between climate change and social determinants of health, and climate-related mental health issues. Commenters encouraged AHRQ to develop additional quality metrics related to climate change and to implement policy changes that might promote sustainable practices. Many commenters urged AHRQ to provide technical assistance funding to provider organizations in addition to resources such as practice change toolkits.

SAMHSA's RFI sought input from members of the public about how the agency could best address the behavioral health impacts of climate change and health equity considerations, collecting information on suggested priorities, resources, partners and collaborating agencies and organizations. SAMHSA received 77 relevant, nonduplicative comments from individuals and behavioral health providers, government and community agencies, nonprofits, professional associations, and academia. Commenters' responses pointed to the stress, anxiety and depression accompanying climate change and natural disasters and noted that behavioral health systems must account for climate-related challenges moving forward. They requested more climate-related funding to organizations that work in support of mental health and substance use disorders, as well as more flexibility in how those funds were allocated. Commenters also recommended policy changes, suggesting that SAMHSA pay close attention to the needs of vulnerable populations including those most impacted by climate change and natural disasters such as those in rural areas, tribal populations, persons with behavioral health conditions and youth. Commenters suggested SAMHSA develop climate-related action plans and provide support (through SAMHSA Block Grants, for example) for additional research, tool clearinghouses, technical assistance and training for grantees in service of educating health professionals and the general public about the behavioral health impacts of climate change. (The latest SAMHSA Block Grant application for fiscal years 2024-2025 does expressly discuss climate change.)

While each of the agencies that issued RFIs has a unique mission, there were several themes that emerged across these RFIs that could help inform future directions for HHS' work on climate change:

- **Deepening Research on the Impacts of Climate Change and Climate Health Solutions** – Commenters noted gaps in research on climate change's impacts on the health and well-being of individuals and communities in the U.S., suggesting more comprehensive research on both acute and chronic impacts and recommending the development of a broader set of evidence-based practices to address climate-related threats.
- **Increasing Subject Matter Knowledge on Climate Health and Equity** – Commenters emphasized the importance of education, training and outreach, both for health professionals and communities most impacted by climate change. This included educating clinicians on how climate change may influence social determinants of health and how chronic conditions and behavioral health conditions are exacerbated by climate change. Commenters saw a clear role for healthcare providers in helping their patients be better prepared for climate change's impacts.
- **Increasing Funding** – Commenters often identified the need for additional funding from the federal government to support their efforts to address climate change. In addition to direct funding via grants and support for climate-related infrastructure investments, commenters also suggested that the government adopt incentives for healthcare facilities and insurers to enhance climate resilience and sustainability.

- **Increasing Technical Assistance** – In addition to funding, commenters requested HHS support organizations seeking to take climate-related actions by developing tools and supports and providing technical assistance. They noted that this could include clearinghouses for sharing best practices and hands-on learning networks at a national and regional level that assist organizations in becoming more resilient and reducing their emissions.
- **Strengthening Measurement and Data Collection** – Commenters noted the need for standard measures to assess community and facility resilience, as well as the sustainability and emissions of healthcare stakeholder organizations, and further requested that HHS strengthen data collection across agency programs related to climate change.
- **Developing Supportive Policy** – Many commenters recommended developing policies to address the harmful impacts of climate change. These included conditions of participation from CMS that would require more attention to climate-related threats as part of emergency preparedness regulations and other requirements on providers to report on emissions that contribute to climate-related health challenges.
- **Centering Equity** – Equity was also recognized consistently across the comments as central to HHS efforts to address health impacts of climate change, as commenters cited racial, ethnic, historical, and geographic factors contributing to greater climate-related exposure for certain populations living in the U.S. Commenters also identified specific threats for specific sub-populations, including lesbian, gay, bisexual, transgender, queer+ populations, institutionalized populations, indigenous populations, rural communities, persons with disabilities, children, and people living in poverty.
- **Enhancing Collaboration** – Collaboration and partnership was a key theme across the RFIs including support for enhanced coordination across federal programs and across disciplines and programmatic areas. Respondents noted that the challenges presented by climate change will necessarily require federal agencies to work together. Commenters also suggested partnerships between and among federal, state, tribal and local governments, and community organizations and key healthcare sector businesses including healthcare providers and suppliers.

Notably, the RFIs described here were not the only source of feedback to HHS. The Office of Climate Change and Health Equity and the Administration for Children and Families conducted conversations in communities around the country, culminating in an August 2023 Summit meeting in Washington, DC. In addition, advocacy groups, congressional offices and other stakeholders have submitted letters and published papers registering their strong opinions on this topic. By and large, these sources of information confirmed the views that were collected in the RFIs summarized here. In short, the healthcare sector understands that climate change represents an enormous threat to global public health, and they must prepare themselves accordingly.

U.S. Department of Housing and Urban Development

2024-2027 CLIMATE ADAPTATION PLAN

Submitted: May 31, 2024

Message from the Acting Secretary

Climate change poses one of the most significant challenges of our time, impacting ecosystems, economies, and communities across the globe. Addressing this challenge requires a comprehensive, science-based approach at the federal level. The Department of Housing and Urban Development (HUD) is committed to tackling the climate crisis through its existing ambitious Climate Action Plan and the following HUD Federal Climate Adaptation Plan.

The Department has already taken significant steps to address climate threats and environmental injustice. HUD has adapted its programs to help communities both prepare for and respond to the effects of climate change and will continue to take comprehensive action to advance this Administration's priorities on climate adaptation, resilience, and environmental justice. Furthermore, HUD will help lead the Federal government's response to this unprecedented challenge consistent with the Department's unique and historic role in supporting underserved communities, investing in housing across the country, and guiding communities through post disaster recovery and rebuilding.

This plan will model the integration of climate resilience and environmental justice into HUD's core programs and policies. The actions outlined in this Adaptation Plan, and HUD's Climate Action Plan, will guide HUD in taking adaptation measures to reduce climate risk in Agency mission and operations while also identifying measures to help communities across the Nation build more resilient infrastructure, promote responsible utility consumption, create good-paying jobs, and address environmental injustices.

Going forward, HUD will work to ensure our policies are guided by the latest scientific research on climate change, ensuring that our actions are evidence-based and effective. Further, we recognize that the impacts of climate change disproportionately affect marginalized communities. Our policies prioritize equity, ensuring that vulnerable populations are not left behind in the transition to a sustainable and climate-resilient future.

To complete our efforts on climate adaptation, we have implemented, and will continue to implement, policies to reduce greenhouse gas emissions across all sectors of the economy impacted by our operations, services, and activities. This includes setting ambitious emissions reduction targets and implementing projects and policies to achieve these targets. HUD will remain committed to implementing a department-wide approach that reduces climate pollution; increases resilience to the impacts of climate change; protects public health; delivers environmental justice; and spurs well-paying union jobs and economic growth.

Adrianne Todman

Acting Secretary of the U.S. Department of Housing and Urban Development (HUD)

SECTION 1: AGENCY PROFILE

Everyone deserves a safe and healthy place to live. Where a person lives is an important factor that shapes their long-term health, education, and employment outcomes. As the agency dedicated to expanding access to healthy homes and vibrant communities, it is central to HUD's mission to deploy the full capacity of its offices to combat the climate crisis and implement a Department-wide approach that reduces climate pollution; increases resilience to climate impacts; protects public health; and spurs well-paying jobs and economic growth. The Department must do so in a way that delivers on the President's commitment to environmental justice[1], as well as promoting racial equity[2].

One of President Biden's first actions in office was issuing Executive Order (EO) 14008, *Tackling the Climate Crisis at Home and Abroad*. It lays out a broad vision for how the Federal government can address climate change while creating economic opportunity. HUD will play a critical role in implementing this vision, elevating people through building more resilient, sustainable, and inclusive communities across the country. Consistent with EO 13985, *Advancing Racial Equity and Support for Underserved Communities Through the Federal Government*, and EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*, HUD allocates resources in a manner that addresses the historic failure of the Federal government to invest sufficiently, justly, and equitably in underserved and disadvantaged communities, particularly low-income households and communities of color.

HUD, through its ambitious Climate Action Plan first issued in 2021 (with a technical update in 2023) as the successor to its Climate Change Adaptation Plan, issued in 2014, sets goals, tracks progress, and guides the comprehensive integration of climate resilience, sustainability, and environmental justice across its portfolio. The Department has maintained, adapted, and created programs and policies to help communities prepare for and respond to the effects of climate change. HUD's Climate Action Plan contains over 100 concrete actions, related to climate resilience, mitigation, and environmental justice, that are monitored by the Department's Climate and Environmental Justice Working Group (CEJWG) and captured in the Department's Strategic Plan.

HUD has affirmed its dedication to the Climate Action Plan's actions by centering them in the Department's current budget priorities. The President's Fiscal Year 2025 Budget included $407 million for targeted investments to improve the quality of housing through climate resilience and energy and water efficiency. As part of the Administration's whole-of-government approach to the climate crisis, the budget reflects HUD's commitment to expanding energy efficiency and climate resiliency in public and assisted housing. HUD's ability to further its commitment hinges upon the support of Congress through appropriation and authorization.

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[1] FACT SHEET: President Biden Signs Executive Order to Revitalize Our Nation's Commitment to Environmental Justice for All | The White House

[2] FACT SHEET: President Biden Signs Executive Order to Strengthen Racial Equity and Support for Underserved Communities Across the Federal Government | The White House

The Department will lead the Federal government's response to this unprecedented challenge, consistent with its unique and historic role in supporting underserved and disadvantaged communities, investing in housing across the country, and helping communities through post disaster recovery and rebuilding. HUD will work with Federal partners, stakeholders, grantees, and members of the public to develop innovative solutions for advancing climate adaptation and resilience.

The actions outlined in the Climate Action Plan, and in this Adaptation Plan, will help to build more resilient infrastructure, promote responsible utility consumption, create good-paying jobs, and address environmental injustices. Through its Climate Adaptation Plan, HUD also advances environmental justice as part of its mission, consistent with EO 14008 and with EO 14096.

AGENCY PROFILE	
Mission	HUD's mission is to create strong, sustainable, inclusive communities and quality affordable homes for all. HUD is working to strengthen the housing market to bolster the economy and protect consumers; meet the need for quality affordable rental homes; utilize housing as a platform for improving quality of life; build inclusive and sustainable communities free from discrimination; and transform the way HUD does business.
Adaptation Plan Scope	Ginnie Mae, Federal Housing Administration (FHA)
Agency Climate Adaptation Official	Kevin McNeely, Chief Sustainability Officer, General Deputy Assistant Secretary for Administration Alexis Pelosi, Senior Advisor for Climate, Office of the Secretary
Agency Risk Officer	Wilmer J. Graham, Chief Risk Officer
Point of Public Contact for Environmental Justice	Claudette Fernandez, General Deputy Assistant Secretary for Community Planning and Development
Owned Buildings	0 - HUD does not own any buildings, except for a small amount of short-term ownership of properties under foreclosed Federal Housing Administration (FHA)-insured mortgages before sale.[3] HUD has authority to operate and maintain only the Robert C. Weaver Building, which is fully serviced under GSA leases.

[3] Given the temporary nature of ownership, these properties are not considered under this plan and the term "portfolio" or "properties" shall only refer to office leases with GSA.

Leased Buildings	91 Occupancy Agreements with a total of 3,321,331.00 RSF (2023 FASTFA Data Call).
Employees	7672 total employees and 72 contractors (2023 FASTFA Data Call).
Budget	FY22 Enacted - $65.653B (FY22 Consolidated Appropriation Act) FY23 Enacted - $72.139B (FY23 Consolidated Appropriation Act) FY24 Enacted- $75.538B (FY24 Enacted Appropriations) FY25 President's Budget- $72.6B
Key Areas of Climate Adaptation Effort	HUD's Strategic Plan outlines three core parts for advancing "Strategic Goal 4: Advance Sustainable Communities." These include to: • Invest in Climate Resilience and Carbon Reduction: Invest in climate resilience, energy efficiency, and renewable energy across HUD programs (*Objective 4A*). • Strengthen Environmental Justice: Reduce exposure to health risks, environmental hazards, and substandard housing, especially for low-income households and communities of color (*Objective 4B)*. • Integrate Healthcare and Housing: Advance policies that recognize housing's role as essential to health (*Objective 4C*). Although adaptation considerations are embedded across Goal 4, Objective 4A places emphasis on adaptation and resilience building. It identifies various strategies and major milestones to advance this work, including to: • Promote climate resilience, decarbonization, and environmental justice across HUD programs; • Create community resilience and sustainability resources; • Improve utility data collection, reporting, and tracking; • Initiate utility benchmarking requirements; • Strengthen green codes and standards across HUD programs; • Foster innovation while removing barriers to energy efficiency and renewable energy in the HUD portfolio; • Eliminate discriminatory barriers to ensure disadvantaged communities can equitably access disaster and mitigation related resources; and • Elevate customer perspectives and experiences to inform future HUD investments into climate resilience, energy efficiency, and renewable energy.

SECTION 2: RISK ASSESSMENT

HUD used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App)— which was developed for federal agencies by the White House Council on Environmental Quality (CEQ) and the National Oceanic and Atmospheric Administration (NOAA) – to conduct a high-level screening of climate hazard exposure for federal facilities and personnel.

HUD assessed the exposure of its buildings and employees to five climate hazards: extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk.

Climate Data Used in Agency Risk Assessment

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the 4th National Climate Assessment.	RCP 4.5 RCP 8.5	CONUS CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5 RCP 8.5	CONUS CONUS and AK
Sea Level Rise	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High sea level rise scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5 RCP 8.5	CONUS and PR CONUS and PR
Wildfire Risk	Measured as whether an asset is in a location that is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR

Exposure to extreme heat, extreme precipitation, and sea level rise were evaluated at mid-(2050) and late-century (2080) under two emissions scenarios, Representative Concentration Pathway (RCP) 4.5 and RCP 8.5. Exposure to flooding and wildfire risk were only evaluated for the present day due to data constraints.

Climate Scenarios Considered in Agency Risk Assessment

Scenario Descriptor		Summary Description from 5th National Climate Assessment (NCA5)
RCP 8.5	Very High Scenario	Among the scenarios described in NCA5, RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46% less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

Additional detail about the data used in this assessment is provided in Appendix A.

2A. Climate Hazard Exposures and Impacts Affecting Federal Buildings

Because HUD does not own any facilities, HUD facilities are included within the General Services Administration (GSA) portfolio analyzed in the risk assessment conducted in the GSA Climate Adaptation Plan. HUD has 91 mission-dependent sites/facilities that are leased from or through GSA. HUD intends to formally partner directly with GSA to address the vulnerabilities of these sites and facilities to incremental climate change and variability. HUD will work with GSA during FY 2024/25 to ensure that leases are captured within the risk assessment for the GSA portfolio and to identify opportunities for partnerships to mitigate risk.

The Robert C. Weaver building, HUD Headquarters, is also a GSA owned building that HUD leases but has delegated authority to operate and maintain.

2B. Climate Hazard Exposures and Impacts Affecting Federal Employees

Indicators of Exposure of Employees to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005	99%	99%	99%	99%
Extreme Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the	99%	99%	99%	99%

99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005				
Sea Level Rise: Percent of employees duty-stationed in counties projected to be inundated by sea level rise	8%	53%	8%	58%
	High Risk	**Very High Risk**	**Extreme Risk**	
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire	1%	3%	1%	

Using the Federal Mapping App, HUD determined that at nearly all Agency staff are expected to experience increased exposure to the identified climate hazards. These hazards include an increased number of annual days of extreme heat and extreme precipitation and rising sea levels. The percentage of employees expected to experience increased wildfire risk is minimal, with approximately 3% at very high risk, 1% within the high risk, and 1% within the extreme risk categories.

While 99% of the HUD's employees are expected to experience an increase in the number of extreme precipitation days utilizing the RCP 4.5 Mid-century projections, it is expected that the majority will see an increase of at least 20% in extreme precipitation days. Using the RCP 8.5 Late-century model, these estimates extend to a 40% increase or higher.

Exposure to extreme heat is calculated in the Federal Mapping App using the estimated annual number of days with a maximum temperature greater than the average of the four hottest days per year historically. As indicated in the chart above, nearly all of HUD's employees are expected to experience exposure to an increased number of days considered to have extreme temperatures. Exposure levels range from a roughly 300-1200% increase (3-12 times the number of days) using the RCP 4.5 Mid-century to a greater than 1500% increase (15 times or greater the number of days) using the RCP 8.5 Late-century estimates.

Sea level rise may affect 8 to 58% of HUD's employees who are located in regions susceptible to these conditions.

2C. Climate Hazard Exposures and Impacts Affecting Mission, Operations and Services

Driven by climate change, the increasing frequency, intensity, and duration of natural disasters and severe weather events present a growing risk to the health and safety of HUD-assisted households and the physical assets financed or

subsidized by HUD.[4] HUD has many programs that help communities recover and build resilience, including HUD's disaster recovery portfolio which alone accounts for the Federal government's single largest investment in recovery and resilience in low-to-moderate-income communities. Increasing investments in areas and communities that are at risk and most vulnerable to high climate hazard exposure bolsters the resilience of public and assisted housing and HUD's mission.[5] HUD's related financial risk exposure and steps to reduce these risks is being assessed through HUD's work with the Office of Management and Budget (OMB) under EO 14030, *Climate-Related Financial Risk*.[6]

[4] See HUD's published Climate Resilience Toolkit, https://www.hudexchange.info/news/resourceavailable-hud-community-resilience-toolkit/

[5] White paper by the Office of Management and Budget, "Climate Financial Risk: The federal Government's Budget Exposure to Financial Risk Due to Climate Change"

[6] https://www.whitehouse.gov/wp-content/uploads/2024/03/ap_11_climate_risk_fy2025.pdf.

SECTION 3: IMPLEMENTATION PLAN

3A. Addressing Climate Hazard Impacts and Exposure

HUD is committed to incorporating climate action and sustainability across its operations. Despite having a relatively small directly managed federal footprint, HUD recognizes opportunities that exist to integrate climate adaptation into the Department's current practices. The Department will continue to identify actions to improve climate resilience, reduce emissions, and promote environmental justice within its own operations and in the communities it supports.

1. Addressing Climate Hazard Exposures and Impacts Affecting Federal Buildings

HUD has only one facility that it manages, the Robert C. Weaver Building, which is HUD's Headquarters located in Washington, DC. The Robert C. Weaver Building is owned by GSA, but HUD has delegated authority to operate and maintain it. HUD's other mission-dependent sites/facilities are GSA leases that HUD does not control.

The Disaster Resilience Planning Act (Pub. L. No. 117-221) (DRPA) and coordinating guidance from the Office of Management and Budget (OMB) direct agencies to incorporate natural disaster resilience into real property asset management and investment decisions. HUD does not own any buildings (except for a small amount of short-term ownership of properties under foreclosed Federal Housing Administration (FHA)-insured mortgages before sale) or land, nor does the agency report its facilities in the Federal Real Property Profile Management System (FRPP MS). HUD's spaces are included within the GSA facilities data. Because HUD does not have any assets as described in DRPA or OMB Memo M-24-03, *Advancing Climate Resilience through Climate-Smart Infrastructure Investments and Implementation Guidance for the Disaster Resiliency Planning Act,* the Department manages its leases in close coordination with GSA. Lease management decisions and GSA coordination are handled within the Office of Administration. This office includes HUD's General Deputy Assistant Secretary (GDAS) for Administration, who is the agency's Chief Sustainability Officer (CSO).

HUD remains committed to advancing adaptation and climate resilience. HUD has made significant investments in building improvements and measures to reduce energy and water consumption at the Robert C. Weaver Building. HUD partnered with GSA in 2013 on a project to replace the roof of the Weaver Building, which included installation of a reflective "cool" roof coating. In 2015 the Department completed work under a large Energy Savings Performance Contract (ESPC) that included building-wide retrofits to lighting, water conservation measures, building envelope improvements, conversion to Variable Air Volume (VAV) systems for heating and cooling, and the installation of direct digital controls for energy-intensive building systems. The benefits from these improvements are multifaceted. The energy and water savings resulting from conservation

measures both reduce the strain on utility systems and reduce greenhouse gas emissions associated with the operation of the facility. These improvements also increase building reliability and resilience to adverse or severe weather conditions.

To further demonstrate HUD's commitment to resilience and energy efficiency, the Department modified the ESPC in FY2023 to fund more conservation measures that are described in the table below.

Prioritized Actions to Address Climate Hazard Exposures and Impacts Affecting Federal Buildings		
Climate Hazard Impact on and/or Exposure to Buildings	Priority Action	Timeline for implementation (2024-2027)
Collaborate with GSA to support climate readiness and net-zero emissions initiatives for government and private leased facilities, relevant to all hazards which will vary by location.	Work with the GSA to assess potential hazard impacts to HUD leased space.	Contact GSA account manager to identify and request climate adaptation measures in HUD's real property portfolio- complete during FY24.
Exposure to extreme heat.	Utilize ESPC to perform retrofits and improvements at the Robert C. Weaver Building.	Perform the following Energy Conservation Measures (ECMs): Replace main chillers at the Weaver Building, which will increase system reliability and reduce risk of cooling loss at critical times- anticipated completion July FY24. Perform LED lighting retrofit to entire Weaver building, which will save energy and reduce cooling load- anticipated completion FY25.

Exposure to extreme heat.	Collaborate with the GSA to replace the main Air Handling Units (AHUs) at the Robert C. Weaver Building.	Complete study and design FY24. Construction expected to start FY25.

2. Addressing Climate Hazard Exposures and Impacts Affecting Federal Employees

The assessment in Section 2B indicates that 99% of HUD employees will experience at least some noticeable increase in days with heat or precipitation that exceeds the 99th percentile of historical extremes. These estimates vary across geographies, ranging from marginal increases of 0-10% to greater than 50% increases in number of days with extreme precipitation. In addition, some areas are projected to see a greater than 1500% increase in number of days with extreme heat. To keep its workforce safe and informed, HUD will use the strategies outlined in the table below to address the risks and create adaptive measures.

Prioritized Actions to Address Climate Hazard Exposures and Impacts Affecting Federal Employees		
Climate Hazard Impact on and/or Exposure to Employees	Priority Actions	Timeline for implementation (2024-2027)
Collaborate with GSA on opportunities to improve climate readiness for employees.	Work with the GSA to identify opportunities to protect occupants, reduce risks, and ensure safety from potential climate hazards in HUD leased space.	Collaborate with GSA account manager(s) to identify and request climate adaptation measures in HUD's real property portfolio during FY24.

Evaluate workforce risks related to occupational hazards.	Determine hazard level to employees based on potential exposure level and factors such as: office-based employees, telework percentage, and onsite field work such as inspections or construction sites.	Develop strategies to reduce employee risks associated with occupational exposures during FY24. Create a campaign to increase employee awareness of hazards and exposure risks during FY25. Evaluate occupational health and safety policy for opportunities to mitigate climate risk and adopt and implement effective solutions – FY25.

3B. Climate-resilient Operations

1. Accounting for Climate Risk in Planning and Decision Making

HUD's mission-dependent sites/facilities are included within the GSA's facilities data. Although HUD does not have any assets as described in DRPA or OMB Memo M-24-03, the Department manages its leases in close coordination with GSA. Lease management decisions and GSA coordination are handled within the Office of Administration.

2. Incorporating Climate Risk Assessment into Budget Planning

During the budget formulation process, HUD issues guidance to all program offices requesting their budget submissions include proposals that consider or address climate risk. In addition, the Department's Annual Strategic Capital Plan is considered during budget formulation to assess funding allocations required for supporting actions designed to reduce emissions and increase sustainable practices and climate resilience within HUD's Headquarters building, field offices, and the HUD leased vehicle fleet. Funding is allocated to support reducing greenhouse gas emissions through consolidation of offices, reduction of HUD's overall footprint, and conversion of the vehicle fleet to Electric Vehicles (EVs).

HUD's budget requests have identified the Department's plan to expand the current scope of the Energy Savings Performance Contract (ESPC) to include new energy conservation measures (ECM) that will replace outdated technology and increase energy savings in the Robert C. Weaver Building. This effort will allow HUD to replace outdated, inefficient, and unreliable building chillers and other equipment and amortize costs over the remaining 10-year term of the ESPC contract. Chiller and LED lighting replacement projects began in November 2023. The benefits from these improvements are multifaceted. The energy and

water savings resulting from conservation measures both reduce the strain on utility systems and reduce greenhouse gas emissions associated with the operation of the facility. These improvements also increase building reliability and resilience to adverse or severe weather conditions.

3. Incorporating Climate Risk into Policy and Programs

HUD programs invest billions of dollars every year in housing, infrastructure, and services for disadvantaged communities. Recognizing the disproportionate impact and burdens of climate change – current and future – on the households and communities HUD serves, the Department is incorporating climate risk into policy and programs, delivering funding, expanding access to information and resources, and adjusting policies to build resilient communities and promote environmental justice. Incorporating climate risk not only protects communities but safeguards Federal dollars and investments.

HUD's Climate Action Plan (CAP) contains over 100 concrete actions related to climate adaptation and resilience, energy efficiency and greenhouse gas reduction, and environmental justice. The CAP serves as a mechanism for tracking progress across programs and policies and incorporates this data into the Agency's Strategic Plan. Policies in the Strategic Plan are coordinated closely with senior HUD leadership, including risk/resilience officers.

In line with the President's whole-of-government approach to tackling climate change, HUD is collaborating with agency partners to amplify these efforts. For example, HUD and HHS are working together to recognize housing as a social determinant of health, and HUD and DOE are continuing their partnership to reduce carbon emissions in the building sector and to cut long-term costs for consumers through energy efficiency improvements.

Climate Adaptation and Resilience: In HUD's Community Development Block Grant-Disaster Recovery (CDBG-DR) program, the Department is finalizing implementing notices to reflect climate priorities and describe policies and requirements that can foster resiliency projects and promote environmental justice. In HUD's Single-Family Program Office, HUD is in the process of reviewing and updating program standards and documentation requirements for underwriting, repairs, and escrow to make it easier for lenders and borrowers to understand and use the 203(k) Rehabilitation Mortgage Insurance Program for Energy Retrofits and Climate Mitigation.

New programs have been established through funding available under the Inflation Reduction Act, such as the Green and Resilient Retrofit Program (GRRP), a first-of-its-kind program at HUD which integrates a focus on climate risk and energy efficiency. GRRP uses FEMA's National Risk Index (NRI) as a tool to identify and prioritize high risk projects and, through funding provided, supports HUD-assisted multifamily housing property owners in increasing climate resilience and adaptation through carbon emissions reductions, utility efficiency improvements, renewable energy generation, and building resilience.

To support these efforts, HUD continues to invest in robust technical assistance, creating new guides, tools, toolkits and learning opportunities across the Department. Earlier this year, the Office of Multifamily Housing Programs developed a Resiliency Assessment Tool which is being piloted as part of GRRP. The tool assists property assessors in the analysis of the vulnerability of properties to impacts caused by natural hazards and identifies opportunities for risk mitigation measures to improve resiliency to these hazards. HUD anticipates making the tool available for broader application across its portfolio in the future.

HUD is partnering with the Federal Emergency Management Agency (FEMA) in the Pre-Disaster Housing Planning Initiative (PDHI) to support state planning for housing recovery before disasters occur and promote collaborative approaches to housing recovery.

Nature-Based Solutions: HUD is promoting nature-based solutions and supporting sustainable planning, design, and management. Development of technical assistance, such as HUD's Nature-based Solutions Implementation Guide, provides step-by-step instructions to assist communities in implementing nature-based solutions. Funds in HUD's CDBG program, which reaches every state and over 1,200 local governments across the country, are commonly used for investments in nature-based solutions: funding parks, playgrounds, open spaces, and other recreational facilities in nature-deprived communities. Since 2016, grantees have spent 3-4% of all CDBG expenditures on parks and recreational facilities. Similarly, HUD's Choice Neighborhoods program integrates nature-based solutions through enhanced or improved access to green spaces and revitalization of severely distressed public and/or assisted housing.

Environmental Justice: Environmental justice is core to HUD's mission to create strong, sustainable, and inclusive communities.

Environmental justice and climate adaptation activities are coordinated at HUD through the Climate and Environmental Justice (CEJ) Council, comprised of senior leadership across all program offices and through its accompanying CEJ Working Group, comprised of staff across the Department. HUD is also a member of the White House Environmental Justice Interagency Council (WHEJAC) and has received recommendations from the WHEJAC on climate planning, preparedness, response, recovery, and impacts.

HUD's efforts to further environmental justice flow across the Department and entail working to ensure protection from environmental and health hazards for communities while investing in the reversal of disparate health outcomes and improved economic opportunity. HUD does this through engagement with communities in the development of rules, regulations, and funding opportunities; working with Tribal communities to achieve safe, resilient housing and infrastructure; and providing technical support to improve equity in community planning and engagement. To support authentic community engagement efforts, HUD developed the Citizen Participation & Equitable Engagement (CPEE) Toolkit,

which provides recommendations and best practices for conducting inclusive and equitable engagement that will inform and help create programs for the whole community, with a special emphasis and a targeted approach on historically vulnerable and underserved areas.

HUD is committed to addressing environmental inequities through enforcement of federal fair housing and civil rights laws, including the Fair Housing Act of 1968, Title VI of the Civil Rights Act of 1964, Section 109 of Title I of the Housing and Community Development Act of 1974, Section 504 of the Rehabilitation Act of 1973, and Title II of the Americans with Disabilities Act of 1990. The Fair Housing Act not only prohibits discrimination in housing on the basis of race, color, national origin, religion, sex (including gender identity and sexual orientation), disability and familial status but also requires HUD and HUD funding recipients to take meaningful actions to overcome patterns of segregation, promote fair housing choice, and foster inclusive communities that are free from discrimination, including disparate access to healthy environments, neighborhoods and homes.

Tribal Nations: HUD works to create opportunities for Tribal partners to provide input related to climate adaptation, when applicable and relevant, through various forums. For example, throughout 2023 and 2024 HUD has engaged in Tribal consultation to solicit feedback on the Indian Community Development Block Grant (ICDBG) program. The feedback received during consultation is documented and submitted to the appropriate HUD program offices. This process is one example of how Tribal consultation and coordination are conducted on an ongoing basis through various formal and informal processes and are guided by the Department's Government-to-Government Tribal Consultation Policy.

The Tribal Intergovernmental Advisory Committee (TIAC) is another important way that HUD is continuously considering the needs of Tribal nations. The TIAC meets monthly and briefs HUD leaders semiannually and develops white papers communicating policy issues and providing formal recommendations to HUD program offices. HUD also leads The Tribal Housing and Related Infrastructure Interagency Task Force, an interagency task force to develop a coordinated and streamlined environmental review for Tribal housing projects comprised of representatives from eight federal agencies and seven Tribes. In the past year the Task Force developed the Tribal/Interagency Environmental Streamlining (TIES) toolkit. TIES is the only Tribally-focused tool that identifies environmental review requirements by agency and provides resources, tools, and best practices for Tribes to streamline environmental review processes.

Tribal consultation has resulted in improvements to program regulations, guidance, and increased technical assistance. HUD has created a Tribal Climate Resilience and Adaptation website specifically for Tribes. The site pulls together tools and resources that are tailored to Tribes, including maps, data sets, and adaptation plans. It also includes information on Federal funding that supports Tribes addressing climate change, as well as case studies. HUD has collaborated with U.S. Departments of Treasury and Energy to

deliver two webinars about federal funding for climate resilience and Tribal housing energy projects.

Co-Benefits of Adaptation: HUD is working to increase climate resilience through incorporating green building requirements or incentives across financing programs and by working to update and strengthen minimum codes or standards. HUD's Green Mortgage Insurance Premium (Green MIP) provides a strong incentive for FHA multifamily borrowers to adopt one of several approved green building standards, lowering mortgage insurance premiums by as much as 50 basis points (0.50%). HUD's Rental Assistance Demonstration (RAD), through a notice published in July 2023, has significant requirements for new construction and rehabilitation that support both energy efficiency and climate resilience. HUD's GRRP Leading-Edge Cohort requires projects to commit to adopting one of several above-code zero energy standards (e.g. Enterprise Green Communities, LEED, National Green Building Standard, Passive House, Zero Energy Ready Multifamily, or Energy Star Nextgen).

In April 2024, HUD published two rules that increase climate resilience and sustainability. On April 23rd, HUD published the **Federal Flood Risk Management Standard (FFRMS)**, a final rule ensuring that federally-funded construction projects are built to withstand current and future flood risks. On April 26th, HUD and the U.S. Department of Agriculture (USDA) published updated Minimum Energy Standards for new construction to strengthen energy efficiency standards and reduce the burden on household budgets, while protecting the environment for future generations.

Through delivering funding, expanding assistance and resources, and amending its policies, HUD programs are strengthening the capacity of communities to adapt to climate change.

4. Climate-Smart Supply Chains and Procurement

HUD's goal is to ensure that 100% of applicable new eligible contract actions, including task or delivery orders under new contracts and existing contracts, meet sustainable acquisition requirements, and require the supply or use of products and services that are energy efficient (ENERGY STAR or Federal Energy Management Program-designated), water efficient, biobased, environmentally preferable, non-ozone depleting, contain recycled content, or are non-toxic or less toxic alternatives.

HUD Procurement Handbook 2210.3, Revision 10, Subchapter 2423.4 Use of Recovered Materials and Biobased Products, states that it is the policy of the Department to procure products containing recovered materials to the greatest extent practicable in accordance with all applicable Federal statutes, regulations, policies, and other guidelines.

HUD's purchasing includes minimal mission-dependent supplies and services. The most critical of these are information and communications technology (ICT) and operational

technology (OT) products and services. Going forward, HUD will assess supply chain vulnerability to potential climate-related disruptions and implement strategies to mitigate the associated risks to operations.

5. Climate-Informed Funding to External Parties

As part of the Administration's whole-of-government approach to the climate crisis, the Department is expanding efficient and resilient housing options in Public Housing and other HUD-assisted housing.

HUD provides various grant and loan programs to help build climate adaptation and resilience while also working to embed climate resilience across the Department's portfolio. For example, through the Indian Housing Block Grant competitive program, HUD provides funds to Native American Tribes to help them build and rehabilitate housing on Tribal lands and prepare for the effects of climate change. Choice Neighborhoods grants are designed to revitalize neighborhoods in an energy-efficient and resilient manner.

HUD's Office of Policy Development and Research has several research priorities studying how best to encourage resilient communities, including housing technology research, which has produced important information on cost-effective building technologies and on building technologies that make the housing stock more energy efficient and resilient, such as the Designing for Natural Hazards Series for builders and developers.

The Department has made important changes to program delivery. For example, HUD overhauled the Agency's disaster recovery efforts to better serve communities that face the direct impacts of weather-related disasters. Based on the increasing number of disasters, the Department established the Office of Disaster Management (ODM) in the Office of the Deputy Secretary, and the Office of Disaster Recovery (ODR) within the Office of Community Planning and Development to streamline the agency's disaster recovery and resilience work by increasing coordination, streamlining internal processes, and increasing capacity to get recovery funding to communities. The CDBG-DR Consolidated Notice included new climate and environmental justice-related requirements that apply to the $10 billion in recovery funds allocated for 2020-2023 disasters to prioritize long-term environmental resilience and disadvantaged communities.

HUD supports disadvantaged communities both through its programs and outreach resources. HUD has various tools and technical assistance initiatives to help communities navigate federal funding opportunities, including the Funding Navigator, the Tribal Climate Resilience and Adaptation Website, the Community Resilience Toolkit and accompanying implementation guides, the Resilient Building Codes Toolkit, the Community Compass Technical Assistance program, and the Climate Communities Initiative (CCI). The CCI has, as of December 2023, provided direct technical assistance

to seven participating communities on local priorities or projects related to climate resilience.

The Notice of Funding Opportunity (NOFO) from HUD's Supportive Housing for the Elderly Program (Section 202), published in September 2022, awarded points for projects that incorporate green and resilient building approaches and outcomes. In January 2024, HUD finalized Climate Preference Guidance for NOFOs. HUD's Supportive Housing for the Disabled (Section 811) FY23 NOFO includes preference points for Environmental Justice and Climate. The Department's 2025 Budget requests $407 million across HUD for targeted investments to improve the quality of housing and support disadvantaged communities through climate resilience, energy, and water efficiency.

3C. Climate Training and Capacity Building for a Climate Informed Workforce

Training and Capacity Building	
Agency Climate Training Efforts	*Percent of the Agency's Federal staff that have taken a 60+ minute introductory climate training course (e.g., Climate 101).* <1% - Two HUD employees completed Climate Audio Summaries of Training, and four employees started climate trainings from the Skillsoft Percipio Training Catalog.
	Percent of the Agency's senior leadership (e.g., Sec, Dep Sec, SES, Directors, Branch Chiefs, etc.) that have completed climate adaptation training. *0%*
	Percent of budget officials that have received climate adaptation related training. *0%*
	Percent acquisition officials that have received climate adaptation related training. *0%*
	Additional efforts the Agency is taking to develop a climate informed workforce. The Department is undertaking efforts to foster a climate-informed and ready workforce, and to train

	staff on new funding resources for resilience and sustainability efforts. The Climate and Environmental Justice Working Group (CEJWG) spearheads monthly meetings to share information, trainings, and resources on key topics related to environmental justice and resilience, and to track progress on objectives outlined in the Climate Action Plan. In January 2024, 200 Denver Field Staff received training on funding opportunities made available through BIL and IRA for climate resilience. HUD maintains the goal of training all field office staff by the end of calendar year 2024. Other examples of staff engagement include: • **Climate Conversations**: HUD-wide employee climate series intended to increase employee knowledge of key elements of the climate portfolio and climate work across programs. • **Counseling trainings**: The Office of Housing hosted sessions to train housing counselors about the key role of energy efficiency in boosting housing affordability and improving health, safety, and comfort. • **Lunch and Learns**: The Office of General Counsel conducted a series on climate and environmental justice for between 140 and 170 OGC staff at each webinar. The Office of Public and Indian Housing established a Climate Action Related Lunch and Learn group that has membership of fourteen PIH Field Office Directors.
Agency Capacity	*Number of full-time Federal staff (FTE) across the Agency that have tasks relevant to climate adaptation in their job description*. Climate adaptation and resilience is part of HUD's mission to create strong, sustainable, inclusive communities and quality affordable homes for all. It is embedded in HUD's Strategic Plan and Climate Action Plan and identifies milestones and actions for each program office. HUD also has a Climate and Environmental Justice Working Group (CEJWG) led by HUD

	program offices that focuses on climate action, resources, and training opportunities across the Department.

HUD's internal Climate and Environmental Justice Working Group, led by the Senior Advisor for Climate and the Office of Environment and Energy, is focused on the long-term integration of climate action and environmental justice into the Department's programs to better achieve HUD's mission, both through implementation of the Department's Climate Action Plan and through building a climate informed workforce. The group has met monthly since 2021 and is comprised of nearly 100 members at varying levels of hierarchy across the Department.

In 2023, the Office of Environment and Energy provided 7.5 hours of climate training and capacity building to over 4,000 participants through a HUD-wide employee Climate Series. The five "Climate Conversations" focused on increasing HUD's employee knowledge of key elements of the climate portfolio and HUD's role in advancing a climate-resilient nation covering topics such as energy and carbon reduction, disaster recovery, sustainability at the HUD Headquarters building, and other cross-cutting topics. "Climate Conversations" will continue in 2024 with five additional training and capacity-building sessions being planned.

The Office of General Counsel (OGC) conducted a series of Lunch and Learns on Climate and Environmental Justice. Between 140 and 170 OGC staff attended each webinar. Topics included Environmental Justice: Its History and HUD's Role; HUD's Climate Action Plan and Justice40 Initiatives (with a focus on the Office of Lead Hazard Control and Healthy Homes); Climate-Related Threats Faced by Our Nation's Indigenous Communities Environmental Justice at HUD: Finding, Remedying, and Preventing the Impacts of Environmental Stressors; Building Flood-Resilient Communities; and Environmental Justice and Title VI. OGC offered this series in part to engage OGC staff and to help staff in different parts of OGC connect with HUD's larger climate and environmental justice goals. The series will continue in 2024.

The Office of Public and Indian Housing created the opportunity for Field Office Directors to learn more about energy efficiency financing, renewable technology, and other available resources through a lunch and learn group where information was shared to help support public housing authorities in reducing energy usage and improving climate resilience.

The Office of Policy Development and Research organized monthly sessions as part of its Knowledge Collaborative on Disaster Recovery and Risk Reduction, hosting external researchers and internal HUD staff to present their work in the disaster recovery or risk reduction space.

3D. SUMMARY FOR MAJOR MILESTONES

Section of the Implementation Plan	Description of Milestone	Climate Risk Addressed	Indicators for success
Section 3A Part 1 *Addressing Climate Hazard Exposures and Impacts Affecting Federal Buildings*	*Collaborate with GSA to support climate readiness and net-zero emissions initiatives for government and private-leased facilities.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*HUD has a sustained relationship with GSA that convenes regularly.* *New initiatives are developed to support the resilience of GSA leases under HUD's purview. FY24/25: Collaborate with GSA to identify key account managers responsible for resilience within HUD's portfolio.*
Section 3A Part 1 *Addressing Climate Hazard Exposures and Impacts Affecting Federal Buildings*	*Utilize ESPC to perform retrofits and improvements at the Robert C. Weaver Building.*	*Extreme Heat*	*FY24/25: Complete the following Energy Conservation Measures (ECMs):* *Replace main chillers at the Weaver Building, which will increase system reliability and reduce risk of cooling loss at critical times.* *Perform LED lighting retrofit to entire Weaver Building, which will reduce energy and reduce cooling load.*

Section 3A Part 1 *Addressing Climate Hazard Exposures and Impacts Affecting Federal Buildings*	*Collaborate with the GSA to replace all the main Air Handling Units (AHUs) at the Weaver Building.*	*Extreme heat*	*Complete study and design FY24* *Construction expected to start FY25.*
Section 3A Part 2 *Evaluate workforce risks related to occupational hazards*	*Collaborate with GSA on opportunities to advance climate readiness for employees.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*FY24: Work with GSA to identify opportunities to protect occupants, reduce risks and ensure safety from potential climate hazards in HUD leased space.*
Section 3A Part 2 *Evaluate workforce risks related to occupational hazards*	*Evaluate workforce risks related to occupational hazards.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*FY24/25: Develop strategies to reduce employee risks associated with occupational exposures.* *FY24: Create a campaign to increase employee awareness of hazards and exposure risks.* *FY24/25: Evaluate occupational health and safety policy for opportunities to mitigate climate risk and adopt and implement effective opportunities.*
Section 3B Part 2 *Incorporating Climate Risk Assessment into Budget Planning*	*Incorporate climate risk into budget planning for programs and services.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Enhance knowledge through research and expand data use to evaluate and protect portfolio from climate risk,*

			such as through integrating National Risk Index data in programs and policies and advancing research through the USGCRP.
3B Part 3 *Incorporating Climate Risk into Policy and Programs*	*Advance climate adaptation and resilience in policies and programs.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Increase the number and percentage of goals completed under HUD's Climate Action Plan to increase climate resilience.* *Enhance the application of program funds toward adaptation and resilience building.* *Advance incentives and requirements for adopting green building codes and energy standards across the HUD portfolio.* *Deliver adaptation funding through GRRP, CDBG (CDBG-DR and CDBG-MIT), and other climate- and energy-focused programs.* *Ensure equitable access to resources through creating toolkits and services and*

			improving user experience through updates, such as to the HUD Exchange website.
3B Part 3 *Incorporating Climate Risk into Policy and Programs*	*Advance use of nature-based solutions (NBS) to address climate risks for more sustainable planning, design, and management.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Expand the percentage of programs and policies that include guidelines and requirements for considering NBS, when viable.* *Encourage awareness of NBS among staff and grantees through training and tools.*
3B Part 3 *Incorporating Climate Risk into Policy and Programs*	*Center environmental justice to support the resilience of disadvantaged communities that are marginalized by underinvestment and overburdened by pollution.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Increase the number and percentage of goals completed under HUD's Climate Action Plan to promote environmental justice.*
3B Part 3 *Incorporating Climate Risk into Policy and Programs*	*Bolster the opportunities for collecting Tribal input to meaningfully adapt programs and policies to better meet needs and priorities.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Ensure adaptation and environmentally focused policies and programs include and incorporate Tribal feedback.*
3B Part 3 *Incorporating Climate Risk into Policy and Programs*	*Advance sustainable communities through investing in climate resilience and carbon reduction strategies.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Increase the number and percentage of goals completed under HUD's Climate Action Plan to*

			increase energy efficiency.
3B Part 5 *Climate Informed Funding to External Parties*	*Maintain, improve, and create opportunities to fund resilience through HUD programs and policies.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Deploy funds through various programs, including CDBG, CDBG-DR, CDBG-MIT, and GRRP, and strengthen climate considerations in other programs, including Choice Neighborhoods, Section 108, Rental Assistance Demonstration Program, Section 202, and more.*
3C *Climate Training and Capacity Building for a Climate Informed Workforce*	*Foster a climate ready and climate informed workforce.*	*Sea level rise* *Extreme heat* *Extreme precipitation* *Wildfire risk*	*Increase the number of Federal staff that have participated in climate training courses, lunch and learns, and climate conversations. Offer Climate 101 to HUD staff during FY24.*

SECTION 4: DEMONSTRATING PROGRESS

4A. Measuring progress

*The metrics below include yes/no/partially questions to establish the Agency's current efforts, as well as process metrics to show how climate adaptation is being integrated across planning and budgeting efforts. These metrics provide a consistent set of information across the Federal government and feed into outcome metrics addressing the **climate resilience and adaptive capacity** of the Federal government to climate hazards in 2050 and 2080 based on RCP4.5 and RCP8.5.*

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in planning and budgeting of agency programs by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3A – Addressing Climate Hazard Impacts and Exposure	Step 1: Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. (Y/N/Partially) Step 2: Agency has a list of discrete actions that will be taken through 2027 as part of their implementation plan. (Y/N/Partially)	Partially for both Steps 1 and 2. There are planned actions in place for HUD's Weaver Building. All other buildings are leases that will require HUD to coordinate hazard assessment and planned actions with the GSA, which owns and manages the buildings.
3B.1 – Accounting for Climate Risk in Decision-making	Agency has an established method of including results of climate hazard risk exposure assessments into planning and decision-making processes. (Y/N/Partially)	No. HUD's building portfolio is comprised of fully serviced GSA leases. HUD will work with GSA to better assess risk exposure for its locations and consider mitigation strategies accordingly.
3B.2 – Incorporating Climate Risk Assessment into Budget Planning	Agency has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions. (Y/N/Partially)	Yes. During the budget formulation process, HUD issues guidance to all program offices requesting their budget submissions include proposals that

		consider or address climate risk. The Department's Annual Strategic Plan incorporates climate risk into planning and budget decisions.
3B.5 – Climate Informed Funding to External Parties	Step 1: By July 2025, Agency will identify grants that can include consideration and/or evaluation of climate risk. Step 2: Agency modernizes all applicable funding announcements/grants to include a requirement for the grantee to consider climate hazard exposures. (Y/N/Partially)	Partially for both Steps 1 and 2. HUD has finalized Climate Preference Guidance for NOFOs. HUD will continue to apply its NOFO template and incorporate evaluation of climate risk across programs and funding opportunities.
Key Performance Indicator: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3A – Addressing Climate Hazard Impacts and Exposure	Agency has identified the information systems that need to incorporate climate change data and information and will incorporate climate change information into those systems by 2027. (Y/N/Partially)	No. HUD will coordinate with its Office of the Chief Information Officer (OCIO) and Office of the Chief Data Officer to determine by 2025 if there are any internal systems that will require the incorporation of climate change data.
Key Performance Indicator: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate nature-based solutions, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.3 – Incorporating Climate Risk	By July 2025, 100% of climate adaptation and resilience policies have been reviewed and revised to (as	Partially. HUD has finalized Climate Preference Guidance for NOFOs. HUD will continue

into Policy and Programs	relevant) incorporate nature-based solutions, mitigation co-benefits, and equity principles. (Y/N/Partially)	to apply its NOFO template and incorporate evaluation of climate risk across programs and funding opportunities.
Key Performance Indicator: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.4 – Climate-Smart Supply Chains and Procurement	Step 1: Agency has assessed climate exposure to its top five most mission-critical supply chains. (Y/N/Partially) Step 2: By July 2026, the Agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards. (Y/N/Partially)	Partially for Steps 1 & 2. HUD is in the process of implementing a Supply Chain Risk Management (SCRM) Program that will include the assessment of climate hazard risk to critical supplies and services. SCRM Program is scheduled to be fully implemented FY 2025 2nd quarter.
	Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services. (Y/N/Partially)	Partially. In the Climate-Smart Supply Chains and Procurement space, the Civilian Agency Acquisition Council has Federal Acquisition Regulation (FAR) Case 2022-006, Sustainable Procurement in the final rule stage of development, after the proposed rule was available for comment. The FAR Case focuses on current environmental and sustainability matters and implements a requirement for agencies to procure sustainable products and services to the maximum extent practicable, in alignment

		with Executive Order 14057, Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, OMB Memorandum M-22-06, and the Council on Environmental Quality Implementing Instructions. Once the rule is finalized, it will be incorporated into the procurement process and the SCRM Program.
Key Performance Indicator: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures.		
Section of the CAP	**Process Metric**	**Agency Response**
3C – Climate Training and Capacity Building for a Climate Informed Workforce	Step 1: By December 2024 100% of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. (Y/N/Partially) Step 2: Does the agency have a Climate 101 training for your workforce? (Y/N/Partially) If yes, what percent of staff have completed the training? Step 3: By July 2025, 100 % employees have completed climate 101 trainings. (Y/N/Partially)	Yes for Step 1. By December 2024, HUD will hold a full leadership briefing on current agency climate adaptation efforts and actions outlined in the 2024 CAP. No for both Steps 2 and 3. In 2024, HUD will explore opportunities to expand access to a Climate 101 training for staff to strengthen climate literacy.

4B. Adaptation in Action

HUD, since its initial 2021 Climate Adaptation Plan, has advanced its goals to (1) update climate risk data and research; (2) enhance mortgage financing; (3) strengthen disaster recovery and resilience; and (4) expand capacity building.

HUD is supporting research and data procurement to assess climate risk within its portfolio. In December 2023, the Department joined the United States Global Change Research Program (USGCRP) to guide and contribute to the federal government's scientific research. Joining USGCRP helps to ensure that the data and products developed can be accessed by and used to support the people and communities that HUD serves. It also is a step to help address challenges the Department has faced in reviewing and addressing the need for building-level, or downscaled data. HUD's working group on climate services focuses on these issues and is working to improve documentation and identify opportunities for filling data gaps. HUD is incorporating FEMA's National Risk Index (NRI) data into its Funding Navigator to assist HUD grantees or assisted property owners in assessing exposure to natural hazards while connecting to funding opportunities to build resilience to these hazards.

The Department is working to enhance mortgage financing to enable capital to fund the purchase, refinance, construction, and rehabilitation of single- and multi-family housing, assisted housing, and healthcare facilities around the country. Ginnie Mae, for instance, has expanded its low-to-moderate income (LMI) disclosure initiative to enhance environmental, social, and governance (ESG) disclosures. This initiative provides market participants with tools and data to concentrate their investments and to discern the social impact of their investment decisions in disadvantaged communities. HUD has also worked to reduce Mortgage Insurance Premiums (MIP) to incentivize property owners to adopt higher building standards.

HUD is strengthening programs to promote disaster recovery and resilience. For example, the Department updated CDBG-DR requirements and released coordinating tools to support grantees in proactively planning for future climate risk. The Department, alongside DOE and DHS, launched a joint effort with Puerto Rico to strengthen the island's grid resilience and advance new initiatives to enhance Puerto Rico's energy future. Additionally, on April 23rd, HUD updated the **Federal Flood Risk Management Standard (FFRMS)**, 24 CFR part 55, a final rule ensuring that federally funded construction projects are built to withstand current and future flood risks.

The Department is expanding capacity-building opportunities to ensure programs reach grantees in an accessible and equitable manner. As detailed in above, the Department has launched various tools and guidance on its HUD Exchange Build for the Future website. Through deploying technical assistance opportunities and planning regional convenings, the Department is working to reach LMI and disadvantaged communities to amplify their capacities for leveraging HUD's available funding sources.

HUD is continuing to reach goals set out in its 2021 Climate Action Plan and to set new ones, recognizing climate adaptation as central to HUD's mission to build resilient, sustainable, and inclusive communities across the nation.

Appendix A: Risk Assessment Data

The Federal Mapping App uses the following data:

Buildings

Buildings data comes from the publicly available Federal Real Property Profile (FRPP). The General Services Administration (GSA) maintains FRPP data and federal agencies are responsible for submitting detailed asset-level data to GSA on an annual basis. Although FRPP data is limited—for example, not all agencies submit complete asset-level data to GSA, building locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures, and properties may be excluded on the basis of national security determinations— it is the best available public dataset for federal real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of federal buildings to climate hazards.

Personnel

Personnel data comes from the Office of Personnel Management's (OPM) non-public dataset of all personnel employed by the federal government that was provided in 2023. The data contains a number of adjustments, including exclusion of military or intelligence agency personnel, aggregation of personnel data to the county level, and suppression of personnel data for duty stations of less than 5 personnel. Despite these adjustments, this data is still useful for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

Climate Hazards

The climate data used in the risk assessment comes from the data in Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool. When agency climate adaptation plans were initiated in 2023, CMRA data included climate data prepared for NCA4. Additional details on this data can be found on the CMRA Assessment Tool Data Sources page. Due to limited data availability, exposure analyses using the Federal Mapping App are largely limited to the contiguous United States (CONUS). Additional information regarding Alaska, Hawai‘i, U.S. Territories, and marine environments has been included as available.

Climate Preparedness and Resilience

POLICY STATEMENT

The primary and overarching policy document for USACE is the USACE Climate Preparedness and Resilience Policy Statement.

As the federal government's largest and oldest manager of water resources, the U.S. Army Corps of Engineers (USACE) has long been adapting its policies, programs, projects, planning, and operations to external stressors and variabilities. It is USACE's policy to integrate climate change preparedness and resilience planning and actions in all activities to enhance community resilience and ensure the effectiveness of our civil works and military support missions.

USACE recognizes the need to innovate and improve while learning more about how best to address the ever-evolving climate change impacts on our projects and supporting our partners in doing the same. USACE will continue to modernize our programs and policies to better assess risk, support climate-resilient investments, and develop tools that bolster climate preparedness, resilience planning, and engineering design. We will also strive to publish guidance that provides best practices for our teams while also providing others outside USACE valuable information and tools to improve their resilience building efforts.

As these activities are pursued, USACE will maintain a focus on underserved and overburdened communities, which are often the most impacted by climate change and lack adequate resources to address these multiplying challenges. USACE will provide opportunities for communities with environmental justice concerns and Tribal Nations to participate in climate adaptation decisions that impact their communities and actively gather and share knowledge of climate change impacts and resilience planning with these partners. We will also endeavor to incorporate Indigenous Knowledge to improve our project development and solutions. USACE will strive to be a leader in environmental justice across the government, using our resources and authorities to the maximum extent possible as we work with all communities, but especially underserved and overburdened ones, on comprehensive, equitable, and innovative solutions to their climate change challenges.

USACE will continue to work with other agencies and collaborators to develop science and engineering research and leverage the best scientific, economic, environmental, and social knowledge of our partners to develop solutions to better adapt to a changing climate. Furthermore, USACE will continue to use the Climate-Informed Science Approach for all civil works studies related to flood resilience and consider potential climate change impacts when undertaking long-term planning, setting priorities, and making decisions that affect its resources, projects, programs, policies, and operations.

USACE will leverage its research and development capabilities and work with partners to address specific knowledge gaps to reduce uncertainty in future climate conditions, while also embracing that uncertainty where it cannot be reduced. Efforts to modernize the planning process and be better prepared for this uncertainty through the Agency Specific Procedures under the Principles, Requirements and Guidelines will help ensure that USACE projects are as prepared as possible for the conditions of the future as well as those of the present. These policy and process improvements will help provide a better understanding of the risks and opportunities facing the nation's water resources infrastructure.

Among the significant impacts of climate change on USACE Civil Works missions, the onset of extreme drought across the nation has been an increasing trend over the past several decades, affecting temperature, precipitation, hydrology, vegetation, and the overall availability of water. Through the flood and coastal storm risk management missions, USACE will continue to address climate change impacts on the opposite end of the spectrum, working to reduce risk to communities from extreme precipitation events as well as regularly occurring flooding. USACE will work to apply its significant capabilities discussed in this plan to build climate change resilience across the nation and to reduce drought and flood impacts.

While the magnitude and complexity of climate change challenges are significant, USACE will continue to modernize our tools, guidance, and research while working with our partners to address impacts to all communities and adapt water resources infrastructure to future conditions using a watershed approach. Through these efforts, we are committed to support resilient, thriving communities across the nation.

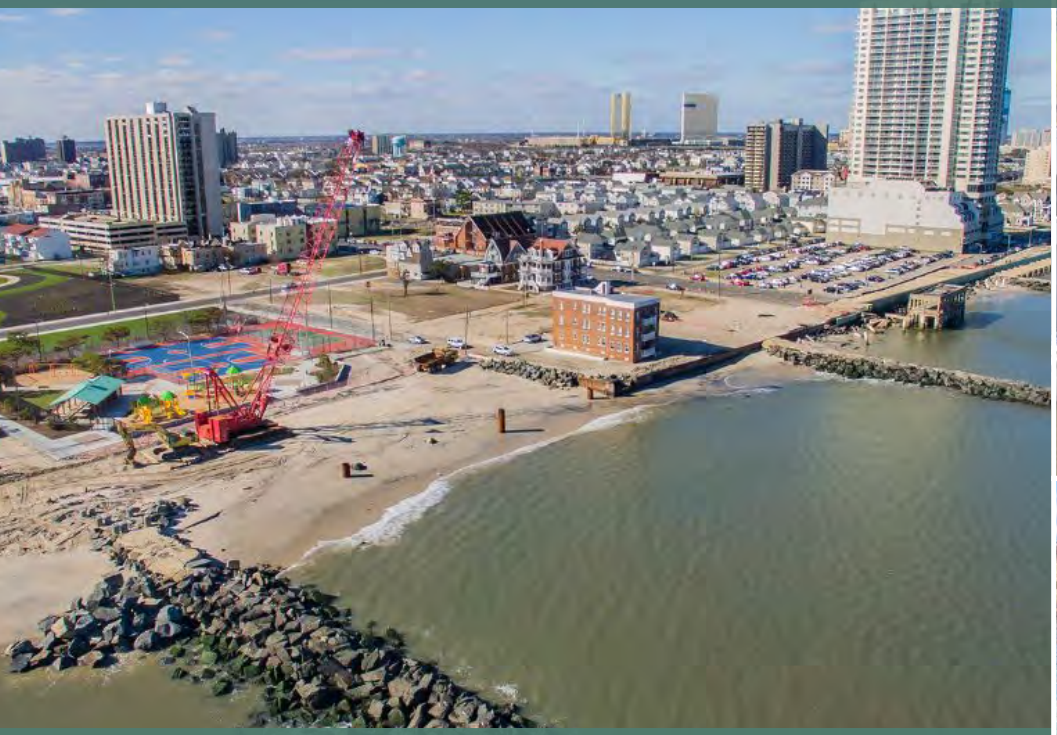
The Assistant Secretary of the Army for Civil Works is the Agency official responsible for ensuring implementation of all aspects of this policy related to USACE Civil Works, including Civil Works actions which support USACE Military Programs. This policy statement reaffirms and supersedes the commitment made by USACE in its 2021 Climate Preparedness and Resilience Policy Statement but does not alter or affect any existing duty or authority. This policy will be effective beginning June 2024, for all USACE missions, operations, programs, and projects and will remain in effect until it is amended, superseded, or revoked.

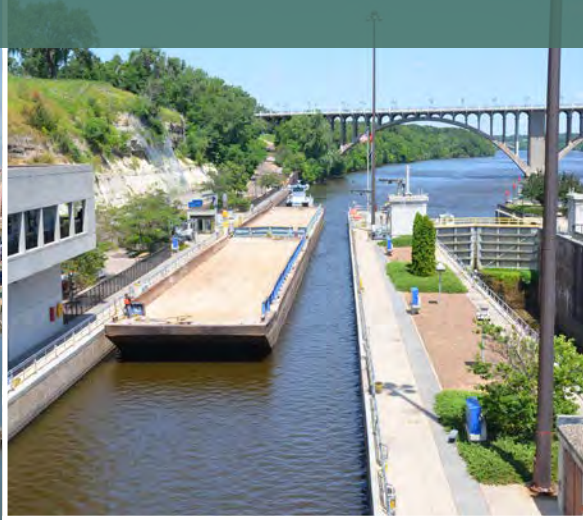
Signed,

Michael Connor
Assistant Secretary of the Army for Civil Works

"USACE continues to implement adaptable and resilient solutions to changing conditions"

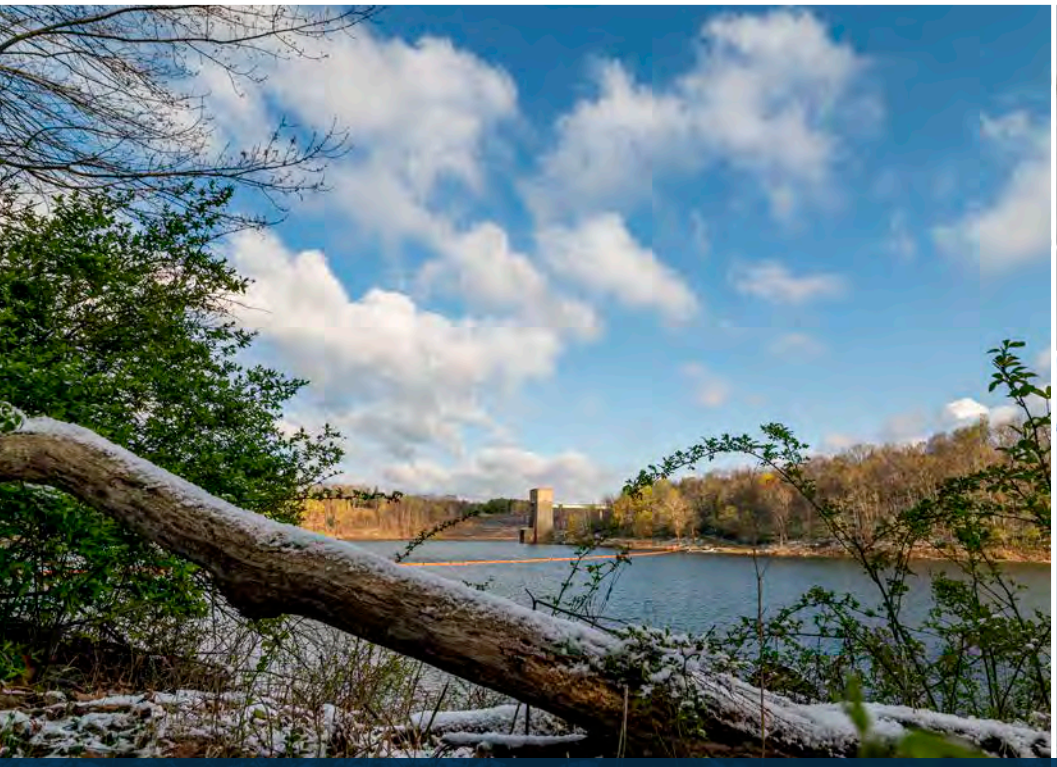
Mr. Edward E. Belk, SES, Director of Civil Works

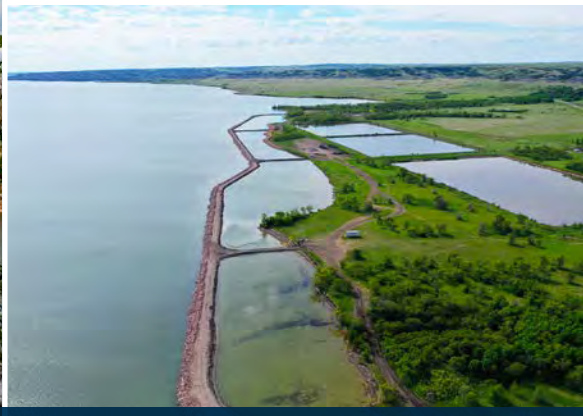




U.S. ARMY CORPS OF ENGINEERS

2024–2027 Climate Adaptation Plan





U.S. ARMY

USACE CLIMATE PREPAREDNESS AND RESILIENCE

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Introduction

This U.S. Army Corps of Engineers (USACE) Climate Adaptation Plan (CAP) for 2024–2027 reflects the numerous advancements in climate science and adaptation methodology since the publication of previous USACE climate action/adaptation plans in 2011, 2014, 2015, and 2021. As science continues to mature and new tools and methods become available, USACE continually updates its technical guidance, tools, and procedures to advance the agency's readiness to execute programs, projects, missions, and operations despite the uncertainties of climate change.

Building on the 2021 Climate Action Plan, USACE's preparation efforts regarding the effects of climate change fall into five categories:

- Modernizing USACE programs and policies to support climate-resilient investments
- Managing USACE lands and waters for climate preparedness and resilience (CPR)
- Enabling state, local, and tribal government preparedness
- Providing actionable climate information, tools, and projections
- Planning for climate change-related risks to USACE missions and operations

As required by the instructions from the White House Council on Environmental Quality (CEQ) regarding plan preparation, this plan differs from prior plans in providing much greater detail on the hazards facing USACE buildings and employees, whereas prior plans were more focused on climate risks to mission success and by extension, public well-being. Other areas of new or particular emphasis in this plan reflect aspects of climate change impact that most urgently threaten USACE missions and projects. The first and most impactful climate change effect on USACE projects is global mean sea level rise (SLR). As described in this plan, USACE will undertake the most significant overhaul of its sea level planning and design guidance since 2012 to coincide with the National Oceanic and Atmospheric Administration (NOAA) National Ocean Service's next National Tidal Datum Epoch publication, anticipated in 2026. This update aligns construction grades with tidal water levels and ensures that USACE's sea level scenarios reflect the latest actionable oceanographic, glaciologic, and climate science.

The other broad category of climate impact that affects most USACE water infrastructure projects involves changes to hydrometeorological processes leading to changes in riverine flow frequency. In 2023, USACE published new guidance on applying climate model outputs in project planning and design. In 2024 and beyond, USACE will build on this document to update all its technical guidance on climate-affected hydrology, providing engineers and planners with actionable information to inform water resources decision-making while avoiding hazardous over-precision. With each of these guidance updates, USACE will deliver associated training, tools, and resources to span the five categories of climate action listed above and ensure effective uptake of the latest actionable climate science and information.

Building on the successes of past plans, USACE will continue to work with nationwide partners and use its research and development (R&D) capabilities to address specific knowledge gaps to reduce uncertainty in future climate conditions, while also embracing that some risks are too uncertain to project with confidence. Simultaneously working to better understand climate change impacts and modernize planning approaches to reflect the deeply uncertain nature of a rapidly changing world ensures that USACE projects are prepared to perform under present and future conditions. This approach also helps senior leadership, stakeholders, and the public understand the risks and opportunities facing the nation's water resources infrastructure.

Section 1: Agency Profile

AGENCY PROFILE	
Mission	Deliver vital engineering solutions, in collaboration with our partners, to secure our nation, energize our economy, and reduce disaster risk.
Agency Climate Adaptation Official	Will Veatch, PhD, PH Lead, Climate Preparedness and Resilience Community of Practice
Agency Risk Officer	Pete G. Perez, PE, SES Chief, Engineering and Construction Division
Point of Public Contact for Environmental Justice	Jerica Richardson Environmental Justice Program Manager
Owned Buildings	22,611 buildings with total area of 63,065,000 square feet[1] (Source: USACE Enterprise Data Warehouse, 2024)
Leased Buildings	181 leased buildings with total area of 2,988,000 square feet[1] (Source: USACE Enterprise Data Warehouse, 2024)
Employees	• 37,933 federal employees as of 31 Mar 2024, of which 26,599 are assigned to Civil Works functions. • Contractor support highly variable by construction season and appropriations (Source: Defense Civilian Personnel Data System, 2024)
Federal Lands and Waters	• Lands and Waters: 12 million acres • Lakes and Reservoirs: 6 million acres • USACE Geospatial Open Data • USACE Reservoirs: Published 07 DEC 2016; Last Updated 18 JAN 2023 • Civil Works Land Data Migration – Sites: Published 29 MAR 2022; Last Updated 27 SEP 2023
Budget	$8.343B FY22 Enacted[2] (P.L. 117-103) $8.310B FY23 Enacted[3] (P.L. 117-328) $8.681B FY24 Enacted[4] (P.L. 118-42) $7.22B FY25 President's Budget (link)
Key Areas of Climate Adaptation Effort	• Flood and Coastal Storm Risk Management • Aquatic Ecosystem Restoration (AER) • Navigation • Water Supply • Hydropower All USACE Civil Works (CW) business lines are water-related and therefore must include climate adaptation considerations. Authorities typically derive from Water Resources Development Acts (WRDAs).

1 The portfolio of USACE owned or leased buildings shown here has been filtered to just those associated with the Civil Works program, which is the focus of this plan.
2 FY22 appropriations also included $22.81B in disaster relief supplemental appropriations and the Bipartisan Infrastructure Law.
3 FY23 appropriations also included $1.48B in disaster relief supplemental appropriations.
4 FY24 appropriation is net of $8.703B in appropriations and $22M in rescissions of unused, previously appropriated funds.

As the Federal Government's largest and oldest manager of water resources, USACE has a long history of delivering programs, projects, planning, and operations that support community resilience and incorporate principles of resilience and adaptability. All USACE Civil Works (CW) mission areas are water related and therefore affected by global climate change through its impacts on the hydrological cycle.[5] As a result, every USACE project faces exposure to climate hazards and supports the nation's preparedness to these hazards.

USACE has long applied resilience principles in project planning, such as allowing room for floodwaters in the Mississippi River and Tributaries project beginning in 1928. The relatively recent reconceptualization of resilience as a more formal design concept led USACE to develop Engineer Pamphlet (EP) 1100-1-2, U.S. Army Corps of Engineers Resilience Initiative Roadmap, in 2016. This roadmap details the USACE "prepare, absorb, recover, and adapt" framework for resilience and actions to align these principles with agency initiatives and programs. Similarly, adaptation has been a part of the agency's policies since at least 1986, when it issued its first guidance on planning for sea level change (SLC) as a CW policy memorandum. In the intervening years, these policies have been updated and expanded over time to reflect the state of science and engineering practices, Administration priorities, and Congressional authorities.

Beyond offering useful information to practitioners, policy and technical guidance documents also provide an enforcement mechanism for agencies to implement preparedness and resilience principles. The USACE CW review policy requires that study reports undergo district quality control review, agency technical review, and policy and legal compliance review to ensure that CPR policies are followed.

USACE's policy is to mainstream CPR into the agency's normal business processes, rather than treat it like a specialty area or a topic for supplementary analysis. Therefore, all USACE employees must have sufficient knowledge of climate preparedness to incorporate these considerations into their normal work activities. The climate preparedness and resilience community of practice (CPR CoP) provides a forum to leverage the diverse skills and expertise across the agency to share best practices, lessons learned, emerging science, and innovative methods with colleagues. CPR CoP subject matter experts (SMEs) develop guidance, deliver training, champion new tools and methods, provide technical review, and advise teams on applying preparedness and resilience analyses.

As an implementor of water resources infrastructure, USACE faces vulnerabilities from climate change impacts that extend beyond its own sites and employees to the preparedness of the nation. By planning adaptable, resilient projects that are prepared to perform despite the uncertainties of climate change, USACE helps ensure the nation's water risks and resources are managed according to the latest actionable climate science, so they continue to deliver value today and in the future.

5 USACE also faces another suite of hazards in its role as a provider of engineering and construction services to the Department of Defense and other partners. As those hazards are the subject of partner agencies' plans, this plan focuses on Civil Works.

Section 2: Risk Assessment

USACE used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App) — which was developed for federal agencies by CEQ and NOAA to conduct a high-level screening of climate hazard exposure for federal facilities and personnel. In addition, USACE used the underlying data from the Department of Defense Climate Assessment Tool (DCAT) to assess extreme heat and precipitation exposure for Alaska and Hawaii and drought exposure for USACE reservoirs across the continental U.S. (CONUS), Alaska, and Hawaii. As a co-contributor to the development of DCAT, USACE is using much of the same exposure information in DCAT to develop a Civil Works Vulnerability Assessment Tool (CWVAT).

USACE assessed the exposure of its buildings; employees; and lands, waters, and cultural and natural resources to five climate hazards: extreme heat, extreme precipitation, SLR, flooding, and wildfire risk. USACE also assessed exposure to drought using several indicators developed for DCAT.

Climate Data Used in Agency Risk Assessment

HAZARD	DESCRIPTION	SCENARIO	GEOGRAPHIC COVERAGE
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the 4th National Climate Assessment.	Representative Concentration Pathway (RCP) 4.5	All 50 States
		RCP 8.5	All 50 States
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5	All 50 States
		RCP 8.5	All 50 States
Sea Level Rise (SLR)	Measured as whether an asset is within the inundation extents from the National Oceanic and Atmospheric Administration (NOAA) Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High SLR scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5	Continental U.S. (CONUS) and Puerto Rico (PR)
		RCP 8.5	CONUS and PR
Wildfire Risk	Measured as whether an asset is in a location is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States

HAZARD	DESCRIPTION	SCENARIO	GEOGRAPHIC COVERAGE
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR
Drought	Measured based on indicators provided through the Federal Mapping App and the Defense Climate Assessment Tool (DCAT): • Consecutive Dry Days – measured as the mean annual maximum number of consecutive dry days with less than 0.01 inches of precipitation. • Mean Annual Streamflow – measured as the mean annual unregulated streamflow. • Aridity – measured as precipitation divided by potential evapotranspiration, also referred to as Aridity Index, represents average dryness. The threshold between humid and arid climates is 0.65, with lower values representing higher aridity. • Drought Year Frequency – measured as the average percentage of years in which the 12-month Standardized Precipitation Evapotranspiration Index (SPEI) is less than -1, which indicates moderate to extreme drought.	RCP 4.5 RCP 8.5	All 50 States

Exposure to extreme heat, extreme precipitation, SLR, and drought parameters were evaluated at mid- (2050) and late-century (2080) under two emissions scenarios, Representative Concentration Pathway (RCP) 4.5 and RCP 8.5. Exposure to flooding and wildfire risk were only evaluated for the present day due to data constraints.

Climate Scenarios Considered in Agency Risk Assessment

SCENARIO DESCRIPTOR		SUMMARY DESCRIPTION FROM 5TH NATIONAL CLIMATE ASSESSMENT
RCP 8.5	Very High Scenario	Among the scenarios described in the 5th National Climate Assessment, RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46% less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

Additional details about the data used in this assessment are provided in Appendix A.

2A. Climate Hazard Exposures and Impacts Affecting Federal Buildings

INDICATORS OF EXPOSURE OF BUILDINGS TO CLIMATE HAZARDS	RCP 4.5 2050 (MID-CENTURY)	RCP 4.5 2080 (LATE CENTURY)	RCP 8.5 2050 (MID-CENTURY)	RCP 8.5 2080 (LATE CENTURY)
Extreme Heat: Percent of buildings projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually) from 1976-2005.	100%	100%	100%	100%
Extreme Precipitation: Percent of buildings projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually) from 1976-2005.	98%	99%	99%	99%
SLR: Percent of buildings projected to be inundated by SLR.	0.1%	0.6%	0.1%	1%

	HIGH RISK	VERY HIGH RISK	EXTREME RISK
Wildfire: Percent of buildings at highest risk to wildfire.	5%	0.4%	0.4%

	100- OR 500- YEAR FLOODPLAIN
Flooding: Percent of buildings located within floodplains.	15%

USACE owns or leases almost 24,000 buildings at 1,575 sites across CONUS, Alaska, and Hawaii.[6] USACE leases a significant amount of space for its district, division, and headquarters offices from private landowners and other federal agencies, with 171 of these buildings leased from or through the General Services Administration (GSA). USACE intends to formally partner directly with GSA to address the vulnerabilities of these sites and facilities to incremental climate change and variability. A larger portion of the USACE building portfolio consists of buildings supporting USACE missions such as lock and dam projects and regulatory offices. The USACE building portfolio spans across the United States with a higher concentration of buildings east of the Mississippi River and along the West Coast.

Increased exposure of the USACE building portfolio to various climate change hazards is expected for both the RCP emission scenarios, RCP 4.5 and RCP 8.5, during the mid- and late-century time periods. Combining an emission scenario and a future time period is known as an epoch-scenario. Maps in Appendix A illustrate the national trends for various climate change hazards required for agency CAPs: extreme temperature, extreme precipitation, SLR, flooding, and wildfire at USACE buildings.

The risk assessment presented here relies primarily on climate projection information provided by CEQ, supplemented with information calculated and assessed using DCAT for Alaska and Hawaii. Mapping for Alaska and Hawaii is not included in the appendices to improve readability and reduce the length of the overall plan, but the risk assessment for Alaska and Hawaii are included in the summary tables using underlying climate projection data from DCAT. The terms extreme temperature and precipitation, as used throughout the main body of this CAP, should be interpreted as higher values of temperature and precipitation, as compared to present-day values. The effects of extreme low precipitation on drought and related impacts, such as reduced streamflow into and higher potential evapotranspiration on USACE reservoirs, are discussed in Section 2E and maps illustrating a risk assessment of drought are provided in Appendix C.

6 The portfolio of USACE owned or leased buildings shown here has been filtered to just those associated with the Civil Works program, which is the focus of this plan.

- Extreme heat is projected to increase across the U.S. By mid-century, larger increases are anticipated in the southern portion of the U.S., generally below the 37th latitude, for both emission scenarios. More significant increases are projected across most of CONUS during the late-century period, especially for the RCP 8.5 emission scenario.
- Extreme precipitation is projected to increase across the U.S., with higher percent changes expected in the Northwestern and Northeastern U.S. In addition to these areas, more significant increases in extreme precipitation are expected to extend into larger portions of the Western and Eastern U.S. for the RCP 8.5 emission scenario. Smaller increases in extreme precipitation are expected in the Great Plains region.
- While SLR, which includes sunny-day and nuisance flooding, poses a significant risk to government-owned buildings, USACE's exposure to SLR is relatively low nationally with less than one percent of all USACE buildings impacted by SLR for any epoch-scenario.
- Evaluating present-day one percent annual exceedance probability (1% AEP), or 100-year, and 0.2% AEP, or 500-year, floodplain maps indicates that USACE buildings are only moderately impacted by flooding. The 1% AEP and 0.2% AEP events designated by the Federal Emergency Management Agency (FEMA) impact 10.7% and 4.3% of USACE buildings, respectively. Most of the buildings in the USACE portfolio that fall within the FEMA 1% or 0.2% AEP floodplain are along major rivers such as the Ohio and Mississippi Rivers and help support USACE's water resources mission.
- Nationally, USACE buildings have low exposure to the threat of wildfire. Less than 6% of the buildings in USACE's portfolio fall within the high-risk wildfire category, and less than 0.5% of buildings are categorized as having a very high or extreme wildfire risk. The U.S. Forest Service developed the Wildfire Risk to Potential Structures to classify the potential threat of a hypothetical building to wildfire. The data, provided as percentiles of risk, are classified as Low, Moderate, High, Very High, and Extreme. The highest wildfire risk exists in the Western U.S. where the climate is more arid, and the wildland-urban interface creates an advantageous environment for wildfires. Fortunately, USACE does not own or operate in many buildings in the Western U.S. However, additional areas of higher risk exist in the Appalachia region and southern Florida. With climate change, wildfire risk is anticipated to increase across the nation.

USACE buildings represent the locations where USACE missions occur; therefore, maintaining a resilient building portfolio is critical to delivering USACE's water resources mission. Each climate hazard poses a unique risk to the operational capacity of the agency's real property with compounding impacts across multiple hazards, such as prolonged high temperatures increasing the potential for drought conditions that lead to a heightened risk of wildfire.

BUILDING COMPONENTS	IMPACTS
Building Operation	**Extreme Temperature** • High temperatures stress building mechanical systems, affecting performance and longevity of system components and increasing costs through greater energy demand and repair/replacement costs, respectively. • Extended exposure to high temperatures accelerates the deterioration of building materials such as roofing and window seals and the expansion and contraction of structural components, reducing overall structural integrity. • High temperatures also impact the performance and longevity of electrical systems and components such as computers and servers. **Extreme Precipitation, SLR, and Flooding** • SLR, extreme precipitation and increased flooding impact building plumbing systems, damage structures, disrupt utilities, and prohibit access to and evacuation from buildings. Increased frequency and duration of power outages also strain the existing emergency power sources currently designed for USACE buildings. • Heavy precipitation, increased flooding, increased temperatures, and SLR cause land degradation through erosion, permafrost thaw, and landslides. In turn, these impacts cause structural damage, damage to critical infrastructure, and accessibility issues due to disruption of transportation networks. • SLR contributes to saltwater intrusion to freshwater drinking sources, while prolonged extreme heat leads to drought, reducing water supply capacity. Both climate hazards compromise drinking water sources in different ways. • SLR and saltwater intrusion increase exposure of concrete, steel, and other materials critical to building operation to the corrosive effects of saltwater. **Wildfires** • Wildfires directly damage buildings and disrupt critical infrastructure like roads and utilities. • Wildfires also cause large-scale destruction of nearby communities that provide services to USACE buildings and employees.
Building Maintenance	**All Climate Hazards** • Flooding, SLR, heavy precipitation, and wildfires increase the costs for repair, replacement, and rehabilitation of federal buildings. • Extreme heat impacts the performance and lifespan of mechanical systems, electronic equipment, and other critical systems, requiring more frequent repair and maintenance. • Extreme precipitation and SLR impacts lead to water infiltration and deterioration of building components, requiring additional maintenance to buildings. • Flooding, SLR, and storm surge damage utilities and water/wastewater systems, resulting in service outages and increased maintenance costs. • Wildfires cause significant damage to buildings, either directly through partial or complete loss of a building or indirectly through smoke damage.

BUILDING COMPONENTS	IMPACTS
Health and Environment	**All Climate Hazards** • Flooding, SLR, heat and humidity, and extreme precipitation promote mold growth, posing health risks to USACE employees. • Flooding due to SLR and extreme precipitation generates electrical hazards that linger even after floodwater recedes. • Smoke from wildfires affects outdoor air quality and can permeate building HVAC systems, negatively impacting indoor air quality, as well. • Extreme precipitation, flooding, and SLR can contaminate potable water sources, spreading pathogens and increasing the risk of waterborne disease. • High temperatures lead to heat stress, threatening employee health and diminishing productivity.

2B. Climate Hazard Exposures and Impacts Affecting Federal Employees

INDICATORS OF EXPOSURE OF EMPLOYEES TO CLIMATE HAZARDS	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005.[7]	100%	100%	100%	100%
Extreme Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005.[8]	98%	99%	99%	99%
SLR: Percent of employees duty-stationed in counties projected to be inundated by SLR.[9]	17%	24%	26%	26%

	HIGH RISK	VERY HIGH RISK	EXTREME RISK
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire.	7%	1%	3%

7 *Calculations for Alaska and Hawaii are derived from the DCAT.*
8 *Calculations for Alaska and Hawaii are derived from the DCAT.*
9 *SLR information was not available for Alaska and Hawaii.*

According to the Defense Civilian Personnel Data System (DCPDS), USACE employs 37,933 employees globally. For climate hazard exposure of federal employees, this risk assessment includes only the 26,599 Civil Works employees located in CONUS, Alaska, and Hawaii. Like the assessment of USACE buildings, analysts used DCAT to calculate and assess the projection information for temperature and precipitation impacting employees in Alaska and Hawaii. In addition, this risk assessment is based on the number of USACE employees residing in each county, per employee data stored in DCPDS.

While numerous employees work remotely, the vast majority live and work near the 1,575 buildings described in the building risk assessment. A majority of USACE employees supporting the Civil Works Program work in one of the 62 district, division, headquarters, laboratory, or centers of expertise, while the remainder work in regional or satellite offices. Beyond the USACE employees working in a traditional office space, a significant number work in the field.

The projected climate hazards anticipated for USACE's workforce are similar to those expected at USACE's building locations. The magnitude and characteristics of climate impacts to the USACE workforce vary regionally. All climate hazards have the potential to adversely affect the communities in which USACE employees live and work. USACE's skilled workforce is the agency's greatest asset, thus training and maintaining a resilient workforce is critical, as climate impacts threaten USACE's ability to reliably execute its missions.

Extreme Heat

For extreme heat, an indicator of extreme temperature days (annual days above the 99th percentile of daily maximum temperature) helps define an employee's exposure to high heat. All counties in CONUS, Alaska, and Hawaii are expected to see an increase in the indicator for future epoch-scenarios. The greatest percent increase in extreme temperature days is expected in southern Florida, the downstream reaches of the Mississippi River in Louisiana, and the southeastern portion of the Rio Grande River watershed in Texas; however, the number of extreme heat days are also expected to increase nationally.

Extreme heat will impact USACE employees in the workplace as described in Section 2A. Extreme heat poses an even greater risk to employees working in the field, as they are more likely to experience heat-related illnesses, reduced work productivity, and more extreme weather events. Outside of work activities, USACE employees may also encounter increased energy costs, heat stress, water scarcity, food insecurity, more prevalent spread of disease, and political unrest, which may stress the effectiveness of the USACE workforce and may more directly impact the USACE's remote workforce.

Extreme Precipitation and Flooding

For extreme precipitation, an indicator of extreme precipitation days (annual days above the 99th percentile of daily maximum precipitation) helps define an employee's exposure to extreme precipitation. Almost all counties in CONUS, Alaska, and Hawaii are expected to see an increase in this indicator for all future epoch-scenarios except for areas in the Southwest U.S., southern areas of the Great Plains, and southern Florida. The greatest percent increases in extreme precipitation are expected in the Pacific Northwest, the northern coast of California, and the Northeast, to include the Ohio River Basin and Great Lakes region.

Extreme precipitation will impact USACE employees in the workplace, in the field, and in the locations where they reside. USACE employees will face pluvial and fluvial flooding that can impact their homes and the critical infrastructure and transportation systems on which they rely. Employees may see the spread of waterborne diseases and contamination to public water supply sources. Employees may also experience financial burdens including repairs for and protection against extreme precipitation events and increases in insurance needs and premiums.

Flood risk is closely correlated with extreme precipitation. The most critical impact of flooding on USACE employees is the potential for loss of life and damage to personal assets. Flooding also increases financial burdens through the need and cost of insurance premiums as well as the costs to mitigate against flood risk. Like the other climate hazards, flooding poses threats to public health, emergency services, critical infrastructure, and housing/urban planning. Although this assessment uses historical floodplain information, increases in the intensity and frequency of future extreme storm events, coupled with SLR, will likely cause increases in future flood risk in some parts of the country.

SLR

Data required to evaluate a USACE employee's risk to SLR is found in the 2022 Interagency Sea Level Rise Technical Report. As illustrated in Table 2B of this plan, about 20-25% of the counties where USACE employees reside are impacted by SLR. While the counties along the Gulf and Eastern coastline will be most impacted by SLR, USACE employees may still be vulnerable to coastal hazards and flood risks, which are magnified and intensified by SLR. USACE employees will likely experience nuisance flooding from increased SLR and more extreme coastal storm events.

SLR poses many threats including strains on the emergency response system, zoning challenges, utility service vulnerabilities and disruption, and in extreme cases, population displacement. The analysis of the impact of SLR on USACE personnel for this assessment assumes that all employees within a county are vulnerable to SLR if the data indicates that any portion of the county could be impacted by SLR. Although employees may be indirectly impacted by SLR, the estimated number of impacted employees is most likely overestimated in this assessment.

Wildfire

Wildfire risk, representing risk to U.S. structures, is based on vegetation and wildland fuels data from LANDFIRE 2014 (version 1.4.0), which reflects landscape conditions as of the end of 2014. Wildfire risk is highest in the Western U.S., areas of Appalachia, and southern Florida.

Wildfire poses a catastrophic risk to USACE employees through loss of life and asset destruction (land and property). Wildfires also degrade air quality and pose a quality-of-life risk to employees. In addition to these direct risks, debris generated by wildfires damages water resources infrastructure, increases pollutant loads, and increases rainfall-runoff due to land cover and soil characteristic changes. Watershed hydrology could be permanently impacted by wildfire due to its catastrophic destruction, which could result in dramatic changes for employees in these watersheds.

Maps in Appendix B illustrate the national trends for various climate change hazards including extreme temperature, extreme precipitation, SLR, flooding, and wildfire for USACE personnel. Please note that Alaska and Hawaii are not included in the maps in Appendixes A, B, and C to improve readability, but the risk assessment for Alaska and Hawaii are included in the summary tables using underlying climate projection data from DCAT.

2C. Climate Hazard Exposures and Impacts Affecting Federal Lands, Waters and Associated Cultural Resources

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
USACE Lakes and Reservoirs (approximately 6 million acres)	**Extreme Heat** • Although extreme temperatures pose challenges to USACE mission areas, USACE currently manages its waters effectively against the impacts of higher temperatures through application of laws, policy, and guidance. • Shifts in temperature caused by extreme heat change the timing of thermal stratification and lake turnover. Turnover is critical to dissolved oxygen (DO) levels in lakes. In turn, DO impacts the distribution and behavior of aquatic organisms. • USACE effectively manages its lakes and reservoirs based on Congressionally authorized purposes of the lakes, such as hydropower, water supply, and recreation. During drought and high heat periods, increased evaporation rates and higher risk of drought cause declining water levels, presenting challenges to these authorized purposes. • USACE currently manages the impacts of harmful algal blooms, which can be worsened by increased water temperatures. These blooms create public health issues and threaten terrestrial and aquatic ecosystem health. • Increased temperatures release more nutrients from soils via nitrification, mineralization, carbon from organic matter, and phosphorous release. This degrades water quality in lakes and reservoirs.	**Extreme Heat** • Increasing temperature trends can catastrophically impact thermal stratification and lake turnover characteristics. Higher temperatures lengthen the stratification period and make thermal mixing more difficult, both of which are critical characteristics of a healthy lake ecosystem. Stratification changes could lower DO levels at deeper depths, which provide refuge for many lake species during heat waves and cause trophic mismatch between lake species with symbiotic relationships. • Increasing temperatures, especially the magnitude, frequency, and duration of extreme temperatures, pose a major threat to USACE's water management missions due to higher evaporation rates and risk of drought. • Further reduction of DO levels in lakes could irreversibly impact fish and other aquatic organisms. • Higher temperatures increase the risk and magnitude of harmful algal blooms, creating greater public safety risks and placing additional strain on water management missions. • Increased temperature poses an even greater challenge to USACE's water management missions related to maintaining water quality in its lakes and reservoirs. • Increasing temperatures can shift seasonality, necessitate changes in reservoir management rules, and cause greater river forecast uncertainty. These effects may create challenges to water management in terms of maintaining water supply and managing flood response (e.g., time-based reliability of operations, reliance on historic behavior to inform water management). • Shifts in the growing season due to temperature and precipitation changes can result in longer periods of exposed soil, which may increase sediment loads to lakes in agricultural watersheds.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
USACE Lakes and Reservoirs (approximately 6 million acres), cont.	**Extreme Precipitation** • Although extreme precipitation poses challenges to USACE mission areas, USACE currently manages its waters effectively against the impacts of extreme precipitation through application of laws, policy, and guidance. • Extreme precipitation poses challenges to USACE's water management role. Climate change increases uncertainty of future frequency, intensity, and duration of extreme precipitation events, as well as droughts. • Higher precipitation changes lake levels more rapidly, leading to increased shoreline erosion. • Storm events increase sediment loads to lakes from streambank and bed erosion, reducing available lake storage. • Increased inflow of contaminants (e.g., nitrogen and phosphorus loads) and other hazardous materials to lakes impacts public health.	**Extreme Precipitation** • Climate change increases uncertainty of future frequency, intensity, and duration of extreme precipitation events, as well as droughts. • With more extreme storm events, rapid changes in lake levels could lead to even more significant shoreline erosion. • Increased sediment loads to reservoirs are expected due to the erosion from extreme precipitation events. Additional sediment further reduces available lake storage and undermines the Congressionally authorized purposes of the lakes, such as water supply and flood risk management (FRM). • More intense and frequent storm events could further increase the inflow of contaminants (e.g., nitrogen and phosphorus loads) and other hazardous materials to lakes, impacting public health.
	SLR • SLR poses various challenges to USACE's waters and waterways; however, these challenges are effectively mitigated through water management policies, guidance, and approaches. • USACE currently faces challenges with saltwater intrusion impacts to lake water quality, water supply sources, and mechanical components associated with USACE lakes, especially as drought conditions lower water levels along rivers flowing into the ocean.	**SLR** • Increased SLR could impact critical infrastructure, like roads, buildings, and utilities, directly or indirectly associated with USACE lakes. • SLR, coupled with other coastal hazards like coastal storms and flooding, could create effects further inland, posing even greater impacts to infrastructure that historically has not experienced them. • Greater saltwater intrusion impacts are expected due to SLR, especially as other adverse conditions from climate change increase, such as drought. • Increasing SLR could reduce wetlands both along the coast and associated with coastal lakes.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
USACE Lakes and Reservoirs (approximately 6 million acres), cont.	**Flooding** • Flooding is a major threat to USACE missions. While USACE effectively manages flooding through its water management approaches, USACE's FRM business line specifically focuses on managing flood risk and its associated consequences. • Increased inflow of nutrients from increased flooding contributes to the occurrence of harmful algal blooms. • Intense flooding results in higher influxes of sediments to USACE lakes. • Impacts to the thermal stratification of lakes affect water temperatures, nutrients, and oxygen levels. • Impacts of flooding are especially amplified in coastal areas where compound flooding related to pluvial, fluvial, and coastal flooding commonly occurs coincidently.	**Flooding** • Increased flooding poses even greater life safety risks and economic consequences. • A higher frequency of flood events impacting the Congressionally authorized purposes increases stress on water management staff. • Increased impacts to mechanical systems at USACE lakes and reservoirs results in the need for additional maintenance and potentially reduces the lifespan of these systems. • Increased flooding also poses risks to non-federal lands within the flood control (and surcharge) pool of USACE reservoirs, impacting operations at these projects. • An increased inflow of nutrients from increased flooding contributes to the more frequent occurrence of harmful algal blooms. • Intense flooding causes even higher influxes of sediments to USACE lakes, impacting the Congressionally authorized purposes and expanding the USACE dredging program. • Recurrent or prolonged flooding events have long-term effects on the sedimentation and nutrient dynamics of the lake, negatively impacting habitat availability and overall lake ecosystems. • Greater impacts to thermal stratification of lakes can irreversibly damage ecosystems and environmental health. • Impacts of coastal storm events that cause flooding are expected to increase, especially in combination with SLR and extreme precipitation.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
USACE Lakes and Reservoirs (approximately 6 million acres), cont.	**Wildfire** • Wildfire reduces the vegetation cover and alters the soil characteristics in the upland watershed, impacting inflows to USACE lakes. • Loss of vegetation cover from the landscape increases erosion in the watershed, resulting in higher sedimentation and debris flows into USACE lakes. • Greater areas of exposed soil introduce higher concentrations of nutrients to lakes. • Reduced riparian vegetation lowers its benefits: filtering pollutant inflow, shading water, and reducing shoreline erosion. • Wildfire alters downstream flood risk at the decadal scale and affects the performance of downstream FRM infrastructure.	**Wildfire** • Anthropogenic climate change is projected to increase the area, frequency, and severity of fire weather. • Climates could no longer be suitable to re-establish historical vegetation communities. Conifer forests that burn with high intensity in many areas could re-establish as grassland or shrubland, with long-term changes to watershed hydrology. • Rising temperatures contribute to more intense drought and fire weather and increase the portion of the year when wildfires occur. In many parts of the West and boreal North America, fire weather and devastating wildfires are already no longer confined to a single season. • More frequent, larger, and more intense wildfires will further alter downstream flood risk and affect the performance of downstream FRM infrastructure. • Loss of vegetation cover from the landscape increases erosion in the watershed, resulting in higher sedimentation and debris flows into USACE lakes. • Greater areas of exposed soil introduce higher concentrations of nutrients to lakes. • Reduced riparian vegetation lowers its benefits: filtering pollutant inflow, shading water, and reducing shoreline erosion.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
USACE Lands (approximately 12 million acres)	**Extreme Heat** • High heat poses the risk of heat-related illnesses for staff and visitors to USACE-owned lands. • Heat detrimentally impacts staff performing field work, construction (e.g., adverse weather days), and operations and maintenance (O&M) supporting USACE missions. • Increases in the number of visitors to USACE recreation areas typically occur during high-temperature periods, due to the water-related nature of USACE's recreation areas. Increased visitation causes more drownings and swift water rescues. • Extreme heat increases the likelihood of drought.	**Extreme Heat** • High heat increases the risk of heat-related illnesses for staff and visitors to USACE-owned lands. • Heat increases the detrimental impacts to staff performing field work, construction (e.g., adverse weather days), and O&M supporting USACE missions. • Increased temperatures could drive more visitors to USACE recreation areas, resulting in higher life safety risks and the need for additional staff to maintain recreation services. • Extremely high temperatures beyond a certain threshold could reduce the number of visitors experiencing the benefits of USACE recreation areas. • Heat detrimentally impacts ecosystem health and services on USACE lands. • Extreme heat increases the likelihood of drought, which necessitates modifying USACE land management.
	Extreme Precipitation • Current flooding, especially pluvial and coastal compound flooding, damages structures, risks life safety, and stresses sewer/stormwater systems on USACE lands. • Extreme precipitation detrimentally impacts O&M, as well as construction (e.g., increases in adverse weather days) conducted on USACE lands.	**Extreme Precipitation** • Increased flooding, especially pluvial and coastal compound flooding, damages structures, risks life safety, and stresses sewer/stormwater systems on USACE lands. • Increases in extreme precipitation events could detrimentally impact O&M, as well as construction (e.g., increases in adverse weather days) conducted on USACE lands.
	SLR • SLR creates nuisance and event-based flooding issues, which USACE manages through its coastal storm risk management (CSRM) business line. • Shoreline erosion threatens USACE lands. • Saltwater intrusion and increased flooding affect the ecosystem on USACE lands.	**SLR** • SLR could significantly increase nuisance and event-based flooding of USACE lands, impacting mission and recreation opportunities. Land near the coastlines is at risk of being permanently inundated. • SLR, coupled with other coastal hazards like coastal storms and flooding, could create impacts further inland, posing an even greater impact to USACE lands. • SLR reduces the effectiveness of breakwaters and jetties, possibly requiring their modification. • Increased shoreline erosion threatens USACE lands. • Saltwater intrusion and increased flooding could further affect ecosystem services on USACE lands.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
USACE Lands (approximately 12 million acres), cont.	**Flooding** • Damage to USACE assets requires repair, replacement, rehabilitation, and/or modification. • Flooding threatens the performance of USACE assets, such as dikes, flood control structures, and recreation facilities that support USACE missions. • Sedimentation from floods impacts the effectiveness of USACE projects such as locks, dams, and diversion channels.	**Flooding** • Increased flooding poses life safety risks and causes more costly damages to USACE lands, projects, and structures. • Increases in flood magnitude and frequency could pose an even greater threat to USACE assets, resulting in greater needs for repair, replacement, rehabilitation, and/or modification. • Increases in flooding continue to threaten the performance of USACE assets, such as dikes, flood control structures, and recreation facilities that support USACE missions, potentially requiring investment in adaptation to improve the performance of these assets. • Increased flooding also poses risks to non-federal lands within the flood control (and surcharge) pool of USACE reservoirs, impacting operations at these projects. • Increased sedimentation impacts the effectiveness of USACE projects such as locks, dams, and diversion channels.
	Wildfire • Fires unnaturally change vegetation cover and soil characteristics on USACE lands, potentially increasing flooding and erosion. • Wildfires destroy USACE lands and threaten the purposes of those lands, including ecosystems located in recreation, natural, and wildlife areas. • Wildfires threaten the lives of visitors to the vast recreation areas managed by USACE.	**Wildfire** • Anthropogenic climate change is projected to increase the area, frequency, and severity of wildfires. • Increased wildfire risk catastrophically damages USACE lands, potentially significantly enough to limit the recovery of the pre-fire land cover. • Wildfires threaten the lives of visitors to the vast recreation areas managed by USACE. • Climates may no longer be suitable to re-establish historical vegetation communities. Conifer forests that burn with high intensity in many areas could re-establish as grassland or shrubland, with attendant long-term changes to watershed hydrology.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
Navigable Waterways and Harbors (191 lock sites, 25,000 miles of Waterways and 926 coastal, Great Lakes and inland harbors)	**Extreme Heat** • High heat poses the risk of heat-related illnesses for staff. • O&M staff, who are more commonly in the field, are impacted by the effects of extreme heat. • Heat detrimentally impacts ecosystem health and services within USACE harbors and waterways by stressing the current conditions necessary for ecosystem health. • Drought and lower water levels undermine USACE's navigation mission by necessitating load lightening and creating more frequent and longer wait times for barge traffic.	**Extreme Heat** • High heat increases the risk of heat-related illnesses for staff. • Heat increases the detrimental impacts to staff performing O&M, potentially necessitating changes to current standard procedures for field employees. • Heat increases the detrimental impacts to ecosystem health and services within USACE harbors and waterways, potentially resulting in irreversible changes to the current ecosystem. • An increased likelihood of drought and more frequent lower water levels undermine USACE's navigation mission by necessitating load lightening and creating more frequent and longer wait times for barge traffic.
	Extreme Precipitation • Flooding, especially pluvial and coastal compound flooding, damages structures and disrupts navigation. • Extreme precipitation detrimentally impacts O&M by creating more dangerous conditions in the field. • Resulting flooding increases sediment loads and erosion. • High/fast water causes navigation hazards and/or waterway closures and lock stoppages/delays.	**Extreme Precipitation** • Increased risk of flooding, especially pluvial and coastal compound flooding, damages structures and disrupts navigation and lockages. • Extreme precipitation causes more detrimental impacts to O&M. • Sediment loads and erosion significantly increase, placing added stress on USACE dredge operations. • Increases in high/fast water causes navigation hazards and/or waterway closures and lock stoppages/delays.
	SLR • Increased nuisance and event-based flooding disrupts and impacts USACE navigable waterways by creating more dangerous flow conditions and potentially reducing bridge clearances in coastal areas.	**SLR** • Increased nuisance and event-based flooding disrupts and impacts USACE navigable waterways. • SLR, in combination with other coastal hazards like storm surge, extreme precipitation, and flooding, could create adverse navigation conditions further inland.
	Flooding • Damage to USACE navigation infrastructure requires repair, replacement, rehabilitation, or modification. • Increased sedimentation impacts the effectiveness of USACE projects, such as locks and dams, and places additional stress on the USACE dredge fleet.	**Flooding** • More extensive and costly damage to USACE navigation infrastructure requires repair, replacement, rehabilitation, or modification. • Increased flooding threatens the future performance of USACE navigation structures, dredge operations and dredge disposal areas. • More severe sedimentation impacts the effectiveness of USACE projects, such as locks and dams, and places additional stress on the USACE dredge fleet.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
Navigable Waterways and Harbors (191 lock sites, 25,000 miles of Waterways and 926 coastal, Great Lakes and inland harbors), cont.	**Wildfire** • Unnaturally changed vegetation cover and soil characteristics on USACE lands increase flooding, debris flow, and/or erosion.	**Wildfire** • More extensively changed vegetation cover and soil characteristics on USACE lands increase flooding, debris flow, and/or erosion. • Wildfire can alter downstream flood conditions at the decadal scale and affect the performance of downstream navigation infrastructure.
Archaeological Sites	**Extreme Heat** • Temperature impacts site and artifact stability because of increased exposure, shifts in soil characteristics, and changes in biochemical processes and biota. • Heat stress is a threat to archaeological professionals and USACE employees responsible for site maintenance, preservation, and identification. • Drought conditions expose normally flooded sites which could increase rates of decay and exposure to human interference.	**Extreme Heat** • Increased extreme heat impacts site and artifact stability because of increased exposure, shifts in soil characteristics, and changes in biochemical processes and biota. • Increased future temperatures accelerate degradation of exposed artifacts, which become brittle and crumble under increased temperature and drier conditions. • Heat stress poses an elevated threat to archaeological professionals and USACE employees responsible for site maintenance, preservation, and identification. • Increases in the frequency and duration of drought conditions expose sites to more extreme temperature impacts, especially normally flooded sites.
	Extreme Precipitation • Extreme precipitation intensity and frequency results in erosion, which damages sites, moves artifacts, and disrupts context. • Extreme precipitation can expose new sites, increasing the risks of natural exposure and theft or vandalism. • Increased lake pool levels flood terrestrial sites, requiring a deviation from normal operating procedures.	**Extreme Precipitation** • Increases in extreme precipitation intensity and frequency increase erosion, which damages sites, moves artifacts, and disrupts context. • Extreme precipitation can expose even more new sites, increasing the risks of natural exposure, theft, or vandalism. • Increased lake pool levels more frequently flood terrestrial sites, requiring a deviation from normal operating procedures.
	SLR • Coastal storm hazards impact sites through nuisance and event-based flooding and erosion. • Saltwater intrusion, a variable connected to SLR, exposes artifacts to corrosion (of particular concern for metal artifacts). • Sea water impacts shallow-water or land-water interface sites which could increase rates of decay and exposure to human interference.	**SLR** • Increased shoreline erosion puts sites at greater risk of damage. • SLR, in combination with coastal storm hazards, could further impact sites through nuisance and event-based flooding. Some sites near the coastline are at risk of being permanently inundated. • Increased ocean acidification and saltwater intrusion, variables connected to SLR, expose artifacts to higher corrosion rates (of particular concern for metal artifacts). • Shallow-water or land-water interface sites become underwater sites.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
Archaeological Sites, cont.	**Flooding** • Inundation of terrestrial sites cause damage, disruption (loss of context), and destruction of sites and artifacts. Flooding also causes mold growth and uproots artifacts. • Flooding reduces access to sites by archaeological professionals and tribes. Tribal access could be impeded for sacred sites or locations associated with sacred sites. • Floods pose life safety risks to archaeological professionals.	**Flooding** • Increased inundation of terrestrial sites causes greater and more prevalent damage, disruption (loss of context), and destruction of sites and artifacts. Flooding also causes mold growth and uproots artifacts. • Reduced access to sites by archaeological professionals and tribes is more frequent and of longer duration. Tribal access could be impeded for sacred sites or locations associated with sacred sites. • Increased flooding increases life safety risks to archaeological professionals.
	Wildfire • Fire irreparably damages sites and archaeological artifacts. • Fire poses life safety risks to archaeological professionals.	**Wildfire** • Anthropogenic climate change is projected to increase the area, frequency, and severity of wildfires, more significantly impacting archaeological sites. • Fires cause more expansive irreparable damage to sites and archaeological artifacts. • Increased wildfires increase life safety risks to archaeological professionals.
Sacred Sites and Traditional Cultural Places	**Extreme Heat** • Temperature impacts site and artifact stability because of increased exposure, shifts in soil characteristics, and changes in biochemical processes and biota. • Heat stress poses a threat to archaeological professionals and USACE employees responsible for site maintenance, preservation, and identification. • Drought conditions expose normally flooded sites which could increase rates of decay and exposure to human interference.	**Extreme Heat** • Increased extreme heat further impacts site and artifact stability because of increased exposure, shifts in soil characteristics, and changes in biochemical processes and biota. • Increased future temperatures accelerate degradation to exposed artifacts, which become brittle and crumble under increased temperature and drier conditions. • Heat stress poses an elevated threat to archaeological professionals and USACE employees responsible for site maintenance, preservation, and identification. • Increases in the frequency and duration of drought conditions expose sites to more extreme temperature impacts, especially normally flooded sites.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
Sacred Sites and Traditional Cultural Places, cont.	**Extreme Precipitation** • Extreme precipitation intensity and frequency results in erosion, which damages sites, moves artifacts, and disrupts context. • Extreme precipitation exposes new sites, increasing the risk of natural exposure, as well as theft, vandalism, and human interference. • Increased lake pool levels flood terrestrial sites, requiring a deviation from normal operating procedures.	**Extreme Precipitation** • Increases in extreme precipitation intensity and frequency increase erosion, which damages sites, moves artifacts, and disrupts context. • Extreme precipitation exposes more new sites than presently expected, increasing the risk of natural exposure, as well as theft or vandalism. • Increased lake pool levels more frequently flood terrestrial sites, requiring a deviation from normal operating procedures.
	SLR • Coastal storm hazards impact sites through nuisance and event-based flooding and erosion. • Saltwater intrusion, a variable connected to SLR, exposes sites to corrosion. • Shallow-water or land-water interface sites are impacted by sea water.	**SLR** • Increased shoreline erosion puts sites at greater risk of damage. • SLR, in combination with coastal storm hazards, could further impact sites through nuisance and event-based flooding. Some sites near the coastline are at risk of being permanently inundated. • Increased ocean acidification and saltwater intrusion, variables connected to SLR, expose sites to higher corrosion rates. • Shallow-water or land-water interface sites become underwater sites.
	Flooding • Inundation of terrestrial sites causes damage, disruption (loss of context), and destruction of sites and artifacts. Flooding also causes mold growth and uproots artifacts. • Flooding reduces access to sites by archaeological professionals and tribes. Tribal access could be impeded for sacred sites or locations associated with sacred sites. • Flooding poses life safety risks to archaeological professionals and tribes.	**Flooding** • Increased inundation of terrestrial sites causes greater and more prevalent damage, disruption (loss of context), and destruction of sites and artifacts. Flooding also causes mold growth and uproots artifacts. • Reduced access to sites by archaeological professionals and tribes is more frequent and of longer duration. Tribal access could be impeded for sacred sites or locations associated with sacred sites. • Increased flooding increases life safety risks to archaeological professionals and tribes.
	Wildfire • Fire irreparably damages sites and archaeological and tribal artifacts. • Fire poses life safety risks to archaeological professionals and tribes.	**Wildfire** • Anthropogenic climate change is projected to increase the area, frequency, and severity of wildfires, more significantly impacting sacred sites and traditional cultural places. • Fires cause more expansive irreparable damage to sites and artifacts. • Increased wildfires increase life safety risks to archaeological professionals and tribes.

FEDERAL ASSET	CURRENT CLIMATE HAZARD IMPACT OR EXPOSURE	FUTURE CLIMATE HAZARD IMPACT OR EXPOSURE
Historic Buildings and Structures	**Extreme Heat** • Heat degrades building materials. • Heat impacts the cost of historic building climate control, potentially necessitating future O&M costs to upgrade building utilities and retrofit buildings with air conditioning units.	**Extreme Heat** • Heat increases degradation of building materials, potentially irreparably damaging the buildings or requiring more extensive maintenance. • The cost of historic building climate control could significantly increase, necessitating future O&M costs to upgrade building utilities and retrofit buildings with air conditioning units.
	Extreme Precipitation • Extreme precipitation intensity and frequency causes erosion, which damages buildings. • Flooding impacts historic buildings, requiring measures to protect these structures. • Water leaks irreparably damage buildings.	**Extreme Precipitation** • Increases in extreme precipitation intensity and frequency increase erosion, which significantly damages buildings. • Increased magnitude and frequency of flooding significantly damages historic buildings, requiring measures to protect these structures. • Increased likelihood, frequency, and severity of water leaks irreparably damages buildings.
	SLR • Coastal storm hazards impact sites through nuisance and event-based flooding and erosion. • Saltwater intrusion, a variable connected to SLR, exposes buildings to corrosion.	**SLR** • Increased shoreline erosion puts buildings at greater risk of damage. • SLR, in combination with coastal storm hazards, could further impact buildings through nuisance and event-based flooding. Some sites near the coastline are at risk of being permanently inundated. • Increased ocean acidification and saltwater intrusion, variables connected to SLR, expose sites to higher corrosion rates.
	Flooding • Inundation damages and destroys buildings and contents. • Flooding limits access to buildings by professionals. • Floods pose life safety risks to professionals supporting the historic buildings.	**Flooding** • Increased inundation of buildings damages and destroys the buildings and contents. • Frequency, magnitude, and duration of flooding could increase in the future. • Flooding further reduces access to buildings by professionals. • Increased flooding increases life safety risks to professionals supporting the historic buildings.
	Wildfire • Fire irreparably damages buildings and contents. • Fire poses life safety risks to professionals supporting the historic buildings.	**Wildfire** • Anthropogenic climate change is projected to increase the area, frequency, and severity of wildfires, posing a more significant impact to historic buildings and structures. • Fires cause more expansive irreparable damage to buildings and contents. • More extreme wildfires increase life safety risks to professionals supporting the historic buildings.

The impacts of climate change-driven hazards to USACE assets vary by region and depend on how a given asset is managed and used. Climate-driven hazards to USACE assets include those associated with extreme heat/warming temperatures; extreme precipitation; flooding; increasing intensity, frequency, and severity of storms; SLR; and wildfire. In the future, the impacts of climate hazards may be amplified due to potential increases in extreme temperatures and precipitation, increased drought frequency, SLR, flooding, and wildfires. Human-driven climate change impacts introduce a source of additional and significant uncertainty and present a challenge to effective asset management.

USACE is the largest water management organization in the nation; therefore, climate change will have a detrimental impact on many aspects of USACE's water management missions including flood risk management (FRM), ecosystem management, navigation, hydropower, water supply, and recreation. For instance, increasing temperatures degrade aquatic ecosystems by altering thermal lake stratification, lowering dissolved oxygen levels, and causing harmful algal blooms. SLR is expected to increase flooding and saltwater intrusion into USACE reservoirs, degrading equipment, water quality, and ecosystem function. SLR also causes upstream saltwater wedge migration on USACE-maintained waterways and has implications for freshwater intakes (e.g., Mississippi River among other waterways affiliated with USACE dredging and operations activities). Wildfires, which will likely increase in frequency, scale, duration, and severity, alter vegetative cover and soil characteristics and exacerbate flooding. Erosion driven by prolonged drought, extreme storms, and wildfire increases sediment loads to USACE reservoirs and waterways, while sedimentation impacts available reservoir storage volume.

In addition to managing reservoirs, USACE provides safe, reliable, efficient, and sustainable waterborne transportation systems (harbors and waterways). The impacts of SLC and climate change-driven increases in drought and extreme storm frequency and intensity threaten to undermine USACE's navigation mission by interrupting navigation and threating navigation infrastructure.

USACE is the steward of almost 50,000 cultural sites that include archaeological sites, historic buildings/structures, and Tribal-sacred sites/cultural places. USACE works with both Tribal Nations and State Historic Preservation officers (SHPOs) to protect these resources. Extreme storms, flooding, climate change-driven shifts in management practices, wildfire-induced erosion, and drought can all expose a previously protected cultural resource or disrupt its context. Context, where an artifact is found and associated with other findings, is one of the most important pieces of information archeologists gather from a site. After exposure, cultural resources become vulnerable to damage, destruction, and human interference. Wildfires, flooding, and extreme storms also destroy historic structures, buildings, and associated features. Relative water level changes that affect lands along the nation's coastlines (including the Great Lakes) expose sites to damage and destruction from wave action and inundation. Places that are significant to Tribal Nations as sacred sites or traditional cultural places may no longer be accessible for ceremonies or cultural activities due to relative water level changes.

Environmental justice (EJ) is also an important consideration in USACE management of its lands, waters, and cultural resources. Communities with EJ concerns face significant risk from the effects of climate change and have decreased ability to recover from climate-related disasters. USACE strives to manage its natural and cultural resources in a manner that lessens the burdens on these communities. In addition, as a member of the White House Environmental Justice Interagency Council, USACE received recommendations on Climate Planning, Preparedness, Response, Recovery and Impacts from the White House Environmental Justice Advisory Council (WHEJAC). The report includes many recommendations that are relevant to the work of the USACE. USACE is reviewing the recommendations and, as appropriate and to the maximum extent permitted by law, is taking steps to address the WHEJAC's recommendations.

2D. Climate Hazard Exposures and Impacts Affecting Mission, Operations and Services

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
Navigation	Extreme Temperature	• Increases in extreme temperature include heat waves and a broader range of extremes in water availability, impeding ability to maintain approved navigation depths on waterways. • Low water events increase mission requirements related to safety and coordination.
	Extreme Precipitation	• Increases in frequency and intensity of large storm events and associated flooding impede navigation in waterways and coastal zones. • Extreme events may also increase water turbidity and come with high winds. • Extreme low precipitation can cause low sailing drafts and reduce navigability.
	SLR	• Increases in SLR impact the functionality of coastal navigation structures, ports, and harbors and waterways. • Increases in SLR impact bridge clearances along coastal zone waterways and contribute to upstream migration of saltwater wedges, affecting river ecosystems, water intakes, and potable water supplies.
	Flooding	• More frequent large flood events reduce the time in service for many navigable waterways and harbors. • Supporting structures and personnel servicing the navigation mission may be impacted by extreme floods and storm damages. • Debris removal and survey mission areas see increased demand.
	Wildfire	• Wildfires lead to soil erosion and sedimentation in waterways, estuaries, and bays, reducing draft depths and requiring alterations to maritime and navigation charts. • Fires generate debris in waterways. • Smoke from wildfires reduces air quality and visibility.

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
FRM	Extreme Temperature	• Increasing temperatures change the seasonality and drivers of annual peak floods (rainfall vs. snowmelt driven), shifts in the growing season, and changes in river ice dynamics, all factors that impact the magnitude and timing of floods. • Increasing temperatures also cause higher evapotranspiration rates and reduce soil moisture, which can offset the impacts of extreme precipitation.
	Extreme Precipitation	• In much of the U.S., the frequency and intensity of extreme precipitation events is projected to increase. • Increases in extreme rainfall cause increased runoff and may cause flash floods, especially impactful in urban areas, which typically have higher populations.
	SLR	• Observed sea level is rising and is anticipated to continue to rise. • SLR, coupled with storm surge and high tides, poses many impacts to USACE's FRM mission and coastal communities. • Increases in nuisance or sunny-day, tidally driven flooding present a hazard to impacted infrastructure and populations. • Coastal storm risk and compound flooding are amplified by rising sea levels and is currently an issue. • SLR may require constructing coastal barrier structures and/or modifying existing structures.
	Flooding	• Some parts of the country show evidence that annual precipitation, extreme storm events, and peak flows are increasing and are likely to continue increasing. • FRM projects continue to be critical for reducing the impacts of flood risk. • Existing FRM projects may experience increased stress due to increases in the frequency, duration, and magnitude of storms and high-water events.
	Wildfire	• Wildfire increases erosion, resulting in sedimentation changes in streams that may change stream flow conveyance characteristics. • Wildfire destroys vegetation cover, reducing capture of precipitation and reducing a basin's evapotranspiration capacity. • Wildfire impacts soil infiltration characteristics. Reduced channel conveyance and decreased loss rates potentially lead to increased runoff.

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
Water Supply	Extreme Temperature	• Increases in extreme temperatures and general warming trends over time, along with increased frequency and magnitude of heat waves, make managing competing water needs a challenge. This is especially true where water supplies rely on snowmelt and where warming trends reduce or eliminate annual snowpacks. • Increased temperatures are projected to increase the frequency, magnitude, and duration of droughts. • Increased water demand, combined with higher evaporative and sedimentation rates, impacts water supply storage, stressing USACE's water supply mission. • Extreme loss of water supply storage also impacts the reliability of water supply infrastructure.
	Extreme Precipitation	• Extreme precipitation causes erosion, leading to increased sediment flow into lakes and reservoirs, thus decreasing their storage volume. • Debris impacts water supply intakes and equipment. • Added stress on infrastructure due to extreme precipitation events (sometimes in short duration) increases risk of flooding/reservoirs reaching capacity.
	SLR	• Sea levels along the coastline are projected to increase and may exacerbate saltwater intrusion into the freshwater water supply. • Reservoir releases, combined with SLR, may increase compound flooding in estuarine environments, particularly during major storm events. • SLR in some locations, such as Hawaii, is also raising the water table and threatening groundwater/water supply.
	Flooding	• Flooding increases bank and bed erosion of sediment loads to reservoirs. Increased sediment loads reduce available storage volume allocated for water supply. • Flood-borne debris impacts water supply intakes and equipment. • The priority of water supply as a Congressionally authorized purpose may be downgraded during flood events for other purposes such as FRM and/or hydropower.
	Wildfire	• Wildfires increase erosion from the landscape, leading to increased sediment flow into lakes and reservoirs, thus decreasing their storage volume. • Debris flowing into reservoirs after wildfires impacts water supply intakes and equipment.

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
Aquatic Ecosystem Restoration and Environmental Stewardship	Extreme Temperature	• Increased ambient air temperatures increase water temperatures, change seasonality, alter snow dynamics, and shift lake stratification and turnover. These lead to water quality concerns, particularly in terms of decreased DO levels and increased water temperatures. • Increased air temperature is associated with the growth of harmful algal blooms and the spread of invasive species. • Changes in air temperature both directly and indirectly influence fish and wildlife by altering things like range, life cycle, and food chain dynamics.
	Extreme Precipitation	• Increased extreme storm intensity and frequency and more prolonged and frequent drought conditions, coupled with greater uncertainty about future conditions, make planning for ecosystem needs difficult. • These conditions also stress USACE's ability to manage invasive species.
	SLR	• SLR increases nuisance flooding, coastal storm risk, and permanent inundation along the coast. • Increased flooding alters coastal ecosystems, including wetlands. This may undermine the critical ecosystem services that natural systems provide. • Saltwater intrusion may modify or destroy existing coastal ecosystems.
	Flooding	• Increases in inundation in coastal zones and potential shifts in inland floodplain dynamics, driven by either higher peak flows or lower low flows, may negatively impact ecosystems.
	Wildfire	• While wildfire at a certain frequency is required to maintain ecosystem dynamics, wildfire poses multiple threats to ecosystem function. • Wildfire may directly destroy habitat while also negatively impacting air and water quality, which could be detrimental to adjacent and downstream ecosystem function. • Increased sedimentation from wildfire could alter water chemistry and flood/floodplain dynamics.

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
Hydropower	Extreme Temperature	• Extreme temperatures increase energy demand, increasing the strain on the energy grid. • Increased air temperatures increase in drought intensity and frequency and evaporation rates, resulting in lower inflows and water levels. Lower water levels reduce the amount of power that hydropower plants can generate. • Increases in water temperatures may influence the operation and performance of hydropower plants.
	Extreme Precipitation	• While annual precipitation totals may not increase in some regions, the distribution of precipitation may become more variable seasonally. Seasons with higher precipitation totals may require bypassing hydropower units to maintain reservoir pool levels, while seasons with lower precipitation totals may limit hydropower production. • Increased river flows may lead to increased power generation; however, projected increases in variability and the uncertainty associated with future conditions may make hydropower as an energy source more unpredictable.
	SLR	• SLR affects the capacity of reservoirs, reducing their ability to store water and impacting a plant's efficiency. • Rising sea levels contribute to an increased risk of coastal flooding. For hydropower plants in coastal areas, rising sea levels inundate infrastructure, submerge turbines, corrode hydropower components, and disrupt operations.
	Flooding	• Flood events may be beneficial for hydropower plants, as increased river flows may lead to increased water available for power generation; conversely, flood events may inundate hydropower infrastructure, submerge turbines, and disrupt operations. • Shifts in the timing of flows due to changes in seasonality and snow dynamics may impact the amount of storable water available for hydropower generation and how it aligns with periods of significant demand.
	Wildfire	• Wildfires in the vicinity of hydropower facilities pose safety concerns for workers. • Wildfires increase sedimentation, reducing the storage capacity of reservoirs. • Increased water temperatures and sediment and debris loads also influence the operation and performance of hydropower plants.

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
Recreation	Extreme Temperature	• USACE has seen increases in visitation during heat waves, causing increased drownings and swift water and downstream rescues; however, as extreme heat increases beyond a certain threshold, this trend may change. • Periods of extreme high heat pose human health concerns. • Higher water temperatures result in harmful algal blooms. • Changes in air and water temperature, seasonality, lake stratification, etc., alter fish and wildlife dynamics. • Periods of low water driven by drought impede access to boat launches and water access points.
	Extreme Precipitation	• Increases in extreme storm events make recreational activity difficult, dangerous, or impossible. • Extreme precipitation leads to flooding and bank/shoreline erosion, which decreases the number of visitors to USACE recreation areas and reduces access to boat launches, piers, and docks, while also posing life safety risks to visitors and recreation staff.
	SLR	• SLR threatens cultural and heritage sites, impacting the cultural and historical experiences that contribute to recreational tourism. • SLR reduces access to shorelines and undermines coastal infrastructure, such as entry points, ports, harbors, and piers. • SLR contributes to loss of shoreline through beach erosion. • Saltwater intrusion into estuaries and coastal wetlands affects aquatic habitats, impacting recreational fishing opportunities.
	Flooding	• Flooding creates hazardous conditions for visitors and employees at USACE-owned/managed recreation sites. • More frequent flooding of sites could deter visitors and reduce access to boat ramps, piers, and dock access points. • Flooding damages recreation areas and their associated infrastructure, making them unusable or out of service for extended periods of time. • Flooding increases shoreline erosion.
	Wildfire	• Wildfire prevents access to, destroys, or damages recreation areas. • Wildfires place visitors and recreation staff at risk. • Wildfire also reduces air and water quality at recreation areas and detrimentally impacts fish and wildlife. • Wildfires undermine the natural beauty that draws visitors to recreation areas.

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
Emergency Management	Extreme Temperature	• Extreme temperatures pose a heat stress-driven health concern, especially in areas where another climate-related emergency is being managed. • Warmer water temperatures increase the potential for waterborne diseases and harmful algae blooms. • The increased risk of waterborne pathogens is compounded by increased precipitation, flooding, and SLR, which increase health safety risks, including emergency endemics and pandemics.
	Extreme Precipitation	• Extreme storm events create emergency situations and disrupt critical infrastructure and utilities. • Extreme storms are capable of intense precipitation, winds, and storm surge in coastal areas and may occur more frequently and be of greater intensity, increasing the need for assistance in disaster response and recovery. • Extreme low precipitation can lead to low river flows and saltwater intrusion, requiring measures to protect municipal drinking water supplies.
	SLR	• SLR amplifies the impacts of coastal floods driven by tropical storms, hurricanes, and cyclones, creating emergency conditions. • Coastal flooding is also intensified when coupled with storm surge, wave conditions, extreme tidal conditions, and/or inland flooding.
	Flooding	• Flooding is one of the most common challenges for USACE emergency management operations, as USACE provides assistance to FEMA in response to federally declared flooding emergencies. • In some regions, including coastal areas already impacted by SLR, more frequent and larger magnitude storms result in higher instances of flood events. • Increases in flood frequency strain the federal agencies responding to these emergencies.
	Wildfire	• Wildfires frequently necessitate an emergency response and result in large areas of land and property being destroyed. • After a wildfire, the denuded landscape poses an increased flood risk, affecting critical public infrastructure such as floodways and roadways and water treatment facilities. • Wildfire poses a major life safety and human health risk. • The frequency and intensity of wildfires is projected to increase.

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	**Identified Climate Hazard**	**Description**
Regulatory	Extreme Temperature	• USACE's Regulatory Program (permitting) evaluates permit applications for essentially all construction activities in the nation's waters, including wetlands. Extreme temperatures, particularly heat waves, change water availability and quality. Permits for constructing or modifying structures such as water intakes and outfalls may need to account for variations in water levels during periods of extreme heat or drought. • Extreme temperatures and drought result in more frequent wetland drying and soil structure changes. Additionally, warming changes the timing and amount of water that wetlands receive from snowmelt. Changes in wetland dynamics might result in the need to modify existing policies or procedures.
	Extreme Precipitation	• Assessments developed during regulatory review may need to account for impacts from extreme precipitation events, such as changes in hydrological regimes, potential habitat loss, and the impact on vulnerable species. • Permits related to constructing and maintaining infrastructure need to account for the challenges of working in wetter conditions.
	SLR	• SLR changes wetland boundaries and coastal landscapes through inundation, saltwater intrusion, and shoreline erosion. • Over time, shifts in water levels and the extent of tidal influence may change the identified boundaries of jurisdictional Waters of the United States (WOTUS). • Permitting reviews would need to consider the influence from SLR.
	Flooding	• Potential increases in future flooding have similar impacts on USACE's Regulatory Program as those described for extreme precipitation and SLR. • Some wetlands may become wetter, and others may experience prolonged water levels too deep for current plant species to survive. These impacts may at times require further analysis during the National Environmental Policy Act (NEPA) and permitting process. • The USACE Regulatory Program administers the Clean Water Act Section 404 program, which regulates the discharge of dredged or fill material into WOTUS, including wetlands. Flooding may necessitate emergency response measures, so USACE may need to expedite permitting processes while ensuring environmental safeguards are in place (USACE regulations contain emergency permitting procedures for expedited response to these types of situations).
	Wildfire	• Wildfires lead to vegetative loss, increase erosion and sedimentation, change soil structure (including soil moisture), and change hydrologic response. • Wildfires negatively impact wetlands and riparian areas and catalyze shifts in hydrologic regime. • "Emergency situations" after a fire necessitate expediting permits to discharge dredged or fill material into WOTUS to respond to current and imminent threats. Emergency permitting procedures are available to facilitate a timely response. • After the emergency phase passes, permit applications may need to consider post-wildfire conditions.

Climate change poses significant challenges to USACE missions: navigation, FRM, water supply, aquatic ecosystem restoration (AER), hydropower, recreation, emergency management, and regulatory. The impacts of extreme/warming temperatures, extreme precipitation, SLR, flooding, and wildfires are multifaceted, influencing the planning,

execution, and success of USACE missions.

Navigation. Rising temperatures cause more frequent drought and lower water levels, impacting the navigability of U.S. waterways. Extreme rainfall events, SLR, and flood events impede navigation, particularly in coastal zones. Climate-driven flood events and wildfire may damage critical navigation infrastructure, requiring emergency response and recovery efforts. Extreme precipitation, flooding, and wildfires lead to sedimentation and debris in rivers, impacting navigation channels. Increased sedimentation may require adjustments in dredging and survey operations. SLR influences tidal dynamics and saltwater intrusion, particularly in estuarine environments, causing added wear on coastal infrastructure.

Flood Risk Management. Increased precipitation intensity and variability contribute to heightened flood risks and compound hazards. USACE FRM efforts may need to account for changing precipitation patterns and anticipate more frequent and severe flood events. Rising temperatures influence snowpack accumulation and melting patterns, affecting river flows and the timing of peak runoff. This temperature change influences FRM strategies. SLR elevates the risk of coastal hazard impacts and flooding, necessitating enhanced coastal protection measures. USACE must consider SLR coupled with other environmental stressors in designing and maintaining flood control infrastructure. Wildfires lead to increased runoff and flash floods in burned areas, influencing FRM.

Water Supply. Extreme temperatures impact water availability and demand. Warmer temperatures may increase evaporation rates, affecting reservoir storage and water supply reliability. Altered precipitation patterns shift the timing and magnitude of water availability. Extended droughts and changes in snowpack affect water supply planning. SLR contributes to saltwater intrusion into freshwater sources, impacting water availability. USACE must consider these effects in managing water supply infrastructure. Increased wildfire frequency causes higher sediment loads and decreases water quality that sustains lake ecosystems. Additionally, debris and sediment from wildfires damages water supply infrastructure.

Aquatic Ecosystem Restoration and Environmental Stewardship. Temperature changes impact the structure and function of ecosystems and USACE's ability to manage, conserve, and protect natural resources. For instance, warmer temperatures increase harmful algae blooms and the spread of invasive species. More frequent extreme precipitation events, shifts in drought frequency/intensity, changes in wildfire dynamics, SLR, and flood events all significantly impact ecosystems. For example, altered precipitation patterns affect wetland hydrology and impact the success of aquatic ecosystem restoration projects. Drought conditions may hinder the establishment of vegetation. Coastal aquatic ecosystem restoration projects face challenges from SLR, impacting the viability of restored habitats. Creating more resilient and adaptive aquatic ecosystem restoration strategies is essential in the face of changing conditions and increasing climatic uncertainty. Flooding disrupts restoration efforts, while wildfires may destroy restored habitats. USACE must implement resilient restoration designs to withstand these hazards. Trends for all climate variables could result in invasive species proliferation, which is a common challenge to USACE's aquatic ecosystem restoration mission. Future climate scenarios must be considered when planning AER project goals, objectives, and success criteria to avoid setting goals/objective/criteria that are unobtainable and might otherwise require endless chasing of ever-moving targets. As USACE moves to consider the effects of its non-AER missions on ecosystem goods and services, implications of climate hazards on these services should also be considered (i.e., demand for and supply of reliable and predictable service delivery).

Hydropower. As temperatures increase, energy demand is likely to increase. Increases in the frequency and duration of drought conditions may reduce water availability for power production. Higher temperatures also result in earlier snowmelt, resulting in less water being available to meet late-season (summer) hydropower demand. Extreme precipitation events are expected to increase in intensity and frequency. Flooding after heavy rains may threaten the structural integrity of hydropower facilities and/or disrupt operations. SLR poses similar risks to coastal hydropower infrastructure. Wildfires impact power transmission lines and damage or destroy hydropower infrastructure, either directly or via increased sediment and debris loads.

Recreation. USACE is one of the nation's leading federal providers of outdoor recreation with more than 400 lake and river projects. Visitors enjoy activities like hiking, boating, fishing, camping, and hunting. While increases in temperature typically result in increased visitation to USACE recreation areas, extreme increases in temperature could result in a reduction in visitors and increases in heat-related safety risks to both visitors and staff. Warmer water temperatures result in declining ecosystems, negatively impacting fish and wildlife. Low water levels caused

by increases in drought frequency and intensity reduce access to boat ramps, docks, etc. Increased precipitation intensity more frequently disrupts outdoor recreation and reduces access to and damages recreational facilities. As a result of SLR, coastal sites face the risk of permanent or more frequent inundation, changes in fish and wildlife habitat, and shoreline erosion. Wildfires damage recreational infrastructure and present a safety risk to staff and visitors. Adaptation strategies are needed to maintain and effectively operate USACE's recreational facilities. Emergency management and recovery efforts are crucial for restoring recreational amenities after severe weather, flooding, or wildfire.

Emergency Management. Since extreme temperatures influence the intensity and frequency of heat waves, emergency management plans must consider health impacts driven by warming temperatures including increases in waterborne disease and harmful algae blooms. Intense precipitation events contribute to flooding emergencies. SLR increases the risk of coastal storm hazards, infrastructure damages, and flooding emergencies. Emergency management plans must account for the potential displacement of communities and critical infrastructure. Flooding and wildfires are primary drivers of life safety risk and emergency situations. USACE is involved in planning, response, and recovery efforts for these hazards, requiring coordination with other agencies. USACE also plays a key role in emergency response efforts, including water management, flood response technical and direct assistance to tribal and state agencies, infrastructure repair, and assistance to the Department of Homeland Security.

Regulatory. USACE's Regulatory (permitting) Program evaluates permit applications for essentially all construction activities that occur in the jurisdictional waters of the U.S., including wetlands. This includes emergency response permits and facility/infrastructure recovery and repair post-disaster. Increasing temperatures influence soil characteristics, snowmelt dynamics, and water quantity, having substantial impacts on aquatic ecosystems. Altered precipitation patterns affect stormwater runoff. Increases in flood frequency are also driven by more frequent and intense rainfall events. Newly inundated areas produced by SLR and shifts in flood/drought dynamics may affect the boundaries of U.S. jurisdictional waters. Saltwater intrusion driven by SLR impacts aquatic habitats. Increases in wildfire frequency shift hydrologic response and ecosystem dynamics. Flooding and wildfires prompt emergency permitting needs. The USACE Regulatory Program is flexible and adapts to changing circumstances, fulfilling its mission to protect the nation's aquatic resources while allowing reasonable development through fair, flexible, and balanced permit decisions.

Climate change hazards present complex challenges for USACE across its diverse missions. Adaptive strategies, resilience planning, and collaboration with various stakeholders are essential to navigate the evolving impacts of extreme temperature, extreme precipitation, SLR, flooding, and wildfires on water resources and infrastructure. USACE must continue to integrate climate change considerations into its planning and decision-making processes to fulfill its crucial roles in the nation's water resource management and environmental stewardship.

2E. Impacts from and Exposure to Drought

CLIMATE HAZARD EXPOSURE TO DROUGHT		RCP 4.5 2050 (MID-CENTURY)	RCP 4.5 2080 (LATE CENTURY)	RCP 8.5 2050 (MID-CENTURY)	RCP 8.5 2080 (LATE CENTURY)
% of reservoirs located in areas projected to be exposed to an increase in the annual maximum number of consecutive dry days		96.9%	96.9%	95.7%	98.3%
Annual maximum number of consecutive dry days statistics	Range	8.6 to 148.2	8.8 to 147.3	8.8 to 151.4	9.6 to 156.5
	Average	23.9	24.1	24.3	25.6
% of reservoirs located in areas projected to be exposed to decreasing mean annual inflows		40.1%	49.6%	38.4%	40.1%
% of reservoirs located in areas with projected aridity values less than 0.65 (indicative of arid climate)		11%	11.5%	8.6%	17.4%

CLIMATE HAZARD EXPOSURE TO DROUGHT	RCP 4.5 2050 (MID-CENTURY)	RCP 4.5 2080 (LATE CENTURY)	RCP 8.5 2050 (MID-CENTURY)	RCP 8.5 2080 (LATE CENTURY)
% of reservoirs located in areas with projected aridity values decreasing from baseline (indicative of increasingly arid climate)	100%	99.8%	91.2%	100%
% of reservoirs located in areas projected to be exposed to an increase in drought year frequency	99.5%	100%	100%	100%
% of reservoirs located in areas projected to be exposed to an increase in flash drought frequency	99.8%	99.5%	99.5%	97.1%

Extreme drought has been an increasing trend across the U.S. over the past several decades and is recognized as a hazard that contributes to vulnerability for USACE and its large portfolio of water resources infrastructure, including multi-purpose reservoirs. Highlighting the criticality of this hazard, the Assistant Secretary of the Army for Civil Works (ASW(CW)) issued a policy memorandum in July 2022 focused on Army CW programs supporting drought resilience across America's communities. In addition to discussing the impacts of drought on communities and USACE projects, the memorandum also discusses many of the strategies USACE has employed to overcome the challenges of extreme drought and directs USACE to provide a comprehensive brief to the ASA(CW) on the ongoing, planned, and potential additional CW actions to ensure community resilience to drought at local and regional scales.

The drought hazard is evaluated at USACE reservoirs, where vulnerability to drought is critical, using historic and projected consecutive dry days (CDDs), based on Localized Constructed Analogs (LOCA)-downscaled Coupled Model Intercomparison Project Phase 5 (CMIP5) Global Climate Model (GCM) outputs. Gridded geospatial data representing annual maximum number of CDDs over each 30-year epoch (historic baseline [1975–2005], mid-century [2036–2065], and late-century [2070–2099]) was provided by CEQ as supplementary information. The gridded annual maximum CDDs information is developed by the National Climate Organization and provided through the Climate Mapping for Resilience and Adaptation portal. The maps in Appendix C illustrate the exposure of drought risk throughout each epoch-scenario.

The Western U.S., especially the Southwest, experiences the highest number of annual maximum CDDs. Climate model projections project that the highest values will continue to be in the Western U.S., increasing in the northeastern direction from the Southwest. This observation of the climate projections does not imply that the Southwest is the only area of the U.S. that will be impacted by drought. Large percent increases in the annual maximum CDDs are projected in the Great Plains, the Pacific Northwest, and the Ohio River Valley for all epoch-scenarios while some of these same regions may see increases in extreme precipitation during portions of the year.

Annual maximum CDDs is only one indicator of drought hazard risk. For instance, mean annual streamflow (MAF), aridity, drought year frequency (DYF), and flash drought frequency (FDF) are other drought indicators used for screening level risk assessments. For this assessment, USACE utilized the DCAT climate projection database to qualitatively evaluate these other indicators. As depicted in the drought exposure maps in Appendix B, the upper Colorado and Rio Grande River basins and the northern portions of the Mountain West are projected to see the largest decreases in MAF, the greatest contributing indicator to the drought hazard according to DCAT. The lower Mississippi River basin, Gulf Coast, and headwaters of the Ohio River basin, critical areas for USACE missions such as navigation, hydropower, and flood risk management, are also projected to see significant decreases in MAF. For aridity, smaller values indicate greater aridity with arid climate zones represented by values less than 0.65. The Western U.S. and Florida are projected to have the greatest exposure to aridity. DYF is expected to increase across the Southwest with very high increases in the Western and Southern U.S. for the RCP 8.5 late century epoch-scenario. FDF is expected to increase broadly across the U.S. with higher occurrences of FDF in the Great Basin and Great Plains regions. For the RCP 8.5 late century epoch-scenario, higher FDF occurrences are projected for the Great Lakes region and portions of the east coast.

Drought profoundly impacts USACE activities across various areas. Drought disrupts water management efforts by diminishing water availability in reservoirs and rivers managed by USACE, affecting tasks like flood control, navigation, and aquatic ecosystem restoration. Drought impacts hydropower generation as reduced water levels and flows impede the capacity of hydroelectric power plants operated by USACE, potentially leading to power generation reductions or shutdowns. Navigation, which already experiences drought-related impacts, becomes challenging or impossible due to decreased water levels in rivers and channels, prompting USACE to undertake dredging operations or impose restrictions on vessel traffic to ensure safe navigation. AER is a primary USACE mission. Drought could result in adverse ecological impacts like habitat degradation and fish kills, necessitating USACE to implement measures to mitigate these effects, such as releasing water from reservoirs to maintain minimum flows or conducting AER projects to make ecosystems more resilient. Drought also strains water supply infrastructure, including dams, reservoirs, and treatment facilities, leading USACE to implement emergency measures to ensure continued water supply to communities, industries, and agriculture.

While USACE meets the challenges currently posed by drought through its policies, programs, and operations of reservoirs, the location and severity of drought are anticipated to become broader and more extreme, respectively, based on the parameters evaluated through this assessment. USACE will use a comprehensive, coordinated strategy, developed in response to the ASA(CW) drought policy memorandum, to apply its missions and capabilities to address the impacts of drought and to build drought resilience in alignment with the White House Resilience Interagency Working Groups and the USACE Climate Adaptation Plan priorities.

Section 3: Implementation Plan

3A. Addressing Climate Hazard Impacts and Exposures

3A.1 Addressing Climate Hazard Exposures and Impacts Affecting Federal Buildings

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD IMPACTS ON AND EXPOSURE OF FEDERAL BUILDINGS[10]		
Climate Hazard Impact on and/or Exposure of Federal Buildings	**Priority Action**	**Timeline for implementation (2024–2027)**
All Climate Hazards	Perform enterprise-wide vulnerability assessment of USACE building portfolio.	• Complete assessment – Fiscal Year (FY) 2024 (FY24). • Conduct future assessments on five-year interval.
All Climate Hazards	Integrate climate vulnerability assessments and hazard-specific plans into the Strategic Asset Management Plan.	• Update Strategic Asset Management Plan (FY27 or sooner depending on update to current management plan).
All Climate Hazards	Develop climate-informed design standards or update existing design standards as necessary to include climate-resilient designs.	• Evaluate existing design standards to prioritize needs (FY24). • Develop/Update standards based on prioritization (FY25–27).
All Climate Hazards	Coordinate with the managing federal agencies where USACE leases buildings/ office space.	• Establish dedicated liaisons with federal agencies responsible for USACE office leases. • Include assessing climate impacts to leased USACE building/office space to the USACE POCs who liaise with managing federal agencies.
Flooding and SLR	Develop an overall flood mitigation plan in concert with the overall vulnerability assessment of the USACE building portfolio.	• Develop flood mitigation plan (FY25).
Wildfire	Develop an overall wildfire mitigation plan in concert with the overall vulnerability assessment of the USACE building portfolio.	• Develop wildfire mitigation plan (FY25).
Extreme Temperature and Precipitation	Implement smart building technologies to monitor temperature, precipitation, and other environmental parameters critical to building function.	• Investigate potential technologies for investment (FY25). • Develop an implementation plan for smart building technologies (FY26).

10 Supports the requirements of Office of Management and Budget (OMB) M-24-03, Advancing Climate Resilience through Climate-Smart Infrastructure Investments and Implementation Guidance for the Disaster Resiliency Planning Act.

USACE's building portfolio of almost 23,000 buildings at 1,575 sites in CONUS, Alaska, and Hawaii includes business offices, satellite offices, and field offices. USACE buildings are currently impacted by various natural hazards. Some of the primary natural hazards affecting USACE buildings include: extreme weather events, flooding, extreme heat, drought, wildfire, storm surge, and erosion. The specific impact of natural hazards on USACE buildings depends on factors such as location, building design, and the intensity of the hazard event. The actions provided in the 3A.1 table are summarized below to provide additional context.

Current USACE Climate Resilience Approach

USACE continually engages in efforts to assess vulnerabilities, implement resilience measures, and develop emergency response plans to mitigate the impacts of natural hazards on its buildings and infrastructure. USACE took a proactive approach to understanding vulnerabilities and resilient design by developing CWVAT, the Corps Project Exposure Tool (CorpsPET), and the Comprehensive Evaluation of Coastal Hazard due to Sea Level Change (CESL) approach and by acting as a primary developer of DCAT. These tools are part of a suite of USACE CPR tools and resources that provide climate exposure and vulnerability assessments of USACE assets including projects, studies, and infrastructure.

In March 2015, the Chief of Engineers established USACE's Resilience Initiative. This initiative updates USACE's standards and criteria to reflect the latest actionable risk-informed decision-making practices for improved project resilience and provides greater support to community resilience both locally and through national policies. In August 2022, USACE published the USACE Civil Works Strategic Asset Management Plan, which focuses on six policy goals: Cross-Functional Integration; Asset Information Standards; Maintenance; Investment Criteria; Investment Recommendations; and Investment Planning. The Civil Works Asset Management System framework synthesizes guidance, provides tools, and drives practices to optimize value from CW's portfolio of physical assets.

As an agency responsible for operating and maintaining a portfolio of water resources infrastructure and planning, designing, and constructing public water resources infrastructure, USACE has always focused on resilience to natural hazards. In 2014, USACE established the USACE CPR CoP to specifically focus on developing practical, nationally consistent, and cost-effective approaches and policies to reduce potential vulnerabilities to the nation's water infrastructure resulting from climate change and variability.

Building Resilience Implementation Summary

USACE has a range of options available to improve the resilience of its buildings and structures in the face of climate change and other potential hazards. Resilience involves the ability of infrastructure systems to anticipate, prepare for, respond to, and recover from disruptive events. Generally, to meet the challenges of projected climate impacts on its building portfolio, USACE needs to enhance and extend its current CPR approach.

- **Vulnerability Assessments** – While USACE currently conducts climate change vulnerability assessments for planning studies, projects, budget work package submittals, and on an ad hoc basis, the agency has yet to complete a comprehensive vulnerability assessment of USACE-owned buildings and structures. The results of the proposed portfolio-wide vulnerability assessment, coordinated with federal agencies like GSA where USACE leases space, should be incorporated into the Civil Works Asset Management System to determine where detailed analyses employing more advanced approaches and software are needed. By incorporating Climate Change Vulnerability Assessment results into the Civil Works Asset Management System, results effectively support life-cycle performance through cross-functional integration, asset information standards, maintenance, and resilience-informed investment strategies.
- **Climate-Informed Design Standards** – In 2016, USACE published its most recent Resilience Initiative Roadmap (RIR) per Executive Order (EO) 13653, Preparing the U.S. for the Impacts of Climate Change. The RIR serves as the agency's roadmap to implement several key resilience-related strategies. Strategy 1 of the RIR is to "Evolve USACE Resilience Practices." Although USACE made progress ensuring that each USACE project/system being designed/delivered includes baseline resilience, a similar strategy should be applied to the agency's portfolio of buildings and structures. To accomplish this, USACE will identify ways to incorporate resilient practices into building design standards and include a climate-informed design framework in updated policies. USACE will also conduct a review of existing applicable standards to make updates and/or identify areas where new policy and guidance is required.

- **Sustainability and EO 14057 –** USACE is strategically aligning with EO 14057, Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, to achieve 100% carbon pollution-free electricity (CFE) by FY30, as outlined in the 2022 USACE Sustainability Plan. The approach involves a dual focus on on-site CFE and purchased CFE, emphasizing renewable sources such as new solar or wind projects and incremental hydropower. Prioritization for on-site CFE considers factors like balancing authority, viability, site suitability, and alignment with EJ initiatives, with attention to life-cycle costs. While these efforts are primarily focused on climate mitigation through reducing GHG emissions, on-site generation of CFE can also increase resilience to power outages including those caused by extreme weather events.

The priority actions identified in this section directly support the requirements of the Office of Management and Budget (OMB) M-24-03, Advancing Climate Resilience through Climate-Smart Infrastructure Investments and Implementation Guidance for the Disaster Resiliency Planning Act. So that USACE buildings and structures are resilient to the natural and climate hazards identified in Section 2, USACE will incorporate vulnerability assessments into an asset management system framework to develop and execute a responsible investment strategy. USACE will also focus on sustainability, including energy and water conservation and moving toward CFE.

3A.2 Addressing Climate Hazard Exposures and Impacts Affecting Federal Employees

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD IMPACTS ON AND EXPOSURE OF FEDERAL EMPLOYEES		
Climate Hazard Impact on and/or Exposure of Federal Employees	**Priority Actions**	**Timeline for implementation (2024–2027)**
Extreme Temperature	Augment existing training materials on heat safety with regional estimations of projected extreme temperatures.	• Evaluate and update training material (FY24).
Extreme Weather Events **Wildfire** **Flooding**	Incorporate climate considerations into personal employee emergency response planning materials through collaboration with the safety office.	• Develop/Update employee emergency response planning materials (FY25).
All Climate Hazards	Expand Climate 101 training to educate employees across the USACE organization on topics that provide general overviews of climate hazards.	• Expand various components of Climate 101 training (FY25–27).
All Climate Hazards	Improve climate resilience in communities where USACE employees reside by facilitating climate resilience planning through USACE planning authorities (e.g., floodplain management services and Silver Jackets) and upon request of state, local, tribal, or territorial entities.	• Ongoing and continuous.

To effectively address climate impacts, USACE must continue to build a culture that values and supports innovative thinking around climate change. This culture must extend to the agency's greatest asset, its people. The workforce of the future requires knowledge and skills to address the challenge of climate change at work and home to provide the public services enhancing community resilience, while also understanding the hazards to themselves and their families. USACE must transition from viewing knowledge of climate change and related issues as a specialized discipline to recognizing it as a fundamental component of all USACE decision-making and actions.

USACE, like all federal agencies, is subject to Occupational Safety and Health Administration (OSHA) regulations that include provisions for protecting workers from various workplace hazards, including those related to extreme weather conditions. These regulations may cover issues such as heat stress, cold stress, and other weather-related risks. USACE has policies, guidance, and regulations in place to address employee protection from extreme weather events. USACE manages its own Safety and Occupational Health Office that provides policy, programs, technical

services, oversight, and outreach related to safety and occupational health matters to safeguard the well-being of its employees. This program may include specific guidance on working in adverse weather conditions and protective measures. USACE's Engineer Manual (EM) 385-1-1, Safety and Occupational Health Requirements, defines the requirements, processes, and procedures to provide a safe workplace. EM 385-1-1 establishes safety roles and the precautions and actions to take in the event of a severe weather event and strategies to monitor for and combat the effects of extreme heat.

USACE develops emergency response plans to address various scenarios, including those related to extreme weather events. These plans outline procedures for employee safety, evacuation, and emergency response in the event of severe weather conditions. USACE offices and installations typically have local safety policies and guidelines in place that consider the specific weather risks in their regions. These policies may address issues such as hurricanes, tornadoes, floods, or extreme temperatures.

USACE employs various communication and notification systems to disseminate effective and timely information to its personnel. USACE uses the Department of Defense (DoD) Alert Mass Notification System to alert employees of natural disasters like extreme weather events, critical events, and urgent situations based on geographic proximity of personnel to the critical event. DoD Alert provides two-way communication allowing personnel to acknowledge receipt of alerts. USACE also employes the U.S. Army Disaster Personnel Accountability and Assessment System (ADPAAS), which standardizes a method for the Army to account, assess, manage, and monitor the recovery process for personnel and their families affected and/or scattered by a wide-spread catastrophic event. ADPAAS provides valuable information to all levels of the Army chain of command, allowing commanders to make strategic decisions that facilitate a return to stability. ADPAAS allows Army personnel to do the following: report accounting status, update contact information, provide location information, complete a needs assessment, and view reference information. These systems are tested and used as part of training exercises on a regular basis.

Education is the most critical step to enabling a resilient workforce. USACE provides training and awareness programs to educate employees about the risks and hazards associated with heat stress, extreme weather events, flooding, and wildfire and the preventive measures they should take to protect themselves. USACE's safety hazard training program continues to improve by engaging USACE social scientists to develop multi-tiered, innovative communication tools and training plans that support integrating climate change concepts to inform the workforce on the impacts of climate hazards, which in many cases will vary regionally. The expected outcome is an educated workforce that understands current and future climate risks and how these risks may impact their professional roles and personal safety.

USACE focuses on all aspects of employee safety, including the hazards that are and will be associated with climate change; therefore, USACE is already implementing many of the actions that prepare its employees for the impacts of climate change. However, the standard practices already implemented can be enhanced and new practices can be developed to improve employee resilience professionally and personally. More specific details of the actions outlined in the 3A.2 table include:

- **Maintain a robust employee alert system**. The existing systems need to be continuously maintained and tested through exercises.
- **Training**. USACE should continue to train and educate its employees on the impacts of climate-driven hazards like heat stress, extreme weather, high water, and wildfire so that employees perform their jobs safely. In addition to USACE's traditional safety and occupational health training program, USACE should provide comprehensive training programs targeted at educating agency employees on the impacts of climate change and how it might change the environments in which they live and work. Changes in the hazards people might face in terms of severity and frequency should be emphasized, as well as actions to reduce vulnerability (e.g., resilient infrastructure construction, monitoring, emergency management, adaptive management, and personal safety).
- **Emergency response planning**. USACE must continue to enhance emergency response planning to include climate-related scenarios. Training on emergency protocols is also critical to ensure plans are in place to protect both personnel and critical infrastructure during extreme events including extreme storms, hurricanes, floods, and wildfires. As part of this action, USACE must also promote personal emergency response planning to

provide employees with the tools to protect themselves and their families.

- **Employee wellness programs**. USACE should continue to implement wellness programs that address physical and mental health increasing employee resilience to climate-related stressors (e.g., damage to personal possessions due to extreme storms/wildfire/flooding, trauma related to serving as part of USACE's emergency response mission). USACE's robust Employee Assistance Program (EAP) offers counseling services, financial assistance, and other support mechanisms for employees facing personal or professional challenges.
- **Community engagement and support**. USACE should facilitate community engagement initiatives, especially in the communities in which employees reside, that allow USACE employees to contribute to local resilience efforts. This fosters a sense of purpose and community support during climate-related challenges.

USACE's employees are its most important asset, which is one of the reasons USACE focuses so heavily on safety. The effects of climate change present increasing and new safety challenges to USACE. To address future safety risks, climate change-induced hazards must be tackled by taking effective and proactive action.

3A.3 Addressing Climate Hazard Exposures and Impacts Affecting Federal Lands, Waters and Associated Cultural Resources

TYPE OF LAND OR WATER ASSET: USACE LANDS AND WATERS (APPROXIMATELY 12 MILLION ACRES)	
Climate Hazard Impact on and/or Exposure of the Asset: ☑ Extreme Temperature ☑ Extreme Precipitation ☑ SLR ☑ Flooding ☑ Extreme Weather Events ☑ Wildfire ☑ Coastal Flooding ☑ Drought	
Priority Actions	**USACE Lakes and Reservoirs** • Continue to use and maintain web-based portals such as the Reservoir Sedimentation Portal (also used by the U.S. Bureau of Reclamation [USBR]) and Access to Water (for pool elevation, precipitation, flow status, and water control manuals [WCMs]) to make USACE data public. • Continue to maintain WCMs and drought contingency plans (DCPs) to facilitate monitoring. • Screen existing USACE project sites for climate-driven vulnerabilities using indicators tied to climate projections (CWVAT), as well as the CESL (where applicable). • Reduce extreme weather disruptions at projects by updating WCMs, DCPs, and natural resources management guides to reflect climate as it changes. **USACE Lands** • Screen existing USACE project sites for vulnerabilities using indicators tied to climate projections (CWVAT), as well as the CESL (where applicable). • Continue implementing the Sustainable Rivers Program (SRP) to further demonstrate that a strategic and science-based approach at USACE reservoirs maintains or enhances the environmental benefits and reduces negative environmental consequences of downstream flows. • Continue applying USACE's Environmental Operating Principles, developed so that USACE missions totally integrate sustainable environmental practices, which directly applies to how USACE manages, conserves, and protects natural and cultural resources at USACE-operated projects.

TYPE OF LAND OR WATER ASSET: USACE LANDS AND WATERS (APPROXIMATELY 12 MILLION ACRES)	
Climate Hazard Impact on and/or Exposure of the Asset: ☑ Extreme Temperature ☑ Extreme Precipitation ☑ SLR ☑ Flooding ☑ Extreme Weather Events ☑ Wildfire ☐ Coastal Flooding ☑ Drought	
Priority Actions	**USACE Lakes and Reservoirs** • Apply best practices for shoreline resilience of reservoirs, as vegetation adapts to changes in water level and salinity. **USACE Lands** • Expand use of unmanned aerial vehicles (UAVs) and remote-controlled vessels to collect sedimentation and other information faster and more cheaply, providing insight into sedimentation changes as climate changes. • Develop and deliver workshops on appropriately applying natural and nature-based features that may display some degree of self-adaptation to climate changes but also entail specific climate-related considerations. • Apply best practices for floodplain resilience. • Consider future climate change impacts when developing long-term aquatic ecosystem restoration strategies. • Consider including climate change in existing habitat models to assess impacts on species.
TYPE OF LAND OR WATER ASSET: ARCHAEOLOGICAL SITES, SACRED SITES, TRADITIONAL CULTURAL PLACES, HISTORIC BUILDINGS AND STRUCTURES	
Climate Hazard Impact on and/or Exposure of the Asset: ☑ Wildfire	
Priority Actions	• As necessary and able, provide information to help avoid sites and areas that might be sensitive to cultural resources during firefighting. • During and subsequent to wildfire events, take steps to minimize effects of increased erosion resulting from the loss of vegetation on protected sites. • Subsequent to wildfire events, visually inspect the affected areas to determine any effects to cultural resources.
TYPE OF LAND OR WATER ASSET: ARCHAEOLOGICAL SITES, SACRED SITES, TRADITIONAL CULTURAL PLACES, HISTORIC BUILDINGS AND STRUCTURES	
Climate Hazard Impact on and/or Exposure of the Asset: ☑ Extreme Temperature ☑ Extreme Precipitation ☑ SLR ☑ Flooding ☑ Coastal Flooding ☑ Drought	
Priority Actions	• Use technology, such as drones, to monitor shoreline erosion, which may be related to effects of extreme heat, drought, extreme precipitation, SLR, and flooding (riverine and coastal). • Subsequent to flood events, visually inspect affected areas to determine any adverse effects to cultural resources. • Where erosion is having an adverse effect, consider protective measures, such as the placement of fill or stone.

USACE is actively managing lands and waters for CPR in alignment with EO 14057. The initiative, led by the Directorate of Civil Works at Headquarters USACE (HQUSACE) and supported by key stakeholders, aims to increase the resilience of USACE-managed water resources, natural resources, ecosystems, and the associated communities and economies to SLR, extreme weather, and changing climate conditions.

With over 400 lake and river projects across 43 states, covering 12 million acres of public lands and waters, USACE recognizes the significance of taking proactive management action in response to climate change as illustrated through the environmental stewardship business line and the Environmental Operating Principles. The overall objective of USACE's current lands and water management approach is to reduce recovery costs and minimize impacts on USACE mission readiness. This 2024–2027 CAP is an opportunity to enhance ongoing management practices by incorporating more climate change adaptation while aligning with climate change mitigation goals.

The scale of the effort is national, addressing the diverse portfolio of USACE-managed resources. The timeframe is ongoing. Actions include regularly revising project Water Control Manuals (WCMs), updating project Master Plans, leveraging drought periods for cost-effective remote sensing surveys, conducting vulnerability assessments, continuously maintaining and improving the Reservoir Sedimentation and Access to Water portals, and generating an inventory of projects requiring Drought Contingency Plans (DCPs). Per the 2021 Climate Action Plan, an inventory of WCMs and DCPs and an intermediate climate vulnerability assessment of project sites was performed. Performance actions for priority actions include confirming that 100% of WCM and DCP updates incorporate climate change considerations by FY25 and publishing 100% of Water Control Manuals in Access to Water by FY25. Additional performance actions include an update to the CWVAT and the Comprehensive Evaluation of Projects with Respect to Sea Level (CESL) tool in FY24; updated vulnerability assessments of USACE lands, waters, and pertinent components by FY25; and development of Nature-Based Solutions (NBS) guidance in FY24.

Proposed implementation methods include using web-based portals for public data access, expanding deployment of unmanned aerial vehicles (UAVs) and remote-controlled vessels for efficient data collection, presenting workshops on NBS application, sharing best practices for shoreline resilience, including climate change in habitat models, conducting vulnerability assessments of USACE project sites, implementing the Sustainable Rivers Program (SRP), and incorporating climate adaptation into WCMs, DCPs, and natural resources management guides.

Archaeological sites, sacred sites, traditional cultural places, and historic buildings and structures within USACE lands and waters are susceptible to climate change-driven hazards including wildfire, extreme temperature, flooding, SLR, and extreme precipitation. To monitor sites and protect against these hazards, Districts developed a variety of strategies to identify impacts and recommend and implement remedies for adverse effects. Districts use a variety of techniques to monitor for the effects of climate change. For instance, drones track erosion following a period of prolonged drought or after an extreme event. Where adverse effects are identified, protective measures may be recommended, such as the placement of fill or stone to protect sites from further damage.

Managing USACE lands and waters for CPR while aligning with climate mitigation goals continues to be one of the agency's highest priorities. By implementing these priority actions and continuing the efforts already undertaken, USACE will prioritize climate resilience of its natural resources by mainstreaming climate adaptation into all USACE mission areas.

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Each of the efforts identified highlight program aspects that strengthen the climate resilience of natural resource assets.	
Natural Resources Program Management	To further promote effective and efficient management of USACE's natural resource assets, the program developed a 10-year strategic plan. The plan integrates the management of diverse cultural and natural resource components such as fish, wildlife, forest, wetlands, grasslands, soils, and water with providing recreational opportunities to the public.

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Each of the efforts identified highlight program aspects that strengthen the climate resilience of natural resource assets.	
Natural Resource Conservation	USACE recently issued revised an invasive species policy focused on restoring habitat to remove and prevent re-establishment of invasive species and to promote native, resilient ecological communities. USACE is also finalizing a strategic plan focused on invasive species management. The plan identifies an overarching framework for the broad spectrum of activities that are performed by USACE, nationwide. The strategies reflect both work that is ongoing and opportunities to focus on emerging priorities affecting ecological connectivity and wildlife corridors.
Species Conservation	USACE supports species conservation through efforts such as Migratory Bird Best Management Practices (BMPs), which include considerations for ecological connectivity and wildlife corridors. USACE continues to support collaborative partnerships that promote restoration, conservation, and enhancement of fish, forest, and wildlife habitats. For example, many USACE lakes fall along the central core of the migration pathway for the endangered whooping crane. USACE, is actively managing and researching methodologies to maximize the availability of suitable critical stopover habitat for this species.
Habitat Conservation	USACE furthers habitat conservation through both terrestrial and aquatic measures. USACE work includes managing over 25,000 acres of pollinator-specific habitat. The number of actively managed acres continues to grow, as engagement with partners supports federal initiatives to provide critical habitat for a variety of pollinator species.
Sustainable Recreation Facilities	The USACE Recreation program is supporting sustainable recreation facilities by improving energy and water use efficiency and supporting long-term resilience by ensuring that facilities and infrastructure can withstand increases in climate-driven hazards such as floods, fires, and extreme storms.
Sustainable Rivers Program	In partnership with The Nature Conservancy, the SRP focused on improving the health and life of rivers by changing infrastructure operations. In 2022 and 2023, the program engaged 10 new river systems through collaboration with tribes and other stakeholders and now includes more than 12,000 river miles in 45 river systems.
Bipartisan Infrastructure Law (BIL)-Funded Barrier Removal Carve-Out through the Continuing Authorities Program (CAP 206)	The BIL provided $115 million to the Continuing Authorities Program (CAP 206) to restore rivers by removal of in-stream barriers that contribute to degrading ecosystem health.

USACE will use various strategies and actions that were initiated in 2023 to advance the national conservation goal to protect, sustain, and improve the natural and man-made environment of our nation. The **Natural Resources Management Strategic Plan** supports these strategies. This 10-year plan was developed to advance effective and efficient management of USACE's diverse natural resource assets with the provision of public recreation opportunities. These include initiatives targeted at preventing or reducing invasive species, effective habitat and ecosystem management, and work to support a more resilient and sustainable USACE Recreation program. In 2023, USACE issued a **Revised Invasive Species Policy**. This policy directs that "Measures to either prevent or reduce establishment of invasive and non-native species will be a component of all USACE CW projects and will be applied to invasive species issues in the execution of all CW programs. The intent is to integrate the Invasive Species Policy into all projects and programs to manage invasive and non-native species effectively and efficiently, including harmful algal blooms." This policy focuses on restoring habitat to remove and prevent re-establishment of

invasive species and to promote native, resilient ecological communities. In 2023, USACE also drafted an **Invasive Species Strategic Plan**. This plan, developed according to the John D. Dingell, Jr., Conservation, Recreation, and Management Act (Public Law [PL] 116-9), provides an overarching framework for the broad spectrum of activities that are performed nationwide by USACE related to invasive species. The plan includes goals, objectives, strategies, and metrics. The strategies reflect invasive species related work that is ongoing and identifies opportunities to focus on emerging priorities in which invasive species negatively affect the resilience of native communities, ecological connectivity, and wildlife corridors, along with serving as a catalyst in climate-relate natural disasters (i.e., invasive grasses fueling wildfires). **Noxious Weed Cooperative Agreements** targeted at encouraging the removal of invasive and undesirable vegetation were also implemented in 2023**.** This implementation guidance was issued according to EOs 13751 and 13112 and the Federal Noxious Weed Act of 1974 (7 U.S.C. § 2814) and facilitates using Cooperative Agreements with state or local government partners to remove targeted vegetation from project lands.

USACE focuses on supporting management practices that promote conservation and improve habitat and ecosystem function. In collaboration with the U.S. Fish and Wildlife Service, USACE is developing **Migratory Bird Best Management Practices (BMPs)** that include considerations for ecological connectivity and wildlife corridors. USACE continues to support **collaborative partnerships** that promote climate resilient actions and facilities, restoration, conservation, and enhancement of fish, forest, and wildlife habitat as recognized in over 30 Memorandums of Understanding (MOUs) or Memorandums of Agreements with federal and state partners like the U.S. Department of the Interior, U.S. Department of Agriculture, the Federal Aviation Administration, and the U.S. Forestry Service, as well as nonprofits like the National Fish and Wildlife Foundation and non-governmental organizations like Ducks Unlimited, the National Wild Turkey Federation, the National Audubon Society, The Nature Conservancy, etc. Examples of actions taken to support such partnerships include new national USACE MOUs with Trout Unlimited and the Back Country Hunters and Anglers. The Trout Unlimited MOU provides a foundation for collaboration related to the protection, restoration, and management of cold-water fisheries. The Back Country Hunters and Anglers MOU provides a framework to develop and expand interest in wildlife-dependent outdoor recreation and sustainable wildlife habitat.

The USACE **Recreation Program strategically uses supplemental funds**, when recieved from avenues such as the BIL and the Disaster Relief Supplemental Appropriations Act (DRSAA 2022) (PL 117-43), to conduct work reflective of Administration priorities. Additionally, the USACE Recreation Program is investing in supporting **Sustainable Recreation Facilities** by improving energy and water use efficiency and is supporting **long-term resilience** by ensuring that facilities and infrastructure can withstand increases in climate change-driven hazards like floods, fires, and extreme storms. For example, DRSAA 2022 provided $5.711 billion in supplemental funds for the Army CW program. The Recreation Program received a portion of these funds and used over $20 million for qualifying flood and storm damage repair. These repair efforts included a focus on supporting long-term resilience by relocating impacted facilities to less flood-prone zones, stabilizing shorelines, and restoring infrastructure in a manner that is considerate of climate driven impacts. The FY22–24 BIL provided over $100 million in supplemental funds designated for expenditure by USACE's Recreation Program for investments in infrastructure that strengthen resilience to climate change while benefiting communities with EJ concerns. Across USACE, over 185 CW projects with a recreation mission intersect with at least one ASA focus metric disadvantage tract; nearly 50 of these projects received BIL funding. For example, Carr Creek Lake in Sassafras, Kentucky will work to execute $3 million in FY24 BIL funding to replace a failing chemical wastewater treatment plant with an environmentally friendly ultraviolet light treatment system. Associated sewage lines and lift stations, with energy efficient pumps, controls, and electrical system repairs and replacements, will also occur as part of this effort to support sustainable, reliable, and climate resilient recreation infrastructure. USACE, under the requirements of the 2005 Energy Policy Act (PL 109-58) and the 2007 Energy Independence and Security Act (PL 110-140), identified and implemented energy, water, and petroleum conservation measures, in addition to providing greater long-term infrastructure resilience, as means to gain operational efficiencies and reduce operating costs. To further modernize the USACE Recreation Program, over the past 10 years, USACE focused significant effort and funding to revise project master plans. Project master plans are strategic land-use management documents that guide the comprehensive management and development of all recreational, natural, and cultural resources throughout the water resource project's life. The majority of USACE projects that provide recreational facilities were constructed between the early 1930s and the late 1980s; subsequently, project master

plans were written during that same period. This effort ensures that each project uses a relevant, concise plan for strategic management.

USACE continues to implement its **Sustainable Rivers Program**, a 20-year partnership with The Nature Conservancy. The mission of Sustainable Rivers is to improve the health and life of rivers by changing existing USACE infrastructure operations to restore and protect ecosystems, while maintaining or enhancing other project benefits. The program's primary vehicle for realizing environmental benefits is focused on enabling and supporting local teams to pursue environmental ideas that they propose and that align with program objectives. This proactive approach furthers environmental stewardship by helping teams advance, implement, and incorporate environmental strategies.

In addition to habitat improvements implemented through its $600 million annual Aquatic Ecosystem Restoration Program, USACE received $115 million through the Bipartisan Infrastructure Law (BIL) provided for the Continuing Authorities Program (CAP 206) to restore rivers by **removal of in-stream barriers** that have contributed to degrading ecosystem health. USACE selected several projects for implementation and is working with the Federal Interagency Fish Passage Task Force to leverage multiple funding sources to address high-priority needs throughout the country, in cooperation with multiple other partners. The resulting increases in aquatic connectivity will promote migration pathways for species under changing climate conditions, particularly as they affect water temperature and hydrologic patterns.

3B. Climate-Resilient Operations

3B.1 Accounting for Climate Risk in Planning and Decision-Making

USACE CLIMATE RISK ASSESSMENTS IN PRACTICE	
Established Climate Hazard Risk Exposure Assessment Method	Description of how risk assessments are used in planning and decision-making processes.
Portfolio Risk Assessments	USACE performs portfolio risk assessments to understand and manage risk across USACE-operated and -maintained projects. Portfolio risk assessments enable USACE to understand how infrastructure responds to climate change and prioritize USACE's response. USACE completed an initial Portfolio Risk Assessment using a new tool developed for this purpose, similar to the USACE CWVAT. In FY23–24, the CPR CoP is improving its CWVAT by updating the tool's inputs and rebuilding it to evaluate climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding). Upon re-release, a vulnerability screening of USACE projects will inform prioritization for further analysis using existing USACE software.
Coastal Risk Assessments	Under Engineer Regulation (ER) 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, teams conducting applicable USACE studies must demonstrate how sensitive alternative plans and designs are to the rates of future local mean SLC, how this sensitivity affects calculated risk, and what design or O&M measures to implement to minimize adverse consequences of SLC while maximizing beneficial effects. Alternative plans and designs are formulated and evaluated for three possible future scenarios of SLC. In FY24, USACE will also execute a CESL.
Climate Change Risk Assessments	Engineering and Construction Bulletin (ECB) 2018-14 (rev. 2, 2022), Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects, requires that climate change and variability be characterized across a project's life cycle. ECB 2018-14 applies to all hydrologic analyses supporting planning and engineering decisions having an extended decision time frame. It provides guidance for incorporating climate change information in hydrologic analyses according to the USACE overarching CPR policy and the USACE Planning Guidance Notebook (ER 1105-2-100).

USACE CLIMATE RISK ASSESSMENTS IN PRACTICE	
Established Climate Hazard Risk Exposure Assessment Method	Description of how risk assessments are used in planning and decision-making processes.
Continuity of Operations Planning (COOP) Program	Under the National Emergency Preparedness Program, USACE maintains a COOP program (ER 500- 1-18) that requires all-hazards COOP planning, including climate change-related hazards, across the USACE enterprise. COOP activities include analyzing resources, preparing and publishing contingency plans to prevent disruptions in communications, and identifying Emergency Relocation Facilities (ERFs) in response to either a natural or man-made disaster/event.
Dam Safety Program	A climate risk assessment is performed as part of all Dam Safety Issue Evaluation Studies (IESs). IES results inform the development of the Future Without Action Condition (FWAC) scenario, which is the baseline against which Dam Safety Risk Management Plans (RMPs) are evaluated and compared. When ECB 2018-14, climate risk, and/or SLC assessments indicate a significant change in future hydrology, the USACE Dam Safety Modification Mandatory Center of Expertise (DSMM) includes greater measures for resilience to account for future climate variability.
Project Risk Registers, Risk-Informed Decision-Making, and Enterprise Risk Register (ERR)	USACE project delivery teams develop risk registers for each study and perform risk-informed decision-making. Risks due to SLC and climate change are documented where relevant within each project's risk register. In addition, the USACE ERR is available to help project teams and leadership better assess, manage, reduce, mitigate for, and view risks to CW projects, including climate financial risks, through a transparent, accessible, and integrated online platform. The ERR adds consistency to USACE's risk-informed decision-making across project life cycles, portfolios, and programs. The ERR lets personnel learn from previously identified risks and mitigation measures, both specific to a project and from USACE's entire portfolio of projects.
Climate Risk Informed Decision Analysis (CRIDA)	The CRIDA approach provides a framework for water managers and policy makers to assess the impact of climate uncertainty and change on their water resources and to work toward effective adaptation strategies. CRIDA is a multi-step, bottom-up process that identifies water security hazards. Scientific modeling and climate analysis teams in local communities provide information that allows tailoring of the design of the analysis, moving away from a "one size fits all" approach. The USACE Interagency and International Services (IIS) program has used CRIDA for international water resources planning, and pilot projects are evaluating the approach for further expansion.
Environmental Justice	EJ has been a part of planning a decision-making process since EO 12898 was issued in 1994. EO 14008, Tackling the Climate Crisis at Home and Abroad, created the Justice40 Initiative, which sets a goal that 40% of overall benefits of investments in climate, clean energy, water, and other areas benefit communities with EJ concerns. EO 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All, has created an opportunity for USACE to reaffirm its commitment toward addressing EJ in all levels of the agency, where applicable. This commitment supports more sustainable and resilient communities with EJ concerns so they are better protected from risks and hazards related to climate change (and SLC).
Wildfire	USACE CW authorities, such as Section 729 and Section 203 Watershed Assessments, and Planning Assistance to States (PAS) support assessing pre- and post-fire flood risk. The USACE CPR CoP is developing the Post-Fire Risk Exposure (Post-FiRE) Decision Support Tool, a pre-hazard planning tool for communities to assess their current and projected future vulnerability to post-fire flood risk if a wildfire significantly impacts their upstream watershed. This tool is slated for development in FY24.

USACE currently considers the risk of climate hazard risk exposure, including the effects of SLC and impacts to inland hydrologic processes, in its missions, operations, programs, and projects. The planning of USACE's water resources development projects in and adjacent to coastal zones must consider the potential for future SLC. Currently, ER 1100-2-8162, Incorporating Sea Level Change in Civil Works Programs, and EP 1100-2-1, Procedures to Evaluate Sea Level Change: Impacts, Response, and Adaptation, both provide direction and procedures for evaluating SLC impacts to coastal studies, designs, and projects.

ECB 2018-14, Guidance for Incorporating Climate Change Impacts to Inland Hydrology (rev. 2, 2022), prescribes a weight-of-evidence-based approach to determining whether evidence exists that climate change presents an operationally significant risk to a given study area, water resources decision, and/or project feature. This approach includes applying the CWVAT, summarizing peer-reviewed literature describing observed and future trends in hydrology and meteorology, a time series-based statistical assessment of the stationarity assumption using the Time Series Toolbox, and an evaluation of watershed-specific projections of hydrology and meteorology via the Climate Hydrology Assessment Tool (CHAT).

In addition to performing risk assessments for USACE studies, project designs, and operation planning, USACE is seeking to conduct climate change and SLC risk vulnerability screenings of existing project sites and programs (e.g., hydropower, navigation) using the CESL approach and the CWVAT. Such evaluations provide a better understanding of vulnerabilities and support developing strategies for addressing climate change risk to USACE projects, operations, and missions. By performing vulnerability assessments, program managers gain a greater understanding of which hazards present an increasing risk at a specific site or within a given watershed or region. CESL integrates a series of progressively more detailed screening-level assessments of the USACE project's vulnerability to SLC. Using the CWVAT and/or CorpsPET to screen USACE projects will result in a ranked list of projects by hazard and categorization into groups corresponding to high, moderate, and low risk or no impact. Vulnerability assessments identify projects that require more detailed analyses and those that require adaptation sooner. For projects identified as high risk, further analysis (using tools like USACE hydrologic modeling software) can determine consequences of inaction and appropriate adaptation steps. The results of the vulnerability assessments help prioritize cost-shared re-evaluation studies (Section 216 of the Flood Control Act of 1970) targeted at altering project design or operations to better manage flood risk as the climate changes.

To prepare, USACE published Engineer Circular (EC) 1100-1-113, and pilot study applications to better quantify risk to inland projects using the outputs from global climate models/earth system models. This includes several pilot studies implementing the Climate Risk Informed Decision Analysis (CRIDA) approach to identify system vulnerabilities.

To further reduce climate change vulnerabilities at existing USACE projects, per ER 500-1-18, the USACE Continuity of Operations Planning (COOP) program ensures USACE missions can be sustained during severe weather events by creating communications redundancies, maintaining COOP sites in strategic locations, and protecting against information loss. To evaluate and identify vulnerabilities, USACE conducts a COOP exercise at least every two years.

3B.2 Incorporating Climate Risk Assessment into Budget Planning

PLANNING AND BUDGET	
High-Level Budget/ Planning Example	Describe how agency leadership incorporates climate risk into high- level budget and planning decisions.
USACE Responses to Climate Change	The USACE CPR CoP helms USACE's Responses to Climate Change (RCC) initiatives. The RCC budget supports the development and improvement of methods, tools, and approaches to evaluate and implement measures to address the effects of climate change and variability on developing, managing, protecting, restoring, and protecting water resources.
Feasibility Studies– Project Planning	USACE policy requires that climate change be incorporated into project planning. In accordance with ER 1100-2-8162 and ECB 2018-14, this includes accounting for SLC when computing costs and benefits and qualitatively evaluating residual risk due to climate change. USACE EP 1100-1-5, USACE Guide to Resilience Practices, requires that projects be prepared, resistant, repairable, and adaptable to reduce downtimes and repair costs after disasters, thereby improving performance and reducing federal financial risk.
Floodplain Management Services (FPMS)	Under the authority provided by Section 206 of the 1960 Flood Control Act (PL 86-645), as amended, USACE can provide the full range of technical services and planning guidance to support effective floodplain management. Efforts under this program are generally conducted at 100% federal expense. USACE considers climate change, among other factors, when prioritizing new requests for FPMS funding. Specifically, as part of the request for funding, requesters are asked to identify whether the project supports planning and/ or preparedness for climate change impacts.
Planning Assistance to States	When reviewing PAS project requests, USACE determines and records whether the proposed project supports/ addresses climate change and climate change resilience. Addressing climate change risk is one of the priority focus areas of the program.
Portfolio Risk Assessments	One area of known, climate-related financial risk is the exposure of USACE projects to extreme events. Risk is evaluated by conducting portfolio-wide vulnerability assessments to identify and budget for climate change financial risk. Risk assessments are conducted using the CWVAT. Coastal risk is tracked by conducting a CESL.
Climate Change Response (CCR) Budget Process	USACE uses targeted, metric-based activities to reduce climate change risk. These metrics report to the OMB Scorecard, inform the Sustainability and CCR budget process, maintain USACE awareness of potential areas for improvement, and highlight success stories across the agency. These metrics also support initiatives to improve energy and water efficiency and transition buildings and vehicle fleets toward using carbon-free energy. Such actions also improve resilience to outages and increase operational sustainability.
Accelerating Nature-Based Solutions (NBS) in USACE CW Planning	Climate change is predicted to cause substantial loss of natural systems, both coastal and inland, that provide significant community resilience. The USACE Institute for Water Resources (IWR) Systems Approach to Geomorphic Engineering (SAGE) program, in coordination with the Engineer Research and Development Center (ERDC) Engineering With Nature (EWN) program, is developing a series of technical notes to identify and communicate innovative financing mechanisms that use unique funding sources from public-private partnerships to apply NBS in CW. SAGE is making these strategies accessible to local, state, and regional stakeholders interested in leveraging existing financing strategies with demonstrated success.

PLANNING AND BUDGET	
High-Level Budget/ Planning Example	Describe how agency leadership incorporates climate risk into high- level budget and planning decisions.
Environmental Justice	Communities with EJ concerns face significant risk from the effects of climate change due to several factors, including decreased ability to recover from climate-related disasters. Under USACE's EJ Strategic Plan and associated planning guidance, USACE provides opportunities for meaningful engagement of persons and communities with EJ concerns who are potentially affected by USACE's activities so that their input is fully considered as part of decision-making processes. USACE policy/guidance is consistent with and includes actions that support the Justice40 initiative, which sets a goal that 40% of the overall benefits of investments in climate, clean energy, water and other areas flow towards communities with EJ concerns. USACE activities stem from congressional authorities and 2020 marked a pivotal year in which the agency was specifically authorized through a WRDA bill to address impacts and benefits to communities with EJ concerns. WRDA Sec. 165a covers our Continuing Authorities Programs (CAP) and focuses on the nine sections within that program to assess small scale water resource related needs in rural, urban, and tribal communities. WRDA Sec. 118 will also yield a number of fully funded projects that can address environmental, climate, coastal, flood, or other needs within these same communities. These activities along with Justice40 activities and guidance outlined in EO 14096 dedicate resource funding to address EJ.

The USACE budget process is based on projects that are individually appropriated by Congress, precluding agency-wide incorporation of climate risk into the Congressional budget process. However, USACE does incorporate climate risk into budget and planning decision-making. USACE has taken significant action to develop and incorporate process(es) and/or tools that incorporate climate risk into planning and budget decisions. The USACE RCC program is 100% federally funded and is authorized by various authorities including Section 216 of the River and Harbor and Flood Control Act of 1970 and sections of the Water Resources Development Act (WRDA) 1986 and Water Resources Reform Development Act of 2014. Annual funding is used to: (1) continue developing and implementing methods, tools, and approaches to translate evolving climate science into actionable information that supports risk-informed decision-making to reduce known vulnerabilities of USACE-owned projects to changing climate; (2) develop practical guidance and policies for planners and engineers that support incorporating climate resilience into USACE planning engineering, construction, operations, and maintenance of USACE-owned projects; and (3) develop and disseminate training on CPR policy, guidance, tools, and methods.

It is the policy of USACE to integrate climate change preparedness and resilience planning and actions in all activities for the purpose of enhancing community resilience through water-resource projects. For CSRM, the federal interest is determined using SLC scenarios that are evaluated to determine the effects on design and performance of project alternatives. SLC scenarios consider the timing and consequences of climate impacts. For inland studies, USACE produced tools and guidance that evaluate the effects of climate change on alternative performance while also identifying residual risks. Overall, identifying potential vulnerabilities and risk due to climate change facilitates adaptable and resilient alternatives for both coastal and inland projects. As part of the USACE Floodplain Management Services (FPMS) and the Planning Assistance to States (PAS) programs climate change preparedness and resilience are prioritized program areas. The Institute for Water Resources (IWR) is collaborating with the Engineering with Nature (EWN) program and the Water Institute to co-produce a report on accelerating NBS in USACE CW planning. This report will include identifying innovative financing mechanisms for supporting NBS, which are critical to offset project future losses of natural systems due to climate change.

One area of known, climate-related financial risk is the exposure of USACE office sites to extreme events. Offices at project sites are evaluated under the vulnerability assessments that pertain to projects and are planned with climate change considerations along with the rest of the project. Climate change risk and exposure for existing projects is evaluated using the CWVAT, the CorpsPET, and the CESL. The USACE CPR CoP supports the development of a Post-FiRE Decision Support Tool slated for FY24 that would enable communities to assess their current and projected vulnerability to post-fire risk as part of a USACE-led watershed assessment. For office spaces leased

from the GSA, other federal agencies, and private entities, USACE identified an action to coordinate with the site owner to manage the risk of climate impacts. For the relatively few office sites that USACE owns outright but are not associated with projects, USACE is developing a process for climate vulnerability assessments like the ones used for project sites.

The uncertainty associated with future conditions driven by climate change presents a recognized financial risk to USACE missions, including emergency management, navigation, water supply, hydropower, and recreation. For example, the Hydropower Program recognizes that climate change impacts the cost of spillway operations. The recreation business line prioritizes actions and investments to make USACE's Recreation Program function more resilient to future climate change impacts. For instance, in FY22, USACE's Sustainability Program provided $10.5 million dollars to fix waterline breaks, reduce water usage, and ensure the availability of USACE recreation facilities for communities. USACE has used its allocation of O&M BIL funding to help ensure water supply projects continue to serve community needs by replacing water intakes and embankment repair. With respect to water management, ER 1110-2-1941, Drought Contingency Plans, recognizes the need to use the best available and actionable science on climate impacts to water resources as part of USACE's overall water management activities, specifically with reference to updating project DCPs.

3B.3 Incorporating Climate Risk into Policy and Programs

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Climate Adaptation and Resilience	
• **U.S. Ocean Climate Action Plan (OCAP)**. The Ocean Policy Committee, co-chaired by the White House Council on Environmental Quality and the White House Office of Science and Technology Policy, released the OCAP to guide and coordinate actions of the federal government and civil society to address ocean-, coastal-, and Great Lakes-based mitigation and adaptation solutions to climate change while building resilience to impacts. The report identifies USACE as a key or supporting agency for 53 actions to meet the OCAP goals. • **ASA(CW) Guidance**. The ASA(CW) published a policy memorandum in July 2022 focused on Army CW programs supporting drought resilience across America's communities. The memorandum calls for action targeted at addressing near-term and long-term drought resilience goals at both local and regional scales. • **USACE Directorate of Civil Works**. At the request of the Directorate of Civil Works multidisciplinary teams from across the agency review and develop resources to address the increasing challenges posed by climate change. Past publications include USACE Civil Works Technical Series (CWTS) 2013-3, Coastal Risk Reduction and Resilience: Using the Full Array of Measures.	1. **Sea Level Change Guidance Update**. Updated SLC guidance for the next National Tidal Datum Epoch in 2026. The USACE CPR CoP is modernizing the USACE Sea Level Change Analysis Tool (SLAT) to support forthcoming guidance updates. 2. **Climate Change and Hydrologic Analysis Update**. Updated guidance on incorporating climate change impacts in hydrologic analyses (inland focus) to replace ECB 2018-14 (rev. 2, 2022) and ETL 1100-2-3, as well as future updates to support EC 1100-1-113. A team is currently working on the ECB 2018-14 and ETL 1100-2-3 guidance update. Updated guidance should be published by the end of FY24. Updates are necessary to respond to the latest actionable science, including the projected 2026 publication of NOAA Atlas 15. To support guidance updates, the USACE CPR CoP is developing high-quality data sets, pilot studies, and research projects to help develop and evaluate options where climate changes may impact USACE projects. USACE recently published a best practice guide for using projected future hydroclimatology (EC 1100-1-113) and has updated the USACE CHAT to facilitate characterizing

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Climate Adaptation and Resilience, cont.	
• **HQUSACE RCC Program/CPR CoP**. The RCC Program is responsible for drafting, reviewing, and updating USACE's: ◦ 2021 Climate Action Plan ◦ CPR Policy Statement ◦ Agency-wide reports (e.g., USACE CWTS 2016-05, Reservoir Sedimentation in the Context of Climate Change). ◦ Engineering and planning guidance targeted at topics such as: ▪ Incorporating SLC considerations (e.g., EP 1100-2-1, ER 1100-2-8162) ▪ Incorporating climate change impacts into hydrologic analysis (e.g., ECB 2018-18, Engineer Technical Letter (ETL) 1100-2-3, EC 1100-1-113) ▪ NBS ▪ Greenhouse gas (GHG) accounting ▪ Ecosystem climate impacts ▪ Maintaining tidal datum information ◦ CPR CoP technical and policy and legal compliance review standards of practice. • **HQUSACE Hydrology, Hydraulics and Coastal (HH&C) CoP**. The HH&C CoP collaborates with the HQ CPR CoP to generate, review, and update engineering and design guidance relevant to HH&C applications. The HH&C CoP seeks to reduce extreme weather disruptions at projects by updating WCMs, DCPs, and natural resources management guides to reflect climate as it changes. Examples of pertinent engineering guidance include: ◦ ER 1110-2-1941, Drought Contingency Plans ◦ ECB 2023-12, Methods for Storage/Yield Analysis ◦ ER 1100-2-8156, Preparation of Water Control Manuals ◦ EM 110-2-1420, Hydrologic Engineering Requirements for Reservoirs.	future hydrologic response. USACE is carrying out a state of the science review on hydrologic nonstationarity to support the forthcoming guidance update and an update to USACE's Timeseries Toolbox application. USACE is also currently working on updating the CWVAT, as well as producing a series of regional literature syntheses to support the guidance update. 3. **New Guidance on Climate Change and Ecosystems**. Guidance in the form of an ecosystem climate impacts and responses ETL. 4. **Update Extant HH&C Guidance**. Update relevant existing guidance (e.g., EM 1110-2-1415, Hydrologic Frequency Analysis) to include the latest actionable science related to CPR (contingent on funding availability). 5. **New Nonstructural Guidance**. With the increase of nonstructural features in USACE FRM and CSRM projects, USACE is in the final stages of releasing interim guidance for nonstructural implementation and is developing an ER to establish a Nonstructural Mandatory Center of Expertise (MCX). A future ER will provide further guidance. HQUSACE is concurrently developing guidance for conducting nonstructural replacements. 6. **EJ Strategic Plan, Program Management Plan, Policy, and Guidance**. HQUSACE issued updates to guidance and policy and will issue an agency EJ strategic plan (per EO 14096) and further update guidance as other rule-making initiatives are finalized. The major subordinate commands (MSCs) endorsed district EJ Strategic Engagement Plans and will post those to the EJ website. Communities with EJ concerns face significant risk from the effects of climate change due to several factors, including decreased ability to recover from climate-related disasters. Inclusion of these communities in the planning process, and policy/guidance updates provide opportunities for USACE to consider impacts and benefits to communities with EJ concerns that help build resilience to climate-driven risks.

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Climate Adaptation and Resilience, cont.	
◦ Required periodic updates to management plans that include revising USACE WCMs and revising project Master Plans. WCMs for reservoirs and other water resource projects are updated to include recent climate information every 10 years (the same frequency as NOAA's updates to 30-year U.S. Climate Normals).[11] Project Master Plans are updated every 15–20 years to reflect the recent climate in management of lands and waters. • **ERDC** conducts research and development (R&D) in support of the USACE CW mission. ◦ Forecast-Informed Reservoir Operations (FIRO) is a research-and-operations partnership strategy that seeks to optimize reservoir management in response to a growing demand for water supply coupled with increasingly frequent drought and flood risk. The FIRO program supports ER 1110-2-240 that allows water management operations planning to use forecasted conditions. ◦ USACE's EWN program consistently promotes collaboration for identifying innovative NBS that lead to more resilient communities and water-based infrastructure. USACE has a EWN strategic plan for 2018–2023. The program recently published International Guidelines on Natural and Nature-Based Features for Flood Risk Management (NNBF). ◦ The Coastal Hazards System (CHS) quantifies coastal hazards, such as storm surge, waves, and flooding, including SLC, using a consistent methodology and level of accuracy. ◦ ERDC is collaborating with Arizona State University to conduct a Managed Aquifer Recharge (MAR) Planning and Guidance Study to identify optimal sites for MAR. MAR are NBS applied to offset drought risk. MAR captures surface water to replenish groundwater. ◦ ERDC's Coastal and Hydraulics Laboratory (CHL), Post-Wildfire Strategic R&D, and IWR-Hydrologic Engineering Center (HEC) are collaborating to improve modeling of erosion, sedimentation, streamflows, and debris flows within post-wildfire landscapes.	7. **New and Updated NBS Guidance**. These include an update to USACE's EWN Strategic Plan and updates to NBS technical reports, pamphlets, guidance, and policy memorandums. 8. **Unified Facilities Criteria (UFC) Updates**. The Army is making ongoing updates to UFCs, and USACE is considering their inclusion in CW guidance. 9. **Policy Memos**. These memos clarify support for, and identify resources and guidance for innovative approaches to including climate change preparedness and resilience in project design/planning. To support this a policy review is underway to identify opportunities to reduce climate uncertainties in costs and benefits computation. 10. **Resilience Guidance/Memorandum Updates**. USACE has acted to promote resilience thinking (e.g., EP 1100-1-5, published 1 December 2020) and engineering judgment (Civil Works Planning Transformation Memo, 8 February 2012) and continues to produce and update guidance and memorandums directed at improving resilience in USACE projects, missions, and operations.

11 The 1991–2002 U.S. Climate Normals are the latest in a series of decadal normals first produced in the 1950s. Climate normals are used to characterize typical climate conditions across the U.S. and consist of representative averages and statistics for various climatological variables.

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Climate Adaptation and Resilience, cont.	
• **National Flood Risk Management Business Line Community of Practice (FRM CoP)**. In September 2023, the FRM CoP published the memorandum Resilience Integration in the USACE Flood Risk Management Mission. • **HQUSACE Civil Works Planning and the Planning Centers of Expertise and Planning Community of Practice (PCoP)**. USACE Planning oversees and develops the CW planning mission. The PCoP develops relevant policy doctrine and guidance that is housed in the Planning Community Toolbox. The PCoP collaborates with the CPR CoP, the HH&C CoP and the FRM CoP to ensure that USACE's Planning Guidance promotes climate adaptive capacity and resilience and that investments strategically consider future conditions and are climate smart. Examples of pertinent guidance are: ◦ Planning Guidance Notebook (ER 1105-2-100 – Sec. E-24 (k) Sea Level Rise. ◦ ER 1105-2-103, Policy for Conducting Civil Works Planning Studies. ◦ ECB 2020-06, Implementation of Resilience Principles in the Engineering & Construction Community of Practice. ◦ EP 1100-1-2, USACE Resilience Initiative Roadmap. ◦ EP 1100-1-5, USACE Guide to Resilience Practices. ◦ Guidance on Nonstructural Implementation. • **The IWR-Led Sustainable Rivers Program**. The SRP is an ongoing national program to increase environmental benefits provided by USACE's already built water resources projects. The SRP is developing and evaluating adaptive management strategies that, if proven effective, can be incorporated into USACE guidance updates. • **Natural Resource Management/Environmental Stewardship: Wildfire**. USACE is required to manage its lands for wildfire, including conducting prescribed burns and fire suppression activities (EP 1130-2-540, Environmental Stewardship Operations and Maintenance Guidance and Procedures).	

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Nature-Based Solutions	
• **PL 84-99/Emergency Management: Wildfire**. ◦ USACE is the responsible agency for water quality permitting under Section 404 of the Clean Water Act. In the case of natural disasters, including wildfire, it establishes Emergency Regional General Permits covering emergency actions such as levee reconstruction, bank stabilization, and debris removal. ◦ Under PL 84-99, USACE can take emergency actions and provide technical assistance to communities to mitigate post-fire flood risk. • **2021 Climate Action Plan**. As part of this plan, USACE sought to develop and deliver workshops on appropriately applying NBS. The CPR CoP led a workshop, in collaboration with EWN, in May 2023 to determine actions toward creating engineering guidance on NBS. • **Beneficial Use of Dredged Material Command Philosophy Notice**. In a Command Philosophy Notice dated January 2023, the Chief of Engineers established the goal of using 70% of dredged material from construction and O&M water resources projects for beneficial uses by the year 2030. To track progress toward the Chief's goal, the USACE Regional Sediment Management (RSM) Program maintains the RSM Sediment Placement Data Viewer to quantify the percent of beneficial use across the enterprise. Currently, USACE beneficially uses approximately 30–40% of its dredged material.	1. **NBS EP and Technical Reports**. USACE is currently developing an Engineering and Planning EP for NBS in conjunction with four technical reports on vegetated bank biostabilization, floodplain reconnection, oyster reefs, and constructed coastal wetlands. Additional technical reports will be created after publication of the first four. 2. **NBS Planning Guidance**. NBS guidance, accompanied by a technical report on coastal NBS, is being developed to quantify or qualify flood resistance benefits and to provide direction to districts for incorporating NBS into alternative plans. 3. **NBS Director's Policy Memo**. This memo is being developed to address opportunities and needs for applying NBS to existing and planned USACE programs and projects. 4. **Papers to Advance NBS**. The USACE IWR SAGE is developing papers to offer approaches to advance planning solutions and guidelines that support NBS in USACE CW planning and beyond. 5. **Joint Technical Research Projects**. IWR SAGE, in coordination with ERDC Environmental Lab (EL), is working on a joint technical research project focused on the design, performance, risk reduction, and long-term adaptation of NBS coastal settings.
Category: Environmental Justice	
• **Modernization Initiatives**. USACE modernized the CW program through several policy initiatives to better serve the needs of communities with EJ concerns. ◦ In FY23, USACE published a new Interim EJ Strategic Engagement Plan. ◦ USACE is drafting an agency EJ strategic plan (per EO 14096) to be completed in FY24. ◦ USACE identified dedicated EJ coordinators at the district and division levels to act as local points of contact to address each region's unique needs and challenges. ◦ USACE also hired an EJ program manager at headquarters to provide program oversight and guidance. EJ input to the CAP was coordinated through the HQUSACE EJ Program Manager.	1. **Interim EJ Strategic Engagement Plan**. A key goal of the new Interim EJ Strategic Engagement Plan is to ensure EJ groups and Tribes are at the center of any climate disaster response or climate preparedness planning and are meaningfully engaged as decision makers. USACE will create a modern system of transparency which seeks to increase access to engagement, technical assistance, funding, cultural access, etc., as well as effective communication to communities on legacy, systemic, past, present, and looming climate impacts. The plan will foundationally change how the USACE CW program supports and communicates with partners in the future. Note the Interim EJ Strategic Plan is specific to USACE CW Planning Studies, not to be confused with the agency EJ Strategic Plan.

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Environmental Justice, cont.	
• **White House Environmental Justice Advisory Council's Recommendations on Climate Planning, Preparedness, Response, Recovery, and Impacts (September 2023)** ◦ "The actions of Federal agencies [...including USACE in response] to climate disasters must not further or exacerbate the harm to vulnerable communities and populations." ◦ "The way that Federal agencies [including USACE...] prepare for, respond to, and prevent climate disasters in vulnerable communities requires an unprecedented amount of coordination within government but also with communities and populations most directly impacted." ◦ USACE "must intimately involve local residents, community groups, EJ groups, and Tribes in creating and implementing community level emergency and climate change adaptation plans." This should be accomplished by: ▪ "Increase[ing] access to engagement, decision-making, planning, research, technical assistance, funding, and resources, including language access, financial access, cultural access, etc." ▪ Ensuring that USACE creates "an interoperable, modern system of transparency on progress of programs and communications to communities on legacy, systemic, past, present, and looming climate impacts." ◦ In the face of climate driven disaster, the goal of USACE should be first and foremost to support communities to emerge stronger and more secure than before. If a community incurs insurmountable damages, or it is no longer safe for the community to remain, a just approach to relocation should be adopted. When relocation is necessary USACE should ensure it is done in a transparent way, in consultation with the community. Relocation must prioritize, life, property, and wellbeing, as well as cultural integrity of the displaced community. Relocation should improve the conditions of communities with EJ concerns.	2. Once the **agency EJ Strategic Plan** is approved it will be posted on the USACE Headquarters' EJ webpage.

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Tribal Nations	
• **Tribal Partnership Program (TPP) Guidance**. In FY24, the ASA (CW) issued the updated USACE Tribal Consultation Policy and USACE issued EP 1105-2-64, Tribal Partnership Program. The EP provides a strategy for the program established by WRDA 2000 (Section 203), as amended. The TPP guidance includes specific sections for USACE consultation with tribes for the assessment of climate change risk and to implement climate change preparedness and resilience projects on tribal lands.	As a result of consultation with tribes, the guidance includes specific reference for using the TPP to provide tribes with information and potential courses of action to understand climate risk to resources on tribal lands.
Category: Co-Benefits of Adaptation	
• **UFC 1-200-02**. USACE, working with the Navy and Air Force, regularly updates UFC 1-200-02, High Performance and Sustainable Building Requirements, to incorporate principles of climate change mitigation, installation resilience, and climate resilience into military construction. • **Updated Standards and Guidance**. Other documents created or updated in the last year include: ◦ Electrification of Standard Building Operations DoD Memo, 29 March 2023. ◦ Army Electrification Guidance for Military Construction (MILCON) Projects, 18 May 2023. ◦ Metrics and Standards for Energy Resilience at Military Installations, 20 May 2021. ◦ UFC 3-550-04, Installation Microgrid Design (Pending Final Approval and Publication). ◦ UFC 3-520-02, Facility Energy System Resilience and Reliability. • **Application to CW Construction**. USACE also applies these criteria in support of USACE CW construction, e.g., project offices, visitor centers, and access ramps. • **Guidance Related to Sustainability**. In 2023, USACE published the Army Sustainability Implementation Guide, and ECBs on LEED, ASHRAE 90.1, Electrification, and Mass Timber.	1. **Updates to the UFC 1-200-02**. These include incorporating American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 90.1 and the International Energy Conservation Code and Leadership in Energy and Environmental Design (LEED) Silver Certification. 2. **Pilot Construction Projects**. USACE Engineering and Construction and ERDC are partnering with the Navy, Air Force, and private industry to execute pilot construction projects that reduce carbon emissions on military installations through sustainable materials and net-zero operations. These projects will seek to use innovative acquisition processes with the goal to exceed energy use intensity targets, produce net-zero emissions, electrify building operations, achieve elements of passive design, and use sustainable building materials. ◦ Examples of sustainable materials pilots include the FY24 Army barracks project at Joint Base Lewis-McChord JBLM), Washington, which will use low global warming potential concrete, and the FY25 JBLM Army Barracks project, which will use mass timber. ◦ Army net-zero pilot projects include the FY24 Army Barracks at Fort Liberty, North Carolina; FY24 Army Barracks renovation at Fort Campbell, Kentucky; and the FY25 Component Rebuild Shop at Fort Letterkenny, Pennsylvania.

AGENCY POLICIES REVIEWED	
Sub-agencies and departmental offices reviewing policies and the type of polices that are being reviewed (memos, MOUs, agency guidance, planning documents) to better incorporate climate adaptive capacity and resilience	10 key policies that could or should be revised to incorporate adaptation and resilience capabilities.
Category: Co-Benefits of Adaptation, cont.	
	3. **Data Tracking System Enhancements and Sustainable Project Dashboard**. USACE is currently enhancing its data tracking systems to ensure compliance with relevant sustainability-related laws, policies, and criteria at every level of the enterprise. This endeavor involves establishing new reporting fields, which necessitates routine updates from Project Delivery Teams (PDTs). As part of this comprehensive sustainability initiative, USACE is set to introduce a novel tool known as the "USACE Sustainable Project Dashboard." This innovative dashboard consolidates data from various sources, enabling real-time project status monitoring in relation to sustainability goals. The dashboard will be a dynamic and accessible resource, offering transparency and insights into the progress of ongoing initiatives. 4. **Assistance to PDTs**. Assists PDTs in meeting Code of Federal Regulations (CFR) 433.100, EO 14057, the Army sustainable design and development policy, and 2023 DoD and Army policies on electrification of building infrastructure, reducing climate change vulnerability, and decreasing emissions.

The USACE RCC program and CPR CoP provide planning and engineering guidance to enhance resilience and reduce vulnerability of USACE projects, systems, and programs to observed or expected changes in climate. The CPR CoP regularly issues and updates technical guidance to support climate change and SLC considerations in decision-making, planning, and design. Focus areas include SLC, U.S. Ocean Climate Action Plan (OCAP) goals, climate change impacts to hydrologic processes, wildfire frequency and ecosystems, NBS, resilience, and climate change impacts on reservoir management (i.e., reservoir sedimentation). In June 2023, the CPR CoP released a new EC 1100-1-113 and is currently updating ECB 2018-14. USACE is also initiating an update of guidance for incorporating SLC in advance of NOAA's next National Tidal Datum Epoch publication, anticipated in 2026. Guidance updates are supported by advances in tool and resource development.

The CPR CoP prioritizes initiatives targeted at advancing applications, planning solutions, and technical guidelines that support NBS. USACE's commitment to using NBS will be highlighted in a FY24 NBS Director's Memorandum. Concurrent to this policy memorandum, initiatives are being undertaken to develop CW NBS guidance documents and technical reports. To further these initiatives, USACE's IWR and Engineer Research and Development Center (ERDC) are conducting research on design criteria and developing papers aimed at advancing NBS solutions and guidelines. The CPR CoP collaborates with the Hydrology, Hydraulics and Coastal Community of Practice (HH&C CoP), the Planning Centers of Expertise and Planning Community of Practice (PCoP), and the Flood Risk Management Business Line Community of Practice (FRM CoP) to generate management plan updates, reports, policies, memorandums, and guidance targeted at increasing USACE's climate change resilience. USACE recently released a Memorandum for Resilience Integration in the USACE FRM Mission. As part of this guidance, USACE will identify ways to further actualize resilience throughout the FRM project life cycle and encourage resilience-focused thinking when discussing FRM-related

community needs, while aligning with the USACE FRM mission of reducing the threat to life and property from flooding and coastal storms. USACE is also in the final stages of releasing interim guidance for nonstructural implementation and is developing an ER with guidance for nonstructural elevations, floodproofing, acquisition, relocation, and replacement.

Additional USACE initiatives targeted at improving climate change preparedness, adaptive capacity, and resilience include Forecast Informed Reservoir Operations (FIRO), the Coastal Hazards System (CHS), and the SRP. FIRO addresses challenges posed by climate change-driven increases in frequency and intensity of extreme events to management activities at existing water resources infrastructure. FIRO is designed to make USACE's water management projects more adaptive in continuing to manage flood risk while also providing increased flexibility to improve water availability during intense droughts. The CHS is a national coastal storm hazard data resource for probabilistic coastal hazard assessment results and statistics, storing numerical and probabilistic modeling results including storm surge, astronomical tide, waves, currents, and wind. Hazards from hurricanes and extratropical storms include storm surge, waves, wind, rainfall, compound coastal-inland flooding, seiche, and extreme tides, among others. CHS is targeted at developing a consistent and accurate methodology to characterize coastal storm hazards. The IWR SRP is an interagency program with The Nature Conservancy demonstrating that a strategic, science-based approach at USACE reservoirs maintains or enhances the environmental resilience. Both ERDC and the USACE CPR CoP lead research and pilot studies targeted at supporting a better understanding of climate change impacts due to hydrologic drivers like permafrost melt, rain-on-snow events and ice jams, SLR, coastal storm risk, connectivity (e.g. power, road, waterway) resilience, compounding hazards, and mitigation co-benefits. Many CPR CoP research efforts involve collaborations with the National Atmospheric Research Center and are focused on identifying and developing actionable climate change science that supports decision-making for and design of water resources.

USACE worked to modernize the CW program through several policy initiatives to better serve the needs of communities with EJ concerns as it relates to climate change. These policies were developed to meet the directives put forth by the WRDAs of 2020 (PL 116-260) and 2022 (PL 117-263), which address EJ in CW programs, projects, and construction activities. For example, USACE produced an EJ Strategic Engagement Plan with associated guidance that creates an enterprise-wide structure for effective engagement. Communities with EJ concerns have been demonstrated to lack sufficient resources for expedited recovery from flood events, and the actions identified in the Strategic Engagement Plan provide direction for USACE to combat the effects of climate change on vulnerable populations through greater inclusion in decision-making and the analysis of comprehensive benefits beyond cost effectiveness. USACE is committed to meeting the goals of the Justice40 Initiative, including transforming its covered programs and policies to address the needs of communities with EJ concerns. In FY24, the ASA (CW) issued the updated USACE Tribal Consultation Policy and USACE issued EP 1105-2-64, Tribal Partnership Program. The Tribal Partnership Program (TPP) guidance includes specific sections for USACE consultation with tribes for the assessment of climate change risk and to implement climate change preparedness and resilience projects on tribal lands. In FY24, USACE is expected to complete requirements of EO 14096 in the development of an agency-wide EJ strategic plan to address not only CW activities, but all business lines as appropriate.

To slow the rate of climate change and increase climate resilience associated with USACE missions and operations, the agency must continually improve processes while also meeting performance targets for energy and water reduction, reduction in GHG emissions, and electric vehicle fleet implementation. Some sustainability and mitigation actions may provide adaptation co-benefits, as when water-efficiency upgrades to buildings provide resilience against droughts. USACE works with the Navy and Air Force to regularly update Unified Facilities Criteria (UFC) to include principles of climate resilience and mitigation. In addition to updating UFCs, USACE published new or updated implementation guides, memos, guidance, and standards to assist USACE Project Delivery Teams (PDTs) in meeting CFR 433.100, EO 14057, the army sustainable design and development policy, and 2023 DoD and Army policies on electrification of building infrastructure. Updated UFCs and publications include provisions to reduce climate change vulnerability and emissions. The ERDC develops codes, standards, and construction methodologies for additive construction to meet the needs of expeditionary and installation infrastructure to address a changing climate. The ERDC initiatives support structural integrity, sustainable material solutions, building envelope performance, assessing structure lifespan, and reducing GHG emissions.

Within the HQUSACE Operations and Regulatory Division, actions are being taken to better understand climate

change-driven risks to business lines like hydropower, recreation, navigation, and water supply. For example, a pilot study to support the water supply business line is currently underway to evaluate how downscaled global climate model projections can inform USACE's understanding of future water availability. USACE is taking action through its Enhancing Reservoir Sedimentation Information for Climate Preparedness and Resilience effort and its tracking of Drought Contingency Plan implementation to better track and understand the impact that climate change and SLC have on reservoir storage.

3B.4 Climate-Smart Supply Chains and Procurement

SUPPLY CHAIN AND PROCUREMENT – HYDROPOWER	
Agency has assessed climate hazard risk to critical supplies and services.	(Yes, No, Partial) Explain assessment and steps taken to improve adaptive capacity of critical supply chains.
Hydropower	**Partial**. As part of the Federal Hydropower Council, USACE, USBR, and the Department of Energy's Power Marketing Administrations established a multi-agency PDT with the following objectives: 1. Identify and evaluate impact of supply chain risks. 2. Identify existing best practices (including benchmarks from industry) to manage risks. 3. Define new risk management practices. 4. Recommend actions for specific entities to develop guidance, policy, and/or further analysis to implement risk management actions. The outcome of this PDT was a supply chain risk guide analyzing five major components that are critical to hydropower. Note that while climate hazards received some consideration, that was not the only focus of the report.
Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services.	(Yes, No, Partial) Explain priorities identified, strategies developed, and goals established, or the steps to develop them.
Hydropower	**No**
Agency has developed an implementation plan to address supplies and/or services disruption from climate hazards.	(Yes, No, Partial) Explain the implementation plans or the steps to develop one.
Hydropower	**No**

SUPPLY CHAIN AND PROCUREMENT – EMERGENCY MANAGEMENT/PUBLIC LAW 84-99	
Agency has assessed climate hazard risk to critical supplies and services.	(Yes, No, Partial) Explain assessment and steps taken to improve adaptive capacity of critical supply chains.
PL 84-99 Program	**Yes**. The PL 84-99 Program is a multifaceted USACE CW program that encompasses disaster preparedness, flood response, and recovery activities in support of federal, state, local, and tribal stakeholders. The program's goals are to provide timely and effective disaster preparedness, response, recovery, and mitigation projects and services on a nationwide basis to reduce loss of life and property damage. Critical supply chains include flood response supplies and equipment. Through climate hazard risk analysis, USACE addresses redundancies by maintaining existing stockpiles and established contracts with the private sector. Further analysis is planned for private sector supply chain resilience.

SUPPLY CHAIN AND PROCUREMENT – EMERGENCY MANAGEMENT/PUBLIC LAW 84-99, CONT.	
Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services.	(Yes, No, Partial) Explain priorities identified, strategies developed, and goals established, or the steps to develop them.
PL 84-99 Program	**Yes**. Supply chain priorities include maintaining supplies and equipment for flood response efforts.
Agency has developed an implementation plan to address supplies and/or services disruption from climate hazards.	(Yes, No, Partial) Explain the implementation plans or the steps to develop one.
PL 84-99 Program	**Yes**. USACE districts have developed flood response standard operating procedures, to include properly maintained supply stockpiles, to enhance supply chain resilience.

SUPPLY CHAIN AND PROCUREMENT – NAVIGATION	
Agency has assessed climate hazard risk to critical supplies and services.	(Yes, No, Partial) Explain assessment and steps taken to improve adaptive capacity of critical supply chains.
Navigation	**Yes**. From the very conception of its navigation projects, USACE CW considered the potential for severe flooding impacts. The original designs provide for complete and repeated inundation of the facilities. Site warehouses contain stocks of supplies to provide O&M during extreme events when access to materials might be otherwise limited. USACE navigation facilities have on-site maintenance staff and/or access to fleet staff who have the skills to address any damage to USACE facilities and equipment induced by extreme weather conditions.
Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services.	(Yes, No, Partial) Explain priorities identified, strategies developed, and goals established, or the steps to develop them.
Navigation	**Yes**. The agency houses locally adapted plans within O&M manuals to manage supplies and services for individual facilities. Plans are developed for each site and the conditions/vulnerabilities of that site. These manuals prescribe weather-related response and contingency plans to operate the facility during severe weather conditions.
Agency has developed an implementation plan to address supplies and/or services disruption from climate hazards.	(Yes, No, Partial) Explain the implementation plans or the steps to develop one.
Navigation	**Yes**. USACE CW formulates and designs its navigation facilities around severe weather and hydrologic conditions, so implementation is via mainstreaming climate considerations into normal business processes.

SUPPLY CHAIN AND PROCUREMENT – CONSTRUCTION	
Agency has assessed climate hazard risk to critical supplies and services.	(Yes, No, Partial) Explain assessment and steps taken to improve adaptive capacity of critical supply chains.
Construction	**Yes**. One of the primary actions being considered and implemented by USACE incorporates climate risk assessments into supply chain management. Recognizing the vulnerabilities posed by extreme weather events and rising sea levels, USACE is evaluating its suppliers' locations, infrastructure, and vulnerability to climate-related risks. This assessment includes identifying critical supply chain modes that could be impacted by climate change, such as ports, warehouses, and transportation routes. Furthermore, USACE encourages adopting innovative technologies and practices that reduce GHG emissions and enhance the resilience of supply chain operations.
Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services.	(Yes, No, Partial) Explain priorities identified, strategies developed, and goals established, or the steps to develop them.
Construction	**Partial**. USACE is revising its guidance, specifications, and requirements to align with climate adaptation and mitigation goals. This includes incorporating criteria that prioritize environmentally friendly and climate-resilient products and services. USACE is implementing technology like Internet of Things (IoT) devices to help identify supply chain vulnerabilities and investing in research targeted at developing climate-resilient infrastructure and technologies. Some USACE districts (e.g., Transatlantic Middle East District [TAM]) have been proactive in identifying multiple suppliers for required commodities and use multiple-award contracts to have more than one vendor available.
Agency has developed an implementation plan to address supplies and/or services disruption from climate hazards.	(Yes, No, Partial) Explain the implementation plans or the steps to develop one.
Construction	**Partial**. USACE is taking proactive steps to adapt to climate change in its construction supply chains and procurement processes. By integrating climate risk assessments, fostering partnerships with resilient suppliers, revising procurement criteria, investing in research, and fostering collaboration, USACE is building more resilient and sustainable infrastructure in the face of climate challenges.

AT RISK SUPPLIES/SERVICES	OUTLINE ACTIONS TO ADDRESS HAZARD(S)	IDENTIFY PROGRESS TOWARD ADDRESSING HAZARD(S)
Describe the acute and/or long-term climate hazard posed to mission-critical supply chains or services.	Outline actions to address the hazard(s).	Identify any current progress made toward addressing the hazard(s).
1. USACE Navigation Mission: Harbors and Waterways (Services). Changes in floods and drought frequency, intensity, and duration due to climate change (including SLC impacts) can impact waterways and channels, damaging facilities and navigation aids or reducing sailing drafts that can limit access or require lightering. This can undermine USACE's navigation mission thereby undermining national supply chains.	The USACE navigation mission is both a user of services and supplies and a critical component of the nation's supply chains. Actions to maintain coastal and inland navigation, and by extension supply chains, include continued emphasis on maintenance of the USACE locks and dams and ongoing studies to reevaluate existing locks for potential replacement. For coastal projects, actively monitoring SLC is also important. Such proactive actions make these waterway networks more resilient to floods, droughts, and other weather disruptions expected to become more frequent with a warming climate.	USACE integrates climate change and SLC in vulnerability assessments and project planning through the multiple sea level scenario approach required by ER 1100-2-8162, the CESL initiative, and the qualitative characterization of residual risk due to climate change required by ECB 2018-14 (rev. 2, 2022). Applying this guidance increases the resilience and adaptability of ports and navigable waterways to climate change impacts.
2. Labor and Lodging (Supplies). When USACE constructs a large project in a low population area, skilled or specialized labor is often scarce, requiring adjustment to standard contract labor rates. This is especially true when local populations are disrupted by severe weather events, as during post-disaster repairs or when workers are exposed to atypical risks. After disasters, worker housing is also often disrupted. To the extent that disasters could become more common in the future, the limited supplies of labor and lodging could become more impactful to the USACE supply chain over time.	Recognized, proactive actions to address this risk are to conduct cost engineering research and studies of local area market labor availability. Based on such investigations, specific locales or regions can address labor supply issues by adjusting independent government estimates (IGEs) to account for labor premium and overtime pay.	USACE employs GSA Emergency Lodging Services and makes use of military housing or temporary housing when necessary. For example, in the aftermath of Hurricane Maria in Puerto Rico, emergency housing was scarce, requiring the use of a hospital ship, the U.S. Naval Ship Comfort, for lodging.

AT RISK SUPPLIES/SERVICES	OUTLINE ACTIONS TO ADDRESS HAZARD(S)	IDENTIFY PROGRESS TOWARD ADDRESSING HAZARD(S)
Describe the acute and/or long-term climate hazard posed to mission-critical supply chains or services.	Outline actions to address the hazard(s).	Identify any current progress made toward addressing the hazard(s).
3. Dredging (Supplies and Services). Dredging demand is anticipated to increase for coastal restoration and channel maintenance due to anticipated increases in extreme weather events and flooding on U.S. rivers. There is also a strong demand for deeper channels to support supply chains. This strain on a limited dredge fleet can cause draft restrictions, longer wait times, and load lightening for vessels. **4. Emergency Response (Supplies and Services)**. A flood, hurricane, tornado, or other weather disruption limits emergency supplies to fight floods and reduce damage during severe weather events (e.g., Hesco bastions, one-ton "supersack" sandbags, sandbag filling machines, and dewatering pumps). Additionally, after a severe weather event the road network is frequently damaged, blocked by debris and downed utility poles, or otherwise compromised. This limits the response time for USACE's emergency management mission and causes supply chain disruptions for emergency supplies. As discussed in Chapter 4 of the 5th National Climate Assessment, this may be a more severe problem in the future as climate change leads to more compound or coincident events, including regional floods that require large amounts of supplies to be deployed to numerous areas simultaneously.	USACE is investigating improved planning approaches to be better equipped to manage storm response and emergency surges and dredging demand. Better understanding is needed as to whether climate change and SLC are resulting in higher or altered sedimentation rates and consequently changes in the required location and volume of dredging, particularly in coastal areas. USACE is investigating state of the art sustainable maintenance dredge design solutions that limit impacts to the environment. Long-term, sustainable FRM solutions are the best hope for avoiding supply chain issues in future emergencies. Further analysis of private sector supply chain resilience is necessary. Further analysis of government personnel required to deliver longer term mission-critical supply chains and services may also be needed. USACE is investigating additional measures and policy to strengthen this system, while promoting action so that emergency repairs do not evolve into unsustainable long-term solutions.	The dredging industry is responding to this market pressure with increased investment in new dredging capacity. The Government is responding with dredge fleet recapitalization efforts with focus on: • Vessel energy efficiency, including emission reduction, vessel "future proofing" to accept energy transition towards renewable energy, propulsive efficiency, and automation, • Marine life enhancements, and • Marine environmental considerations. Sustainment of dredge recapitalization efforts will enable continued climate-related advancements and adaptation in the USACE dredge fleet. During emergency response events, USACE presently uses manned and unmanned aerial vehicles to perform roadway to perform roadway route reconnaissance and identify barriers to accessing affected areas but is investigating usage of satellite data and other potential improvements. USACE policy and guidance requiring consideration of SLR and inland flood-frequency changes in design of infrastructure help maintain performance despite changing conditions. USACE manages the PL 84-99 emergency repair program to identify emerging FRM issues and partners with local and state flood managers through interagency Silver Jackets teams to address them in a comprehensive manner.

AT RISK SUPPLIES/SERVICES	OUTLINE ACTIONS TO ADDRESS HAZARD(S)	IDENTIFY PROGRESS TOWARD ADDRESSING HAZARD(S)
Describe the acute and/or long-term climate hazard posed to mission-critical supply chains or services.	Outline actions to address the hazard(s).	Identify any current progress made toward addressing the hazard(s).
5. Construction Supplies. Materials required for USACE construction missions, such as mechanical and electrical equipment and raw material like lumber and steel, may be disrupted by climate or severe weather impacts in the form of shipping or manufacturing bottlenecks and/or long lead times. This causes and exacerbates delays in maintenance and repairs. Additionally, construction material prices are subject to fluctuation (i.e., inflation) depending on economic conditions. When procuring construction materials in support of USACE applications, the need to adopt innovative technologies and practices that reduce GHG emissions is recognized.	To identify critical supply chain nodes that could be impacted by climate change, USACE is starting to conduct climate risk assessments as part of supply chain management. Additional actions taken to better understand construction supply chain vulnerabilities include cost engineering research and market studies, which are used to help predict procurement lead times and fluctuations in market price. In the procurement of construction materials for infrastructure projects, USACE has modified its specifications and contract requirements to prioritize materials that demonstrate climate resilience and contribute to climate change mitigation strategies (lower carbon footprint, energy efficiency, etc.).	USACE uses a three-level redundant supply chain to ensure sufficient supply of emergency materials: district-level stockpiles, the National Flood Fight Materiel Center located at the Rock Island (Illinois) Arsenal, and pre-negotiated private supply contracts. In emergencies, districts may also borrow materials from each other. In extreme cases, the Defense Production Act may be exercised to acquire certain supplies, within legal limitations and when authority is granted from FEMA. USACE has completed climate risk assessments related to supply chain management. Leveraging IoT devices across supply chains enables monitoring and tracking goods in real time and collects data to advance analytics and machine learning algorithms to help USACE predict potential risks from climate-related events. USACE contracts increasingly include clauses that prompt contractors to integrate climate adaptation measures into their construction and operation plans. Contractors are encouraged or mandated to develop and implement strategies that account for climate change impacts throughout the project life cycle. Due to high inflation rates post-covid, cost engineers are required to obtain up-to-date pricing from manufactures and apply market adjustments to IGEs based on the local construction market. USACE is already taking action to account for mechanical and electrical procurement schedule delays due to equipment procurement in the overall construction schedule of the project. USACE is leveraging multiple-award contracts and identifying multiple vendor options as strategies to address construction material supply chain issues.

USACE recognizes the critical need to address climate change impacts on its supply chains and procurement processes, as well as in executing USACE's navigation mission as a critical component of the nation's supply chains. The four USACE mission areas with particularly notable significant supply chain and procurement exposure due to climate change hazards are hydropower, emergency management (PL 84-99), navigation, and construction. The navigation mission includes maintenance and new work dredging completed by USACE's dredge fleet and contract dredges. Damages from extreme weather disruptions (floods and droughts), as well as coastal storms and SLR, are expected to increase in frequency and severity. These disruptions have the potential to compromise USACE's procurement processes, supply chains, and navigation mission. As climate change increasingly affects infrastructure, operations, and logistics, USACE is taking climate adaptation steps to maintain resilience and sustainability by placing emphasis on related EJ activities, including the Justice40 Initiative, enhancing the resilience of supply chain operations and encouraging the adoption of innovative technologies and practices that reduce GHG emissions.

While most USACE construction contractors are experienced in supply chain management and address potential issues proactively, an internal assessment of business line managers, acquisitions professionals, and logistics leaders revealed foreseeable shortages in goods and services, which could result in contract modifications and/or negative impacts on project delivery. USACE seeks to apply resilient procurement practices by diversifying suppliers across multiple regions, minimizing reliance on single points of failure, and adopting flexible procurement and sourcing practices, as well as using multiple-award contracts for redundant sources. USACE is seeking to incorporate climate risk assessments into agency supply chain management. Recognizing the vulnerabilities posed by extreme weather events and SLR, USACE is evaluating its suppliers' locations, infrastructure, and vulnerability to climate-related risks. Assessments include identifying critical supply chain nodes vulnerable to climate change impacts, such as ports, warehouses, and transportation routes.

USACE is revising its procurement specifications and requirements to align with climate adaptation and mitigation goals. This includes incorporating criteria that prioritize environmentally friendly and climate-resilient products and services. USACE prioritizes suppliers that offer sustainable materials, use energy-efficient technologies, or implement measures to reduce their carbon footprint. Examples include incorporating LEED and Green Procurement in designs and construction and using sustainable acquisition tools. USACE uses the sustainable acquisition tool to confirm that contracting officers include the necessary sustainability clauses in contracts. These clauses include using materials with recycled content, bio-based products, and water-efficient and energy-efficient products. The following are specific procurement actions USACE takes to meet climate adaptation and mitigation goals:

- When working with supply chains for procurement actions, USACE works with external stakeholders to ensure materials, storage facilities, and transport activities minimize impacts on communities with EJ concerns in the vicinity.
- In May 2022, USACE signed a Partnership Charter with the Association of General Contractors of America in a joint effort to overcome obstacles and increase innovation, resiliency, sustainability, agility, and efficiency.
- USACE is also taking action targeted at increasing the use of government and privately owned electric vehicles and reducing emissions associated with government travel. Besides directly reducing USACE GHG emissions, electric vehicles offer mobile, redundant energy storage to use during severe weather events.
- USACE procures a number of supplies and services through GSA. USACE will formally partner with GSA by providing a list of its mission-critical and mission-dependent products and services. USACE will address its supply chain vulnerabilities to climate change (as well as extreme weather incidents) at the order level, and GSA will determine if opportunities exist to address vulnerabilities in contract vehicles.

Moreover, USACE is investing in R&D targeted at developing climate-resilient infrastructure and technologies. This includes exploring advanced materials to withstand extreme weather events, integrating renewable energy solutions into infrastructure projects, and employing NBS for flood protection and ecosystem restoration. USACE construction materials guidance advances initiatives targeted at purchasing low-carbon products to support adaptation and/or resilience strategies. For example, ECB 2023-14 requires mandatory consideration of mass timber in Army Military Construction (MILCON) and CW vertical construction projects. The guidance identifies mass timber as a lower carbon alternative to energy-intensive structural materials. EO 14057 and ECB 2023-08 emphasize implementing clean

energy initiatives in construction to promote Federal Sustainability. The guidance is specific to MILCON projects but is a reference for applicable CW construction projects as well. It highlights the need to "incorporate building design techniques, building features, and proven efficiency technologies to ensure energy and water conservation and resilience." When DD Form 1391 programming documents are submitted as justification for MILCON vertical construction projects to Congress, emphasis is placed on incorporating renewable energy sources and resilient features such as portable/fire protection water storage and emergency generators, as well as requirements for recycled contents. Additionally, USACE is fostering collaboration with other government agencies, academia, and industry partners to share best practices, leverage expertise, and develop strategies for climate adaptation in supply chains and procurement processes. USACE aims to create a comprehensive framework that integrates climate resilience into every aspect of its supply chains and procurement operations.

USACE's navigation mission consists of providing the nation with safe, reliable, efficient, and environmentally sustainable waterborne transportation systems (i.e., channels and harbors). Floods and droughts impact ports and channels, damaging facilities or reducing sailing drafts, which limits access or requires lightering. USACE navigation infrastructure like locks and dams (L&Ds) are designed to withstand extreme conditions; for instance, they are engineered for repeated inundation and quick return back into service. On-site warehouses at the L&Ds contain stocks of oils and grease to allow sustained O&M during extreme conditions where external supply chains may be interrupted. One recognized risk is that some older L&Ds are single points-of-failure in waterway networks that are critical nodes in larger supply chains.

The USACE dredge fleet serves in a ready-reserve role, with private contract dredges acting as the first option for dredging (per PL 95-269). With SLR, sedimentation patterns in coastal channels will change, and demand for dredged material may increase to replace eroding shorelines. Increasing interest in natural and NBS for ecosystem restoration and shoreline protection, such as beaches, dunes, and coastal wetlands, is expected to cause increases in demand for dredged material as well. Climate change-induced changes in drought frequency/intensity and increases in extreme storm and flood occurrence and intensity will result in more frequent disruptions of dredge activities. This could result in longer wait times for shipping vessels or for them to lighten while they await dredges to arrive. Increased drought frequency also increases the need for dredging to keep navigation channels open, as observed during the severe summertime droughts on the Mississippi River in 2022 and 2023, which, for both years, extended into the fall and winter months. The 2022 and 2023 drought events resulted in 92 navigation vessel groundings and 57 closures. In 2023, USACE significantly reduced the negative effects on navigation during droughts, with 70% fewer hours of closures than in 2022. USACE achieved this improvement by using nine dredges to remove 22.5 million cubic yards of material throughout the drought event, which illustrates USACE's capacity to learn from previous events and adapt to low water conditions. This impact to navigation not only compromises the USACE supply chain of goods normally moved by barge (e.g., fuels, rock, sand, metals), and that of the nation at large, but also causes increased emissions of GHGs when shipping is diverted to more carbon-intensive road and rail options.

3B.5 Climate-Informed Funding to External Parties

USACE partnerships with external parties are critical to addressing climate change-driven issues. When working with external partners, USACE seeks to integrate EJ principles into its operations and activities. In general, USACE is not a grant/loan agency, though one program that it can use to offer external funding is the Corps Water Infrastructure Financing Program (CWIFP). CWIFP enables local investment in infrastructure projects that enhance community resilience to flooding, promote economic prosperity, and improve environmental quality. Through CWIFP, USACE provides long-term, low-cost loans to external partners. CWIFP prioritizes projects that serve communities with EJ concerns and projects related to climate adaptation or resilience. For projects that serve communities with EJ concerns, CWIFP increases financing limits from 49% to 80% of the total project cost and waives the $25,000 loan application fee. R&D grants are another avenue for external funding; the ERDC has issued a Broad Agency Announcement (BAA) to solicit proposals for R&D. Awards may be issued through contracts, grants, and other agreements, pending funding availability. A grant can be used when the principal purpose of a transaction is for a public support or stimulation effort that is authorized by federal statute and that may be related to climate change R&D as outlined in the BAA solicitation.

The Interagency and International Services (IIS) program allows USACE to provide management and technical services

to requesting federal agencies domestically and abroad. Most IIS work is funded on a reimbursable basis.[12] IIS initiatives include USACE's work with interagency partners on the U.S. Global Water Strategy and the President's Emergency Plan for Adaptation and Resilience with goals of improving water security and supporting climate change adaptation.

USACE works closely with non-federal partners to develop water resources projects. Many of these projects are ultimately owned and operated by non-federal partners. Additionally, USACE uses several programs to support non-federal planning for climate change. Through USACE's PAS program, USACE provides technical expertise through cost-shared (50% federal/50% non-federal) planning level projects that include consideration for SLR and CPR. The TPP supports cost-shared projects on tribal lands and specifically references addressing climate change risk. Through the FPMS program, USACE provides information on flood hazards to external parties. FPMS requests targeted at reducing climate change risk and encouraging adaptation and resilience are prioritized for funding. Under the National Flood Risk Management (NFRM) program, USACE supports interagency Silver Jackets teams. Recent Silver Jackets initiatives have focused on reducing climate change-driven risks, including adaptive management/ resilient features in design and pre- and post-hazard wildfire flood risk planning.

The need to review the disproportionate impacts to and outcomes of the cost sharing agreement (CSA) requirements presented to communities with EJ concerns is often cited as a recommended action for federal agencies. To start to address the burden these impacts place on these communities, WRDA 2022 (Section 8119) provides a PAS cost-share waiver for eligible communities with EJ concerns. Under WRDA 2020 (Section 165a), USACE's Continuing Authorities Program (CAP) launched a pilot program to fund small water resources projects for communities with EJ concerns. While Continuing Authorities Program (CAP) projects typically require a CSA with a non-federal sponsor, this pilot program will fully fund the selected projects. Under the TPP, feasibility CSAs qualify for a cost-share waiver of up to $665,000, and project partnership agreements (PPAs) qualify for an additional waiver of $665,000 regarding the tribe's cost share.

3C. Climate Training and Capacity Building for a Climate-Informed Workforce

TRAINING AND CAPACITY BUILDING	
Agency Climate Training Efforts	Percentage of the agency's federal staff who have taken a 60+ minute introductory climate training course (e.g., Climate 101): **Unknown**. • USACE Climate 101 Training is offered on-demand in five parts. The availability of the web-based training module has been widely publicized throughout the agency. USACE embedded an optional survey into the course material as a mechanism to help track participation and receive feedback on content. Because the training module is relatively new, its survey has not yet gathered enough data to report on participation. • USACE CPR in-person technical training is offered periodically to USACE divisions. This course covers introductory and intermediate topics related to sea level and climate change. ◦ Since 2021, division training has been offered to six of the seven USACE CONUS divisions: Mississippi Valley Division (MVD), Northwestern Division (NWD), Great Lakes and Ohio River Division (LRD), South Atlantic Division (SAD), the South Pacific Division (SPD) and the North Atlantic Division (NAD). ◦ Participation is comprised mostly of working-level planners, project managers (PMs) and HH&C CoP members. ◦ Participation since 2021: ▪ March 2021 NWD & LRD: 177 participants (50% HH&C CoP and 50% planners & PMs). ▪ February 2022 SPD: 75 participants (90% HH&C CoP and 10% planners & PMs). ▪ March 2022 NAD & SAD: 39 participants (80% HH&C CoP and 20% planners). ▪ June 2022 MVD: 56 participants (90% HH&C CoP and 10% planners & PMs).

12 *Economy Act (31 U.S.C. § 1535) or Project Order authority (41 U.S.C. § 6307).*

TRAINING AND CAPACITY BUILDING	
Agency Climate Training Efforts, cont.	Percentage of the agency's senior leadership (e.g., Secretary, Deputy Secretary, SES, Directors, Branch Chiefs) who have completed climate adaptation training): **Limited Participation/Percentage Unknown**. • In February of 2022, the CPR CoP lead, Dr. Will Veatch, delivered an executive climate briefing to the ASA(CW), the Honorable Mr. Michael L. Connor. • USACE does not currently have a CPR training program specifically targeted at senior leadership (SES, Deputy Secretary, Directors, etc.) and is not tracking how many senior leaders have taken Climate 101 training. • About 10%–20% of the participants in the in-person, 3-day division CPR Training are senior leaders (district section chiefs, branch chiefs, program managers, division leadership, national leadership). ◦ NWD & LRD training (17% of participants in senior leadership roles). ◦ SPD training (17% of participants in senior leadership roles). ◦ SAD & NAD training (10% senior leadership roles). ◦ MVD training (16% in senior leadership roles).
	Percentage of budget officials who have received climate adaptation-related training: **0%**.
	Percentage of acquisition officials who have received climate adaptation-related training: **0%**.
	Additional efforts the agency is taking to develop a climate-informed workforce: **Conference Participation**. District, division, and headquarters staff involved with the CPR CoP attend, present, participate on panels, and generate posters in support of numerous conferences that include presentations targeted at climate change science, SLC science, and climate change preparedness and resilience. Examples include participation in the annual American Geophysical Union Fall Meeting, the annual Northwest Climate Conference, the annual Midwest Climate Resilience Conference, Environmental & Water Resources Institute (EWRI) Conferences, and the American Meteorological Society Conferences. Most recently, the USACE CPR CoP presented a workshop on USACE's CPR program, tools, and resources at the 2023 Sedimentation and Hydrologic Modeling Conference. **Workshops**. District, division, and headquarters staff involved with the CPR CoP participate in workshops on behalf of USACE and the CPR CoP. Examples include the Department of Energy Puget Sound Earth-Human System Dynamic Workshop and 2023 the Nature-Based Solutions Upper Mississippi River Basin Workshop. The USACE IWR, in collaboration with the Rijkwaterstaat (Netherlands) held a workshop in July 2023 on Mainstreaming Nature-Based Solutions. The purpose of the workshop was to 1. Develop a shared vision for NBS; 2. Identify goals and actions to reach the vision; 3. Make connections across USACE teams working on NBS. **National Working Groups**. Members of the USACE CPR CoP participate in numerous national working groups such as the USACE FRM CoP and FRM CoP Advisory Board (FRM CAB), Climate-Smart Infrastructure Working Group, Flood Resilience Interagency Working Group, U.S. OCAP working groups, and the Coastal Working Group. **CPR CoP**. The USACE CPR CoP hosts periodic in-person meetings and targeted training (reviewer training, etc.), as well as monthly calls that include a presentation on a climate change- or SLC-related topic. Some USACE districts and divisions have dedicated CPR leads, regional technical specialists, and CPR sub-CoPs that provide guidance and support to technical personnel and provide climate training in the form of periodic web-based and in-person presentations.

TRAINING AND CAPACITY BUILDING	
Agency Climate Training Efforts, cont.	**EWN Program.** In 2020, the ERDC launched its Engineering with Nature podcast series. This podcast covers the application of EWN principles and practices. The podcast brings together collaborators from local, national, and international agencies; private and not-for-profit organizations; and academia to discuss idea and applications of NBS. The Network for Engineering with Nature (N-EWN) also holds webinars monthly, since 2021. These webinars focus on various NBS topics, including best practices, cutting-edge research, and the latest developments in the field of natural infrastructure (continuing education credits are available for these webinars). In collaboration with Texas A&M, EWN also held its first Short Course on Coastal Engineering and Nature-Based Solutions. The course was an immense success and will be offered again next year. **Sustainability Training.** USACE delivers sustainability training to the workforce through live and on-demand webinars and formal training, such as PROSPECT Course 244 Sustainable Military Building Design and Construction. Content for this training is consistently updated to reflect new sustainable and resilient building policies. **ERDC's CHL, Post-Wildfire Strategic R&D, and IWR-HEC Training**. This training improves USACE's ability to perform hydrologic and hydraulic modeling to represent wildfire-impacted stream flows and flood extents. • Corps Water Management System (CWMS) Wildfire Workshop (April 2023). • 2023 Federal Interagency Sedimentation and Hydrology (SEDHYD) Modeling Conference Short Course and Presentation (May 2023). • California (CA) Department of Water Resources (DWR) Wildfire Workshop (2023).
Agency Capacity	In support of the development of this 2024–2027 CAP, USACE performed a review of its FASCLASS system (repository of position descriptions [PDs]). As per USACE's 2021 Climate Preparedness and Resilience Policy Statement, planners, project managers, engineers, and scientists throughout USACE are required "to integrate climate change preparedness and resilience planning and actions in all activities." Based on the FASCLASS system review, USACE employs more than 6,500 civil engineers. USACE's HH&C CoP staff perform most of the technical analyses related to the effects of climate change. HH&C CoP staff consist of nearly 900 hydrologic and/or hydraulic engineers. Additionally, the CoP has over 300 environmental engineers, 40 hydrologists and 69 hydrologic technicians. Finally, USACE has three meteorologists, and 15 oceanographers. In all, USACE has nearly 1,500 HH&C scientists and engineers whose duties involve planning for and responding to climate change. For FY22 and FY23 combined, USACE had 366 job announcements for the above positions.
	Some of USACE's HH&C professionals are also part of the USACE CPR CoP, which has over 250 members and meets monthly. Although many USACE employees perform tasks related to CPR, only a small number of USACE district and division employees have tasks relevant to climate change in their official job descriptions. Nine employees have "Sea Level Rise" as part of the duties, and 28 employees have duties pertaining to "Army Climate Strategy" or "Climate Action Plan" in their PDs. Outside the HH&C CoP, USACE has 47 foresters and 2 forest technicians whose duties, among others, include preventing wildfires associated with climate change.

TRAINING AND CAPACITY BUILDING	
Agency Capacity, cont.	Within USACE, several leadership positions directly support the CPR CoP. HQUSACE currently has four dedicated full-time CPR CoP-specific positions. In addition, HQUSACE employs an EJ/Justice40 Program Manager, who coordinates across the Civil Works Directorate. The USACE IWR, in collaboration with the CPR CoP, employs an FTE specifically focused on climate science, whose responsibilities include translating climate science into all USACE missions, coordinating on climate adaptation guidance, and collaborating as the USACE climate science liaison with other federal agencies. IWR is also considering the establishment of an NBS detail to provide support throughout the USACE CW program, enabling a wide range of employees to support USACE's climate change mission. Within CW, approximately three senior Regional Technical Specialist (RTS) GS-13 positions officially have "climate change" in the job description. Beginning in 2021, ERDC created a Climate Change Tiger Team that informally reviewed which of ERDC's 2,400+ personnel have climate relevant skills and expertise. The review indicated that over 300 employees had a level of expertise and background related to climate mitigation and/or climate adaptation. ERDC actively recruits both mid- and entry-level employees with advanced degrees in fields related to climate change/SLC science, adaptation, and mitigation. Both ERDC personnel and USACE CPR CoP members are serving or have served in temporary details in support of the Office of the Deputy Assistant Secretary of Defense's (Energy Resilience & Optimization) Climate Action Team.

USACE employs thousands of dedicated professionals working together and with its valued partners to provide safe, sustainable solutions for planning, designing, building, and operating the agency's projects and facilities. Since the publication of the 2021 Climate Action Plan, the USACE CPR CoP coordinated several strategic efforts targeted at improving climate literacy including updating the CorpsClimate website, integrating context related to climate change into other training programs offered throughout the agency, delivering of presentations from USACE and external climate experts, and participating in a multitude of interagency efforts. The USACE IWR supports CPR CoP activities by executing contracts, government orders, and Intergovernmental Personnel Act (IPA) agreements, which help produce resources for improving and building tools and data necessary for climate resilience and adaptation activities within USACE.

The CPR CoP offers a forum for new and experienced practitioners to learn about USACE climate resilience efforts and advancements across disciplines. Through CoP engagement, staff suggest topics, offer presentations, and engage in unique opportunities. USACE also continues to identify skills and disciplines (including engineering disciplines, such as electrical and structural, and social science disciplines, such as sociology, demography, and anthropology) that future climate change mitigation and adaptation programs and projects will require. USACE continues to support science, technology, engineering, and mathematics (STEM) learning in schools with a focus on climate change skills and abilities to build the future workforce. Staff from divisions and districts routinely participate in STEM events at schools. In recognition of Earth Day 2023, the ERDC hosted a STEM event for approximately 120 eighth graders that featured demonstrations of various technologies that support sustainability and resilience. Annually, USACE engages in outreach activities online and in-person that support National Engineers Week. Activities include online posts and gatherings, which serve to recognize achievements in the engineering profession, improve understanding of USACE contributions to the nation through engineering, and promote professional development of engineers.

The USACE CPR CoP's climate and SLC training program currently includes on-demand training, in-person technical training, monthly web-based technical presentations, and specified reviewer training. As a first step to improve climate literacy across the enterprise, the USACE CPR CoP released a five-part, on-demand Climate 101 training course in April 2023. This course includes novice- and intermediate-level climate change-related content. A new module specifically targeting senior leaders (i.e., Commanders and SES) is under consideration as well. Additionally, a more technically oriented CPR training course is offered periodically to USACE divisions. The interactive, 3-day course is targeted at engineers, planners, project managers, and scientists and covers topics

like policy, planning, science, SLC, CPR tools, and vulnerability assessments. Other ongoing activities to increase climate literacy include USACE climate guidance and tools; training on risk-informed decision-making; and several USACE working groups on Adaptation, Non-Structural Solutions, the U.S. OCAP, and a Federal Climate Change Water Working Group. Between FY24 and FY27, USACE will continue to expand existing training, working groups, and interagency partnerships through varied and recurring communications infused across the agency. This includes continuing to engage USACE social scientists to develop multi-tiered, innovative communication tools and training plans that support the climate literacy of USACE's practitioners, supervisors, and managers.

The ERDC EWN program is also active in creating opportunities for USACE practitioners to gain expertise in applying NBS. EWN hosts "The Engineering with Nature" podcast, which brings together internal and external collaborators to discuss ideas and applications of NBS. EWN has held webinars monthly since 2021. These webinars focus on various NBS topics including best practices, cutting-edge research, and the latest developments in the field. In collaboration with Texas A&M, EWN also held its first Short Course on Coastal Engineering and NBS.

At a district and division level, integrating climate change into long-term planning studies is flagged as a priority, with district Commanders increasing the emphasis on initiatives targeted at NBS, EWN, SLC, EJ, and climate change impacts relevant to inland applications. In addition to integrating climate change expertise into existing roles, USACE established CPR-specific positions. This includes hiring an EJ National Program Manager and recently hiring two new headquarters employees dedicated to furthering USACE's CPR mission areas. The CPR CoP is also working alongside USACE districts and divisions to establish SMEs and RTSs in each major subordinate command (MSC) to provide on-site training, review, and on-call assistance as needed to the local workforce. USACE also established EJ leads at all eight MSCs and identified EJ coordinators at each district office to address EJ in USACE missions, projects, and studies. Future FTE positions may be established based on MSC or district needs.

In 2022, USACE contracted an external expert panel to evaluate barriers that limit USACE's ability to incorporate CPR into its activities. The project team identified 12 overarching barriers and provided 21 recommendations for more proactive climate change preparedness and resilience in USACE. In response to these findings, USACE will convene a high-level panel charged with examining these barriers and tasked with evaluating and implementing recommendations.

3D. Summary of Major Milestones

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3A.1. Addressing Climate Hazard Impacts on and Exposures of Federal Buildings	• Perform enterprise-wide vulnerability assessment of USACE building portfolio. • Integrate climate vulnerability assessments and hazard-specific plans into the Strategic Asset Management Plan.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Complete assessment – FY24. • Conduct future assessments on 5-year interval. • Develop hazard-specific mitigation plans for critical climate hazards. • Develop hazard-specific mitigation plans – FY25. • Update the Strategic Asset Management Plan – FY27 or sooner depending on an update to current management plan.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3A.1. Addressing Climate Hazard Impacts on and Exposures of Federal Buildings	• Develop climate-informed design standards or update existing design standards to include climate-resilient designs.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Evaluate existing design standards to prioritize needs – FY24. • Develop/Update standards based on prioritization – FY25–27.
Section 3A.1. Addressing Climate Hazard Impacts on and Exposures of Federal Buildings	• Coordinate with managing federal agencies where USACE leases buildings/ office space.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Establish dedicated liaisons with federal agencies responsible for USACE office leases – FY24–25. • Include assessment of climate impacts to leased USACE building/office space to the USACE POCs responsible for liaising with managing federal agencies.
Section 3A.1. Addressing Climate Hazard Impacts on and Exposures of Federal Buildings	• Implement smart building technologies to monitor temperature, precipitation, and other environmental parameters critical to building function.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Investigate potential technologies for investment – FY25. • Develop an implementation plan for smart building technologies – FY26.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3A.2. Addressing Climate Hazard Impacts on and Exposures of Federal Employees	• Expand Climate 101 training to educate employees across the USACE organization on topics that provide general overviews of climate hazards. • Augment existing training materials on heat safety with regional estimations of projected extreme temperatures. • Incorporate climate considerations into personal employee emergency response planning materials through collaboration with the Safety and Occupational Health Office. • Improve climate resilience in communities where USACE employees reside by promoting climate resilience planning through USACE planning authorities (e.g., floodplain management services and Silver Jackets) and upon request of state, local, tribal, or territorial entities.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Develop Climate 101 modules based on need – FY25–27. • Update heat safety training – FY24. • Develop personal emergency response planning materials – FY25.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3A.3. Addressing Climate Hazard Impacts on and Exposure of Federal Lands, Waters, and Cultural Resources	• Continue to use and maintain web-based portals such as the Reservoir Sedimentation Portal (also used by the USBR) and Access to Water (for pool elevation, precipitation, flow status, and WCMs) to make USACE data public. • Continue to maintain WCMs and DCPs to facilitate monitoring. • Screen existing USACE project sites for climate-driven vulnerabilities using indicators tied to climate projections (CWVAT), as well as the CESL (where applicable). • Expand use of UAVs and remote-controlled vessels to collect sedimentation and other information faster and more cheaply, providing insight into sedimentation changes as climate changes. • Develop and deliver workshops on appropriately applying natural and nature-based features that may display some degree of self-adaptation to climate changes but which also entail specific climate-related considerations. • Apply best practices for shoreline resilience of reservoirs as vegetation adapts to changes in water level and salinity. • Apply best practices for floodplain resilience.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Maintain web portals with latest information. • Establish a series of NBS workshops. Develop content FY24; begin hosting FY25. • Partner with the Ecosystem Restoration business line to incorporate climate change into habitat models – begin FY25. • Perform a portfolio vulnerability assessment – FY25. • Maintain manuals, plans, and guides on the schedules prescribed in policy and guidance. • Update all DCPs by FY28. Where necessary, collect updated hydrologic data and incorporate that information into the contingency plans.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3A.3. Addressing Climate Hazard Impacts on and Exposure of Federal Lands, Waters, and Cultural Resources, cont.	• Consider future climate change impacts when developing long-term ecosystem restoration strategies. • Consider including climate change in existing habitat models to assess impacts on species. • Continue implementing the SRP to further demonstrate that a strategic and science-based approach at USACE reservoirs maintains or enhances the environmental benefits and reduces negative environmental consequences of downstream flows. • Continue applying USACE's Environmental Operating Principles, developed so that USACE missions totally integrate sustainable environmental practices, which directly apply to how USACE manages, conserves, and protects natural and cultural resources at USACE-operated projects. • Reduce extreme weather disruptions at projects by updating WCMs, DCPs, and natural resources management guides to reflect climate as it changes.		

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3A.3. Addressing Climate Hazard Impacts on and Exposure of Federal Lands, Waters, and Cultural Resources	• As necessary and able, provide information to help avoid sites and areas that might be sensitive cultural resources during firefighting. • During and subsequent to wildfire events, take steps to minimize effects of increased erosion resulting from the loss of vegetation on protected sites. • Subsequent to wildfire events, visually inspect the affected areas to determine any adverse effects to cultural resources.	Wildfire	• Continue to implement and establish new technologies (e.g., unmanned vehicles) to more efficiently inspect and evaluate sites.
Section 3A.3. Addressing Climate Hazard Impacts on and Exposure of Federal Lands, Waters, and Cultural Resources	• Use technology, such as drones, to monitor shoreline erosion that may be related to effects of extreme heat, drought, extreme precipitation, SLR, and flooding (riverine and coastal). • Subsequent to flood events, visually inspect the affected areas to determine any adverse effects to cultural resources. • Where erosion is having an adverse effect, consider protective measures, such as the placement of fill or stone.	Flooding, SLR, extreme temperature, drought, extreme precipitation	• Continue to implement and establish new technologies (e.g., unmanned vehicles) to more efficiently inspect and evaluate sites.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3A.4. Accounting for Climate Risk in Planning and Decision-Making: Portfolio Risk Assessments	• Update CWVAT. • Conduct portfolio risk assessments using the CWVAT and CESL and develop strategy for the application of results and next steps. • Release the Coastal Hazards and Risk Toolkit (CHART) for CSRM life-cycle planning assessments.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Release the improved CWVAT – FY24. • CWVAT Portfolio Risk Assessments Report and Results – FY25. • Portfolio-wide CESL Report and Results. • Determine how to use portfolio risk assessments to inform USACE actions, including budgeting. • Demo and refine CHART numerical model and online user documentation with two case studies via field user group – FY26.
Section 3B. Incorporating Climate Risk into Policy and Programs: United States OCAP Goals	Inclusion of communities with EJ concerns in the planning process, and policy/guidance updates provide opportunities for USACE to consider impacts and benefits to communities with EJ concerns that help build resilience to climate driven risks. Relevant milestones are as follows: • Integrate EJ principles into the federal government's ocean activities. • Improve ports to help facilitate offshore wind energy deployment and "green" the nation's ports. • Take actions to support the Accelerate Nature-Based Solutions goal. • Promote coastal community resilience strategies that are adaptive, equitable, and based on best practices.	EJ (communities with EJ concerns face significant climate change driven risks [e.g., decreased ability to recover from climate-related disasters]), resilient supply chains, SLR/coastal flooding	• Develop ocean justice strategy. • Assist in upgrading port facilities infrastructure. • Incorporate nature-based features and performance monitoring in coastal resilience projects; augment engineered projects with NBS; and promote managed wetland migration in response to SLR. • Plan and construct coastal storm risk reduction projects that meet community needs, employ best-available science, including NBS, and protect ecosystems.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3B. Incorporating Climate Risk into Policy and Programs: USACE CPR Guidance Updates	• Update climate change and inland hydrology guidance and supporting resources. • Update SLC guidance and tools. • Create climate change- and ecosystem-specific guidance. • Update relevant HH&C guidance (contingent on funding availability).	SLR, coastal flooding, extreme precipitation, shifts in drought frequency/intensity, riverine flooding, ecosystem degradation	• Publish updated SLC guidance for the next National Tidal Datum Epoch in 2026. • Modernize the USACE SLAT. • Publish guidance on characterizing climate change impacts in hydrologic analyses (inland focus) to replace ECB 2018-14 and ETL 1100-2-3, as well as updates and/or resources to support in-depth inland climate change analysis guidance EC 1100-1-113. • Publish standalone guidance or new verbiage in updated, existing CPR, HH&C, and/or PCoP guidance specific to addressing climate change hazards to ecosystems. • Update relevant HH&C guidance to include the latest actionable science related to CPR (contingent on funding availability).
Section 3B. Incorporating Climate Risk into Policy and Programs: Wildfire and Drought Initiatives	• Embed drought resilience in all existing and future USACE projects. • Develop the Post-FiRE Decision Support Tool and corresponding technical guidance. • Develop regional post-wildfire flood and debris flow models. • Develop a low-water operational model for the Mississippi River System. • Conduct FIRO site-specific viability assessments and pilot studies. • Develop post-crisis debris removal technologies.	Drought, wildfire	• Create an agency-wide, strategic approach to drought resilience. Supporting products to include: ◦ A technical report on drought lessons learned. ◦ An interactive GIS-based webpage providing access to DCPs, current conditions, and other resources at a project scale. ◦ Continue to update HEC's Hydrologic Modeling System (HEC-HMS) to better represent post-wildfire conditions. ◦ Release the Post-FiRE Decision Support Tool. Release engineering guidance covering post-wildfire modeling best practices in conjunction with the tool.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3B. Incorporating Climate Risk into Policy and Programs: Wildfire and Drought Initiatives, cont.			• Deliver region-specific models to mitigate post-fire flood and debris flows, integrating remote sensing data for flow forecasting – FY26. • Deliver beta debris classification and quantification software, demo unmanned equipment for route clearance and debris removal, and test model to estimate debris for unplanned extreme events – FY26. • Deliver beta version of Low Water Operational Model for Mississippi River System for navigation resilience – FY27. • Complete FIRO viability assessment of 14 dams in Willamette River Basin, initiate national application of FIRO screening process to USACE dams, and complete viability assessments of at least eight systems of dams in non-Western regions – FY27.
Section 3B. Incorporating Climate Risk into Policy and Programs: EJ Initiatives	• Update USACE CW policy and guidance to include EJ/Justice40 initiatives. • Develop an agency-wide EJ strategic plan (per EO 14096). • Develop a preliminary EJ Program Management Plan (PgMP). • Develop a training module for CW to address EJ.	EJ (communities with EJ concerns face significant climate change driven risks [e.g., decreased ability to recover from climate-related disasters])	• Implement updated policies in the planning process. • Obtain MSC endorsement of EJ strategic engagement plans. • Obtain HQUSACE approval of EJ PgMP. • Launch pilot EJ training.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3B. Incorporating Climate Risk into Policy and Programs: NBS Initiatives	• Develop NBS guidance for engineering and construction. • Meet the requirements of the Beneficial Use of Dredged Material Command Philosophy Notice (per 2023 Notice). • Assess short- and long-term climate change impacts to AER projects. • Develop methods to incorporate GHG and carbon capture in AER projects. • Develop methods and tools to quantify the multi-mission benefits of NBS/EWN, including improvements to water quantity and reduction of wildfire and drought impacts. • Develop guidance, methods, and tools to incorporate MAR into USACE operations.	Riverine flooding, coastal flooding, SLR, drought	• Publish an NBS Director's Policy Memorandum. • Publish an EP specific to NBS. • Publish technical reports on oyster reefs, constructed coastal wetlands, alternative bank protection, and floodplain reconnection. • Publish the NBS Planning Guidance and Coastal NBS Technical Report. • Make progress toward goal of using 70% of dredged material from construction and O&M water resources projects for beneficial uses by 2030. • Complete a MAR Planning and Guidance Study and develop tools and guidance based on the study's findings.
Section 3B. Incorporating Climate Risk into Policy and Programs: Nonstructural Solutions	• Develop nonstructural guidance, to include the following: ◦ Develop interim nonstructural guidance. ◦ Establish a nonstructural MCX to provide expertise in addressing SLR and extreme precipitation through nonstructural projects. ◦ Develop a nonstructural ER to provide guidance and policy for implementing nonstructural projects to reduce the risk of inland and coastal flooding (includes SLR and extreme precipitation).	Inland flooding, coastal flooding, SLR, extreme precipitation	• Publish Interim Nonstructural Guidance (slated for publication in May 2024). • Establish a nonstructural MCX (expected by 4th quarter FY25). • Publish a nonstructural ER – covering further guidance (planning, real estate, engineering and construction) (expected by 4th quarter FY25). • Deliver Chief's reports with nonstructural plans; construct authorized projects.

SECTION OF THE IMPLEMENTATION PLAN	DESCRIPTION OF MILESTONE	CLIMATE RISK ADDRESED	INDICATORS FOR SUCCESS
Section 3E. Climate Training and Capacity Building for a Climate-Informed Workforce: Training	• Expand training for senior leadership. • Conduct technical training. • Increase the number of recognized CPR-related SME and RTS positions within districts and divisions.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Update the Technical Review Training and Review Guide. • Generate on-demand training for SLAT and CWVAT. • Conduct in-person or web-based division training for the Southwest Division, Pacific Ocean Division, and Transatlantic Division. • Add a module to Climate 101 specifically for senior leaders. • Establish CPR SMEs and RTSs at each MSC.
Section 3E. Climate Training and Capacity Building for a Climate-Informed Workforce: Climate Literacy	• Translate the Barriers to CPR report into an implementation plan.	Comprehensive climate hazard exposure (e.g., wildfire, drought, ecosystem degradation, flood risk, coastal flooding)	• Stand up a high-level internal panel to identify barriers. • Develop an evaluation and implementation plan to address barriers identified.

Section 4: Demonstrating Progress

4A. Measuring Progress

KEY PERFORMANCE INDICATOR: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027		
Section of the CAP	Process Metric	Agency Response
3A – Addressing Climate Hazard Impacts and Exposures	**Step 1**: Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. (Y/N/Partially) **Step 2**: Agency has a list of discrete actions to take through 2027 as part of their implementation plan. (Y/N/ Partially)	Step 1: **Partially**. A detailed implementation plan with discrete actions will be developed internally on publication of the CAP. The goal is to identify actions to address as many climate hazard impacts and exposures as is reasonably feasible given resource constraints and USACE's authority. Step 2: **Partially**. The discrete actions identified as part of the detailed implementation plan above will be acted on through 2027 as is feasible given resource constraints.
3B.1 – Accounting for Climate Risk in Decision-making	Agency has an established method of including results of climate hazard risk exposure assessments into planning and decision-making processes. (Y/N/Partially)	**Yes**. USACE currently considers the risk of climate hazard risk exposure, including the effects of SLC and impacts to inland hydrologic processes, in its missions, operations, programs, and projects. Please see Section 3B.1 Table for more detail.
3B.2 –Incorporating Climate Risk Assessment into Budget Planning	Agency has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions. (Y/N/Partially)	**No**. The USACE budget process is based on projects that are individually appropriated by Congress, precluding agency-wide incorporation of climate risk into the Congressional budget process. However, USACE does incorporate climate risk into budget and planning decision-making as detailed in the table in Section 3B.2, and individual projects are required to mainstream climate considerations into planning, including their projected costs and benefits.

KEY PERFORMANCE INDICATOR: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027, cont.		
Section of the CAP	Process Metric	Agency Response
3B.5 – Climate-Informed Funding to External Parties	**Step 1**: By July 2025, agency identifies grants that include considering and/or evaluating climate risk. **Step 2**: Agency modernizes all applicable funding announcements/ grants to include a requirement for the grantee to consider climate hazard exposures. (Y/N/Partially)	Step 1: **Yes**. In general, USACE is not a grant/loan agency. One exception is the CWIFP. The only other grants USACE offers are in support of ERDC R&D. Step 2: **Yes**. CWIFP already prioritizes projects that serve communities with EJ concerns and projects related to climate adaptation or resilience. Climate change/SLR science, impacts, resilience, adaptation, and mitigation are already high priorities for ERDC's R&D program.
KEY PERFORMANCE INDICATOR: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027		
Section of the CAP	Process Metric	Agency Response
3A – Addressing Climate Hazard Impacts and Exposures	Agency has identified the information systems that need to incorporate climate change data and information and incorporates climate change information into those systems by 2027. (Y/N/Partially)	**Partially**. USACE uses a wide range of information systems that have the potential to be modified to better incorporate climate change data and information. The CPR CoP actively works with other USACE programs to identify systems that better support agency-wide CPR. Examples of information systems that are actively managed to reduce climate hazard risk to USACE are CPR-specific tools and databases that include the suite of tools to perform vulnerability assessments (CWVAT, CorpsPET, CESL, DCAT), tidal gauge datum maintenance, the Reservoir Sedimentation Information database, and inventorying DCPs and CPR training models (i.e., Climate 101). Climate Change is also incorporated into regular updates to USACE WCMs and project Master Plans. Other systems or programs identified as priorities for incorporation of climate change information or vulnerability assessment results include USACE's ERR, the Civil Works Asset Management System, the CHS, and the FIRO program. USACE is also dedicated to modernizing and maintaining its disaster response systems that are critical in responding to climate-driven hazards like extreme storms, flooding, and wildfire. These systems include the DoD Alert Mass Notification System and the U.S. Army Disaster Personnel Accountability and Assessment System (ADPAAS), as well as updates in support of the USACE COOP program.

KEY PERFORMANCE INDICATOR: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate NBS, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives		
Section of the CAP	Process Metric	Agency Response
3B.3 – Incorporating Climate Risk into Policy and Programs	By July 2025, 100% of climate adaptation and resilience policies have been reviewed and revised to (as relevant) incorporate NBS, mitigation co-benefits, and equity principles. (Y/N/Partially)	**Partially**. The CPR CoP leadership is dedicated to continually reviewing and updating climate adaptation and resilience policies, guidance, resources, and directives. Resources permitting, policy, guidance, etc. will be updated. This includes the initiatives specifically highlighted within Section 3F Timeline Summary for Major Milestones. Efforts to incorporate NBS, mitigation co-benefits, and equity principles into new and existing guidance/policy are high priority actions and many related initiatives are already planned or underway. USACE has an extensive library of active and proposed policy and guidance documents with relevance to climate adaptation and resilience in the queue for revision, updates, and development. Availability of resources to support all potential updates and new guidance/policy documents by July 2025 is unlikely.
KEY PERFORMANCE INDICATOR: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027		
Section of the CAP	Process Metric	Agency Response
3B.4 – Climate-Smart Supply Chains and Procurement	**Step 1**: Agency has assessed climate exposure to its top 5 most mission-critical supply chains. (Y/N/Partially) **Step 2**: By July 2026, agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards. (Y/N/Partially)	Better understanding is needed of how climate and SLR impacts affect USACE's dredging supplies and services. Further analysis of the supply chains that support and provide emergency response services and materials for USACE construction missions is required. Additionally, USACE is investigating specifications, measures, and policies to strengthen these systems. Step 1: **Partially**. This step is considered complete for the Navigation and Labor and Lodging supply chains Step 2: **Partially**. By July 2026, USACE anticipates additional progress toward identifying and planning for supply chain/procurement disruptions driven by climate change-related hazards. However, USACE's ability to address/overcome supply chain disruptions is limited, because USACE relies on the private sector to obtain construction materials and emergency response supplies. Similarly, USACE relies on privately owned dredge vessels to supplement the agency's in-house dredge fleet. As a result, USACE cannot unilaterally address climate change-driven supply chain issues. These risks, at least in part, have to be recognized and mitigated within the private sector.
	Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services. (Y/N/Partially)	**Partially**. The four USACE mission areas with particularly significant supply chain and procurement exposure to climate change hazards are hydropower, emergency management (PL 84-99), navigation, and construction. This metric was evaluated separately for each mission area as indicated below. More detail is provided within the tables in Section 3B.4. • Hydropower: No • PL 84-99: Yes • Navigation: Yes • Construction: Partial

KEY PERFORMANCE INDICATOR: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures		
Section of the CAP	Process Metric	Agency Response
3C – Climate Training and Capacity Building for a Climate-Informed Workforce	Step 1: By December 2024 100% of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. (Y/N/Partially) Step 2: Does the agency have a Climate 101 training for your workforce? (Y/N/ Partially) If yes, what percent of staff have completed the training? Step 3: By July 2025, 100 % employees have completed Climate 101 trainings. (Y/N/Partially)	Step 1: **Partially**. Efforts are currently made to provide USACE leadership with briefings targeted at providing an overview of USACE's CPR-related actions, policy, guidance, etc. Technical leaders are encouraged to participate in CPR CoP monthly calls and to attend USACE's 3-day, in-person CPR training course. A goal of this 2024–2027 CAP is to add a module targeted at senior leadership to USACE's Climate 101 on-demand training course. Once added, a concerted effort will encourage participation. However, having 100% of the agency's leadership take a course or be otherwise briefed on USACE's CPR-related activities by December 2024 is unlikely. The goal as is presented herein is to move toward **partial** completion by that timeline. Step 2: **Yes**. However, the percentage of staff who have completed the training is currently unknown. The training module currently has no means of tracking participation. It does have an optional survey that could potentially help track participation in the future. Since the training module is relatively new, its survey has not yet gathered enough data to report on participation. Step 3: **Partially**. Likely to be partially completed by 2025. To accomplish this, a more robust mechanism for tracking participation would also have to be developed.

4B. Adaptation in Action

Actions to promote climate change adaptation and resilience span all of USACE's activities for the purposes of enhancing community resilience and the effectiveness of the military support mission. USACE CPR initiatives support communication with stakeholders and the public. USACE has been addressing climate change issues like SLR since the late 1970s. Actions initiated in response to EO 14008, the 2021 Climate Action Plan, and this document build on USACE's existing programs. USACE strives to integrate climate change considerations across its business processes so that agency projects, programs, missions, and operations perform as intended despite uncertain future conditions. For example, USACE requires that projected SLR (with uncertainty) be incorporated into plans and designs to support project performance over a full range of plausible future scenarios. This approach informs adaptation pathways that specify triggers, thresholds, and lead times for future adaptation. For other applications, where future conditions are too uncertain to project with confidence, USACE employs techniques for decision-making under deep uncertainty. For these applications, potential vulnerabilities are identified and tied to potential future hazards. In cases marked by deep uncertainty, resilience strategies focusing on preparedness and rapid recovery may be more appropriate. A few specific examples of successes or challenges in implementing climate adaptation are detailed in the following paragraphs.

Since the publication of the 2021 Climate Action Plan, USACE updated and published numerous **policy and technical guidance documents**. This includes the development of a CPR Technical Review Guide and the publication of EC 1100-1-113. USACE is also dedicated to enhancing its implementation of NBS, as demonstrated by the USACE EWN program producing International Guidelines on NBS for FRM in September 2021 and helping facilitate a National Academy of Engineering workshop on NBS policy and guidance in May 2022. USACE also published its updated planning guidance ER 1105-2-103, Policy for Conducting Civil Works Planning Studies, that reflects the need and

requirement to consider climate change, NBS, and nonstructural features in formulating CW projects. The 2021 Climate Action Plan placed emphasis on the **provision of actionable climate information, tools, and projections**. USACE continues to produce rigorous, actionable climate information and to update and improve its suite of climate change-related tools and resources. To reduce cybersecurity threats and improve reliability, all USACE's climate web tools were migrated to the Amazon Web Services (AWS) cloud in 2022. Since 2021, USACE updated CHAT to better communicate climate change impacts and risk based on downscaled climate model outputs. The widespread uncertainty in climate model-based projections of hydrometeorology remains a challenge for its application to project planning and design. USACE continues to work with the science agencies and other partners to reduce and understand uncertainty in climate model output, while also developing planning approaches that do not rely on precisely characterizing future climate. In contrast to hydrometeorology, projecting SLR has relatively lower uncertainty and thus more direct applicability in project design. In 2023, the Sea Level Curve Calculator and Sea Level Tracker tools were consolidated into the Sea Level Analysis Tool to improve efficiency, streamline application, and reduce costs.

USACE has also evolved how the agency **manages its lands and waters** for CPR. Since 2021, USACE completed screening-level assessments of existing USACE FRM project sites for climate change vulnerabilities and is committed to applying its CESL tool to characterize vulnerabilities to SLR. USACE is currently working on updating CWVAT, the tool used to perform vulnerability assessments. USACE WCMs and DCPs are continually updated to reflect climate change-driven challenges to project management.

USACE is dedicated to **enabling state, local, and tribal government preparedness** in the face of changing conditions. USACE leverages its NFRM program through support for interagency Silver Jackets teams, as well as the TPP, FPMS, PAS, Silver Jackets, and Continuing Authorities programs to improve the awareness and understanding that state partners, local governments, and tribes have regarding flood risk challenges in the face of climate change.

The 2021 Climate Action Plan placed particular emphasis on USACE's tribal partnerships. Since the publication of the 2021 Climate Action Plan, several project-specific examples of climate change consideration have supported projects on tribal lands. For instance, the Lower Brule Sioux Tribe Sewage Lagoon and Ecosystem Restoration Project addresses climate change risk by leveraging both USACE's technical support, closely collaborating with the Lower Brule Sioux Tribe and integrating indigenous knowledge.

In addition to collaborating with state, local, and tribal partners, USACE builds relationships with other federal agencies, academia, interagency groups, and science organizations to further USACE's ability to address climate change risk and create robust climate adaptation and resilience strategies. Key collaborations since 2021 include work in support of the Columbia River Treaty with Canada and a United States Geological Survey-led study of the stationarity in the Upper Mississippi River Basin. USACE continues to participate in numerous interagency working groups focused on climate adaptation, including the White House Flood Resilience Interagency Working Group and the DoD Coastal Assessment Regional Scenario Working Group.

USACE is also undertaking actions to better **plan for climate change-related risks**. Since 2021, USACE prioritized initiatives targeted at increasing electrical vehicle usage. Besides directly reducing USACE GHG emissions, electric vehicles offer mobile, redundant energy storage to use during severe weather events. USACE also launched an Enterprise Risk Register (ERR) to help project and leadership teams better review project financial risks, including those driven by climate change, to USACE CW projects.

Improving **climate literacy** is an agency priority highlighted in both the 2021 Climate Action Plan and this 2024–2027 CAP. USACE conducted climate and sea level technical training for all USACE CONUS divisions except for the Southwestern Division (postponed due to flood events). Between FY24 and FY27, USACE will conduct in-person or web-based training for the remaining three divisions (Southwest, Pacific Ocean, and Transatlantic). USACE also developed and delivered a Climate 101 training module for a general audience and climate assessment-specific training for technical reviewers.

Since the publication of the 2021 Climate Action Plan, USACE made substantial progress in implementing **EJ initiatives**. In March 2022, the ASA(CW) issued interim guidance for implementing EJ and the Justice40 initiative. In the summer of 2022, the ASA(CW), with support from USACE, conducted a series of public and tribal virtual meetings to gather feedback targeted at modernizing the USACE CW program to reduce the negative impacts of climate change on

communities with EJ concerns. USACE district offices have also developed EJ strategic communication plans endorsed by division Commanders, which are updated periodically and maintained on district websites. USACE is currently developing its Environmental Justice Strategic Plan per EO 14096 and based on guidance provided by the Chair of CEQ under section 9 of that order. This plan will set forth the USACE vision, goals, priority actions, and metrics to address and advance EJ, including through the identification of new staffing, policies, regulations, or guidance documents, and will identify opportunities through regulations, policies, permits, or other means to improve accountability and compliance with any statute the agency administers that affects the health and environment of communities with EJ concerns.

In addition to these specific examples of successes and challenges, USACE remains committed to engaging in critical self-reflection to facilitate continuous improvement in implementing climate adaptation. In FY23, USACE assessed barriers to climate change adaptation within the agency. The identified barriers are the basis for defining discrete actions as part of the 2024–2027 CAP to improve USACE's ability to adapt to climate change.

Glossary of Terms and Acronyms

Assistant Secretary of the Army for Civil Works (ASA(CW) or ASA): The political appointee responsible for overseeing the USACE Civil Works program.

Civil Works (CW): The portion of the USACE mission that focuses on managing and developing the nation's water resources and infrastructure through projects that address national problems and opportunities related to water resources challenges such as flood risk management, navigation, or environmental restoration. The program aims to collaborate with federal, state, local, and tribal partners to provide sustainable solutions for water-related challenges, enhance economic development, and promote environmental stewardship across the United States.

Climate Change Response (CCR) budget process: A targeted, metric-based budgeting process to reduce climate change risk. Metrics are used to report emissions, identify potential areas for improvement, and highlight successes. Metrics also support initiatives to improve energy and water efficiency and transition toward lower carbon energy sources. Such actions also support climate resilience through improved readiness to outages and increased operational sustainability.

Climate Preparedness and Resilience (CPR): The collection of activities that serve to ensure USACE missions, programs, projects, and operations are prepared to perform now and in the future despite the uncertainties of changing climate conditions. CPR may also refer to the Climate Preparedness and Resilience Community of Practice (CPR CoP), a collective of professionals working to improve USACE preparedness to the effects of climate change.

Coastal Hazards System (CHS): A national coastal storm hazard data resource for probabilistic coastal hazard assessment results and statistics, including storm surge, astronomical tide, waves, currents, and wind. Based on high-resolution numerical modeling of coastal storms spanning practical probability and forcing parameters, these results directly support probabilistic design or risk assessment.

Community of Practice (CoP): A voluntary collective of employees and partners organized to share knowledge and practices on a particular area of professional specialization.

Engineer Circular (EC): A guidance document containing policy that is parallel to an ER (i.e., directive in nature) but with applicability that is transitory (one-time occurrence or otherwise temporary). ECs remain active for up to two years.

Engineering and Construction Bulletin (ECB): A guidance document that disseminates important information, updates, and guidance related to engineering and construction activities. ECBs provide timely communication on specific issues and/or changes in policies, procedures, or technical requirements that may impact ongoing or future engineering projects.

Engineer Manual (EM): A guidance document that provides detailed procedures, methods, and standards for executing engineering projects or activities. EMs are more specific and detailed than ERs, offering guidance on how to carry out tasks within the framework set by ERs.

Engineer Pamphlet (EP): A guidance or reference document of a continuing nature, which may be either procedural or informational. A procedural EP contains functional, instructional, or procedural guidance needed to implement programs or systems directed in regulations. An informational EP is a non-policy publication designed for information only. It may consist of booklets, leaflets, and/or folders on various information, recruitment literature, historical studies, and reference texts.

Engineer Regulation (ER): A guidance document that establishes policies, assigns responsibilities, and provides procedures for implementing engineering programs or activities. ERs are directive documents that cover broad topics and set the framework for specific engineering areas.

Engineering With Nature (EWN): A program of the Engineer Research and Development Center (ERDC) that promotes sustainable and environmentally friendly engineering practices by integrating natural processes and ecosystems into engineering solutions.

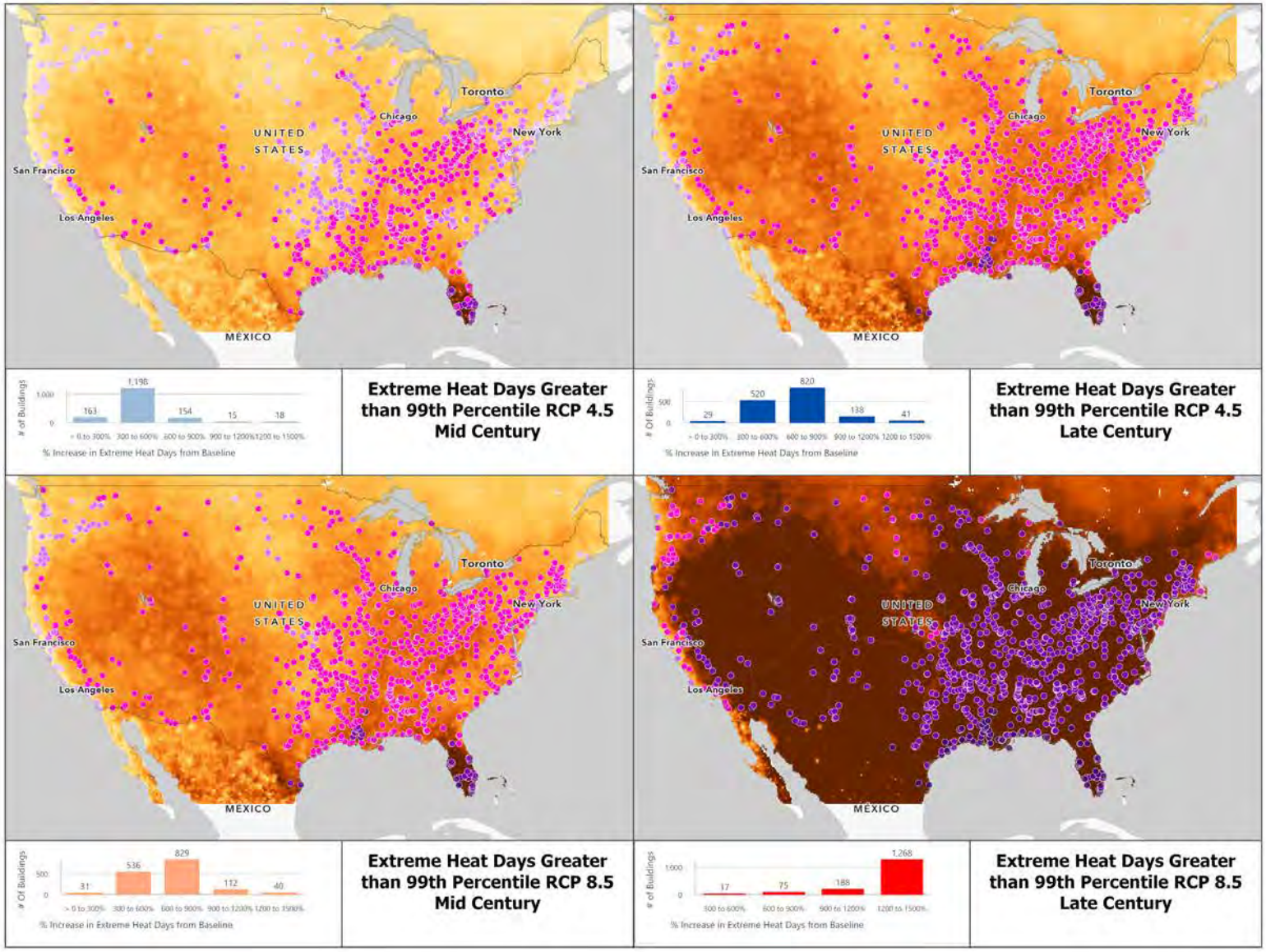
Forecast-Informed Reservoir Operations (FIRO): An approach to managing reservoirs that integrates real-time weather forecasts into operational decision-making processes. The goal of FIRO is to optimize the release of water from reservoirs based on accurate and timely weather predictions, improving the reservoir's ability to balance water supply, flood control, and environmental needs. FIRO represents a shift from traditional reservoir operations that rely on observed data to a more dynamic and forward-looking approach that considers forecasted weather conditions.

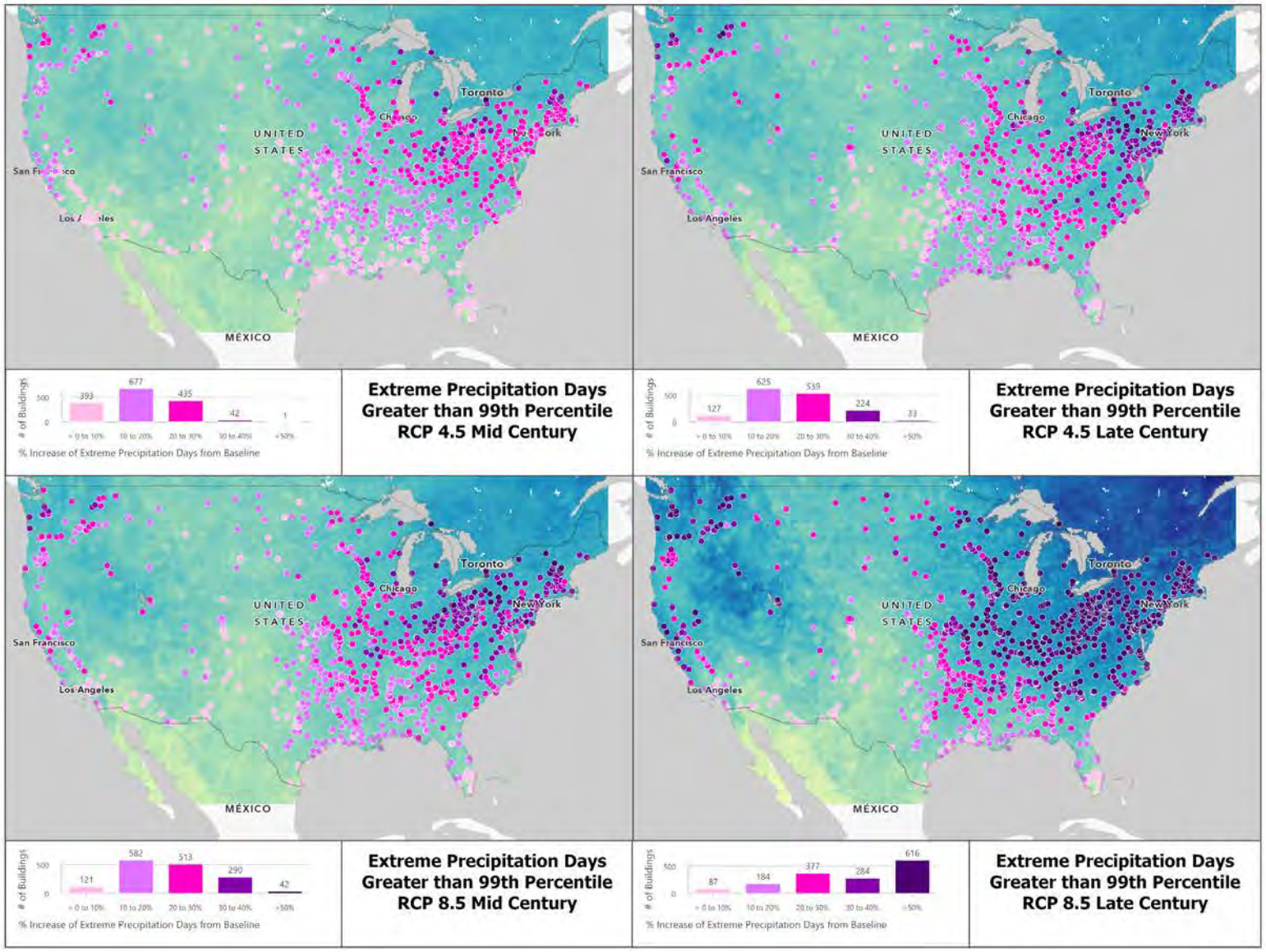
Flood Risk Management (FRM): A mission area that includes activities and projects aimed at reducing the risks and impacts of flooding on communities, infrastructure, and the environment.

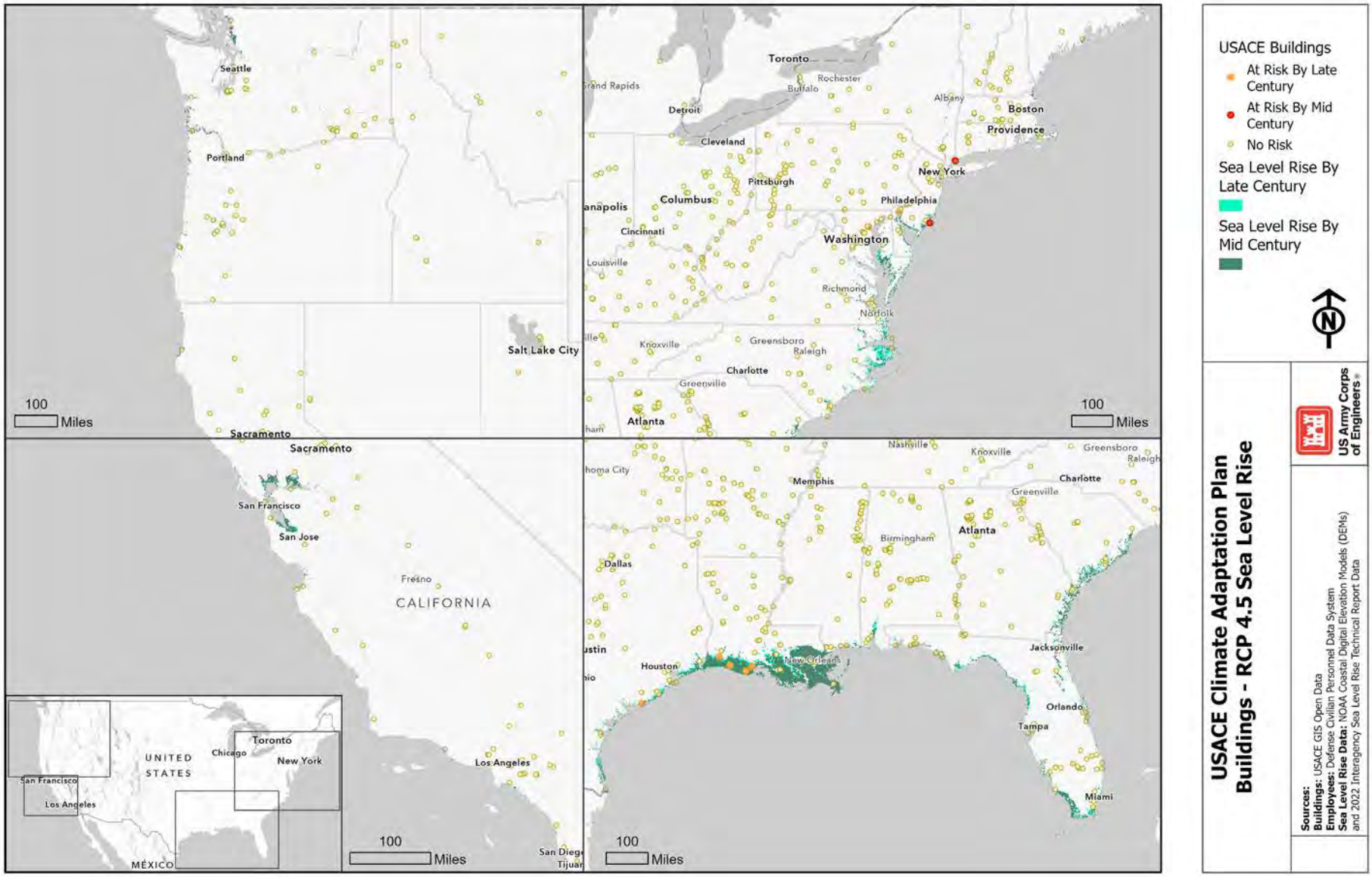
Military Program (MP): The portion of the USACE mission that focuses on providing engineering expertise and support to the U.S. military and DoD. This program involves the planning, design, construction, and maintenance of military infrastructure, including military bases, training facilities, and other defense-related projects.

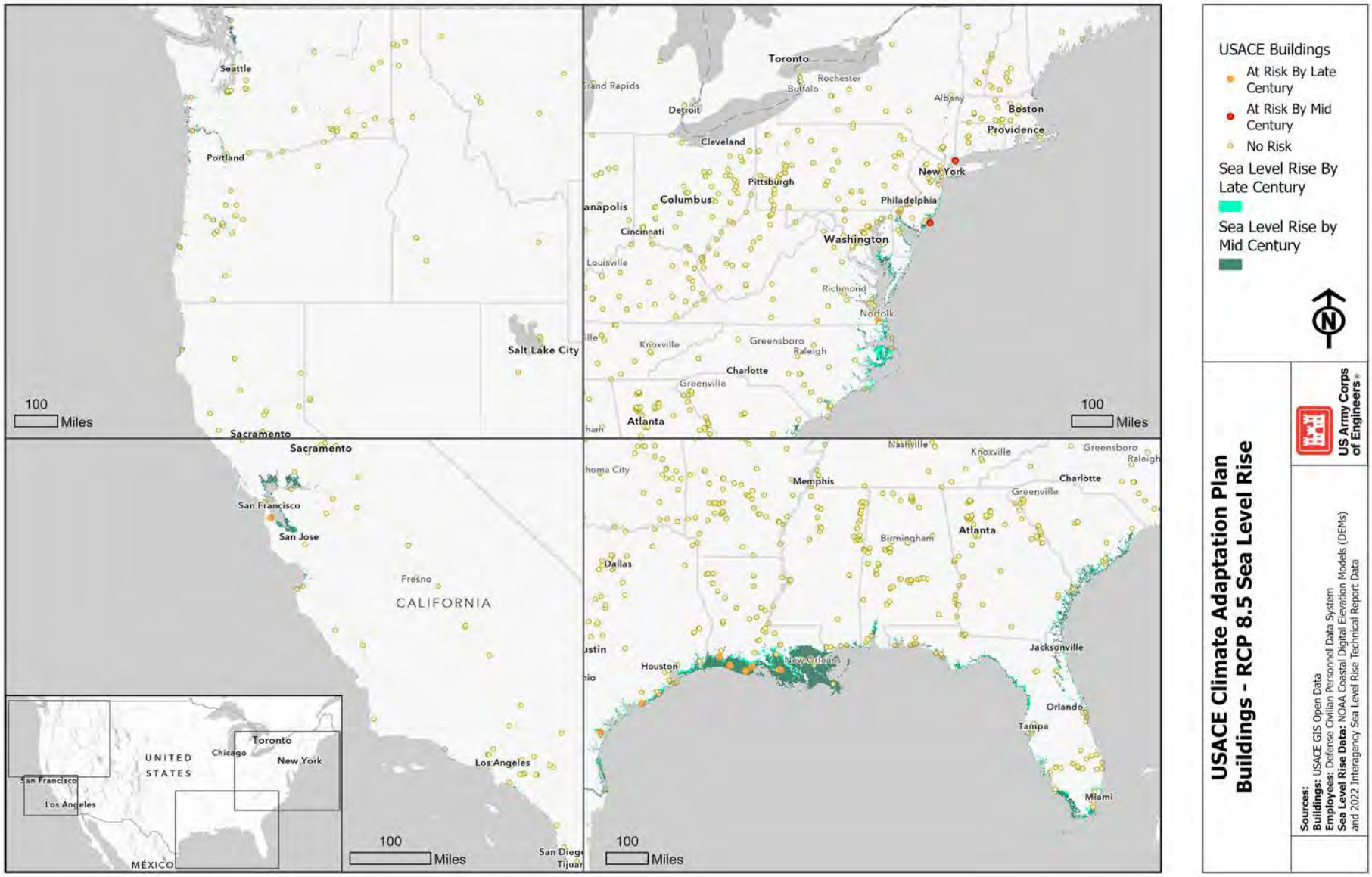
Sustainable Rivers Program (SRP): A USACE initiative that focuses on managing river systems in a sustainable and environmentally friendly manner. The program aims to balance the multiple uses of rivers, including navigation, flood risk management, water supply, and environmental conservation.

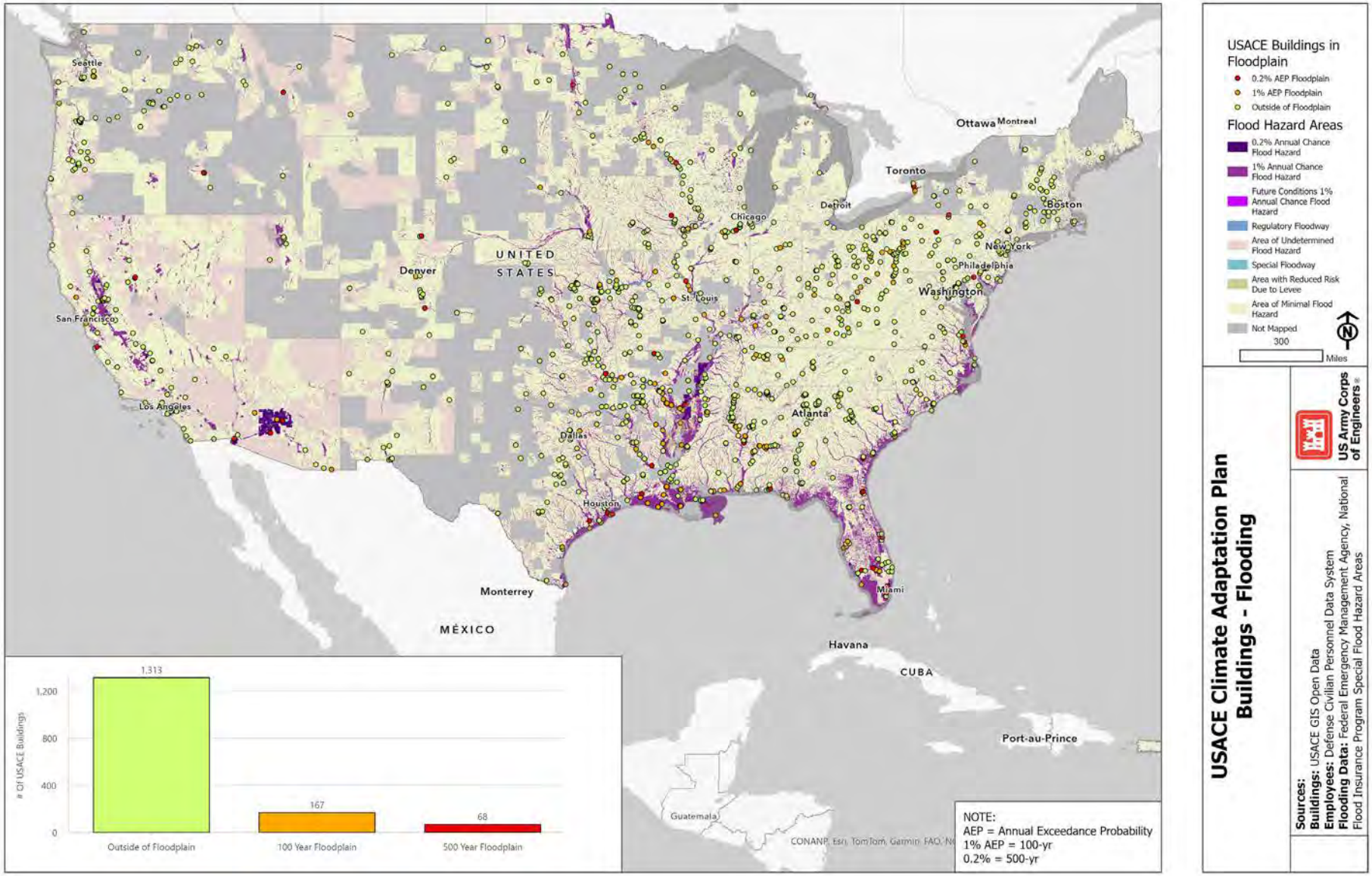
Appendix A – Climate Exposure Maps for Buildings

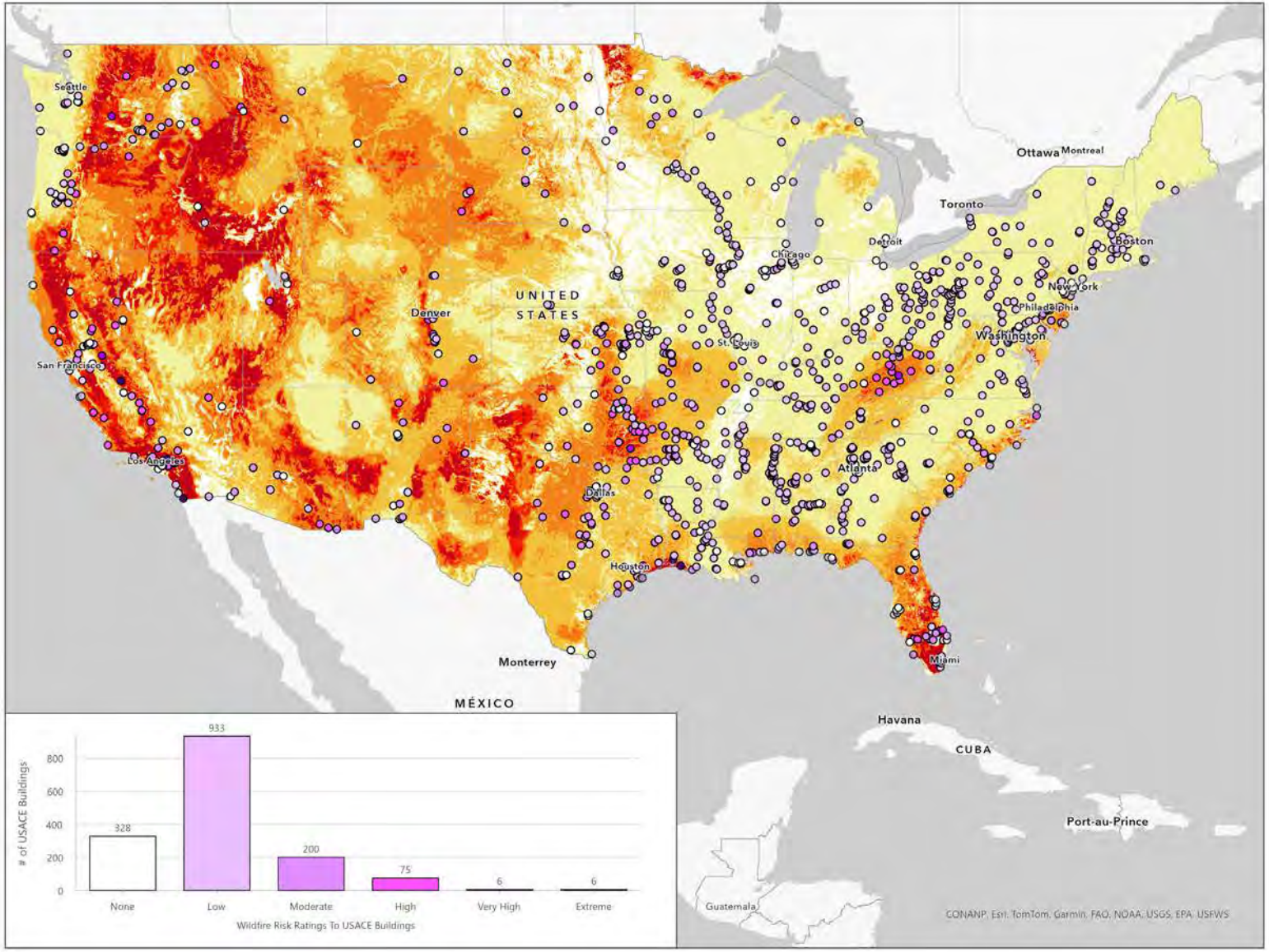



Toronto
Chicago
New York
UNITED STATES
San Francisco
Los Angeles
MÉXICO
# of Buildings
% Increase of Extreme Precipitation Days from Baseline
393
677
435
42
1
Extreme Precipitation Days Greater than 99th Percentile RCP 4.5 Mid Century
127
625
539
224
33
Extreme Precipitation Days Greater than 99th Percentile RCP 4.5 Late Century
121
582
513
290
42
Extreme Precipitation Days Greater than 99th Percentile RCP 8.5 Mid Century
87
184
377
284
616
Extreme Precipitation Days Greater than 99th Percentile RCP 8.5 Late Century
% Increase Of Days USACE Buildings Can Expect Extreme Precipitation
>50%
30 to 40%
20 to 30%
10 to 20%
> 0 to 10%
Extreme Precipitation Days Greater than 99th Percentile
8
2
500
Miles
N
USACE Climate Adaptation Plan
Buildings - Extreme Precipitation
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Precipitation Data: National Climate Organization, 32 CMIP5 Model Ensemble downscaled using LOCA


Seattle
Portland
Salt Lake City
Sacramento
San Francisco
San Jose
Fresno
CALIFORNIA
Los Angeles
San Diego
Tijuana
MÉXICO
UNITED STATES
Chicago
Toronto
New York
Houston
Dallas
Atlanta
Memphis
Nashville
Knoxville
Charlotte
Greensboro
Raleigh
Greenville
Birmingham
Jacksonville
Orlando
Tampa
Miami
Detroit
Cleveland
Buffalo
Rochester
Albany
Boston
Providence
Pittsburgh
Columbus
Cincinnati
Philadelphia
Washington
Louisville
Richmond
Norfolk
100 Miles
USACE Buildings
At Risk By Late Century
At Risk By Mid Century
No Risk
Sea Level Rise By Late Century
Sea Level Rise By Mid Century
N
USACE Climate Adaptation Plan
Buildings - RCP 4.5 Sea Level Rise
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Sea Level Rise Data: NOAA Coastal Digital Elevation Models (DEMs) and 2022 Interagency Sea Level Rise Technical Report Data


USACE Buildings
At Risk By Late Century
At Risk By Mid Century
No Risk
Sea Level Rise By Late Century
Sea Level Rise by Mid Century
N
USACE Climate Adaptation Plan
Buildings - RCP 8.5 Sea Level Rise
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Sea Level Rise Data: NOAA Coastal Digital Elevation Models (DEMs) and 2022 Interagency Sea Level Rise Technical Report Data
Seattle
Portland
Salt Lake City
Sacramento
San Francisco
San Jose
Fresno
CALIFORNIA
Los Angeles
San Diego
Tijuana
Toronto
Detroit
Cleveland
Pittsburgh
Columbus
Cincinnati
Louisville
Indianapolis
Buffalo
Rochester
Albany
Boston
Providence
New York
Philadelphia
Washington
Richmond
Norfolk
Knoxville
Greensboro
Raleigh
Charlotte
Greenville
Atlanta
Nashville
Memphis
Birmingham
Dallas
Houston
New Orleans
Jacksonville
Orlando
Tampa
Miami
100 Miles
UNITED STATES
MÉXICO
Chicago
New York
Toronto
San Francisco
Los Angeles


USACE Buildings in Floodplain
0.2% AEP Floodplain
1% AEP Floodplain
Outside of Floodplain
Flood Hazard Areas
0.2% Annual Chance Flood Hazard
1% Annual Chance Flood Hazard
Future Conditions 1% Annual Chance Flood Hazard
Regulatory Floodway
Area of Undetermined Flood Hazard
Special Floodway
Area with Reduced Risk Due to Levee
Area of Minimal Flood Hazard
Not Mapped
300
Miles
N
Seattle
San Francisco
Los Angeles
Denver
UNITED STATES
Chicago
Detroit
Toronto
Ottawa
Montreal
Boston
New York
Philadelphia
Washington
St. Louis
Atlanta
Dallas
Houston
Monterrey
MÉXICO
Miami
Havana
CUBA
Port-au-Prince
Guatemala
CONANP, Esri, TomTom, Garmin, FAO, NO
Of USACE Buildings
1,200
800
400
0
1,313
167
68
Outside of Floodplain
100 Year Floodplain
500 Year Floodplain
NOTE:
AEP = Annual Exceedance Probability
1% AEP = 100-yr
0.2% = 500-yr
USACE Climate Adaptation Plan
Buildings - Flooding
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Flooding Data: Federal Emergency Management Agency, National Flood Insurance Program Special Flood Hazard Areas



Wildfire Risk Ratings To USACE Buildings

- Extreme
- Very High
- High
- Moderate
- Low
- None

Wildfire Risk To Potential Structures In Percentiles

- 95th to 100th
- 90th to 95th
- 70th to 90th
- 40th to 70th
- 0 to 40th
- 0

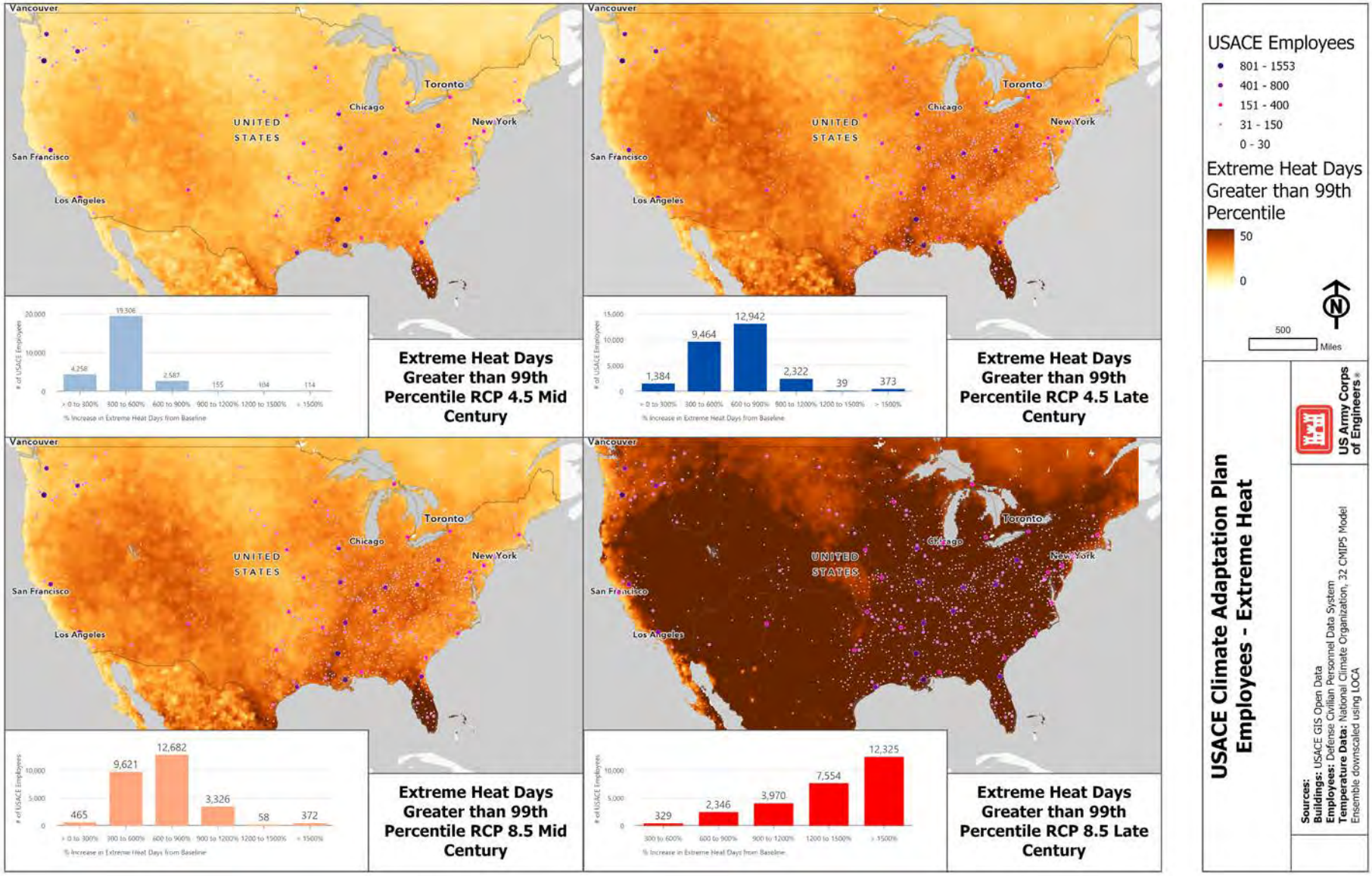
300 Miles

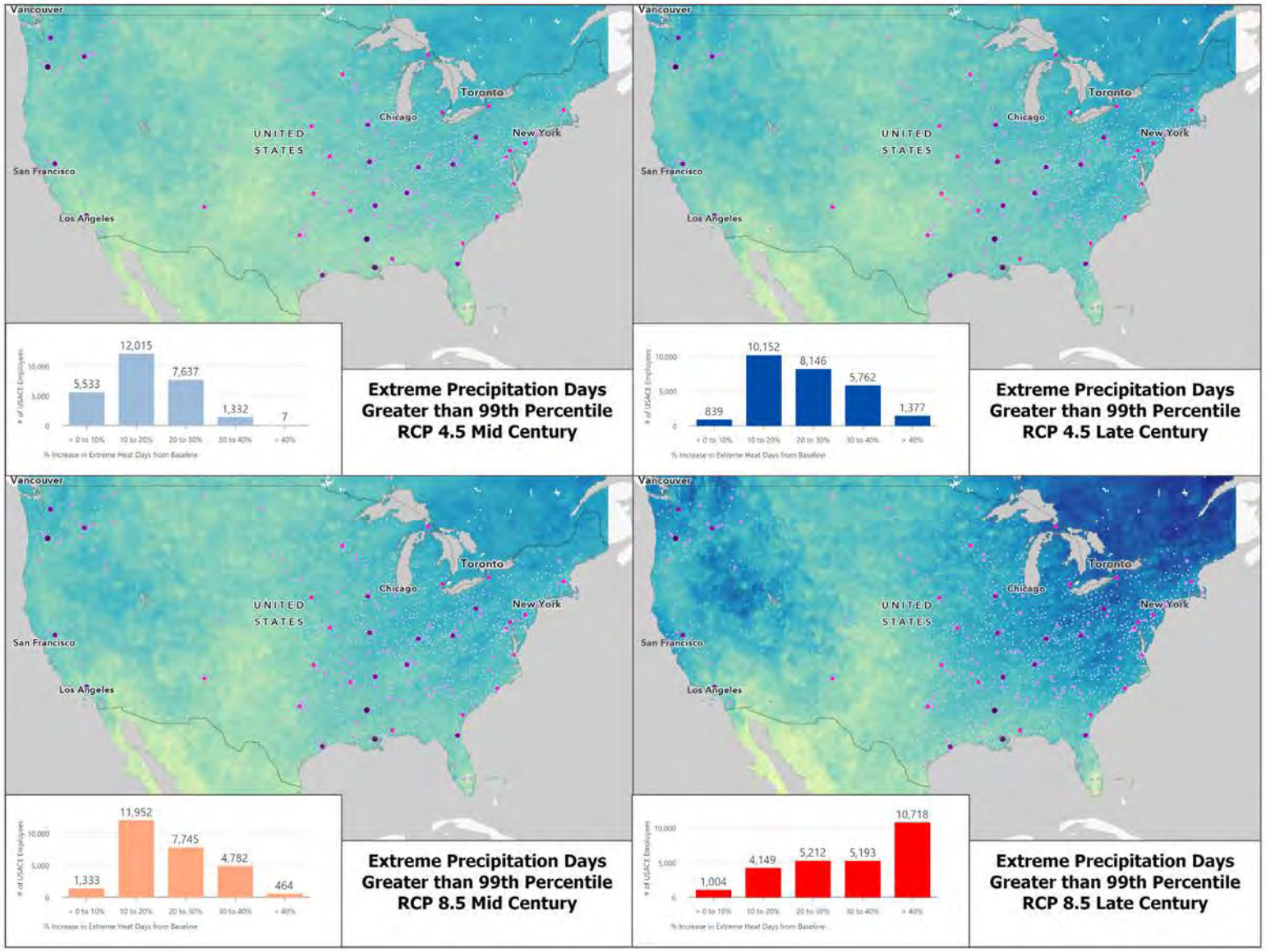
USACE Climate Adaptation Plan
Buildings - Wildfire

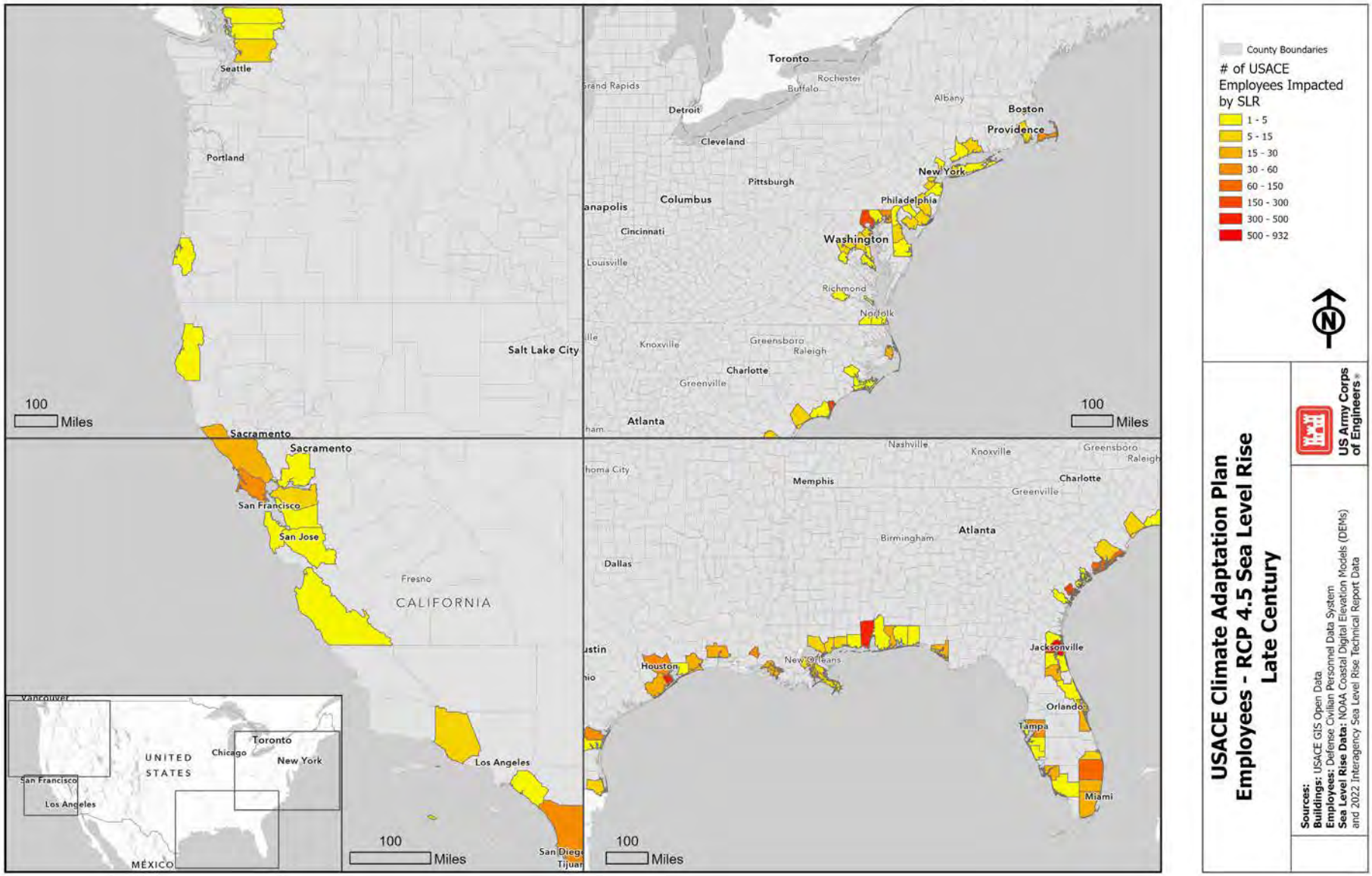
US Army Corps of Engineers®

Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Wildfire Data: US Forest Service, LANDFIRE 2014 (version 1.4.0)

Appendix B – Climate Exposure Maps for Employees




Vancouver
Toronto
Chicago
New York
UNITED STATES
San Francisco
Los Angeles
5,533
12,015
7,637
1,332
7
Extreme Precipitation Days Greater than 99th Percentile RCP 4.5 Mid Century
839
10,152
8,146
5,762
1,377
Extreme Precipitation Days Greater than 99th Percentile RCP 4.5 Late Century
1,333
11,952
7,745
4,782
464
Extreme Precipitation Days Greater than 99th Percentile RCP 8.5 Mid Century
1,004
4,149
5,212
5,193
10,718
Extreme Precipitation Days Greater than 99th Percentile RCP 8.5 Late Century
Extreme Precipitation Days Greater than 99th Percentile
8
2
USACE Employees
801 - 1553
401 - 800
151 - 400
31 - 150
0 - 30
500
Miles
USACE Climate Adaptation Plan
Employees - Extreme Precipitation
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Precipitation Data: National Climate Organization, 32 CMIP5 Model Ensemble downscaled using LOCA


County Boundaries
# of USACE Employees Impacted by SLR
1 - 5
5 - 15
15 - 30
30 - 60
60 - 150
150 - 300
300 - 500
500 - 932
N
USACE Climate Adaptation Plan
Employees - RCP 4.5 Sea Level Rise
Late Century
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Sea Level Rise Data: NOAA Coastal Digital Elevation Models (DEMs) and 2022 Interagency Sea Level Rise Technical Report Data
100 Miles
Seattle
Portland
Salt Lake City
Sacramento
San Francisco
San Jose
Fresno
CALIFORNIA
Los Angeles
San Diego
Tijuana
Toronto
Rochester
Buffalo
Albany
Boston
Providence
Detroit
Cleveland
Pittsburgh
New York
Columbus
Philadelphia
Cincinnati
Washington
Louisville
Richmond
Norfolk
Knoxville
Greensboro
Raleigh
Charlotte
Greenville
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Jacksonville
Orlando
Tampa
Miami
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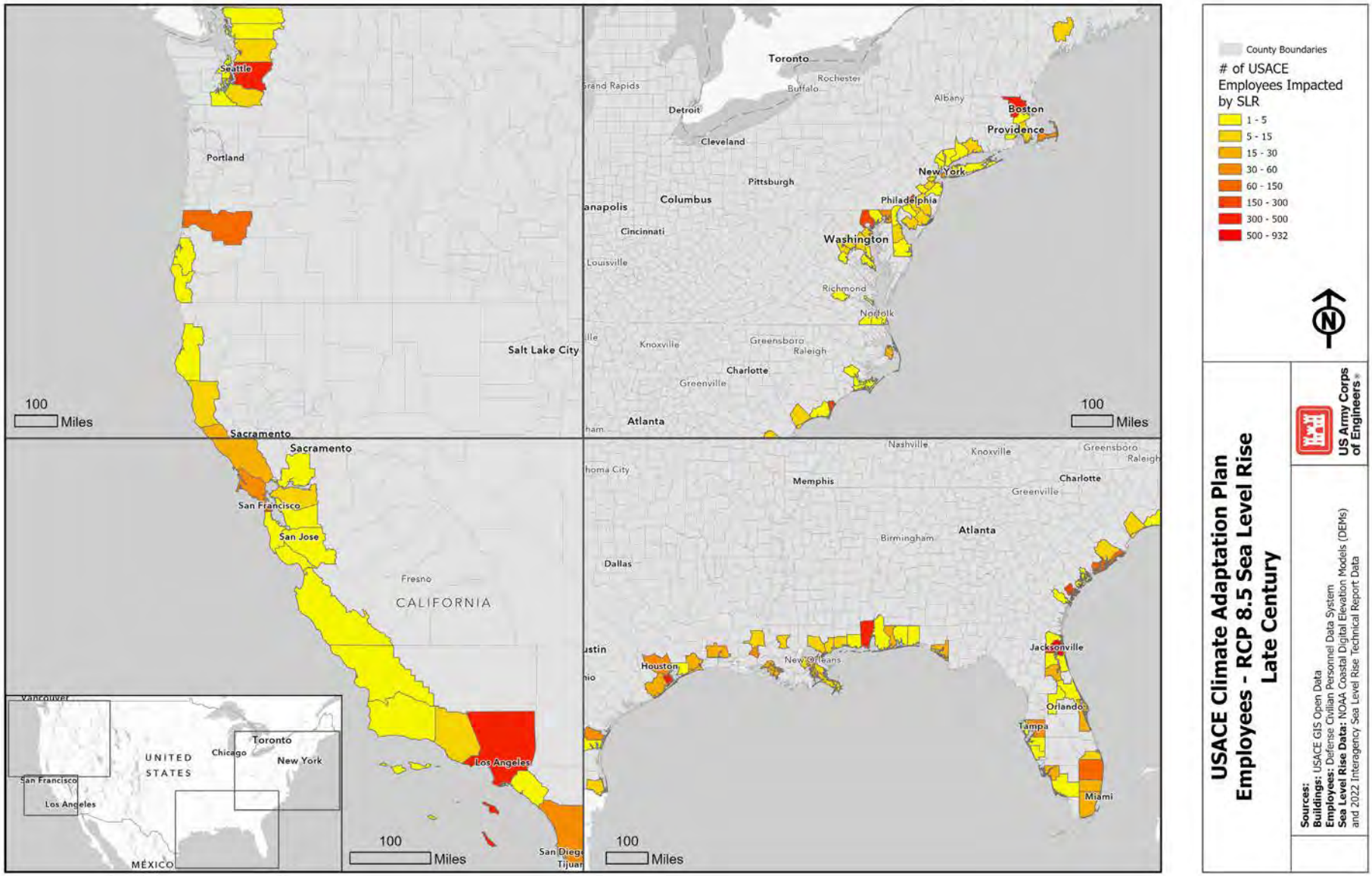
MÉXICO
Vancouver
Chicago


County Boundaries
# of USACE Employees Impacted by SLR
1 - 5
5 - 15
15 - 30
30 - 60
60 - 150
150 - 300
300 - 500
500 - 932
N
USACE Climate Adaptation Plan
Employees - RCP 8.5 Sea Level Rise
Late Century
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Sea Level Rise Data: NOAA Coastal Digital Elevation Models (DEMs) and 2022 Interagency Sea Level Rise Technical Report Data
Seattle
Portland
Salt Lake City
Sacramento
San Francisco
San Jose
Fresno
CALIFORNIA
Los Angeles
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Atlanta
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Jacksonville
Orlando
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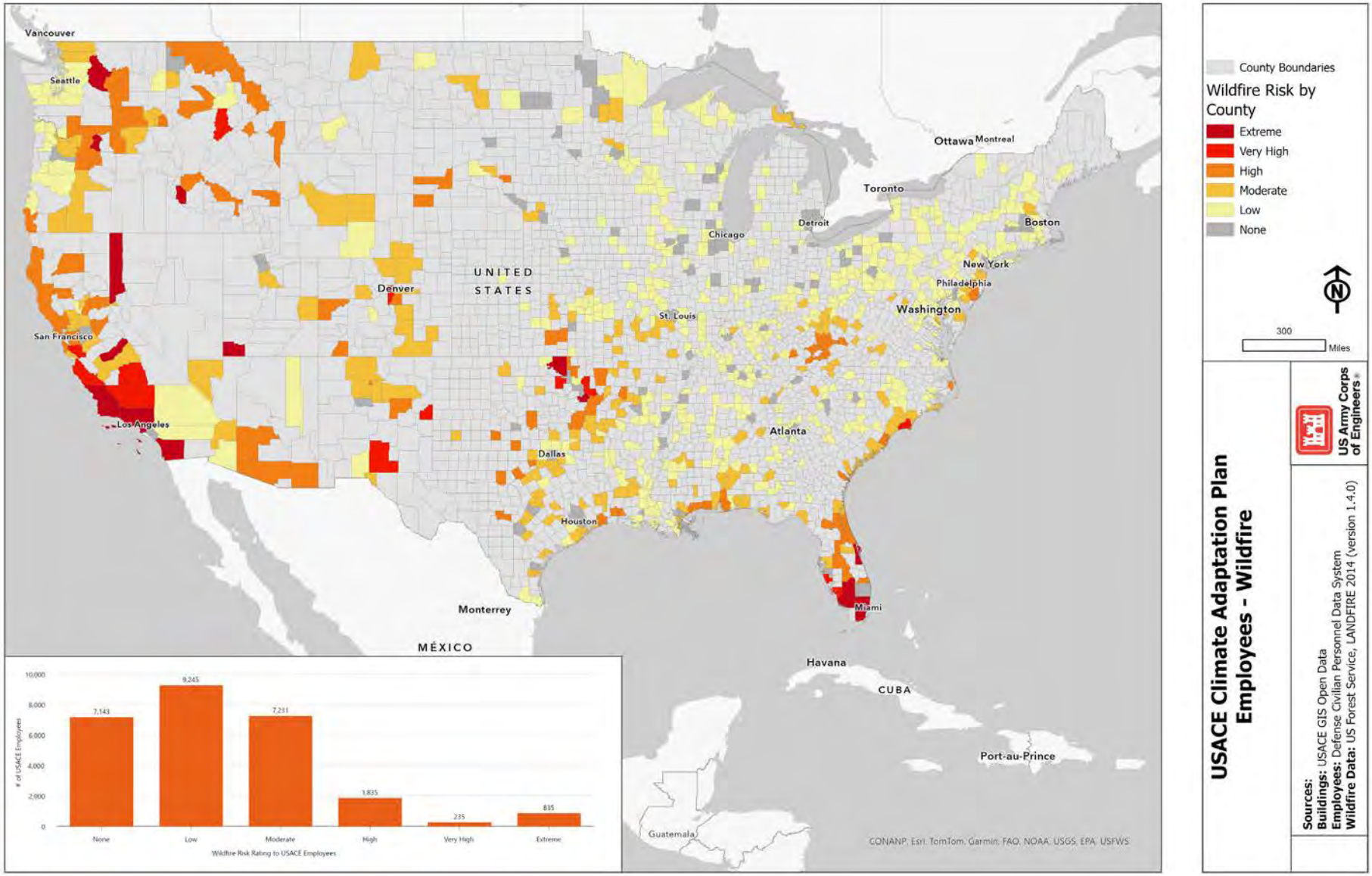
Miami
UNITED STATES
Vancouver
Chicago
MÉXICO
100 Miles


Vancouver
Seattle
San Francisco
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Chicago
Detroit
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Ottawa
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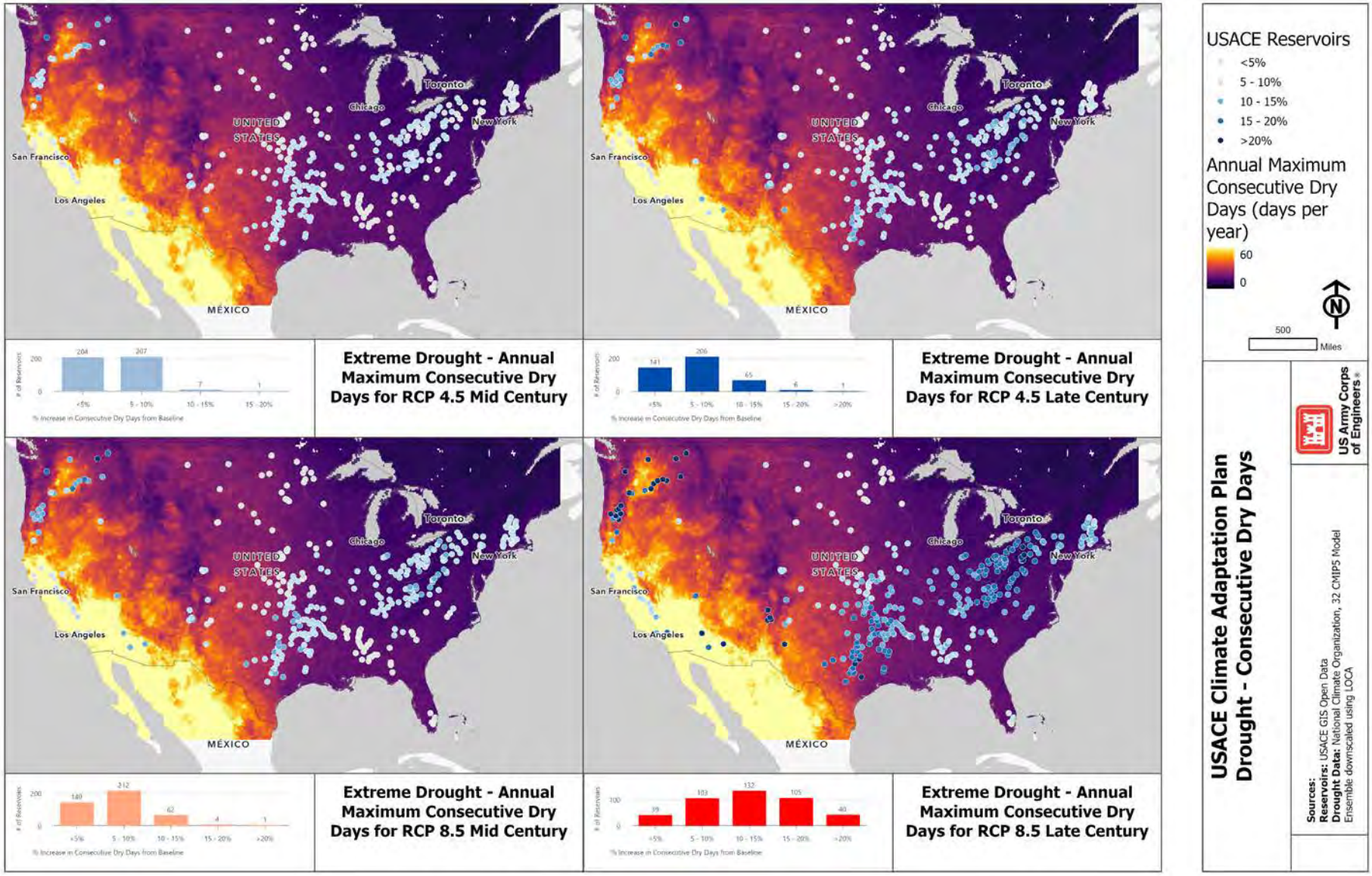
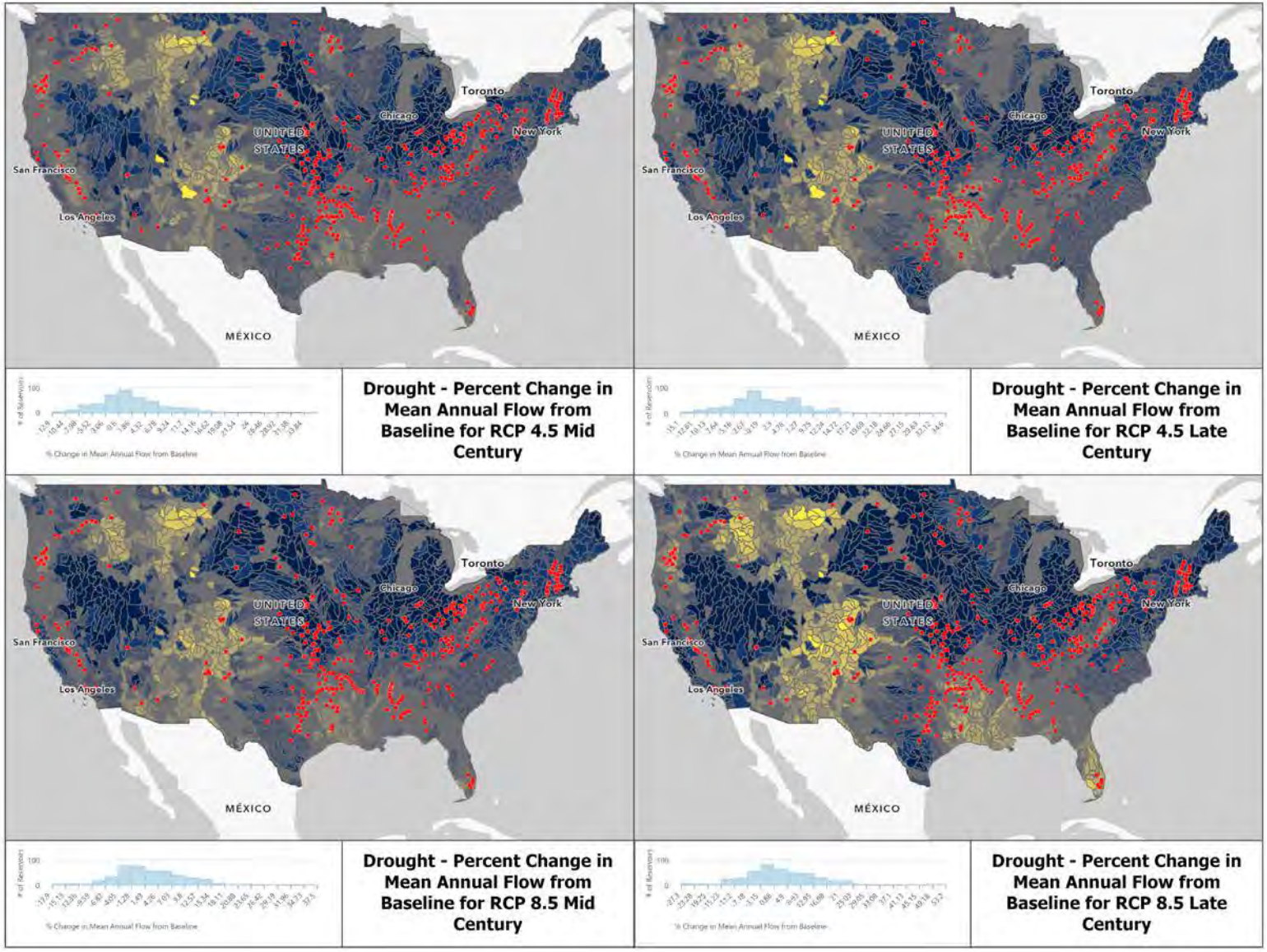
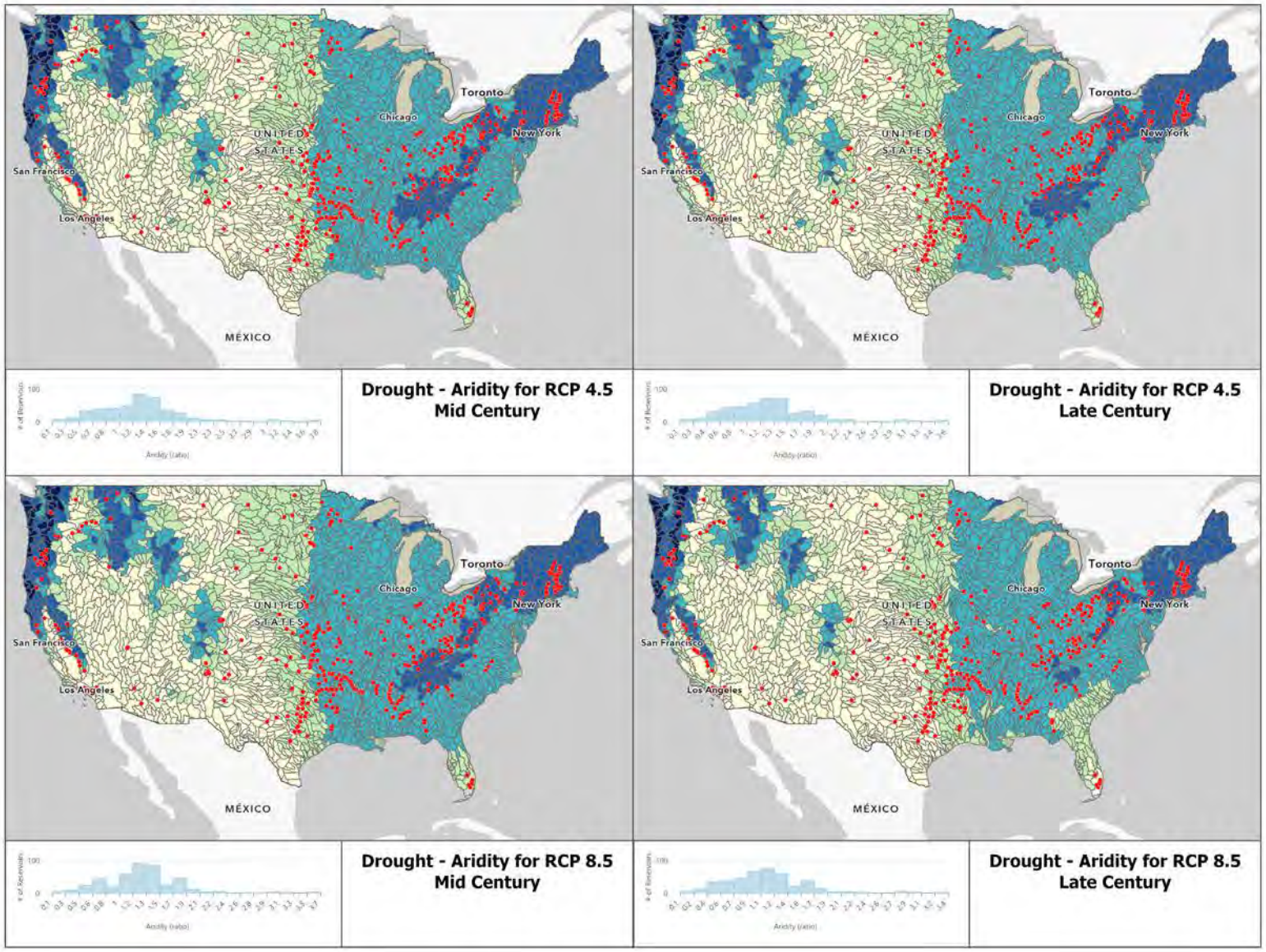
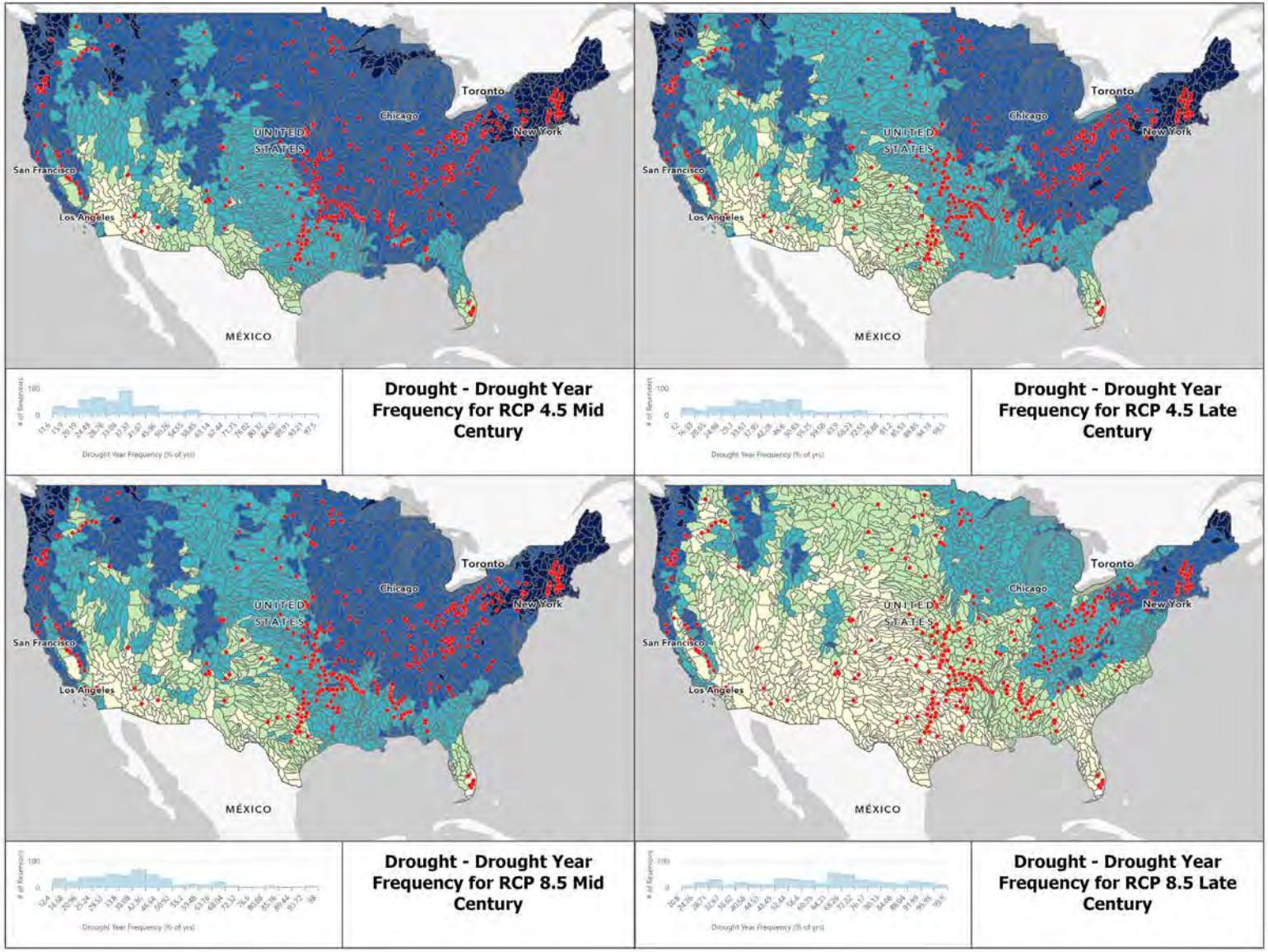
Boston
New York
Philadelphia
Washington
St. Louis
Atlanta
Dallas
Houston
Monterrey
MÉXICO
Miami
Havana
CUBA
Port-au-Prince
Guatemala
CONANP, Esri, TomTom, Garmin, FAO, NOAA, USGS, EPA, USFWS
10,000
8,000
6,000
4,000
2,000
0
# of USACE Employees
7,143
9,245
7,231
1,835
235
835
None
Low
Moderate
High
Very High
Extreme
Wildfire Risk Rating to USACE Employees
County Boundaries
Wildfire Risk by County
Extreme
Very High
High
Moderate
Low
None
N
300
Miles
USACE Climate Adaptation Plan
Employees - Wildfire
US Army Corps of Engineers
Sources:
Buildings: USACE GIS Open Data
Employees: Defense Civilian Personnel Data System
Wildfire Data: US Forest Service, LANDFIRE 2014 (version 1.4.0)

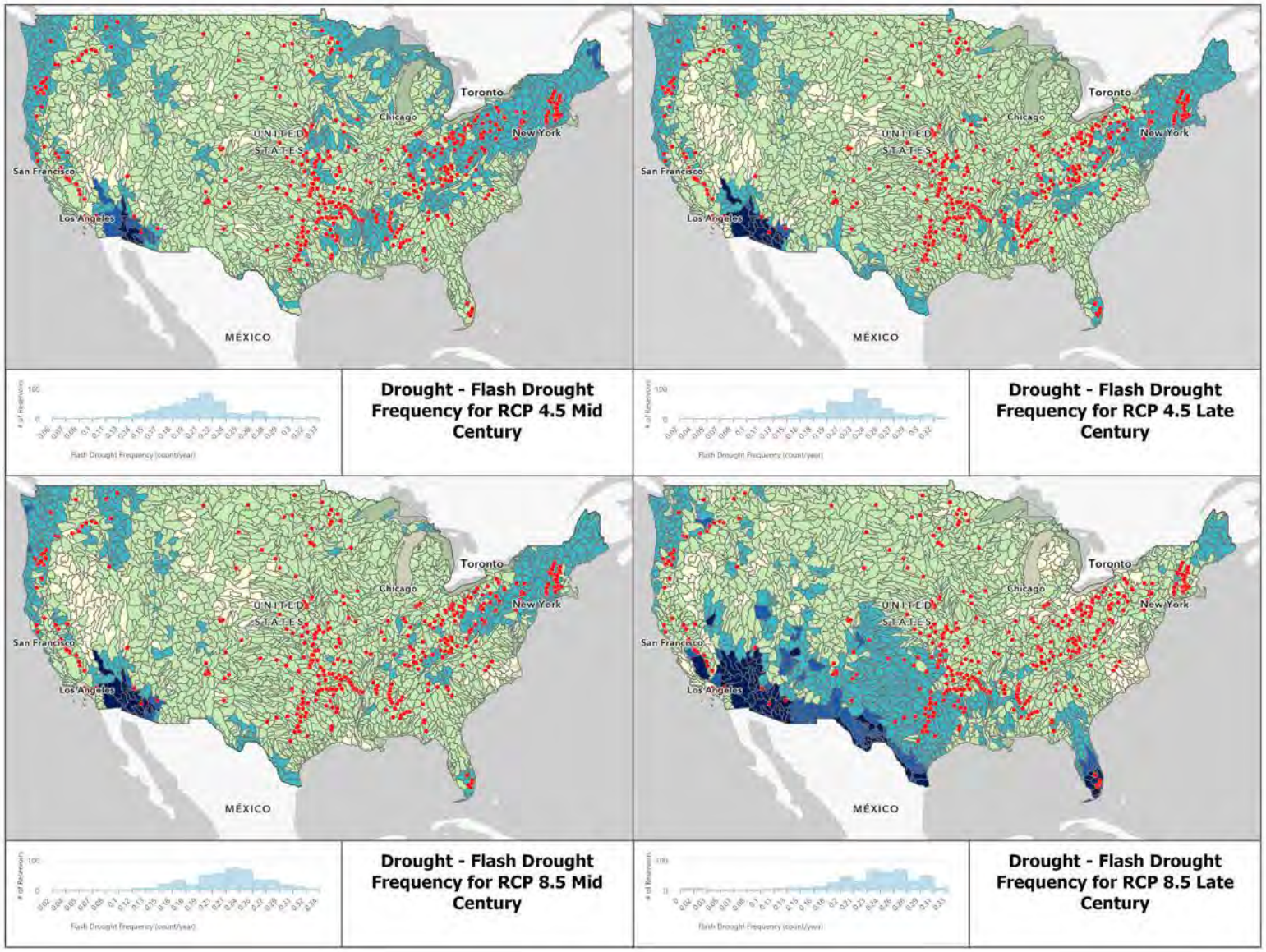
Appendix C – Drought Exposure Maps for USACE Reservoirs




Toronto
Chicago
New York
UNITED STATES
San Francisco
Los Angeles
MÉXICO
Drought - Percent Change in Mean Annual Flow from Baseline for RCP 4.5 Mid Century
Drought - Percent Change in Mean Annual Flow from Baseline for RCP 4.5 Late Century
Drought - Percent Change in Mean Annual Flow from Baseline for RCP 8.5 Mid Century
Drought - Percent Change in Mean Annual Flow from Baseline for RCP 8.5 Late Century
USACE Reservoirs
% Change in Mean Annual Flow from Baseline
<-30%
-30 - -20%
-20 - -10%
-10 - -5%
-5 - 0%
0 - 5%
5 - 10%
>10%
N
500
Miles
USACE Climate Adaptation Plan
Drought - Mean Annual Flow
US Army Corps of Engineers
Sources:
Reservoirs: USACE GIS Open Data
Drought Data: DoD Climate Assessment Tool


Toronto
Chicago
New York
UNITED STATES
San Francisco
Los Angeles
MÉXICO
Drought - Aridity for RCP 4.5 Mid Century
Drought - Aridity for RCP 4.5 Late Century
Drought - Aridity for RCP 8.5 Mid Century
Drought - Aridity for RCP 8.5 Late Century
USACE Reservoirs
Aridity - Average Dryness of Climate (<0.65 = Arid Climate)
<0.65
0.65 - 1
1 - 1.5
1.5 - 3
>3
500
Miles
USACE Climate Adaptation Plan
Drought - Aridity
US Army Corps of Engineers
Sources:
Reservoirs: USACE GIS Open Data
Drought Data: DoD Climate Assessment Tool


Toronto
Chicago
New York
UNITED STATES
San Francisco
Los Angeles
MÉXICO
Drought - Drought Year Frequency for RCP 4.5 Mid Century
Drought - Drought Year Frequency for RCP 4.5 Late Century
Drought - Drought Year Frequency for RCP 8.5 Mid Century
Drought - Drought Year Frequency for RCP 8.5 Late Century
USACE Reservoirs
Drought Year Frequency (% of drought years in the epoch)
80 - 100%
60 - 80%
40 - 60%
20 - 40%
<20%
500
Miles
USACE Climate Adaptation Plan
Drought - Drought Year Frequency
US Army Corps of Engineers
Sources:
Reservoirs: USACE GIS Open Data
Drought Data: DoD Climate Assessment Tool


Toronto
Chicago
New York
UNITED STATES
San Francisco
Los Angeles
MÉXICO
Drought - Flash Drought Frequency for RCP 4.5 Mid Century
Drought - Flash Drought Frequency for RCP 4.5 Late Century
Drought - Flash Drought Frequency for RCP 8.5 Mid Century
Drought - Flash Drought Frequency for RCP 8.5 Late Century
USACE Reservoirs
Flash Drought Frequency (average # of flash droughts per year)
>0.3
0.2 - 0.3
0.1 - 0.2
0.05 - 0.1
<0.05
500
Miles
USACE Climate Adaptation Plan
Drought - Flash Drought Frequency
US Army Corps of Engineers
Sources:
Reservoirs: USACE GIS Open Data
Drought Data: DoD Climate Assessment Tool

Appendix D – Risk Assessment Data

This risk assessment uses the following data:

Buildings

Buildings data come from two sources: the USACE real property database maintained by USACE's Real Estate Division and a GIS buildings layer maintained by the USACE GIS and Remote Sensing Center of Expertise. The buildings records in the USACE real property database are comprehensive and include the full range of building sizes from large office buildings down to small utility sheds located at USACE projects. The USACE real property database provides the asset-level data, such as square footage, property type, and property ownership; therefore, the information in the real property database is utilized to compute the summary numbers provided in Section 1. The GIS buildings layer includes major buildings and captures the location of all buildings in the real property database, therefore, the GIS database is used to perform the climate risk assessment in Section 2. Building locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures. These databases are the best available datasets for USACE real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of federal buildings to climate hazards.

Personnel

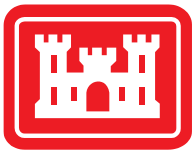
Personnel data comes from DCPDS non-public dataset of all personnel employed by USACE that was provided in 2023. DCPDS is a multifunction, web-based civilian HR information management and transaction processing system. This data represents the best available personnel data and is appropriate for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

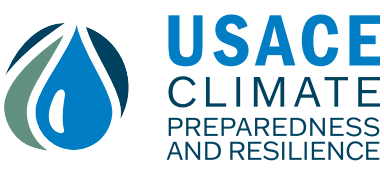
Climate Hazards

The climate data used in the risk assessment comes from the data in Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool. When agency climate adaptation plans were initiated in 2023, CMRA data included climate data prepared for the 4th National Climate Assessment. Additional details on this data can be found on the CMRA Assessment Tool Data Sources page. Due to limited data availability, exposure analyses using the Federal Mapping App are largely limited to CONUS. Additional information regarding Alaska, Hawaii, U.S. Territories, and marine environments has been included as available.

In addition to this data, USACE used the underlying climate hazard information from DCAT, which will also serve as the underlying data for the USACE CWVAT. The data from DCAT was used to fill the climate hazard information gaps in the CMRA database for Alaska and Hawaii as well as to perform a risk assessment associated with drought. Drought is a primary concern for USACE's portfolio of dams and reservoirs and USACE's responsibilities to maintaining navigable waterways.

U.S. Army Corps of Engineers
2024–2027 Climate Adaptation Plan
Prepared per Executive Orders 14008, 14030, and 14057





1,740 feet of seawall USACE built helps protect Atlantic City, NJ, from sea level rise and storm surge

Lock and Dam 1 in Minneapolis on the Mississippi River, one of over 700 lock and dam USACE projects nationwide

USACE repairs the south breakwater in New York's Buffalo Harbor

Crooked Creek Lake, one of 16 flood control reservoirs within the Pittsburgh District of the U.S. Army Corps of Engineers

Flooding in a small Virginia fishing community experiencing subsidence and relative sea level rise

Aquatic Ecosystem Restoration Project (breakwater structure) that was the result of a feasibility study completed through a partnership with the Lower Brule Sioux Tribe

U.S. ARMY

USACE CLIMATE PREPAREDNESS AND RESILIENCE

U.S. Department of Transportation

2024 - 2027 Climate Adaptation Plan

June 2024

FOREWORD

Communities across our country are facing extreme weather events that damage our transportation infrastructure and cost large sums to repair, not to mention the cost to the economy and individual lives from disrupted travel. These events—including heat waves, wildfires, tropical storms, high winds, storm surges and heavy downpours—are becoming more frequent and severe as the climate changes. The Department of Transportation is working to integrate consideration of climate resilience and risk across transportation decision-making and to ensure that transportation investments incorporate evidence-based climate resilience measures or features.

I am proud of the accomplishments this Department has made since the release of our 2021 Climate Adaptation Plan. We have launched the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program, the first of its kind federal transportation program to help make surface transportation more resilient through support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk costal infrastructure. In addition, we have incorporated climate resilience considerations into criteria for discretionary grant funding across the Department, as appropriate and consistent with statute. When it comes to our internal operations and facilities, we have issued a new DOT Order 4360: Climate Change Adaptation and Resilience Policy for DOT Operational Assets and completed climate risk assessments for dozens of mission-critical DOT facilities.

And now with the publication of our 2024-2027 Climate Adaptation Plan, we will continue to build on this work, supporting continued investments in climate-smart transportation infrastructure and incorporating natural hazard and climate risk information into federal property management decisions. I look forward to working with other Federal agencies as they implement their own Climate Adaptation Plans, as well as state and local communities on the front lines of climate impacts, as we work together to address the risks of climate change.

Pete Buttigieg

Secretary of Transportation

Table of Contents

U.S. Department of Transportation
2024 - 2027 Climate Adaptation Plan

INTRODUCTION

The U.S. Department of Transportation (DOT or Department) has prepared this Climate Adaptation Plan (CAP or Plan) in accordance with: Section 211 of Executive Order (E.O.) 14008, *Tackling the Climate Crisis at Home and Abroad;* section 5(d) of E.O. 14030*, Climate-Related Financial Risk*; section 503 of E.O.14057*, Catalyzing Clean Energy Industries And Jobs Through Federal Sustainability*; and with the Council on Environmental Quality's (CEQ) Implementing Instructions. The 2024-2027 CAP builds on the previous DOT Climate Adaptation Plans prepared in 2012, 2014, and the *Climate Action Plan: Revitalizing Efforts to Bolster Adaptation and Increase Resilience* published in 2021. The 2012 Action Plan focused on climate change impacts to DOT's critical mission activities—safety, state of good repair and sustainability of federally owned buildings. The 2014 CAP provided updates on DOT's recent accomplishments and new priorities. The 2021 plan and 2022 progress update highlighted the commitment of the Department to ensure that DOT funding programs, policies, guidance, and operations consider climate impacts and incorporate resilience solutions. Looking forward, the Department will support continued investments in climate-smart transportation infrastructure and incorporate natural hazard and climate risk information into federal property management decisions, funding programs, policies, guidance, and operations, prioritizing investments that achieve the quadruple benefit of advancing resilience, supporting adaptation, addressing environmental justice, and strengthening climate mitigation.

Recent Climate Adaptation and Resilience Accomplishments:

- Launched the first federal program to protect transportation infrastructure from extreme weather through the Federal Highway Administration (FHWA) Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation (PROTECT) program which will provide a total of over $9 billion for climate resilience projects.
- Incorporated climate resilience considerations into grant funding criteria for all DOT modal administrations, as appropriate.
- Issued the new DOT Order 4360: Climate Change Adaptation and Resilience Policy for DOT Operational Assets on September 18, 2023.
- Completed climate risk assessments for dozens of mission-critical[1] DOT facilities with progress metrics tracked in a summary dashboard.
- Implemented a Buy Clean program including a lower carbon procurement pilot project and carbon pollution free energy procurement to build energy resilience.
- Collaborated across the government with numerous departments and agencies to implement CAP priorities:

[1] Mission-critical buildings are DOT-leased or owned facilities that support activities that cannot be disrupted. Mission-critical assets include non-building infrastructure (e.g., ships or equipment), operations, and activities that support statutory goals, provide vital services, and maintain the safety and health of the public.

- Deployed Climate Change and Transportation 101 training for DOT staff and stakeholders, including extensive collaboration with the National Oceanic and Atmospheric Administration (NOAA) on climate science.
- Presented a resilience symposium in cooperation with the Transportation Research Board of the National Academy of Sciences.
- Included Federal Emergency Management Agency (FEMA)-designated Community Disaster Resilience Zones as a consideration in the updated DOT Discretionary Grant Guidance.

2024-2027 CAP Priorities:

- Support investments in climate-smart infrastructure across all transportation modes with continued guidance, technical assistance, and decision support tools.
- Expand coordination between climate resilience and environmental justice activities through grant programs and technical assistance.
- Leverage federal climate data services to provide decision support resources for climate resilience and adaptation activities to DOT stakeholders.
- Implement projects to reduce climate impacts on federal property, operations, and supply chains identified through ongoing natural hazard risk assessments.

This Plan follows the CEQ instructions for preparing agency CAPs under E.O. 14008 and focuses on climate adaptation and resilience across agency programs and the management of Federal procurement, real property, public lands and waters, and financial programs. The Department is engaged in a wide variety of activities related to reducing transportation sector greenhouse gas (GHG) emissions; however, this Plan focuses on actions to bolster adaptation and increase resilience.

Through its CAP, the Department is also able to advance environmental justice as part of its mission, consistent with E.O. 14008 and with E.O. 14096 on *Revitalizing Our Nation's Commitment to Environmental Justice for All*. As the Department implements its CAP to increase the resilience of its facilities and operations, the agency will use its best efforts to, as appropriate and consistent with applicable law: address disproportionate and adverse environmental and health effects (including risks) and hazards, including those related to climate change and cumulative impacts of environmental and other burdens on communities with environmental justice concerns; and, provide opportunities for the meaningful engagement of persons and communities with environmental justice concerns.

In addition, as a member of the White House Environmental Justice Interagency Council, the Department received recommendations on Climate Planning, Preparedness, Response, Recovery and Impacts from the White House Environmental Justice Advisory Council (WHEJAC). The report includes many recommendations that are relevant to the work of the Department. The Department is reviewing the recommendations and, as appropriate and consistent with applicable law, is taking steps to address the WHEJAC's recommendations.

SECTION 1: AGENCY PROFILE

Mission	To deliver the world's leading transportation system, serving the American people and economy through the safe, efficient, sustainable, and equitable movement of people and goods.
Adaptation Plan Scope	▪ Office of the Secretary (OST) - Research & Technology (-R); Administration (-M); Policy (-P), and International (-X) ▪ Build America Bureau ▪ Bureau of Transportation Statistics (BTS) ▪ Federal Aviation Administration (FAA) ▪ Federal Highway Administration (FHWA) ▪ Federal Motor Carrier Safety Administration (FMCSA) ▪ Federal Railroad Administration (FRA) ▪ Federal Transit Administration (FTA) ▪ Maritime Administration (MARAD) ▪ National Highway Traffic Safety Administration (NHTSA) ▪ Pipeline and Hazardous Materials Safety Administration (PHMSA) ▪ Great Lakes St. Lawrence Seaway Development Corporation (GLS)
Agency Climate Adaptation Official	Ann Shikany (DOT Deputy Assistant Secretary for Transportation Policy)
Agency Risk Officer	John Giorgis, Director, Performance, Evidence, and Enterprise Risk, Office of the Secretary
Point of Public Contact for Environmental Justice	Kelsey Owens, Senior Policy Analyst, Office of the Secretary - Office of Policy
Owned Buildings	Over 9,100 owned buildings of approximately 17M square feet. (Real Estate Management System (REMS). Data is through November 2023.)
Leased Buildings	Over 1,000 leased buildings of approximately 7.5M square feet. (Real Estate Management System (REMS). Data is through November 2023.)
Employees	Total Employees: 55,930 Total FTEs: 54,164 Total Contractors: 6,900 (Workforce Information, Onboard Data by Month, November 2023; From MAX Budget Season Report: FY 2025 BUDGET – CIVILIAN FTE REPORT. Schedule Q, Personnel Summary Presidential Budget Level (PB25PS01). Pulled 05 January 2024; Security/Badging Office.)
Federal Lands and Waters	The Office of Federal Lands Highway (FLH) in FHWA provides financial resources and transportation engineering assistance for public roads, bridges, and other transportation infrastructure that service the transportation needs for the approximately 650 million acres of land owned and managed by the federal government, and Indian lands, in the United States.

Budget	$148.9 billion FY22 Enacted (P.L. 117-103, Consolidated Appropriations Act, 2022) $145.1 billion FY23 Enacted (P.L. 117-328, Consolidated Appropriations Act, 2023) $145.0 billion FY24 Enacted (P.L. 118-42, Consolidated Appropriations Act, 2024) $146.2 billion FY25 President's Budget (FY2025 Budget Highlights (transportation.gov))
Key Areas of Climate Adaptation Effort	• Incorporate Resilience into DOT Grant and Loan Programs • Enhance Resilience Throughout the Project Planning and Development Process • Ensure Resiliency of DOT Facilities and Operational Assets • Ensure Climate-ready Services and Supplies • Improve Climate Education and Research on Resilience

Building Resilience and Adaptive Capacity at DOT

DOT has a long history of considering climate hazard impacts on the national transportation system. The U.S. DOT Center for Climate Change and Environmental Forecasting (DOT Climate Change Center) was established in 1999, and the FHWA started to issue reports on the potential impacts of climate change on transportation as early as 2002. For over two decades DOT has issued policy and guidance, supported research and case studies, and provided technical assistance to build resilience and adaptive capacity with the goal of reducing climate hazard impacts on transportation infrastructure, including federally funded projects. Most recently DOT has amplified these efforts through progress on the following actions from the 2021 CAP:

- Incorporating resilience into grant and loan programs
- Enhancing resilience throughout the project planning and development process
- Ensuring resiliency of DOT facilities and operational assets
- Ensuring climate-ready services and supplies
- Improving climate education and research on resilience

DOT issued new internal guidance for incorporating Administration priorities such as safety, climate change and sustainability, and equity and Justice40 into grant funding opportunities, as appropriate and consistent with existing law. The guidance aims to streamline the grant process to enable all applicants, regardless of capacity or experience with DOT grants to understand federal and program requirements. DOT resources to support applicants include a Grant Application Checklist for Climate Change in the DOT Navigator, which serves as a resource to help communities understand the best ways to apply for grants. The Justice40 Initiative sets a goal that 40 percent of the overall benefits of certain Federal climate and other investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution. Disadvantaged communities are identified using the using the Climate and Economic Justice Screening Tool (CEJST) developed by CEQ. DOT also launched the Equitable Transportation Community (ETC) Explorer, an interactive web application to explore the

cumulative burden communities experience as a result of under investment in transportation. It is designed to complement CEQ's CEJST by providing users deeper insight into the Transportation Disadvantaged component of CEJST.

Led by the Chief Sustainability Officer and the Office of the Assistant Secretary for Administration, DOT has continued efforts to ensure that its facilities and operational assets are climate smart. DOT developed a Climate Hazard Exposure and Risk (CHER) tool to support system-wide analysis of climate exposure for DOT operational assets. Facility-level climate hazard exposure data were made available to DOT facility managers in 2022 to inform planning and project development. The risk-based management framework combines facility manager ratings of the vulnerability of critical systems to each climate hazard (based on sensitivity and adaptive capacity) with exposure metrics to score each mission-critical asset. The risk assessments in turn inform high-priority resilience strategies for project planning and development. The DOT team continues to integrate new climate projections from federal data sources into the CHER tool through annual updates.

In addition, DOT evaluated facility climate hazard exposure using CEQ's Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App) released in late Fall 2023 to support the preparation of this CAP (see Appendix A). The App provides a broad view of climate exposure across all DOT facilities (including unstaffed and leased facilities) from the federal property management database. The DOT actions for operational assets outlined in this plan utilize the more detailed CHER tool climate risk scores.

To ensure climate-ready services and supplies, DOT has completed multiple projects that address energy supply resilience. DOT has also initiated updates to Acquisition Management Systems, guidance documents, and acquisition professionals' training to incorporate climate resilience.

The Department's actions to bolster resilience and adaptive capacity are implemented through collaborative efforts of the Policy, Research, Administration, and International offices. Activities are coordinated through the revitalized DOT Climate Change Center, along with interagency and internal working groups and task forces. The DOT Climate Change Center is the focal point for policy and action on climate change within the Department. The policy and research units within the Office of the Secretary of Transportation (OST) co-chair the center, and its membership comprises the DOT operating administrations (OAs) and OST offices. Participation in DOT Climate Change Center meetings and activities is open to all DOT employees to leverage the passion, expertise, and diverse perspectives they bring. The regular meetings include technical climate and resilience presentations, discussion of how climate resilience or mitigation can be incorporated into DOT activities, and coordination between OAs on policy updates, climate challenges, and other priority activities. Through these efforts, the Department is building a transportation system that is resilient to the impacts of climate change, while advancing climate and environmental justice.

SECTION 2: RISK ASSESSMENT

DOT used the Federal Mapping App—which was developed for federal agencies by CEQ and NOAA to conduct a high-level screening of climate hazard exposure for federal facilities and personnel. DOT assessed the exposure of its buildings; employees; and lands, waters, and cultural and natural resources to five climate hazards: extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk.

Climate Data Used in Agency Risk Assessment

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the Fourth National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS and AK
Sea Level Rise (SLR)	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High SLR scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5	CONUS and PR
		RCP 8.5	CONUS and PR
Wildfire Risk	Measured as whether an asset is in a location is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR

Exposure to extreme heat, extreme precipitation, and sea level rise were evaluated at mid- (2050) and late-century (2080) under two emissions scenarios, Representative Concentration Pathway (RCP) 4.5 and RCP 8.5. Exposure to flooding and wildfire risk were only evaluated for the present day due to data constraints.

Climate Scenarios Considered in Agency Risk Assessment

Scenario Descriptor		Summary Description from the Fifth National Climate Assessment
RCP 8.5	Very High Scenario	Among the scenarios described in NCA5, RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46% less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

Additional details about the data used in this assessment are provided in Appendix A.

2A. Climate Hazard Exposures and Impacts Affecting Federal Buildings

Indicators of Exposure of Buildings to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of buildings projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually) from 1976-2005[2]	100%	100%	100%	100%
Extreme Precipitation: Percent of buildings projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually) from 1976-2005[1]	99%	100%	97%	96%
SLR: Percent of buildings projected to be inundated by SLR	3%	4%	3%	4%

Indicator of Exposure of Buildings to Wildfire	High Risk	Very High Risk	Extreme Risk
Wildfire: Percent of buildings at highest risk to wildfire	11%	1%	1%

Indicator of Exposure of Buildings to Flooding	100- or 500- year floodplain
Flooding: Percent of buildings located within floodplains	6% (100-yr) or 6% (500-yr)

The DOT operational assets included in the CEQ Federal Mapping App include buildings that seven OAs and OST own or manage. The analysis using the Federal Mapping App of owned DOT buildings suggests that nearly all will be exposed to increased temperature and precipitation by 2050 and 2080. In contrast, fewer than 6 percent of DOT buildings will be exposed to SLR, are located within a 500-year floodplain, or face extreme wildfire exposure.

In addition to the system-wide analysis of DOT owned buildings (shown in the table above in Section 2A), the Department also conducted a regional analysis for owned buildings using data

[2] Heat and precipitation data are not available in the Federal Mapping App for approximately 5 to 20 percent of DOT buildings; the percentage values in the table only represent climate hazard exposure for DOT buildings with available data.

from the CEQ Federal Mapping App. The regional analysis considers the 10 regions in the Fourth and Fifth National Climate Assessment, and highlighted results for each hazard are as follows:

- Wildfire: The Southwest region has the most buildings with elevated wildfire exposure (36 total including three extreme). The Northwest region has three buildings with extreme wildfire exposure, even though the total number of buildings with elevated exposure is small across the region.
- Flooding: The Southeast region has the highest number and percentage of buildings in the 100-year and 500-year floodplains. The Southwest region also has several buildings in the 100-year floodplain. Floodplain data have limited geographic coverage, meaning the estimates of exposure are likely conservative.
- Extreme Temperature: All buildings (with available data) are expected to see increased exposure to extreme heat in both the near (2050) and more distant (2080) future compared to historical precedent. In both time periods and under both emissions scenarios, the greatest increase in extreme heat is expected in the Southeast region. By 2080, between 8 percent (lower emissions scenario) and 100 percent (higher emissions scenario) of buildings in this region can expect to experience in excess of 50 extreme heat days per year. The high emissions scenario predicts much more extreme heat in 2080 than the low emissions scenario. Nonetheless, in each region the majority of buildings will experience in excess of 20 extreme heat days per year by 2080, even under the low emissions scenario (except in the Northwest, 49 percent).
- Extreme Precipitation: Nearly all buildings (with available data) are expected to see increased exposure to extreme precipitation in both the near (2050) and more distant (2080) future, but the increases are moderate. Only for certain buildings in Alaska is the number of extreme precipitation days expected to exceed 10 days per year (compared to the historical 3.67 days/year) in either 2050 or 2080. Nonetheless, facilities that already see impacts from major precipitation events can expect to see greater and more frequent impacts in the future.
- SLR: Under both emissions scenarios and in 2050 and 2080, the regions that show the greatest exposure to SLR are the Northeast, Southeast, and Southwest. Although more facilities will face inundation in 2080 compared with 2050, both scenarios show similar patterns in 2050 and in 2080.

The CEQ Federal Mapping App includes all DOT buildings and real property entries from the federal property management system. DOT has identified a subset of the buildings and operational assets as mission-critical for resilience assessments. To address priority actions identified in the 2014 and 2016 Climate Action Plans, DOT developed the CHER Tool in 2021-2022 to guide OAs through climate risk assessments for mission-critical operational assets. For each mission-critical building, the tool provides climate hazard exposure scores that combine with user ratings for asset criticality, dependencies, and vulnerability to generate site-level climate risk scores. DOT compiled original historical and projected climate exposure data from several federal resources to provide OAs with consistent, high-quality information that will support system-wide comparisons of climate risk.

In accordance with DOT Order 4360, Climate Change Adaptation and Resilience Policy for DOT Operational Assets issued in September 2023, OAs are required to use the CHER Tool to

assess location-specific vulnerabilities and risk facing mission-critical DOT operational assets. The risk assessments will inform the prioritization of adaptation and resilience strategies. DOT will track and report progress on the implementation of resilience measures that reduce vulnerability, thereby mitigating risk to natural hazard and climate exposures.

2B. Climate Hazard Exposures and Impacts Affecting Federal Employees

Indicators of Exposure of Employees to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005	100%	100%	100%	100%
Extreme Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005	100%	100%	100%	98%
SLR: Percent of employees duty-stationed in counties projected to be inundated by SLR	16%	37%	17%	41%

Indicators of Exposure of Employees to Wildfire	High Risk	Very High Risk	Extreme Risk
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire	12%	3%	4%

DOT staff are highly concentrated at DOT headquarters and large research facilities, meaning that the most important exposures facing staff may differ from those of DOT facilities as a whole. Resilience priorities and solutions may also differ given discrepancies between hazard impacts on staff versus infrastructure. To supplement the system-wide analysis of DOT employees (shown in the table above in Section 2B), the DOT also conducted a regional analysis for all DOT employees using data from the CEQ Federal Mapping App. Most DOT staff, and most DOT Non-seasonal Full-time Permanent (NSFTP) staff, are in the Northeast, Southeast, Southern Great Plains, Southwest, and Midwest regions. Fewer than 10 percent of all staff are in the Northwest, Alaska, Northern Great Plains, and Hawaii regions combined.

- Wildfire: The Southwest region has the greatest wildfire exposure for employees. The Southeast also has high exposure to this hazard, including a large number of employees exposed at extreme levels.
- Extreme Temperature: The Southeast region stands out as showing the greatest increase in extreme heat days. By 2080, between 57 percent (low emissions scenario) and 100 percent (high emissions scenario) of the more than 10,000 employees in this region are expected to see an average of 20 or more extreme heat days each year.
- Extreme Precipitation: The number of extreme precipitation days that staff will experience does not exceed 10 days under any of the scenarios or regions in the CEQ Federal Mapping App. The Northwest region will experience the most widespread change by 2080, but few staff will be affected.

- SLR: Under both scenarios and in 2050 and 2080, the regions that show the greatest exposure of employees to SLR are the Northeast, Southeast, and Southwest. Both scenarios show similar patterns in 2050. Under the higher emissions scenario in 2080, over 12,000 employees in the Northeast are expected to be in counties affected by SLR, and every region has at least 1,000 employees in exposed counties. However, the Southeast region may have more widespread impacts from SLR inundation (in excess of 20 sq. mi. per county).

The system-wide and regional exposures to employees that have been identified using the CEQ Federal Mapping App will inform DOT's ongoing efforts to assess and mitigate climate risks to employee health and safety and to mission-critical operations.

2C. Climate Hazard Exposures and Impacts Affecting Federal Lands, Waters, and Cultural Resources

Federal Asset	Current Climate Hazard Impact or Exposure	Future Climate Hazard Impact or Exposure
Unstaffed and primarily leased land parcels devoted to air navigation and air traffic purposes (includes 90% of DOT-affiliated lands listed in the CEQ Federal Mapping App).	Assets on unstaffed land parcels are currently not considered to be highly vulnerable to climate hazards. Although a subset of sites has high exposure to specific climate hazards such as SLR or exposure to the 100-year floodplain, the assets on these lands are built to withstand a wide variety of weather and environmental hazards. Additionally, these systems have high levels of redundancy across sites.	Nearly all land parcels will see small increases in extreme precipitation days (on average fewer than 6 extreme precipitation days per year total under both scenarios in 2050 and 2080, compared to the historical precedent of 3.7 days per year). A small percentage of all DOT-affiliated properties face exposure to the 100-year floodplain (6%), elevated wildfire risk (12%), or sea level rise (4.2 to 5.1% depending on the scenario and timeframe).

The CEQ Federal Mapping App contains 5,122 DOT-affiliated lands, of which nearly 4,000 are leased. Climate projection data in the App suggest that all lands will see an increase in extreme heat days. Nearly all lands will see an increase in extreme precipitation days, although the overall change is small (on average fewer than 6 extreme precipitation days per year total under both scenarios in 2050 and 2080, compared to the historical precedent of 3.7 days per year). A much lower percentage of properties face exposure to the 100-year floodplain (6 percent), elevated wildfire risk (12 percent), or SLR (4.2 to 5.1 percent depending on scenario and timeframe).

DOT will continue to review and update the most appropriate siting, construction, operation, and maintenance standards for its lands and landed assets in response to changing climate hazards. Over 90 percent of all DOT-affiliated lands are unstaffed parcels devoted to air navigation and air traffic purposes (such as ground-based navigational transmission and wind alert systems). The assets on these lands are built to withstand a wide variety of weather and environmental hazards. Additionally, these systems have high levels of redundancy across sites.

A select number of properties owned by DOT are listed in the National Register of Historic Places. For example, MARAD's historic properties include one historic district, one building,

and one National Historic Landmark. The coastal properties are exposed to flooding, high winds, extreme heat, extreme precipitation, and sea level rise.

DOT also supports the resilience of transportation assets on other federal lands that are not included in the CEQ Federal Mapping App. For instance, FHWA's Office of Federal Lands Highway (FLH) provides technical services to Federal Land Management Agencies (FLMAs), States, Territorial partners, Local governments, and Tribal governments to improve transportation to and within Federal and Tribal lands. Examples include a 2022 publication: Infrastructure Resilience to Extreme Events & Climate Change - Federal Lands Sensitivity Case Studies and a FLMA Southeast Region Climate Change Transportation Tool.

2D. Climate Hazard Exposures and Impacts Affecting Mission, Operations, and Services

Summary Of Key Current And Projected Climate Hazard Impacts And Exposures

Area of Impact or Exposure	Identified Climate Hazard	Description
National transportation system infrastructure	Wildfires	Directly damages roadways, railways, and pipelines and leads to landslides during subsequent rain events that threaten lives, and property and cause more extensive infrastructure damage; Causes road closures, health impacts, and reduced visibility for drivers and pilots over large regions during active events; Induces the release of toxic chemicals from plastic pipeline infrastructure; Smoke impacts the health of employees operating and maintaining National Airspace System (NAS) infrastructure or working outdoors.
National transportation system infrastructure	Extreme precipitation	Causes erosion and saturated soil that damage roadways, airport runways, railways, waterways, and pipelines; Increases risk of landslides that may impact infrastructure viability; Damages culvert and drainage infrastructure which may increase current and future flooding; Results in pipeline shift or fracture.
National transportation system infrastructure	Extreme heat	Causes railways, roadways, sidewalks, and runways to buckle, crack, and rut; Reduces service life of infrastructure; Induces permafrost melt that destroys infrastructure; Creates unsafe working conditions; Necessitates that trains operate at lower speeds; Induces catenary line sag thus impacting train operability; Reduces NAS capacity via impacts on required lift for larger aircraft.
National transportation system infrastructure	SLR, storm surge	Leads to more frequent/severe flooding of underground tunnels and low-lying infrastructure, requiring improved drainage and pumping, repair, or replacement; Causes coastal airport water intrusion.
DOT Operational Assets	Extreme precipitation	Causes riverine or pluvial flooding that damages assets located in basements or ground level; Prevents facility access for employees or emergency response personnel; Causes hazardous waste releases if accumulation areas are vulnerable to flooding.
DOT Operational Assets	Extreme heat	Hinders communication systems on site (e.g., radio, telephones), halting activities and increasing safety risks; Compromises personal health and safety of employees; Causes extended power outages that impact facility operations, laboratories, ships, and critical national airspace equipment.

DOT and its OAs oversee the safe, efficient, sustainable, and equitable operation of the United States transportation system including more than 4.1 million miles of public roads, 617,000 bridges, 136,851 railroad route miles, 3.3 million miles of pipelines, 25,000 miles of commercially navigable waterways, 3,321 public-use airports, 950 urban transit agencies, and more than 300 coastal, Great Lakes, and inland waterways ports.[3] The Fifth National Climate Assessment highlights the current and projected negative impacts of extreme weather on transportation modes and human safety.[4] Significant portions of the U.S. transportation system are currently impacted by climate hazards including extreme temperatures, storms, drought, and fire with exposure projected to increase over the next several decades.

The range of impacts on the national transportation system from exposure to climate hazards includes runway, roadway, bridge, railway, port, and pipeline damage from heat and thawing permafrost, soil subsidence, flooding, and coastal airport water intrusion; increased risk of landslides; limited waterway access; unsafe working conditions, and adverse health effects for active transport. Extreme weather conditions reduce the life of capital assets, increase operational disruptions, and create the need for new infrastructure such as evacuation routes. Addressing the impacts of climate hazard exposure for vulnerable infrastructure requires significant adjustments to standard planning, design, construction, and operational processes. DOT has deployed numerous climate adaptation and resilience efforts including guidance, memos, memoranda of understanding (MOUs), technical support and funding programs to reduce the impacts of climate hazard exposure on the mission and services.

The Department is committed to reducing climate hazard impacts on internal operations and improving resilience. DOT owns or operates research facilities and laboratories, ship fleets, academic buildings, heavy machinery, vehicle fleets, electrical substations, safety test tracks, data centers, air traffic control facilities and equipment, communication assets, historic properties, and office buildings. The DOT actions to improve resilience of these assets are consistent with the Disaster Resiliency Planning Act (DRPA). The Department has been systematically incorporating natural hazard and climate vulnerability assessments into real property risk management practices for over 10 years. DOT initially utilized resources from the U.S. Climate Resilience Toolkit, guidance and lessons learned from FHWA pilot studies, and the National Climate Assessments, among others. In 2021 DOT initiated the CAP priority action to develop the CHER Tool.

2E. Impacts from and Exposure to Additional Hazards

The CHER Tool is designed to guide OAs through risk assessments for mission-critical operational assets. The tool combines climate hazard exposure data (including climate projections) from many federal sources with user ratings of asset criticality, dependencies, and vulnerability to generate site-level climate risk scores (refer to appendix A for a list of climate hazards included in the CHER tool). The tool was designed to address a significant barrier that facility managers faced when completing climate vulnerability assessments: expertise required to research, download, compile, and interpret climate hazard exposure data. Using a consistent approach provides the Department with a system-wide overview of climate hazard exposure to

[3] Landmark Fifth National Climate Assessment Highlights Key Climate Change Risks and Opportunities for the Transportation Sector

[4] Transportation (globalchange.gov)

inform which sites to prioritize for vulnerability assessments. The CHER tool integrates facility manager ratings of the vulnerability of critical systems for each site with climate hazard exposure data to rate climate risk and inform resilience solutions.

Several mission-critical buildings are exposed to increasingly regular high-tide flooding and salt-water intrusion that can damage building structures, utility systems, and communications. National Reserve Defense Fleet stations experience damage from increased storm surges and tides. Extreme precipitation causes flooding that prevents facility access for employees or emergency response personnel. Extreme heat can stress utility systems, reduce the service life of structural materials, and impact NAS capacity. In contrast, DOT buildings and employees have only limited direct exposure and vulnerability to wildfire.

The CHER tool provides location-specific exposure data for climate hazards (over 20 in the 2023 version) so that facilities managers can provide information on facility vulnerability, allowing for an overall estimate of risk as well as risk from each climate hazard. Of the climate hazards included in the CHER tool (fourteen historical and nine projection-based), mission-critical, staffed DOT facilities have the highest exposure to future (2050) high temperatures and extreme precipitation, coastal flooding, and hurricanes. In using the CHER tool, OAs have identified their greatest vulnerabilities as hurricanes, coastal flooding, ice storms, and strong winds. Thus, the overall ranking of climate hazards that pose the greatest risk (a measure that combines exposure, criticality, dependency, and vulnerability) can differ from hazard importance estimated by exposure alone.

Both vulnerability and exposure are key to understanding climate impacts, and the CHER tool demonstrates how a fuller understanding of both can inform project planning, development, and prioritization. DOT OAs have used the CHER tool to complete resilience assessments for dozens of mission-critical facilities. The Department has created a Climate Risk Dashboard to track progress towards completing the vulnerability assessments for all DOT mission-critical facilities and to automate the process to synthesize the results across the organization.[5] DOT is continuing to update the CHER tool as climate hazard exposure data are published or revised and as the Department's climate assessment activities mature.

[5] See Appendix A

SECTION 3: IMPLEMENTATION PLAN

3A. Addressing Climate Hazard Impacts and Exposure

1. Prioritized Actions To Address Climate Hazard Exposures and Impacts Affecting Federal Buildings

Climate Hazard Impact on and/or Exposure to Buildings	Priority Action	Timeline for Implementation (2024-2027)
National Impacts: All climate and natural hazards included in the CHER tool (historical exposure for all variables and projected exposure for extreme temperatures, precipitation, and SLR)	Complete vulnerability assessments of all mission-critical facilities using the CHER tool as part of ongoing sustainment activities.	Complete assessments for mission-critical facilities by the end of FY 2026. Review assessments for approximately 25% of mission-critical facilities annually, such that all are reassessed every four years.
National Impacts: Extreme heat	Consider the impacts of projected increases in extreme heat on cooling day requirements when planning for 100% carbon-free electricity (CFE) and utility costs.	Ongoing activity to support performance contracts, deep energy retrofits, optimizing or right-sizing heating, ventilation, and air conditioning (HVAC) equipment, and onsite renewable energy projects.
National Impacts: Extreme temperature, precipitation, flooding, and SLR	Install renewable energy and microgrid projects to improve energy resilience and reduce dependency on outside resources (energy, suppliers). Action will support the E.O. 14057 CFE goals.	Ongoing activity to support the installation of onsite renewable energy projects that power DOT facilities.
National Impacts: Extreme temperature, precipitation, flooding, and SLR	Evaluate benefits of monitoring and control system improvements to identify and correct impending system failures.	Ongoing activity to support performance contracts.
National Impacts: Extreme temperature, precipitation, flooding, and SLR	Update design processes to evaluate new information, strategies, and materials that enhance the climate resiliency of operational infrastructure.	Ongoing requirement in all major renovation and new construction projects.
National Impacts: Extreme precipitation and Flooding	Move high-value items from the basement and ground floor levels to reduce the potential for preventable flood damage. Plan to move all such assets out of flood-prone areas.	Ongoing requirement in all major renovation and new construction projects.
Regional Impacts: Extreme precipitation, flooding, storm surge, and SLR	Renovate seawalls and evaluate nature-based solutions to attenuate wave action and reduce damage to shoreside assets.	Include SLR and storm surge projections in design requirements for new seawall infrastructure in 2024.
Regional Impacts: Extreme precipitation	Upgrade stormwater management systems at large campuses and facilities to reduce flooding and runoff from extreme precipitation events.	Complete major upgrades for one large DOT campus by the end of 2025.
Regional Impacts: Extreme weather events	Review Heavy Weather Mooring plans and update them to withstand 100-year storm events under future SLR and storm surge conditions.	Identify recommended updates in FY 2024 and complete revisions by the end of FY 2025.

The Department owns or operates more than 10,000 staffed and unstaffed assets across 10 climatic regions identified in the newly released fifth National Climate Assessment. Many air traffic control assets, offices, research laboratories, and other mission-critical buildings in widely dispersed locations will experience a range of climate impacts, from extreme storms worsened by sea level rise to longer lasting and more extreme heat waves and extreme cold, to increased numbers and severities of hurricanes, wildfires, tornadoes, and floods. In accordance with DRPA, DOT is considering climate risk information and enhancing the resilience of agency assets by identifying and implementing priority adaptation actions.

DOT developed the CHER tool (described in Section 2E above) to integrate climate exposure data with asset criticality and system vulnerability to estimate climate risk across the portfolio of DOT facilities and operational assets. Most OAs have completed an initial round of assessments using the CHER tool with results compiled in an interactive dashboard for easy reference when making investment decisions.[6] DOT Order 4360 is aligned with the guidance and requirements of E.O. 14008, E.O. 14057, the *Disaster Resiliency Planning Act*, OMB circular A-11, and OMB memo M-24-03.

The CHER tool risk assessments will inform the prioritization of the resilience strategies highlighted in the table above, and other site-specific adaptations to reduce sensitivity to climate hazard exposure. For instance, OAs in areas with increased wildfire exposure can update HVAC systems to reduce impacts from wildfire smoke. OAs are already taking several steps to address vulnerabilities associated with climate change. Examples include introducing changes in building design at the time of new construction, locating data centers on higher floors to avoid possible flooding and the use of different, more resilient construction materials. OAs are upgrading structural elements, including sea walls and mooring systems to withstand greater force from surging seas. A large DOT facility is updating the stormwater management system to reduce flooding impacts and run-off during extreme precipitation events. OAs are also installing alternative and back-up power systems, including micro-grids. Onsite renewable energy facilities can increase resilience by reducing reliance on power grids and avoiding power outages while at the same time addressing sustainability and net zero emissions goals.

DOT actively participates in the White House Flood Resiliency Interagency Working Group to coordinate implementation of the Federal Flood Risk Management Standard (FFRMS). The Department is drawing on interim resources, including the Congressional Research Service FFRMS report,[7] while the final policy is under development. For example, OAs are using site-specific flood exposure maps to evaluate climate risks when renewing leases or relocating facilities. Additional engagement with interagency working groups for resilience, nature-based solutions, and climate services will provide the needed data and information for addressing climate hazard impacts and exposure.

[6] See Appendix A.
[7] IN12193 (congress.gov)

2. Prioritized Actions To Address Climate Hazard Exposures and Impacts Affecting Federal Employees

Climate Hazard Impact on and/or Exposure to Employees	Priority Actions	Timeline for implementation (2024-2027)
National Impacts: Extreme temperature, precipitation, flooding, and SLR. Severe weather or other climate-related events could expose personnel to personal health and safety risks.	Increase general knowledge among employees and supervisors about the potential impacts of severe weather and environmental hazards through the DOT Climate and Transportation 101 training and other resources. Provide support for personnel impacted by climate disasters.	Distribute annual summaries of available climate information and decision support resources to DOT personnel on internal web pages at least twice per year. Provide advisory information on how to prepare for and reduce the impacts of extreme weather events on communities and personal property.
National Impacts: Extreme temperature, precipitation, flooding, and SLR. Inclement weather or other climate-related events could expose personnel to personal health and safety risks.	Include impacts of climate hazard exposure on personnel health and safety as a top criterion when evaluating lease renewals or selecting new lease or property purchase locations.	Include guidance for climate hazard exposure in DOT Sustainable Buildings Order when revised in 2024.
National Impacts: Extreme heat	Adjust working hours of employees working in field locations to avoid extreme heat exposure. Review current procedures (Occupational Safety and Health Administration (OSHA) protocols) to protect worker safety. Utilize telework and Continuity of Operations Plan (COOP) protocols to avoid exposure to extreme heat when feasible. Rail testing schedules will be adjusted to more night schedules than day schedules to take advantage of cooler evening temperatures.	Include guidance or references for when to adjust working hours in the DOT Overarching Sustainability Order to be revised in 2024. Review telework and COOP guidance to include considerations for field personnel exposure to extreme weather under future climate conditions by 2025.
Coastal Impacts: Warmer temperatures	Warmer water temperatures may result in the increase of insect populations and vulnerability to personnel from disease.	Track local health advisories and offer resources to support protective actions as relevant to reduce risk of personnel exposure.

The CHER tool helps DOT evaluate the impacts of climate hazard exposure on property and buildings. CEQ's Federal Mapping App more directly evaluates employee exposure, and indicates that for the Department, the most significant climate hazard exposure for employees is from flooding, wildfires, extreme heat, and SLR.

Exposure to natural climate hazards can make it difficult for mission-critical personnel to accomplish their work, which could have broad consequences for the DOT mission and programs. If personnel are able to continue working, their personal health and safety may be compromised under certain conditions. For example, if operations can continue during extreme

weather or flooding, personnel are often required to continue working which can result in unexpected and longer operating shifts in adverse conditions. Personnel who work in outdoor settings are susceptible to exposure to extreme heat. The integrity and safety of systems may be compromised with climate change related conditions. For example, low availability of water in extreme heat may lead to cancellations of emergency testing or system maintenance due to lack of water for personnel or if testing itself requires significant amounts of water. Communication between DOT personnel at different locations with emergency responders and Headquarters could be hindered. Thus, operations continuity and repair of system damages could be delayed and impaired.

The Department will prioritize actions that will both reduce the exposure of personnel to these natural climate hazards and reduce the impacts of exposure. These actions will include education through the DOT Climate 101 training, adjustments to work requirements, and consideration of climate impacts when selecting work locations.

3. Prioritized Actions To Address Climate Hazard Exposures and Impacts Affecting Federal Lands, Waters and Cultural Resources

Type of Land or Water Asset	Climate Hazard Impact on and/or Exposure to the Asset	Priority Action
Unstaffed parcels devoted to air navigation and air traffic purposes (includes 90% of DOT-affiliated lands listed in the CEQ Federal Mapping App).	DOT assets on unstaffed parcels have not been identified as highly vulnerable to current or future climate hazards. The assets on these lands are built to withstand a wide variety of weather and environmental hazards, and these systems have high levels of redundancy across sites.	Mission-critical land and water assets will be included in DOT climate hazard assessments to inform investment priorities. DOT will continue to review and update the most appropriate siting, construction, operation, and maintenance standards for its lands and landed assets in response to changing climate hazards.

The majority of DOT lands included in the CEQ Federal Mapping App are leased unstaffed parcels devoted to air navigation and air traffic purposes (such as ground-based navigational transmission and wind alert systems). The assets on these lands are built to withstand a wide variety of weather and environmental hazards. Additionally, these systems have high levels of redundancy across sites. These DOT assets on unstaffed parcels have not been identified as highly vulnerable to current or future climate hazards. DOT will continue to review and update the most appropriate siting, construction, operation, and maintenance standards for its lands and landed assets in response to changing climate hazards.

Advancing the America the Beautiful Initiative	
DOT discretionary grant programs now include standard language for integrating climate resilience and nature-based solutions into project planning, development, and capital funding decisions.	DOT grant programs such as Culvert Aquatic Organism Passage (Culvert AOP) and Neighborhood Access and Equity (NAE) encourage projects that incorporate the use of natural infrastructure, also known as nature-based solutions, including: • Conservation, • Restoration, • Construction of wetlands, • Native vegetation, • Stormwater bioswales, • Parks, • Urban forests and shade trees. These efforts can result in projects that reduce flood risks, erosion, wave damage, and heat impacts while also creating habitat, filtering pollutants, and providing recreational benefits.

DOT is home to several innovative grant programs that fund projects at the critical nexus of conservation and climate resilience, as well as programs that broadly advance national conservation goals. Additional information on these programs is found below, including general timelines for award announcements and open application periods.

FHWA's Culvert AOP Grant program delivers $1 billion in Bipartisan Infrastructure Law (BIL) funding over five years (2022-2026) to replace, remove, and repair culverts and weirs to meaningfully improve or restore fish passages for anadromous fish. In August 2023, FHWA announced the first round of grants under this program to fix or remove almost 170 barriers and improve approximately 550 miles of stream habitat across the country, with a total of $196 million dollars in grant funding to 59 Tribal, state, and local governments. Projects will not only improve habitat connectivity for anadromous fish but may also have co-benefits such as increased resiliency of aquatic ecosystems and of transportation assets. The next application period is scheduled to start mid-2024.

FHWA's Wildlife Crossings Pilot Program (WCPP) delivers $350 million in BIL funding over five years (2022-2026) to protect motorists and wildlife by reducing wildlife-vehicle collisions and improving habitat connectivity for terrestrial and aquatic species. Each year, it is estimated that there are more than one million wildlife vehicle collisions in the U.S. Wildlife-vehicle collisions involving animals result in injuries to drivers and their passengers, representing approximately 200 human fatalities and 26,000 injuries to drivers and their passengers each year. These collisions also cost the public more than $10 billion annually. This includes economic costs caused by wildlife crashes, such as loss of income, medical costs, property damage, and more. Improving migrations of species is critical to protecting biodiversity, especially in a changing climate. Protecting biodiversity ensures healthy and thriving ecosystems that, in turn, provide resilience benefits such as stormwater management and flood protection. In April 2023, FHWA announced the first Notice of Funding Opportunity (NOFO) for this program by making available nearly $112 million in WCPP funds. In August 2023, FHWA received 67 applications

from applicants in 34 States requesting $549 million in WCPP funds. This represents nearly five times the amount available in the first NOFO, and over one and a half times the amount available for the program over the life of the BIL. In December 2023, FHWA announced the first round of grant awards under this program for 19 wildlife crossing projects in 17 states, including four Indian Tribes.

Another program DOT is working to implement is the Neighborhood Access and Equity (NAE) Grant Program, which demonstrates how federal mechanisms can weave funding for nature-based and climate resilience solutions together to strengthen local transportation planning. More specifically, the NAE program offers approximately $3.2 billion to improve walkability, safety, and affordable transportation access through projects that are context-sensitive and mitigate or remediate negative impacts on the human or natural environment resulting from a transportation facility in a disadvantaged community. Of the total amount, $1.3 billion is dedicated to projects in disadvantaged communities. A portion of the program funds community planning initiatives that include monitoring and assessing local gaps in tree canopy and green space, urban heat islands (UHI), extreme precipitation, flooding, and other climate risks. This holistic approach helps communities address hyper-local challenges, select the most appropriate sets of interventions, and plan how best to integrate natural infrastructure into adaptation-focused transportation investments, such as:

- Planning and/or construction of greenways, highway capping, pedestrian, and bicycle trails.
- Expansion of and access to green space for nature deprived communities.
- Increased tree planting and vegetated areas to help mitigate flooding and manage stormwater impacts to critical bridges, roads, and evacuation routes.

3B. Climate-Resilient Operations

1. Accounting for Climate Risk in Planning and Decision Making

DOT has a long history of incorporating climate risk considerations into planning and decision making to increase the resilience of transportation infrastructure and operational systems. DOT senior leadership participates in Climate Principals conversations and DOT Climate Change Center meetings facilitate the incorporation of climate adaptation priorities into decision making across the organization. The DOT Climate Change Center website includes a list of climate adaptation resources and tools produced by the department and resources from other agencies.[8] DOT continues to develop resilience assessment guidance and tools, provide technical assistance, and implement projects to conduct vulnerability and adaptation assessments for different transportation modes, locations, and systems. Each of DOT's nine OAs will develop CAPs to address climate hazards and resilience in project development, programs, and operations as part of the implementation of this CAP.

The Department includes climate resilience criteria in discretionary grant programs where appropriate. DOT issued revised internal discretionary grant guidance in December 2023 that includes information on how to incorporate criteria for evidence-based climate resilience and

[8] Climate Adaptation Resources and Tools | U.S. Department of Transportation

adaptation measures or features. Numerous grant programs provide funding for projects that use the best-available climate data and tools to assess climate-related vulnerabilities and risks, and to develop resilience solutions to address those risks. For example, the Federal Railroad Administration (FRA) considers resiliency in the review of grants for the Consolidated Rail Infrastructure and Safety Improvement program which funds rail infrastructure development and maintenance. In addition, the BIL established the PROTECT Program to provide formula and discretionary grant funding for Planning, Resilience Improvements, Community Resilience and Evacuation Routes, and At-Risk Coastal Infrastructure. The program website has compiled an extensive list of DOT and other federal resources that provide information on methods and tools for assessing and addressing resilience, including Resilience Improvement Plans (RIP).[9]

The Department completed a Consensus Study on Resilience Metrics in the Fall of 2021 with the National Academies of Science/Transportation Research Board (Investing in Transportation Resilience: A Framework for Informed Choices). The Department is working to address recommendations from the Consensus Study on Resilience Metrics, including promoting the use of benefit-cost analysis. The Department is also conducting a priority research project to develop a tool to assess the costs and benefits of building resilient transportation infrastructure. The Resilience Disaster Recovery tool analyzes resilience investments for Long-Range Transportation Planning and is now being implemented at state and local levels.

In September 2023, DOT issued Order 4360: *Climate Change Adaptation and Resilience Policy for DOT Operational Assets*. The Order delegates authority and assigns responsibility to ensure that DOT and its OAs integrate climate change adaptation (climate adaptation or adaptation) and climate change resilience (climate resilience or resilience) requirements into agency planning, supply chain sustainability, and mission-critical assets for internal operations. The Order outlines the DOT policy to pursue cost-effective, innovative strategies that build climate adaptation and resilience through planning, governance, oversight, financial management, and acquisition. OAs are required to use the DOT-developed CHER tool for vulnerability and risk assessments of DOT buildings and other property, with DOT Order 4360 outlining the process to apply results to planning and decision making for DOT operational assets.

OST and DOT OAs have created many climate resilience resources and tools that provide decision support for a variety of transportation infrastructure and operational system applications:

- FHWA: More than 40 resources[10] including information on Addressing Resilience to Climate Change & Extreme Weather in Transportation Asset Management (2023), the Vulnerability Assessment Scoring Tool (VAST) and adaptation framework (2017 update), Pavement Resilience (2023), and nationwide resilience pilot projects; the National Highway Institute (NHI) course "Addressing Climate Resilience in Highway Project Development and Preliminary Design".
- FAA: Airport Resilience Assessment Framework (ARAF), under development (2022-2026) to assist FAA and airport operators to better incorporate resilience analysis and prioritization into airport project planning and funding.[11]

[9] Resources - PROTECT - Environment - FHWA (dot.gov)
[10] Publications - Resilience - Sustainability - Environment - FHWA (dot.gov)
[11] Improving Airport Resilience, September 2022 (faa.gov)

- OST-R: Resilience and Disaster Recovery (RDR) Tool enables transportation agencies to assess resilience investments under a range of potential hazard conditions for Long-Range Transportation Planning. RDR is now being used as a decision support tool.
- OST-R: A white paper for industry groups, decision-makers, the public and others interested in the transportation sector on the needs and challenges of integrating quantitative metrics for assessing resilience into transportation infrastructure along with findings on how to address these identified needs and challenges.
- OST-R: Best practices for utilizing industrial waste as supplementary cementitious materials to substantially lowering the levels of embodied GHG emissions associated with construction materials and building an environmentally sustainable and climate-resilient infrastructure system.
- Federal Transit Administration (FTA): Climate considerations website with FTA research on adapting public transportation to climate change impacts and information from FTA-funded climate adaptation pilots.[12]
- FRA: Includes resiliency considerations and information in infrastructure project grant applications for the Consolidated Rail Infrastructure and Safety Improvements (CRISI) grant program. FRA is conducting research on climate impacts on rail infrastructure and recommendations for the rail industry.
- MARAD and the Great Lakes St. Lawrence Seaway Development Corporation (GLS) will continue to address resilience for shipping and ports with the U.S. Committee on the Marine Transportation System (CMTS) and the Ocean Climate Action Plan.

The Transportation Vulnerability and Resilience Data Program (TVRDP) is a new Bureau of Transportation Statistics (BTS) initiative to fill data gaps and provide access to data, statistics, and analyses tools needed to measure the vulnerability of transportation systems to the direct and indirect disruptions caused by natural, manufactured, and cyber events. The evaluation of the ability of the national transportation system to recover from those disruptions will support DOT efforts to meet local decision-maker needs for community resilience to extreme weather identified in the Work Plan to Provide Federal Support for Local Decision-making[13] required by Section 25003 of BIL.

2. Incorporating Climate Risk Assessment into Budget Planning

OST is responsible for the oversight of climate-related risks and opportunities, through the leadership of the Deputy Assistant Secretary for Policy and Chief Sustainability Officer (CSO), in coordination with the Department's OAs, the Office of the General Counsel, and the Office of the Chief Financial Officer. Additionally, the Office of Policy, within OST, coordinates climate adaptation actions with support from DOT's Climate Change Center.

The FY 2023 DOT Agency Financial Report (AFR) includes a summary of DOT's budget and financial risk management processes. Included in the AFR and related to real property and climate risk management, the Department has implemented a multi-step climate resiliency process. Given the great diversity of asset types held, the Department is utilizing multiple strategies to ensure climate resilience at its facilities. The Department has identified its major mission-critical buildings and operational assets. In addition, mission-critical operations include activities completed in support of DOT's own business processes. The Department will continue

[12] Climate Considerations | FTA (dot.gov)
[13] https://doi.org/10.21949/1528355

performing climate change vulnerability assessments for mission-critical buildings and operational assets using the internally developed CHER tool. Each OA has completed initial assessments of their mission-critical assets and OST is analyzing the results. Upon completion of the assessment, each mission-critical building will have an overall climate risk score and a risk score for each environmental hazard, which can be ranked in priority order and addressed through adaptation strategies as resources are available. To proactively integrate climate resilience into existing management processes, OAs can incorporate priority adaptation and mitigation strategies into their Capital Asset Plans, new building design standards, and facility operation and maintenance schedules.

OST has also developed internal energy, environmental, and sustainability performance metrics. Aligned with the Administration's ambitious climate and environmental priorities, these metrics will include adaptation targets to enhance resiliency along with other important energy, environmental, and procurement actions. The internal report will also establish accountability and governance across the agency, ensuring DOT leads by example through continued progress. The Department's Office of the Budget, CSO, and the DOT Climate Change Center, with representatives from across all DOT offices, will oversee and coordinate these efforts.

3. Incorporating Climate Risk into Policy and Programs

Agency Policies Reviewed

Topics	Policies and Guidance	Examples
Climate Adaptation and Resilience	Every DOT OA and Office has reviewed policies and guidance documents to incorporate Administration priorities including climate adaptation and resilience where relevant. The Department has also issued or is developing numerous new policies and programs that support climate adaptation and resilience. Examples include: • FY 2022-26 DOT Strategic Plan: climate as a strategic priority • 2021 DOT CAP and 2022 CAP Progress Report • The U.S. National Blueprint for Transportation Decarbonization: A Joint Strategy to Transform Transportation • FAA: 2021 Aviation Climate Action Plan • FHWA: Addressing Resilience to Climate Change & Extreme Weather in Transportation Asset Management • FHWA: Pavement Resilience: State of the Practice Report • FHWA: Geohazards, Extreme Weather Events and Climate Change Resilience Manual	DOT issued new Order 4360: Climate Adaptation and Resilience Policy for DOT Operational Assets on September 18, 2023. DOT issued revised internal discretionary grant guidance on December 22, 2023, that includes guidance for how to incorporate criteria for evidence-based climate resilience and adaptation measures or features. The BIL provided a legislative definition of resilience and included resilience activities as explicitly eligible under multiple DOT grant programs, including the National Highway Performance Program, Surface Transportation Block Grant Program, and FHWA's Emergency Relief Program. FHWA has shared information with States to make sure they know of these eligibilities. BIL established the PROTECT program to fund projects to improve transportation resilience and program guidance incorporates resilience considerations thoroughly. The Department will continue to evaluate policies to confirm that climate adaptation and

	• FHWA: Infrastructure Resilience to Extreme Events and Climate Change - Federal Lands Sensitivity Case Studies • FHWA: Highways in the River Environment - Floodplains, Extreme Events, Risk, and Resilience • FTA: Climate Resilience Guidebook (in development) • OST-R: Resilience and Disaster Recovery Tool Suite OST-X: Global Engagement Program *MOMENTUM*	resilience considerations are fully incorporated. The Climate Adaptation and Resilience Review will evaluate all policies to identify any that need to be updated. • For example, FHWA Order 5520 from 2014 on preparedness and resilience to climate change and extreme weather events is one order that could be replicated for other DOT OAs.
Nature-Based Solutions	DOT encourages the use of nature-based solutions or green infrastructure through policy and a significant body of technical guidance. The BIL prioritizes natural infrastructure as a resilience solution, provides a definition of natural infrastructure, and expands opportunities to utilize funding for natural infrastructure within the new PROTECT program. DOT issued revised internal discretionary grant guidance on December 22, 2023, that includes guidance for how to incorporate criteria for evidence-based climate resilience and adaptation measures or features including nature-based solutions.	FHWA has long encouraged nature-based solutions to improve the resilience of transportation projects. Examples of policies or guidance that include nature-based solutions or green infrastructure include: • A summary of fourteen case studies published in 2018 on green infrastructure pilots completed from 2009-2015 • Inflation Reduction Act (IRA): Neighborhood Access and Equity Grants • FHWA's Nature-Based Solutions for Coastal Highway Resilience Implementation Guide • FHWA Case Studies in Realizing Co-Benefits of Multimodal Roadway Design and Gray and Green Infrastructure • Public Roads Magazine: Nature-Based Solutions for Coastal Highway Resilience (2021) • FHWA Eco-logical Approach (Environmental Review Toolkit)
Environmental Justice	DOT has incorporated Environmental Justice considerations into numerous policies, guidance, or planning documents that influence activities related to climate adaptation and resilience across DOT OAs including: • DOT Justice40 Initiative • DOT Climate Change Center • DOT Asian American, Native Hawaiian, and Pacific Islander Action Plan • DOT Environmental Justice Orders ○ FAA Order 1050.1F, CHG 1 (July 16, 2015) • FHWA Guidance on Environmental Justice and NEPA • FHWA Environmental Justice Reference Guide • DOT Equitable Transportation Community (ETC) Explorer, designed to complement the CEQ	DOT issued revised internal discretionary grant guidance on December 22, 2023, that includes guidelines for incorporating Administration priorities related to climate change and sustainability, equity, and Justice40. DOT is updating the Environmental Justice strategy and will coordinate activities related to resilience. The Department is taking steps to address the WHEJAC's recommendations, including disaster preparedness and relief. Several OAs administer emergency relief programs, such as: FTA Emergency Relief Program, FHWA Emergency Relief Program, and the Public Transportation Emergency Relief Program. These programs provide communities with the necessary funding to replace, and repair infrastructure, and incorporate resilience into transportation systems following extreme weather events and natural disasters.

	Climate and Economic Justice Screening Tool • FHWA Environmental Justice FAQ • FAA Office of Airports on Environmental Justice and Related Issues • FTA Environmental Justice FAQs • FTA Environmental Justice Circular for FTA recipients • FRA Justice40 Rail Explorer mapping tool • DOT Climate Action Plan: Revitalizing Efforts to Bolster Adaptation & Increase Resilience Plan • DOT Climate Action Plan for Resilience: 2022 Progress Report • DOT co-chairs the White House effort to develop an EJ Science, Data, and Research Plan, per E.O. 14096 • DOT participated in the Ocean Justice Strategy	DOT Environmental Justice Subject Matter Experts participate in the White House Environmental Justice Interagency Council (IAC) - NEPA Committee/Working Group.
Tribal Nations	The DOT Tribal Transportation Self-Governance program provides federally recognized Tribes and Tribal organizations with greater control, flexibility, and decision-making authority over DOT funds used to carry out tribal transportation programs, functions, services, and activities in tribal communities. • DOT signed the first compact under the program with the Cherokee Nation in June 2022. • DOT signed the second compact with Ohkay Owingeh tribal leaders in January 2024. As a follow-up action to the President's January 26, 2021, Memorandum on Tribal Consultation and Strengthening Nation-to-Nation Relationships, the U.S. DOT, after consultations with Tribes, issued an update to its Tribal Consultation Policy and Tribal Consultation Plan to improve and implement the policies and directives of Executive Order 13175. DOT hosted a tribal consultation on BIL in February 2022 and on the Strengthening Mobility and Revolutionizing Transportation (SMART) grant program in July 2022 regarding funding opportunities available to Tribes.	DOT administers many programs and policies for consultation with Tribal Nations that inform agency actions including activities to enhance resilience, in accordance with federal policy: • Tribal Consultation Presidential Memorandum • PHMSA Tribal Assistance Protocol • Thriving Communities Program • PROTECT • Tribal Transportation Self-Governance Program • FTA Public Transportation on Indian Reservations Program; Tribal Transit Competitive Program (Example: National RTAP Tribal Transit Mini Conference) • FHWA Tribal Transportation Program • Tribal Transportation Program Safety Fund (TTPSF) • Tribal Transportation Facility Bridge Program • Tribal High Priority Projects Program • Nationally Significant Federal Lands and Tribal Projects Program • Public Transportation on Indian Reservations (Tribal Transit) Program • Rural and Tribal Assistance Pilot Program • Hazardous Materials Emergency Preparedness (HMEP) Tribal Grant • Tribal College Initiative Grants Program

	FTA conducted a listening session during the Tribal Transit Symposium in Oklahoma City in May 2023 regarding potential policy changes under the Tribal Transit Competitive Program. FHWA FLH Program administers the Tribal Transportation Program (TTP) to provide stewardship and oversight for direct funding agreements with 135 federally recognized Tribes. TTP is the largest program in FLH, with the stated objective "to contribute to the economic development, self-determination, and employment of Indians and Native Americans." BIL includes set-aside funds for Tribal High Priority projects and authorization for general treasury funds for transportation projects. DOT has incorporated resilience into eligibility criteria for funding opportunities.	• Indian Highway Safety Occupant Protection Grant • Indian Highway Safety Law Enforcement Grants • DERA Tribal and Insular Area Grants To ensure Tribal and rural communities can take advantage of existing resources and funding opportunities, the U.S. DOT is developing a Tribal and Rural Climate Adaptation and Resilience Toolkit. The toolkit will address the challenges tribal and rural communities face with respect to the impacts of extreme weather and climate changes on transportation infrastructure, and provide user-friendly information on how to identify vulnerability, and plan, fund, and implement adaptation and resilience measures.
Co-Benefits of Adaptation	Every DOT OA and Office has reviewed policies and guidance documents to incorporate Administration priorities including climate adaptation and resilience where relevant. Resilience and climate adaptation principles have been considered in all new DOT actions related to climate mitigation. The Department has also amplified efforts to consider climate hazard exposure and vulnerability when evaluating energy efficiency or other mitigation projects through the development and application of the CHER tool.	The 2021 MOU between the U.S. Department of Energy and the U.S. DOT to establish the Joint Office to support the deployment of zero-emission, convenient, accessible, equitable transportation infrastructure. The MOU highlights community resilience and electric vehicle integration as a priority. The 2023 U.S. National Blueprint for Transportation Decarbonization highlights the need for coordinated actions to enhance infrastructure resiliency, while simultaneously improving quality of life, health outcomes, and economic opportunity, particularly in overburdened and historically underserved communities. DOT issued guidance to help states use their existing transportation rights-of-ways to support decarbonization and enhance energy system resilience by leveraging pre-existing sites to host critical infrastructure, such as electric vehicle charging infrastructure, electricity transmission lines and renewable energy systems with lower approval barriers. Additionally, states are utilizing rights-of-way (ROWs) to advance biological sequestration projects, such as rain gardens and native plant installations that ameliorate localized stormwater management.[14]

[14] State DOTs Leveraging Alternative Uses of the Highway Right-of-Way Guidance - Corridor Management - Right-of-Way - Real Estate - FHWA

BIL included new formula programs to reduce GHG emissions from America's transportation network, while also enhancing resilience to increasingly extreme weather and other climate impacts. The BIL provided a legislative definition of resilience[15] and dedicates billions of dollars to transportation resilience programs. DOT is working to ensure the transportation system can withstand the impacts of climate change by providing funding for resilience projects through the FHWA's PROTECT program and by incorporating climate resilience as a consideration in many formula and discretionary grants.

4. Climate-Smart Supply Chains and Procurement

The Department has evaluated the estimated GHG emissions for all of its suppliers based on data the General Services Administration (GSA) provided. Building on this analysis, the Department continues to explore and refine climate hazard risk for critical supplies and services by piloting the novel integration of contract-level information and detailed emission profile data. The Department continues to develop strategies and goals intended to mitigate climate hazard risks.

The procurement of climate-ready services and supplies contributes to sound management of the Department's financial resources along with building and non-building (e.g., ships, vehicles, and radar equipment) infrastructure. To ensure essential services and supplies are delivered to DOT sites across the nation, the Office of the Senior Procurement Executive (OSPE) will work with program managers to ensure climate considerations and sustainability requirements are included throughout the acquisition process, including the Acquisition Strategy Review Board meetings. Also, OSPE will encourage source selection criteria to include life cycle cost-effective adaptation actions. Additionally, OSPE will work to align contractor profitability more tightly with Department goals and employ appropriate contract types (such as investigating use of incentive type contracts).

At Risk Supplies or Services	Actions to Address Hazard(s)	Progress Towards Addressing Hazard(s)
Utilities: The Department is dependent on the continuous supply of utilities (e.g., electricity, water, and natural gas) to ensure its buildings and equipment operate completely to fulfill mission requirements. Power distribution lines located above ground are susceptible to extreme heat, intense storms, flooding, and wind, as well as snow.	Employ alternative emergency power systems to ensure uninterrupted operation of critical equipment. Implement renewable energy projects to provide independent utility sources of energy. Partner with utility providers that incorporate climate-smart principles into their infrastructure and operations.	DOT has identified vulnerable transportation systems from assessments of mission-critical facilities using the CHER tool, which will facilitate prioritization of utility-related resilience projects at current high-risk facilities. DOT continues to pursue new partnerships with utilities and energy services companies to enhance site resilience through conservation measures and other best practices.

[15]A project with the ability to anticipate, prepare for, or adapt to conditions or withstand, respond to, or recover rapidly from disruptions, including the ability— (A)(i) to resist hazards or withstand impacts from weather events and natural disasters; or (ii) to reduce the magnitude or duration of impacts of a disruptive weather event or natural disaster on a project; and (B) to have the absorptive capacity, adaptive capacity, and recoverability to decrease project vulnerability to weather events or other natural disasters. (Section 11103 codified at 23 U.S.C. § 101(a)(24)).

Fleet Vehicles: The Department owns or operates nearly 6,000 automobiles to perform essential equipment maintenance, safety inspections, and enforcement actions. Additionally, the Department maintains a fleet of ships (approximately 50 in the Ready Reserve Fleet) to respond to natural and man-made disasters along with a fleet of airplanes (approximately 10) to provide essential safety training and flight instruction. SLR and flooding can affect vehicle function as well as impeding access and mobility. SLR and storm surge can also damage moorings and ships.	Complete climate assessments of vehicle locations for fleet vehicles that perform critical DOT operations and evaluate changes to siting or siting design as necessary to maintain function in the face of climate hazards. Review mooring plans and identify any changes necessary to accommodate SLR and future storm surge.	DOT has identified vulnerable transportation systems using the CHER tool, which will facilitate prioritization of resilient transportation support at current high-risk facilities.
Engineering/Construction Services: The Department uses engineering and construction service companies to reliably operate and maintain many of its buildings and equipment. Additionally, these companies provide essential operation and maintenance for transportation safety equipment and design services for external infrastructure. Impacts of climate hazard exposure on service company operations may disrupt completion of services for contracts awarded by DOT.	Update contractual language to promote climate-smart design and use of materials. Specify that architects and civil engineers will evaluate materials and design strategies that reduce risks from climate changes.	DOT established the Buy Clean Program that incorporates sustainability and resilience attributes and preferences. Lower carbon materials include those with longer service life that require less maintenance and withstand extreme weather events to reduce repair or replacement requirements and materials with efficient production processes. DOT continues to update design processes that will enhance the climate resiliency of operational infrastructure.
Information Technology Equipment and Services: The Department relies on many vendors and specialists to operate and maintain its network of computers, information databases, data centers, and other transportation safety equipment operating systems. Impacts of climate hazard exposure on service company operations may disrupt completion of services for contracts awarded by DOT.	Ensure backups of critical digital resources are retained in climate-secure and/or cloud-based backup systems.	DOT has identified vulnerable IT systems using the CHER tool, which will facilitate prioritization of IT and communication resilience projects at current high-risk facilities.
Technical/Consulting/Administrative services: Essential procurement, accounting, human resources, strategic planning, research/data analysis, and training services are provided by many vendors to ensure the Department continues to perform mission-critical actions. Providers that have high climate vulnerability or that have not evaluated their climate vulnerability may be susceptible to disruptions of their service.	As information is available, evaluate climate risk disclosures from DOT service providers. Consider climate risk of providers as selection criteria.	Established the DOT Buy Clean Program that incorporates sustainability attributes and preferences into acquisitions. Collaborations with NOAA for climate training. Exploring opportunities related to disclosing climate risks.

In 2022, the Department launched a lower carbon procurement pilot for key products and services to address embodied carbon emissions associated with products used in the construction, operation and maintenance of DOT buildings and facilities. In FY 2024, DOT is transitioning to an overarching sustainable acquisition program that will include lower carbon strategies along with all other sustainability attributes. This program will also focus on climate risks, including decarbonization and Scope 3 GHG emissions, in DOT's supply chain. The new Buy Clean Program will integrate successes and lessons learned from the pilot, but also prioritize the use of multi-attribute sustainable products and services, such as ecolabels; and new solutions for addressing electronic stewardship, lowering carbon emissions, obtaining per- and polyfluoroalkyl substances (PFAS)-free alternatives, and eliminating single use plastics in all new procurements and modifications. More importantly, these actions will drive market innovation and advance the decarbonization of our supply chain thereby making DOT more resilient by ensuring critical products, materials and services are provided during natural and man-made disasters.

The Buy Clean Program will incorporate sustainability attributes and preferences in all new and existing acquisitions to the maximum extent practicable. It will enable DOT to successfully meet the acquisition-related goals and requirements of Executive Order 14057, OMB Memorandum M-22-06, and Implementing Instructions: *Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability,* including the achievement of net zero procurement by 2050 at DOT.

DOT is also exploring opportunities to consider GHG emission and mitigation disclosures from government services providers when awarding contracts. The Department will further evaluate impacts of climate hazards on supply chains if federal-wide processes to disclose climate-related financial risks are implemented.

5. Climate Informed Funding to External Parties

To ensure DOT is investing in climate-smart infrastructure, the Department is including consideration of climate resilience in discretionary grant Notices of Funding Opportunities, as appropriate and consistent with existing law. DOT has developed and refined standard language that program managers can incorporate into funding availability notices. Applications for funding should consider climate resilience in the planning stage and in project delivery, such as through incorporating specific design elements that address climate change impacts and including approaches consistent with the FFRMS. Examples include an FTA funding opportunity issued in 2022 to develop standards for exportable power systems from electric and fuel cell-powered buses, which can supply electricity to community buildings, emergency shelters and hospitals during power disruptions. The Rebuilding American Infrastructure with Sustainability and Equity (RAISE) grant program, which funds critical freight and passenger transportation infrastructure projects, and the Port Infrastructure Development Program (PIDP), which funds projects to improve the safety, efficiency, or reliability of goods movement through ports, are examples of funding opportunities that incorporate adaptation and resilience evaluation criteria.

PROTECT is DOT's first funding program dedicated exclusively to making surface transportation more resilient to natural hazards, including climate change, sea level rise, flooding, extreme weather events, and other natural disasters. PROTECT deploys $7.3 billion in formula funding to states and $1.4 billion in competitive grants over five years (2022-2026), and

an additional $400 million so far in supplemental appropriations, for over $9 billion in total program investments. The program funds projects for surface transportation resilience to natural hazards including climate change, SLR, flooding, extreme weather events, and other natural disasters through support of planning activities, resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure. Under this program, nature-based solutions are an encouraged approach to adapting transportation infrastructure. The first round of PROTECT discretionary awards was announced in April 2024 and another grant cycle is expected to open later in 2024.

The DOT Climate Change Center and DOT Navigator are online resources to help staff and grant applicants find climate change resources and communities understand how to apply for grants, and plan for and deliver transformative infrastructure projects and services. A Climate mitigation, adaptation, and resilience checklist for grant applicants is an example of a resource available on DOT Navigator. The Thriving Communities Program is bringing resources to communities that need technical assistance and other support. The Thriving Communities Program funds organizations ("Capacity Builders") to provide technical assistance, planning, and capacity building support to disadvantaged and under-resourced communities, enabling them to advance transportation projects that support community-driven economic development, health, environment, mobility, and access goals.

DOT also has several formula grant programs that advance the national conservation goal by allowing the Department to support states, tribes, and other applicants' efforts to increase access to Federal lands such as parks, wilderness preserves, and natural areas. First, FHWA's Recreational Trails Program, which is a set-aside of the Transportation Alternatives within Surface Transportation Block Grants, is a formula program that provides States approximately $80 million dollars each year to support access to park and recreation facilities. Also, FHWA's Federal Lands Access Program improves transportation facilities that provide access to, are adjacent to, or are located within Federal lands. The program provides approximately $1.5 billion over the course of the BIL to supplement State and local resources for public roads, transit systems, and other transportation facilities, with an emphasis on access to high use recreation sites and economic generators.

Similarly, the FHWA's Federal Land Transportation Program provides approximately $375 million in FY 2022 and $2.2 billion over the course of BIL (FY 2022-2026) in partnership with the Departments of the Interior, Agriculture and the Army Corps of Engineers for projects that support transportation access to our federal lands. These funds support safe, multi-modal access, including roads, trails, and transit, within our treasured Federal lands that, together, support over 980 million visitors annually.

Lastly, FHWA's Nationally Significant Federal Lands and Tribal Projects program provides $55 million in funding each year of the BIL for the construction, reconstruction, and rehabilitation of nationally significant projects within, adjacent to, or accessing Federal and Tribal lands. This program provides an opportunity to address significant access challenges across the nation for transportation facilities that serve Federal natural areas and Tribal nations.

The Department has also established a Climate Change and Transportation Research Initiative to advance the research and technology needed to tackle the Nation's climate and transportation challenges. The initiative will be led by University of California, Davis with several partner institutions and funded at $1.7 million in the first year, subject to renewal for up to five years. The initiative will focus on advancing research and technologies that support the Nation's goals to decarbonize the transportation sector by 2050, strengthen resilience of the Nation's transportation infrastructure, and address adverse environmental impacts created by the transportation system.

3C. Climate Training and Capacity Building for a Climate Informed Workforce

The DOT is working to ensure that all Department staff have the knowledge to make decisions that are grounded in the best-available scientific understanding of climate change risks, impacts, and vulnerabilities. A commitment to improving climate education across the DOT was included as part of the Department's 2021 Climate Action Plan for Resilience and the FY 2022-2026 Strategic Plan. The reinvigorated DOT Climate Change Center began bringing representatives from all OAs and relevant OST offices together in early 2021 to discuss climate-related activities across DOT. The Center serves as a cross-modal resource to implement the BIL with the strongest climate lens possible. Activities have included convening working groups around specific issues such as transportation decarbonization, alternative uses of the transportation ROW, and DOT staff performance plans and climate training. The Climate Center regularly hosts presentations from other Federal agencies, non-profits, and other stakeholders.

In 2023, the DOT Climate Change Center organized a climate training entitled "Climate Change and Transportation 101" that covers the basics of incorporating climate change considerations into the work of the DOT. The three training modules are: 1) Introduction and why climate change matters to transportation; 2) The Science and its Implications (developed by scientists and communications specialists at the NOAA), and 3) DOT Climate Action and What You Can Do. "Climate Change and Transportation 101" was available to all employees as a webinar on Earth Day, 2023 and is maintained as a training opportunity in the DOT Learns platform and the Department intranet. According to data from the DOT Learns platform, the Climate 101 training has been completed by 891 employees in a live session and an additional 245 employees online, or over 10 percent of all DOT staff since 2021. Over 13 percent of staff from the U.S. DOT Volpe Center have taken the course through the DOT learning system, in addition to 0.3 percent of senior leadership. In addition, the recording is posted for viewing on demand by DOT employees.

In celebration of Earth Month in April 2023, DOT's Office of the Assistant Secretary for Administration (M) hosted weekly Lunch-N-Learn (LNL) speaker series showcasing the diverse sustainability activities the Department is engaged in (both internally and externally) to prevent climate change and advance actions to meet the President's ambitious goals in E.O. 14057. The series included a series of six presentations:

- Sustainable Procurement in the Federal Government
- Sustainable Buildings in the Federal Government
- Sustainability at Department of Transportation

- Climate Resiliency in the Federal Government
- Zero Emission Vehicles in the Federal Government
- Active Commuting in the Federal Government

Individual operating administrations are also developing climate training relevant to their specific missions and systems. For example, FHWA has released several training courses focused on resilience to climate change and extreme weather events. Individual courses guide trainees through gathering relevant climate information, vulnerability assessment techniques, adaptation analysis and project decision making, and incorporating resilience into design.

3D. Summary of Major Milestones

Section of the Implementation Plan	Description of Milestone	Climate Risk Addressed	Indicators for Success
3A. Sustainability Orders	DOT will update the energy, buildings, acquisitions, and overarching sustainability orders to incorporate resilience by the end of 2024	Revised orders will provide guidance for how to address risk for climate hazards relevant to the facility	Number of revised Orders issued
3A. CHER tool assessments	DOT will complete resilience assessments for all mission-critical DOT facilities by the end of 2026	The assessments consider the vulnerability of DOT facilities to climate hazard exposure to prioritize actions that reduce risk	Number and percent of mission-critical facilities with completed assessments
3B. OA CAPs	DOT modes will prepare individual CAPs by 2025	The plans will address all climate risks relevant to mission-critical activities	Number of modes with completed plans
3B, 3C. DOT Climate Change Center	Continue the Center as a communication hub for DOT through 2027	All risks	Continued regular meetings and engagement from DOT stakeholders
3B. BTS-Transportation Vulnerability and Resilience Data Program (TVRDP)	BTS will prepare a climate data services and metrics web hub (platform) by 2025	Provide data to support climate risk assessments and decision-making for transportation projects at all levels of government.	Release of climate data services and metrics web hub
3B. Tribal and Rural Resilience Toolkit	Target completion in 2025	Provide data to support climate risk assessments for rural and tribal transportation projects	Release of toolkit materials
3B. RDR Tool	DOT will work to refine the analysis. Target completion in 2025	Provide benefit-cost analysis for resilience investments and disaster recovery.	Broad dissemination of tool after pilot at various State and local agencies
3B. Resilience Coalition white paper on quantitative assessment of resilience infrastructure challenges	Target completion in 2024	Provide barriers/challenges and needs/gaps for Resilience Planning and Implementation	Published white paper
3B. Best-practice guide	Target completion 2027	Provide guidance on reducing the construction materials' carbon footprint	Best-practice guide

Section 4: Demonstrating Progress

4A. Measuring progress

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.

Section of the CAP	Process Metric	DOT Status
3A –Addressing Climate Hazard Impacts and Exposure	Step 1: Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. Step 2: Agency has a list of discrete actions that will be taken through 2027 as part of their implementation plan.	Step 1: Yes, resilience assessments for mission-critical facilities incorporate planned actions to address risks. Step 2: Yes, the DOT AFR incorporates resilience assessments to inform planning and budget decisions.
3B.1 – Accounting for Climate Risk in Decision-making	Agency has an established method of including results of climate hazard risk exposure assessments into planning and decision-making processes.	Yes, DOT and the Department OAs have many established methods of including results of climate hazard risk exposure assessments into planning and decision-making processes that are appropriate to the mode and discipline of focus.
3B.2 –Incorporating Climate Risk Assessment into Budget Planning	Agency has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions.	Yes, the FY 2023 DOT Agency Financial Report (AFR) includes a summary of DOT's budget and financial risk management processes. Included in the AFR and related to real property and climate risk management, the Department has implemented a multi-step climate resiliency process.
3B.5 – Climate Informed Funding to External Parties	Step 1: By July 2025, the agency will identify grants that can include consideration and/or evaluation of climate risk. Step 2: Agency modernizes all applicable funding announcements/grants to include a requirement for the grantee to consider climate hazard exposures.	Step 1: Yes, DOT has incorporated consideration or evaluation of climate risk into grant opportunities, as appropriate. Step 2: Yes, Grant guidance and standard language was released in December 2023.

Key Performance Indicator: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.

Section of the CAP	Process Metric	DOT Status
3A –Addressing Climate Hazard Impacts and Exposure	Agency has identified the information systems that need to incorporate climate change data and information and will incorporate climate change information into those systems by 2027.	Partially. OST-M will update the climate exposure data used in the CHER tool annually to support facility-level resilience assessments for operational assets and personnel. DOT will continue existing partnerships with NOAA, the United States Global Change Research Program (USGCRP), and others on climate services data and tools. BTS TVRDP program will produce a state of practice report and develop a plan for a Transportation Vulnerability and Resilience data and tools sharing web-hub (platform).

Key Performance Indicator: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate nature-based solutions, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives.

Section of the CAP	Process Metric	DOT Status
3B.3 –Incorporating Climate Risk into Policy and Programs	By July 2025, 100% of climate adaptation and resilience policies have been reviewed and revised to (as relevant) incorporate nature-based solutions, mitigation co-benefits, and equity principles.	Yes. The Climate Adaptation and Resilience Review will track status. Nature-based solutions Standard Language developed.

Key Performance Indicator: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.

Section of the CAP	Process Metric	DOT Status
3B.4 – Climate-Smart Supply Chains and Procurement	Step 1: Agency has assessed climate exposure to its top 5 most mission-critical supply chains. Step 2: By July 2026, agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards.	Step 1: DOT is working to assess climate exposure more thoroughly for its top five most mission-critical supply chains, but climate risk disclosure information is not widely available from service providers. Step 2: Actions are planned to assess services but depend on availability of risk disclosure information.
	Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services.	Yes, the Department continues to develop strategies and goals intended to mitigate climate hazard risks. Specifically, in 2022 the Department launched a lower carbon procurement pilot for key products and services to address embodied carbon emissions associated with products used in the construction, operation and maintenance of DOT buildings and facilities.

Key Performance Indicator: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures.

Section of the CAP	Process Metric	DOT Status
3C – Climate Training and Capacity Building for a Climate Informed Workforce	Step 1: By December 2024 100% of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. Step 2: Does the agency have a Climate 101 training for your workforce? If yes, what percent of staff have completed the training? Step 3: By July 2025, 100 % of employees have completed climate 101 training.	Step 1: Yes, Modal leadership briefing on CAP and Climate Adaptation and Resilience Review in Spring 2024. Step 2: Yes. DOT has a Climate 101 training course available on the DOT training platform. Over 10% of DOT staff have completed the training live or online. Step 3: Training is not required for all employees.

4B. Adaptation in Action

DOT has embraced this generational opportunity to address climate change risks to the safety, effectiveness, equity, and sustainability of our transportation infrastructure and the communities it serves. The 2021 CAP identified five priority strategies to bolster adaptive capacity and resilience of the national transportation system, building on decades of DOT leadership. The Department has completed many priority actions and is continuing to make significant progress towards climate action goals, highlighted at the United Nation 28th Conference of the Parties.

Incorporating resilience into grant and loan programs: DOT includes climate resilience as a consideration in many discretionary grants to increase funding for projects that use the best-available climate data and tools to assess climate-related vulnerabilities and risks and develop resilience solutions to address those risks. In addition, the BIL included PROTECT, the first DOT-administered program dedicated to resilience. PROTECT includes funding for evacuation routes, coastal resilience, making existing infrastructure more resilient, or efforts to move infrastructure to nearby locations not continuously impacted by extreme weather and natural disasters. The BIL prioritizes natural infrastructure as a resilience solution, provides a definition of natural infrastructure, and expands opportunities to utilize funding for natural infrastructure within the PROTECT program. This includes projects like tidal wetlands that not only protect our infrastructure from flooding, but often also help reduce carbon emissions through sequestration.

Enhancing resilience throughout the project planning and development process: The new U.S. DOT Project Delivery Center of Excellence (Center) enables the successful implementation of the BIL by accelerating completion of local transportation infrastructure investments. The Center's Project Delivery Toolbox provides resources and best practices for public engagement, environmental impact, civil rights, equity, and other topics critical for successful project planning. The toolbox includes information on DOT Climate and Sustainability priorities. For DOT operations, OAs are incorporating priority adaptation and mitigation strategies into their Capital Asset Plans, new building design standards, and facility operation and maintenance schedules. The Department incorporates natural hazard and climate risk information into federal property management decisions and is making continued investments in climate-smart transportation infrastructure.

DOT is committed to ensuring that programs, policies, guidance, and operations consider climate impacts and incorporate resilience solutions to protect infrastructure from extreme weather. Resilience solutions must also incorporate equity priorities and decarbonization goals. As part of the Biden-Harris Administration's Justice40 Initiative, which establishes the goal that 40 percent of the overall benefits of certain federal investments flow to disadvantaged communities, DOT has committed to advance environmental justice and ensure no one is left behind in the transition to a decarbonized and resilient transportation system. DOT has identified 39 programs that are covered by the Justice40 Initiative.

Ensuring resiliency of DOT facilities and operational assets: DOT developed a climate resilience assessment tool that uses critical system vulnerability data, historical exposure data, and projected exposure to heat and precipitation data from downscaled global climate models to calculate site-specific climate risk scores for Departmental facilities and operational assets. In addition, DOT also developed a vulnerability assessment framework and partnered with more

than 50 pilot project teams across the U.S. to conduct climate change vulnerability assessments and analyze options for improving resilience.

Improving climate education and research on resilience: DOT collaborated with NOAA to develop a "Climate Change and Transportation 101" training, available to all employees as a webinar on Earth Day, 2023. The training is maintained as an opportunity on the DOT Learns platform and the department intranet. The initial content developed with NOAA has served as a template for climate training courses for other agencies. In addition, FHWA's NHI offers many resilience-related courses, including "Addressing Climate Resilience in Highway Project Development and Preliminary Design" for engineering, design, and project development/NEPA staff from state DOTs, local governments, Tribal governments, Federal State agencies, and consultants. The BIL authorizes the creation of new DOT Resilience and Adaptation Centers of Excellence. These Centers will advance research to help make surface transportation infrastructure more resilient to natural disasters and extreme weather.

DOT is also working to improve access to climate research as it relates to transportation. DOT is ensuring continued research in transportation resilience to fill gaps in climate knowledge and use of new technologies. The DOT Climate Change Center and the BTS National Transportation Library maintain the Transportation and Climate Change Clearinghouse, a curated collection of information on transportation and climate change issues that also provides monthly bibliographies of the latest research.[16]

Addressing climate change with our foreign partners: DOT launched a global engagement program, *MOMENTUM*, in which DOT works with foreign partners to share knowledge and best practices focused on seven key areas, including climate change. This program offers toolkits and workshops to our international partners to reduce GHG emissions, mitigate climate change impacts, and build a more resilient transportation system.

This 2024-2027 Climate Adaptation Plan builds on the previous DOT CAPs prepared in 2012, 2014, and the *Climate Action Plan: Revitalizing Efforts to Bolster Adaptation and Increase Resilience* published in 2021. Looking forward, the Department will support continued investments in climate-smart transportation infrastructure and incorporate natural hazard and climate risk information into federal property management decisions, policies, guidance, and operations, prioritizing investments that achieve the quadruple benefit of advancing resilience, supporting adaptation, addressing environmental justice, and strengthening climate mitigation. The CAP will guide the Department to ensure climate adaptation and resilience will be incorporated in grant and loan programs, project planning and development, education and workforce training, research, and additional activities that will help address the climate crisis.

[16] Transportation and Climate Change Clearinghouse

APPENDIX A: RISK ASSESSMENT DATA

The Federal Mapping App uses the following data:

Buildings
Buildings data comes from the publicly available Federal Real Property Profile (FRPP). GSA maintains FRPP data and federal agencies are responsible for submitting detailed asset-level data to GSA on an annual basis. Although FRPP data is limited—for example, not all agencies submit complete asset-level data to GSA, building locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures, and properties may be excluded on the basis of national security determinations— it is the best available public dataset for federal real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of federal buildings to climate hazards.

Personnel
Personnel data comes from the Office of Personnel Management's (OPM) non-public dataset of all personnel employed by the federal government that was provided in 2023. The data contains a number of adjustments, including exclusion of military or intelligence agency personnel, aggregation of personnel data to the county level, and suppression of personnel data for duty stations of less than five personnel. Despite these adjustments, this data is still useful for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

Climate Hazards
The climate data used in the risk assessment comes from the data in Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool. When agency climate adaptation plans were initiated in 2023, CMRA data included climate data prepared for the Fourth National Climate Assessment. Additional details on this data can be found on the CMRA Assessment Tool Data Sources page. Due to limited data availability, exposure analyses using the Federal Mapping App are largely limited to the contiguous United States (CONUS). Additional information regarding Alaska, Hawai'i, U.S. Territories, and marine environments has been included as available.

In addition to these data, DOT included climate and natural hazard information from the CHER Tool, which provides location-specific exposure data for climate hazards at mission-critical facilities. The CHER tool sourced historical climate hazard information from the FEMA National Risk Index (NRI)[17] and includes annualized occurrence frequencies of fourteen climate-related hazards: Coastal Flooding, Cold Wave, Drought, Hail, Heat Wave, Hurricane, Ice Storm, Landslide, Lightning, Riverine Flooding, Strong Wind, Tornado, Wildfire, and Winter Weather. An additional eight climate hazards derive from data in the World Climate Research Programme's (WCRP) phase 5 Coupled Model Intercomparison Project (CMIP).[18] The CHER tool uses climate projection data centered on the year 2050[19] and considers temperatures in the

[17] FEMA National Risk Index for Natural Hazards
[18] WCRP (2021). WCRP Coupled Model Intercomparison Project (CMIP). https://www.wcrpclimate.org/wgcm-cmip
[19] https://www.worldclim.org/data/v1.4/cmip5.html

hottest and coldest months, and precipitation in the wettest and driest months. Finally, the tool includes estimates of inundation due to SLR on top of mean higher high water (MHHW) from NOAA.[20]

Snapshot of the Dashboard Demonstrating Results of Vulnerability and Risk Assessments Completed Using the CHER Tool

Summary of U.S. DOT risk assessments submitted by Sep. 1, 2023.

[20] NOAA Method: Mapping Sea Level Rise Inundation

U.S. Department of Commerce

2024-2027 Climate Adaptation Plan

May 31, 2024

Photo provided by Ping Sun, Office of Inspector General

Secretary of Commerce

U.S. Department of Commerce

2024-2027 Climate Adaptation Plan

Section 1: Agency Profile

Addressing the climate crisis is an essential and existential component of the Department of Commerce (the Department) mission to create the conditions for economic growth and opportunity. In support of the government-wide approach to tackle the climate crisis as outlined in Executive Order (E.O.) 14008, *Tackling the Climate Crisis at Home and Abroad*, the Department drives mitigation, adaptation, and resilience efforts that leverage Operating Units/Bureaus' expertise and capabilities to make the Department's missions, facilities, lands, waters, and employees more resilient to climate change[1]. These efforts include accelerating clean technology development and deployment, providing actionable climate information and tools to decisionmakers, implementing climate adaptation efforts to sustain the nation's valuable living marine resources, and providing support for vulnerable communities to address climate-related risks in every sector of the economy.

The Department's 2022-2026 Strategic Plan sets specific goals and targets to address the climate crisis by using cutting edge technologies to monitor and forecast climate change and building partnerships both internally and externally. Specific goals set forth in the Strategic Plan include:

- Increasing the impact of climate data and services for decisionmakers through enhanced service delivery and improved weather, water, and climate forecasts.
- Strengthening coastal resilience and advancing conservation and restoration of lands and waters for current and future generations.
- Accelerating development and deployment of clean technologies.
- Embedding climate considerations across Department programs.

The Department provides vast amounts of data to inform better decisions for business, government, and the public. For example, the National Oceanic and Atmospheric Administration (NOAA) provides actionable weather, water, and climate data, forecasts, warnings, and other environmental information that help decision makers prepare for and respond to extreme weather and other events and increase resilience to the impacts of climate change; The Bureau of Economic Analysis (BEA) produces the national economic accounts, including gross domestic product (GDP); and The U.S. Census Bureau delivers essential data on the U.S. population and economy, including the decennial census of people and households. The U.S. Census Bureau's collaboration across the Department also supports evaluation and evidence-building activities. For example, the Census Bureau Center for Economic Studies supports evidence/evaluation efforts of other Operating Units/Bureaus and collaborates with the Economic Development Administration (EDA) on new economic indicators and data tools that are useful in both project selection and monitoring and has provided technical assistance in support of the International Trade Administration (ITA) survey research. Furthermore, NOAA is collaborating with the General Services Administration's (GSA) Office of Evaluation Sciences on research supporting

[1] For definitions of these and other key terms in this Climate Adaptation Plan, please see the Fifth National Climate Assessment (globalchange.gov).

improved communication of weather and climate information to communities with environmental justice concerns, and EDA now requires all grant applicants that propose infrastructure projects to consider impacts from climate change in project design.

NOAA is also addressing the increasing demand for science and services needed to enhance ocean and coastal resilience to climate change. The natural and economic resilience of oceans and coasts will be advanced using state-of-the-art risk-based tools and actionable information, strengthening on-the-ground partnerships, and improving place-based conservation efforts. To understand and prepare for the future, NOAA will identify what additional modeling capabilities and tools will be needed for communities to prepare for various scenarios of coastal inundation, shifting fish stock distributions, and other climate-related stressors.

Through its Climate Adaptation Plan, the Department is also able to advance environmental justice as part of its mission, consistent with E.O. 14008 and E.O. 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All. As the Department implements its Climate Adaptation Plan to increase the resilience of its facilities and operations, it also addresses disproportionate and adverse environmental and health effects and risks and hazards. It evaluates climate change and cumulative impacts of environmental burdens on communities with environmental justice concerns and provides opportunities for the meaningful engagement of persons and communities with environmental justice concerns. The Department is a member of the White House Environmental Justice Interagency Council (WHEJIC), and received recommendations on Climate Planning, Preparedness, Response, Recovery and Impacts from the White House Environmental Justice Advisory Council (WHEJAC). The Department is reviewing the recommendations and, as appropriate and to the maximum extent permitted by law, is taking steps to address the WHEJAC's recommendations.

Recognizing the inextricable links between mission, internal expertise, employee engagement, and physical footprint, the Department is incorporating climate considerations, including mitigation, adaptation, and resilience measures, into all relevant aspects of its policies and programs. The Department is building a network of climate adaptation and resilience expertise that will help identify climate risks, build a climate literate workforce, and integrate equitable climate considerations into policies, operations, facility management, real property, acquisitions, and the use of resources. Please see standard Department profile information in Appendix A.

Section 2: Risk Assessment

The Department used the Federal Climate Mapping for Resilience and Adaptation Application (Federal Mapping App), which was developed for federal agencies by the White House Council on Environmental Quality (CEQ) and NOAA, to conduct a high-level screening of climate hazard exposure for federal facilities and personnel.

The Department assessed the exposure of its buildings, employees, and lands, waters, and cultural and natural resources to five climate hazards: extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk. Exposure to extreme heat, extreme precipitation, and sea level rise were evaluated at mid- (2050) and late century (2080) under two emissions scenarios, Representative Concentration Pathway (RCP) 4.5 and RCP 8.5. Exposure to flooding and

wildfire risk were only evaluated for the present day due to data constraints. For a description of the climate data used and climate scenarios considered in the assessment, please see Table 2E.

2A. CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS

In coordination with the Operating Units/Bureaus, the Department conducted a climate vulnerability assessment in 2011 and updated the assessment in 2014, as part of the *Department of Commerce Climate Change Adaptation Strategy* development. The 2014 assessment found that the Department's buildings could be vulnerable to extreme weather events, including increased precipitation and extreme heat, which would increase the risk of flooding and increase cooling loads on building heating, ventilation, and air conditioning (HVAC) systems. Since these initial assessments in 2011 and 2014, the Department's Operating Units/Bureaus have continued to re-assess vulnerabilities to their owned building inventories, using data from the *National Climate Assessments*.

The Federal Mapping App demonstrates that hazard forecasts for extreme heat and precipitation pose the greatest threats to the Department's owned buildings. Heat is projected to impact all the Department's owned buildings for all RCP scenarios modeled, while extreme precipitation is expected to impact 98% of the Department's assets in each scenario, increasing to 99% of assets impacted by RCP 8.5 (high greenhouse gas emissions scenario) by 2080. Sea level rise follows extreme heat and precipitation in impacts to the Department's owned buildings. Flooding, including inland flooding, is the fourth most impactful hazard to the Department's owned buildings and associated assets. The results of the Federal Mapping App screenings are found in Appendix C.

The Department has a longstanding role in the protection of life and property from environmental hazards and climate change, in alignment with the missions of NOAA. For over two decades, NOAA has been focused on climate data-driven decision making on their real property portfolio. As the owner of most buildings in the Department, NOAA has evaluated climate change risks and incorporated adaptation measures and resiliency into the analysis of alternatives as part of the business case for facility capital planning. NOAA follows the National Environmental Policy Act (NEPA) procedures and considers opportunities to improve facility energy performance and environmental impacts on planned facility investments. NOAA's most recent facility capital investment planning activities are focused on keeping only mission essential properties located in vulnerable areas. The goal is to limit facility footprints located on waterfront sites in floodplains by either moving properties or improving facility performance by consolidating multiple site locations into federally owned locations shared with mission partners.

NOAA's future facilities planning efforts will realign space requirements across the entire real property portfolio and evaluate opportunities to reduce the real property footprint in floodplains (current 2024 data shows 20% of Department owned buildings are in the 100-year or 500-year floodplain), review space efficiencies, and relocate properties located in floodplains or other locations vulnerable to climate change.

To further evaluate climate change impacts on NOAA's real property portfolio, NOAA

completed a multi-phased Climate Change Assessment and Impact analysis in 2014. This analysis identified the most vulnerable campuses/buildings and recommended appropriate measures to increase climate resilience and adapt to the projected changes, including rough order of magnitude cost estimates associated with these measures. In phase 1, the buildings were grouped into geographic location, climate type factors, facility condition rating and mission criticality. The analysis provided NOAA with a ranking and categorization of owned and leased buildings that are most vulnerable to future climate change. In Phase 2, the potential threats identified in Phase 1 were transitioned to two site-specific case studies of owned and leased facilities (one Southeast Coastal area and one Great Plains area, as these two areas have disparate climate change risks). Phase 2 analyses recommended appropriate mitigation measures and strategies per climate impact, provided cost estimates associated with each measure, and included collateral impacts, which could occur during or after certain climate change threat-events such as salt-water inundation, utility disruption, transportation disruption, or facility destruction.

NOAA has and will continue to evaluate climate vulnerabilities and adaptation strategies in its capital project planning processes through Business Case Analyses (BCAs) and Analyses of Alternatives (AOAs). Planning efforts consider multifactorial risk data, when available, that take into consideration hurricanes, tornadoes, earthquakes, hail, wind, drought, floods, high daily precipitation, snowfall, wildfires, and extreme temperatures. Projects in areas with particularly high vulnerability also include an evaluation of specific/discreet natural hazard risks, such as Hurricane Impact Probability. A recent example of incorporating climate-resistant adaptations into design and construction is the newly built Aircraft Operation Center (AOC) in Lakeland, Florida. This Center was built not only to withstand hurricanes but also to maintain critical operations during these severe weather events.

2B. CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL EMPLOYEES

The Department has over 50,000 employees. The Department's workforce ranges from 341 uniformed service officers in the NOAA Commissioned Officer Corps, 263 diplomats who are Foreign Commercial Service Officers, 166 badged law enforcement officers in the Bureau of Industry and Security (BIS), 8,961 patent examiners at U.S. Patent and Trademark Office (USPTO), and more than 37,000 other civil service employees who deliver critical services directly to U.S. businesses and the public.[2]

Department employees are at risk of exposure to many different combinations of the 18 hazards identified in Section 3a.1, due to their geographic disbursement across the U.S. and internationally. To categorize these hazards further, the Department has identified the following potential climate hazards to its federal workforce:

- **Health and Safety:**
  Extreme weather events, rising temperatures, and other climate-related hazards pose direct threats to the health and safety of Department employees. Heat waves, storms, and air quality issues may impact working conditions and employee well-being.

[2] DOC Contingency Plan 092793 (commerce.gov) and U.S. Department of Commerce 2022 – 2026 Strategic Plan

- **Infrastructure and Commute:**
  Department owned and occupied facilities face increased vulnerability to climate-related damage, affecting the daily operations of the Department's workforce. Disruptions to transportation infrastructure, such as roads and public transit, can impact the commute and accessibility of workplaces.

- **Productivity and Work Disruptions:**
  Climate hazards may lead to work disruptions due to office closures, evacuation orders, or remote work challenges. This can affect the productivity and efficiency of the Department's workforce, particularly if critical operations are impacted.

- **Emergency Response and Preparedness:**
  Federal agencies involved in emergency response and management (e.g., NOAA) may experience increased demand during climate-related events. This can place additional stress on the workforce, requiring effective coordination and preparedness measures.

The Federal Mapping App results in Appendix C, Table 2B demonstrate that hazard forecasts for extreme heat and precipitation pose the greatest threats to the Department's employees overall. Increases in heat exposure are projected to be experienced by 98% of the Department's employees and 97-98% of employees are projected to experience increased precipitation exposure. Exposure to sea level rise is expected to increase for between a third and almost half of the Department's employees between the near and long-term modeled scenarios.

While exposures classified as high to extreme risks of wildfire are lower than other hazards in the screening tool, with 8% at high risk, 2% at very high risk and another 2% at extreme risk, for the three Bureaus with employees working in facilities in Boulder, Colorado, wildfires present an acute concern and are a serious hazard to employees. Beyond the direct fire hazard, wildfires produce large quantities of harmful gases and particulate matter that have negative impacts on human health, particularly individuals that have existing respiratory or cardiac disease, elderly, and children. Furthermore, wildfires have direct impacts on those employees working outdoors and can cause the cancelation of outdoor activities if pollution levels go above healthy standards. The Department's Boulder facilities are the home of scientific laboratories for NOAA, National Institute of Standards and Technology (NIST), and the National Telecommunications and Information Administration (NTIA), where almost 1,000 employees are located. The city of Boulder and the surrounding area are projected to have high, very high, and extreme exposure to wildfire risk. Therefore, the risk to employees and their families extends into the communities where they live and recreate.

The Department also has a concentration of approximately 1,000 employees located in the Northwestern United States. The screening tool forecasts an almost 300% increase in extreme heat days, compared to the current day, a trend that has been underway for the past decade. Extreme heat is an acute climate hazard across much of this region, which has not historically invested in cooling technologies. This puts employees and their families at risk during heat waves, forcing them to leave their residences, schools, or workplace to seek cooling centers. Elderly, children, individuals with preexisting health conditions, and those that work outside are particularly vulnerable. The type of work done by many Department employees, outdoors on

docks and boats or in uncooled laboratories and facilities, makes them more vulnerable.

The screening tool shows an increase in extreme precipitation, forecasting that some of the Department's workplace buildings could experience up to a 30% increase. Extreme precipitation is a hazard to employees because it presents a flooding risk, especially in areas with poor storm water management. Flooding can occur where employees live and work, in streets and neighborhoods and has the potential to cause landslides and transportation challenges.

The Department has several thousand employees located in Florida. The screening tool forecasts that Florida's exposure to extreme precipitation could increase by as much as 19% in the near-term and up to 29% in the long-term in some locations. About 300 Department employees are in southern Florida, where the screening tool suggests current exposure to wildfire risk is extreme. And based on location and NOAA's heat.gov (HEAT.gov - National Integrated Heat Health Information System), the Department's employees in Florida will experience increases in extreme heat days, up to 150% more days, which would be about half of the year. Extreme heat impacts humans more in humid areas like Florida, where the wet bulb globe temperatures can increase dramatically during heat waves, not allowing humans to evaporate their sweat, the primary method of cooling the body.

2C. CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL LANDS, WATERS, AND CULTUREAL RESOURCES

The Department has approximately 5,387,032 acres of land across the U.S. and abroad. Most of these lands are held by NOAA and NIST in Alaska, Washington, Colorado, and Maryland, and are used for research and development. In addition, the Department manages 397 million acres of ocean and Great Lakes waters and bottomlands as National Marine Sanctuaries and marine national monuments. The Department also holds stewardship and management responsibilities for living marine resources (e.g., fisheries, protected species) within the U.S. Exclusive Economic Zone, which covers approximately 3 billion acres of ocean and 95,000 miles of coastline. Across these lands and waters, the impacts of climate change vary with location and geography. Overall, extreme heat and extreme precipitation have the widest reaching impact, but other climate hazards, such as flooding, wildfires, and sea level rise also have impacts.

To address these climate hazards the Department's facility planning efforts, which include decision making around lands, consider multifactorial risk data available from Operating Units/Bureaus, other federal agencies, institutions, and private sectors that take into consideration hurricanes, tornadoes, earthquakes, hail, wind, drought, floods, high daily precipitation, snowfall, and extreme temperatures. Projects in areas with particularly high vulnerability include evaluation of specific/discreet natural hazard risks. In addition, cascading and compounding impacts, where one climate impact causes others to follow and multiple impacts occur at the same time, are especially noteworthy.

Interesting examples of cascading and compounding risks are found in Florida, Colorado, and the Pacific Northwest. These locations face a variety of climate hazards that can be expected to occur simultaneously including extreme heat, extreme precipitation, flooding, and sea level rise. Florida has approximately 43 acres of Department lands, plus the Florida Keys National Marine Sanctuary, Tortugas Ecological Reserve, and Western Sambo Ecological Reserve covering over

2.5 million acres of ocean surface off the southern coast of the state. Sea level rise impacts occur along Florida's coastlines and projected exposure is noted South of Naples into Key West, impacting NOAA's Marine Sanctuaries. Increasing ocean temperatures and extreme heat events have affected the distribution and abundance of marine species in many regions, with impacts on businesses and communities that depend on them. This coincides with projected increased exposures to extreme precipitation and freshwater flooding, making climate resilience and adaptation efforts in this region extremely important.

In much of the western U.S., wildfires are increasing due to drought conditions coinciding with increased heat and severe weather. While this region may also experience increased precipitation intensity, these climate hazards can be exclusive and do not necessarily occur during the same season or help alleviate the other's impact. Wildfires pose a significant threat to ecosystems, facilities, and human health and change land management plans significantly. The Department has a campus in Boulder, Colorado which houses three scientific laboratories belonging to NIST, NOAA, and NTIA. In 2021, the Marshall Fire caused $2 billion in damage and reached within 5 miles of the Boulder campus. Projections for this region are for an increased number of days at temperatures above the 99th percentile combined with drought, creating increased wildfire risk. The threat of wildfires extends across the region outside of Boulder to areas like Fort Collins and Erie, CO, where Department employees live. Wildfires have catastrophic impacts on the communities where they occur, destroying land and infrastructure, and the impact on air quality creates further health risks to surrounding communities and those downwind of the smoke. Climate change is significantly impacting valuable marine ecosystems and living marine resources within U.S. Ocean areas including those existing on Department lands and in waters designated as marine sanctuaries and marine monuments. Warming oceans, rising seas, melting sea ice, increasing acidification, decreasing oxygen levels, and altered weather patterns and storms are some of the climate impacts rapidly affecting the structure of marine ecosystems, including the distribution and abundance of species in many regions. Climate projections for the next 50 years suggest these changes will likely accelerate, generating economic issues around these resources.

2D. CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING MISSION, OPERATIONS, AND SERVICES

The mission of the Department is to create the conditions for economic growth and opportunity for all communities. Working across thirteen Operating Units/Bureaus, the Department offers U.S. based companies and entrepreneurs invaluable tools through a variety of programs such as the decennial census, the Foreign Commercial Service, the National Weather Service (NWS), and NOAA's multitude of public facing climate data. The Department's mission is being impacted by climate hazards in a variety of ways, but the primary impact is seen on climate's direct effect on the economy, including climate change created risks to assets and publicly traded securities, investments, companies, communities, and workers (E.O. 14030).

To build resilience to the economy and ensure the mission, the Department provides a wide range of data, tools, and information to help people understand and prepare for climate variability and risk. Since the production and dissemination of climate data, resilience information, and risk analysis is part of the Department's mission, the operation and services provided by the

Operating Units/Bureaus is directly linked to the climate hazard exposure of the mission.

Department buildings, infrastructure, and surrounding communities are mission critical and have the potential to suffer catastrophic loss due to extreme events such as hurricanes, tornadoes, wildfires, earthquakes, droughts, and flooding. At present, the availability of metrics, tools, and standards needed to ensure structural and community resilience are limited at these facilities (and to the public), making it difficult for Department facilities (and public communities) to recover rapidly. This can lead to loss of life, damage to buildings and infrastructure, and disruption to commerce. It is the Department's mission to increase the available climate information for Department facilities and business communities, particularly to those with increased risk or in areas that have historically been underrepresented.

The Department plays an essential role in advancing the nation's weather, water, and climate science to improve understanding of the changing risk from climate change, including coastal inundation, heat waves, droughts, and extreme events and storms. Understanding future risk will enable better vulnerability assessments and target where economic and adaptation strategies are needed. NOAA, NIST, Census Bureau, and BEA support and enhance scientific information and services needed to make informed decisions and manage risk. One example of the Department's work in this area is the Mauna Loa Observatory (MLO), located in Waimea, Hawaii. This observatory is considered the definitive source for documenting the increased atmospheric burden of fossil fuel emissions through the carbon dioxide gas measurements that show the Keeling Curve. On Nov. 28, 2022, all measurements and radio transmissions from MLO ceased as lava from the Mauna Loa volcano cut the power line and buried over a mile of the access road to the observatory. While this event does not point to a climate hazard, it exposes the vulnerability and lack of resilience present at this critical facility as the event halted all but the most essential atmospheric measurements supported by weekly helicopter visits. Because this facility faces climate hazards such as typhoons, it suggests more attention must be paid to increasing its climate resilience in support of the mission. In FY2024, NOAA received $5.09M from the Department of Energy's Assisting Federal Facilities with Energy Conservation Technologies (AFFECT) grant program to install solar panels and batteries at the observatory to make the facility net zero emissions. This project will bring the critical atmospheric science instrumentation back online and significantly improve the site's operational climate resiliency. Since MLO already captures its water needs from roof systems, the observatory will be the first Department facility to be net zero for both electricity and water, increasing its climate resilience and readiness to support the mission of measuring critical climate greenhouse gases.

The Department has other facilities that gather, analyze, and disseminate important climate information to the public. These facilities house researchers, experts, and critical infrastructure that support the Department's mission and are facing climate exposure hazards. NIST, NOAA, and NTIA share a campus in Boulder, CO, that is the home of scientific research and engineering in the fields of electromagnetics, materials reliability, optoelectronics, quantum electronics and physics, time and frequency, earth systems, weather, and telecommunications. This campus is facing increasing threats of wildfires, drought, extreme weather, and increased precipitation intensity. As discussed previously, they recently faced a wildfire just 5 miles from campus in 2021. This forced the surrounding communities, where many Department employees live, to evacuate, leaving their homes at risk. When events like these occur, employees miss work and

suffer from increased stress causing a reduction in progress and loss of potential mission critical information. In the aftermath of this event, NIST issued new guidance for emergency response during wildfires by writing the WUI Fire Evacuation and Sheltering Considerations: Assessment, Planning, and Execution (ESCAPE) report to implement wildfire mitigation strategies and creating a Hazard Mitigation Methodology (HMM) website. These resources will continue to be used to implement wildfire mitigation strategies.

The Department's mission is also supported by the operation and services of facilities located in coastal areas. Along the Pacific, Atlantic, and the Gulf of Mexico coastlines, facilities are vulnerable to rising sea levels and stronger and more frequent storms (e.g., hurricanes) making the operation and services of these facilities vulnerable. In Washington state, the Northwest Fisheries Science Center sits on 23 acres of land in Seattle, at sea level. While currently protected behind a dam on Lake Union, climate projections suggest there will likely be large shifts in coastal flood regimes with hightide flooding potentially disrupting this facility.

On the Atlantic coast sits NOAA's Office of Marine and Aviation Operations and National Geodetic Survey in Norfolk, VA. Norfolk and the Elizabeth River area are currently facing hightide flooding from sea level rise, which is expected to become worse over time. During high tide days, occurring at least 15 times a year, traffic intersections become flooded cutting some neighborhoods off from the rest of the city, adding stress and commute issues to employees' lives. In addition, sea level rise exacerbates the impacts of extreme weather, such as hurricanes, as storm surges reach further inland, putting these facilities, their operations, services, and mission support at risk. The Norfolk facility is being moved to Rhode Island where it will benefit from being on a secure military base, Naval Station Newport, and a better geographic location for the operation and assurance of the mission. The Department's ports, piers, warehouses, and critical infrastructure support the fleet of 15 research and survey ships operated by the Office of Marine and Aviation Operations. These ships provide updated nautical charts ensuring safe shipping routes exist following storms. This fleet could become inaccessible or unusable due to sea level rise, inundation, increased storms, and shoreline erosion. Additionally, the Office of Marine and Aviation Operations has 10 specialized environmental data-collecting aircraft supporting many of the Department's missions, including providing stewardship of environmental data and research and development. The home of these aircraft is along the coasts making the tarmacs, towers, and buildings that support them and their mission vulnerable. Moving forward NOAA is continuing to invest in purpose-built ships and increasing investments in uncrewed systems, reducing risk, and revolutionizing how NOAA collects data to ensure the Department's mission is met.

2E. IMPACTS FROM AND EXPOSURE TO ADDITIONAL HAZARDS

It should be noted that the tables in Appendix C display only the five climate hazards identified in the Federal Mapping App: extreme heat, extreme precipitation, sea level rise, flooding, and wildfires. Important physical natural hazards missing from the assessments are extreme weather and drought, and for ocean areas such as the Exclusive Economic Zones and Marine Sanctuaries, sea surface temperature, extreme ocean heat, and the associated impacts of ocean acidification. Each of these hazards presents an exposure that could reduce the ability of the Department facilities to meet operations, service, and mission requirements.

Extreme weather presents a ubiquitous hazard across Department facilities, although the exact type of extreme weather present at any given location varies. For instance, tornado season is becoming more variable in its duration and location. The outbreaks themselves are getting larger and more frequent. Department facilities located in historically high-risk tornado areas, like tornado alley, continue to be impacted by this hazard, but additionally, facilities located in new high-risk areas across the central U.S. from Louisiana to Michigan and along the Gulf and Atlantic coasts are now vulnerable. In addition, hurricanes are hitting the coasts with stronger winds, more rain, and higher storm surge making destruction of Department facilities more likely and more costly.

In Department waters that are designated to protect ocean ecosystems to support the economy and biodiversity, increasing temperatures and ocean acidification are making the habitat unfit for survival. This makes the mission of exploring, conserving, and managing these natural resources extremely challenging because the available resources in these areas are declining. The Florida Keys National Marine Sanctuary, home to over 6000 species of marine life and contributing to over $4 billion annually in tourism, is under stress from climate change. NOAA's Iconic Reefs mission is striving to restore 7 ecologically and culturally significant coral reefs in this area to make them self-sustaining, all while ocean temperatures increase and stay warm over longer than normal durations.

Section 3: Implementation Plan

3A. ADDRESSING CLIMATE HAZARD IMPACTS AND EXPOSURES

1) Addressing Climate Hazard Exposures and Impacts Affecting Federal Buildings:

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL BUILDINGS		
Climate Hazard Impact on and/or Exposure to Buildings	Priority Action	Timeline for implementation (2024-2027)
• Coastal Flooding	• Support federal agencies and their non-federal partners in determining if a proposed federal action will be in a Federal Flood Risk Management Standard (FFRMS) Floodplain	Began in FY23 and will be ongoing.

• Coastal Flooding • Hurricane • Riverine Flooding • Wildfire • Precipitation • Extreme Temperatures	• Continue to integrate NOAA facilities portfolio with the FEMA National Risk Index, FEMA 100-Year Flood Zone, USFS Wildfire Risk and NWS Mean Higher High-Water Coastal Flood Index.	FY 2024-2026 – The Department will develop a Resilience Framework, with technical assistance from National Renewable Energy Laboratory (NREL), to establish a roadmap for incorporating continuity into normal operations and building resilience into critical infrastructure and personnel assets, including owned buildings and vessels, and Department employees.
• Coastal Flooding • Hurricane • Riverine Flooding • Wildfire • Precipitation	• Continue to identify vulnerabilities and assess the potential impact of climate hazards on the NOAA facilities portfolio.	FY2024/2025 – Prioritize investments in facilities that are most vulnerable to climate hazards and identify procurement mechanisms needed to implement.
• Coastal Flooding • Hurricane • Riverine Flooding • Wildfire • Extreme Temperatures	• Analyze NOAA facilities portfolio and risk index to develop priorities for investment to improve resilience and mitigate impacts based on climate risk.	Annually – Update NOAA Facilities Investment Plan and produce a categorized risk- based list of facility capital investment projects, including probability score of resiliency and climate adaptation risk.
• Coastal Flooding • Hurricane	• Develop adaptive strategies for NOAA's coastal facilities to minimize erosion and flooding risks.	FY2024/2025 – Seek funding opportunities (e.g., Department of Energy AFFECT Grant, performance contracting) to retrofit existing NOAA facilities to enhance resilience against climate hazards, including measures to withstand flooding, extreme heat, and sea level rise.
• Coastal Flooding • Riverine Flooding	• Implement nature-based solutions, such as wetland restoration and shoreline vegetation to enhance the NOAA facilities natural resilience against flooding and erosion.	FY 2024-2025 – Incorporate sustainable and climate-resilient design principles into the construction of new and renovated facilities (e.g. Western Regional Center renovations, new Fisheries building – Seattle, WA).
• Precipitation/Storm Water • Riverine Flooding	• Explore green infrastructure options to manage stormwater and reduce flooding risks at NOAA facilities.	Annually – NOAA's capital investment planning Business Case Analyses (BCA) will consider multifactorial risk data and perform analyses designed to identify the most effective solutions to address mission needs.

• Coastal Flooding • Typhoons	• NIST Kauai – Analyze available mitigation measures for coastal flooding and investigate possibilities moving the radio station to an alternate Hawaiian location not susceptible to sea level rise.	By the end of FY2024 and annually thereafter, compare annual low and peak temperatures against spare central plant capacity. By the end of FY2025, award engineering analysis for coastland mitigation measures, including award alternate Hawaiian locations. By end of FY 26, engineering analysis (alternate sites & coastland mitigation measures) will be completed. By end of FY2027, complete costs for existing Hawaii site and alternate site options.
• Extreme Temperatures	• NIST Boulder, CO and Gaithersburg, MD campuses – continue to annually monitor cooling and heating systems (Central Plants) to determine spare capacity. Currently and in near future, NIST anticipates spare capacity for forecasted extreme temperature increases.	FY 2024-2026 Energy efficiency audits will be conducted to best determine investments in this facility to reduce energy consumption and prepare for increasing cooling needs.
• Wildfires	• NIST Boulder, CO campus to utilize the new Hazard Mitigation Methodology (HMM) website and the WUI Fire Evacuation and Sheltering Considerations: Assessment, Planning, and Execution (ESCAPE) report to implement wildfire mitigation strategies.	FY 2024 Continue to use HMM and ESCAPE to guide wildfire implementation progress.

The Department owns approximately 400 buildings across every U.S. state, with diverse missions and operations ranging from large, complex research laboratories at NIST campuses to small NOAA weather stations[3]. As a result of this geographical diversity, the Department's facilities and infrastructure are vulnerable to the full range of climate change impacts.

The table of Priority Actions responds to the analysis results from Section 2 and focuses most closely on the five hazards assessed with the Federal Mapping App – extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk. These are priority actions that are underway or recurring annually and include asset management and investment decisions resulting from incorporating natural hazard and climate risk information into management

[3] NOAA, NIST, and NTIA have facilities owned by the federal government and are under these Bureaus' custody and control. Other Operating Units/Bureaus occupy facilities leased by the Operating Units/Bureaus, and the Operating Units/Bureaus retain authority over facility operations; or the Operating Units/Bureaus occupy a facility under an occupancy agreement with the GSA that may include delegated facility responsibilities.

decisions.

Ninety percent of the Department's approximately 400 owned buildings are owned by NOAA. In addition to the priority actions above, NOAA has a long history of considering assets' hazard vulnerability. Over the past few years, NOAA has significantly improved its asset management program by integrating condition data and real property. For example, one-third of owned facilities are 65 years old. Aged facilities are more susceptible to climate change and severe weather can exacerbate impacts on their condition. This integration has provided NOAA with a more in-depth understanding of the overall condition and composition of its facilities. Additionally, the program has integrated the Federal Emergency Management Agency (FEMA) National Risk Index, which provides visibility from an overall risk score to specific information that scores every county or Census Tract, based on 18 hazard types.

Even though not owned by the Department, facility management personnel at the USPTO Headquarters campus collaborate with the building lessor to identify energy efficiency enhancements to curb possible rising cooling loads on the buildings; conduct assessments of building heating, cooling, and ventilation systems to identify upgrades and enhancements to reduce energy consumption; and operate a demand response program year-round to decrease energy consumption during peak hours. Reducing energy loads is directly correlated to building resilience because lower energy requirements increase energy security. The lower the energy needs, the easier it is for a facility to return to normal operations.

The USPTO conducts assessments to determine the best solutions for reducing climate hazard impacts to the building (elevation of essential systems, floor protection system, etc.). The USPTO is migrating data center infrastructure products to a more resilient offsite location, as well as transferring systems and data to the cloud, to reduce the risk of disruption from climate change events. The offsite location is in FEMA FIRM Zone X, signifying that it is outside of the 500-year FEMA floodplain. The location is also built in an area with the lowest risk category for high winds, based on data provided by NOAA Storm Prediction Center. Additionally, the facility is powered by 100% renewable energy and is a certified "Green Power Pass (GPP) Product." To further mitigate risk, there will be no direct link between the main campus and the data center; the two sites will operate independently, providing a backup if either location is rendered inoperable because of a climate hazard.

2) Addressing Climate Hazard Exposures and Impacts Affecting Federal Employees:

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL EMPLOYEES		
Climate Hazard Impact on and/or Exposure to Employees	Priority Actions	Timeline for implementation (2024-2027)
• Health and Safety • Infrastructure and Commute • Productivity and Work Disruptions • Emergency Response and Preparedness	• Adaptation and Resilience Planning • Employee Training and Education • Flexible Work Policies • Emergency Preparedness Planning and Response • Safe and Resilient Facilities • Health and Wellness • Communication and Alerts • Transportation and Commute Planning • Community Engagement • Research and Data Integration	FY2024-2026 – The Department will develop a Resilience Framework, with technical assistance from NREL, to establish a roadmap for incorporating Continuity into normal operations and building resilience into critical infrastructure and personnel assets, including owned buildings and vessels, and Department employees.

The Department has over 50,000 employees working across every U.S. state and territory and in more than 86 countries worldwide, providing U.S. based companies and entrepreneurs with invaluable tools through programs such as the decennial census, the NWS, the NMFS, and the Foreign Commercial Service.

To address the potential impacts noted in Section 2B outlining the impacts to Department employees, such as health and safety, infrastructure and commute, productivity and work disruption, and emergency response and preparedness, the Department has identified the following priority actions (as shown in the above table):

- **Adaptation and Resilience Planning:**
  Build a resilience framework that will provide guidance on resilience assessments and leverage Department capabilities. This guidance will help Operating Units/Bureaus further invest in adaptation and resilience planning to address the long-term impacts of climate change. This could involve changes in infrastructure, policies, and procedures to ensure the workforce is better prepared for evolving climate hazards. The Resilience Framework will also provide guidance to leverage the Department's expertise, while prioritizing collaboration, literacy, equity, and funding for resilience building.

- **Employee Training and Education:**
  Expand the Department's current training program to include comprehensive training to educate federal employees on resilience assessments and opportunities to build resilience to known hazards. Raise awareness about the potential impacts of wildfires, flooding, extreme heat, extreme precipitation, and sea level rise on employee work environments.

- **Flexible Work Policies:**
  Implement/continue flexible work policies, including telecommuting options, to allow federal employees to work remotely during extreme weather events or hazardous conditions. Establish guidelines for remote work to ensure continuity and efficiency in government operations.

- **Emergency Preparedness Planning:**
  Develop and communicate clear emergency preparedness plans to Department employees, including evacuation procedures, emergency shelters, and communication protocols during climate-related events and conduct regular drills and simulations to ensure that employees are familiar with emergency response procedures.

- **Safe and Resilient Facilities:**
  Retrofit and upgrade Department owned buildings to withstand climate hazards, such as improved infrastructure for flood protection, heat-resistant materials, and wildfire-resistant landscaping and ensure that owned buildings are equipped with emergency backup systems for power, water, and communication, including renewable energy and carbon pollution free energy (CFE) systems and battery storage.

- **Health and Wellness Support:**
  Provide access to healthcare services and mental health resources to help Department employees cope with the physical and psychological impacts of climate-related events and establish support systems for Department employees affected by climate hazards, including counseling services and wellness programs.

- **Communication and Alerts:**
  Implement robust communication systems to disseminate timely and accurate information to Department employees about impending climate hazards. Utilize mobile apps, text alerts, and other communication channels to keep employees informed of emergency situations and safety measures.

- **Transportation and Commute Planning:**
  Develop alternative transportation plans for Department employees in areas prone to flooding or other climate-related disruptions. Encourage the use of public transportation, carpooling, or flexible commuting options to minimize risks during extreme weather events.

- **Community Engagement:**
  Foster community engagement and collaboration to address climate hazards at the local level, including partnerships with local governments, businesses, and non-profit organizations. Encourage Department employees to participate in community resilience initiatives.

- **Research and Data Integration:**
  Integrate climate data and research into workplace policies and decision-making processes to better anticipate and respond to climate hazards.

3) Addressing Climate Hazard Exposures and Impacts Affecting Federal Lands, Waters and Culture Resources:

PRIORITIZED ACTIONS TO ADDRESS CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL LANDS, WATERS AND ASSOCIATED CULTURAL RESOURCES		
Type of Land or Water Asset	Climate Hazard Impact on and/or Exposure to the Asset	Priority Action
• NOAA's National Marine Sanctuary System, 620,000+ square miles of ocean and Great Lakes waters and bottomlands. • NOAA NMFS has stewardship responsibilities for living marine resources (fish, invertebrates, marine mammals, sea turtles and the habitats they depend on) in the U.S. Exclusive Economic Zone (which includes more than 4 million square miles of ocean) and the associated coastal shoreline covering over 95,000 miles. • NIST Boulder Campus includes 103.5 acres of protected open space set aside through a Memorandum of Agreement with Tribes and the City of Boulder.	• Sea level rise • Rising sea surface temperatures • Ocean acidification • Oxygen depletion in ocean waters • Shifting species distribution • Altered weather patterns and storms • Wildfire	• Implement the Office of National Marine Sanctuaries Climate Resilience Plan 2024-2026. • Implement the NIST Wildfire Mitigation Assessment for properties in Colorado – Wildfire mitigation costs estimated at over $82 million in FY2023 in Colorado. • Update NOAA NMFS Ecosystem-Based Fisheries Management (EBFM) Policy and Road Map. • Implement the NOAA • Climate Ecosystems and Fisheries Initiative (CEFI) to provide climate-informed advice for marine resource management and community adaptation.
• The Department's 5 million acres of land across the United States	• Drought • Heat • Wildfires • Precipitation	• Build a Resilience Framework that will include guidance on Nature Based Solutions, in coordination with carbon sequestration efforts. • Continue to implement NIST wildfire mitigation guidance.

Climate impacts such as warming oceans, rising sea levels, melting sea ice, and increasing acidification are affecting the structure of marine ecosystems including the abundance of species in many regions. These changes significantly affect the people, businesses, and economies that rely on them. These changes also affect many parts of NOAA's mission, from fisheries management and aquaculture to conservation of protected resources and habitats.

To prepare and respond to these changes, the Office of National Marine Sanctuaries Climate Resilience Plan 2024-2026 outlines NOAA's commitment to foundational climate change impact monitoring, assessment, education, and outreach, with an increased emphasis on climate change mitigation and adaptation activities within the sanctuary system. Adaptation actions include reducing non-climate stressors to bolster adaptive capacity of ecosystems and species. In certain places within the system, NOAA is also undertaking or supporting restoration of resources that are sustaining climate-related degradation.

One example of the work taking shape is the Department and NOAA commitment of $40 million from the Inflation Reduction Act (IRA) to begin implementing the Climate, Ecosystems and Fisheries Initiative (CEFI) and address the urgent need for actionable information to support climate resilient marine resources and the many people, businesses, and communities that depend on them. This effort will build an operational CEFI Decision Support System to provide national, regional, and local decision-makers with robust information on expected future ocean ecosystem conditions, risks, and best options to reduce impacts and increase resilience to climate change. The funding will build-out the System's major components including state-of-the-art forecasts and projections of future ocean ecosystem conditions and regional decision support teams in all six marine regions to provide the early warnings and advice needed for climate-informed fisheries management, protected species conservation, habitat protection, and fishing community adaptation.

In addition, NOAA NMFS is updating its Ecosystem-Based Fisheries Management (EBFM) Policy and Road Map in FY2024 to guide EBFM efforts that help maintain resilient and productive trust resources and the ecosystems they depend on, in a changing climate. These activities include ecosystem-level planning; advancing understanding of ecosystem processes; prioritizing vulnerabilities and risks; exploring and addressing trade-offs; implementing ecosystem considerations in management; and supporting ecosystem resilience via monitoring and adjusting management actions.

Leveraging the significant investment in IRA funding, NOAA Fisheries is also working with regional fishery management councils to support climate-ready fisheries management. The focus is on the implementation of fishery management measures or processes necessary to improve climate resiliency and responsiveness to climate impacts, and development and advancement of climate-related fisheries management planning and implementation efforts, including those in support of communities with environmental justice concerns.

Example Actions Addressing Climate Exposures and Impacts from the America the Beautiful Program	
Priority Action	Description
Expand the National Marine Sanctuary System	Landscape scale conservation and management of nationally significant marine and Great Lakes resources aids in addressing climate impacts through adaptive management, habitat restoration and protection, and includes monitoring of climate change effects on resources. These efforts build climate resilience by creating stronger ecosystems that are more likely to recover after catastrophic events. They also encourage climate adaptation by allowing the ecosystem to remain healthy and providing it time to adapt to changing environmental conditions.
Expand the National Estuarine Research Reserve System	Through the National Estuarine Research Reserve System, a current network of 30 sites, nearly 1.4 million acres of estuaries are protected and studied. The results benefit natural ecosystems and man-made communities and provide critical information and data on how best to build resilience. Active restoration and protection initiatives are ongoing, as well as monitoring programs and community-based research projects. Results from these projects help inform best-practices for the conservation of coastal ecosystems that reduce the impact of climate hazards like sea level rise and hurricanes.

American Climate Corps	NOAA is part of an interagency partnership to launch the American Climate Corps, a workforce training and service initiative that will ensure more young people have access to the skills-based training necessary for good- paying careers in the clean energy and climate resilience economy. Participating NOAA programs include Gulf Corps and Vet Corps.
Bipartisan Infrastructure Law (BIL)/IRA	The BIL is a transformational opportunity to make an impact against the climate crisis across the country through multiple funding opportunities. It provides nearly $3 billion for NOAA to act over 5 years in the areas of habitat restoration, coastal resilience, climate data and services, and weather forecasting infrastructure. The IRA is a historic, federal government-wide investment that furthers NOAA's efforts to build a Climate-Ready Nation. It provides $3.3 billion for NOAA to build on its commitment to help Americans, including Indian tribes and vulnerable populations, prepare, adapt, and build resilience to weather and climate events; improve supercomputing capacity and research on weather, oceans, and climate; strengthen NOAA's hurricane hunter aircraft and fleet; and replace aging NOAA facilities.
Complete an Atlantic Highly Migratory Species Climate Vulnerability Assessment (HMS CVA)	The HMS CVA is a rapid assessment tool used to identify which species may be most vulnerable based on their exposure to projected changes in the environment (e.g., warming oceans) and their sensitivity or adaptability to handle those changes based on their life history characteristics. Results from the HMS CVA can be used to help prioritize research, resources, and funding. Results can also inform management decision-making, rulemaking, Biological Opinions, Endangered Species listings, and NEPA analyses.
Mission: Iconic Reefs	The Mission: Iconic Reefs initiative aims to help reverse long-term coral reef decline, NOAA and partners have developed an approach to restore seven iconic coral reef sites in the Florida Keys National Marine Sanctuary. It is a phased approach over the next two decades to rebuild coral reef structure, restore a diversity of reef- building stony corals, reintroduce species that support coral health, promote resiliency, and build community stewardship. For coastal communities, healthy coral reef ecosystems provide protection against soil erosion, sea level rise impacts, storm surges, and provide economic resources that help communities grow and sustain resilience efforts.
Marine and Coastal Area-based Management Advisory Committee	NOAA established the Marine and Coastal Area-Based Management Advisory Committee to advise the Under Secretary on science-based approaches to area-based protection, conservation, restoration, and management in marine and coastal areas. The committee provides a forum for discussion and advice on area-based management, including opportunities to enhance conservation of biodiversity, climate resilience, and access to nature for underserved communities with environmental justice concerns.

3B. CLIMATE-RESILENT OPERATIONS

1) Accounting for Climate Risk in Planning and Decision Making

The 2024 Department Risk Profile Report is developed by the Department's Enterprise Risk Management Program (ERM) to identify, evaluate, mitigate, and manage risks across the DOC enterprise, including risks related to development and implementation of policies to address climate risks and key impact areas. Risk and exposure assessments are currently being used to identify projects and prioritize funding for resilience. The Department is currently developing a Resilience Framework which will put these risk assessments into the resilience workflow

providing data, decision-making, and assessment capabilities to the Department's resilience programming.

2) Incorporating Climate Risk Assessment into Budget Planning

Applying the International Organization for Standardization (ISO) 31000's definition for risk, the Department defines risk as the effect of uncertainty on objectives. Since 2011, the Department's Enterprise Risk Management (ERM) Program has advanced an integrated approach to risk management, providing an enterprise process for proactively identifying, managing, and treating risk in achieving the Department's strategic objectives, program execution and Department operations utilizing an ERM program framework. The Department's Strategic Plan objectives and learning agenda are focused on embedding climate considerations into all Department operations, risks and potential impacts from climate hazards. Overall risk management and climate-related financial risks are being assessed through this enterprise process. For example, the 2024 Department Risk Profile Report, an agency-wide process and/or tool, incorporates climate risk into planning and budget decisions.

In addition, as a member of the National Climate Task Force (NCTF), designated in E.O. 14008, the Secretary of Commerce and heads of Operating Units/Bureaus have committed to further integrate climate change adaptation and resilience into all aspects of the Department's planning and operations through transparent decision-making and management of human and capital resources. The Secretary has set a standard for climate literacy within the Department through Department-level town halls, meetings with leadership, and enhanced training on climate change adaptation and resilience. ,. Operating Units/Bureaus also have additional programs to increase staff literacy and capacity for services delivery, as identified in Section 4.

3) Incorporating Climate Risk into Policy and Programs

Agency Policies Reviewed		
Nature-Based Solutions	The Department is actively working to include more nature-based solutions into policies and guidance documents.	In FY2024/2025, the Department will develop a Resilience Framework, with technical assistance from NREL, to establish a roadmap for incorporating continuity into normal operations and building resilience into critical infrastructure and personnel assets, including owned buildings and vessels, and Department employees. One objective of the Resilience Framework is to protect and sustainably manage lands and waters to enhance resilience. This can include nature-based solutions where appropriate, to store carbon and shield neighboring communities from climate impacts and natural hazard risks. The Department will also seek opportunities to implement the recommendations in the White House

		Nature-Based Solutions Roadmap where appropriate.
Environmental Justice	Environmental justice considerations have been included in climate adaptation policies throughout the Department, including the 2022- 2026 Strategic Plan. The Department's Office of Sustainable Energy and Environmental Programs has a Resilience, Climate Adaptation, and Environmental Justice Program Manager who coordinates policies, guidance, programs, and training with the Department's Environmental Justice Officer.	• U.S. Department of Commerce 2022 – 2026 Strategic Plan • U.S. Department of Commerce Equity Action Plan • Department of Commerce Environmental Justice Strategy (Fall of 2024) • Department of Commerce Administrative Order (DAO) Addressing the Climate Crisis • Department of Commerce 2024 Sustainability Strategic Plan Update (Fall-winter 2024)
Tribal Nations	Tribal governments, their business enterprises, their members, and firms that want to do business in Indian Country can tap into the vast resources of the Operating Units/Bureaus of the Department of Commerce to create jobs on and off-reservation. From grants from NTIA to develop broadband infrastructure, to data resources available from the Census Bureau to inform tribal policymakers, to overseas market development assistance through ITA, and funding opportunities available through EDA and the Minority Business Development Agency (MBDA), the Department's resources help tribes, and their citizens create conditions conducive to business development and to seize opportunities in the U.S. and abroad. The Department's partnerships with tribes and firms that want to do business in Indian Country is led by the Secretary's Senior Advisor on Native American Affairs. The Office of the Secretary's Senior Advisor on Native American Affairs is responsible for: (1) coordinating and communicating all Native American issues directly with tribes and across all the Operating Units/Bureaus within the Department and externally with all other federal agencies; (2) coordinating and implementing the Department's Tribal Consultation Policy Plan and consultation sessions; (3) serving as the primary contact for all Tribal Consultation actions and issues; and (4) serving as the facilitator of the Office of Native American Business Development by assisting and consulting with Indian Country in leveraging the combined efforts of the federal programs, tribal governments, private sector businesses and financing to promote economic growth for Tribes and Native Americans.	Tribal Priorities NOAA will provide funding for tribal priorities that incorporates comments received during the IRA tribal consultation. This funding includes a tribal set- aside for fish hatcheries that produce Pacific Salmon and Steelhead to be administered through the Bureau of Indian Affairs; funds for Mitchell Act Hatcheries; funds in additional funding for the Bipartisan Infrastructure Law Restoring Tribal Priority Fish Passage through Barrier Removal Notice of Funding Opportunity; and a tribal set-aside for capacity building, science, and related needs through an updated Bipartisan Infrastructure Law Coastal Habitat Restoration and Resilience Grants for Tribes and Underserved Communities Notice of Funding Opportunity.

Co-Benefits of Adaptation	The Department's 2022-2026 Strategic Plan outlines the Department's commitment and specific priorities on incorporating both mitigation and adaptation measures into all Department policies and programs. Mitigation, the reduction of carbon emissions, is often associated with energy security and land management resilience. Reducing energy needs creates less reliance on fossil fuels and managing lands in ways that sequester carbon help develop sustainable ecosystems. Both actions increase resilience. The Department is currently reviewing policies to better incorporate climate adaptive capacity and resilience in programs, and ensure investments strategically consider future conditions and are climate smart.	• Department of Commerce 2024 Sustainability Strategic Plan • In FY2024/2025 the Department will publish a companion manual to the DAO 217-16, Sustainability and Environmental Management, to include guidance on integrating adaptation and mitigation principles. • The Department's Climate Administrative Order (DAO) ADDRESSING THE CLIMATE CRISIS | U.S. Department of Commerce

Resilience Framework: The Department is developing a Resilience Framework to act as the scaffolding for the Department's cross-cutting resilience efforts. The framework aims to leverage the wide array of resilience expertise found across the Operating Units/Bureaus, while staying focused on important resilience priorities like literacy, equity, and collaboration. In addition, the framework will be designed to best utilize available financial resources and third-party financing to support the Department's goals. It is anticipated that the framework will make a space for every Operating Unit/Bureau and every portfolio to contribute to the resilience efforts of the Department. In conjunction with the Framework development, the Department will create a Resilience Framework Working Group, made up of Operating Unit/Bureau representatives that will create and implement the Framework's guidance.

Environmental Justice: Environmental justice is a key component of resilience and adaptation. Communities that have long stood at the forefront of environmental damage are the same communities that will be hit hardest by climate change. Resilience solutions must be equitable and prioritize the wellness of these communities to be successful. For the first time, the federal government is outlining how it will integrate principles of equity and environmental justice in federal ocean activities, including conservation, management of marine resources, and infrastructure projects. Along with several other federal agencies, NOAA developed the first-ever U.S. Ocean Justice Strategy to advance environmental justice for communities that rely on the ocean and Great Lakes for economic, cultural, spiritual, recreational, and food security purposes. The Strategy outlines overarching goals, principles, and practices that the federal government can adopt to provide long-term, sustainable benefits for people, communities, and the environment.

In May 2023, NOAA NMFS released the Equity and Environmental Strategy, which will guide NMFS on serving all communities more equitably and effectively. This national strategy describes the path NOAA NMFS will take to incorporate equity and environmental justice into the vital services provided to all communities.

Tribal Nations: Climate change negatively impacts the livelihoods, health, and cultural practices of Indigenous Peoples, impacting their ecological resilience, while Indigenous

Knowledge (IK) is recognized as a key component of resilience strategies. In June 2023, NOAA updated its existing policies and guidance documents for tribal consultation and incorporated IK in decision-making, including: (1) *NOAA Procedures for Government-to- Government Consultation with Federally Recognized Indian Tribal Governments (*Consultation Handbook*);* (2) NOAA Administrative Order 218-8, *Policy on Government-to-Government Consultation with Federally Recognized Indian Tribal Governments*; and (3) *NOAA Guidance and Best Practices for Engaging and Incorporating Indigenous Knowledge in Decision-Making*.

As a continuation of our commitment to engage meaningfully with federally recognized Indian tribes, non-recognized Indian tribes and other Indigenous Peoples, NOAA is building upon the *Consultation Handbook* to provide guidance on including IK in federal decisions. This document goes beyond the *Consultation Handbook* to recognize and be inclusive of all Indigenous Peoples within the U.S. and the importance of equitable engagement and involvement of their knowledge (e.g., American Indian, Alaska Natives, Native Hawaiians, Chamorro, American Samoans, and Taíno). NOAA encourages the inclusion of IK, as appropriate and to the extent practicable and permitted by law, in the line offices' environmental science, policy and decision-making processes. This inclusion is intended to better facilitate consultations as required by E.O. 13175, fulfill federal trust responsibilities, respect treaty rights, understand environmental justice concerns as directed by E.O. 14096, inform agency decision making, and to build partnerships with Indigenous Peoples.

Additionally, NOAA has worked to engage federally recognized Indian tribes, non-recognized Indian tribes and other Indigenous Peoples and provide significant IRA and BIL investments on issues pertaining to Offshore Wind and Marine Energy, recovery efforts of Pacific Salmon, developing climate-ready aquaculture, strengthening coastal resilience, and habitat restoration. Members of tribal and indigenous communities were chosen to serve on the Marine and Coastal Area-based Management Advisory Committee as well as the Ocean Research Advisory Panel, which provides advice to the federal government on ocean policy.

NOAA recently re-established the Ocean Research Advisory Panel (ORAP), which advises the White House's Ocean Policy Committee (OPC) and provides independent recommendations to the Federal Government on matters of ocean policy. Membership consists of IK practitioners, scientists, policy experts, entrepreneurs, and engineers, all of whom bring a unique and important perspective to help inform Federal Ocean Policy.

4) Climate-Smart Supply Chains and Procurement

The Department is assessing the climate hazard risks and potential disruptions to critical supplies chains, services, and procurement and has begun identifying priorities, establishing goals, and developing strategies and implementation plans to address these risks and disruptions. Examples include:

- A key strategy objective outlined in the 2022- 2026 Strategic Plan is to make Department facilities and operations more sustainable and efficient. This emphasizes the Department's commitment to invest in and maintain more climate-resilient infrastructure and operations, pursue efficient and pollution-free upgrades, prioritize zero-emission vehicle acquisitions, implement sustainable acquisition processes, and create equitable economic opportunities for

businesses with climate-friendly products.

- As part of the Department Administrative Order (DAO) 216-22, which formalizes the Department's priority focus on addressing the climate crisis, NIST is charged with implementing a dedicated process to review and coordinate ongoing and planned climate-related activities. This will ensure that NIST continues to deliver the most accurate measurements, data, and standards.
- The Department's Resilience Framework, currently being developed, includes a focus on how resilience will be created for critical supplies and services, as part of the expertise and finance collaborations. This will include a roadmap for incorporating continuity into normal operations and building resilience into critical infrastructure and personnel assets and supply chains.
- The Department is currently revising The Commerce Acquisition Manual. Climate resilience and adaptation measures will be integrated into this document as part of the revisions expected in 2024.
- USPTO has established a "Climate Working Group" which includes representatives from the Office of Procurement. These representatives will ensure that USPTO climate risk initiatives are reflected in procurement policies and procedures. For example USPTO is exploring ways to improve climate resiliency of its Alexandria, VA headquarters during the reduction in space effort coordinated by GSA.
- NIST has engaged in crosscutting efforts in life-cycle assessments led by its Applied Economics Office. This work addresses the carbon impact of a range of industry sectors, including buildings, utilities, and material-manufacturing. These types of assessments include insights into areas of the cycle that may be more susceptible to risk and allow acquisition specialists to ensure high-risk initiatives are developed alongside resilience measures. Examples of the tools that have been developed include the Building Industry Reporting and Design for Sustainability (BIRDS) and Building for Environmental and Economic Sustainability (BEES). These tools assess the carbon footprint of buildings and their component materials.

5) Climate Informed Funding to External Parties

Several Operating Units/Bureaus are delivering climate informed funding to external parties including EDA, NOAA, CHIPS Program Office, NTIA and USPTO. The range of activities performed spans Economic Recovery Missions for communities who have already experienced impacts from the changing climate to requirements that include considerations of climate vulnerability in grant applications and grant-making. USPTO is piloting an acceleration of patent application review for innovations in addressing the changing climate and NTIA is expanding access to broadband allowing more communities to access tools to assess their climate vulnerabilities.

Part of the Department's Resilience Framework, currently under development, is an assessment of programs like those listed above. These assessments, and any data provided by the projects themselves, will be used to inform decision making around resilience strategies, programs, and policies.

For more details on these and other Operating Unit/Bureau efforts, please see Appendix D.

3C. CLIMATE TRAINING AND CAPACITY BUILDING FOR A CLIMATE INFORMED WORKFORCE

The Department, primarily through NOAA's efforts, is leading the federal government in climate training. NOAA's Climate Education Program focuses on advancing public climate literacy in partnership with formal and informal educators by incorporating climate data, tools, and information products into classrooms and free-choice learning institutions; equipping educators with well-vetted, standards-based climate and energy lessons, multimedia resources, and visualizations and professional development opportunities; and defining "climate literacy" and helping to establish benchmarks of excellence to help guide educators.

NOAA has also taken on climate literacy efforts through the U.S. Global Change Research Program (USGCRP) and runs several USGCRP working groups including the development of the Climate Literacy Guide and the Climate Workforce Development group. Through these efforts, NOAA has developed a database of all climate training across the federal workspace, brought climate literacy stakeholders together, and leveraged the climate training capacity to the advantage of the entire federal government.

The Department is also developing a cross-cutting climate training plan that will increase climate literacy through collaborative education and awareness programs and address the often-overlooked area of climate decision making for senior executive service (SES) level employees. This work is being conducted with the Federal Executive Institute and the U.S. Geological Survey. Additionally, the Department will provide online training to all employees through programs offered by the Office of Sustainable Energy and Environmental Programs. These combined efforts will increase awareness and knowledge of climate adaptation and resilience.

Training and Capacity Building	
Agency Climate Training Efforts	***Identify the percentage of the agency's Federal staff that have taken a 60+ minute introductory climate training course (e.g. Climate 101):*** Climate 101 courses have been offered by the Department through the Commerce Learning Center and NOAA's climate.gov and education offices. The Department is in the process of gathering data on the number of Federal employees that have completed the course offerings. In FY2021, the Department offered Climate 101 training with climate.gov NOAA colleague that have over 600 Department employees in attendance.
	Detail the percent of the agency's senior leadership (e.g., Sec, Dep Sec, SES, Directors, Branch Chiefs, etc.) that have completed climate adaptation training: In FY2024/2025, the Department will be developing climate adaptation training for different position types, including leadership positions (e.g. acquisitions, budget, real property, facility, and IT).
	Detail the percent acquisition officials that have received climate adaptation related training: The Department currently has an online training series open to all Department employees with four topic areas including Climate Literacy, Sustainability 101, Environmental Compliance, and Technical Development. The number of acquisition officials trained is unknown at this time.
	Detail additional efforts the agency is taking to develop a climate informed workforce: NOAA continues to lead efforts to educate both federal employees and external stakeholders on science-based information on climate. Examples of NOAA's far-reaching climate literacy programs include: Climate.gov; Climate Smart Communities Initiative; Sea Grant; Digital Coast; NOAA's Environmental Literacy Program Grants; Climate Literacy and Energy Awareness Network (CLEAN); the Federal Adaptation and Resilience Group; and the Federal Climate Engagement and Capacity Building Interagency Working Group.

Agency Capacity	***Detail the number of full time Federal staff (FTE) across the agency that have tasks relevant to climate adaptation in their job description. Detail if the agency has contracting staff with tasks relevant to climate adaptation in their job description. Additionally, the agency may include information on climate adaptation staffing approaches in the narrative:*** Department leadership have climate adaptation and mitigation targets identified in their annual performance plans. Further assessment of position descriptions are needed to identify where additional language is required to fully incorporate climate considerations across all position types.

3D. SUMMARY OF MAJOR MILESTONES

Various milestones are included in this Plan and the following are major milestones.

Section of the Implementation Plan	Description of Milestone	Climate Risk Addressed	Indicators for success
3A.1	Develop a Resilience Framework to establish a roadmap for incorporating continuity into normal operations and building resilience into critical infrastructure and personnel assets, including owned buildings and vessels, and Department employees.	All climate hazards	Published Resilience Framework
3A.1	Prioritize investments in facilities that are most vulnerable to climate hazards and identify procurement mechanisms needed to implement.	All climate hazards	System in place to collect data on investments in climate-resilient, sustainable facility improvements
3B	Risk Assessment	All climate hazards	Climate risk assessments around energy and water completed in collaboration with Department of Energy Federal Energy Management Program (FEMP).
3C	Develop and employ a climate literacy plan specific to the Department. This will include trainings, collaborative education, and a focus on SES level climate-informed decision making.	All climate hazards	Publish Climate Literacy Plan and curriculum. Offer trainings.

Section 4: Demonstrating Progress

4A. MEASURING PROGRESS

Key Performance Indicator: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**

3A –Addressing Climate Hazard Impacts and Exposure	Step 1: Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. (Y/N/Partially) Step 2: Agency has a list of discrete actions that will be taken through 2027 as part of their implementation plan. (Y/N/Partially)	Step 1: Y Step 2: Y
3B.1 – Accounting for Climate Risk in Decision-making	Agency has an established method of including results of climate hazard risk exposure assessments into planning and decision-making processes. (Y/N/Partially)	Y
3B.2 – Incorporating Climate Risk Assessment into Budget Planning	Agency has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions. (Y/N/Partially)	Y
3B.5 – Climate Informed Funding to External Parties	Step 1: By July 2025, the agency will identify grants that can include consideration and/or evaluation of climate risk. Step 2: Agency modernizes all applicable funding announcements/grants to include a requirement for the grantee to consider climate hazard exposures. (Y/N/Partially)	Step 1: Y Step 2: Y
Key Performance Indicator: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3A –Addressing Climate Hazard Impacts and Exposure	Agency has identified the information systems that need to incorporate climate change data and information and will incorporate climate change information into those systems by 2027. (Y/N/Partially)	Partially
Key Performance Indicator: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate nature-based solutions, equitable approaches, and mitigation co- benefits to adaptation and resilience objectives.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.3 – Incorporating Climate Risk into Policy and Programs	By July 2025, 100% of climate adaptation and resilience policies have been reviewed and revised to (as relevant) incorporate nature-based solutions, mitigation co-benefits, and equity principles. (Y/N/Partially)	Partially
Key Performance Indicator: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.		
Section of the CAP	**Process Metric**	**Agency Response**
3B.4 – Climate- Smart Supply Chains and Procurement	Step 1: Agency has assessed climate exposure to its top 5 most mission-critical supply chains. (Y/N/Partially) Step 2: By July 2026, the agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards. (Y/N/Partially)	Step 1: Partially Step 2: Partially
	Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services. (Y/N/Partially)	Partially

Key Performance Indicator: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures.		
Section of the CAP	**Process Metric**	**Agency Response**
3C – Climate Training and Capacity Building for a Climate Informed Workforce	Step 1: By December 2024 100% of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. (Y/N/Partially) Step 2: Does the agency have Climate 101 training for your workforce? (Y/N/Partially) If yes, what percent of staff have completed the training? Step 3: By July 2025, 100 % of employees will have completed Climate 101 trainings. (Y/N/Partially)	Step 1: Y Step 2: Y – Approximately 50% Step 3: Partially

4B. ADAPTATION IN ACTION

U.S. Census Bureau:

- Census Bureau is building a microdata infrastructure linking businesses and households with environmental and climate risk information, which is necessary for measuring the distributional effects of climate change. A prototype version of this infrastructure has been built and is being used as the basis for a variety of research projects which will vet additional hazards data. Public facing data products on the distribution of exposure to air pollution and wildfires are in progress. Census Bureau staff continue to present research using this infrastructure at numerous conferences and seminars.
- They are expanding the suite of Community Resilience Estimates (CRE) to include climate-related challenges faced by communities, including extreme heat, flooding, hurricanes, wildfires, and winter weather. The Census Bureau is partnering with other agencies such as NOAA and FEMA to create and release new statistical products that are useful in understanding the impacts of natural hazards on communities.
- Census Bureau is including questions on environment-related innovations by businesses as well as impacts and actions related to climate risk in the 2023 Annual Business Survey. Businesses were asked about innovations in products, services, and processes that reduce energy use, pollution, solid waste, and material and water usage. In addition, businesses were asked about recent losses due to extreme weather events, investments taken to reduce the risk of damage from such events, and their perception of the likelihood of experiencing negative impacts from such events in the future. Early findings from this data collection are expected in late 2024.
- Census Bureau is proposing three new questions be added to the American Community Survey and the Puerto Rico Community Survey for 2025 on solar panels, electric vehicles, and sewage disposal. The final proposal will be submitted to OMB in spring 2024 and accompanied by a Federal Register notice with the final recommendations and seeking public comment.

EDA:

- EDA has incorporated climate into its investment priorities under the Environmentally Sustainable Development investment priority. Since the adoption of the investment priority in FY21, EDA has invested close to $573 million in 138 projects to help communities and

regions build the capacity for environmentally sustainable development. These included over $386.3 million in 89 projects that are, according to recipient estimates, expected to create or retain 25,990 jobs and attract close to $6.4 billion in private investment. EDA also invested over $186.6 million in 49 projects to support planning, research, technical assistance, access to capital, or other activities that are essential for successful economic development and job creation in the future.

- EDA successfully added language on resilience (including climate resilience) beginning with its American Rescue Plan Act Notice of Funding Opportunities (NOFOs) in FY21. Since then, EDA has continued to add climate resilience language to its applicable NOFOs, including its FY23 Public Works and Economic Adjustment Assistance NOFO. Throughout FY24, new, applicable funding opportunities will also include climate resilience language.
- New climate-related language has been added to EDA's Environmental Narrative Template, and this revised document has been in use since late-June 2021, with a general expectation that all applicants for infrastructure projects will use this new narrative. In addition, relevant EDA application reviewers (i.e., REOs), Engineers and Construction Managers) have been briefed on the changes to the Environmental Narrative Template. This template asks infrastructure project applicants to consider climate resilience in their project design.
- EDA is including information in the Comprehensive Economic Development Strategy (CEDS) Content Guidelines that encourages climate resilience be incorporated in the resilience components of each CEDS. As the economic development plans for a region, the CEDS are a key component in establishing and maintaining a robust economic ecosystem by helping to build regional economic development capacities. They provide a vehicle for individuals, organizations, local governments, institutes of learning, underserved communities, and private industry to engage in a meaningful conversation about what efforts and initiatives would best serve economic development in the region. In early 2023, the CEDS Content Guidelines were updated to include climate resilience language, encouraging consideration of both mitigation as well as adaptation strategies, as well as providing resources and discussion on: assessing risks and vulnerabilities; prioritizing identified actions; and investigating options to implement. The new climate resilience language encourages entities to incorporate climate resilience when creating/revising individual CEDS, with the goal of more climate-conscious regional economic development. This language provides reference to relevant links, tools, and sources of knowledge around climate-resilient economic development. This resource provides useful guidance to Economic Development Districts and other regional entities on how to either develop or redevelop their local infrastructure in congruence with considerations and assessments of natural hazard and climate risk. Beginning in FY24, machine learning algorithms will be applied to submitted CEDS documents, with analysis being performed to identify trends that include if and how certain priorities (such as climate resilience) are being included in CEDS documents. This analysis will help to quantify/qualify how climate resilience is being addressed in the CEDS and assist in informing future revisions to the CEDS Content Guidelines.
- In addition, 37% of EDA grant awards in FY2024 will support entrepreneurship in underserved communities and regions.

NIST:

- NIST has issued a NOFO, seeking eligible applicants for the creation of an interdisciplinary Center of Excellence in Climate Measurements. The center will coordinate activities to

advance efforts to establish national standardization of methods and metrics for forecasting consequences of climate trends at scales important to communities across multiple geographies and over time. The center will carry out research and will act as a convener and leader in this field of research by collaborating with NIST and other stakeholders to develop standard practices, methodologies, and tools that will assist communities in making quantitative predictions of climate- related effects on their communities. In FY2024, NIST anticipates funding one award for up to $2,667,900 in federal funding and with a project performance period of up to three (3) years.

- NIST made strategic investments ($11.7 million) in climate, energy, and resilience research and development (R&D) to ensure NIST continues to deliver the most accurate measurements, data, and standards to industry, academia, Federal and local Government. The investments include the Innovation in Measurement Science program, Strategic and Emerging Research Initiative program, and programs outlined in the FY 2023 appropriations.
- NIST made significant progress to advance climate science and metrology. Examples include new Standard Reference Materials and Traceable Reference Materials, a Standard Reference Instrument and accompanying Calibration Service for photovoltaic cells, new datasets, software, and models that cover greenhouse gas (GHG) measurements, energy efficiency, and carbon capture; NIST informed best practices for combating the increasing number of wildfires, and contributed to the latest International Building Code and state building codes that mandate construction techniques to mitigate the impact of tornadoes.
- NIST engaged in a variety of domestic and international fora to advance standards, research, and measurements. Some notable examples include drafting sections of National Climate Assessment 5; participating in the Interagency Working Groups Initiative; establishing Low Carbon Cement and Concrete Consortium; co- sponsoring and organizing workshops, conferences, and roundtables; serving on delegations to negotiate a global treaty on plastic pollution; and partnering with Manufacturing Extension Partnership Centers to explore sustainable business practices.

NOAA:

- NOAA has significantly advanced the provision of climate services to the U.S. through expanded partnerships and increased investment in six mission areas (coasts, marine ecosystems, drought, extreme heat, flooding, and wildfires). NOAA is also helping coastal communities build the future they want to see by investing in high-impact natural infrastructure projects that build coastal resilience, create jobs, store carbon, and restore habitat.
- NOAA launched its Ocean-Based Climate Resilience Accelerators program in July 2023. This program will support approximately $60 in million IRA investments in the development and implementation of novel business accelerators to help American small businesses develop sustainable technologies geared toward climate resilience, attract capital, and mature their technologies and scale their business models to find solutions for climate- driven challenges.
- In January 2024, NOAA launched its Industry Proving Ground initiative, which will leverage $85 million in IRA funding to foster partnerships with key industry sectors (insurance, retail, architecture, and engineering) and accelerate the provision of essential climate services to U.S. industries by expanding their use of NOAA's trusted and authoritative data and information through products that are tailored to their needs.

- In April, 2023, NOAA, with Vice President Harris, announced $562 million in BIL and IRA awards supporting nearly 150 projects across 30 coastal and Great Lakes states and territories that will support important coastal resilience and restoration work in communities that will restore important coastal habitats, address pollution and marine debris, reduce community risks to coastal hazards, create jobs, and build the capacity of tribal and communities with environmental justice concerns to prepare for the impacts of climate change. As part of this portfolio of awards, NOAA Fisheries Services made more than $53 million in grants to support 25 tribal projects (including both federally recognized and non-federally recognized Indian tribes) in BIL funds including a dedicated tribal fish passage funding opportunity.
- In June 2023, NOAA launched the first-ever Climate Resilience Regional Challenge, which will provide up to $575 million in IRA funding to help coastal and Great Lakes communities, including Tribal communities in those regions, become more resilient to extreme weather and other impacts of the climate crisis. The Climate Resilience Regional Challenge is unique in its focus on enhancing equity and inclusion, building enduring capacity within and across regional networks, and in support of holistic approaches to building climate resilience. NOAA saw enormous demand for this funding, receiving nearly 870 letters of requests seeking more than $16 billion in funding, demonstrating the necessity and urgency for funding programs like the Regional Challenge.
- NOAA also launched the Climate Ready Workforce program in June 2023, which will support up to $50 million in IRA funding to assist communities in coastal and Great Lakes states, territories and Indian tribes so they may form partnerships that train workers and place them into jobs that enhance climate resilience. Part of the Justice40 Initiative, this program helps to advance environmental justice.
- NOAA and the state of Alaska announced a collaborative effort to identify Aquaculture Opportunity Areas (AOAs) in Alaska's waters. With a coastline longer than the lower 48 states combined, Alaska holds tremendous potential for climate- ready and sustainable aquaculture development through the farming of shellfish, other invertebrates, and seaweed. NOAA works with Federal, State, and Local agencies, appropriate Regional Fishery Management Councils, and in coordination with appropriate tribal governments to identify AOAs. In October 2023, NOAA announced a request for information to aid in the identification of AOAs in Alaska state waters that balance environmental, economic, and cultural considerations. NOAA is using this input to identify AOA through a deliberative process, including public outreach, spatial analysis, and environmental review.
- NOAA supported the growth of climate-ready sustainable aquaculture with tribal partners in the Pacific Northwest. NOAA collaborated with the Swinomish Indian Tribal Community and key partners, including Washington Sea Grant, to help build the first modern clam garden in the United States. Clam gardens are an ancient Indigenous practice, passed down through generations, that increase biodiversity and resilience, provide food, and preserve cultural heritage. A video released in December 2023 illustrates what this garden means for the Swinomish community and how they will use the harvest.
- NOAA selected 20 members to serve on the inaugural Marine and Coastal Area- based Management Advisory Committee. Members reflect a wide spectrum of perspectives, including tribal and Indigenous communities, conservation, philanthropic and non-governmental organizations, and organizations focusing on youth engagement, education, outreach and environmental justice. The committee will provide a forum for discussion and advice on NOAA’s area-based management, including opportunities to enhance conservation

of biodiversity, climate resilience, and expanding access to nature for communities with environmental justice concerns.

- NOAA worked closely with Federal Agencies to help develop a historic agreement to work in partnership with Tribal Nations and States from the Pacific Northwest to restore wild salmon populations, expand tribally sponsored clean energy production, and provide stability for communities that depend on the Columbia River System for agriculture, energy, recreation, and transportation.
- NOAA was a key partner in the quadrennial National Climate Assessment 5.0 released in mid-November 2023. From chapter authors to technical and production support, approximately 100 NOAA staff members– the largest of any federal agency– contributed to the report which is a roadmap to a better future through science-based information, data, and real-world examples of ways to reduce greenhouse gas pollution and develop resilience strategies.
- NOAA released its first ever Request for Information to get public input on how best to enhance delivery of climate data, information, science, and tools and ensure that this delivery is equitable, accessible, and effective.
- NOAA is working to update and enhance its Climate Mapping for Resilience and Adaptation (CMRA) portal. CMRA combines critical climate data and climate- hazard information with the resources America needs to help fund resilience and adaptation projects. CMRA provides real-time maps showing where extreme heat, fires, inland and coastal flooding, and drought are affecting U.S. communities and provided new links to BIL and other federal funding opportunities. NOAA completed work to expand the scope and utility of the CMRA, organizing focus groups to solicit stakeholder feedback on the CMRA, and building new capabilities into the portal. The portal will be updated continuously with new climate information and links to new funding opportunities, as they become available.
- NOAA also worked with partners and launched important tools for helping communities build resilience to climate impacts, like Heat.gov and Drought.gov. Heat.gov is a website to provide the public and decision-makers with clear, timely and science-based information to understand and reduce the health risks of extreme heat. Heat.gov provides critical resources to the Nation that include guidance from the White House and FEMA on ways State, Local, Tribal and Territorial leaders can protect workers from extreme heat, and a new surveillance dashboard to track heat- related, emergency medical services (EMS) response for every county in the country. Similarly, Drought.gov provides a "one-stop-shop" portal for finding authoritative drought information, including data, decision- support products, resources, to inform planning and preparedness activities.
- Currently, NOAA's forthcoming oceanographic vessels and charting and mapping vessels will adopt high efficiency engines. NOAA's new vessel facilities, such as the newly opened Ketchikan, AK pier and the forthcoming facilities and piers in Charleston, SC and Newport, RI, will have the latest technology to support NOAA ships and are designed to be more resilient to the changing climate.
- The NOAA Climate, Ecosystems, and Fisheries Initiative (CEFI) will build the end-to-end, operational modeling and decision support system needed to provide information and capacity resource managers and stakeholders need to reduce impacts and increase resilience in a changing climate. This cross-NOAA effort to build nationwide ocean modeling will help adapt to changing ocean conditions. The system will provide decision makers with the actionable information and capacity they need to prepare for and respond to changing

conditions today, next year, and for decades to come. The system addresses four core requirements for climate-ready decision-making for marine resources:

1. Robust forecasts and projections of ocean and Great Lakes conditions for use in developing climate-informed advice.
2. Operational capability to assess risks, evaluate options, and provide robust advice on adapting to changing conditions.
3. Decision-maker capability to use climate-informed advice to reduce risks and increase the resilience of resources and the people that depend on them.
4. Continuous validation and innovation through observations and research.

The Initiative is a timely, efficient, and effective way to address NOAA's requirements for climate-informed management of marine and Great Lakes resources. Working with many partners, the Initiative will provide decision makers with the information and capacity they need to help safeguard resources and resource-dependent communities in a rapidly changing world. The CEFI is an essential part of the U.S. Ocean Climate Action Plan and NOAA's Climate Ready Nation Strategic Plan.

MBDA:

- In September 2023, MBDA made 43 awards under the Capital Readiness Program. Of notable mention, one of the awardees is "Exponential Impact" d.b.a. "Climate Capital Bio." The project titled Climate Capital Bio Incubator ("CCBI") is an incubator for early-stage biotechnology companies creating products that directly benefit the environment and address climate change. MBDA awarded $3 million to support the CCBI project over the course of 4 years (2023–2027).

USPTO:

- In June 2023, the USPTO expanded the eligibility requirements to include more technologies which will progress toward the goal of net-zero greenhouse gas emissions. Under the expanded Climate Change Mitigation Pilot Program, qualifying applications involving technologies that reduce, remove, prevent, and/or monitor greenhouse gas emissions, will be advanced to expedite a first Office action. An Office action is a patent examiner's written notice of findings for the patent application.

APPENDIX A: AGENCY PROFILE TABLE

Agency Profile	
Mission	To create the conditions for economic growth and opportunity for all communities. Through its 13 bureaus, the Department works to drive U.S. economic competitiveness, strengthen domestic industry, and spur the growth of quality jobs in all communities across the country.
Adaptation Plan Scope	1. Bureau of Economic Analysis (BEA) 2. Bureau of Industry and Security (BIS) **3.** U.S. Census Bureau 4. Economic Development Administration (EDA) 5. Office of the Under Secretary for Economic Affairs (OUS/EA) 6. International Trade Administration (ITA) 7. Minority Business Development Agency (MBDA) 8. National Institute of Standards and Technology (NIST) 9. National Oceanic and Atmospheric Administration (NOAA) 10. National Technical Information Service (NTIS) 11. National Telecommunications and Information Administration (NTIA) 12. U.S. Patent and Trademark Office (USPTO) 13. Office of the Secretary (OS)
Agency Climate Adaptation Official	**Don Graves**, Deputy Secretary of Commerce
Agency Risk Officer	**Mark Daley**, Deputy for Acquisition Program Risk and Grants
Point of Public Contact for Environmental Justice	**Sarah Watling**, Senior Resilience, Climate Adaptation, and Environmental Justice Program Manager
Owned Buildings	466 owned buildings of 8,007,862 gross square feet (Department of Commerce Federal Real Property Profile (FRPP) – December 2023)
Leased Buildings	54 leased buildings of 865,469 usable square feet (Department of Commerce Federal Real Property Profile (FRPP) – December 2023)
Employees	Approximately 37,672 civil service employees[4]
Federal Lands and Waters	157 owned lands, 5,387,032 managed acres (Department of Commerce FRPP – December 2023)

[4] The Department's workforce ranges from uniformed service officers, diplomats who are Foreign Commercial Officers, badged law enforcement officers, patent examiners and civil service employees (U.S. Department of Commerce 2022 – 2026 Strategic Plan). Total Department employees in FY 2023 was approximately 52,500 (DOC Contingency Plan 092723 (commerce.gov).

Budget	$9.9 billion FY22 Enacted (P.L. 117-103) $11.1 billion FY23 Enacted (P.L.117-328) $10.8 billion FY24 Enacted (P.L.118-42) $15.4 billion FY25 President's Budget [FY 2025 Budget in Brief (commerce.gov)]
Key Areas of Climate Adaptation Effort	• Procurement – utilizing the Department's power of procurement to create equitable economic opportunities. • Facilities Management – investing in and maintaining climate-ready and resilient facilities, products, and services. • Climate Science Services – providing climate science and services to the Federal Government and other stakeholders to support climate adaptation and resilience, including advanced measurements, tools and standards for climate consideration and decision support. • Climate Information for Strategic Planning and Implementation – assisting federal agencies, local governments, regional entities, states, and Indigenous communities in understanding climate variability and integrating climate information and resiliency into their near- term and long-term strategies and actions, including economic development and natural resources stewardship. • Market Opportunities – promoting the advancements of a climate-resilient economy and sustainable growth to create market opportunities (both domestic and abroad), new businesses, advanced technologies, and quality jobs.

APPENDIX B: RISK ASSESSMENT DATA

The Federal Mapping App uses the following data:

Buildings
Buildings data comes from the publicly available Federal Real Property Profile (FRPP). Federal Real Property Profile (FRPP). The General Services Administration (GSA) maintains FRPP data and federal agencies are responsible for submitting detailed asset-level data to GSA on an annual basis. Although FRPP data is limited—for example, not all agencies submit complete asset-level data to GSA, building locations are denoted by a single point and do not represent the entirety of a structure or could represent multiple structures, and properties may be excluded on the basis of national security determinations— it is the best available public dataset for federal real property. Despite these limitations, this data is sufficient for screening-level exposure assessments to provide a sense of potential exposure of federal buildings to climate hazards.

Personnel
Personnel data comes from the Office of Personnel Management's (OPM) non-public dataset of all personnel employed by the federal government that was provided in 2023. The data contains a number of adjustments, including exclusion of military or intelligence agency personnel, aggregation of personnel data to the county level, and suppression of personnel data for duty stations of less than 5 personnel.

Despite these adjustments, this data is still useful for screening-level exposure assessments to provide a sense of key areas of climate hazard exposure for agency personnel.

Climate Hazards
The climate data used in the risk assessment comes from the data in Climate Mapping for Resilience and Adaptation (CMRA) Assessment Tool. When agency climate adaptation plans were initiated in 2023, CMRA data included climate data prepared for NCA4. Additional details on this data can be found on the CMRA Assessment Tool Data Sources page. Due to limited data availability, exposure analyses using the Federal Mapping App are largely limited to the contiguous United States (CONUS). Additional information regarding Alaska, Hawaii, U.S. Territories, and marine environments has been included as available.

APPENDIX C: RISK ASSESSMENT TABLES

Table 2A: Climate Hazard Exposure and Impacts Affecting Federal Buildings

Indicators of Exposure of Buildings to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of buildings projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually) from 1976- 2005	100%	100%	100%	100%
Extreme Precipitation: Percent of buildings projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually) from 1976-2005	99%	100%	100%	100%
Sea Level Rise: Percent of buildings projected to be inundated by sea level rise	15%	15%	15%	15%
	High Risk	**Very High Risk**		**Extreme Risk**
Wildfire: Percent of buildings at highest risk to wildfire	6%	1%		1%
	100- or 500- year floodplain			
Flooding: Percent of buildings located within floodplains	20%			

Table 2B. Climate Hazard Exposure and Impacts Affecting Federal Employees

Indicators of Exposure of Employees to Climate Hazards	RCP 4.5 2050	RCP 4.5 2080	RCP 8.5 2050	RCP 8.5 2080
Extreme Heat: Percent of employees duty-stationed in counties projected to be exposed to more days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), from 1976-2005	98%	98%	98%	98%
Extreme Precipitation: Percent of employees duty-stationed in counties projected to be exposed to more days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amount (calculated annually), from 1976-2005	97%	98%	98%	97%
Sea Level Rise: Percent of employees duty-stationed in counties projected to be inundated by sea level rise	32%	41%	32%	44%
	High Risk	**Very High Risk**		**Extreme Risk**
Wildfire: Percent of employees duty-stationed in counties at highest risk to wildfire	8%	2%		2%

Table 2C. Climate Hazard Exposure and Impacts Affecting Federal Lands, Waters and Cultural Resources

Federal Asset	Current Climate Hazard Impact or Exposure	Future Climate Hazard Impact or Exposure
• 43 acres in Florida Several NOAA sites for research and development	• Flooding	• Extreme Heat These lands could be exposed to temperatures above the 99th percentile under all climate scenarios. Using the RCP 4.5 mid scenario, these lands could see between 30 and 40 days a year above the 99th percentile temperature, but using the RCP 8.5 late scenario, they could see between 125 and 140 days a year above this threshold.
• 149 acres in Galveston, TX NOAA NMFS Southeast Fisheries Science Center research and development	• Flooding This parcel is exposed to freshwater/riverine flooding as it sits within the 100-year flood plain.	• Extreme Heat This land parcel could be exposed to 16 days above 99th percentile temperatures (RCP 4.5 Mid) and 62 days under the RCP 8.5 Late scenario.
• 759 acres in Colorado NIST, NOAA, and NTIA sites for research and development	• Flooding • Wildfire	• Extreme Heat These lands could be exposed to temperatures above the 99th percentile for over 60 days a year by late periods under the 8.5 RCP scenarios.
• 103.5 acres in Colorado • NIST Boulder Campus Protected open space set aside through a Memorandum of Agreement (MOA) with Tribes and the City of Boulder	• Wildfire This land parcel is vulnerable to wildfires. The Marshall Fire of 2021 ($2B in damage) reached within less than 5 miles of the Boulder, CO campus 100% of NIST facilities/land in Boulder and Fort Collins are vulnerable to wildfires.	• Extreme Heat This land could be exposed to temperatures above the 99th percentile for over 19 days a year under the RCP 4.5 Mid scenario and over 60 days a year under the RCP 8.5 Late scenario.
• 2358 acres in Alaska NOAA research and development, ports, and housing	• Flooding	• Extreme Precipitation • Sea level rise These lands could be exposed to extreme precipitation above the 99th percentile under the RCP 8.5 Mid and late scenarios.
• 23 acres in Juneau, Alaska NOAA NMFS Alaska Fisheries Science Center research and development	• Flooding This parcel could be exposed to freshwater/riverine flooding as it sits within the 100-year flood plain.	• Extreme precipitation • Sea level rise
• 59 acres in Michigan Several NOAA sites for research and development	• Flooding	• Extreme precipitation These lands could be exposed to extreme precipitation above the 99th percentile under all climate scenarios.

• 263 acres in Washington Several NOAA sites for research and development	• Flooding	• Extreme heat • Extreme precipitation • Sea level rise These lands could be exposed to extreme precipitation above the 99th percentile under all climate scenarios.
• 28 acres in Spokane, Washington NOAA NWS Weather Forecasting Office research and development	• Flooding • Wildfire This land parcel has a very high probability of being exposed to freshwater flooding and wildfires.	• Extreme heat • Extreme precipitation • Sea level rise
• 46 acres in Manchester (Port Orchard), Washington NOAA NWFS Manchester Research Station, Northwest Fisheries Science Center	• Flooding	• Extreme heat • Extreme precipitation • Sea level rise This land parcel could be exposed to sea level rise under all the climate scenarios.
• 42 acres in Tucson, Arizona NOAA NWS research and development	• Flooding • Wildfire This land has a high probability of being exposed to freshwater flooding and wildfires.	• Severe weather • Extreme heat • Extreme precipitation This land parcel could be exposed to 15 and 57 days above 99th percentile temperatures under the different climate scenarios.
• 7 acres in Norfolk, Virginia NOAA Office of Marine and Aviation Operations (OMAO) Marine Operations Center and Geodetic Survey Field Office NOAA Ship Thomas Jefferson (homeport)	• Flooding	• Extreme heat • Extreme precipitation • Sea level rise These lands/waters could be exposed to sea level rise under all the climate scenarios.
• 397 million acres (or 620,000+ square miles) ocean/lake waters or bottomlands NOAA National Marine Sanctuaries	• Flooding	• Extreme Heat • Sea level rise Climate change and the associated increases in sea surface temperatures, ocean acidification, and sea level rise will expose ocean ecosystems and species to extreme vulnerabilities. U.S. Exclusive Economic Zone (which includes more than 4 million square miles of ocean) and the associated coastal shoreline covering over 95,000 miles.
Federally managed fisheries throughout the U.S. Exclusive Economic Zone (4,383,000 sq mi)	• Flooding	• Extreme Heat • Sea level rise Climate change is challenging the Department's ability to maintain resilient

		and productive trust resources and the ecosystems they depend on. These activities include ecosystem-level planning; advancing understanding of ecosystem processes; prioritizing vulnerabilities and risks; exploring and addressing trade-offs; implementing ecosystem considerations in management; and supporting ecosystem resilience via monitoring and adjusting management actions.
• 30 acres in Kauai, Hawaii • NIST Kehaka, Kauai Campus Listed in National Register of Historic Places	• Flooding	• Extreme heat • Sea level rise This land parcel could be exposed to sea level rise under all climate scenarios.

Table 2D. Climate Hazard Impacts on and Exposures to Mission, Operations and Services

SUMMARY OF KEY CURRENT AND PROJECTED CLIMATE HAZARD IMPACTS AND EXPOSURES		
Area of Impact or Exposure	Identified Climate Hazard	Description
Create the conditions for economic growth and opportunity	All climate hazards	Climate change impacts on the Department's primary customer base – U.S. businesses, workers, and communities – affect the Department's ability to foster business and economic development.
Create jobs that will sustain economic growth	All climate hazards	Climate change impacts on U.S. businesses and communities increase the interest in sustainable technologies and capitalize on new, entrepreneurial opportunities. The increased demand for climate change adaptation-related technologies impacts U.S. competitiveness and economic growth.
Information and Communications Technology (ICT) Supply Chain	All climate hazards	Destruction of critical infrastructure needed to move goods into and across the United States impacts the supply chain.
Economic Supply Chains or Services	All climate hazards	Disruptions in ports, other transportation infrastructure, and supply chains greatly impacts the Department's ability to promote U.S. exports and drive economic growth.
Research and Development	All climate hazards	Impacts to research laboratories slows the advancement of knowledge and growth of the U.S. economy.
Conserve and manage coastal and marine ecosystems and resources	All climate hazards	Extreme weather, heat, and precipitation are negatively impacting existing conserved lands and waters, destroying ecosystems and resources held within their boundaries.
Stewardship and provision of environmental data, products and services	All climate hazards	Employing the correct workforce to address the rapidly changing science and technology needed to collect, analyze, and manage climate data is a challenge.

Facilities and operations	All climate hazards	See Section 2A
Protect life and property from environmental hazards and predict changes in climate, weather, oceans, and coasts	All climate hazards	If current trends continue, $66 to $106 billion dollars of existing U.S. coastal property could be below sea level by 2050. Furthermore, the United States could see at least 1 percent reduction in its GDP by 2100 due to coastal flooding.

Table 2E. Assessment Data and Scenarios

Climate Data Used in Agency Risk Assessment

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5	CONUS
		RCP 8.5	CONUS and AK
Sea Level Rise	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report.2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High Sea level rise scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5	CONUS and PR
		RCP 8.5	CONUS and PR
Wildfire Risk	Measured as whether an asset is in a location is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR

Hazard	Description	Scenario	Geographic Coverage
Extreme Heat	Measured as whether an asset is projected to be exposed to an increased number of days with temperatures exceeding the 99th percentile of daily maximum temperatures (calculated annually), calculated with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the Localized Constructed Analogs (LOCA) dataset prepared for the 4th National Climate Assessment.	RCP 4.5 RCP 8.5	CONUS CONUS
Extreme Precipitation	Measured as whether an asset is projected to be exposed to an increased number of days with precipitation amounts exceeding the 99th percentile of daily maximum precipitation amounts (calculated annually), with reference to 1976-2005. Data are from high-resolution, downscaled climate model projections based on the LOCA dataset prepared for the 4th National Climate Assessment.	RCP 4.5 RCP 8.5	CONUS CONUS and AK
Sea Level Rise	Measured as whether an asset is within the inundation extents from NOAA Coastal Digital Elevation Models and the 2022 Interagency Sea Level Rise Technical Report.2022 Interagency Sea Level Rise Technical Report. Intermediate and Intermediate-High Sea level rise scenarios used as proxies for RCP 4.5 and 8.5, respectively.	RCP 4.5 RCP 8.5	CONUS and PR CONUS and PR
Wildfire Risk	Measured as whether an asset is in a location is rated as high, very high, or extreme risk based on the U.S. Forest Service Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities), which estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	All 50 States
Flooding	Measured as whether an asset is located within a 100-year floodplain (1% annual chance of flooding) or 500-year floodplain (0.2% annual chance of flooding), as mapped by the Federal Emergency Management Agency National Flood Hazard Layer.	Historical	All 50 States and PR

Climate Scenarios Considered in Agency Risk Assessment

Scenario Descriptor		Summary Description from 5th National Climate Assessment5th National Climate Assessment
RCP 8.5	Very High Scenario	Among the scenarios described in NCA5, RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are quadruple emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46% less than the year 2000. Mitigation efforts include expanded renewable energy compared to 2000.

APPENDIX D: Examples of Climate Informed Funding to External Parties

EDA

- EDA supports a variety of economic development investment priorities which provide an overarching framework to ensure its grant investment portfolio contributes to local efforts to build, improve, or better leverage economic assets that allow businesses to succeed and regional economies to prosper and become more resilient. Through its Environmentally-Sustainable Development investment priority, EDA funds economic development planning or implementation projects that help address the climate crisis through the development and implementation of green products, green processes, (including green infrastructure), green places, and green buildings. This type of development and implementation reduces greenhouse gas emissions, helping reduce warming to the lowest levels possible. Every degree of warming decreases the likelihood that resilience and adaptation will be successful. EDA's Recovery & Resilience investment priority supports economic development planning or implementation projects that build economic resilience to and long-term recovery from economic shocks, including resilience from climate-driven disasters. Under this effort, EDA brings the expertise and resources of EDA and other DOC bureaus (NOAA, NIST, BEA, Census, ITA, MBDA) and Economic Recovery Support Function (ERSF) support agencies (e.g., USDA, DOL, HUD, SBA, EPA, FEMA, AmeriCorps, Treasury) to assist states and communities affected by catastrophic natural disasters. As part of these efforts, FEMA assigns EDA to lead various Economic Recovery Missions in areas grappling with long-term recovery from natural disasters, many of which have been caused or exacerbated by climate change.
- EDA revised language in Notice of Funding Opportunities (NOFO) to include climate resilience considerations. The included language encouraged applicants to minimize the potential for adverse impacts on the environment and the local community, including communities with environmental justice concerns. Additionally, the added language encouraged applicants to account for, or have a plan to account for, current and future weather and climate-related risks, such as wildfires, droughts, extreme heat and cold, inland, Inclusion of similar climate considerations in future NOFOs is planned.
- EDA is helping infrastructure project applicants to consider climate resilience in their project design by providing climate-related information in EDA's Environmental Narrative Template (which is used in EDA's environmental review of projects). A new climate-related language has been added to the Environmental Narrative Template, and this revised document has been in use since late-June 2021, with a general expectation that all applicants for infrastructure projects will use this new narrative. This document is publicly available on EDA's website (here). In addition, relevant EDA application reviewers (i.e., Regional Environmental Officers, Engineers and Construction Managers) have been briefed on the changes to the Environmental Narrative Template to aid in targeting consideration of climate resilience principles in applications.

NOAA

- NOAA is using its allocated funding from the IRA and BIL to prepare, adapt, and build U.S. resilience to weather and climate hazards. With BIL and IRA funds, NOAA was able to amplify investment in each of its six Climate Ready Nation (CRN) mission areas (coasts, marine ecosystems, drought, extreme heat, flooding, and wildfires), with Climate-Ready Coasts and Oceans receiving a total of $4.1B from the two supplements. Through Climate-Ready Coasts and Communities initiatives, NOAA is working with state, local, and tribal governments and organizations, non-government organizations, and the private sector in coastal and Great Lakes communities to develop and support durable, local capacity to adapt to climate change impacts, while growing economies, protecting fisheries, addressing environmental justice, and developing a climate-ready workforce.

Additional funding supported Integrated Ocean Observing Systems, habitat restoration and fish passage, marine sanctuary designations, NOAA facility improvements, and Technical Assistance to states, localities, Indian tribes, and other partners will also improve delivery of climate data and services to American industries and build partnerships with the private sector. This initiative will advance research, observations, modeling, prediction, information dissemination, and service delivery for disasters such as wildfires, drought, floods, and heat. Funds will improve NOAA's ability to provide critical climate and weather data, services, and information by improving storm tracking, models, and data assimilation, bolstering successful existing place-based and regional programs, and expanding weather, climate, and other support services in the Arctic region – a place that is changing more rapidly than the lower 48 states because of climate change. These Climate-Ready Nation initiatives include:

  - Phased Array Radar
  - Regional Climate Data and Information
  - Enhanced Modeling Capacity
  - Industry Proving Grounds
  - BIL-funded Climate Data and Services programs that will help to get critical climate information in the hands of decision makers.

- NOAA has already released a climate service, like that described above, for the public. The Climate Mapping for Resilience and Adaptation tool, which integrates information from across the federal government to help people consider their location exposure to climate-related hazards.

CHIPS Program Office

- CHIPS and Science Act implementation. On February 28, 2023, the CHIPS Program Office released its first notice of funding opportunity, which requires each applicant to submit a climate and environmental responsibility plan that includes detailed metrics and processes the applicant will use to measure, track, and publicly report its climate and environmental responsibility goals and commitments. On June 23, 2023, the Department announced a funding opportunity and application process for large semiconductor supply chain projects and will release a separate process for smaller projects in the fall. Large semiconductor supply chain projects include materials and manufacturing equipment facility projects with capital investments equal to or exceeding $300 million, and smaller projects are below that threshold. On September 29, 2023, CHIPS for America released its second funding opportunity to strengthen the resilience of the semiconductor supply chain, advance U.S. technology leadership, and support vibrant domestic semiconductor clusters. This funding opportunity seeks applications for projects for the construction, expansion, or modernization of commercial facilities for semiconductor materials and manufacturing equipment with capital investments less than $300 million.

NTIA

- NTIA provided Broadband Equity Access and Deployment Program (BEAD) eligible entities/applicants guidance on climate resiliency requirements for the Initial Proposal submissions in winter 2023/2024. They also provided multiple technical assistance products for meeting Environmental and Historic Preservation requirements, including climate resiliency. The Tribal Broadband Connectivity Program is a $3 billion program, from President Biden's Bipartisan Infrastructure Law and the Consolidated Appropriations Act. The program supports Tribal governments by bringing high-speed Internet to Tribal lands, allowing for telehealth, distance learning, affordability, and digital inclusion initiatives. The program seeks to improve quality of life, spur economic development, and create opportunities for remote employment, online

entrepreneurship, remote learning, and telehealth by expanding broadband access and by providing digital training and inclusion programs to Native American communities. The second round of funding from the Tribal Broadband Connectivity Program will make approximately $980 million available on Native American, Alaska Native and Native Hawaiian lands for deployment of Internet infrastructure, affordability programs, telehealth and distance learning initiatives.

USPTO:

- On June 6, 2023, the USPTO extended and expanded the Climate Change Mitigation Pilot Program, which accelerates the review of patent applications for innovations designed to mitigate climate change. The program was extended to run until either June 7, 2027, or the date that the USPTO accepts 4,000 grantable petitions, whichever occurs first. Eligibility criteria for the program was expanded to include technologies designed to reduce, remove, prevent, and/or monitor greenhouse gas emissions. As of February 13, 2024, the USPTO had received a petition to make special status under the program in 787 applications, with 569 of those being granted special status.

Department of Defense Climate Adaptation Plan

2024–2027

PLEASE CITE THIS DOCUMENT AS:

Department of Defense, Office of the Undersecretary of Defense (Acquisition and Sustainment). 2024. Department of Defense 2024 2027 Climate Adaptation Plan. Report Submitted to National Climate Task Force and Federal Chief Sustainability Officer. 5 September 2024.

FOREWORD

Climate change fundamentally alters the conditions that shape military operations at home and around the world. At the same time, climate change is reshaping our strategic interests. As changes in the physical environment create the opportunity for well-prepared forces to secure a competitive advantage, deter aggression, and protect the United States and its interests, the Department of Defense (DOD) must both understand and adapt to the ways in which extreme weather and climate change affect our readiness and capabilities.

Over the past decade alone, extreme weather has significantly disrupted military readiness and driven tens of billions of dollars in damage and recovery costs across DOD. These extreme weather events, typical of those fueled by climate change, also impact training, testing, equipment availability, and infrastructure and thus compromise DOD's ability to execute its mission. As emphasized in the National Defense Strategy, accounting for climate change effects in strategic readiness planning and decision-making processes remains essential to secure our nation's defense.

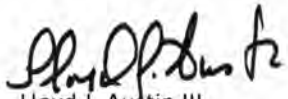
In the face of domestic and overseas challenges, the Department must modernize and adapt the Joint Force in ways that enhance the mission and sustain readiness. The Department continues to respond to climate change in two ways: adaptation to enhance resilience and mitigation to reduce greenhouse gas emissions.

This includes increasing platform efficiencies and accelerating innovations to reduce logistics burdens in contested environments, hardening critical infrastructure against the impacts of extreme weather and climate change, and improving agility and flexibility of supply chains against shocks and disruptions. In addition, DOD must adapt the built and natural infrastructure on our installations to ensure their continued readiness to serve as the platforms from which DOD trains, organizes, equips, cares for, and sustains forces and their families.

Climate adaptation also supports the Department's commitment to ensuring resilient and healthy defense communities. Supporting our Service members requires that we implement effective resilience measures to reduce the effects of extreme weather and climate change, environmental hazards, and other risks that can disrupt our installations and surrounding communities.

This update to our DOD Climate Adaptation Plan provides a roadmap for the period 2024 through 2027 and builds on our 2021 Climate Adaptation Plan and previous Progress Reports. This plan further underscores our commitment to ensure that DOD can operate under changing climate conditions, preserving operational capability and enhancing the natural and man-made systems essential to the Department's success.

To train, fight, and win in an increasingly complex threat environment, we must consider the effects of extreme weather and climate change at every level of the enterprise.



Lloyd J. Austin III
Secretary of Defense

DEPARTMENT OF DEFENSE CLIMATE ADAPTATION END STATE:

Ensure the Department of Defense can operate under changing climate conditions, preserving operational capability and enhancing the natural and man-made systems essential to the Department's success.

CONTENTS

Figure 1. Adaptation, resilience, and mitigation summary.

Adaptation: Adjustment in natural or human systems in anticipation of or response to a changing environment in a way that effectively uses beneficial opportunities or reduces negative efforts.

Resilience: The ability to anticipate, prepare for, and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

— *Department of Defense Directive 4715.21, Climate Change Adaptation and Resilience*

Mitigation: Measures to reduce the amount and speed of future climate change by reducing emissions of heat-trapping gases or removing carbon dioxide from the atmosphere.

— *Fifth National Climate Assessment*

2024-2027 CLIMATE ADAPTATION PLAN EXECUTIVE SUMMARY

Climate change continues to increase the demand and scope for military operations at home and around the world. The Department of Defense's (DOD) missions and operations are adversely impacted by climate change through amplifying operational demands on the force, degrading installations, infrastructure, and systems, and increasing health risks to Service members.

The DOD has been forced to absorb billions of dollars in recovery costs from extreme weather events typical of those fueled by climate change. This includes $3 billion to rebuild Camp Lejeune, North Carolina, after Hurricane Florence in 2018; $3.7 billion to rebuild Tyndall Air Force Base, Florida, after Hurricane Michael in 2018; $1 billion to rebuild Offutt Air Force Base, Nebraska, after historic floods in 2019; and more than $3.5 billion to support recovery efforts for military installations in Guam following Typhoon Mawar in 2023. Most recently, estimates show that an extreme precipitation event at the U.S. Military Academy, West Point, New York, in July 2023 caused more than $200 million in damages to military training infrastructure.

Climate adaptation efforts must align with and support the Department's warfighting requirements. Reducing climate risks and bolstering installation resilience is critical to prevent disruptions to DOD's operational plans, enable rapid recovery from extreme weather and climate impacts, and maintain mission readiness. The DOD is invested in increasing its resilience and improving combat capability, all while reducing the Department's own contributions to climate change. Efforts include reducing energy demand, substituting clean energy and materials, and leveraging rapid advancements in clean energy markets and technologies. Preparedness and adaptation require the incorporation of climate considerations into strategic, operational, and tactical decision-making. To be effective globally, these efforts need to be done in collaboration with allies and partners.

The National Defense Strategy (NDS) emphasizes the Department's strategic commitment to incorporating climate risk assessments into planning and decision-making processes. The 2022 NDS details the Department's path forward to secure our nation's defense. Among other actions, the NDS calls for the DOD to make supporting systems more resilient and agile to address multiple threats ranging from competitors to the effects of climate change. The NDS also calls for the DOD to build resilience in the face of destabilizing and potentially catastrophic transboundary challenges such as climate change and pandemics. The NDS recognizes that climate change, as well as other threats, increases demands on the resources of the DOD, federal civil authorities, and the public and private sectors. The NDS notes that by "joining with allies and partners in efforts to enhance resilience to climate change, we will both strengthen defense relationships and reduce the need for force to respond to instability and humanitarian emergencies." Furthermore, the NDS reiterates the DOD's commitment to account for climate change impacts in strategic readiness planning and threat assessments, including accounting for climate extremes in training and equipping the force.

The DOD Climate Adaptation Plan (CAP) for 2024–2027 continues to rely on the 2021 climate adaptation strategic framework (Figure 2) with five major lines of effort (LOEs) and four enablers designed to support and integrate the LOEs. The examples provided throughout this document represent just a few activities from a larger compilation of climate resilience efforts across the Department.

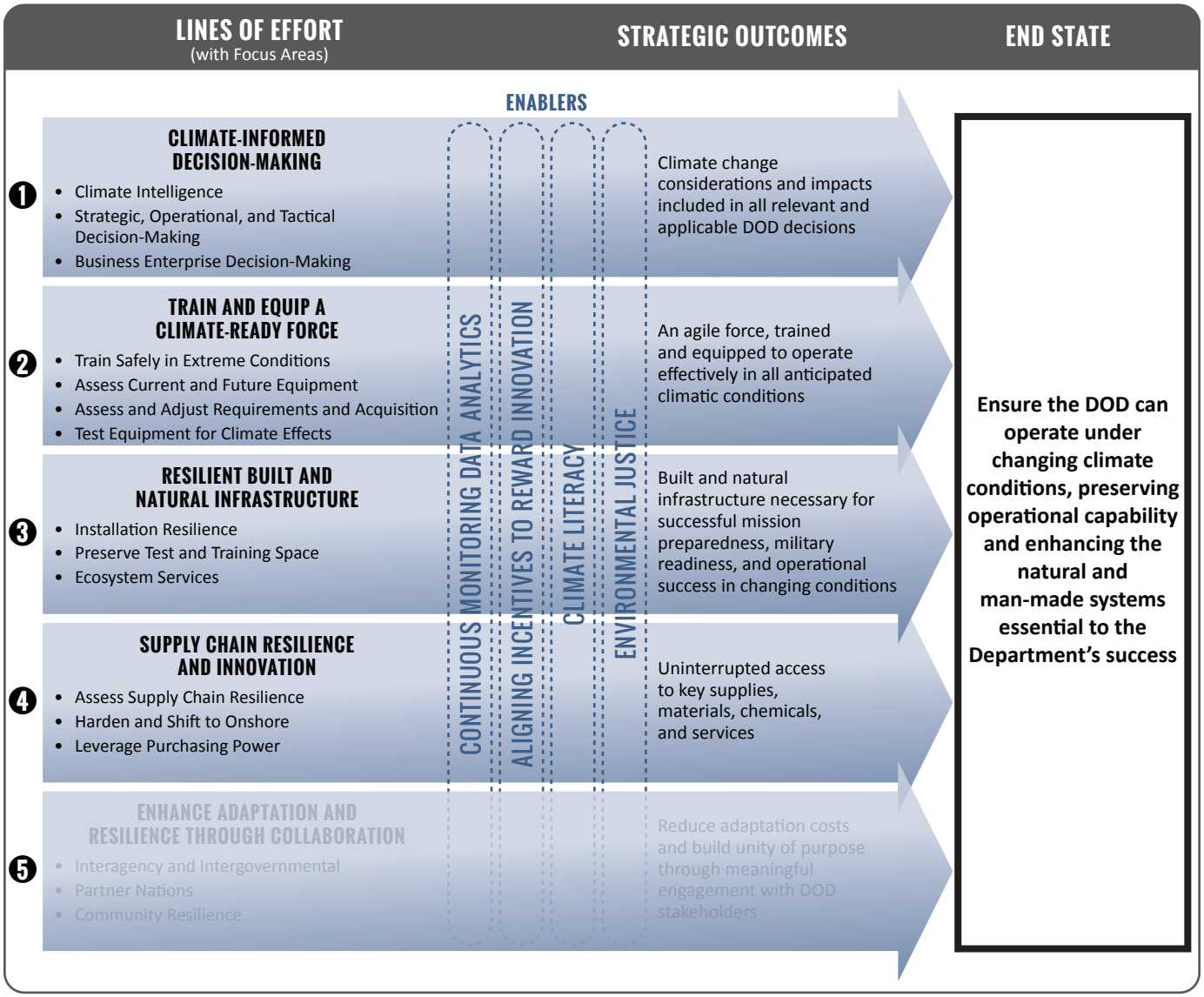


Figure 2. DOD Climate Adaptation Strategy Framework for Current and Future Force Decisions, from 2021 CAP.

Table 1. DOD Profile.

AGENCY PROFILE	
Agency Mission	The DOD provides the military forces needed to deter war and ensure our nations' security. –- *Department of Defense Strategic Management Plan (SMP) Fiscal Years 2022-2026*
Agency Bureaus in the Climate Adaptation Plan	The Office of the Secretary of Defense (OSD), the Military Departments (Army, Navy, Air Force), the Office of the Chairman of the Joint Chiefs of Staff and the Joint Staff, the Combatant Commands, the Defense Agencies, the DOD Field Activities, and all other organizational entities within the DOD (referred to collectively in this issuance as the "DOD Components")
Agency Climate Adaptation Official	Dr. Kate White, Climate Change Program Director, Office of the Deputy Assistant Secretary of Defense for Energy Resilience and Optimization
Agency Risk Officer	N/A. Risk Management occurs through the Department and Components.
Point of Public Contact for Environmental Justice	*Executive Order (EO) 14096* requires agencies and departments to designate a Chief Environmental Justice Officer. The DOD is in the process of designating a Chief Environmental Justice Officer.

Table 1. DOD Profile (continued).

AGENCY PROFILE	
Owned Buildings[1]	157,129 buildings (1,638,862,108 square feet)
Leased Buildings[1]	3,574 buildings (27,578,130 square feet of rentable space)
Employees[2]	1,895,647 civilian and military employees 1,058,884 contractor support
Federal Lands and Waters (Acres)[1]	8,276,467 acres owned (number of acres owned by the federal government) 24,619,495 acres total (number of total acres at the site; includes government-owned land, public land, public land withdrawn for military use, licensed and permitted land and acreage of foreign land used by DOD)
Budget	$776.6B enacted in Fiscal Year (FY) (Public Law [P.L.]. 117-81) $851.8B enacted in FY 2023 (P.L. 117-263) $842.0B requested in FY 2024 (P.L. 118-31) $849.8B FY 2025 President's Budget (PB)
Key Areas and Programs Where Climate Adaptation Efforts Occur	DOD policy states that all operations, planning activities, business processes, and resource allocation decisions shall include climate change considerations through the five LOEs and enablers.

1 The BSR represents a snapshot of the DOD real property inventory as of 30 September 2022 in line with *DOD Instruction 4165.14: Real Property Inventory and Forecasting* which supports the requirements of 10 USC 2721.
2 2022 data for contractor support from FY 2022 Inventory of Contractors for Services reported to Congress per 10 USC 4505(c). The data represents all full time equivalents working as primes or subcontractors on DOD contracts.

LINE OF EFFORT 1:
CLIMATE-INFORMED DECISION-MAKING

Meeting National Defense requirements is our highest priority. This CAP informs these requirements by having the DOD consider the effects of climate change in all relevant plans, processes, and decisions in accordance with the Chairman's Risk Terminology identified in Chairman of the Joint Chiefs of Staff Manual 3105.01 and Joint Publication 5.0.

More than 30 individuals participated in a Climate Change Wargame co-hosted by the Center for Excellence in Disaster Management and Humanitarian Assistance and the Office of the Under Secretary of Defense for Policy Arctic and Global Resilience team. The wargame, "Ho'okele Mua" or "Navigating the Future", was designed by The Center for Naval Analyses to address various scenarios in which the U.S. Indo-Pacific Command can best prepare for strategic and operational climate change impacts in the region.

Climate considerations are becoming an integral element of DOD's enterprise-wide resource allocation and operational decision-making processes. DOD climate assessments are based on the best available, validated, and actionable climate science that informs the most likely climate change outcomes. To account for the rapid rate of climate change, climate data sources are continuously monitored and updated while considering operational impacts. **All other actions in this plan are dependent on the successful outcomes of this Line of Effort**.

The Department's existing guidance for adaptation and resilience dates to the release of the DOD's *2014 Climate Change Adaptation Roadmap* and the 2016 policy, *DOD Directive (DODD) 4715.21: Climate Change Adaptation and Resilience*. The DOD's climate resilience guidance and policy also addresses energy and water resilience, both of which can be adversely impacted by extreme weather and climate change. The Department issued the following policies related to adaptation and resilience: *DODD 4180.01, DOD Energy Policy*, and *DOD Instruction (DODI) 4170.11, Installation Energy Management*.

RELEVANT EXECUTIVE ORDERS

Several EOs relate to climate risk reduction, including:
EO 14008, Tackling the Climate Crisis at Home and Abroad;
EO 14017, Executive Order on America's Supply Chains;
EO 14030, Climate-Related Financial Risk;
EO 14057, Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability;
EO 14072, Strengthening the Nation's Forests, Communities, and Local Economies;
EO 14082, Implementation of the Energy and Infrastructure Provisions of the Inflation Reduction Act of 2022; and
EO 14096, Revitalizing Our Nation's Commitment to Environmental Justice for All.

Successful implementation of LOE 1 will be demonstrated when climate change and associated impacts are considered in all relevant and applicable decisions. These decisions range from historical lessons learned to current and future operations, exercise and contingency planning, and budgeting and strategy development. Relevant and applicable decisions also include longer-term weapon system and infrastructure planning decades into the future. To maximize the utility of climate-informed decisions, the Department must know what information to use at the right timescale and where to find that information. Figure 3 shows examples of how the Department is accounting for climate considerations across the continuum. For more information, see Appendix 2.

The Department has developed several tools and resources to incorporate climate projections into its climate risk assessments to address statutory and Office of Management and Budget (OMB) requirements. These tools use the best available and actionable climate information.

The primary tool is the DOD Climate Assessment Tool (DCAT), which meets the requirements of Section 326 of the National Defense Authorization Act (NDAA) of FY 2020. DCAT also complies with *OMB Circular A-11* and its components, including the *Capital Programming Guide* and *Appendix 13,* for use in assessing climate considerations and risks. DCAT supports climate-informed decision-making to increase resilience against climate hazards while preserving operational capability and enhancing the natural and man-made systems essential to the Department's success.

In FY 2023, the DOD produced stand-alone versions of DCAT to support Partner Nation (PN) use of climate information in long-term planning and international decision-making. The PN Climate Assessment Tools (CATs) use globally available data and authoritative information on historical extreme weather conditions and projected climate information to identify PN exposure to climate hazards over time. Using the PN CAT as part of a comprehensive analysis will help international decision-makers determine where best to apply resources to improve climate adaptation and resilience.

CLIMATE-INFORMED DECISION SUPPORT

In January 2024, DOD entered into a formal agreement with the Federal Emergency Management Agency (FEMA) to co-fund and co-develop probabilistic coastal flood hazards inundation mapping for the U.S. territories of Guam and Commonwealth of the Northern Mariana Islands for present and future conditions including multiple sea level rise scenarios. Flood mapping products will be incorporated into the DOD Regional Sea Level (DRSL) database and DCAT. In early 2024, DOD also developed a climate dashboard for Guam to inform and facilitate ongoing recovery and reconstruction efforts and other strategic initiatives. DOD continues to enhance, develop, and socialize actionable tools for climate-informed planning and decision-making across the Department.

The DRSL database provides projected sea level rise data for DOD coastal and tidally influenced military sites worldwide. DRSL is informed by an interagency Coastal Assessment Regional Scenario Working Group that includes subject matter experts from the DOD, the U.S. Army Corps of Engineers, the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the Environmental Protection Agency (EPA), U.S. Geological Survey (USGS), and others.

DOD Components also issue specific climate-related policies and memoranda. Military Departments use the following resources to identify relevant hazards, and plan and implement resilience measures for extreme weather and climate change: *Army Climate Resilience Handbook*; *the Naval Facilities Engineering Systems Command (NAVFAC) Installation Adaptation and Resilience Climate Change Planning Handbook*; *the Air Force Civil Engineer Severe Weather/Climate Hazard Screening and Risk Assessment Playbook*; and applicable Unified Facilities Criteria (UFC); and DOD Instructions, Directives, Manuals, and memoranda.

"The Department will include the security implications of climate change in all our risk analyses, strategy development, and planning. These are essential steps to defend the nation under all conditions."
— Lloyd J. Austin III, Secretary of Defense

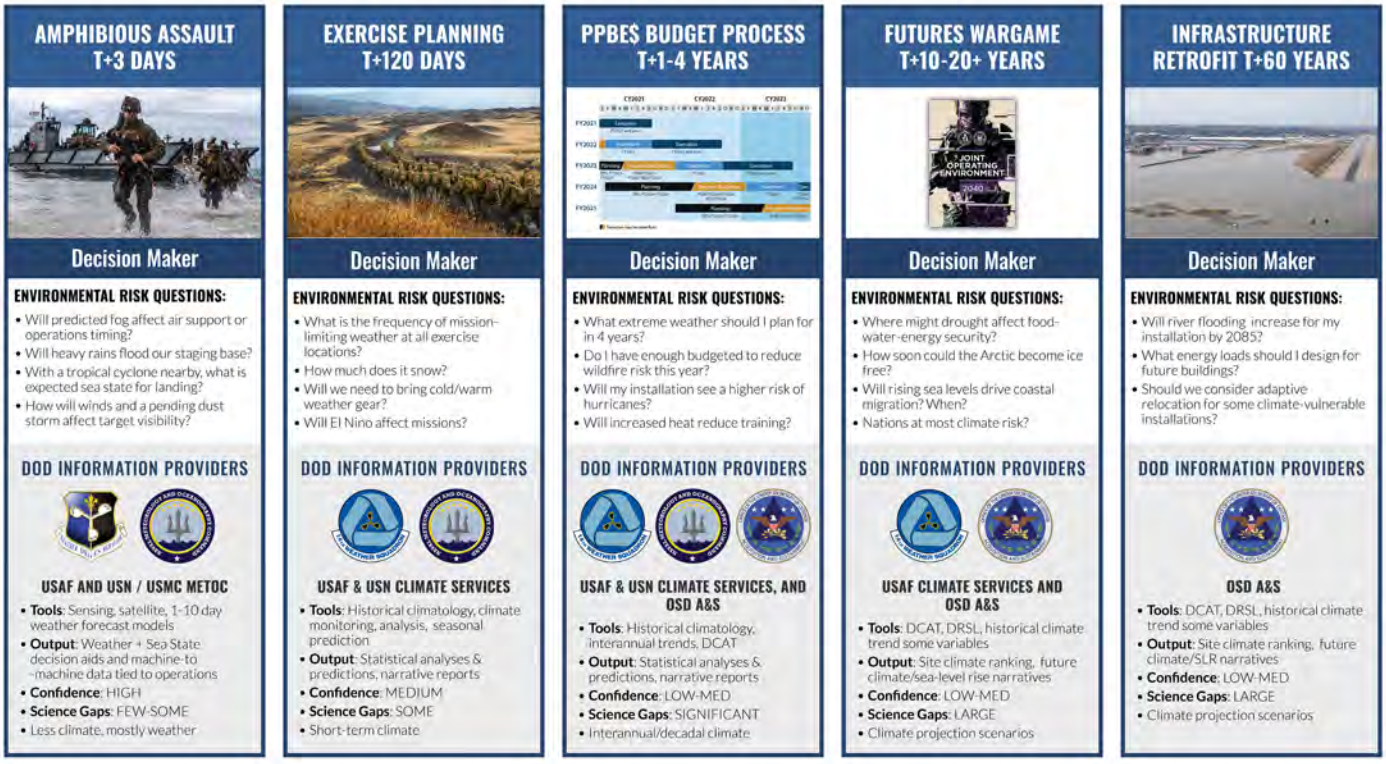


Figure 3. Example DOD decisions and considerations across the Weather to Climate Continuum. OSD, Department of the Navy (DON), and Department of the Air Force Meteorological and Oceanographic communities and where their decision-space lies are represented by the appropriate office symbol.

INSTALLATION CLIMATE RESILIENCE PLAN:

The FY 2020 and FY 2022 National Defense Authorization Acts, and later 10 U.S. Code (USC) 2864, directed the DOD to develop a "military installation resilience component" within Installation Master Plans for major military installations. UFC 2-100-01, Installation Master Planning, labeled this component the Installation Climate Resilience Plan (ICRP). An ICRP assesses current and future hazards and risks to installation resilience and contains eight sections including assets and infrastructure at risk, lessons learned, ongoing and planned risk mitigation projects, and agreements and efforts with local communities.

INCORPORATING CLIMATE RISK ASSESSMENT INTO BUDGET PLANNING

The financial consequences of failing to adapt to climate change compound over time and are measured in terms of lost military capability, weakened alliances, weakened international stature, degraded infrastructure, and missed opportunities for technical innovation and economic growth. Since the release of the *DOD 2014 Climate Change Adaptation Roadmap*, Department policy has been updated to require all operations, planning activities, business processes, and resource allocation decisions to consider climate change.

CLIMATE RISK: AIR FORCE

Documents from the DOD and the Department of the Air Force (DAF), as well as guidance from UFC 2-100-01, *Installation Master Planning*, mandate that DAF installation professionals include severe weather and climate risk in Installation Development Plans (IDPs) and facility projects. The *Severe Weather/Climate Hazard Screening and Risk Assessment Playbook (Playbook)* provides a consistent and systematic framework to screen and assess severe weather and climate hazards, while addressing associated current and future risks at DAF installations. Planners leverage the Playbook to develop and inform ICRPs (See ICRP callout box above).

CLIMATE RISK: ARMY

The Army piloted ICRPs in 2022 and 2023 at seven installations. The ICRPs help installations ensure they meet critical missions under current and future weather conditions. DCAT, the National Climate Assessment, and NOAA supplied the authoritative climate data used in the ICRPs' risk projections.

The DOD commits to considering climate change as an integral element of enterprise-wide resource allocation and operational decision-making processes. The Department works with other federal agencies, interagency working groups (IWGs), international working groups, academics, non-governmental organizations (NGOs), and the private sector to continuously monitor and update climate data and information sources to account for accelerating and varying rates of climate change and its impacts across the globe.

The DOD incorporated climate risk into budget planning, in accordance with *EO 14030, Climate-Related Financial Risk*, as reflected in the $3.1 billion subset of the FY 2023 budget request in the FY 2023 report *Meeting the Climate Challenge*. Further investments described in the FY 2024 report *Enhancing Climate Capability – Mitigating Climate Risk* ensure the Department can meet all mission requirements and maintain the ability to operate in all conditions. Since 2022, the DOD has reported climate-related risk in the Department's *Agency Financial Report*. DOD will assess any new Congressional climate resilience funding from 2024 through 2027.

INCORPORATING CLIMATE RISK

Strategic objectives and performance goals in the Department's SMP for FY 2022-2026 articulate the Secretary of Defense's strategic management priorities and reflect the DOD's long-term goals and DOD Components' priorities, which align with the NDS. For example, the SMP's Strategic Priority 3: *Strengthen Resilience and Adaptability of our Defense Ecosystem* identifies climate, energy, and environmental challenges as a strategic objective. Strategic Objective 3.3: *Enhance the DOD's Ability to Combat 21st Century Climate, Energy, and Environmental Challenges* can also be found in the following: Agency Priority Goals (APG) (*Reduce Climate Impacts to DOD Installations*); Secretary of Defense Priority *Defend the Nation* (*Tackle the Climate Crisis*); and the Office of the Undersecretary of Defense (OUSD) for Acquisition and Sustainment's (A&S) Big Plays (*Climate Change*). By including climate in high-level goals and priorities, the DOD better integrates climate risk assessments into planning and decision-making processes.

INCORPORATING CLIMATE RISK INTO POLICY AND PROGRAMS

The Department is taking bold steps to accelerate integrated installation resilience to meet current and future all-hazards challenges through policy and programs. These efforts align policy and guidance with strategic objectives and mission requirements so our military can continue to deter aggression and defend the Nation under all conditions. The DOD APG to "Improve Resilience of DOD Installations" has a metric to measure progress on incorporating climate risk into policies and technical guidance. APGs highlight priority policy and management areas to achieve near-term performance advancement through focused senior leadership attention.

The Department reviewed statutory requirements and EOs to identify the issuances, technical guidance, and UFCs that need updates to properly guide climate-informed decision-making, planning and implementation, investment prioritization, and business processes. This review enables DOD to establish a more comprehensive approach to all-hazards planning that will integrate climate, energy, and water resilience into planning and implementation together with a climate resilience strategy that encompasses climate adaptation, mitigation, and sustainable operations.

DOD POLICY, TECHNICAL GUIDANCE, AND UPDATES WILL ADDRESS THE FOLLOWING STATUTORY REQUIREMENTS RELATED TO CLIMATE, WATER, AND ENERGY RESILIENCE:

10 USC 101, Definitions

10 USC 2285, Department of Defense Climate Resilience Infrastructure Initiative

10 USC 2691, Restoration of land used by permit or damaged by mishap; reimbursement of State costs of fighting wildland fires

10 USC 2694, Conservation and cultural activities

10 USC 2802, Military construction projects

10 USC 2815, Military installation resilience projects

10 USC 2816, Consideration of energy security and energy resilience in life-cycle costs for military construction

10 USC 2864, Master plans for major military installations

10 USC 2866, Water conservation at military installations

10 USC 2911, Energy policy of the Department of Defense

10 USC 2915, Facilities: Use of renewable forms of energy and energy efficient products

10 USC 2919, Department of Defense participation in programs for management of energy demand or reduction of energy use during peak periods

10 USC 2920, Energy resilience and energy security measures on military installations

10 USC 2925, Annual Department of Defense Energy Management Report

POLICY, PLANS, AND STRATEGY UPDATES

CLIMATE ADAPTATION AND RESILIENCE

Army: The Army updated Installation Energy and Water Plans (IEWPs) to consider climate risk and the results of DCAT. The IEWPs use risk assessment to inform planning and investment for increased installation energy and water resilience. As part of Army's Military Installation Resilience Planning, the Army conducts policy and implementation review of IEWPs, ICRPs, Mission Assurance Assessments, Integrated Natural Resources Management Plans (INRMPs), and the Army Real Property Master Plans to identify opportunities to consider acute and long-term climate hazards in risk assessments and align planning requirements.

Navy: Navy has issued annual policy on master planning prioritization that states the importance of climate resilience planning and provides a rubric to help regions plan for subsequent updates. Navy Master Planning is primarily done by in-house workforce, and the Navy shore enterprise has held multiple training sessions annually to ensure installation personnel understand the new UFC requirement and how to use the Navy's *Installation Adaptation and Resilience Climate Change Planning Handbook*.

As part of its efforts to integrate climate change considerations into master planning, Navy issued a standard operating procedure titled "Resilience Component to the Master Plan" on August 23, 2022, which defines the minimum requirements of an ICRP. In addition to completing an ICRP at Naval Base San Diego, DON is actively performing ICRPs at Joint Base Pearl Harbor-Hickam, Naval Air Station (NAS) Joint Reserve Base (JRB) New Orleans, NAS Whiting Field, Commander Fleet Activities Yokosuka, Naval Base Guam, Naval Support Activity (NSA) Marine Corps Base (MCB) Camp Blaz, NSA Hampton Roads, NSA Bethesda, Naval Submarine Base Kings Bay, NAS JRB Fort Worth, NSA Jacksonville, Naval Station Mayport, and Naval Base Coronado.

Marine Corps Installations Command is preparing a worksheet for installations with climate and resilience goals and targets to ensure they are built into the Installation Master Plans. Using the existing conditions analysis, the installations and planning teams will develop new actionable and measurable climate and resilience projects for the master plans.

Air Force: The DAF is actively incorporating risk assessments into several procedures and plans. Climate and severe weather hazards and controls are incorporated into its Mission Sustainment Risk Report (MSRR) database and reporting framework, to consider holistic current and future risk for DAF locations and missions. Additionally, climate assessment information is incorporated into its INRMPs and Integrated Cultural Resources Management Plans (ICRMPs), to include climate projections for 2030 and 2050, potential effects on natural infrastructure, and management strategies to build climate resilience.

ENVIRONMENTAL JUSTICE

DOD released the *Equity Action Plan 2023 Update* which outlines the Department's equity advances, including Environmental Justice actions, such as integrating environmental justice tools into DOD's own planning tools for decision-making, where appropriate. The 2023 Update also highlights DOD's Environmental Justice Scorecard, which assesses DOD's progress in delivering environmental and health benefits to underserved communities.

DOD is also a member of the White House Environmental Justice Interagency Council (IAC). The Department is reviewing the recommendations that were provided to the IAC in the *White House Environmental Justice Advisory Council Recommendations: Climate Planning, Preparedness, Response, Recovery and Impacts Workgroup* report, and is taking steps to address them, as appropriate and as permitted by law.

ENVIRONMENTAL JUSTICE (CONTINUED)

Defense Logistics Agency (DLA): The DLA incorporated Environmental Justice considerations into the *FY 2022 DLA Zero Emission Vehicle (ZEV) Strategic Plan*.

The Environmental Justice Screening and Mapping Tool (EJSCREEN) Tool was used for a 1-mile diameter surrounding each host site, factoring socioeconomic indicators as well as environmental indictors, with special attention paid to the particulate matter 2.5 and ozone pollution indicators. This resulted in prioritizing early rollout of ZEVs to DLA Defense Supply Center Columbus (Ohio) to advance Environmental Justice by reducing Scope 1 emissions from fleet vehicles. Resilient defense communities require implementation of both adaptation and mitigation efforts.

TRIBAL NATIONS

Under DODI 4710.02, *DOD Interactions With Federally Recognized Tribes*, and DODI 4710.03, *Consultation With Native Hawaiian Organizations*, military installations are required to engage in regular, meaningful, and robust consultation with federally recognized tribes and Native Hawaiian Organizations (NHO) affiliated with installation-managed lands on proposed projects or ongoing mission-focused activities which may affect the Tribe's or NHO's lands, rights, or resources. Installations routinely consult and coordinate with Tribes and NHOs on cultural and natural resources management plans, projects proposed to address emerging climate-related threats to mission-critical activities and facilities, and threats to Tribal or NHO resources on installation-managed lands. These examples of consultation also highlight where DOD installations are requesting opportunities to collaborate with Tribes and NHOs to determine how their indigenous knowledge may help inform solutions to climate-related challenges.

Navy: The DON has hired its first Director of Tribal and Indigenous Affairs to build the DON's Tribal and Indigenous Program. DON has also established Tribal Liaison positions in Navy Region Northwest and at NAS Fallon, as well as a Native Hawaiian Coordinator in Hawai'i. DON understands that the needs of Tribal Nations and ensuring mission readiness should not be exclusive and that environmental stewardship is an asset to advancing the mission.

In FY 2023, the Navy, in direct partnership with Skagit River System Cooperative, a natural resource consortium of the Sauk-Suiattle Indian Tribe and the Swinomish Indian Tribal Community, awarded a project to assess and plan the restoration of 5,000 linear feet of coastal stream that drain into a large, previously restored pocket estuary at Crescent Harbor Lagoon on Tribal conservation lands near Naval Air Station Whidbey Island. The stream provides valuable non-natal rearing habitat for juvenile Chinook salmon.

In May 2023, Marine Corps Base Hawai'i (MCBH) signed a memorandum of understanding (MOU) with a consortium of NHOs from Windward O'ahu. The MOU reflects the MCBH's commitment to work with community representatives to develop ways to assist in active management of both cultural and natural resources in MCBH's Nu'upia Fishponds.

CO-BENEFITS OF ADAPTATION

Army: The Army released the *Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in Army National Environmental Policy Act Reviews* memorandum in June 2023. This policy highlights certain communities for Environmental Justice concerns, including communities that are underserved, racial and ethnic minorities, those with low socioeconomic status, Tribal nations, and indigenous communities, that are especially vulnerable to climate-related effects. This ensures that Army greenhouse gas-related actions, both the proposed action and any mitigation measures, are consistent with applicable laws and policies of state, local, and tribal governments, and that National Environmental Policy Act (NEPA) analyses comport with referenced standards.

CO-BENEFITS OF ADAPTATION (CONTINUED)

Navy: The DON has released five Chief Sustainability Officer serial memos to establish additional policy and guidance regarding the implementation of sustainability goals. The Office of the Assistant Secretary of the Navy for Energy, Installations, and Environment issued a policy memorandum in September 2023 providing direction to DON components on investments in resilience planning, implementation of nature-based solutions (NBS) and nature-based carbon sequestration, and incorporating water resilience and mitigation recommendations into the Installation Energy Program Summaries and Installation Energy Security Plans.

WILDFIRE NATIONAL STANDARDS

In December 2022, the DOD became a primary member of the National Wildfire Coordinating Group (NWCG). The NWCG develops national standards for federal and interagency wildland fire operations. DOD's membership in the NWCG provides access to the standards development process and enables autonomy in personnel training and credentialling. The DOD is integrating NWCG standards for training and qualifications across the Department to properly train the workforce to respond to wildfires and to manage ecosystems with prescribed fires. DOD's membership builds on previous efforts such as the Joint Army/Air Force Wildland Fire Training Academy. Since 2015, this academy provides DOD wildland fire personnel access to NWCG training courses and interagency instructors. NWCG personnel qualification standards contribute to effective management of its fire dependent ecosystems and supporting the mission through safe, effective, and risk-based wildfire response.

LINE OF EFFORT 2:
TRAIN AND EQUIP A CLIMATE-READY FORCE

The 2021 CAP stated that the DOD, to successfully accomplish their mission, must prepare combat forces to operate under the most extreme and adverse weather and terrain conditions. Climate change complexities require the Department to anticipate, train, and equip the force to account for emerging environmental conditions that differ from the range of environments known today. This effort considers both the compounding effects of climate hazards as well as the effects' interactions with other disruptions (e.g., pandemic).

The evolving operational environment and the need to operate in new and more extreme environments may require changes to where and how U.S. forces train for future conflict. Additionally, the Department must account for the new operational environment when developing new capabilities. Lastly, the Department must consider environmental factors in acquisition and sustainment planning (e.g., installation energy resilience both on- and off-base, within and outside the U.S.).

A C-130J Hercules assigned to the 146th Airlift Wing based at Channel Islands Air National Guard Base in Port Hueneme, Calif., which is carrying the Modular Airborne Fire Fighting System, drops fire retardant onto a ridge line above Santa Barbara, Calif., on Dec. 13, 2017, as part of the effort to contain the Thomas wildfire.

The DOD continues to incorporate climate considerations into wargames, tabletop exercises (TTXs), and studies to gain insight into how climate change could impact the Department's ability to achieve its mission and to identify changes to deliberate plans, global defense posture, or operational capabilities. The Climate Wargaming Sub-Working Group, led by the Joint Staff, advocates for the inclusion of appropriate climate change data into operationally focused wargames, TTXs, and studies to generate actionable outcomes that inform future planning or capability development. The sub-working group identifies and supports analytical partnerships to understand the impacts of climate change and potential adaptation and mitigation measures for the Joint Force. The work of the sub-working group informs day-to-day operations, potential contingencies, and future warfighting environments which impact the DOD's readiness and investment strategies.

In the past year, six combatant commands actively pursued climate-informed TTXs or studies addressing a range of strategic and operational subjects including defense posture and basing, regional security, and ally and partner engagement. For 2024, the Department allocated $3 million from the Wargame Incentive Fund for additional wargames, TTXs, and studies that address challenges identified in the NDS through a climate security lens.

OPERATIONAL ENERGY CAPABILITY IMPROVEMENT FUND/OPERATIONAL ENERGY PROTOTYPING FUND

Operational Energy Innovation: The Department leverages the Operational Energy Capability Improvement Fund (OECIF) to advance technology development and the Operational Energy Prototyping Fund (OEPF) to validate more mature technologies and accelerate their transition to the warfighter. Operational Energy-Innovation investments drive operational energy capability improvements required for advanced warfighting capabilities. A further benefit of these advancements are positive climate impacts through demand reduction, increased efficiencies, and clean energy technologies that reduce climate adaptation needs. OECIF and OEPF are investing to develop new technologies and practices in four main thrust areas:

- **Contested Logistics and Battlespace Awareness** focuses technology investments across strategic, operational, and tactical environments. These environments are characterized by competition for access to resources, services, and capabilities, as well as adversarial actions. Operational Energy technology improvements better the acts of planning, executing, and enabling the movement, fires, and support of military forces by bringing energy awareness—coupled with climate considerations—into the DOD's platform and weapon system missions and command and control architectures.

OPERATIONAL ENERGY CAPABILITY IMPROVEMENT FUND/OPERATIONAL ENERGY PROTOTYPING FUND (CONTINUED)

- **Operational Energy Resilience** is a critical enabler for mission assurance, operational flexibility, and freedom of maneuver. Technical innovation areas include climate-informed energy diversification, standardization, interoperability, and energy components advancing next-generation warfighting capabilities.
- **Operational Energy Demand Reduction** drives innovations reducing operational energy requirements, increases efficiencies across all domains, especially aviation and space, and reduces risks by providing next-generation power and clean energy delivery options for military effectiveness in contested and denied environments.
- **Nuclear Power** encompasses DOD innovations enabling nuclear power supply and electrification for the battlespace. Technology advancement investment areas include nuclear fuel fabrication processes, energy conversion methods, novel power generation, and energy storage technologies.

Sea level rise, increased temperatures, and other hazards identified in the *Department of Defense Climate Risk Analysis* will affect the military operating environment. Training on the projected conditions can reduce operational risks. The DOD also conducted a climate change and training assessment that considered the potential consequences of climate change for military training for the near-term (2030) and mid-term (2050). The assessment developed a methodology that uses the best available data and, as a case study, focused on the western Pacific's First Island Chain and a unit with mission responsibilities in that area. A follow-on study is underway for the Arctic region to validate the DOD's methodology and to provide a case study for selected units with mission responsibilities in the High North. Results of the DOD's military training climate assessments will inform future policy and program decisions.

In 2022, OUSD Personnel and Readiness (P&R) sponsored a study on *Understanding Climate Vulnerability of U.S. Joint Force Readiness* conducted by the research organization RAND. The study developed and populated a framework for analyzing pathways through which climate change presents risk to military readiness. The study also collected opportunities for the framework to inform readiness decision-making and future descriptive and predictive analytic models. The resulting framework helped the DOD to understand the impact of climate hazards on unit readiness.

In 2023, OUSD (P&R) leveraged RAND's previous work and sponsored an additional Climate Impacts Study to apply the developed climate readiness framework to accomplish the following:

- Identify requirements for metrics, data, and quantitative assessments for evaluating the risk to training readiness from climate change;
- Identify existing or potentially promising data sources and analytic capabilities to support such risk evaluation; and
- Build analytic capabilities to quantify the extent to which climate change may reduce flexibility in terms of available training time and quality.

The desired end-state is to incorporate this framework into the Readiness Decision Impact Model (RDIM) used to enhance senior leader decision-making processes. This study is expected to conclude with the release of a final report and model documentation in November 2024.

EMERGENCY MANAGEMENT PROGRAMS

DOD installations use an all-hazards threat assessment framework across the planning, response, recovery, and risk reduction phases of their emergency management programs and capabilities, including those provided by Fire and Emergency Services personnel and equipment. Fully staffing these all-hazards management programs with appropriately resourced, credentialed personnel positions the DOD to better plan for, respond to, and recover from incidents efficiently and effectively. Personnel must also be appropriately informed of climate's influence on natural hazards. Emergency management programs serve on the front lines when incidents occur. These programs improve installations' resilience with appropriate resourcing and training.

LINE OF EFFORT 3:
RESILIENT BUILT AND NATURAL INSTALLATION INFRASTRUCTURE

Built and natural infrastructure serve as the platforms from which the DOD executes its mission, sustains forces, maintains mission readiness and resilience, and also cares for its people. DOD released the *Resilient and Healthy Defense Communities (RHDC) Strategy* in February 2024, which will guide the Department's actions in the coming years to improve the built and natural environment on defense installations. These installations are built and natural spaces where our people live, work, train, raise their children, and spend time with their families. The RHDC will guide the Department's actions to achieve healthy, safe, functional, and resilient spaces that enhance the quality of life and readiness of our Service members, families, and civilian workforce. This includes integrating climate risk assessments and natural infrastructure resilience strategies into design and construction processes.

Navy Seabees deployed with Naval Mobile Construction Battalion (NMCB) 5 place concrete for the seawall project on board White Beach Naval Facility. NMCB-5 is deployed across the Indo-Pacific region conducting high-quality construction to support U.S. and partner nations to strengthen partnerships, deter aggression, and enable expeditionary logistics and naval power projection.

The Department's 2021 CAP identified three implementation activities to achieve resilient built and natural installation infrastructure: installation resilience; testing and training space preservation; and ecosystem services.

The DOD promotes resilient built and natural infrastructure through comprehensive installation assessments (e.g., installation energy, water, and climate plans), INRMPs, and the Master Planning Process. Expanded programs and partnerships, such as the Readiness and Environmental Protection Integration (REPI) Program, the Office of Local Defense Community Cooperation (OLDCC), and the Sentinel Landscapes Partnership, enhance natural infrastructure mission capabilities. The DOD is currently updating program policies to further support built and natural infrastructure by including climate, NEPA, natural and cultural resources, range planning, and real estate considerations. The DOD encourages Nature-Based Solutions (NBS), where appropriate, by supporting built and natural infrastructure in its policies.

The Department is working to better understand how DOD's existing building criteria can be optimized to deliver healthy, functional, and reliable spaces that reduce risks to people and alleviate the demands placed on critical supply chains, which strengthens both mission resilience and readiness. Through engagements with building code experts across federal agencies and within industry, the Department will compare existing DOD building criteria against industry-leading standards and best practices and seek to prioritize revisions that will increase the performance of existing and new infrastructure, enhance mission resilience, reduce operational and embodied carbon, enhance efficiency, and improve quality of life. DOD building criteria experts will have final determination on the adoption of recommendations provided to the government.

The DOD must be able to defend the nation operating from and within any environment. The DOD selects locations for installations and supporting real property assets and infrastructure based on a range of factors including operational military effectiveness, the environment, risks, and Congressional appropriations. Using long-term climate planning tools such as DCAT, the Department can now also identify locations, facilities, and infrastructure most exposed to climate hazards (Watch the DCAT video on climate.mil). Decision-makers use models and datasets to reliably capture whether and how the major climate drivers are likely to change and how potential changes impact performance or vulnerability of project military missions, operations, personnel, infrastructure, and systems.

A critical part of wildland fire management, and climate resilience, is pre-planning. Wildland Fire Managers at DOD installations apply wildfire risk assessments informed by hazard assessment tools, such as DCAT, and those available through interagency partners within the U.S. Department of Agriculture (USDA) and the Department of the Interior (DOI). These wildfire hazard and risk assessments inform the need for wildfire planning, risk reduction, response, and recovery activities within Integrated Wildland Fire Management Plans (IWFMPs) at the installation level to ensure appropriate preparation and resourcing near-and long-term wildfire resilience. IWFMPs also document how proactive fire use, including prescribed burns, will be used on military installation landscapes to sustain and enhance ecosystem function and biodiversity, another key to climate resilience.

Investment programs that support the architectural, non-structural, and engineering modification of installations bolster installation resilience, improve adaptive capacity, and improve long-term performance and reliability in a changing climate. Climate exposure information from DCAT provides context for applications to the Energy Resilience and Conservation Investment Program (ERCIP) to enhance energy and water infrastructure and resilience while accounting for changing climate and avoiding exposure (e.g., wildfire, flood inundation). The DOD Legacy Program included an FY 2023 NBS Program to assist installations in identifying structural and non-structural NBS to reduce the impacts of extreme weather and climate change. Likewise, the REPI Program funds off-base NBS, through its REPI Installation Resilience Projects, to reduce the effects of extreme weather and climate change on DOD testing and training lands, infrastructure, and community facilities that safeguard military missions. The OLDCC awards installation resilience grants across the country to address resilience and encroachment risks and impacts and assists installations with optimizing their missions.

NATURE-BASED SOLUTIONS

Army: The Army's NBS reduce wildfire and flooding risks, stabilize permafrost, and improve at-risk species habitat at installations ranging from the Kwajalein Atoll to Puerto Rico and Alaska, as well as at sites across the continental U.S. Many of these projects also provide direct resilience benefits to the surrounding communities. Throughout the process, the Army's approach to NBS leveraged partner agency and organizations' expertise to identify priority issues and apply proven approaches. The Kentucky Army National Guard's Wendell H. Ford Regional training center, for example, is restoring nearly five miles of the Cypress Creek corridor and floodplains to a more stable and natural condition. Project plans such as installing native seeds, trees, shrubs, and live stakes, and reshaping existing channels, will improve water flow during flooding events. The training center is also used by personnel from other DOD and federal agencies. Providing sustainable training land is imperative to the center's mission.

Navy: Navy and Marine Corps installations and training ranges throughout the west face climate change-induced impacts like drought, wildfires, dust, and extreme flooding events that threaten infrastructure, water supplies, and assets critical to readiness. The Navy and Marine Corps, as stewards to more than 2 million acres of arid and semi-arid ecosystems, are identifying high-impact opportunities to implement NBS and sustainable land management practices that build resilience at the scale of the challenge. The Department of Navy was designated the lead service for the Strategic Environmental Research Program (SERDP) and the Environmental Security Technology Certification Program's (ESTCP) Southwest National Innovation Landscape Network which aims to accelerate the development of climate adaptation practices that positively impact groundwater recharge, fire risk reduction, dust mitigation, and provide other resilience benefits.

Air Force: Tyndall Air Force Base has several NBS pilot projects, including a living shoreline, oyster reefs, and saltwater marsh enhancement to reduce erosion and mitigate wave energy, and coastal dune restoration using sand accretion processes. MacDill Air Force Base created oyster reefs off the coastline to counteract rapid erosion near the vulnerable West Indian manatee critical habitat and several important Native American burial sites. The oyster reefs also help safeguard the nearby commercial shipping lane. The NBS projects depend upon a range of stakeholders from within the DOD, local, state and federal agencies, conservation organizations, and academia.

ADVANCING THE AMERICA THE BEAUTIFUL INITIATIVE

Table 2. America the Beautiful Initiative.

AMERICA THE BEAUTIFUL	
ACTION	**ADVANCING THE NATIONAL CONSERVATION GOAL TO INCREASE CLIMATE ADAPTATION AND RESILIENCE**
In 2024, the DOD REPI Program will dedicate $5 million (subject to the availability of funds) to projects funded through the National Fish and Wildlife Foundation's (NFWF) America the Beautiful Challenge (ATBC). Through the ATBC, the DOD, the USDA, and the DOI fund conservation and restoration projects to invest in watershed restoration, climate resilience, equitable access, workforce development, and other efforts consistent with the ATBC initiative.	*Since 2022, the DOD REPI Program dedicated nearly $7 million to the ATBC to support nine projects across sentinel landscapes that contain areas of strategic importance for the DOD, the USDA, and the DOI. These projects are increasing climate resilience and supporting national conservation goals by preserving critical habitats for endangered species, implementing NBS to respond to changing climactic conditions, and establishing new local partnerships to help streamline landscape-scale efforts. For example, in 2023, the Avon Park Air Force Range Sentinel Landscape in Florida received $1.4 million in DOD REPI funding to recruit private landowners to develop individualized climate-smart management plans for future land protection efforts and quantify the economic and environmental impacts of those land management practices. This project will provide technical and financial assistance to landowners across 40,000 acres to help maintain the viability of working rangelands, reestablish native species, and create invasive species control measures.* *Highlights are provided below; additional details are found in the Department's FY 2021–2023 ATBC annual reports.*

Conservation efforts can facilitate improved climate resilience in the form of risk reduction to flooding, wildfires, and urban heat. In FY 2024–2027, the DOD will continue to support the ATBC key tenets of supporting Tribally led conservation and restoration priorities, expanding collaborative conservation of fish and wildlife habitats and corridors, and incentivizing and rewarding the voluntary conservation efforts of fishers, ranchers, farmers, and forest owners through the Native American Lands and Environmental Mitigation Program (NALEMP), the Recovery and Sustainment Partnership (RASP), and the Sentinel Landscapes Partnership. Each of these programs will continue to build on DOD's FY 2021–2023 accomplishments and support priorities and initiatives that DOD stated in its Conservation Action Plan and reported on through its FY 2021–2023 ATBC annual reports.

To support Tribally led conservation and restoration priorities for ATBC, the DOD, through the NALEMP, will continue to develop Cooperative Agreements (CAs) that support Tribal priorities for addressing environmental impacts to their lands from past military activities with maximum Tribal participation through government-to-government consultation. DOD NALEMP cleanup actions will continue to support Tribal conservation and restoration priorities; expand collaborative conservation of fish and wildlife habitats; increase access to safe areas for traditional cultural and subsistence practices; develop economic and outdoor recreation opportunities; and create jobs by investing in the capacity of Tribal community members to manage and support NALEMP projects.

In FY 2022, under NALEMP, the DOD entered into two-year CAs with 13 Federally Recognized Tribes (10 in Alaska and 3 in New Mexico) and appropriated $20 million to the program–the most ever awarded–to address environmental impacts on Tribal lands from past DOD activities. In FY 2023, the DOD executed 14 CAs with Federally Recognized Tribes (9 in Alaska and 5 in the lower 48). The total CA funding for FY 2023 was $15.5 million.

The DOD also contributes funding to ATBC projects through REPI. The REPI Program protects military missions by helping promote compatible land uses near installations, address endangered species restrictions that inhibit military activities, and enhance military installation resilience to climate change. REPI projects align with the core focal areas for the ATBC by protecting open, natural landscapes outside DOD installations and ranges and improving installation resilience to climate change.

For FY 2024–2027, the DOD, with its partners, through the Sentinel Landscapes Federal Coordinating Committee will explore designating additional Sentinel Landscapes. The Sentinel Landscapes Partnership is a coalition of federal agencies, state and local governments, and NGOs that work with willing landowners and land managers to advance sustainable land use practices around military installations and ranges. Founded in 2013 by the USDA, DOD, and DOI, the Sentinel Landscapes Partnership's mission is to strengthen military readiness, conserve natural resources, bolster agricultural and forestry economies, increase public access to outdoor recreation, and enhance resilience to climate change.

As of January 2024, there are 13 designated sentinel landscapes. The Sentinel Landscapes Partnership designates new landscapes through a biennial designation cycle. The next of which is scheduled to run from 2025–2026.

ARMY:

The Army preserved 6,672 acres of the Franklin Mountains Range by Fort Bliss, Texas. The Army used the area for testing and training from 1926 to 1966. President Biden designated the protected area the Castner Range National Monument on March 21, 2023. The Castner Range National Monument connects open spaces and will eventually offer outdoor opportunities to the city of more than 800,000 people, many with limited access to natural and cultural landscapes. Castner Range National Monument will help to mediate some impacts of climate change by keeping the land open for long-term water recharge and maintaining a cooler urban setting through landscape conservation.

DOD LEGACY PROGRAM:

The Office of the Deputy Assistant Secretary of Defense for Environmental Management and Restoration's Legacy Resource Management Program, in support of NBS Projects, provided funding to the Defense Supply Center Columbus (Ohio) to address installation stormwater runoff by adapting dry detention ponds to create constructed wetlands. This project is expected to improve stormwater runoff quality and alleviate current and future flooding and stream bank erosion problems. As a result, the installation will reduce the rising costs to maintain and repair damaged infrastructure from more frequent and extreme weather events caused by climate change. The new wetlands, and the native plants and trees incorporated into the design, will provide habitat for pollinators and migratory birds identified by the U.S. Fish and Wildlife Service (USFWS) as species of concern, threatened, or endangered and that may be further impacted by climate change.

DOD REPI PROGRAM: SOUTHEASTERN SENTINEL LANDSCAPES

(Georgia, Northwest Florida, Avon Park Air Force Range, South Carolina Lowcountry, and Eastern North Carolina)

To protect the fire-dependent longleaf pine forests from future degradation, this 2023 NFWF America the Beautiful Challenge project received over $800,000 in REPI Program funding and $1.7 million from DOI to execute prescribed burns on more than 42,000 acres. The project activities also include several measures to protect threatened species across the four states, such as planting more than 300 acres of trees and restoring 100 acres of wetlands. This project supports the goals of all five sentinel landscapes by retaining working forestry lands, increasing the resilience and sustainability of natural systems, and improving habitat for endangered species outside installations and ranges.

DOD REPI PROGRAM: CAMP BULLIS SENTINEL LANDSCAPES

Joint Base San Antonio (JBSA) relies on two aquifers, the Edwards and Trinity Aquifers, for their primary source of water. However, there is limited data on the water levels in the Edwards and Trinity Aquifers, which limits JBSA's understanding of how to effectively protect this critical resource. To fill the data gap, his 2023 NFWF America the Beautiful Challenge project received over $700,000 in REPI Program funding to create a new web mapping application for the Camp Bullis Sentinel Landscape that combines the following into a single application: groundwater data, climate data, mission training data from JBSA, ecological data for the Air Force Civil Engineering System, and wildfire risk data. The project will also conduct water level surveys to understand the groundwater flow paths within the aquifers and water levels during peak demand in the summer.

LINE OF EFFORT 4:
SUPPLY CHAIN RESILIENCE AND INNOVATION

CLIMATE-SMART SUPPLY CHAINS AND PROCUREMENT

A climate resilient supply chain ensures that DOD suppliers and industries can effectively manufacture and deliver critical material and other supplies to the warfighter despite disruptions from the effects of a changing climate and extreme weather events. This is especially true when these supply chains are across dispersed and austere locations with limited infrastructure and little ability to respond quickly to shocks. To improve supply chain resilience, the DOD must become more agile and flexible in responding to changing conditions through actions such as improving the efficient delivery and use of energy to reduce demand and the supporting logistics requirements. Achieving this requires the DOD acquisition system to consider Operational Energy Key Performance Parameters (per 10 USC 2911) and the Operational Energy Strategy in the development of all its weapons platforms. The optimization of logistical support and delivery requirements and capabilities can make our forward supply lines less vulnerable to the effects of climate change and our adversaries.

Resilient and innovative operations and supply chain management continue to be a primary focus for the DOD under CAP LOE 4. Globally-connected and transborder stressors such as the COVID-19 pandemic, the Russian Federation's invasion of Ukraine, and increased efforts to obtain secure access to critical minerals have resulted in an increased strain on available resources. As the Fifth National Climate Assessment (NCA5) notes, international stressors, combined with extreme weather and climate-induced shocks, can affect the supply chains and the Defense Industrial Base (DIB). One notable example involved a period of extreme drought in Taiwan in 2020–2021 that resulted in the island's worst water shortage in half a century and increased strain on semiconductor production, a highly water-intensive industry.

To better prepare for supply chain shocks, the Department, as required by *EO 14017: America's Supply Chains*, released a strategic report in 2022 to address supply chain vulnerabilities in the DIB. The report, *Securing Defense-Critical Supply Chains*, articulates the Department's plans to ensure supply chain security vital to national security. The focus areas in the report include kinetic capabilities, energy storage and batteries, castings and forgings, microelectronics, and strategic and critical materials. The report lays the foundation for the Department's inaugural *National Defense Industrial Strategy* (NDIS) released in 2024.

Director of Technology and Partnerships for the Marine Corps Installation Next Program observes solar panels at Marine Corps Air Station Miramar on July 15, 2020.

DLA:

The DLA uses a Supply Chain Risk Management approach to illuminate risk across the various supply chains. The approach enables the DLA to prioritize efforts and resources to reduce impact. Then, the DLA reviews and updates policies accordingly to align with DOD resilience policies, goals, and initiatives. The DLA continues to update its design directive to include updated energy codes, OSD electrification memorandum, and the Federal Building Performance Standards. The DLA is currently updating DLA Instruction 4170.11: Energy and Water Resource Management to capture the resilience practices and goals of DODI 4170.11: Installation Energy Management *and the OUSD for* A&S Memorandum: Metrics and Standards for Energy Resilience. *This update will stress the importance of seeking project funding through methods such as Energy Savings Performance Contracts, Utility Energy Service Contracts, ERCIP, and Power Purchase Agreements.*

Regardless of the type of supply chain shock, the Department intends to use a flexible framework of actions to achieve resilient supply chains, as found in Section 2.1 of the NDIS. These actions will:

- Incentivize industry to improve resilience by investing in extra capacity;
- Manage inventory and stockpile planning to decrease near-term risk;
- Continue and expand support for domestic production;
- Diversify supplier base and invest in new production methods;
- Leverage data analytics to improve sub-tier visibility to identify and minimize strategic supply chain risks and to manage disruptions proactively;
- Engage allies and partners to expand global defense production and increase supply chain resilience;
- Improve the Foreign Military Sales process; and
- Enhance industrial cybersecurity.

The *Securing Defense-Critical Supply Chains* and *NDIS* reports are DOD's first strategies to ensure supply chain security, including from the effects of climate change. DOD has begun to identify priorities and establish goals based on these assessments. All of DLA's Supply Centers have been added to DCAT and climate exposure assessments have been completed. DOD will continue to identify priorities and develop strategies to improve adaptive capacity, as climate hazard risk assessments to critical supplies and services are refined and expanded. The upcoming transition of DCAT to a global gridded framework will allow for additional climate exposure assessments across the Department's supply chains.

In addition, the Department will continue to innovate and consider logistic support of supply chains (e.g., fuel and power requirements) in austere locations that are more vulnerable to climate-related effects. Programs such as the OECIF and the OEPF improve the energy efficiency of combat operations and platforms while envisioning climate informed ways for deploying new technologies that improve lethality and reduce logistics risk in contested environments. Throughout, these programs leverage innovations to build operational advantages. These are not only essential steps for the climate of the world that we share, but also strategic moves to defend our country and strengthen our military. To remain agile and flexible in responding to changing conditions, the Department will continue to take actions and advance policies that make use of advanced technologies to lower our energy demand, reduce logistics requirements, and optimize water and energy usage for both operational and installation energy needs.

ENERGY RESILIENCE AND INNOVATION

Navy: Marine Corps Logistics Base (MCLB) Albany possesses load-shedding and peak shaving capabilities, along with the ability for the installation to island itself as a result of its advanced microgrid controls. Through its extensive investments in heating, ventilation, and conditioning upgrades, in addition to the usage of a biomass steam turbine and landfill gas generators interconnected with Georgia Power, MCLB Albany has been able to not only supply most of their energy needs but also export energy back to the grid.

Air Force: The DAF is ruggedizing installations against the spectrum of natural and man-made threats with integrated solutions critical to ensuring that we can project power and compete in an era of Great Power Competition. The DAF is piloting DOD's first nuclear micro-reactor at Eielson Air Force Base, a pathfinder pilot to develop, certify, and operate a new technology with potential to improve DOD and commercial energy resilience. Additionally, they are developing 10 projects worth $520 million to establish microgrids and improve resilience of base electrical systems for ERCIP funding, as well as executing Defense Innovation Unit prototypes at Mountain Home and Joint Base San Antonio to assess if cutting-edge geothermal technologies can develop a utility-scale, on-site facility to provide energy and improve resilience.

The DAF also continues to improve the energy efficiency of its legacy aircraft to increase combat capability while pushing for revolutionary aircraft designs like the Blended Wing Body aircraft demonstrator that will change the future of aviation.

LINE OF EFFORT 5:
ENHANCE ADAPTATION AND RESILIENCE THROUGH COLLABORATION

Effective and efficient climate adaptation over the range of DOD missions, operations, and infrastructure requires leveraging all relevant information, methods, technologies, and approaches. The Department builds unity of effort and mission across DOD Components, commands, services, and theaters to exploit lessons learned and economies of scale. Close cooperation with all who have a stake in our national security (other federal agencies, Congress, private industry, academia, NGOs, the American people, and allies), as well as other nations, will help secure our common interests and promote our shared values.

Interagency and academic partnerships through the competitively funded SERDP, ESTCP, OECIF and OEPF are critical to develop and test new technologies that ensure the DOD can operate under changing climate conditions, preserve operational capability, and enhance the natural and man-made systems essential to the Department's success.

The Navy's only forward-deployed aircraft carrier, USS RONALD REAGAN (CVN 76), steams in formation with ships from Carrier Strike Group Five (CSG 5) and the Republic of Korea Navy during Exercise Invincible Spirit.

SERDP/ESTCP

SERDP and ESTCP provide science-based tools that enable installations to plan for, respond to, and rapidly recover from extreme weather events. Several funded projects led to the development and refinement of two key climate adaptation tools, DCAT and the DRSL database, that installations are now required to use for planning. SERDP and ESTCP recently launched the National Innovation Landscape Network with the USGS and other partner research and land management agencies to accelerate the development and adoption of technologies that protect DOD test and training lands. The network, comprised of three regional landscapes in Alaska, the Eastern U.S., and the Southwestern U.S., addresses rapid ecological changes impacting military operations.

OUSD Policy directs, controls, and administers the Defense Operational Resilience International Cooperation (DORIC) pilot program. DORIC supports engagement with the national security forces of partner countries on defense-related environmental and operational energy issues in support of the theater campaign plans of the Geographic Combatant Commands. DORIC also supports DOD regional centers and the Center for Excellence in Disaster Management and Humanitarian Assistance to increase understanding of climate impacts on international DOD partnerships, including how they pertain to ongoing operations, missions, and activities. Notably, DORIC is the only security cooperation authority explicitly addressing climate resilience considerations.

DOD hosted the inaugural International Climate and Energy Security Forum (ICESF) to bring together close defense allies to discuss shared national security concerns related to climate change and energy security. The ICESF built relationships in this emerging space and identified actions that Defense Ministries can take to address these challenges from a security perspective. The ICESF also provided an important opportunity to exchange views and deepen understanding on respective strategies and national priorities, wargaming analyses, security cooperation related to climate resilience, and energy technology innovation.

DOD climate adaptation is intrinsically interconnected with the decisions made by neighboring communities. Military installations coordinate and cooperate with nearby communities for commodities and infrastructure, such as access roads and telecommunications. The DOD strengthens partnerships and increases adaptation and resilience capabilities and capacity through the OLDCC and the REPI Program.

INTERAGENCY WILDLAND FIRE EFFORTS

DOD participates in numerous IWGs at the Department level, including the Wildfire Resilience IWG, the Wildland Fire Leadership Council, the NWCG, National Prescribed Fire Training Center, and collaborates with each of the National Cohesive Wildland Fire Management Strategy regional committees. At the installation level, DOD wildland fire managers collaborate with partners across federal, state, tribal, and local agencies and organizations to ensure optimal preparedness for and interoperability during wildland fire events.

CLIMATE INFORMED FUNDING TO EXTERNAL PARTIES

OLDCC furthers the priorities of the NDS by supporting the readiness and resilience of military installations and defense communities.

OLDCC's Installation Resilience Program provides states and communities the opportunity to partner with their local installations to identify man-made or natural threats across the community that are likely to impair the continued operational utility of local military installations. Once threats are identified, the partners collaborate to plan and carry out responses, including the enhancement of both man-made and natural infrastructure as well as assessment of community assets, such as housing, education, and healthcare.

In FY 2023, OLDCC enabled 17 locally-led TTXs. A TTX can facilitate a threat-based scenario to "dry run" planned emergency response to disasters and catastrophic events. The goal is to validate that response actions on- and off-installation are executed effectively and to identify gaps in critical infrastructure. Once an installation-community team assesses the ability of military mission and public infrastructure owners to continue their missions in the face of attack or disaster, they can collectively identify opportunities for future projects to preserve and enhance mission resilience and assurance.

OLDCC's Defense Community Infrastructure Program (DCIP) addresses deficiencies in community infrastructure that support a military installation through construction projects to enhance military value, cadet training at covered educational institutions, installation resilience, and family quality of life. 10 U.S. Code 2391(d) authorizes the Secretary of Defense, through DCIP, to make grants, conclude cooperative agreements, and supplement funds available under other federal programs in support of the program. Proposals evaluated under the installation resilience category are assessed for their evidence to enhance military installation resilience as defined under this authority.

On behalf of the Department, OLDCC also carries out an invitation-based Public Schools on Military Installations Program. For a Priority List of schools approved by the Deputy Secretary of Defense, the program allocates funding to local education agencies to develop proposals to address the condition and capacity issues that underly a specific school's ranking in the Priority List. In response to *EO 14057*, the program also encourages local education agencies to design net-zero projects that can both significantly offset their energy use and be resilient to the region's natural threats.

The REPI Program preserves military missions by promoting compatible land uses near DOD installations, addressing endangered species restrictions that inhibit military activities, and enhancing military installation resilience to climate change. By collaborating with NGOs and state and local governments on climate change projects, the REPI Program can accelerate project outcomes to defend national security while supporting sustainable land management practices. The Military Services and their dedicated partners can receive REPI Program funding for climate resilience projects through multiple opportunities including, but not limited to, the following: annual REPI proposals, REPI Challenge, the NFWF's National Coastal Resilience Fund, the NFWF's ATBC, and the DOI's Readiness and Recreation Initiative.

In 2023, the Sentinel Landscapes Partnership designated three new sentinel landscapes: the Lowcountry Sentinel Landscape in South Carolina; the Potomac Sentinel Landscape in Virginia; and the Tidewater Sentinel Landscapes also in Virginia. The South Carolina Lowcountry Sentinel Landscape supports immense biodiversity, encompassing more than 2.2 million acres of longleaf pine forest, ranchlands, salt marsh, forested wetlands, and unbroken wildlife corridors.

The two Virginia Sentinel Landscapes make up more than 2.9 million acres of land and water in Virginia's "Golden Crescent," an area of high military concentration, agricultural lands, and complex marsh and riverine systems that connect to the Chesapeake Bay.

DUGWAY PROVIDING GROUND – PUBLIC SCHOOLS ON MILITARY INSTALLATIONS

OLDCC assistance rebuilt the Dugway High School to correct capacity and facility deficiencies. The project uses a renewable energy geothermal ground source heat pump system to heat and cool the new school. This system reduces life-cycle costs and carbon emissions, building resilience through both adaptation and mitigation measures.

PORT OF SAN DIEGO – INSTALLATION RESILIENCE

This project enables the San Diego Unified Port District to collaborate with Naval Base Coronado, Naval Base Point Loma, and Naval Base San Diego to identify site-specific opportunities for sustainable restoration, enhancement, or retrofitting of existing shorelines throughout San Diego Bay to improve the installations' resilience. The project will result in a proactive, digital planning tool that will identify shoreline vulnerabilities and provide alternative site-specific, resilient solutions. The project will enable stakeholders to improve strategic collaboration and partnerships to pursue funding opportunities for the design, construction, and implementation of shoreline projects throughout San Diego Bay.

PORT OF ALASKA STORMWATER SYSTEM RECONSTRUCTION PROJECT – DEFENSE COMMUNITY INFRASTRUCTURE PROGRAM

This project enables the Port of Alaska to replace aged stormwater management infrastructure, alleviating flooding and soil erosion issues that impact mission readiness and execution both on Joint Base Elmendorf-Richardson and at the Port of Alaska, a strategic commercial port used extensively by the installation.

MAUNAWILI FOREST – RESTRICTIVE USE EASEMENT

On O'ahu, the U.S. Forest Service (USFS), the State of Hawai'i, and the Trust for Public Land worked in partnership with the REPI Program to bring together more than $32 million to purchase a restrictive use easement of 1,084 acres in the Maunawili Forest. This easement ensures compatible land uses that will not impact operations and flyover access at the adjacent Marine Corps Base Hawai'i training areas while supporting critical waterways, cultural and historic sites, and fertile agricultural lands.

PACIFIC MISSILE RANGE FACILITY BARKING SANDS – RESTORATION AND CONSERVATION

On the island of Kaua'i, Pacific Missile Range Facility Barking Sands received more than $5.1 million in REPI funding to reduce upland flood potential, soil erosion, and wildfire potential while restoring habitat for endangered seabirds. Restoration and conservation of native forests will increase water supply for the long-term benefit of the military mission at Pacific Missile Range Facility Barking Sands.

ADDRESSING CLIMATE HAZARD IMPACTS AND EXPOSURES

DOD used DCAT to conduct a high-level screening of climate hazard exposure for federal facilities and personnel. In addition to this high-level screening, DOD used Climate Mapping for Resilience and Adaptation (CMRA) data to assess exposure of DOD personnel to sea level rise, the FEMA National Flood Hazard Layer (NFHL) to assess exposure of DOD personnel to riverine flooding, and the USFS Wildfire Risk to Communities data to assess potential exposure of buildings and personnel to wildfire.

DOD assessed the exposure of its buildings; employees; and lands, waters, and cultural and natural resources to five climate hazards: extreme heat, extreme precipitation, sea level rise, flooding, and wildfire risk.

Table 3. Climate data used in agency risk assessment.

HAZARD	DESCRIPTION	SCENARIO	GEOGRAPHIC COVERAGE
Extreme Heat	For this hazard, the DCAT indicator for High Heat Days was used. High Heat Days is the average number of days in which temperatures exceed the 99th percentile temperature in the historic baseline period. On average in the historic baseline period, only three days per year exceed the 99th percentile temperature value. For CONUS locations, the data source is 32 Coupled Model Intercomparison Project Phase 5 (CMIP5) General Circulation Models (GCMs) model runs downscaled using the LOcalized Constructed Analogs (LOCA) method for daily temperature data. For Alaska and Hawai'i, the data source is 25 CMIP5 GCMs downscaled via the Bias Correction and Spatial Disaggregation (BCSD) method for daily temperature data. For overseas locations, the data source is 21 CMIP5 GCMs downscaled via the BCSD method for daily temperature data.	Representative Concentration Pathway (RCP) 4.5 RCP 8.5	Global
Extreme Precipitation	For this hazard, the DCAT indicator for Extreme Precipitation Days was used. Extreme Precipitation Days is the average annual number of days that precipitation in a future epoch scenario is greater than what would have been considered an extreme precipitation day historically (a 1% annual chance precipitation event). For CONUS locations, the data source is 32 CMIP5 GCM model runs downscaled using the LOCA method for daily precipitation data. For Alaska and Hawai'i, the data source is 25 CMIP5 GCMs downscaled via the BCSD method for daily precipitation data. For overseas locations, the data source is 21 CMIP5 GCMs downscaled via the BCSD method for daily precipitation data.	RCP 4.5 RCP 8.5	Global
Coastal Flooding	The DRSL database containing the 1% annual exceedance probability (AEP) coastal water levels for lowest and highest sea level scenarios drove a Geographic Information System bathtub model to translate these elevations into areas of inundation based on a digital elevation model (DEM) topographic map. This data was crosswalked with building data from the Real Property Asset Database and Defense Installation Spatial Data Infrastructure geospatial platform to identify buildings potentially impacted by this hazard.	RCP 4.5 RCP 8.5	Global
Sea Level Rise	To assess this hazard as it pertains to DOD personnel at the county level, CMRA data was used. The CMRA sea level rise coastal inundation layers were created using existing federal products: the NOAA Coastal DEMs and 2022 Interagency Sea Level Rise Technical Report Data Files.	Intermediate 2050, Intermediate-High 2050, Intermediate 2090, Intermediate-High 2090	CONUS Only

Table 3. Climate data used in agency risk assessment (continued).

HAZARD	DESCRIPTION	SCENARIO	GEOGRAPHIC COVERAGE
Wildfire Risk	This risk measures whether an asset is in a location rated as having direct, indirect, or no exposure to wildfire based on the USFS Wildfire Risk to Potential Structures (a data product of Wildfire Risk to Communities). This product estimates the likelihood of structures being lost to wildfire based on the probability of a fire occurring in a location and likely fire intensity. Data reflects wildfires and other major disturbances as of 2014.	Historical	CONUS/AK/HI
Riverine Flooding	DCAT displays Riverine Flooding exposure for a 1% AEP event. Future extents are based the Federal Flood Risk Management Standards (FFRMS) freeboard approach of adding 2 feet (low) and 3 feet (high) to the flood elevations and estimating the resulting extent of flooding. Where available, historical inundation areas are based on the FEMA NFHL 1% AEP inundation maps. Where not available, a two-dimensional Hydrologic Engineering Center River Analysis Tool (HEC-RAS) model was developed based on 10-meter DEM data and the 1% precipitation depths from the NOAA Atlas 14 and Atlas 2 precipitation datasets to delineate historical floodplains. For overseas locations, the European Centre for Medium-Range Weather Forecasts Parametrized eXtreme Rain-2 (PXR-2) dataset was used.	Historical; + 2 feet, + 3 feet FFRMS freeboard approach	Global

Exposure to extreme heat, extreme precipitation, and sea level rise were evaluated at mid- (2050) and late-century (2080) under two emissions scenarios, RCP 4.5 and RCP 8.5. Exposure to wildfire was only evaluated for the present day due to data constraints.

Table 4. Climate scenarios considered in agency risk assessment.

SCENARIO DESCRIPTOR		SUMMARY DESCRIPTION FROM NCA5
RCP 8.5	Very High Scenario	Among the scenarios described in NCA5, RCP 8.5 reflects the highest range of carbon dioxide (CO_2) emissions and no mitigation. Total annual global CO_2 emissions in 2100 are four times the emissions in 2000. Population growth in 2100 doubles from 2000. This scenario includes continued fossil fuel development.
RCP 4.5	Intermediate Scenario	This scenario reflects reductions in CO_2 emissions from current levels. Total annual CO_2 emissions in 2100 are 46 percent less than in 2000. Mitigation efforts include expanded renewable energy compared to 2000.

Additional details about the data used in this assessment are provided in Appendix 1.

ADDRESSING CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL CIVILIAN EMPLOYEES AND BUILDINGS

DOD civilian employees (DOD civilians) play an important role in supporting the U.S. Armed Forces. More than 750,000 DOD civilians work in more than 650 occupations in the U.S. and around the globe, in nearly every industry and work setting. DOD analyzed climate hazard exposure for approximately 649,000 DOD civilians[3] in the continental U.S., Alaska, and Hawai'i (CONUS/AK/HI) to provide the estimates in the tables below. Tables 5 and 6 show that in the coming decades, DOD civilians will be exposed to multiple climate hazards and may experience serious climate impacts, such as heat-, water-, and food-related illnesses or injuries. Climate exposure and related impacts vary by location as well as time (mid-century, late-century) and greenhouse gas emission scenarios.

3 Due to data limitations, this analysis did not include DOD civilians for whom full location data was not available (86,000 or 11% of all DOD civilians), nor those stationed outside of the U.S. (35,000 or 4%).

The DOD has an expansive global footprint, with buildings both leased and owned serving many purposes and located in a wide variety of landscapes. Table 5 documents the results of an analysis using the most current geospatial data representing DOD buildings in DCAT. Table 6 documents an analysis of climate hazard exposure conducted for 407,351 DOD buildings globally,[4] representing more than 90 percent of buildings in the DOD portfolio.

As stated in the RHDC, DOD will integrate climate risk assessments and natural infrastructure resilience strategies, such as NBS, into design and construction processes, understanding that proactive management of our infrastructure to adapt to or mitigate against evolving risks will have significant impacts on our people and buildings. This will better equip our installation managers to plan for an uncertain future. It will also inform installation master plans that drive design, construction, and maintenance decisions, including which materials to use and where to locate new infrastructure. These scenarios and impacts shall inform installation INRMPs to develop actions to reduce environmental risks, improve environmental quality, and promote resilience.

Table 5. DOD civilian exposure to climate hazards.

INDICATORS OF EXPOSURE OF FEDERAL EMPLOYEES TO CLIMATE HAZARDS	RCP 4.5 2050 (MID-CENTURY)	RCP 4.5 2080 (LATE-CENTURY)	RCP 8.5 2050 (MID-CENTURY)	RCP 8.5 2080 (LATE-CENTURY)
Extreme Heat. *% of employees duty-stationed in counties projected to be exposed to an increase in the annual number of days with the maximum temperature greater than the 99th percentile*	100%	100%	100%	100%
Extreme Precipitation. *% of employees duty-stationed in counties projected to be exposed to an increase in the annual number of days with precipitation exceeding the 99th percentile*	95.0%	91.7%	95.1%	96.0%
Sea Level Rise. *% of employees duty-stationed in counties projected to be inundated by sea level rise*	45.0%	45.0%	45.0%	45.0%
Wildfire. *% of employees duty-stationed in counties at highest risk to wildfire*	Not exposed: 3.7%	Indirectly exposed: 3.3%	Directly exposed: 92.8%	

Table 6. DOD buildings exposure to climate hazards.

INDICATORS OF EXPOSURE OF BUILDINGS TO CLIMATE HAZARD	RCP4.5 2050 (MID-CENTURY)	RCP4.5 2080 (LATE-CENTURY)	RCP8.5 2050 (MID-CENTURY)	RCP8.5 2080 (LATE-CENTURY)
Extreme Heat. *% of agency federal buildings globally in areas projected to be exposed to an increase in the annual number of days with the maximum temperature greater than the 99th percentile*	100%	100%	100%	100%
Extreme Precipitation. *% of agency federal buildings globally in areas projected to be exposed to an increase in the annual number of days with precipitation exceeding the 99th percentile*	93.0%	93.5%	93.3%	96.8%
Sea Level Rise. *% of agency federal buildings globally projected to be inundated by sea level rise*	3.6%	3.9%	5.0%	7.7%
Wildfire. *% of buildings at highest risk to wildfire*	Not exposed: 15.6%	Indirectly exposed: 59.9%	Directly exposed: 24.4%	
Flooding. *% of buildings located within floodplains*	Within 100-year riverine floodplain: 20.7%	Within 100-year riverine floodplain + 2 feet:[5] 45.2%	Within 100-year riverine floodplain + 3 feet:[4] 50.0%	

4 Based on a dataset comprised of FY 2022 building feature locations provided by the Defense Installations Spatial Data Infrastructure Program that was cross-referenced with Real Property Sites in DCAT.

5 Per the freeboard option of the FFRMS.

EXTREME HEAT EXPOSURE

Employees. DOD personnel will experience large increases in the number of days of extreme heat. Hot days will become more common by mid-century. The average DOD Service member and civilian could experience four to eight times as many high heat days and three times the number of days more than 95°F as compared to the current climate. Extreme heat impacts may be particularly noticeable in the Midwest, Northeast, Northern Great Plains, Northwest, and Alaska Regions, where DOD personnel currently experience fewer days with temperatures more than 95°F. Increased temperatures will increase employees' risk for heat-related issues including heat stroke and exhaustion. DOD's Defense Health Agency tracks heat-related morbidity and mortality across the Department.

Buildings. DOD buildings are in areas that will be exposed to large increases in the number of days of extreme heat. Hot days will become more common. In the RCP 4.5 (2050 epoch scenario), the average site with a DOD building will experience more than seven times as many high heat days. In the RCP 8.5 (2050 epoch scenario), these locations will experience more than 10 times as many high heat days on average compared to the base climate. Internationally, under both high and low RCP (both mid- and late-century epochs), heat impacts may be especially larger at sites in the Small Islands Region, as well as sites in Central and South America, though all regions globally and domestically will experience an increase in high heat days. In the U.S., although all regions may experience an increase in high heat days, the greatest heat impacts may be at sites in Hawai'i, the Southeast, the Southern Great Plains, and the Midwest. With severe heat, facility HVAC systems may be overused or inadequate. High heat days in the Arctic can lead to permafrost thaw, impairing the structural integrity of infrastructure and facilities.

EXTREME PRECIPITATION EXPOSURE

Employees. DOD personnel will experience increasing precipitation hazards that lead to riverine and surface water flooding. Flooding may disrupt employee access to and from installations and result in the loss of transportation facilities and means. During extreme events, it can also result loss of life. DOD personnel in the Northwest and Alaska Regions will experience the largest percent increases in rainfall amounts. By mid-century, the average DOD Service member or civilian in the Northwest Region will experience heavier total precipitation and about two additional extreme precipitation days each year. DOD personnel in the Southwest, Southern Great Plains, and Northern Great Plains will experience the smallest increases in extreme rainfall. The Department is analyzing how extreme precipitation can result in stormwater flood events that expose installation residents and employees to pollutants.

Buildings. Most DOD buildings are in areas that will experience increasing precipitation hazards that lead to riverine and surface water flooding. Flooding may disrupt employee access to and from installations as well as loss of facilities, roads, and other infrastructure. However, the following regions may experience a slight decrease in the number of days per year with extreme precipitation events: Small Islands Region under RCP 4.5 (2050 epoch scenario) and the Hawai'i Region under RCP 4.5 (2050 epoch scenario), RCP 4.5 (2085 epoch scenario), and RCP 8.5 (2050 epoch scenario). DOD buildings in the Polar, Alaska, and Central and South America Regions will be exposed to the largest percent increases in the average number of days per year with extreme precipitation. In the RCP 8.5 (2050 epoch scenario), an average DOD building in the Polar and Alaska Regions will experience four additional days of extreme precipitation each year. DOD buildings in the Southwest, Southern Great Plains, and Northern Great Plains will experience the smallest increases in extreme rainfall, with average indicator values increasing by 20 percent or less in three of four epoch scenarios.

SEA LEVEL RISE AND RIVERINE FLOODING EXPOSURE

Employees. At the county-level resolution, approximately 45 percent of DOD civilians are stationed in a county exposed to sea level rise, while nearly all DOD civilians live in a county with a 100-year or 500-year floodplain. At the requested resolution, the exposure does not change noticeably between epoch scenarios. At a higher resolution, the exposure across epoch scenarios will change. Flooding may disrupt employee access to and from installations and result in the loss of transportation facilities and means. During extreme events, it can also result loss of life. Rising sea level also increases saline intrusion, with potential to adversely impact underground utilities and drinking water sources. Sea level rise can cause tidal inundation events that expose installation residents and staff to waterborne pollutants.

Buildings. More than 7 percent of DOD buildings are in an area exposed to sea level rise under the RCP 8.5 (2085 epoch scenario), while approximately 50 percent of DOD buildings are found within a 500-year floodplain. Of the buildings exposed to coastal flooding under RCP 8.5 2085, the majority are in the Southeast Region. Flooding may disrupt employee access to and from installations as well as loss of facilities, roads, and other infrastructure. Rising sea level also increases saline intrusion, with potential to adversely impact underground utilities and drinking water sources.

WILDFIRE EXPOSURE

Employees. Currently, approximately 93 percent of DOD civilians work in a zip code with direct exposure to wildfire hazards. DOD personnel will be more likely to experience wildfire impacts in the future. In the Midwest, Northeast, Northern Great Plains, and Northwest Regions, zip codes wherein DOD personnel reside that have historically experienced less than a day of fire season length[6] conditions will see multiple days of fire season length conditions on average in the future. Specific zip codes in the Southwest and Southern Great Plains where DOD personnel live will experience at least 20 more days of fire season conditions through the end of the century. Health impacts of wildfire include air quality hazards resulting from particulates.

Buildings. Wildfires can cause extensive and severe damage to buildings and property, causing long-term disruption to operations. Currently, approximately 84 percent of DOD buildings are on an installation directly exposed to wildfire hazards. DOD buildings are more likely to be impacted by wildfire in the future. At DOD installations in the Midwest, Northeast, Northern Great Plains, Northwest, Southeast, and Southwest Regions, DOD buildings at sites that have historically experienced less than a day of fire season length conditions will see multiple days of fire season length conditions on average in the future. At DOD installations in the Midwest, Northeast, Southeast, Southern Great Plains, and Southwest, DOD buildings will be exposed, on average, to at least 20 more days of fire season length conditions in all epoch scenarios.

6 Fire Season Length is the average annual number of days in which the Keetch-Byram Drought Index (KBDI) is > 600, indicating long-term arid conditions and dry coarse fuels.

ADDRESSING CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING MISSION, OPERATIONS, AND SERVICES

The DOD is committed to the health, safety, and wellbeing of its workforce and surrounding communities. Per DODI 6055.17, *DOD Emergency Management Program*, installations address potential hazards in a comprehensive, all-hazards Emergency Management Plan coordinated with federal, state, regional, and local government and emergency response entities. These plans align with the five mission areas of prevention, protection, mitigation, response, and recovery, and must be flexible enough for use in all emergencies, including unforeseen events, but detailed enough to provide an initial course of action for installation commanders to proceed with pre-planned responses to potential unexpected events. Installation Emergency Managers conduct all-hazards threat assessments to consider the impact of any natural or human-caused hazard on the installation, its people, infrastructure, and mission. These plans include a risk communication plan, evacuation plans, and an outreach component to make Service members and DOD civilians aware of the hazards and risk reduction strategies. In addition to the Installation Emergency Management Plans, Services and individual installations engage in their own efforts to increase hazard awareness among the workforce and implement safety measures in the event of climate exposure.

Measures to help prepare Service members, DOD civilians, on-site contractors, installations, and surrounding communities absorb, recover from, and adapt to weather and climate exposure include the following:

- Improve education around heat-related morbidity and mortality including recognizing conditions under which outdoor activity should be reduced; identifying signs and symptoms of heat-related illness; and communicating methods of treatment in the field.
- Increase acclimatization times for newly arrived personnel on installations during the warmer months and adjust the schedule of outdoor activities to coincide with cooler portions of the day.
- Designate locations to function as cooling centers during heat waves, as necessary, particularly in locations where air conditioning is not a common facility feature.
- Engage in pre-disaster evacuation planning that accounts for social vulnerability and other demographic factors.
- Improve Joint Force knowledge of personnel safety in extreme conditions.
- Reduce the likelihood of brownouts and blackouts during heat waves by requiring improvements to the energy efficiency of buildings and infrastructure to reduce energy demand. These improvements could include passive heating and cooling, passive solar design, use of solar canopies over adjacent parking areas, and integration of buildings with microgrids, battery storage, and installation-wide controls systems.
- For installations where drought is a concern, provide the necessary drought education to comply with water use restrictions. Such education addresses water use issues but also drought-related issues such as water quality, wildfire, and heat stress. These installations should also have a water conservation plan with long-term goals for water supply management. The plan should also identify water supply thresholds below which increasingly stringent water restrictions would come into effect.
- For installations where wildfire exposure is a concern, employ wildfire resilience strategies including fire-resistant landscaping, defensible spacing, and structure hardening. Non-structural strategies may include prescribed fires, which enhance ecosystems, build wildfire resilience, and provide realistic, resilient, training environments for the mission.

ADAPTATION — RELOCATION:

An example where the DOD relocated functions to a lower risk property is in Guam where the NAVFAC Marianas partnered with the Guam Power Authority in 2010 to move power generation from shore side to higher inland areas due to risks associated with tsunamis, storm surge, and rising sea levels.

Actions to address climate sensitive buildings at risk from flooding due to riverine and coastal inundation include:

- **Adaptation** measures such as the elevation of buildings, roads, and utilities; dry and wet floodproofing; floodable development; floatable development; and ring walls and levees;
- **Relocation** or removal measures that consist of moving facilities and buildings from impacted or exposed areas out of reach of floodwaters;
- **Mission changing measures** that align mission criticality and operations accordingly with asset vulnerabilities; and
- **Repurposing** measures that designate buildings and facilities to house activities with lower mission criticality; repurposing can provide the additional benefit of use of the evacuated area, building, or facility.

FLOOD HAZARD EDUCATION:

Fort Cavazos is the Army's premier installation to train and deploy heavy forces. Fort Cavazos, with 214,968 acres, is the only post in the U.S. capable of stationing and training two armored divisions. The rolling, semi-arid terrain is ideal for multifaceted training and testing of military units and troops. In response to changing flash flood risks associated with higher rainfall and increased rainfall intensities, Fort Cavazos improved active communication of flood hazards. Namely, Fort Cavazos asks its personnel to maintain heightened awareness at low water crossings, even those that have not flooded in the past. In collaboration with the USGS, Fort Cavazos raised flood hazard awareness and established and supported the operation and maintenance of stream gauges for several low water crossings. The installation introduced several safety measures to reduce the risk of flash floods, including new bridges over low-water crossings, water gauges to measure the current amount of water in a certain area, and closed roadways when there is an immediate risk of flash flooding.

CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL LANDS, WATERS, AND ASSOCIATED CULTURAL RESOURCES

With its large global footprint, the DOD assessed projected climate exposures to federal lands and waters in a regional, screening-level assessment using DCAT (Figure 4). DCAT currently includes regional summaries from the Fourth National Climate Assessment (NCA4), produced by the U.S. Global Change Research Program, and from the Fifth Assessment Report by the Intergovernmental Panel on Climate Change (IPCC), which provide overviews of climate change causes and effects. Information from the recently released NCA5 and Sixth Assessment Report of the IPCC will update these regional summary assessments in FY 2024.

The Department uses more than 27 million acres of land including government-owned land, public land, public land withdrawn for military use, licensed and permitted land, and foreign land used by the DOD. To successfully manage federal lands, waters, and cultural resources, the DOD must understand climate threats to the species and habitats on the lands. There are more than 550 threatened and endangered species on DOD installations and ranges. Of those more than 550 species, 54 listed species, and 74 at-risk species exist only on DOD lands. The DOD has long understood that conserving military lands protects the species and their habitats.

To advance understanding of climate risks to military lands, DCAT identifies the potential Threatened, Endangered, and At-Risk Species (TER-S) that are known or predicted to be on installations. For each potential TER-S, the DOD assessed the vulnerability of the species to each climate-related hazard based on a combination of known threats to the species, the particular habitats the species is associated with, their known susceptibility to climate-related hazards, and ecological characteristics of the species and their implied effect on vulnerability to climate-related hazards. Summary installation climate exposure reports within DCAT include projected vulnerabilities of TER-S to climate-related hazards using the NatureServe Network Program.

The DOD also manages several types of cultural resources, including historic buildings and structures, archeological resources and sites, objects, historic districts and landscapes, ethnographic resources, sacred sites, and burial sites. Climate hazards have overlapping or similar impacts on cultural resources. For example, sea level rise is causing erosion on coastal sites and cemeteries. Melting ice and permafrost is also causing coastal erosion, as well as allowing millennia-old organic remains that had been preserved in ice to become exposed and rot. Increased rainfall, river flow, and downcutting is eroding mud-brick ruins and buried archaeological sites. Drought and rising temperatures will pose threats to wooden buildings as termites and other pests are able to survive at higher latitudes and altitudes. Desert sands are damaging traces of ancient civilizations, and increased lightning strikes and fires are destroying historic buildings and archaeological sites, as well as facilitating the erosion of buried archaeological sites.

NAVY:

Western Landscapes Resilience Initiative*: Across the DON's western installations and ranges, extreme temperatures, drought, wildfire, dust, and flooding events threaten built and natural training assets. In April 2023, the DON established the requirement for Navy and Marine Corps to collectively identify 500 thousand acres on or around arid and semi-arid installations in the Western U.S. to take actions that positively impact groundwater recharge, stormwater retention, and sustainable land management. Installations identified parcels where NBS could be implemented to enhance mission resilience (e.g., range access roads washing out; training interruptions; water security) as well as natural resources management (e.g., habitat enhancement; water sources for listed species; biodiversity; carbon sequestration). The DON is investing in several FY 2024 projects as demonstrations that can be leveraged by other installations and scaled up to inform future implementation.*

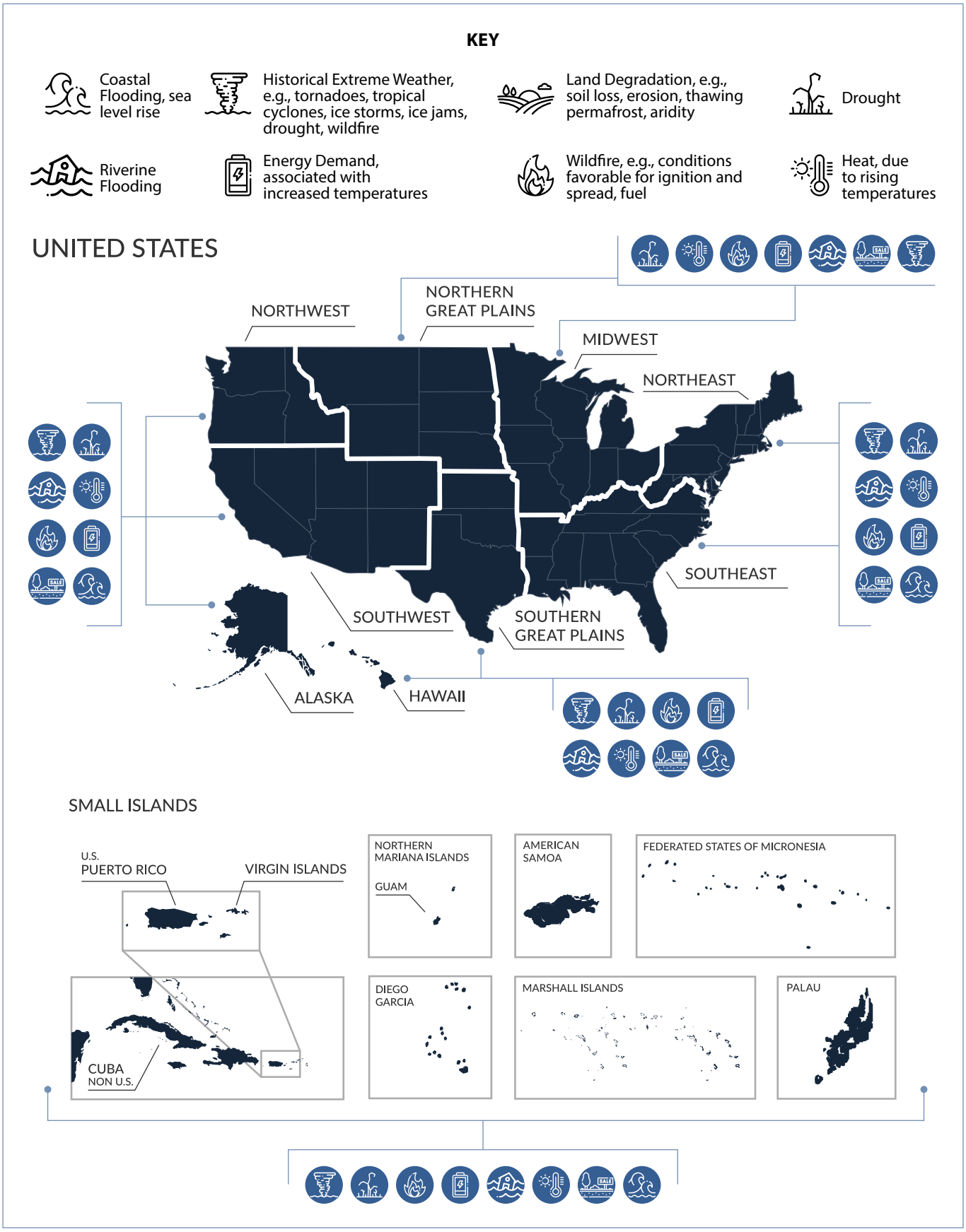


Figure 4. Projected regional climate hazard exposures to DOD installations, lands, and waters using DCAT identified climate hazards and regional summaries.

ADDRESSING CLIMATE HAZARD EXPOSURES AND IMPACTS AFFECTING FEDERAL LANDS, WATERS, AND ASSOCIATED CULTURAL RESOURCES

DOD's natural infrastructure is critical to military combat readiness through its ability to provide realistic operational testing and combat environments and conditions. Climate-informed natural resource plans focus on protecting and enhancing testing and training. Natural resource managers work with surrounding communities to protect land near installations and proactively engage with the private sector to address impacts of off-base development. They also work to enhance the management of DOD natural assets to preserve or expand ecosystem services, building resilience at the regional level. Examples and highlights are provided below.

Prescribed fire, the planned use of wildland fire to restore and maintain ecosystems and to reduce wildfire severity, is a critical tool used by DOD wildland fire managers. On average, the Department uses prescribed fires on a higher ratio of its managed lands than any other federal agency, and in many cases, the use of prescribed fire has helped the recovery of many threatened and endangered species. Prescribed fires are conducted to reduce fuel loading on installation training and testing ranges, increase accessibility to training lands, reduce hazards near facilities, maintain diverse and resilient ecosystems, and train wildfire response personnel. These factors make prescribed fires an effective tool for ensuring resilient natural infrastructure on DOD lands.

In June 2023, DOD published the *Climate Adaptation Guide for Cultural Resources*. This guidance document presents methodology for considering and integrating climate change risks into cultural resources management and potential ways to improve resilience for cultural resources. This guide also presents ways to integrate these climate adaptation strategies into Integrated Cultural Resources Management Plans.

Changing climate conditions may lead to declines in species, making them eligible for legal protection under the Endangered Species Act (ESA) and more difficult for installations to manage. The RASP initiative builds on years of collaboration and innovation under the ESA between DOD and DOI. The partnership was established in 2018 to develop and promote species conservation while promoting increased flexibility for mission activities. Since its inception and through conservation efforts, the RASP has positively impacted the status of 11 species listed under the ESA that are found on DOD lands and waters. The RASP also aims to recognize and respond to the current and projected impacts of climate change on ecosystems and watersheds, and on the species within those ecosystems and watersheds.

In 2023, RASP focused on improving the conservation status of more than 55 species, and celebrated numerous successes. In 2023, six species, all endemic to DOD lands, were declared recovered and removed from the ESA. This extraordinary accomplishment showcases DOD's continued commitment to species protection while enhancing the military mission. The DOD and the USFWS are working together on Species Action Plans (SAPs) that benefit 25 priority species, achieve conservation outcomes, and improve DOD mission flexibility at more than 150 installations and ranges. These SAPs identify priority actions, milestones, and desired outcomes between the two agencies that support the species conservation and recovery while minimizing constraints to military readiness. Additionally, DOD and USFWS will continue to collaborate through partnerships to improve the conservation status and military mission impacts of more than 30 more species.

The DOD will continue to support efforts regarding interagency coordination and collaboration for the protection of Tribal treaty and reserved rights, including increasing the incorporation of the use of Indigenous knowledge and applying the White House Memorandum on Uniform Standards for Tribal Consultation. The DOD makes good faith efforts to build effective relationships with Federally Recognized Tribes and to meet its responsibilities to meaningfully consult with these Tribes on proposed military training and construction actions, plans, and ongoing activities that may have the potential to significantly affect protected Tribal lands, cultural properties, or Tribal treaty rights.

CONSERVATION PROGRESS:

Thanks to conservation efforts, the USFWS downlisted or delisted 11 species found on DOD lands. The Hawaiian goose (Nēnē), American burying beetle, and Stephens' kangaroo rat have been downlisted. The Lesser long-nosed bat, black-capped vireo, five San Clemente Island species (Bell's sparrow, paintbrush, lotus, larkspur, and bush mallow), and Okaloosa darter have been delisted.

CLIMATE LITERACY EFFORTS

The 2021 CAP stated that prepared combat forces capable of operating under the most extreme and adverse weather and terrain conditions are necessary to carry out our mission. Climate change complexities require the Department to anticipate, train, and equip the force to account for emerging environmental conditions different from the range of environments existing in the past. This includes compounding effects of climate hazards together or with other disruptions (e.g., pandemic).

DOD personnel experience the impacts of a changing climate every day. These effects complicate already complex operations and exacerbate risks to Joint Force readiness, lethality, and mission execution. In the 2021 CAP, the DOD identified climate literacy as a key enabler integral to the success of all DOD climate adaptation efforts. Since then, the Department made climate literacy a priority in its overall resilience work.

Public Health Activity Fort Lewis participates in high altitude canine insertion and recovery rotary wing training across the Alaska Mountain Range with the 354th Security Forces and 549th Military Working Dog Detachment on Fort Wainwright on March 17, 2023.

The Department's almost 3 million-member workforce of active-duty, civilian, National Guard and Reserve personnel, and support contractors underpin DOD's ability to address the risks associated with a changing global climate. The knowledge, skills, and capabilities required to address the impacts of a changing climate depend on the unique mission, function, and role of each member of this workforce. Therefore, the climate literacy effort is developing appropriate and tailored information allowing the workforce to understand when, why, and how to apply climate considerations. Innovative solutions from a climate-informed DOD workforce can optimize operational planning and enable effective energy use to reduce future climate risks.

Figure 5. DOD's approach to building and supporting a climate-literate workforce has three pillars: education, training, and engagement.

In 2022 and 2023, the Department issued a voluntary Climate Literacy Pulse Check to assess workforce climate knowledge, use, and requirements for climate information. In both years, this Pulse Check reached a broad cross section of military and civilian personnel across the OSD, the Services, Joint Staff, and Defense Agencies. The Department also conducted a series of Climate Literacy Focus Groups with personnel in career fields closest to the climate challenge, and issued data calls to military education institutions regarding climate-relevant curricula. Cumulatively, these efforts provided important indicators of climate education, training, and resources needed across DOD Components, career fields, and professional rank and grades. DOD senior leadership used the findings from these efforts to develop data-informed recommendations for DOD-wide initiatives to strengthen military and operational resilience to climate change. The Department intends to replicate these efforts annually, or as needed, to measure progress and assess change from the 2022 baseline.

Integrating climate literacy into all education and training remains a cornerstone of DOD's climate literacy efforts, particularly for professional military education (PME) programs. PME programs are essential in the development of future military leaders prepared to navigate the challenges of future operating environments. The DOD identified climate literacy learning outcomes for intermediate- and senior-level PME programs and the DOD supports faculty members to implement these outcomes at the war colleges, command and staff colleges, and Service academies. Standardizing climate literacy learning outcomes across institutions help future PME graduates understand climate risks to military operations. The effort also equips PME graduates with the information, tools, and resources for operational resilience in an evolving climate and security environment.

The Department's Climate Working Group and Sub-Working Groups, Climate Wargaming, Climate Literacy, and Strategic Integration, continue to coordinate responses and track implementation of climate and energy-related directives, actions, and progress. The DOD will continue efforts to integrate climate resilience into curricula, wargames, and TTXs for Military Service members. The Department will also support ally and partner climate military education initiatives, where possible.

The Department launched the Climate Resilience Portal in 2023 to help optimize climate-informed decision-making across its workforce. The Department continues to build additional capabilities into the Portal including general informational materials, tailored education (e.g., senior leader training), and training resources. DOD practitioners use the Portal to guide climate-informed decisions as appropriate to their mission, function, and role.

Table 7. Pulse Check findings.

EDUCATION, TRAINING, ENGAGEMENT, AND CAPACITY BUILDING	
Agency Climate Education, Training, and Engagement Efforts	More than a quarter of pulse check respondents in 2022 and 2023 reported receiving "some" or "extensive" climate education, training, or information related to their job while employed at the Department.
	Respondents at the senior level (i.e., General/Flag Officer, Senior Executive Service) reported receiving slightly more climate education and training than the broader workforce—coming in at around 40 percent.
	Approximately 27 percent of respondents identifying with the financial management and administration career field in 2023 have received climate education, training, or information while at DOD—up from 20 percent in 2022.
	Of the respondents to the 2023 pulse check identifying with career fields in acquisition, operations, supply, logistics, and transportation, roughly 30 percent reported receiving "some" or "extensive" climate education, training, or information—up from a quarter the year prior.
Agency Capacity	Of the more than 12,000 annual responses DOD received to its pulse check in 2022 and 2023, 40 percent thought climate change would affect their work or mission in the near term, and more than 50 percent in the far term.

WILDLAND FIRE TRAINING:

The Army, in conjunction with the Air Force, established a Wildland Fire Academy. The focus of the academy is to provide training on wildland fire management. Army covers 80 percent of the costs for students to attend the training.

The Basilone Complex Fire burned more than 22,000 acres in grass and brush causing evacuations of installation personnel and risk to installation property, facilities, and infrastructure. Camp Pendleton's successful fuel management significantly contributed to halting the Basilone Complex Fire before it could reach installation facilities and other protected resources. Through systematic vegetation clearance in a mechanical fuel treatment zone around the cantonment area and strategic fuel break location, the base established a reliable defensible space against the wildfire's progression. Routine maintenance of firebreaks and proactive application of prescribed fires played a key role in reducing fuel loads, thus reducing the risk of intense fires. The collaborative efforts between Camp Pendleton's firefighting teams and local agencies demonstrated a practical and effective approach to preventing the spread of wildfires, ensuring the safety of the base and its surrounding areas. This proactive approach showcases the military's commitment to wildfire prevention and ensured the protection of both military readiness and the surrounding environment.

The DAF manages more than 9.8 million acres of land across 96 installations that require INRMPs. A significant portion of this land, especially in the southeast, west, and Alaska, is comprised of areas where wildland vegetation and fuels pose a hazard to infrastructure and land uses. In FY 2020, the Air Force Wildland Fire Branch taught 57 courses to 796 students for the Air Force and partner organizations. The Air Force also partners with the Army Wildland Fire Program to deliver 12 additional higher-level wildland fire training courses to develop a 5-year annual average of 40 Air Force natural resources, fire, and emergency services personnel. Training and qualifications follow national standards in wildland fire management set by the National Wildfire Coordinating Group (which is also used by the U.S. Forest Service, DOI, and National Association of State Foresters).

TIMELINE SUMMARY OF MAJOR MILESTONES

SEE THE 2021 CAP FOR ALL PREVIOUS CLIMATE-RELATED ACTIVITIES.

2021

- Secretary of Defense signs the *Department of Defense Climate Adaptation Plan* in September
- Secretary of Defense signs the *Department of Defense Climate Risk Analysis* in October

2022

STRATEGIES AND PLANS:

- DOD releases *Securing Defense-Critical Supply Chains*, an action plan developed in response to President Biden's *EO 14017*, in February
- Department of the Army publishes *United States Army Climate Strategy* in February
- DOD releases the *Department of Defense Equity Action Plan* in April
- DON releases *Climate Action 2030* in May
- DAF releases the *Department of the Air Force Climate Action Plan* in October
- Department of the Army releases the *Army Climate Strategy Implementation Plan Fiscal Years 2023–2027* in October
- Secretary of Defense signs the *Climate Adaptation Plan 2022 Progress Report* in October
- DOD includes climate in the *2022 National Defense Strategy* released in October
- DOD releases the *2022 Department of Defense Sustainability Plan* in November

BUDGET:

- DOD OUSD (Comptroller) includes *Meeting the Climate Challenge* in the FY 2023 budget materials in April
- DOD includes climate-related risk in the Other Information section of the *United States Department of Defense Agency Financial Report for Fiscal Year 2023* in September
- DOD releases the *DOD Strategic Management Plan for Fiscal Years 2022–2026* in October

SELECT REPORTS TO CONGRESS:

- DOD submits the *Department of Defense 2021 Climate Change Adaptation Roadmap* in February
- DOD submits *Improving Water Management and Security on Military Installation*s in April
- DOD submits *Report on Effects of Extreme Weather on the Department of Defense* in April
- DOD submits *Strategic and Operational Impacts of Extreme Weather on the Department of Defense* in May

TOOLS AND CAPABILITIES:

- DOD makes climate exposure assessments available for all major U.S. installations using DCAT in April
- DOD adds flooding and permafrost data crosswalk with DOD buildings to DCAT in May
- DOD added environmental justice layers from the Climate and Economic Justice Screening Tool (CEJST) and EPA's EJScreen Tool to the Defense Installations Spatial Data Infrastructure Program in September
- DOD conducts a Department-wide Climate Literacy Pulse Check questionnaire in November
- DOD conducts first Department-wide Climate Literacy Focus Groups in December

POLICY:

- The Office of the Assistant Secretary of the Army for Installations, Energy, and Environment (ASA (IE&E)) releases the *Installation Climate Resilience Plan (ICRP) of the Installation Master Plan* memorandum in February
- DOD releases *Directive-type Memorandum (DTM) 22-003, "Flood Hazard Area Management for DOD Installations"* in June
- Department of the Army releases *Guidance for Installation Energy and Water Plans (IEWPs)* in May
- DOD releases the memorandum *Climate Parameters for Wargames* in November
- ASA (IE&E) releases the memorandum *Guidance for Installation Climate Resilience Plans (ICRPs*) in November
- The Office of the Assistant Secretary of the Air Force for Energy, Installations, and Environment and the Office of the Deputy Chief of Staff for Logistics, Engineering and Force Protection, Headquarters U.S. Air Force, releases memorandum *Climate Resilience Considerations in Installation Master Planning* in December

2023

STRATEGIES AND PLANS:

- The United States Space Force releases the *Mission Sustainment Strategy* in March
- DOD releases the *Department of Defense Plan to Reduce Greenhouse Gas Emissions* in April
- DOD releases the *Operational Energy Strategy* in May
- DOD releases the *Climate Adaptation Guide for Cultural Resources* in June
- DOD verbally updated the CEQ on progress on the CAP in July
- DAF releases the *Climate Campaign Plan* in July

BUDGET:

- DOD releases the FY 2024 report on *Enhancing Climate Capability – Mitigating Climate Risk* in March
- DOD includes climate-related risk in the Other Information section of the *DOD Agency Financial Report* in August

TOOLS AND CAPABILITIES:

- DOD adds CEQ's CEJST environmental justice data crosswalk with DOD buildings to DCAT in March
- DOD completes climate exposure assessments on all major overseas installations using DCAT in April
- DOD makes DCAT Analog Tool available to six partner nations in April
- DOD adds climate vulnerability of potential TER-S to DCAT in May
- DOD updates climate exposure data in DCAT Overseas in June
- The Office of the Assistant Secretary of Defense for Energy, Installations, and Environment holds the 2023 DOD Climate Resilience Workshop in July
- DOD releases the beta version of the Water Resilience Dashboard in July
- DOD adds a facility crosswalk with climate hazard exposure layers to the Defense Installations Spatial Data Infrastructure Program in August
- The Office of the Assistant Secretary of Defense for Readiness and National Defense University co-host the first DOD faculty workshop on Military Resilience in an Evolving Climate and Security Environment in September
- DOD supports climate literacy by releasing the public version of DOD Climate Resilience Portal (Climate.mil) in October
- DOD conducts a second Department-wide Climate Literacy Pulse Check questionnaire in October

POLICY:

- Dr. William A. LaPlante, Under Secretary of Defense for Acquisition and Sustainment (USD(A&S)) signs the *Electrification of Standard Building Operations* memorandum in March
- Department of the Army releases the Army Electrification Guidance for Military Construction Projects in May
- DOD reissues DTM 22-003: *Flood Hazard Area Management for DOD Installations* in July
- Assistant Secretary of Defense for Readiness signs memorandum on *Integrating Climate Security Learning Outcomes in Professional Military Education* in August
- Department of the Navy issues the *Department of the Navy Building Electrification Implementation Policy* in November

2024 - 2027

STRATEGIES AND PLANS:

- DOD releases the first *National Defense Industrial Strategy*, signed by Deputy Secretary of Defense in January 2024
- DOD releases the *Resilient and Healthy Defense Communities*, signed by Deputy Secretary of Defense in February 2024

BUDGET:

- DOD assesses any new Congressional climate resilience funding

TOOLS AND CAPABILITIES:

- DOD implements the following DCAT enhancements:
  - Climate dashboard for Guam as a pilot for gridded DCAT
  - Continued work on adding sensitivity and adaptive capacity to DCAT to compute vulnerability
  - Updates to DCAT climate data and information
  - Adding any additional major installations per FY Base Structure Reports plus Service-requested sites
  - Transition to global gridded framework
  - Additional Partner Nation CATs for allies and partners
- DOD develops coastal hazard flood maps for Guam and Commonwealth of the Northern Mariana Islands
- DOD incorporates extreme weather and event damages into existing reporting databases
- DOD continues DOD-wide climate literacy pulse checks and onboarding materials
- DOD builds out the DOD Climate Resilience Portal to secure, CAC-enabled version and tailored mission-essential content
- The Office of the Assistant Secretary of Defense for Energy, Installations, and Environment continues DOD Climate Resilience Workshop

POLICY:

- The Office of the Deputy Assistant Secretary of the Air Force for Environment, Safety, and Infrastructure releases policy memorandum *Electrification of Installations, Standard Building Operations, Flightlines, and Non-Tactical Vehicles (NTV)* in February
- DOD releases *Integrated Installation Resilience Planning DOD Instruction*
- DOD releases *Water Resilience Policy Memorandum*
- DOD releases *Water Resilience Policy DOD Instruction*
- DOD releases *Climate Adaptation Policy Memorandum*
- DOD releases UFC updates, including 2-100-01: *Master Planning and 3-201-01 Civil Engineering*

MEASURING PROGRESS

To advance the Department's warfighting efforts, DOD uses several methods to track strategic objectives, performance goals, and priority metrics. The DOD SMP's Strategic Management Framework outlines strategic priorities and objectives which describe how the DOD will achieve its goals and priorities. In addition to the SMP, each year the Department communicates its commitment to strategic planning and performance management by publishing an Annual Performance Plan (APP) and Annual Performance Report (APR). The APR defines specific performance goals and measures for every fiscal year along with targets for successful implementation of the SMP. APGs within the SMP and the APP also highlight near-term priority policy and management areas.

Table 8. Climate adaptation process metrics.

KEY PERFORMANCE INDICATOR: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.	
PROCESS METRIC (PM)	**AGENCY RESPONSE**
PM 1. Agency has an implementation plan for 2024 that connects climate hazard impacts and exposures to discrete actions that must be taken. (Y/N/Partially)	Yes. The Department's 2021 CAP identifies five LOEs, each discussing discrete actions with focus areas and end states. The DOD's 2024-2027 CAP Implementation Plan will continue to identify and measure discrete actions. The NDS emphasizes the Department's strategic commitment to incorporate climate risk assessments into planning and decision-making processes and lays the path forward to identify discrete actions which must be taken.
PM 2. Agency has a list of discrete actions that will be taken through 2027 as part of their implementation plan. (Y/N/Partially)	Yes. Building upon the 2021 CAP and five LOEs, the DOD developed a list of discrete actions which will be taken through 2027 as part of the Department's implementation plan. For example, UFC 2-100-01: *Installation Master Planning* includes master planning processes and products, including energy and climate resilience requirements.
PM 3. Agency has an established method of including results of climate hazard risk exposure assessments into planning and decision-making processes. (Y/N/Partially)	Yes. DOD has an established method for including climate hazard risk exposure assessment results into all relevant plans, processes, and decisions using such tools as DCAT and DRSL in compliance with *OMB Circular A-11*. See Appendix 3 for how the Department is accounting for climate considerations across the continuum. Guidance from UFC 2-100-01, *Installation Master Planning*, and DOD and Military Department documents mandate that installation professionals include severe weather and climate risk in IDPs and facility projects. Each Military Department has a severe weather and/or climate change playbook or handbook which provides a clear methodology and framework for installation planners.
PM 4. Agency has an agency-wide process and/or tools that incorporate climate risk into planning and budget decisions. (Y/N/Partially)	Yes. Department policy has been updated to require all operations, planning activities, business processes, and resource allocation decisions to consider climate change. Coordination is done across the Planning, Programming, Budgeting, and Execution process. Since 2022, the DOD has reported climate-related risk in the Department's Agency Financial Report.

Table 8. Climate adaptation process metrics (continued).

KEY PERFORMANCE INDICATOR: Climate adaptation and resilience objectives and performance measures are incorporated in agency program planning and budgeting by 2027.	
PROCESS METRIC (PM)	**AGENCY RESPONSE**
PM 5. By July 2025, agency will identify grants that can include consideration and/or evaluation of climate risk. (Y/N/Partially)	Yes. Processes for including climate considerations within the DOD's budgetary documents, including grants, are reflected in a $3.1 billion subset of the FY 2023 budget request and are set forth in the FY 2023 *Meeting the Climate Challenge* report (released in April 2022). The *FY 2024 Enhancing Capability – Mitigating Climate Risk Report* identifies the investments needed for the Department to meet all mission requirements and maintain the ability to operate in all conditions in a $5.1 billion subset of the FY 2024 Budget request. Programs with grants which include climate considerations include but are not limited to: • REPI Program (REPI proposals, REPI Challenge, the NFWF's National Coastal Resilience Fund, the NFWF's ATBC, and the DOI's Readiness and Recreation Initiative); • OLDCC's DCIP, Installation Resilience (IR), PSMI; • SERDP and the ESTCP; • DORIC.
PM 6. Agency modernizes all applicable funding announcements/ grants to include a requirement for the grantee to consider climate hazard exposures. (Y/N/Partially)	Partial. Several programs within the Department, including REPI, have included requirements for grantees to consider climate hazard exposure. The Department will continue to identify funding opportunities where requirements may be made.
KEY PERFORMANCE INDICATOR: Data management systems and analytical tools are updated to incorporate relevant climate change information by 2027.	
PROCESS METRIC	**AGENCY RESPONSE**
PM 1. Agency has identified the information systems that need to incorporate climate change data and information, and will incorporate climate change information into those systems by 2027. (Y/N/Partially)	Yes. The Department is incorporating relevant climate change data into data management systems and analytical tools. The Department uses DCAT and the DRSL Database for screening-level assessments of climate change exposure to identify if and where further, more detailed, studies might be required, depending on the decision and its consequences . Future updates to DCAT include a gridded coverage, secure version that includes vulnerability by adding metrics for climate sensitivity and adaptive capacity and a global, watershed-based approach of climate data to more fully incorporate climate information beyond installations (e.g., supply chain planning, contingency basing, and defense communities).

Table 8. Climate adaptation process metrics (continued).

KEY PERFORMANCE INDICATOR: Agency CAPs address multiple climate hazard impacts and other stressors, and demonstrate nature-based solutions, equitable approaches, and mitigation co-benefits to adaptation and resilience objectives.	
PROCESS METRIC (PM)	**AGENCY RESPONSE**
PM 1. By July 2025, 100 percent of climate adaptation and resilience policies have been reviewed and revised to (as relevant) incorporate nature-based solutions, mitigation co-benefits, and equity principles. (Y/N/Partially)	Partially. The Department has a Performance Measure and Agency Priority Goal under the *DOD SMP FY 2022-2026* to report on the number of policy and technical guidance updates submitted for publishing to the Washington Headquarters Service (WHS). The DOD has reviewed statutory requirements and EOs for updates. The DOD plans to revise the issuances, technical guidance, and UFCs on an ongoing basis. Updates must go through formal coordination and WHS processes. The below target policy updates will cover integrated installation resilience, water resilience, federal flood risk management standards, installation energy resilience, ERCIP, and various UFCs, including master planning and civil engineering. **FY 2024 Target:** Update 12 policies and 4 technical guidance documents. **FY 2025 Target:** Update six policies and four technical guidance documents.
KEY PERFORMANCE INDICATOR: Federal assets and supply chains are evaluated for risk to climate hazards and other stressors through existing protocols and/or the development of new protocols; response protocols for extreme events are updated by 2027.	
PROCESS METRIC	**AGENCY RESPONSE**
PM 1. Agency has assessed climate exposure to its top five most mission-critical supply chains. (Y/N/Partially)	Partial. Through the *Securing Defense-Critical Supply Chains* report, the Department identified four focus areas in which critical vulnerabilities pose the most pressing threat to national security: kinetic capabilities, energy storage and batteries, castings and forgings, microelectronics, and strategic and critical materials.
PM 2. By July 2026, agency has assessed services and established a plan for addressing/overcoming disruption from climate hazards. (Y/N/Partially)	Yes. Updating DCAT to gridded coverage will enable DOD to evaluate climate exposure and risk to supply chains and existing protocols by 2026.
PM 3. Agency has identified priorities, developed strategies, and established goals based on the assessment of climate hazard risks to critical supplies and services. (Y/N/Partially)	Partially. The *Securing Defense-Critical Supply Chains* and *NDIS* reports are DOD's first strategies to ensure supply chain security, including from the effects of climate change. DOD has begun to identify priorities and establish goals based on these assessments and DCAT's evaluation of Defense Supply Centers. DOD will continue to identify priorities and develop strategies as climate hazard risk assessments to critical supplies and services are refined and expanded, e.g., transition of DCAT to a global gridded framework.

Table 8. Climate adaptation process metrics (continued).

KEY PERFORMANCE INDICATOR: By 2027, agency staff are trained in climate adaptation and resilience and related agency protocols and procedures.	
PROCESS METRIC (PM)	**AGENCY RESPONSE**
PM 1. By December 2024, 100% of agency leadership have been briefed on current agency climate adaptation efforts and actions outlined in their 2024 CAP. (Y/N/Partially)	Yes. Agency leadership will be briefed on the current climate adaptation efforts and actions outlined in the 2024–2027 CAP through the DOD Climate Working Group, a senior-level group that coordinates responses and tracks implementation of climate and energy-related directives, actions, and progress.
PM 2. Does the agency have a Climate 101 training for your workforce? (Y/N/Partially) If yes, what percent of staff have completed the training?	Partially. DOD is integrating climate into the education and training its workforce already receives. In addition, introductory climate materials are being offered to all members of the workforce via the DOD Climate Resilience Portal. These include onboarding materials and climate resources tailored to DOD functional areas to help build enduring advantages for our military.
PM 3. By July 2025, 100 % employees have completed climate 101 trainings. (Y/N/Partially)	Partially. DOD will continue to integrate climate into education and training across the human capital life-cycle to meet the workforce where they are and give them the information they need, when they need it, at the right stage of their career. DOD is not pursuing additional, mandatory Climate 101 training for its workforce.

ADAPTATION IN ACTION

The Department took significant steps to address climate-related threats since the publication of the 2021 CAP and the 2022 Progress Report. The DOD invested in increasing its resilience and improving combat capability, all while reducing the Department's contributions to climate change. The 2021 CAP's strategic framework outlined five LOEs to enable the DOD to operate under changing climate conditions, preserve operational capability, and enhance the natural and man-made systems essential to the Department's success.

The DOD continues to review and update performance metrics to reflect the evolving understanding of observed and foreseeable climate impacts to each of the five LOEs. The DOD integrated climate metrics into the Department's strategic objectives and performance goals. The climate metrics remain a senior leader priority. The DOD continues to integrate adaptation resource considerations and cost management (including life-cycle costs) into plans, business processes, material management, acquisition strategies, and associated investment and risk management processes. This work requires analyzing the costs associated with climate impacts to all five LOEs and how to reduce the costs through effective climate change adaptation.

LOE 1: CLIMATE-INFORMED DECISION-MAKING

With senior leader support, the DOD uses climate-informed decision-making. See LOE 1 for a few highlighted activities from a larger compilation of climate resilience efforts across the Department.

LOE 2: TRAIN AND EQUIP A CLIMATE-READY FORCE

The DOD continues to prepare a climate-ready force through appropriate training and equipment. The DOD is preparing combat forces capable of operating under the most extreme and adverse weather and terrain conditions. See LOE 2 for a few highlighted activities from a larger compilation of climate resilience efforts across the Department.

LOE 3: RESILIENT BUILT AND NATURAL INSTALLATION INFRASTRUCTURE

The DOD continues to improve the resilience of built and natural installation infrastructure. See LOE 3 for a few highlighted activities from a larger compilation of climate resilience efforts across the Department.

LOE 4: SUPPLY CHAIN RESILIENCE AND INNOVATION

The DOD continues to innovate and improve the resilience of the supply chain. The DOD is continuing to assess its supply chain resilience and how it can leverage purchasing power to spur innovation and deployment of climate adaptation and mitigation technologies. See LOE 4 above for a few highlighted activities from a larger compilation of climate resilience efforts across the Department.

LOE 5: ENHANCE ADAPTATION AND RESILIENCE THROUGH COLLABORATION

The DOD continues to collaborate to enhance adaptation and resilience. The DOD strengthened existing partnerships, formed new partnerships, and increased the capabilities and capacity of adaptation and resilience programs. See LOE 5 above for a few highlighted activities from a larger compilation of climate resilience efforts across the Department.

APPENDIX 1. RISK ASSESSMENT DATA

The Department of Defense's (DOD's) risk assessment uses the following data:

Buildings. The geospatial data delineating Fiscal Year (FY) 2022 DOD building footprints comes from the Defense Installations Spatial Data Infrastructure database. Climate hazard information sourced from the DOD Climate Assessment Tool (DCAT) at the Real Property Site level was joined to the DOD building dataset via a Real Property Site Unique Identifier.

Personnel. Personnel data comes from the Defense Manpower Data Center combined with climate exposure information from DCAT and the Climate Mapping for Resilience and Adaptation (CMRA) tool. An analysis of climate hazard exposure was conducted for approximately 634,000 DOD Civilians in the Continental U.S. and Alaska. This analysis did not include DOD Civilians for whom full location data was not available, nor those stationed in Hawai'i or outside of the U.S.

Climate Hazards. DOD used climate hazard information within DCAT to analyze climate exposure to extreme precipitation days, high heat days, coastal flood extent, and riverine flood extent.

In addition to this high-level screening, DOD used CMRA data to assess sea level rise exposure to DOD personnel, the Federal Emergency Management Agency (FEMA) National Flood Hazard Layer (NFHL) to assess riverine flood exposure to DOD personnel, and the U.S. Forest Service Wildfire Risk to Communities data to assess potential wildfire exposure of buildings and personnel.

APPENDIX 2. RISK ASSESSMENT MAPS

TEMPERATURE AND PRECIPITATION EXPOSURE TO DOD BUILDINGS

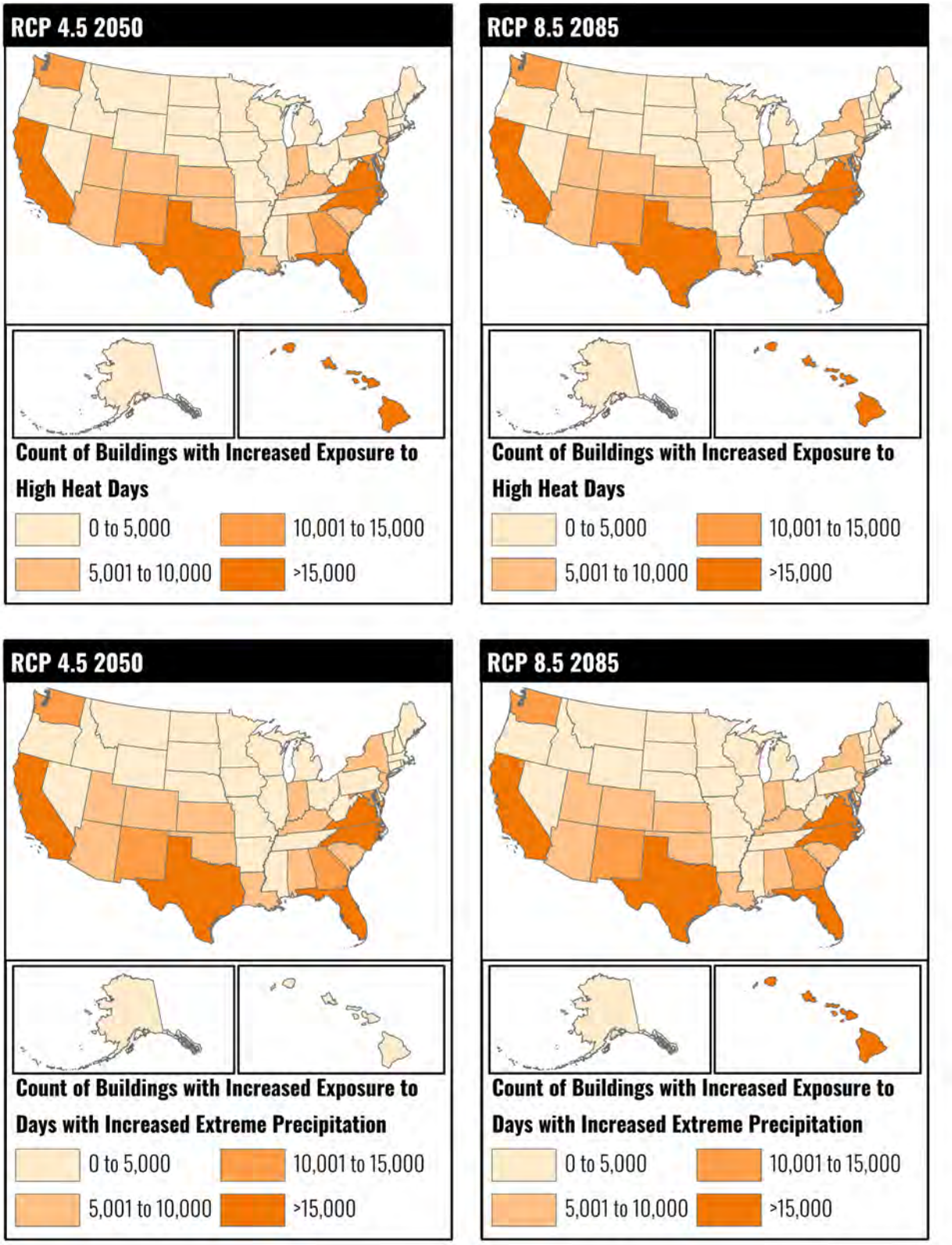


Figure A1. This map series represents the count of DOD buildings in each state that are exposed to either extreme temperature or extreme precipitation under different epoch scenarios, based on geospatial data delineating FY 2022 building footprints, and analysis from DCAT for DOD Real Property Sites. The top row of maps in the series represent the count of buildings in each state that are located at DOD Real Property Sites for which DCAT CONUS/AK/HI indicates potential increased exposure to high heat days under two different epoch scenarios: RCP 4.5 2050 (top left) and RCP 8.5 2085 (top right). The bottom row in the series represent the count of buildings in each state at DOD Real Property Sites for which DCAT CONUS/AK/HI indicates potential increased exposure to extreme precipitation under two different epoch scenarios: RCP 4.5 2050 (bottom left) and RCP 8.5 2085 (bottom right).

COASTAL AND RIVERINE INUNDATION EXPOSURE TO DOD BUILDINGS

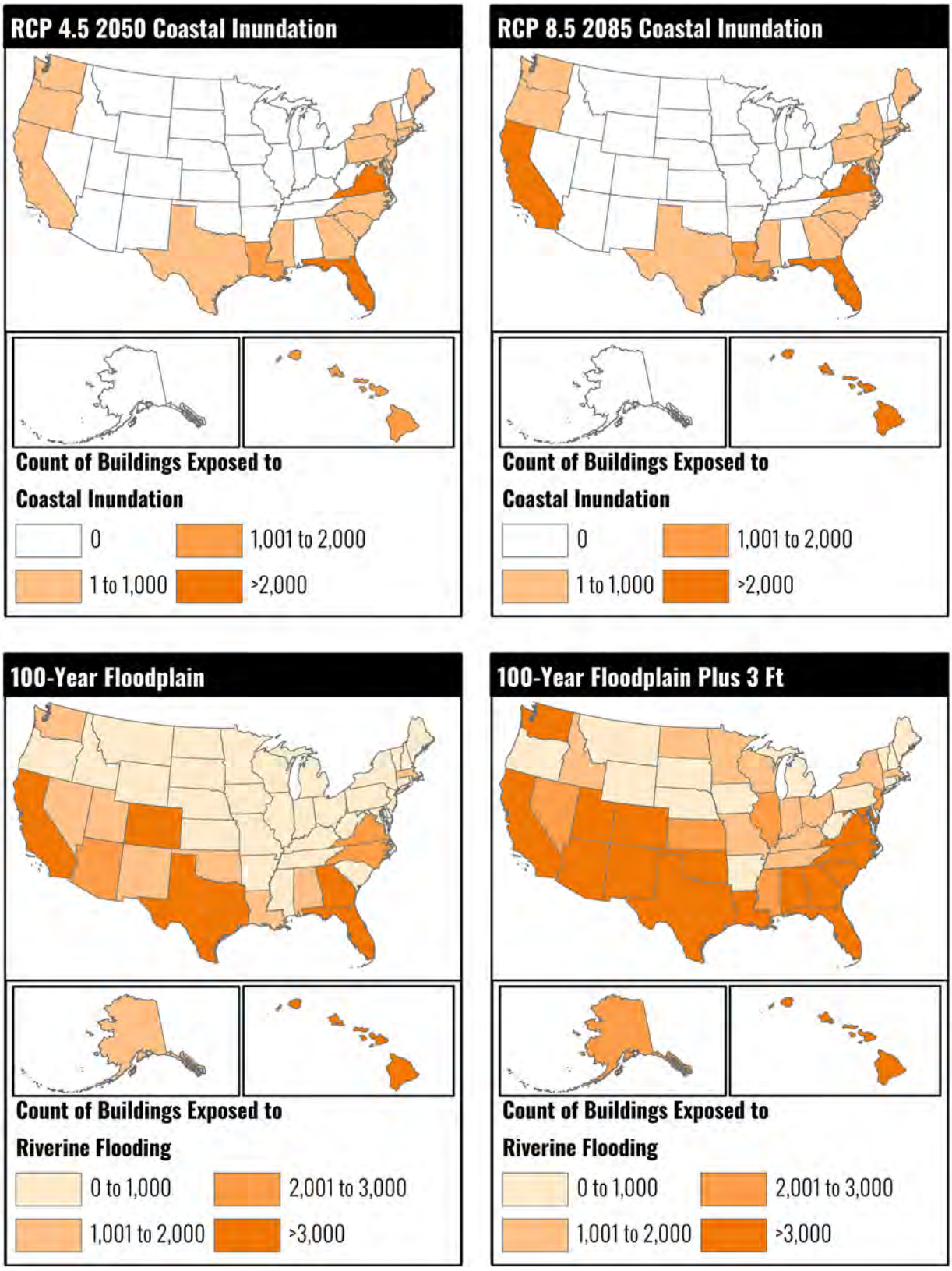


Figure A2. This map series represents the count of DOD buildings in each state that are exposed to coastal or riverine inundation under different scenarios, based on geospatial data delineating FY 2022 building footprints, and the geographic extent of potential coastal and riverine flooding used in DCAT for CONUS/AK/HI. The top row of maps in the series represent the count of buildings in each state that are located within the extent of coastal flood exposure under two different epoch scenarios: RCP 4.5 2050 (top left) and RCP 8.5 2085 (top right). The bottom row in the series represent the count of buildings in each state that are located within the extent of the 100-year floodplain for riverine systems (bottom left) and the 100-year floodplain plus 3 feet (bottom right).

WILDFIRE EXPOSURE TO DOD BUILDINGS

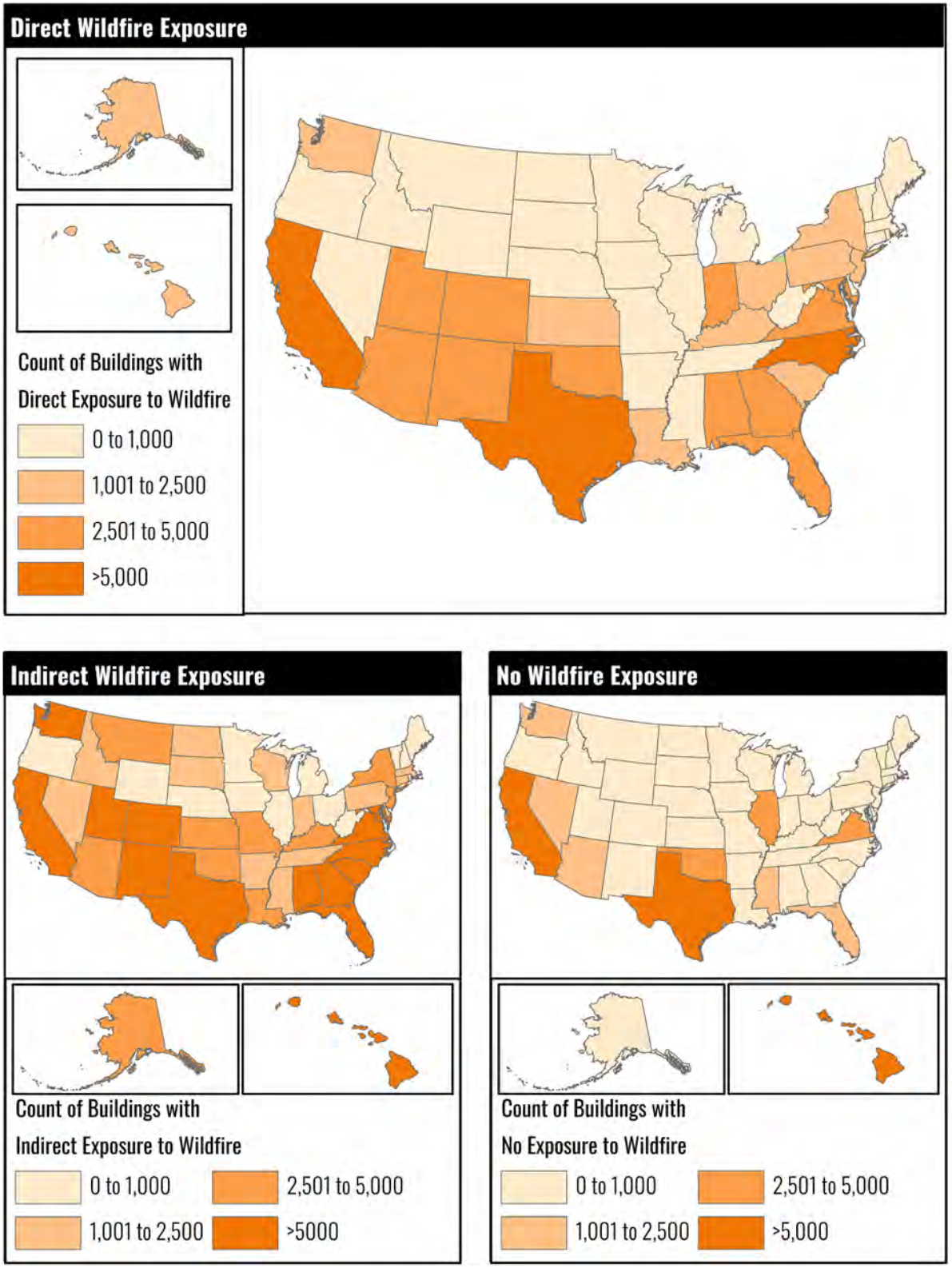


Figure A3. This map series represents the count of DOD buildings in each state that are either directly exposed (top), indirectly exposed (bottom left), or not exposed (bottom right) to wildfire risk as a function of their location, based on geospatial data delineating FY 2022 building footprints and wildfire exposure data made available from the U.S. Forest Service Research Data Archive (citation below).

Citation: Scott, Joe H.; Gilbertson-Day, Julie W.; Moran, Christopher; Dillon, Gregory K.; Short, Karen C.; Vogler, Kevin C. (2020). Wildfire Risk to Communities: Spatial datasets of landscape-wide wildfire risk components for the United States. Fort Collins, CO: Forest Service Research Data Archive. Updated 25 November 2020. https://doi.org/10.2737/RDS-2020-0016

APPENDIX 3. DOD WEATHER TO CLIMATE CONTINUUM

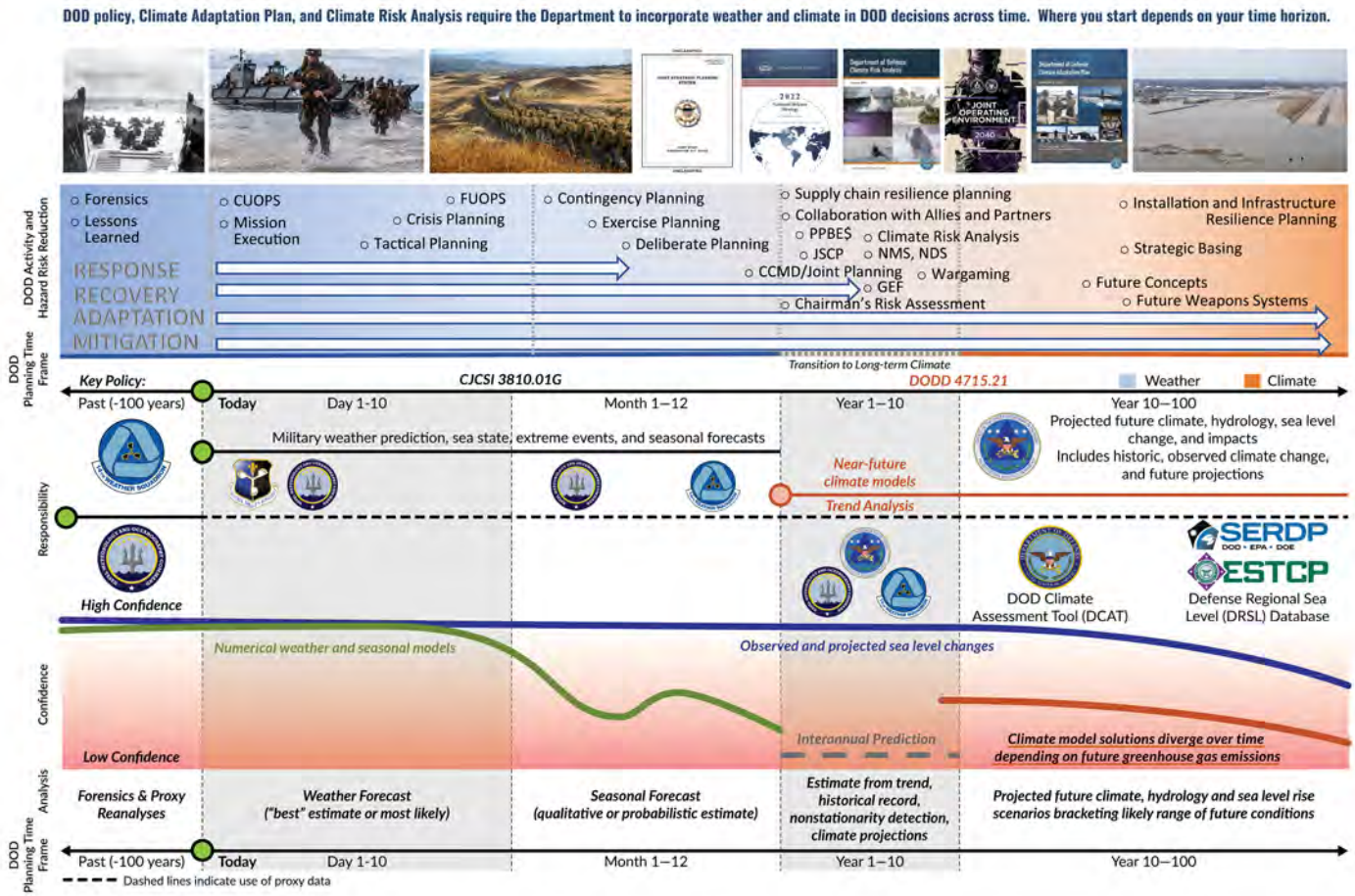


Figure A4. The weather-to-climate continuum is a graphical representation of DOD activities, planning timeframes (from historical to the end of the century), key policies, authoritative climate information sources, relative confidence levels in the weather and climate information, and typical analyses across time. The Office of the Secretary of Defense, Department of the Navy (DON), and Department of the Air Force (DAF) Meteorological and Oceanographic communities and where their decision-space lies are represented by the appropriate office symbol. As noted in the 2022 Climate Adaptation Plan Progress Report, the infographic is the collaborative result of senior Department subject matter experts to identify the proper points of entry for DOD user questions along the continuum of weather to climate change. As shown, the DON and DAF already have several existing weather and past climatology tools and decision aids. These allow decision-makers to understand climate trends to date to set a context for how future projected climate conditions vary from this observed baseline. Data and information from these tools and systems will be integrated with climate projection information as appropriate for strategic, operational, and tactical decisions. Climate information gaps and uncertainty at various points in the continuum point to important research needs. The 1- to 10-year look-ahead period is the most uncertain time horizon, with critical DOD activities such as the National Defense Strategy and budget planning, in that timeframe, requiring both weather and climate expertise to shape and inform those activities. This gap area is currently being addressed through further consideration of four proposals received under the supplemental statement of need Strategy, Framework, and Datasets to Bridge the Weather-to-Climate Continuum Gap in DOD Weather and Climate Change Exposure Assessment, Adaptation, and Resilience, in August 2023.

Tammy West
Keep It Together
(2021, Site-Specific Environmental Art)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.

AMERICAN CONSERVATION AND STEWARDSHIP ATLAS

Supporting Conservation Ambition and Progress across the U.S.

Background

In January 2021, President Biden established the United States' first-ever national conservation goal: to protect, conserve, and restore at least 30 percent of U.S. lands and waters by 2030. To help reach this goal, the Biden-Harris administration launched the *America the Beautiful* initiative – a decade-long effort to tackle the climate and nature crises, create jobs and strengthen the economy, and increase equitable access to nature by supporting locally led, voluntary, community-designed, and partnership-driven work to

conserve the lands and waters upon which we all depend, and which bind us together as a country.

As part of the *America the Beautiful* initiative, Federal agencies began working to develop the American Conservation and Stewardship Atlas (Atlas) – a data and mapping project that aims to better reflect the full scope, scale, and progress of conservation efforts across the U.S.

The Interactive Map

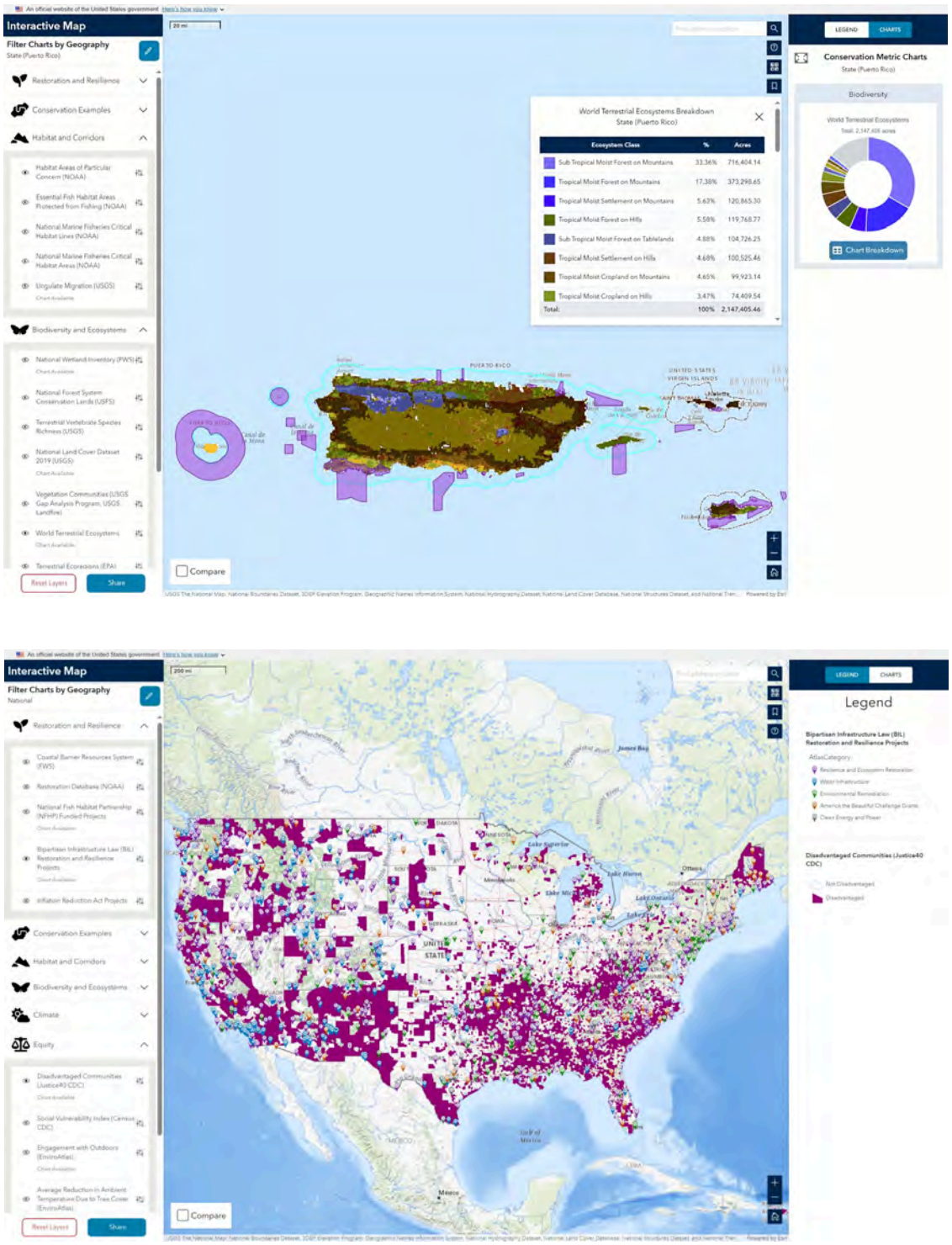
Development of the Atlas is an ongoing effort that will expand and evolve as additional data and resources are integrated. The preliminary – or beta – version of the Atlas includes multiple elements, including resources to explore restoration and resilience projects funded through the Bipartisan Infrastructure Law and the Inflation Reduction Act, a growing catalog of relevant Federal data, a gallery of conservation-related web platforms from across the Federal government, and an interactive map. The interactive map currently presents a wide range of Federally managed data layers, as well as updates on locally led conservation efforts across the country. These data layers showcase the richness and diversity of U.S. conservation efforts and present critical information about the status of our nation's lands, waters, wildlife, and natural systems.

This beta version of the Atlas also provides data and information that can be useful for establishing and assessing progress toward Tribal, State, territorial, regional, and local conservation goals and objectives. Data and mapping layers from the Atlas, for example, may help a local land trust identify opportunities and priorities for conserving key wildlife migration corridors, restoring hydrologic connectivity, or protecting drinking water sources.

The Atlas can also be used to track progress in the protection, conservation, and restoration of lands and waters at the national scale. In the Atlas' interactive map, users can scroll through data layers, including a layer that highlights major ecological restoration projects across the country that are funded by the President's Investing in America agenda. Another data layer, Protected Areas for Biodiversity Conservation, displays lands and waters that are permanently protected, such as lands within national parks, national marine sanctuaries, and wilderness areas.

Importantly, this beta version of the Atlas also begins to provide a picture of how and where lands and waters in the U.S. are conserved, which – as reflected in President Biden's vision for the *America the Beautiful* initiative – includes a broad range of efforts by ranchers, farmers, fishermen, forest owners, Tribal Nations, and communities to durably safeguard the health and integrity of the lands

and waters upon which we all depend.



The interactive map features available and relevant climate, biodiversity, and equity data.

A Locally Led Approach

To help inform how the Atlas collects, organizes, and presents information about conservation efforts across the country, a working group of Federal agencies – organized by the White House Council on Environmental Quality (CEQ) and composed of the Department of the Interior (DOI), U.S. Department of Agriculture (USDA), and the National Oceanic and Atmospheric Administration (NOAA) – invited public input and comments, and organized a series of public listening sessions.

This public input, including the more than 34,500 comments received, was invaluable to the development of Conservation.gov and the beta version of the Atlas, and to informing how the administration begins to assess numerical progress toward the goal of conserving at least 30 percent of lands and waters by 2030.

Based on the public input received, the administration has developed a preliminary framework for assessing progress toward the nation's goal of conserving at least 30 percent of U.S. lands and waters by 2030. This preliminary framework, which is summarized in the diagram below, reflects an inclusive vision for the types of strategies, programs, and initiatives that lead to positive conservation outcomes for lands, waters, and wildlife, while also

reflecting the importance of conservation outcomes that are sustainable and durable over time.

The continuum of conservation efforts incorporated into the preliminary framework includes lands and waters that have traditionally been considered to be “permanently protected” (including national parks, national monuments, wilderness areas, national marine sanctuaries, and national estuarine research reserves), as well lands and waters where data show that they will remain conserved long-term (such as time-bound conservation easements, roadless areas, or deep-sea coral protections). Importantly, the preliminary framework identifies several conservation actions where additional data, analysis, and input are needed to enable an assessment of progress toward the national conservation goal. Additionally, as areas are further analyzed and regularly assessed, they may shift along the continuum.

Management Lands that are Conserved and Restored. Listed examples are representative and do not include all lands and waters contributing to conservation.

Conservation Progress on Lands and Waters

Although additional data and analysis are needed to fully build out the preliminary framework, a review of existing information in the beta version of the Atlas yields several key updates on the status and trends of conservation efforts across the country. In particular:

- **Since the launch of the *America the Beautiful* initiative in early 2021, the U.S. has experienced one of the most rapid accelerations of conservation progress in U.S. history,** with more than **41 million acres of land and water** conserved in three years. These conservation gains include five new national monument designations including the Baaj Nwaavjo I'tah Kukveni – Ancestral Footprints of the Grand Canyon National Monument in Arizona and Avi Kwa Ame National Monument in Nevada that help protect Tribes' ancestral and sacred lands; restoration of protections for more than nine million acres of the Tongass National Forest in Alaska; mineral withdrawals in the Boundary Waters of Minnesota,

Thompson Divide of Colorado, and of Chaco Canyon in New Mexico; designation of the Wisconsin Shipwreck Coast National Marine Sanctuary in Lake Michigan and the Long Island Sound National Estuarine Research Reserve; a 4.3 million-acre expansion of private working lands that are being conserved through the Conservation Reserve Program; the creation of four new national wildlife refuges; and more than 500,000 acres of new agricultural conservation easements that are helping protect ranches, farms, and forests for future generations.

Examples of Conservation Gains:

Baaj Nwaavjo I'tah Kukveni National Monument

Arizona
999,680 acres protected

Lost Trail Conservation Area

Montana
38,052 acres protected

Restoration of Protections for Tongass National Forest

Alaska
9,368,000 acres protected

Wisconsin Shipwreck Coast National Marine Sanctuary

Wisconsin
615,680 acres protected

Restoration of Protections for Grand Staircase-Escalante National Monument

Utah
1,870,000 acres protected

- **The acceleration of locally led conservation and restoration efforts since 2021 is being enabled by unprecedented, generational investments led by President Biden through efforts including the Bipartisan Infrastructure Law and the Inflation Reduction Act, in addition to the Great American Outdoors Act.** Data presented in the Atlas demonstrate how these investments are reducing restoration backlogs on public lands, expanding outdoor opportunities in nature-deprived communities, restoring fish passage, improving

Ritika S.
Youth Entry, Grade 8
Redrawing the Earth
(2023, Colored Pencil)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.

The Climate Resilience Game Changers Assessment

July 2024

THE WHITE HOUSE
WASHINGTON

Table of Contents

Advancing the National Climate Resilience Framework & Catalyzing American Innovation in Climate Resilience

The National Climate Resilience Framework, released by the Biden-Harris Administration in September 2023, set a core objective of catalyzing innovation and mobilizing investment to advance equitable climate resilience at scale.[1] Climate resilience is a major investment opportunity that also safeguards other investments. Some analysts estimate that the global market for climate resilience could be worth as much as $2 trillion by 2026. By other evaluations, however, less than 10% of global climate finance currently targets adaptation and resilience—$63 billion out of a total of $1.27 trillion—and 98% of investment comes from the public sector.

Private and philanthropic investors may perceive climate resilience projects as harder to benchmark and measure than climate mitigation projects, making returns more uncertain. Recent efforts to assess the economic returns from specific climate resilience investments, however, have indicated that certain investments could generate nearly fourfold net benefits over the course of a decade. The *Climate Resilience Game Changers Assessment* identifies a set of specific technologies and solutions for which thoughtful, targeted investments have the potential to prepare the U.S. for current and future impacts of climate change in game-changing ways.

As noted in the Fifth National Climate Assessment, "while adaptation planning and implementation has advanced in the U.S., most adaptation actions to date have been incremental and small in scale. In many cases, more transformative adaptation will be necessary to adequately address the risks of current and future climate change." An equitable and sustainable U.S. response to climate change has the potential to reduce climate impacts while improving well-being, strengthening resilience, benefiting the economy, and, in part, redressing legacies of racism and injustice. Transformative adaptation comes with challenges and trade-offs that would need to be considered to avoid exacerbating or creating new social injustices.

This assessment is designed as a companion to *U.S. Innovation to Meet 2050 Climate Goals*, a 2022 report that identified opportunities for accelerating progress to help the United States reach its 2050 net-zero emissions goal and support global decarbonization. Just as the 2022 report employs innovation to realize the vision of a net-zero nation, the *Climate Resilience Game Changers Assessment* focuses on the American innovation needed to build and empower a climate-resilient nation: one that can endure, adapt, and evolve in the face of current and future climate conditions. This assessment also implements Objective 3 of the National Climate Resilience Framework: to mobilize capital, investment, and innovation to advance climate resilience at scale.

This assessment is intended for use by a diverse set of stakeholders, including private, philanthropic, and non-governmental organizations, as well as federal, state, Tribal, territorial,

[1] In alignment with the National Climate Resilience Framework, this assessment defines "resilience" as the ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions. The term "climate resilience" is used in a matter that is intentionally broad and inclusive of the term "climate adaptation."

and local governmental entities, to help generate new ideas and align potentially catalytic investments and incentives. While this report does not comprise a final or exhaustive list of game-changing solutions for climate resilience, developing and widely deploying these solutions is critical to building a climate-resilient nation.

Developing the Climate Resilience Game Changers

This document was created through an interagency process under the Climate Resilience Game Changers Working Group, organized under the Climate Resilience sub-Interagency Policy Committee of the Recovery Interagency Policy Committee. The Climate Resilience Game Changers Working Group is co-chaired by the White House Climate Policy Office, White House Office of Science and Technology Policy, and White House Council on Environmental Quality, and includes members from the departments and agencies listed below.

Federal Emergency Management Administration (FEMA)
General Services Administration (GSA)
National Oceanic & Atmospheric Administration (NOAA)
National Science Foundation (NSF)
U.S. Army Corps of Engineers (USACE)
U.S. Department of Agriculture (USDA)
U.S. Department of Defense (DOD)
U.S. Department of Energy (DOE)
U.S. Department of Health & Human Services (HHS)
U.S. Department of Homeland Security (DHS)
U.S. Department of Housing & Urban Development (HUD)
U.S. Department of the Interior (DOI)
U.S. Department of Transportation (DOT)
U.S. Environmental Protection Agency (EPA)
White House Climate Policy Office (CPO)
White House Council on Environmental Quality (CEQ)
White House Office of Science & Technology Policy (OSTP)

References and hyperlinks throughout this document support concepts or provide examples of pilot programs, projects, or analogous initiatives to the Game Changers. Where non-governmental references are used, the authors selected examples, articles, or papers that, in their judgment, supported or illustrated the Game Changer or topic being discussed.

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The Need for Breakthrough Innovation in Climate Resilience

Climate change is causing devastating and deadly impacts across the country and around the world. In 2023 alone, communities across the United States experienced extreme heat waves that pushed temperatures to triple digits for days or weeks on end, choking wildfire smoke in areas that had never experienced fires before, and record-breaking floods that washed away property and livelihoods. Extreme-weather events drove more than 2.4 million Americans out of their homes, from Lahaina, Hawai'i to Montpelier, Vermont. Extreme events led to a record-breaking 28 disasters in 2023 that inflicted at least $1 billion of damage each—more than twice the inflation-adjusted average annual number of billion-dollar disasters from 2010 to 2019 and roughly ten times the annual average in the 1980s. At the same time, chronic climate impacts like sea-level rise, habitat loss, repetitive flooding, and changes in rain and snow patterns are creating significant long-term stress on American lives, communities, homes, and the economy. By one analysis, the costs of flooding alone are between $180 billion and $496 billion annually.

While all communities are feeling the impacts of climate change, not all communities are experiencing these impacts equally. Fossil-fuel-based energy systems have resulted in disproportionate public health burdens on communities with environmental justice concerns, including communities of color, low-income communities, Tribal Nations, and both rural and urban areas—from the coasts to former coal communities inland. Many of these same communities are also disproportionately harmed by climate change impacts. The National Climate Resilience Framework recognized the need to advance environmental justice for all, including by addressing the cumulative impacts of climate and other burdens on communities with environmental justice concerns who are most in harm's way.[2]

President Biden's historic Inflation Reduction Act—the largest-ever single investment in tackling the climate crisis—and Bipartisan Infrastructure Law dedicate over $50 billion for climate resilience, in addition to the hundreds of billions of dollars helping reach national goals of cutting carbon pollution in half by 2030 and achieving a fully net-zero economy by 2050. These historic pieces of legislation are the foundation of the American playbook to tackle climate change and advance environmental justice, and have attracted major follow-on investment in clean technologies, materials, and other climate solutions. Many of these federal dollars also benefit, through the President's Justice40 Initiative, the disadvantaged communities most impacted by climate change, pollution, and historic underinvestment.[3]

But even with a rapid reduction in global greenhouse gas emissions, some climate impacts are expected to persist for decades to come. Preparing for these impacts by investing in climate resilience as well as climate mitigation, is therefore both a social and economic imperative. As noted in the National Climate Resilience Framework, achieving the vision of a climate-resilient

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[2] See Executive Order 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*, 88 FR 25,251 (Apr. 26, 2023).

[3] Through the Justice40 Initiative, the federal government has made it a goal that 40 percent of the overall benefits of certain climate, clean energy, affordable and sustainable housing, and other federal investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution, also known as "Justice40 communities." President Biden made this historic commitment when he signed Executive Order 14008 on *Tackling the Climate Crisis at Home and Abroad* within days of taking office.

nation will require developing and deploying solutions that respond directly to climate threats and that serve as the tools in our nation's toolbox for building climate resilience.

To create a common understanding of these "tools," this assessment identifies *Climate Resilience Game Changers* that capture innovative, equitable, and scalable technologies, practices, and strategies that are ripe for research, development, and further investment by a wide range of stakeholders.

Climate Resilience Game Changers

A *Climate Resilience Game Changer* is defined here as a practice, methodology, technology, or institutional, financial, or governance structure that (1) has been identified, prototyped, developed, or significantly refined in the last ten years, (2) has not reached the point of widespread adoption, and (3) if widely and appropriately adopted, would achieve or substantially advance one or more of the objectives of the National Climate Resilience Framework.

Climate Resilience Game Changers include:

- **Management Practices and Methodologies**: Novel (limited-to-no commercial adoption) or significantly improved (much cheaper, more flexible, or more effective) practices that will improve the resilience and adaptability of various systems under changing—and often more challenging—climate conditions.
- **Technologies**: Novel or significantly improved technologies that reduce adverse effects of climate change or improve the adaptive capacity of individuals, communities, and ecosystems.
- **Institutional, Financial, and Governance Structures**: Novel or significantly improved organizational approaches that anticipate and respond to climate impacts, promote resilience-enhancing co-benefits, and reflect the interconnectedness of individuals, communities, and ecosystems.

In this assessment, the Climate Resilience Game Changers Working Group identified the solutions shown below in Figure 1, organized into **sector-specific categories**. The working group acknowledges that many solutions intersect with multiple sectors. For instance, virtual power plants (VPPs) primarily support resilience of the electricity sector by stabilizing power grids and supporting integration of multiple renewable power sources. VPPs also intersect with buildings insofar as rooftop solar installations can be VPP components. For the sake of clarity and scope, the working group assigned each solution to the most relevant sector-specific category. A select number of solutions were determined to have substantial relevance to most or all sectors; these are referred to as **cross-cutting solutions**.

Consistent with the National Climate Resilience Framework, the Working Group acknowledges and emphasizes that there is no universal approach to building climate resilience. Because communities experience climate change in different ways and respond according to their unique needs, capacities, characteristics, histories, and cultures, approaches to building climate resilience must be locally-tailored and community-driven. Bolstering climate resilience often involves systemic change and integration of multiple approaches. While the individual solutions identified in this assessment each hold standalone game-changing potential, they will be most

powerful if deployed as part of a thoughtful, comprehensive, and equitable climate resilience strategy that includes meaningful public engagement and aims to advance environmental justice.

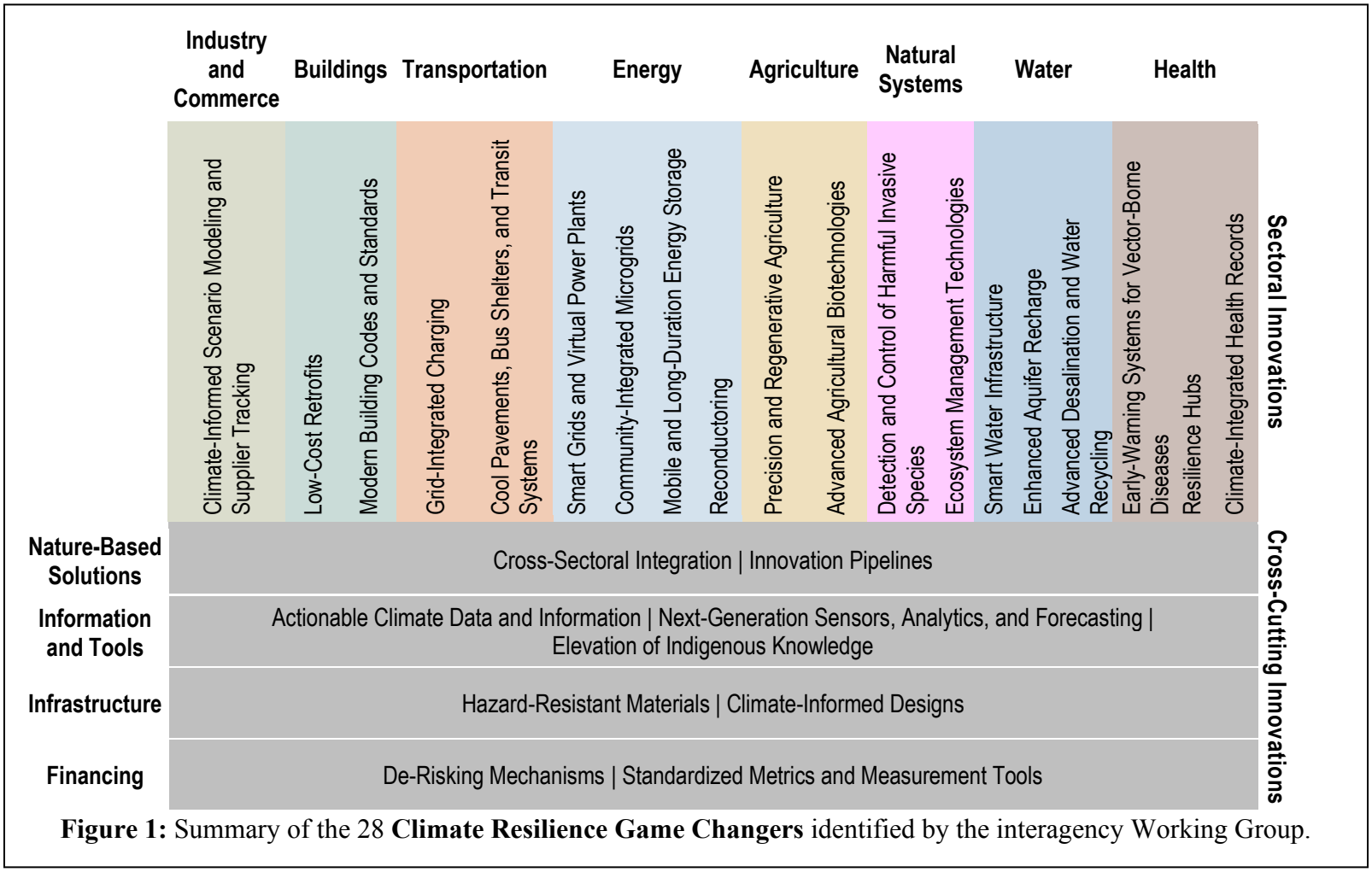

Figure 1: Summary of the 28 **Climate Resilience Game Changers** identified by the interagency Working Group.

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Principles of Climate Resilience

In developing this list of solutions, the Working Group adopted the Principles of Climate Resilience outlined in the National Climate Resilience Framework. These principles were used to curate the list of game-changing solutions and should be applied as a lens to implementing them.

Proactive. *Implement solutions that anticipate and address climate threats and impacts before damages occur. Prioritize activities and investments through risk-based approaches, including approaches that account for complex risks, like cascading impacts and concurrent events, as well as approaches that account for differences in vulnerability and response capabilities within and across communities.*

Whole-System. *Consider the ways in which communities and natural systems are interconnected, including recognizing that risks and impacts from climate change are borderless. Strive both to leverage synergies (e.g., when increased resilience of one community contributes to the resilience of others) and to avoid maladaptive activities (e.g., when efforts to increase resilience in one community impose harms on another).*

Equitable and Just. *Pursue solutions that address, and do not exacerbate, disparities between and within communities. Ensure that strategies respond to the needs of underserved and marginalized communities that have historically borne a disproportionate share of climate impacts and costs.*

People-Centered. *Position the well-being of individuals, families, communities, and society at the center of goals and solutions. Consider the needs and perspectives of all community members, including those that are most vulnerable and have been historically marginalized or disadvantaged.*

Collaborative and Inclusive. *Work across sectors to identify and pursue shared goals. Create pathways for all community members to be meaningfully involved in decision-making, and conduct active outreach to raise awareness of these pathways and address barriers to participation.*

Durable. *Implement solutions that serve current and future needs. Ensure that there is continuity of technical expertise and leadership as needed, including by enhancing or building community capacity to sustain and adapt solutions for the long term.*

Multi-Benefit. *Prioritize solutions, including nature-based solutions, that enhance climate resilience, while simultaneously advancing other community, economic, and societal objectives.*

The Climate Resilience Game Changers Assessment operationalizes these principles by proactively identifying innovative solutions that can, with additional investment, adoption, and equitable delivery, uplift local economies and enhance overall community wellbeing. The Assessment also promotes increased access to capital for solutions with the potential for transformational local impacts in frontline communities, and those communities that experience the worst effects of climate change.

Prospective Benefits of Climate Resilience Game Changers

Investing in, developing, and implementing the Climate Resilience Game Changers will strengthen our health, environment, economy, equity, and security. Several studies have documented high returns for investments in climate resilience solutions. Research from the National Institute for Building Sciences and the U.S. Chamber of Commerce, as well as a report from the U.S. Agency for International Development (USAID), the Global Resilience Partnership, and the Boston Consulting Group have concluded that every dollar spent to implement common adaptation and resilience measures can yield up to $13 in financial benefits. The Global Commission on Adaptation has similarly estimated that investing $1.8 trillion in adaptation and resilience worldwide from 2020 through 2030 could deliver $7.2 trillion in a "triple dividend" of economic, social, and environmental benefits and avoided losses. Investments in innovative resilience measures—such as the Climate Resilience Game Changers—can therefore significantly reduce the estimated costs of climate damage.

If implemented effectively and equitably, the Climate Resilience Game Changers can help communities avoid disruption and damage to human health and wellbeing. Investing in these promising and emerging technologies, practices, and strategies at early stages will enable their rapid deployment before, during, and immediately after disasters. For example, new sewers, flood walls, and other infrastructure improvements in Hoboken, New Jersey allowed the city to withstand 3.5 inches of rain in one day in September 2023, thanks in part to an early investment by HUD's Rebuild by Design competition, launched in 2013. This investment was the result of a game-changing policy and funding innovation—the first-ever set-aside of HUD Community Development Block Grant Disaster Recovery funding devoted to incentivizing the development of regionally-scalable and locally-contextualized resilience solutions, deployed through a competition in partnership with philanthropic, academic, and nonprofit organizations.

Finally, the Climate Resilience Game Changers Assessment is itself a novel step towards coordinating and catalyzing philanthropic and private investments in climate resilience innovation. While this document may highlight a specific set of technologies, practices, and strategies that are innovative at the time of publishing, it has the potential to be updated as technologies advance, markets evolve, and conditions change.

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Climate Resilience Game Changers

Cross-Cutting Innovations

Nature-Based Solutions

Cross-Sectoral Integration

Management practices and methodologies; Institutional, financial, and governance structures

Nature-based solutions (NBS) leverage natural features and processes to enhance resilience and produce economic, environmental, and societal co-benefits. While NBS are increasingly considered in adaptation planning—particularly, under the Biden-Harris Administration's leadership—more systematic and equitable integration of NBS into relevant projects and decision-making processes where appropriate would be a game-changing innovation. Developing replicable pathways to scale up these approaches is also a core component of the National Climate Resilience Framework. And as with the clean energy transition, strategic, purposeful, coordinated investment can accelerate new partnerships and rapid progress.

Opportunities to promote cross-sectoral innovation include:

- Developing engineering guidelines, certification schemes, manuals, and standards to facilitate strategic deployment of NBS.
- Creating a comprehensive clearinghouse of high-quality NBS information and projects to facilitate partnership development, faster permitting, technical assistance, market viability assessment, and matchmaking to funding opportunities.
- Developing consistent approaches to facilitating NBS regulatory review and permitting, which may include regional partnerships, bundling of similar projects, and consideration of net social benefits of NBS strategies over their lifespans.
- Expediting environmental impact reviews and permitting for NBS at all levels of government, especially in response to time-sensitive needs (for example, before, during, and after emergencies occur).
- Creating new or improved research, decision-support, and technical tools, particularly those designed for use by Tribal, rural, or insular communities, for developing, monitoring, and evaluating NBS outcomes. Effective tools would include comparisons against alternatives, account for short- and long-term benefits, and account for particular benefits to communities with environmental justice concerns.

Efforts in this area could build on extensive work by the Biden-Harris Administration and many non-federal stakeholders and federal agencies—including EPA, DOI, the Federal Highway Administration (FHWA), FEMA, the Millennium Challenge Corporation, NOAA, and USACE.

Innovation Pipelines

Technologies; Management practices and methodologies

While many resilience practitioners already acknowledge that NBS can have benefits, game-changing opportunities to build knowledge remain untapped in key areas.

For example, targeted investments in research and development (R&D) of NBS that are deployable at variable scales and geographies, as well as in monitoring and quantifying the long-term effectiveness of these projects, could make scaling and replicating NBS much easier. Establishing new NBS-focused research and extension institutes, NBS incubators, and NBS prize competitions[4] targeted to this goal could drive collaborative action and signal demand to markets.

Investments could also establish new philanthropic or governmental NBS "test beds." Supporting scalable NBS pilot projects[5] would provide invaluable low-risk and high-value opportunities for modeling, monitoring, and demonstrating the value of emerging NBS applied across a range of environments. These "test beds" could also support the development of engineering standards that address performance, reliability, and maintenance costs.

Information and Tools

Actionable Climate Data and Information

Technologies; Management practices and methodologies

Local decisionmakers depend on climate information to assess and communicate risk levels, but often require extensive training, workforce development, or financial resources to use it productively. While a wealth of valuable resources for climate information on regional and national scales already exists,[6] decisionmakers may find it difficult to use this information at a local level. Enabling existing information to be more locally-tailored, accessible, and relevant for decision-making would be a game changer. Some examples include:

- Refining techniques to downscale and visualize national datasets, climate projections, and other climate risk data to make these data more actionable and accessible for community groups and local governments.[7]
- Incorporating new information and tools—such as multi-hazard exposure assessments or early-warning systems—into existing data products (such as real estate postings).
- Developing software to make climate risk visualizations more informative and easier to create, and taking full advantage of new hardware capabilities to enhance climate risk communications. For example, the U.S. Fire Administration is using augmented reality and geospatial tools to improve risk communication in the wildland-urban interface, and the Centers for Disease Control and Prevention (CDC) and the National Weather Service's experimental HeatRisk tool is integrating local climatology and public health information with temperature data to map and forecast overall heat risk.

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[4] For example, see the Department for Homeland Security's Science and Technology Prize Competitions, the NSF's Regional Innovation Engines, and the interagency Civic Innovation Challenge.

[5] For example, in partnership with city parks departments, state and territorial coastal management programs, the National Estuarine Research Reserves, the National Wildlife Refuge System, or the National Park System.

[6] For example, see the U.S. Climate Resilience Toolkit, the Climate Mapping for Resilience and Adaptation portal, and the National Climate Assessment.

[7] For example, see Argonne National Laboratory's Climate Risk and Resilience Portal, the National Climate Task Force's Federal Flood Standard Support Tool (Beta), and FEMA's Future of Flood Risk Data Initiative.

- Creating usable climate information and model curricula for integration into new courses and educational tools for use by elementary, secondary, and post-secondary school educators.
- Aligning key climate data users and producers around common standards,[8] platforms, and system architectures to make climate information more interoperable. For example, the U.S. Global Change Research Program is working to do this across the federal government through its new Subcommittee on Climate Services, and a professional society, the American Society of Civil Engineers (ASCE), has built a platform to look up hazard-specific design parameters specified in ASCE standards for buildings and structures.

These efforts could be paired with scaled-up training and technical assistance programs, including those that take advantage of increasingly sophisticated online pedagogical tools as "force multipliers" to help make climate data more actionable and encourage co-production of climate data with frontline communities. For example, the National Innovation Landscapes Network (NILN) uses immersive engagement techniques with new tools and technologies—like next-generation fire behavior models, and new tools using LiDAR to create 3D maps of forest fuels and virtual reality walkthroughs of forest plots. Regional applied science and service organizations are natural homes for innovating and scaling climate-related training and technical assistance programs.[9]

Next-Generation Sensors, Analytics, and Forecasting

Technologies; Management practices and methodologies

In an era where sensors, analytics, and forecasting tools are rapidly becoming more sophisticated and widespread, tremendous room for innovation exists to make these tools and techniques more advanced, more accessible to the public, and more suitable for climate-related monitoring and forecasting in particular. Developing and deploying these tools would unlock powerful opportunities to rapidly scale, implement, and adjust climate resilience solutions.

Emerging tools, including artificial intelligence (AI), predictive analytics, and generative algorithms, each provide new capabilities for advanced monitoring, understanding, and responding to climate-related opportunities and hazards across scales and sectors. Innovations in real-time monitoring technology (for example, to increase the quality or accessibility of remote sensing data) can help decisionmakers more accurately and easily assess the condition of utilities and critical infrastructure, and enable planners to identify, map, and analyze vulnerabilities and devise more proactive strategies to address damage from climate-related shocks and stresses. In the public sector, for example, with the help of AI, the DOE's Oak Ridge National Laboratory has developed technology to map vulnerability to climate change down to the block and building level, and DOE's Office of Electricity is developing a comprehensive resilience modeling system for all North American energy infrastructure.

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[8] For example, the American National Standard for Flood Mitigation Equipment, supported by DHS's Flood Apex Program.

[9] For example, see the collaborative network comprised of USDA's Climate Hubs, DOI's Climate Adaptation Science Centers (CASCs), and NOAA's Regional Integrated Sciences and Assessment Program (RISA).

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Increasing the availability of low-cost sensors and other monitoring technologies would also be a game changer in pre-disaster resource forecasting and disaster management. For example, low-cost water quality monitors deployed widely in sewer and stormwater systems could greatly increase municipal resilience and facilitate uptake of complementary technologies like inflatable gates to divert water and avoid flooding. Similarly, developing new tools to track waste heat (for example, across a range of vehicle types) could help decision makers mitigate the urban heat island effect—waste heat from buildings, air conditioners, and vehicles contribute significantly to the extra heat added to urban environments from energy consumption. One existing tool in the context of active wildland fires, the AirNow web application, leverages community-based air quality sensor data in the Fire and Smoke Map—a collaborative effort between the U.S. Forest Service (USFS) and EPA—to provide information on active wildland fires, smoke and air quality, and recommended protective actions.

Elevation of Indigenous Knowledge

Management practices and methodologies

Elevating and fully including Indigenous Knowledge (IK) in co-productive and collaborative projects can produce transformative shared benefits for Tribal Nations, Indigenous communities, and climate resilience. However, bolstering resilience by including IK requires building relationships based on reciprocity and trust with respect for the critical principles of causing no harm and receiving free, prior, and informed consent for the inclusion of IK.[10] These partnerships may also require new approaches to information storage, management, and protection, which might include, for example, approaches like the metadata standards in the CARE principles for Indigenous Data Governance.

Indigenous communities—both today and since time immemorial—have used nature-based strategies grounded in context-specific IK to address challenges such as wildfire, drought, flooding, sea-level rise, and the security of traditional foods and culturally important species. For instance, in the Pacific Northwest, the Karuk Tribe is blending traditional and innovative agroecological practices to build soil health and increase drought resilience. Simultaneously, the Western Klamath Restoration Partnership is combining contemporary fire ecology and forest management techniques with IK to pilot prescribed burning and fuels treatments designed to benefit cultural foods and fibers, wildlife habitats, and community wildfire protection.[11] Additional Tribal examples of this work, supported by the Bureau of Indian Affairs' Tribal Climate Resilience Awards, include:

- The Chugach Imaq, which will blend IK with aerial surveys to better-evaluate the effects of climate change on marine mammal population dynamics.

[10] One example of local and regional coordination efforts elevating and blending resilience and adaptation best practices through peer-to-peer learning and sharing is the Bureau of Indian Affairs Regional Tribal Climate Resilience Liaison Program.

[11] Elsewhere, the Confederated Tribes of the Siletz Indians is working with the U.S. Fish and Wildlife Service to reconnect floodplains to restore Tribal fisheries in Oregon, and the San Carlos Apache Tribe is conducting research with U.S. Geological Survey scientists to develop a restoration plan for culturally important riparian areas at risk from climate change.

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- The Blue Lake Rancheria, which will expand a whole-community disaster preparedness campus to prepare for climate change impacts, including by incorporating IK in its programming.
- The Tulalip Tribes of Washington, which will use advanced technologies to support IK that enhances climate resilience and strengthens Tribal relationships by monitoring wildlife populations.

Indigenous communities manage millions of acres of land across the United States, and have ongoing and historic connections to millions more. Developing transformative, co-productive, and collaborative partnerships like these—including partnerships with Indigenous youth[12]—is essential for achieving the nation's climate resilience goals. Game-changing opportunities exist to increase Tribal access to capital and enhance investments in co-stewardship, including by funding land return to Tribes.[13] State, local, private, and philanthropic partners could work with Tribal Nations and Indigenous communities to build on these models—including the first-ever Federal Guidance on Indigenous Knowledge, published by the Biden-Harris Administration—and deploy innovative climate resilience solutions informed and guided by IK.

Infrastructure

Hazard-Resistant Materials

Technologies

Hazard-resistant materials are basic components (like wiring, cement products, and engineered wood) of walls, building enclosures, electrical systems, water systems, and heating, ventilation, and air conditioning (HVAC) systems and other infrastructure that have been strengthened to perform despite the stress of changing climate conditions and improve recovery from extreme-weather events. Once developed and mass-produced, these components can be used by a wide range of facilities and structures. Investing in mass production to make existing hazard-resistant materials cheaper—and in research to develop new materials that improve on their performance—could therefore be transformative in enhancing the resistance and resilience of much of America's built infrastructure.

In construction, some examples of hazard-resistant materials include reflective paints, green roofing layers, high-strength cladding, and building enclosure panels or window systems designed for higher wind loads, heavy rainfall, and projectile impacts—which can each help buildings cope with the impacts of extreme weather. In transportation, permeable pavements, when appropriately maintained, can mitigate the destructive impact of intense rainfall. New production and composition technologies, such as nanotechnologies (for example, applied to create fire-resistant coatings) and 3D printing, offer other important avenues for innovation that

[12] For example, opportunities for youth-led innovation include DOI's Indian Youth Service Corps initiative, the Native Youth Climate Adaptation Leadership Congress, DOI's Bison Apprenticeship Program, USDA's 1994 Tribal Scholars Program, and the Alaska Native Science & Engineering Program, among others.

[13] For example, the Tribal Community Vision Fund seeks to raise and deploy $1.2 billion in private and philanthropic investments to expand access to capital, promote self-determination, and support sustainable economic and community development in Indian Country.

could be well-suited for investment. Hazard-resistant materials can be particularly useful for facilities that provide emergency services, such as fire stations, hospitals, emergency operations centers, and critical manufacturing venues.

Innovation in hazard-resistant materials and enabling technologies can also drive environmental co-benefits—promoting low-embodied-carbon and non-toxic materials. For example, the FHWA is advancing the use of reinforced concrete produced through innovative low-emissions manufacturing processes. Similarly, one analysis of low-carbon concrete made with recycled plastics and coconut fibers concluded that it could significantly reduce hazard loss in high-hurricane-risk areas.

Federal initiatives continue to play a significant role in developing and promoting hazard-resistant materials and technologies in federally-owned and -supported infrastructure. DOE, for example, invests in heat- and cold-tolerant power infrastructure. Additionally, FEMA identifies some building materials as flood-damage-resistant and has collaborated with ASTM International to develop several consensus standards for determining flood damage resistance ratings.

Climate-Informed Designs

Technologies; Management practices and methodologies

Climate-informed designs address future climate conditions by making design choices that factor in a range of anticipated climate risks over the lifetime of the infrastructure, or that preserve options to adjust for future climate conditions. In buildings located in warmer, drier parts of the country, for example, a climate-informed design could incorporate elements that maintain thermal comfort and conserve water, such as cool roofing with integrated stormwater capture, shade elements in the building enclosure, and wastewater treatment and reuse systems. In the transportation context, roadways in flood-prone areas might be elevated or designed with natural and/or gray elements to increase rapidly shed water, increase drainage capacity, and adaptively manage runoff. For example, DOT incorporated climate-informed planning and design in its *Post Hurricane Sandy Transportation Resilience Study in New York, New Jersey, and Connecticut*, identifying infrastructure vulnerabilities alongside solutions to enhance future flood resilience.

Investments in developing replicable climate-informed designs (particularly at cost parity with conventional counterparts) have the potential to save businesses and state and local governments money, cut energy costs, and conserve water. Creating and sharing tools that help architects, construction managers, and engineers evaluate climate risks and more fully integrate climate considerations into their designs could also promote more widespread adoption of climate-informed designs. For example, the Climate Risk Informed Decision Analysis (CRIDA) methodology developed in partnership with USACE provides a detailed tool to help water resources engineers incorporate climate uncertainty in their decisions.

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Financing

De-Risking Mechanisms

Certain investments in resilience may produce large public benefits but lower or uncertain private returns. Green banks and other clean energy finance entities have worked to close the financing gap for clean energy and energy efficiency projects through tailored financial products that facilitate mobilizing additional private capital. The $27 billion Greenhouse Gas Reduction Fund, for example, provides a new and unprecedented opportunity to capitalize clean energy transformations, particularly in low-income and disadvantaged communities. Investments supported with program funds may include resilience-enhancing projects that meet the program's eligibility criteria, including capacity building, workforce development, remediation of legacy pollution, and market development in disadvantaged communities.

Catalyzed by other sources of federal funding, green banks, related financing entities, and their implementation partners can deploy project-level de-risking mechanisms like grants, technical assistance, results-based incentives, financial guarantees, and credit enhancements to strengthen credit profiles and improve the financial predictability of resilience and NBS projects. New public-private partnerships[14] can also be established to mitigate risk by financing the purchase of parametric catastrophe insurance for critical natural infrastructure, such as coral reefs, in cases of ecosystem-disrupting extreme weather events. Novel applications of existing municipal financing tools, such as bonds and tax-increment financing, could make these investments more attractive. For example, environmental impact bonds apply a traditional bond structure but make repayment conditional on achieving specific environmental outcomes—such as the restoration of a city wetland or the creation of a stormwater-retaining park.

A range of potentially transformative blended finance instruments are also emerging to enable investors to capture the economic value of resilience to nearby communities. These tools could play a game-changing role in financing innovative and high-impact investments. In pursuing these transformational investments, partnerships, and financing structures, green banks can also leverage extensive federal resources in this space, including recent guidance from the Office of Management and Budget on the valuation and assessment of ecosystem services.[15]

Standardized Metrics and Measurement Tools

Management practices and methodologies; Institutional, financial, and governance structures

Two important barriers can impede private actors from financing resilience solutions: first, a lack of reliable metrics for measuring impact, and second, an uncertain financial value and return on investment timeline. While investors are beginning to gain more certainty in these areas, they still lack effective tools to measure incremental improvements in adaptive capacity.

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[14] For example, blended finance models like Forest Resilience Bonds implemented by USFS in California and a pooled fund model like the Resilience Fund implemented in Utah for watershed resilience.

[15] These resources also include the National Climate Resilience Framework, the 2023 NBS Resources Guide, and the America's Partnership Fund for Nature established by the Biden-Harris Administration in partnership with the Inter-American Development Bank (IDB).

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Non-profits, philanthropies, and industry groups—along with federal, state, and local governments—are already working to standardize impact metrics for adaptation projects. As this effort moves forward, these metrics could better integrate the key federal performance indicators for climate resilience in the 2024 Federal Climate Adaptation Plans (CAPs), the Climate and Economic Justice Screening Tool (CEJST), and FEMA's Community Disaster Resilience Zone (CDRZ) designations to better align private- and public-sector impact metrics.
Integrating these federal measurement tools could be the foundation of a first-of-its kind resilience investment strategy that enables federal funding to blend more easily with private capital. Additionally, by incorporating federal metrics and equity/vulnerability screening tools when scoping resilience projects, project developers would likely find it easier to unlock even more catalytic policy options like advance market commitments, offtake agreements, investment/loan guarantees, and tax credits. While these instruments have been used for emissions reductions technologies, they have yet to be deployed significantly in the context of climate resilience solutions.

Industry and Commerce

Climate-Informed Scenario Modeling and Supplier Tracking

Technologies; Management practices and methodologies

Widespread adoption of cutting-edge, climate-informed scenario modeling and dynamic supplier tracking systems could revolutionize the way organizations navigate and adapt to climate change impacts on supply chains. Traditionally, scenario modeling and supplier tracking were largely reactive and based on static historical data, limiting their usefulness in a dynamic, changing climate. Instead of relying on historical trends, today's advanced climate-informed scenario modeling and dynamic supplier tracking systems employ real-time data and predictive analytics—for example, by using Internet-of-Things sensors, AI algorithms, and cloud computing—to continuously monitor, analyze, and visualize data on climate patterns and supplier performance.

These innovations allow organizations to better anticipate, preempt, and mitigate potential disruptions before they occur, enabling business continuity planning, increasing operational resilience, and strengthening supply chain adaptability. For example, Gavi, the Vaccine Alliance employs advanced supplier tracking systems to manage the distribution of vaccines in low- and middle-income countries, where climate-related challenges such as extreme temperatures can disrupt the cold chain required for vaccine preservation. Their system allows for real-time monitoring of vaccine shipments and storage conditions, adapting routes and storage strategies based on predictive climate data and current environmental conditions. Gavi's approach helps ensure that vaccines remain viable upon delivery, despite unpredictable climate variations.

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Buildings

Low-Cost Retrofits

Technologies; Management practices and methodologies

Homes and buildings across the country are increasingly at risk from more frequent and severe extreme weather events. This growing risk is making home insurance in many areas unaffordable—and in some cases, unattainable. Innovation in building retrofit approaches and technologies that account for increasing and future risks and can be deployed affordably, at mass scale, and in a variety of different building types and geographic locations, would be a game changer to effectively address the growing climate threats to the built environment.

Developing innovative, low-cost retrofits—including storm- and wind-resistant roofs and windows, floodproofing, and smoke-resistant enclosures and air filtration systems—can increase protection, reduce costs, and make properties more insurable. For example, the Insurance Institute for Business & Home Safety (IBHS) has developed FORTIFIED, a voluntary, evidence-based construction and re-roofing program to strengthen homes and commercial buildings against severe weather, such as high winds, hail, hurricanes, and even tornados. As shown in research by the DOE National Labs, investments in innovative thermal insulation, air-sealing, and energy code measures also save lives by allowing families to retain safe housing during extreme temperatures and extended power outages, and improve grid resilience.[16]

To support lower-cost retrofit methods, states, local governments, utility providers, lenders, and the insurance industry could develop new approaches to financing, permitting, approving, and incentivizing building retrofits. For example, laws in several states require insurance discounts for homeowners that have a FORTIFIED designation. Programs like Strengthen Alabama, offered through the Alabama Department of Insurance, and Louisiana Fortify Homes, offered through the Louisiana Department of Insurance, also provide grant funding that helps homeowners invest in FORTIFIED. Similar approaches include DOE's Property Assessed Clean Energy Programs (PACE), which incentivizes thermal envelope improvements, and DOE's Affordable Home Energy Earthshot, which aims to reduce the cost of energy-efficient home retrofits by 50% within a decade. These programs could also be modeled on federal investments like HUD's Green and Resilient Retrofit Program (GRRP), which provides climate resilience funding to affordable housing properties like "Revive 103," a 60-unit low-income apartment community in New York, which received GRRP funding to tighten the building envelope and seal all windows and openings—reducing heating and cooling costs, and providing more comfortable and predictable temperatures for residents during extreme weather events.

Modern Building Codes and Standards

Management practices and methodologies; Institutional, financial, and governance structures

In 2023, FEMA estimated that only 31% of hazard-prone jurisdictions in the United States have adopted modern building codes with hazard-resistant provisions. Incentivizing the development, deployment, and uptake of modern, climate-resilient, and consensus-based building codes and standards, including energy codes, will help prepare communities for climate change and natural

[16] For additional examples, see a variety of exhibitors at HUD's Innovative Housing Showcase.

hazards. There is also evidence that adopting modern codes and standards can be a good investment: the National Institute of Building Sciences, for example, has identified $11 saved for every $1 spent in adopting the latest building code requirements.

Game-changing investments in developing and deploying modern building codes and standards could include:

- Providing technical assistance for local governments developing, adopting, and enforcing resilient modern building codes and standards. For example, DOE's State and Community Energy Program and FEMA's Building Code Plus-Up grants are supporting local adoption of building codes with technical assistance through the President's Investing in America Agenda.
- Integrating new code enforcement technology, such as through augmented reality, can increase local capacity and decrease review times after disasters, while also increasing compliance with flood and fire risk standards.
- Adopting maximum safe indoor temperature regulations as part of a state or local Renters Bill of Rights and in building design and occupancy standards.
- Adopting heating, ventilation, and air conditioning (HVAC) standards that reduce wildfire smoke infiltration to protect against increasing climate risks.
- Developing resilience rating systems for next-generation resilient neighborhoods, buildings, homes, and infrastructure (for example, like the LEED Design for Enhanced Resilience pilot program) to guide future community development.
- Incorporating temporary islanding capability for critical facilities that are equipped with renewable power generation to allow these facilities to operate during a disaster.
- Adopting energy codes alongside building codes to protect occupants during extreme temperature events and increase grid reliability.

Investments to make these innovative technologies, practices, and frameworks more available, user-friendly, and locally-customizable could support a game-changing level of adoption.

Transportation

Grid-Integrated Charging

Technologies; Management practices and methodologies

Electric vehicles (EVs) and EV charging infrastructure are actively reshaping the nation's energy infrastructure. These changes present a transformative opportunity to integrate EVs into the electric grid at a national scale, resulting in a more reliable and resilient energy system. Bidirectional charging technologies, for example, can transform EVs into mobile back-up power storage systems during extreme-weather events. And combining grid access points with other parts of the built environment—such as lampposts, in Los Angeles—can help make EV charging infrastructure itself more resilient to disruptions.

Grid-integrated charging also increases redundancy for power systems in our nation's buildings, homes, and community infrastructure. Redundant power systems save lives during extreme-

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weather emergencies and are particularly critical to facilities that provide health services and house vulnerable populations. Utilities in California, for example, are beginning to integrate the data, forecasting, and infrastructure required for grid-integrated charging in pilot projects, providing backup power during outages and assistance meeting peak power needs.

Taking actions to integrate charging infrastructure more fully with the grid also fulfills a goal of the National Climate Resilience Framework: to proactively build resilience and reduce disruption across critical services—such as hospitals and medical care facilities, utilities, and more—in anticipation of extreme-weather events. Brought to scale, grid-integrated charging and management practices can ensure the nation's power system and EV infrastructure work interchangeably to contribute to the safety, security, and climate resilience of communities leading up to, during, and after extreme-weather events.

Cool Pavements, Bus Shelters, and Transit Systems

Technologies; Management practices and methodologies

Urban areas featuring structures like buildings, roads, and sidewalks experience higher temperatures than natural landscapes. Walking to and waiting for public transit also exposes people to extreme temperatures and weather conditions, and particularly, extreme heat. At the same time, increasing public transit use is a key priority in lowering transportation-sector greenhouse gas emissions.

Investments to integrate heat mitigation into transportation systems could therefore have outsized positive effects, particularly on transit-oriented communities. Three areas in particular stand out:

- Efforts that focus on developing effective, low-cost, and modular transit resilience products—such as cool, reflective, high-albedo pavements and cool bus shelters—would be particularly impactful for cities seeking to install these technologies across an entire transit system. For example, FHWA's PROTECT grant program awarded nearly $24 million to the City of Davis, CA to install cool pavement technologies and replace roadway underlayment to mitigate extreme heat.
- Third-party mechanisms—like a public scorecard—to compare the effectiveness of similar products like pavement paints and commercial bus shelters in reducing heat exposure would make it significantly easier for decisionmakers to safely invest in the most promising products.
- Investments that allow transit system assets to serve a dual function during heat waves by enabling access to cooling and emergency services. For example, buses could be used to provide free access and shuttle services to hospitals, cooling centers, or shelters, or to communicate essential safety information; thoughtful design of transit system assets could integrate shade trees around public plazas and transit hubs. In 2023, for example, the District of Columbia provided free transportation to several cooling centers during a hot weather emergency. Phoenix, AZ and Jacksonville, FL have also used public buses and bus shelters as cooling facilities to protect residents during extreme heat events.

Examples of many of these interventions exist, but implementing these at lower costs and city-wide scales would be a game changer. These investments also align with a key objective of the

National Climate Resilience Framework: to "help communities become not only more resilient, but also safer, healthier, equitable, and economically strong."

Energy

Smart Grids and Virtual Power Plants

Technologies; Management practices and methodologies

In recent years, climate-change-driven extreme-weather events have strained the U.S. power grid to the breaking point—most notably in 2021, when a severe winter storm caused hundreds of fatalities and millions of power outages in Texas.

Strategic deployment of smart grids and Virtual Power Plants (VPPs) can improve grid flexibility and reliability in the face of extreme-weather events. VPPs are aggregations of distributed energy resources such as rooftop solar with batteries, smart appliances, EVs and chargers, and commercial and industrial loads. Smart grids use advanced sensors, meters, and control systems (such as dynamic line readings and advanced switching) to track real-time information and improve operations, providing the visibility and control grid operators need to flexibly integrate new energy resources, avoid potential outage conditions, and quickly respond to disruptions.

VPPs and smart grids can optimize balancing of electricity demand and supply against grid constraints, enabling grid resilience to extreme-weather disruptions and improving the delivery of grid services under challenging conditions. For example, in Hawai'i, one company is working to aggregate 80 MW of distributed energy resources across three islands into a VPP, which could save participants thousands of dollars, enable customer control over home energy systems during outages, and provide valuable services to the grid. Together, these emerging approaches support grid reliability and resilience through integration of backup power, reduction of single-point-of-failures, and allowing optimal use of existing grid infrastructure. If integrated with traditional energy systems at scale, they could each reduce grid costs and additional infrastructure buildout needs significantly, while increasing performance and stability.

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Community-Integrated Microgrids

Technologies; Management practices and methodologies

Community-based microgrids can deliver diversified and decentralized energy production to increase the disaster resilience of communities and critical infrastructure. A microgrid is "a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single, controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island mode." Deploying microgrids strategically in disaster-prone communities across the country, as well as developing new hardware, software, technical approaches, and regulatory structures that enable microgrids and improve microgrid performance and accessibility would be game-changing steps forward in this space.

Microgrid-enabling technologies (including distributed renewable generation, battery storage, power transmission via "multi-nodal, small-scale, high-voltage direct current, advanced demand-side management strategies," and microgrid control systems) can significantly increase access to, and therefore impact of, microgrids during extreme-weather events and provide continuous backup power during these events. For example, advanced microgrid controllers can allow a microgrid to switch seamlessly from a grid-connected to an islanded mode and vice-versa. The Borrego Springs microgrid in San Diego County uses this technology to keep the power on in fire stations, schools, and other critical facilities during Public Safety Power Shutoffs. During a grid power outage, microgrids can also avert financial losses by businesses and support critical infrastructure, such as hospitals and emergency responders. Microgrids can also increase resilience by providing backup power and easing strain on the central grid in times of peak demand, such as a heat wave.

The global microgrid market is expected to increase rapidly in the coming decade. To maximize the impact of this growth in the United States, capital cost and project development timelines could be lowered through technological and policy advances—particularly, policies aimed at standardizing tariff structures for compensation, increasing interconnection ability, and enabling private or community-owned electric infrastructure to cross property lines. DOE's Grid Deployment Office has supported research and deployment of microgrids, including, for example, in Michigan, where a $22.9M investment will deploy "new grid sensing and fault location devices, communications devices, and reclosers" to "lay the foundation for developing a 100% renewable adaptive networked microgrid." In Bronzeville, on Chicago's south side, a new microgrid supported by DOE and implemented by the local utility will connect 1,000 customers who would particularly benefit from resilience services, and also serve as a vehicle to pilot several innovative microgrid technologies.

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Mobile and Long-Duration Energy Storage

Technologies; Management practices and methodologies

As described above, climate change-fueled extreme-weather events can create localized disruptions to power supplies—sometimes causing multi-day outages. Deploying affordable, mobile, long-duration, and renewable energy storage systems at scale would dramatically reduce the severity and duration of these disruptions.

Long-duration energy storage (LDES) includes storage that can shift loads by more than a few hours and that enables flexibility between generation and use of electricity. It can provide power for up to multi-day periods during extreme weather or other events that result in reduced availability of other generation resources. Mobile energy storage refers to storage technologies that can be moved and deployed quickly in areas where there are acute impacts to grid connectivity or energy generation. If deployed affordably and in complement to one another, these technologies could significantly reduce the impact of load loss due to extreme weather or disasters, which will become increasingly important as electrification of transportation, HVAC, and other vital systems advance.

While these two technologies are typically deployed separately, with different types of storage technologies optimized for each application, investments in creating energy storage at scale that is both mobile and longer-duration would be truly game-changing. Recognizing the potential of these technologies, for example, DOE recently awarded $9.5 million to bring mobile LDES systems to communities in rural Vermont with historically unreliable electric service during severe weather events. DOE has also launched a Long-Duration Storage Earthshot to reduce the cost of 10+ hour storage systems by 90% within the decade.

Reconductoring

Technologies

Reconductoring involves replacing conventional steel and aluminum grid cables with advanced cables that can deliver up to twice the power for the same-sized cable, and resist sagging under high temperatures. Advanced conductors are thus both more resilient to extreme weather and heat, and also allow for more energy transmission on a grid that will serve growing loads from increasing electrification and new customers. Reconductoring will allow for significantly more energy transmission within the existing grid footprint, easing strain on the grid and reducing the need for additional transmission siting and buildout.

For example, the Lower Rio Grande Valley's reconductoring project, completed in 2016, was motivated by rolling backouts during the South Texas Ice Storm in February 2011, partially resulting from new customers increasing strain on the grid. After considering many options, the utility reconductored two transmission lines, doubling transmission capacity without taking the existing lines out of service. DOE's Grid Resilience and Innovation Partnerships program has also funded several reconductoring projects, including one project in greater Philadelphia which will combine reconductoring with upgrades to monitoring and control technologies and installation of backup battery systems.

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Agricultural Production

Precision and Regenerative Agriculture

Technologies; Management practices and methodologies

Investments in precision and regenerative agriculture that foster soil health, optimize resource use, and decrease input costs could help farmers become more economically- and climate-resilient.

Sustainable precision agriculture includes using new and enhanced technologies and decision-support tools that leverage data to help farmers observe, measure, and respond to soil and microenvironmental variability at the farm, field, and sub-field levels. These technologies and tools—including geospatial tools, uncrewed aerial vehicles (UAVs), and machine learning algorithms—can reduce the need for water, fertilizer, and other resource inputs by allowing resources to be targeted more specifically. For example, one user-friendly toolkit developed by USDA (GRAPEX ET) combines Earth observations from satellites and UAVs such as drones to provide real-time data that can be integrated into existing irrigation schedules used by the wine industry to efficiently irrigate vineyards.

Regenerative agriculture focuses on improving soil health as a means to increase ecosystem services and crop resilience. Healthy soils store more water, and thus can help plants withstand intense drought, while also reducing runoff and erosion during extreme rainfall events. Healthy soils can also sequester carbon. Regenerative practices include diverse cropping systems, crop rotations, extended living cover, integrating livestock through prescribed grazing and grazed cropland, compost production and application, reduced- or no-tillage, interseeding, agroforestry, and more. These practices have both climate adaptation and mitigation benefits. For example, cover crops can increase resilience to drought and extreme rainfall while also providing other ecosystem services such as improved soil fertility, weed control, and soil erosion control.

Advanced Agricultural Biotechnologies

Technologies

Climate change presents many challenges for our nation's farmers—from altering growing zones, to stressing plants and animals with extreme temperatures and more variable precipitation, to impacting crops with smoke taint from wildfires, to wind damage from derechos. Advanced agricultural biotechnologies can help enhance adaptation to climate change and address global food security.

Advanced agricultural biotechnologies include genomics-informed breeding, gene editing, biotechnology risk assessment tools, advanced plant regeneration methods, and functional microbes. These technologies can provide a transformative boost for farmers, ranchers, and foresters seeking to enhance the resilience of their plants and animals to increased temperatures, drought, new diseases, or other stresses resulting from climate change. For example, plant scientists are beginning to use CRISPR technology to develop new varieties of drought-tolerant wheat, corn, rice, tomatoes, soybeans, and cotton seeds.

These technologies can improve agricultural resilience and sustainably increase the yield of nutritious food and other biobased products, particularly when combined with regenerative

practices. For example, enhanced soil microbes can help produce a wide variety of ingredients for food production, support plant growth, and reduce crop dependence on fertilizer. So-called precision fermentation can reduce agriculture's impact on the environment, while increasing predictability and yields in the face of more challenging weather conditions. New investments could also refine and improve existing biotechnologies, such as transgenic herbicide tolerance traits that reduce the need for tillage and pest-resistant traits that reduce pesticide use.

USDA's Agricultural Research Service supports this work through a wide range of programs, and the National Institute of Food and Agriculture similarly supports advances in agricultural biotechnology through multiple funding programs. President Biden has also announced federal support for the North Dakota Advanced Agriculture Technology Engine, which will spur the responsible development of advanced agricultural biotechnologies in partnership with local communities. However, widespread adoption will require additional work to develop clearer paths to market and more streamlined, science-based regulatory regimes. Innovations will also need to be affordable, sustainable, and accessible for smaller agricultural producers.

Natural Systems

Detection and Control of Harmful Invasive Species

Management practices and methodologies; *Institutional, financial, and governance structures*

Harmful invasive species impact America's environment, economy, public health, recreation, and overall livelihood at a cost of $21 billion annually. They challenge efforts to build resilience to climate change by compromising natural climate solutions (such as carbon sequestration and storage), undermining built and natural infrastructure (for example, through wildfires fueled by invasive grasses, tree mortality from invasive insect pests, degradation of coral reefs and wetlands by aquatic invasive species), threatening public health (for example, through new or expanding disease vectors such as ticks and mosquitoes), and stressing ecosystems.

Investments in innovative invasive species detection, control, and eradication techniques could facilitate rapid responses when introductions of new invasive species inadvertently occur and could also help slow or halt the spread of established invasive species across a landscape. For example:

- Emerging technological solutions, including genomic data and tools, AI used for rapid data processing, remote sensing, and automated delivery mechanisms for treatments could dramatically increase monitoring and control capabilities. For example, the Biden-Harris Administration is supporting the Chickasaw Nation in using satellite imagery to address invasive red cedar trees and increase the accuracy of prescribed burns.
- Environmental DNA (eDNA)—organismal DNA that can be found in the environment—and early-warning sensors can support national biosecurity at ports of entry (for example, testing imported goods and shipping containers) and early detection (for example, surveillance for aquatic invasive species and forest insect pests).
- R&D in integrated pest management, including in applying machine-learning-assisted monitoring and detection to improve targeting, efficacy, and specificity of treatments; as

well as in leveraging biological processes like RNAi; and in using new molecular and other novel technologies and techniques to complement classical biocontrol tools.

- Demonstration projects to effectively spotlight novel technologies and techniques, which can increase access to these management options for federal agencies, states, Tribes, territories, local governments, the private sector, and other impacted groups.

DOI, NOAA, USDA, and other agencies under the National Invasive Species Council are critical partners in responsibly developing, regulating, and disseminating these technologies.

Ecosystem Management Technologies

Technologies; Management practices and methodologies

In a changing climate, restoring, conserving, and improving the health of natural systems can foster resilience to a wide range of climate challenges. This can include the "rewilding" of degraded ecosystems, replacing species that have become locally extinct, providing new pathways for species movement, or pursuing assisted migration. However, in the context of a changing climate, conservation, restoration, and rewilding increasingly require novel approaches based upon the latest advances in technology, Indigenous Knowledge, and scientific understanding.

The ability to understand animal populations and current and changing habitat needs is currently limited by traditional resource-intensive tracking methods. Developing new approaches and technologies that incorporate machine learning for species identification, new UAV technology to remotely map habitats, telemetry and tracking methods (for example, long-range wide area network tracking), and eDNA to measure and monitor biodiversity would give managers a much broader information base with which to make management decisions.

Vulnerable coastal and marine habitats could benefit from a wide range of innovative and resilience-enhancing technologies and practices, including improved early-warning systems, innovative approaches to measuring blue and wetland carbon, new coastal change modeling approaches using machine learning and artificial intelligence, and satellite monitoring of climate-stressed fisheries. Developing new techniques for coral restoration, such as bioengineering corals resistant to increased temperatures and ocean acidification, producing artificial reefs using recycled materials, and 3D-printing cost-effective and accessible reef structures, would enhance coral reef resilience.

For agriculture, forestry, and land management, new and expanded technologies are needed to identify genotypes resistant to climate-related stressors and to determine genetically appropriate seed transfer guidelines for climate-informed revegetation. Conservation and restoration of natural systems, especially native species of vegetation like the five North American Ash, will benefit from using innovative technologies (such as gene editing), climate-informed management strategies (including selective breeding and adaptive silvicultural techniques), and improved seed technologies. Supporting the National Seed Strategy, a collaboration between 12 federal agencies and over 300 non-federal partners, will also ensure a diverse supply of seeds to restore and rehabilitate native plants across ecosystems.

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Water

Smart Water Infrastructure

Technologies; Management practices and methodologies

Smart water infrastructure, incorporating SMART (self-monitoring, analysis, and repairing technology), is a transformative approach to water management. By integrating advanced sensors (in network and in upstream watersheds) and valves, along with regulatory innovations like stormwater utility programs, smart water infrastructure optimizes water supply, hydropower generation, and stormwater management, while also being able to monitor and assess supporting physical infrastructure.[17]

Case studies, including the installation of smart water meters in cities like Los Angeles and Seattle, demonstrate efficacy in reducing water wastage and improving service delivery. President Biden's Bipartisan Infrastructure Law has also provided new transformative support for smart water infrastructure—including a recent investment of $179 million in innovative water reuse projects across the West. Further increasing public, private, and philanthropic investment in developing and deploying SMART water technology, as well as complementary approaches, such as dynamic pressure management and variable speed drives to reduce water loss, would be extremely impactful. Deploying smart water infrastructure at scale will require addressing challenges, including data privacy, cybersecurity, financial planning, and workforce transition, as well as robust safeguards and strategic approaches to ensure equitable and sustainable deployment.

Enhanced Aquifer Recharge

Climate change, urbanization, and population growth have challenged the aquifers that millions of Americans rely on. One analysis last year of 80,000 wells across the country found that 45% had experienced statistically significant water level reductions since 1980. Enhanced aquifer recharge (EAR) systems can play an important role in replenishing, stabilizing, and buffering these critical systems against drought. According to EPA, EAR techniques, including a variety of surface infiltration systems and injection wells, have "tremendous potential" to "augment water supplies, replenish groundwater, and restore streamflow" in the face of climate change and other stresses.

Initiatives like EPA's Science to Achieve Results research grants, Water Infrastructure Finance and Innovation Act (WIFIA) program and the U.S. Geological Survey's Groundwater and Streamflow Information Program support EAR advancement and highlight innovation in EAR-related water management and monitoring technologies. Non-federal initiatives like Orange County's Groundwater Replenishment System demonstrate the efficacy of EAR through a state-of-the-art water purification project that has been able to produce 130 million gallons of high-quality water every day. Additional innovations in the recharge technology itself, alongside the development of new applications for alternative water sources and advances in groundwater monitoring and management, would be productive areas of further investment.

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[17] Initiatives like the EPA's Drinking Water System Infrastructure Resilience and Sustainability Program support the development and adoption of smart water infrastructure nationwide.

EAR at scale also poses challenges related to energy consumption and land use. Managing these challenges will require additional innovations in groundwater and surface water monitoring technologies. Stakeholder engagement, adoption, and planning are important to navigate these risks, maximizing EAR's climate resilience benefits, while addressing environmental justice concerns. If implemented carefully, EAR should promote equity and environmental justice by ensuring access to clean water for disadvantaged communities.

Advanced Desalination and Water Recycling

Technologies

Innovations in desalination and water reuse technologies could advance equitable access to clean water and be a pivotal game changer in addressing water scarcity and building climate resilience.[18] Investments to make advanced desalination and water recycling processes like reverse osmosis, advanced greywater recycling, hydropanels, and stormwater harvesting, more accessible and affordable could open up a new suite of opportunities for communities experiencing longer and more severe droughts. These innovations maximize resource efficiency, diversify water sources, and reduce strain on ecosystems.[19]

Some examples of these technologies, recently supported through the Bureau of Reclamation's Desalination and Water Purification Research program, include:

- Sustainable solvents for use in desalination;
- Advanced desalination and purification membranes;
- Enhanced evaporation systems with selective precipitation; and
- Improved electrodialysis technologies.

Additionally, game-changing investments could be made to mitigate environmental challenges associated with desalination and water reuse projects. For example, desalination plants commonly employ open intake systems, which can potentially pose ecological issues. Improved technologies, such as submerged and cable intake systems and beach wells, are alternatives that, if fully developed and deployed, could minimize these impacts. Developing ecologically and economically viable desalination concentrate management practices also has the potential to expand the use of the technology in cultivating new water supplies, including inland brackish sources. Investment in research to minimize the life cycle greenhouse gas emissions associated with the manufacturing, materials, and operation of these technologies is also key.

[18] DOE, EPA, DOD, DOI/Bureau of Reclamation, and NOAA conduct research to improve the desalination process, including intake technology, and develop it as a more viable water supply source, including addressing energy consumption, brine disposal, and environmental impact challenges

[19] EPA, DOE, and DOI/Bureau of Reclamation invest significantly in research projects to explore the benefits of water reuse, while also providing resources to track the National Water Reuse Action Plan and better understand state regulations and guidelines. Through programs such as the Title XVI Water Reclamation and Reuse Program and the new Large-Scale Water Recycling Program, DOI/Bureau of Reclamation also invests in construction of innovative water recycling projects that allow communities to develop local, drought-resistant supplies through treatment and distribution of municipal wastewater.

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Health

Early-Warning Systems for Vector-Borne Diseases

Technologies; Management practices and methodologies

Warmer winters, increases in extreme weather events, and other physical stressors with widespread significant impacts on ecosystems have widened the distribution of many vector-borne diseases. This is especially concerning in parts of the world where new species interactions could enable disease emergence.

Enhancing public health early-warning systems using both biosurveillance tools and predictive modeling would be a game changer in reducing the climate-driven risks of vector-borne diseases. This could incorporate, for example, improving monitoring and surveillance of human systems (like wastewater and syndromic surveillance), such as by layering and more fully integrating data collection and analysis platforms, and increasing the quality and availability of rapid, at-home, multi-pathogen diagnostic tests. For example, the National Institutes of Health's Rapid Acceleration of Diagnostics (RADx) initiative has helped accelerate innovation in mobile and accessible SARS-CoV-2 testing and reporting that could be replicated in the context of other vector-borne diseases and by non-governmental actors.

Similarly, the federal and Ohio Environmental Protection Agencies jointly developed new targeted methods for detecting SARS-CoV-2 in wastewater using RNA markers, and these approaches could be expanded to emphasize metagenomic-based, pathogen-agnostic approaches to surveil climate-related disease outbreaks. Linking monitoring systems to the CDC's growing National Wastewater Surveillance System and National Syndromic Surveillance System could also enhance data quality and improve surveillance capabilities for communities across the country. Finally, the development of sophisticated artificial-intelligence-enhanced algorithms could more generally improve the effectiveness of early-warning systems.

Resilience Hubs

Institutional, financial, and governance structures

Resilience hubs are trusted physical sites in neighborhoods that serve as gathering spaces, information centers, and places of recreation, gathering, or community connection in everyday life. During disruptions like extreme weather events, resilience hubs assist the community in partnership with local emergency managers—for example, by providing shelter, communications support, or emergency supplies—and can also assist in post-disruption recovery.

Co-locating a resilience hub with health services or trusted staff from community health centers or hospitals can streamline access to basic health programs and increase the uptake of health care and social services simultaneously. More effectively integrating resilience hubs with community health care workers and promotores from community-based organizations or healthcare systems can also increase access to care during times of disruption. For example:

- A resilience hub in Boyle Heights, Los Angeles provides art programs and youth-led radio programming. During local disruptions, the hub provides outreach services, including multilingual emergency broadcasting.

- A resilience hub in Ward 7, District of Columbia provides workforce development programs and youth and senior services. During disruptions, the hub uses a Community Emergency Response Team to connect people most at risk of adverse health outcomes in the community with site resources.
- A resilience hub in Sacramento, California provides youth-focused behavioral health services, youth and adult education, and job training and placement. In the event of a disruption, the hub is able to provide emergency behavioral health services or serve as an emergency warming or cooling shelter.

Additional resilience hubs can be identified with the DHS Resilience Hub Finder tool.

While resilience hubs are already being developed across the United States,[20] providing long-term, sustained, and coordinated public-private support to establish permanent and well-equipped resilience hubs in communities nationwide would be a game changer.[21] It also would require flexibility in program design, as different communities of varied population density, geographies, community needs, and climate hazards would require different resources from resilience hubs. Developing a system to link individual hubs into a resilience network would also improve sharing of resources, local knowledge, scientific data, and tools, which would further enhance the effectiveness of individual hubs.

Climate-Integrated Health Records

Management practices and methodologies

Electronic health records (EHR) are used by doctors and health officials to understand patient needs and to monitor and predict trends in public health. Linking climate services information with EHR and informatics methodologies to identify at-risk patients, especially in populations most at risk from climate-related hazards, could be a game changer for clinical providers working to tailor care.

No integrated system currently exists that links information on climate risk directly with information on at-risk patients or to health care providers and patients, but initiatives such as the HHS emPOWER Program hold promise. If developed and adopted, this kind of system could help care providers share location-specific climate risk information with at-risk patients through EHR health portals, including predictions or warnings of extreme heat, wildfire smoke, vector-borne disease outbreaks, and flood risks. Care providers could also use this kind of system to develop more sophisticated plans of care for patients before, during, and after extreme-weather events.

Climate-integrated health records could reduce exposure to a variety of risk factors, for example, by enabling prescriptions for air filters or cooling devices. They could also play a role in raising patient awareness of increased risk during and after events. Care providers could also make use

[20] For example, see the City of Austin's Resilience Hub program, which plans to leverage funding from President Biden's American Rescue Plan.

[21] For example, through its Community Change Grants, EPA provides free technical assistance and $2 billion in implementation grants for disadvantaged communities, which can include climate resilience projects that create or upgrade community-level resilience hubs.

of the data from these health records to better manage healthcare availability, for example, using the data to improve planning and surge staffing during and directly after wildfire smoke or extreme heat events. HHS (including CDC and NIH) and EPA are supporting innovative research linking EHR with environmental data in some locations and health systems. A national real-time system linking climate risk and EHR data could facilitate innovative research to understand and mitigate climate impacts on health, greatly benefiting overburdened populations at the frontline of climate change impacts.

Conclusion

The United States has always been a nation of innovators. Our world-leading universities, pioneering national laboratories, and competitive marketplaces have fostered breakthroughs in computing, batteries, healthcare, artificial intelligence, robotics, and more. This assessment highlights the tremendous opportunity to harness that ingenuity to strengthen the resilience of our nation—across communities, natural systems, small businesses and schools.

By making thoughtful and targeted investments in the *Climate Resilience Game Changers*, private, philanthropic, and non-governmental organizations, as well as federal, state, Tribal, territorial, and local governmental entities have the opportunity to continue this legacy of innovation, and to work to build a better and more climate-resilient future for all Americans.

Ree Nancarrow
Spruce Smoke
(2012, Quilted Fur)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.

APRIL 30, 2024

National Security Memorandum on Critical Infrastructure Security and Resilience

NATIONAL SECURITY MEMORANDUM/NSM-22

MEMORANDUM FOR THE VICE PRESIDENT
THE SECRETARY OF STATE
THE SECRETARY OF THE TREASURY
THE SECRETARY OF DEFENSE
THE ATTORNEY GENERAL
THE SECRETARY OF THE INTERIOR
THE SECRETARY OF AGRICULTURE
THE SECRETARY OF COMMERCE
THE SECRETARY OF HEALTH AND HUMAN SERVICES
THE SECRETARY OF HOUSING AND URBAN DEVELOPMENT
THE SECRETARY OF TRANSPORTATION
THE SECRETARY OF ENERGY
THE SECRETARY OF EDUCATION
THE SECRETARY OF HOMELAND SECURITY
THE ASSISTANT TO THE PRESIDENT AND CHIEF OF STAFF
THE ASSISTANT TO THE PRESIDENT FOR NATIONAL SECURITY AFFAIRS
THE ASSISTANT TO THE PRESIDENT AND HOMELAND SECURITY ADVISOR
THE ASSISTANT TO THE PRESIDENT AND DIRECTOR OF THE NATIONAL ECONOMIC COUNCIL
THE ASSISTANT TO THE PRESIDENT AND DIRECTOR OF THE OFFICE OF INTERGOVERNMENTAL AFFAIRS
THE ADMINISTRATOR OF THE ENVIRONMENTAL PROTECTION AGENCY
THE DIRECTOR OF THE OFFICE OF MANAGEMENT AND BUDGET
THE DIRECTOR OF NATIONAL INTELLIGENCE

THE DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY
THE DIRECTOR OF THE CENTRAL INTELLIGENCE AGENCY
THE DIRECTOR OF THE FEDERAL BUREAU OF INVESTIGATION
THE CHAIRMAN OF THE JOINT CHIEFS OF STAFF
THE ADMINISTRATOR OF GENERAL SERVICES
THE CHAIR OF THE NUCLEAR REGULATORY COMMISSION
THE CHAIR OF THE FEDERAL COMMUNICATIONS COMMISSION
THE NATIONAL CYBER DIRECTOR
THE POSTMASTER GENERAL AND CHIEF EXECUTIVE OFFICER OF THE UNITED STATES POSTAL SERVICE

SUBJECT: Critical Infrastructure Security and Resilience

Critical infrastructure comprises the physical and virtual assets and systems so vital to the Nation that their incapacity or destruction would have a debilitating impact on national security, national economic security, or national public health or safety. It is diverse and complex, and includes distributed networks, varied organizational structures, operating models, interdependent systems, and governance constructs.

The United States is in the midst of a generational investment in the Nation's infrastructure. This investment, and the emergence of new technologies, presents an opportunity to build for the future. In the 21st century, the United States will rely on new sources of energy, modes of transportation, and an increasingly interconnected and interdependent economy. This modernization effort will ensure critical infrastructure provides a strong and innovative economy, protects American families, and enhances our collective resilience to disasters before they happen — creating a resilient Nation for generations to come.

The United States also faces an era of strategic competition with nation-state actors who target American critical infrastructure and tolerate or enable malicious actions conducted by non-state actors. Adversaries target our critical infrastructure using licit and illicit means. In the event of crisis or

conflict, the Nation's adversaries will also likely increase their efforts to compromise critical infrastructure to undermine the will of the American public and jeopardize the projection of United States military power. The growing impact of climate change, including changes to the frequency and intensity of natural hazards, as well as scarcities; supply chain shocks; and the potential for instability, conflict, or mass displacement places further strain on the assets and systems that Americans depend upon to live and do business.

This memorandum advances our national unity of effort to strengthen and maintain secure, functioning, and resilient critical infrastructure.

Policy Principles and Objectives

It is the policy of the United States to strengthen the security and resilience of its critical infrastructure, consistent with the following principles:

1. Shared Responsibility. Safeguarding critical infrastructure is a responsibility shared by Federal, State, local, Tribal, and territorial entities, and the public or private owners and operators of critical infrastructure (owners and operators). All stakeholders have unique roles to contribute to the national unity of effort. Public-private collaboration is vital to this effort.

2. Risk-Based Approach. Advancing critical infrastructure security and resilience requires a risk-based approach. The prioritization of national efforts must be informed by the relationship between specific infrastructure and national security (including national defense), national economic security, national public health or safety, and the Federal Government's ability to perform essential functions and services. Risk assessments must consider all threats and hazards, likelihood, vulnerabilities, and consequences, including shocks and stressors — as well as the scope and scale of dependencies within and across critical infrastructure sectors, immediate and long-term consequences, and cascading effects. Owners and operators are uniquely positioned to manage risks to their individual operations and assets, including their interdependencies with other entities and sectors.

3. Minimum Requirements. Federal, State, local, Tribal, and territorial regulatory and oversight entities have a responsibility to prioritize establishing and implementing minimum requirements for risk management, including those requirements that address sector-specific and cross-sector risks. These requirements should also leverage existing guidance where applicable. Regulatory frameworks should be risk- and performance-based when feasible; informed by existing requirements, standards, and guidelines; aligned to reduce unnecessary duplication; complementary to voluntary public-private collaboration; and scalable and adaptable to an evolving risk environment. Requiring and enforcing minimum resilience and security requirements and recommendations that direct building resilience into critical infrastructure assets and systems upfront, and by-design, shall be a primary responsibility of the Federal Government.

4. Accountability. Robust accountability and enforcement mechanisms from Federal, State, local, Tribal, territorial, and private sector entities, as well as independent third parties, are an essential component of effective risk management for critical infrastructure. Accountability mechanisms should continuously evolve to keep pace with the Nation's risk environment.

5. Information Exchange. The appropriate sharing of timely, actionable information, which may include relevant classified and unclassified intelligence and law enforcement sensitive information, among Federal, State, local, Tribal, and territorial entities; owners and operators; and other relevant stakeholders, is essential for effective risk management. The Federal Government will support a robust information sharing environment and public-private cooperation that enables actions and outcomes that reduce risk.

6. Expertise and Technical Resources. The Federal Government will leverage expertise and technical resources from all relevant Federal departments and agencies to mature the capacity and capability of each federally led effort to manage sector-specific risk under the umbrella of the national effort to secure United States critical infrastructure. A primary objective of this effort will be to create a consistent experience for owners and operators; State, local, Tribal, and territorial

governments; and other essential stakeholders who collaborate with the Federal Government.

7. International Engagement. Recognizing the global interconnectedness and interdependencies of critical infrastructure, the Federal Government will work closely with international partners to strengthen the security and resilience of the international critical infrastructure on which the United States depends.

8. Policy Alignment. Efforts to safeguard critical infrastructure will be fully integrated and coordinated with complementary Federal policies and frameworks, including domestic incident management and national preparedness; national continuity, including Federal Mission Resilience; and counterterrorism, counterintelligence, cybersecurity, and other threat-, hazard-, or sector-specific policies and frameworks.

It is the objective of the United States under this national effort to:

1. Refine and clarify the roles and responsibilities of the Federal Government for critical infrastructure security, resilience, and risk management.

2. Identify and prioritize critical infrastructure security and resilience based on risk and implement a coordinated national approach to assess and manage sector-specific and cross-sector risk.

3. Establish minimum requirements and accountability mechanisms for the security and resilience of critical infrastructure, including through aligned and effective regulatory frameworks.

4. Leverage Federal Government agreements, including grants, loans, and procurement processes**,** to require or encourage owners and operators to meet or exceed minimum security and resilience requirements.

5. Enhance and improve the quality of intelligence collection and analysis pertaining to threats to critical infrastructure.

6. Improve the real-time sharing of timely, actionable intelligence and information at the lowest possible classification level among Federal, State, local, Tribal, territorial, private sector, and international partners to facilitate risk mitigation to critical infrastructure.

7. Promote timely and cost-effective investments in technologies and solutions that mitigate risk from evolving threats and hazards to critical infrastructure.

8. Strengthen the security and resilience of critical infrastructure by engaging international partners and allies to build situational awareness and capacity, facilitate operational collaboration, promote effective infrastructure risk management globally, and develop and promote international security and resilience recommendations.

Federal departments and agencies shall implement this memorandum in a manner consistent with applicable law; Presidential directives; and Federal regulations, including those protecting privacy, civil rights, and civil liberties.

Roles and Responsibilities

The Federal Government relies on the specialized authorities, capabilities, and expertise of Federal departments and agencies to ensure an effective, whole-of-government effort to secure critical infrastructure. Under this effort, the Secretary of Homeland Security shall provide strategic guidance and coordinate Federal cross-sector risk management and resilience activities. Sector Risk Management Agencies (SRMAs) shall serve as day-to-day Federal interfaces for their designated critical infrastructure sector and conduct sector-specific risk management and resilience activities. Elements of the Intelligence Community (IC) and law enforcement, regulatory, and other Federal departments and agencies also play key roles in increasing the security and resilience of critical infrastructure, including responding to all threats and hazards that may affect critical infrastructure.

Close and continuous coordination among the Department of Homeland Security (DHS), SRMAs, and other relevant Federal departments and agencies, to include law enforcement and the IC, is essential to ensuring a national unity of effort and accomplishing the objectives of this memorandum. The Federal Government also seeks to encourage and enable strong collaboration with owners and operators; State, local, Tribal, and territorial governments; international partners; and other entities. While most of the Nation's critical infrastructure is owned and operated by non-Federal entities, which are primarily responsible for individual assets' security and resilience, both Government and the private sector have a

mutual responsibility and incentive to reduce the risk to critical infrastructure.

Secretary of Homeland Security

The Secretary of Homeland Security shall coordinate the national effort to enhance the security and resilience of United States critical infrastructure and provide strategic guidance on this national effort, based on national priorities and sector-specific or cross-sector risk assessments and plans, including through the National Infrastructure Risk Management Plan (National Plan), as required by statute. The Secretary of Homeland Security shall maintain situational awareness about emerging trends, imminent threats, vulnerabilities, and the consequences of incidents that could jeopardize the security and resilience of critical infrastructure. The Secretary of Homeland Security shall make recommendations to the President, in coordination with SRMAs and other relevant departments and agencies, on the list of designated critical infrastructure sectors, subsectors, and SRMAs — prioritizing critical infrastructure for national security and resilience efforts.

The Secretary of Homeland Security, acting through the Director of the Cybersecurity and Infrastructure Security Agency (CISA) as the National Coordinator for the Security and Resilience of Critical Infrastructure (National Coordinator), shall, in coordination with SRMAs and other Federal departments and agencies:

1. Coordinate with SRMAs to fulfill their roles and responsibilities to implement national priorities consistent with strategic guidance and the National Plan and continuously strengthen a unified approach to critical infrastructure security and resilience;

2. Assess progress against national priorities and national resilience and support efforts that measure and enhance the strength of critical infrastructure sectors and partnerships;

3. Identify and assess sector and cross-sector risk, analyze the dependencies among assets and systems that comprise critical infrastructure, and consider key interdependencies of potential sector and cross-sector consequences associated with physical and cyber

threats and vulnerabilities to support critical infrastructure risk management and prioritization;

4. Assess sector and SRMA designations to inform recommendations to the President;

5. Recommend measures to protect the critical infrastructure of the United States; and

6. Identify security and resilience functions that are necessary for effective public-private engagement with all critical infrastructure sectors.

To provide expertise in support of national critical infrastructure security and resilience efforts, the Director of CISA, in coordination with SRMAs and, as appropriate, other relevant agencies, shall also:

1. Provide capabilities and resources, such as cybersecurity expertise, risk assessments, and other services, to support SRMAs and national critical infrastructure security and resilience efforts;

2. Develop plans and enable integrated actions for cyber defense campaigns at scale and to otherwise mitigate risks to critical infrastructure nationally;

3. Engage international partners to enhance the security and resilience of critical infrastructure globally; and

4. Provide technical and operational assistance, best practices based on existing standards and guidance to the greatest extent possible, and capacity development to State, local, Tribal, and territorial governments; other Federal entities; owners and operators; and international partners to enhance the security and resilience of critical infrastructure.

Other Department of Homeland Security Activities

As reflected in statute and Presidential policy, the Secretary of Homeland Security has responsibilities for coordinating Federal preparedness activities and response operations in the United States, including when critical infrastructure impacts are implicated. The Secretary of Homeland Security is the principal Federal official for domestic incident management and, consistent with existing Federal law and policy, including Homeland Security

Presidential Directive 5 of February 28, 2003 (Management of Domestic Incidents), as amended, DHS may coordinate Federal Government resources used in the response to or recovery from terrorist attacks, major disasters, or other emergencies, or as otherwise requested or directed by the President. In addition, the Secretary of Homeland Security, acting through the Administrator of the Federal Emergency Management Agency (FEMA), works to reduce the loss of life and property by minimizing the impact of disasters and protecting the Nation from all hazards. DHS, acting through the Director of CISA, serves as the lead Federal agency for cyber asset response activities in accordance with Presidential Policy Directive 41 of July 26, 2016 (United States Cyber Incident Coordination) (PPD-41). Further, the Secretary of Homeland Security, acting through the Administrator of the Transportation Security Administration and the Commandant of the United States Coast Guard, has broad authority to assess security risks to the Marine Transportation System and other modes of transportation, develop security measures and regulations, and seek or ensure compliance with those measures and regulations.

Sector Risk Management Agencies

Each critical infrastructure sector has unique characteristics, operating models, and risk profiles that benefit from an identified SRMA with institutional knowledge, specialized expertise, and established relationships across the sector. SRMAs help drive the national effort to strengthen the security and resilience of critical infrastructure. Consistent with the statutorily defined roles and responsibilities of SRMAs, SRMAs shall carry out the following roles and responsibilities for their respective sectors, in coordination with DHS, including the National Coordinator, and, as appropriate, other relevant departments and agencies:

1. Serve as day-to-day Federal interfaces for the prioritization and coordination of sector-specific activities, including the provision of technical expertise and assistance, serving as the Federal Government coordinating council chair; and participating in cross-sector coordinating councils. Continually collaborate and communicate through regular and appropriate outreach and engagement mechanisms with their sector's owners and operators, promoting the use of risk mitigation, to include Government-furnished capabilities and services

for State, local, Tribal, and territorial governments; owners and operators; and other non-Federal entities.

2. Lead outreach to owners and operators within their respective sectors on security and resilience issues, consistent with their available authorities.

3. Designate the Accountable Senior Officials — Assistant Secretary equivalent or above — to serve as the Coordinators of the SRMA Function, with the ability to delegate responsibilities to other senior leaders within their agencies. The designees will be responsible and accountable for the implementation and performance of all SRMA roles and responsibilities.

4. Lead sector risk management within their sector and support cross-sector risk management, including establishing and implementing programs or initiatives to assist owners and operators and State, local, Tribal, and territorial governments with identifying, understanding, planning for, and mitigating risks to the systems, assets, or services in their respective sector. This should include recommending sector-specific measures to protect critical infrastructure.

5. Identify, assess, and prioritize sector-specific risk and support cross-sector and national risk assessment efforts.

6. Facilitate the identification of essential critical infrastructure-related workforce needs and priorities for security and resilience.

7. Incorporate identified national priorities, including Defense Critical Infrastructure (DCI), climate change, and emerging technology, into sector risk management responsibilities.

8. Identify sector-specific information and intelligence needs and priorities, in consultation with owners and operators, and facilitate the exchange of information and intelligence, as appropriate, regarding risks to sector-specific critical infrastructure.

9. Share and receive information and intelligence directly with critical infrastructure owners and operators in their respective sectors, as appropriate and in coordination with the IC.

10. Support domestic incident management, emergency preparedness, and national continuity, including Federal Mission Resilience.

11. Serve as the lead Federal agencies for certain domestic incidents primarily impacting their respective sectors consistent with existing Federal law and policy, including when requested or directed by the President.

12. Provide, support, or facilitate the provision of technical assistance to sectors' owners and operators to mitigate risk, and collaborate with those owners and operators to identify joint priorities that enhance the security and resilience of the sectors.

Additional Federal Roles and Responsibilities

1. The Federal Senior Leadership Council (FSLC) shall be the consensus-based body that coordinates and deconflicts the shared responsibilities and activities of Federal departments and agencies under this policy, and will be informed by engagement with the National Security Council. The FSLC shall be co-chaired by the Director of CISA and a non-CISA Accountable Senior Official for an SRMA that serves a 2-year term. The co-chairs shall coordinate regularly with each SRMA's respective Accountable Senior Official on all sector-specific activity and regularly brief the FSLC on cross-sector initiatives, including the sharing of best practices, data, and tools from those initiatives. The FSLC shall, at least annually, communicate to SRMAs national and cross-sector guidance and priorities for SRMA efforts. SRMAs shall provide regular updates to the FSLC on the implementation of their roles and responsibilities and on the implementation of FSLC guidance and priorities. The FSLC shall develop shared SRMA processes and doctrine. If there is a conflict between members that cannot be resolved through consensus at the FSLC, it will be elevated to the National Security Council for resolution.

2. The Department of State shall lead the effort to engage foreign governments, international organizations, and international partners — in coordination with other Federal departments and agencies — to facilitate collaboration and capacity building and to strengthen the security and resilience of foreign critical infrastructure upon which the Nation depends.

3. The Department of Defense (DOD) shall lead the evaluation of the risk to and prioritization of mitigations for sector-specific DCI, in coordination with the National Coordinator, the IC, and relevant SRMAs. DOD shall provide DHS, relevant SRMAs, and other Federal departments and agencies with advice to further these efforts and support sector and cross-sector outreach to strengthen the security and resilience of non-DOD-owned DCI. As part of its national defense mission, DOD supports defense of critical infrastructure.

4. The Department of Justice (DOJ), including the Federal Bureau of Investigation (FBI), shall lead counterterrorism and counterintelligence law enforcement activities for critical infrastructure. Such activities include leading criminal investigations into and the operational response to terrorist threats and incidents that concern critical infrastructure – including those that involve weapons of mass destruction, sabotage, and counterintelligence threats — and the identification of critical infrastructure owner and operator information requirements to inform collection and analysis. The FBI shall, as appropriate, coordinate with DHS, SRMAs, and other law enforcement entities or Federal departments and agencies. In the event of significant cyber incidents involving critical infrastructure, DOJ, acting through the FBI and the National Cyber Investigative Joint Task Force, shall carry out its responsibilities as the Federal lead agency coordinating for threat response activities under PPD-41.

5. The Department of Commerce shall carry out its statutory responsibilities to lead the development of standards and to facilitate and support guidelines, best practices, methodologies, procedures, and processes to reduce cybersecurity risks to critical infrastructure. The Department of Commerce shall consult with DHS and engage with other Federal departments and agencies, as well as with the private sector, research organizations, academic organizations, or other Government organizations, to: (1) improve security for hardware and software technologies and associated tools related to cyber-based systems; (2) improve resilience standards, guidelines, best practices, tools, technologies, testing, and references for physical infrastructure and social or economic systems; and (3) promote the development of other efforts related to critical infrastructure to enable the timely availability

of industrial products, materials, and services to meet homeland security requirements.

6. The Department of Energy (DOE) shall carry out its statutory responsibilities to address the short-, mid-, and long-term energy challenges facing the Nation, including those implicating electricity, petroleum, natural gas, nuclear material, and other energy resources and services, in coordination with relevant Federal departments and agencies, as appropriate. Consistent with authorities, DOE leads the policy, preparedness, risk analysis, technical assistance, research and development, operational collaboration, and emergency response activities for the United States energy sector.

7. The IC, led by the Director of National Intelligence (DNI), shall coordinate with DHS and SRMAs to identify critical infrastructure owner and operator intelligence needs. The IC shall provide intelligence to the National Coordinator and SRMAs regarding threats to critical infrastructure and coordinate on intelligence and other sensitive or proprietary information related to critical infrastructure, as appropriate. In the event of significant cyber incidents involving critical infrastructure, the DNI, acting through the Director of the Cyber Threat Intelligence Integration Center, shall carry out its responsibilities as the Federal lead agency for intelligence support and related activities under PPD-41.

8. The Director of the National Security Agency, as the National Manager for National Security Systems (NSS), shall assess the overall security posture of NSS, disseminate information on threats to and vulnerabilities of NSS, and direct actions for cybersecurity-related improvements needed on NSS. NSS that are owned, operated, managed, or used by a Federal entity are not otherwise subject to the requirements of this memorandum. In addition, information security policies, directives, standards, and guidelines for safeguarding NSS shall be overseen as directed by the President or applicable law, and in accordance with that direction, shall be carried out under the authority of the heads of agencies that operate or exercise authority over such NSS.

9. The General Services Administration (GSA), in consultation with DOD, DHS, and other departments and agencies, shall provide or support Government-wide contracts for critical infrastructure assets and

systems, and shall ensure that such contracts include appropriate audit rights for the security and resilience of critical infrastructure, including the cybersecurity of critical infrastructure-enabling technology.

10. The Nuclear Regulatory Commission (NRC) shall oversee its licensees' protection of commercial nuclear power reactors and non-power nuclear reactors used for research, testing, and training; nuclear materials in medical, industrial, and academic settings, and facilities that fabricate nuclear fuel; and the transportation, storage, and disposal of nuclear materials and waste. As appropriate, the NRC shall collaborate with DHS, DOJ, DOE, the FBI, FEMA, and other Federal departments and agencies on strengthening critical infrastructure security and resilience.

11. The Federal Communications Commission will, to the extent permitted by law and in coordination with DHS and other Federal departments and agencies: (1) identify and prioritize communications infrastructure by collecting information regarding communications networks; (2) assess communications sector risks and work to mitigate those risks by requiring, as appropriate, regulated entities to take specific actions to protect communications networks and infrastructure; and (3) collaborate with communications sector industry members, foreign governments, international organizations, and other stakeholders to identify best practices and impose corresponding regulations.

12. In accordance with applicable law and policy, Federal departments and agencies shall exchange timely data and information with DHS necessary to assess and manage risks to critical infrastructure, and with the FBI to assist in relevant law enforcement activities.

13. In accordance with applicable law and policy, Federal departments and agencies with regulatory authorities shall utilize regulation, drawing on existing voluntary consensus standards as appropriate, to establish minimum requirements and effective accountability mechanisms for the security and resilience of critical infrastructure. Departments and agencies shall work to harmonize these efforts to the maximum extent possible through participation in Federal interagency working groups, such as the Cybersecurity Forum for Independent and Executive Branch Regulators. Departments and agencies shall continue to support the development of voluntary consensus standards that enable critical

infrastructure innovation to occur in a secure and resilient manner that considers the impacts and effects of risk.

14. Federal department and agency heads are responsible for activities concerning the identification, prioritization, assessment, remediation, and security of their respective internal critical infrastructure and associated infrastructure that supports mission essential functions. Infrastructure supporting primary mission essential functions shall be addressed in the plans and execution of the requirements in all applicable Executive Orders, National Continuity Policies, strategies, and directives.

15. Consistent with applicable law and policy, Federal departments and agencies, regardless of designation as an SRMA, shall leverage existing authorities to promote security and resilience of critical infrastructure including, but not limited to:

16. Integrating security and resilience into Federal acquisition programs relating to critical infrastructure.

17. Utilizing grants, loans, and other Federal Government funding mechanisms to ensure minimum security and resilience requirements and effective accountability mechanisms are incorporated into critical infrastructure-related projects that receive Federal funding, where determined necessary to mitigate risk by the administering departments or agencies. Where applicable law limits the ability of Federal departments and agencies to establish minimum requirements through agreements, they shall provide guidance and recommendations for appropriate security and resilience measures alongside the provision of Federal funding.

18. Interagency bodies, such as the Committee on Foreign Investment in the United States and the Federal Acquisition Security Council, have specific roles in protecting and securing critical infrastructure through the review of foreign investment transactions, and shall leverage existing authorities to also address the risks to critical infrastructure posed by foreign investment activity, and supply chain reliability and illicit access to sensitive information, respectively.

Risk Management

The Federal Government, including SRMAs, shall use a common risk-based approach to reducing risk to critical infrastructure. Critical infrastructure risks can be assessed in terms of threats or hazards, vulnerability, and consequence. For the purposes of this effort, the term "risk" refers to the potential for an unwanted outcome, as determined by its likelihood and the consequences. Risk management efforts should be prioritized based on this shared definition, which necessitates identifying the criticality of assets and systems within and across sectors.

Asset-level Risk

Critical infrastructure owners and operators have primary responsibility, and are uniquely positioned, to manage most risks to their operations and assets. The policy of the Federal Government shall be to support and guide the entities that own, operate, or otherwise control critical infrastructure assets and systems by providing these entities with the information, intelligence analysis, and other support, as appropriate, to manage and mitigate asset-level risks.

Nationally Significant Risk

Effective risk management necessitates the Federal Government, in coordination with owners and operators to the extent practicable, identify, assess, prioritize, mitigate, and monitor risks that may have a potentially debilitating impact on national security (including national defense and continuity of Government), national economic security, or public health or safety. These nationally significant risks may arise within and impact particular sectors or cut across multiple sectors. Federal departments and agencies have the responsibility to identify and mitigate national-level risk through this whole-of-government effort based on the roles and responsibilities enumerated in statute, regulation, and this memorandum. This effort shall be led by DHS in coordination with SRMAs and supported by other Federal departments and agencies with the necessary expertise, resources, and regulatory authorities to support or direct risk mitigation activity. Federal departments and agencies shall leverage all available resources, capabilities, and authorities — including regulatory authorities —

to ensure owners and operators implement risk mitigation measures that limit national-level risks. This work shall be coordinated by the National Coordinator, in consultation with the National Security Council staff and the National Cyber Director, as appropriate.

Sector Risk

Certain risks that rise to national concern are common to entities within a particular sector. SRMAs are responsible for day-to-day prioritization and coordination of efforts to mitigate risks within each sector, as part of the broader whole-of-government effort coordinated by DHS, including the National Coordinator, to secure United States critical infrastructure. The Federal Government will support owners and operators as they manage sector-level risk to individual assets and systems.

Systemic and Cross-sector Risk

Critical infrastructure has grown increasingly interdependent and interconnected due to trends in the modern economy, including digitization and electrification. These trends are poised to accelerate over the coming decade due to historic Federal investments in the modernization of the Nation's infrastructure. As such, risks to individual sectors can quickly cascade into other sectors, necessitating coordinated action to understand and mitigate risk.

The National Coordinator shall actively manage systemic and cross-sector risk by working with SRMAs, Federal departments and agencies, and industry to identify, analyze, prioritize, and manage the most significant risks involving multiple sectors. To identify and manage cross-sector risk, SRMAs shall regularly provide the National Coordinator available data on individual assets and systems within their respective sectors. The National Coordinator shall aggregate and analyze this data to improve the identification, prioritization, and mitigation of cross-sector and national risks, and shall provide this analysis to SRMAs to help manage sector-specific risk.

Minimum Security and Resilience Requirements

Effective risk management will require consistent adoption of minimum

security and resilience requirements, where possible based on established consensus-based standards, within and across critical infrastructure sectors. Voluntary approaches to enhance critical infrastructure security and resilience have meaningfully mitigated risk over the past decade, but more must be done to ensure the Nation's critical infrastructure is secure and resilient against all threats and hazards. The Federal Government must focus on increasing the adoption of requirements that address sector, national, and cross-sector risks to critical infrastructure.

DHS, including the National Coordinator, SRMAs, and, as appropriate, regulators, shall coordinate to produce cross-sector and sector-specific guidance, performance goals and metrics, and requirements, consistent with their authorities, to adequately mitigate risk. SRMAs, in coordination with regulators, as appropriate and consistent with their authorities, shall develop sector-specific minimum security and resilience requirements for each respective sector, as necessary, and a plan to use existing authorities or other tools to effectively implement those requirements. SRMAs shall support the development of sector-specific performance goals in accordance with National Security Memorandum 5 of July 28, 2021 (Improving Cybersecurity for Critical Infrastructure Control Systems).

The National Coordinator shall review proposed sector-specific security and resilience guidance, performance goals, and requirements in coordination with SRMAs, and in consultation with regulators, to facilitate the harmonization of these directives and recommendations at the national and cross-sector level. The National Coordinator shall also provide input into the development of these requirements and recommendations to ensure they address cross-sector and national-level risk, while integrating voluntary standards and mandatory requirements into overall risk management plans and helping to prevent the promulgation of conflicting directives or requirements across sectors. In accordance with the National Cybersecurity Strategy, the National Cyber Director, in coordination with the Director of the Office of Management and Budget, shall lead my Administration's efforts for cybersecurity regulatory harmonization with respect to security and resilience requirements, of which portions of the effort outlined in this memorandum are an essential component.

Operational Collaboration

To further drive down the Nation's risk, the Federal Government must improve its ability to collaborate directly with those partners who have the means and capability to take actions that mitigate vulnerabilities, respond to incidents, and build resilience at scale. This will complement individual owners and operators' risk mitigation efforts. The Federal Government will collaborate with private-sector partners; State, local, Tribal, and territorial governments; community organizations; and international partners who can take actions that provide resilience and security benefits to owners and operators in the United States and in other countries.

National Infrastructure Risk Management Plan

The Secretary of Homeland Security shall develop and submit to the President on a recurring basis every 2 years a National Infrastructure Risk Management Plan (National Plan), which shall be informed by: (1) individual sector-specific risk assessments and risk management plans; and (2) a cross-sector risk assessment.

Sector-specific Components

Each SRMA shall develop sector-specific risk assessments and sector-specific risk management plans based on strategic direction provided by the Secretary of Homeland Security, or as prescribed in another National Security Memorandum.

- Sector-specific Risk Assessment: Unless otherwise defined in another National Security Memorandum, each SRMA shall, on a biennial basis, and in consultation with their sector coordinating councils, identify the most significant critical infrastructure risks to their sector, including key cross-sector risks and interdependencies. This review shall be based on appropriate Federal, State, local, Tribal, and territorial government-level data and analysis, enforcement actions, and guidance, as well as information from relevant private sector partners, regulators, intelligence analysts, and law enforcement professionals. The risk assessment shall use all available information and intelligence to identify the risks presented by the current threat environment to critical infrastructure within the covered sector.

- Sector-specific Risk Management Plan**:** Each SRMA shall, on a biennial basis, develop or refresh, in consultation with their sector coordinating councils, a sector-specific risk management plan to leverage both individual SRMA tools and authorities, as well as other Federal tools and authorities, to safeguard critical infrastructure in their sector from all threats and hazards. The plan will take into account national-level priorities and guidance from the Secretary of Homeland Security, as well as other changes in the critical infrastructure risk environment and any deficiencies in the sector's current risk management approach. The sector-specific plan shall also prioritize specific risks and establish corresponding lines of effort that affect resourcing decisions to mitigate risk to critical infrastructure. The plan is intended to prioritize threats based on the sector-specific risk assessment. These efforts shall include:

- A proposal for any necessary authorities to ensure the Federal Government can incentivize and compel the owners and operators to adequately address sector-level risk from all threats and hazards, including:

- The identification, harmonization, or development of recommended, sector-specific minimum security and resilience requirements, consistent with their authorities, for each respective sector based on national and cross-sector security and resilience requirements — and a plan to use existing tools and authorities to implement those requirements across the sector. SRMAs shall coordinate with relevant regulators on the adoption of regulations that promote the implementation of these minimum requirements concurrently with the submission of the National Plan to the President. Where existing authorities are not sufficient, SRMAs shall develop a proposal to request new authorities from the Congress, in coordination with the Office of Management and Budget, the National Security Council, and, to the extent such authorities pertain to cybersecurity, the Office of the National Cyber Director.

- Prioritized lines of effort the SRMA plans to undertake over the next 2 years to mitigate risk to critical infrastructure in their sector, including: efforts to collaborate with law enforcement; State, local, Tribal, and territorial governments; and other domestic or international partners.

- A plan to leverage technological innovation to stay ahead of evolving trends, including coordination on research and development with relevant Federal laboratories.
- A description of each respective sector's information sharing strategy.
- A set of objective measures of success that track the overall security and resilience of the sector and critical assets or systems within the sector.
- For the second biennial National Plan and each one thereafter, an assessment of progress made over the prior 2 years in implementing the previous sector-specific risk management plan.

Sector risk assessments previously directed by statute or executive action will be integrated with the sector-specific risk assessments outlined in this memorandum whenever practical. This integration improves cross-sector security and resilience planning. The National Coordinator and SRMAs will coordinate to synchronize the reporting cycle of risk reporting to improve efficiency and reduce duplication of effort. Government-specific portions of the sector-specific risk assessments should also be shared with the GSA.

Cross-sector Risk Assessment

The National Coordinator shall develop a cross-sector risk assessment in coordination with SRMAs, and share this assessment with SRMAs.

- The cross-sector risk assessment shall identify the most significant cross-sector risks to United States critical infrastructure. This review shall be based on Federal and State-level data and analysis, enforcement actions, and guidance, as well as interviews with relevant private sector partners, SRMA staff, regulators, intelligence analysts, and law enforcement professionals. The cross-sector risk assessment shall use all available information and intelligence to identify the risks presented by the current threat environment to critical infrastructure, with a focus on cross-sector risk. This cross-sector risk assessment will identify risks that span across sectors, including where multiple sectors depend on the same materials or technologies, as well as risks with consequences that cascade across sectors that may be difficult to identify or assess without the cross-sector understanding.

Based on the sector-specific risk assessments and risk management plans and the cross-sector risk assessment, the Secretary of Homeland Security shall develop and submit to the President, through the Assistant to the President and Homeland Security Advisor, the National Plan to guide the Federal effort to mitigate cross-sector and other national risks to critical infrastructure.

This forward-looking National Plan shall identify avenues to leverage all available Federal tools, resources, and authorities to limit national-level risks, including those cascading across sectors of critical infrastructure. The National Plan shall also prioritize specific cross-sector risks, with a focus on new and emerging threats to critical infrastructure, and shall identify innovative approaches to limit the risks from these new and emerging threats, particularly risk mitigation strategies for increasingly interdependent and interconnected assets and systems. This document shall be the Federal Government's comprehensive plan to mitigate and manage cross-sector risk — identifying and funding sensible mitigation actions and investments across sectors, as well as continuously identifying for interagency policymakers the gaps and limitations in existing Federal tools or authorities to address the rapidly changing threat and hazard landscape. The National Plan shall also contain:

- Proposed long-term mitigation activities based on sector-specific and cross-sector risk assessments to incorporate resilience-by-design approaches that enhance the ability of critical infrastructure to prepare for, adapt to, and recover from changing conditions presented by new and emerging threats and hazards.
- The identification, harmonization, and development of recommended national and cross-sector minimum security and resilience requirements to mitigate cross-sector risks not covered under sector-specific requirements, and a plan to use existing tools and authorities to implement those requirements. Where existing authorities are not sufficient to implement these minimum requirements, the National Coordinator shall develop a proposal to request new authorities from the Congress, in coordination with other relevant Federal departments and agencies, the Office of Management and Budget, the National Security

Council, and, to the extent such authorities pertain to cybersecurity, the Office of the National Cyber Director.

- A plan for harmonizing minimum security and resilience requirements across all sectors based on input from SRMAs and other relevant Federal departments and agencies. The National Coordinator, in coordination with regulators, SRMAs, and other appropriate Federal departments and agencies, shall lead this all-hazards effort. The National Cyber Director, in coordination with the Director of the Office of Management and Budget, shall continue to lead my Administration's efforts for cybersecurity regulatory harmonization.
- Recommendations for pilot efforts, led by SRMAs or the National Coordinator, to limit the risks from cross-sector reliance on new or emerging trends in technology, energy production, or sector-specific innovations that potentially increase the attack surface for critical infrastructure.

If the sector-specific strategies and sector-specific plans do not align with the strategic guidance issued by the Secretary of Homeland Security, DHS shall coordinate with SRMAs to resolve any differences, and, as necessary, elevate disagreements to the National Security Council staff.

Systemically Important Entities

The National Coordinator shall regularly identify organizations that own, operate, or otherwise control critical infrastructure that is prioritized based on the potential for its disruption or malfunction to cause nationally significant and cascading negative impacts to national security (including national defense and continuity of Government), national economic security, or national public health or safety. This list of Systemically Important Entities (SIE) shall be informed by inputs received from SRMAs and other Federal departments and agencies as appropriate, based on their respective sector-specific risk assessments, the cross-sector risk assessment, and other relevant critical infrastructure data — including submissions of specific organizations from SRMAs for inclusion in the SIE list. This list of SIE shall be developed in coordination with SRMAs, and in consultation with other relevant Federal departments and agencies and other non-Federal entities, as appropriate. The list will not be made available to the public.

The SIE list shall inform prioritization of Federal activities, including the provision of risk mitigation information and other operational resources to non-Federal entities. The list of SIE developed pursuant to this memorandum, as well as any updates to the list, will satisfy the requirement for the Secretary of Homeland Security to develop the list described in section 9 of Executive Order 13636 of February 12, 2013 (Improving Critical Infrastructure Cybersecurity). Where appropriate, regulators will consider this list when applying adequate risk management requirements.

Scope of Effort

Departments and agencies recognize that critical infrastructure is often interconnected globally and shall, as applicable, consider dependencies and interdependencies with assets, systems, and networks outside the United States as a part of sector risk management processes. Departments and agencies shall also collaborate with private-sector partners; State, local, Tribal, and territorial entities; foreign governments; international partners; and other entities that can take actions that provide resilience and security benefits to critical infrastructure owners and operators in the United States and globally. This effort shall include supporting sector coordinating councils, including the State, Local, Tribal, and Territorial Government Coordinating Council. These councils should be inclusive and include owners and operators, their trade associations, and other industry representatives.

Intelligence Sharing and Information Exchange

Critical infrastructure risk management requires those who own or operate infrastructure to be informed of a wide range of threats that are manmade or result from natural hazards, including by the actionable and timely intelligence and information available on those threats or hazards. To establish a comprehensive, integrated threat picture for United States critical infrastructure, the DNI shall lead IC efforts, in consultation with DHS, including the National Coordinator, SRMAs, and relevant departments and agencies, to:

1. Use applicable tools and authorities to collect, integrate, analyze, and share information from intelligence reporting, data, and assessments to understand and identify threats to critical infrastructure. This shall include prioritizing the issuance of intelligence reports and analysis on such threats at the lowest possible classification level, consistent with the protection of sources and methods, such as through the robust use of tearlines, and, in coordination with SRMAs, disseminating intelligence reports in an accessible, useable, and shareable format for State, local, Tribal, and territorial governments, and owners and operators.

2. Leverage DHS and SRMA Priority Intelligence Requirements to inform collection and intelligence assessments related to threats to critical infrastructure in accordance with National Security Memorandum 12 of July 12, 2022 (The President's Intelligence Priorities), or any successor document, and the associated National Intelligence Priorities Framework (NIPF).

3. Coordinate with DHS, SRMAs, and other relevant Federal departments and agencies; State, local, Tribal, and territorial governments; and the private sector to enhance stakeholder and IC understanding of relevant threats to critical infrastructure and, where appropriate, integrate sector risk perspectives into IC analysis.

4. Produce, receive, integrate, and share information, to include information from intelligence assessments and warnings, that enables Federal department or agency leadership to consider the widest possible options for mitigating a risk or addressing a threat, including the coordinated balancing of national interests, stakeholder equities, and authorities.

5. Share information with regulatory agencies, as appropriate, regarding threats to critical infrastructure to ensure they are aware of such threats, consistent with the protection of sources, methods, and investigations.

6. In coordination with DHS and DOJ, the DNI shall establish a process to ensure that IC elements provide, to the maximum extent possible, timely notification to appropriate Federal elements, including the FBI, CISA, and relevant SRMAs, when IC elements are aware of specific and credible threats to United States critical infrastructure. This process shall be implemented in a manner consistent with the protection of

sources and methods; investigations; Executive Order 12333 of December 4, 1981 (United States Intelligence Activities); Executive Order 13636; applicable IC directives (including ICD-191); and authorities of the IC and its elements, as well as DHS, including title 6 and title 50 of the United States Code. Federal agencies receiving such information from the IC shall, to the maximum extent possible and in a manner consistent with applicable agency authorities and investigative equities, promptly convey threat warnings to the targeted entities.

All departments and agencies, including the IC, shall coordinate with the National Coordinator and SRMAs designated in this memorandum, as appropriate, on outreach to entities within SRMAs' respective sectors to inform sector and cross-sector risk management and convey threat warnings. Collection and analysis of threats to critical infrastructure shall be informed by the President's Intelligence Priorities Framework and further prioritized and coordinated through the NIPF.

CISA shall also facilitate and share information and analysis to support Federal, State, local, Tribal, territorial, and private sector entities actions against all threats and hazards to critical infrastructure, including as the Federal civilian interface for the multi-directional and cross-sector sharing of information, particularly information related to cyber threat indicators, defensive measures, and cybersecurity risks. The SRMAs shall also share and receive information directly from owners and operators in their respective sectors. Information or intelligence shared with the self-organized and self-governed councils — commonly referred to as sector coordinating councils — comprised of a sector's owners and operators, trade associations, and other industry representatives, should be shared through or in coordination with a sector's respective SRMA.

Departments and agencies shall abide by all pertinent legal and policy procedures and use all appropriate legal and policy mechanisms to protect proprietary and sensitive commercial and business information, as well as sensitive intelligence sources, methods, and activities.

Designated Critical Infrastructure Sectors and SRMAs

This memorandum identifies 16 critical infrastructure sectors and designates

associated SRMAs. In some cases, co-SRMAs are designated where multiple departments share the roles and responsibilities of the SRMA. The Secretary of Homeland Security shall periodically evaluate the need for and approve changes to critical infrastructure sectors, and shall make recommendations to the President in accordance with statute and in consultation with the Assistant to the President and Homeland Security Advisor. The sectors and SRMAs are as follows:

Chemical:
Sector Risk Management Agency: DHS

Commercial Facilities:
Sector Risk Management Agency: DHS

Communications:
Sector Risk Management Agency: DHS

Critical Manufacturing:
Sector Risk Management Agency: DHS

Dams:
Sector Risk Management Agency: DHS

Defense Industrial Base:
Sector Risk Management Agency: DOD

Emergency Services:
Sector Risk Management Agency: DHS

Energy:
Sector Risk Management Agency: DOE

Financial Services:
Sector Risk Management Agency: Department of the Treasury

Food and Agriculture:
Co-Sector Risk Management Agencies: Department of Agriculture and Department of Health and Human Services (HHS)

Government Services and Facilities:
Co-Sector Risk Management Agencies: DHS and GSA

Healthcare and Public Health:
Sector Risk Management Agency: HHS

Information Technology:
Sector Risk Management Agency: DHS

Nuclear Reactors, Materials, and Waste:
Sector Risk Management Agency: DHS

Transportation Systems:
Co-Sector Risk Management Agencies: DHS and Department of Transportation

Water and Wastewater Systems:
Sector Risk Management Agency: Environmental Protection Agency

Implementation of This Memorandum

Except where otherwise directed by existing National Security Memoranda or Executive Orders:

1. Within 30 days of the date of this memorandum, SRMAs shall identify a senior leader who will serve as the primary representative to sectoral stakeholders for each respective sector and the day-to-day Coordinator of the SRMA Function.

2. Within 45 days of the date of this memorandum, the Secretary of Homeland Security shall issue strategic guidance that provides national-level priorities and a format that SRMAs shall use in the development of their sector-specific risk assessments and sector-specific risk management plans.

3. Within 180 days of the date of this memorandum, SRMAs, in coordination with the National Coordinator, shall develop plans to execute the required roles and responsibilities of each SRMA to ensure a

continuity of effort and the coordination of policy and resourcing requirements. The plans should detail how the identified senior leaders will have the sufficient expertise, support capacity, and access to resources to consistently execute the roles and responsibilities of an SRMA. Plans should include potential colocation options; an assessment of the current structure; detailee arrangements between DHS, SRMAs, and the IC; and other potential maturity models. The National Coordinator, SRMAs, and other Federal departments and agencies shall, as appropriate, also establish personnel exchanges via Memoranda of Understanding in order to develop subject matter expertise, interagency familiarity, and routine cross-pollination.

4. Within 1 year of the date of this memorandum, DHS, through CISA, shall officially establish or designate an office of the National Coordinator to serve as the single coordination point for SRMAs across the Federal Government. This office shall be distinct from the elements of CISA that carry out its SRMA functions and shall work with SRMAs to perform the duties of the National Coordinator, including managing the production of cross-cutting assessments, guidance, recommendations, and other priorities related to areas of significant cross-sector risk such as climate change, and DCI. It shall also manage the process to identify and support systemically important entities. This office shall also support SRMAs, as they work to execute the roles and responsibilities outlined in this memorandum, using DHS resources and authorities to help execute identified activities and achieve sector-level performance objectives, as appropriate. To the extent practicable, SRMAs will consider detailing sector-specific experts to this office for limited periods of time to enhance the national unity of effort. Alternatively, the National Coordinator will consider detailing representatives to SRMAs.

5. Within 270 days of the date of this memorandum, and on a recurring basis biennially by February 1 of each year, each SRMA shall submit its sector-specific risk management plan to the Secretary of Homeland Security, based on guidance developed by DHS, through their Secretary or Agency Head. The plan shall be informed by the sector-specific risk assessment included as an annex. Each SRMA shall conduct a preliminary interim sector-specific risk assessment for the initial 270-day deliverable, and, on a biennial basis thereafter, a more complete and robust risk assessment. For the first sector-specific risk assessment and

risk management plan cycle, draft sector-specific risk assessments will be provided to the National Coordinator within 180 days of the date of this memorandum to inform the first cross-sector risk assessment.

6. Within 1 year of the date of this memorandum, and on a recurring basis every 2 years thereafter by June 30 of each year, the Secretary of Homeland Security shall submit to the President and the Assistant to the President and Homeland Security Advisor the National Plan for approval. This plan shall be informed by sector-specific risk assessments and the cross-sector risk assessment.

7. Within 270 days of the date of this memorandum, as a one-time report, SRMAs and the National Coordinator shall submit to the Assistant to the President and Homeland Security Advisor a review of the available authorities, incentives, and other tools to encourage and require owners and operators to implement identified sector-specific or cross-sector minimum security and resilience requirements. This review should focus on identifying the most critical gaps in the Federal Government's capacity to require and enforce minimum security and resilience requirements for critical infrastructure. As a part of this one-time report, the National Coordinator and SRMAs should provide the Office of Management and Budget a legislative proposal for any necessary additional authorities or capabilities that could enable the implementation of these minimum security and resilience requirements for critical infrastructure.

8. Within 1 year of the date of this memorandum, the Secretary of Homeland Security shall review the existing Critical Infrastructure Partnership Advisory Council framework for adequacy and make proposed changes. This shall include sector coordinating council requirements.

9. Within 180 days of the date of this memorandum, and thereafter annually by September 30 of each year, the DNI, in coordination with the Secretary of Defense (acting through the Under Secretary of Defense for Intelligence and Security), the Director of the FBI, and the Secretary of Homeland Security (acting through the Under Secretary for Intelligence and Analysis), and in consultation with SRMAs, shall submit to the President an intelligence assessment on threats to United States critical infrastructure. The intelligence assessment shall be submitted to the

President in classified form at the highest level of classification necessary to fully characterize the threats. Within 90 days of the intelligence assessment's publication, including the first issuance and those recurring annually, the DNI, in coordination with the Under Secretary of Defense for Intelligence and Security on behalf of the Secretary of Defense, the Director of the FBI, and the Secretary of Homeland Security (acting through the Under Secretary for Intelligence and Analysis), shall submit to the President a classified version of this assessment for release to appropriately cleared United States critical infrastructure owners and operators and SRMAs, and, within 180 days of the intelligence assessment's publication, share an unclassified version of the assessment with Federal, State, local, Tribal, territorial, and private sector partners, to the maximum extent possible and consistent with the protection of sources and methods.

10. Within 1 year of the date of this memorandum, and thereafter annually by June 30 of each year, the DNI, in coordination with IC elements, shall submit to the President a report on intelligence collection against threats to United States critical infrastructure. The report will describe collection and reporting for the prior year, including (by classification level) quantity, quality, and collection type; identify any intelligence gaps and offer recommendations on how they can be remedied; and analyze the extent to which such collection addresses the current threat, the President's Intelligence Framework, and the NIPF, noting any opportunities for improvement.

11. Within 18 months of the date of this memorandum, and thereafter annually by June 30 of each year, the DNI, in coordination with IC elements, shall submit to the President a report on intelligence and information sharing on threats to United States critical infrastructure with owners and operators and SRMAs. The report will describe, at a strategic level, intelligence and information sharing for the prior year by all IC elements with those entities. This will include summaries of the information sharing between each IC element and other departments and agencies; infrastructure sector(s), including owners and operators; types of content shared (e.g., verbal briefing, written product, such as a tearline, etc.); and classification levels. The report also will identify any barriers to sharing and offer recommendations on how they can be remedied; assess the extent to which the process for reviewing requests

for downgrades is effective and efficient; and evaluate the degree to which sharing in the reporting period addresses the requirements of this memorandum and the 2023 National Intelligence Strategy (or their successor documents), as well as any opportunities for improvement.

12. The DNI, the Secretary of Homeland Security, and SRMAs shall maximize the efficiency and effectiveness of United States Government engagements with critical infrastructure owners and operators by ensuring they are coordinated and deconflicted, consistent with agencies' authorities, third-party agreements, and protection of sources and methods. To accomplish this, the DNI and the Secretary of Homeland Security shall jointly develop, within 180 days of the date of this memorandum, policies, procedures, and guidance to ensure, respectively, the full participation of SRMAs and IC elements in ensuring this outcome. Not later than 180 days after the completion of these guidance documents, the DNI shall institute an organizational approach, to include establishing or designating existing IC offices or elements, for coordinating the tracking of its engagements and information sharing with critical infrastructure owners and operators, and improve centralized reporting on these IC engagements, consistent with the protection of sources and methods and third-party agreements. The organizational approach should specify minimum tracking requirements, such as engagements with SIE, the nature of the engagement, and the date, and what general categories of engagements are excluded from tracking because of sensitivities involving sources, methods, contracts, third-party agreements, and other considerations.

13. Within 12 months of the date of this memorandum, the DNI shall establish implementing guidance to ensure all IC elements, to the maximum extent possible, timely notify appropriate Federal departments and agencies, including the FBI, CISA, and relevant SRMAs, when IC elements are aware of specific and credible threats to United States critical infrastructure. This process shall be implemented in a manner consistent with the protection of sources and methods; investigations; Executive Order 12333; Executive Order 13636; applicable IC directives (including ICD-191); and authorities of the IC and its elements, as well as DHS.

Definitions

The term “critical infrastructure” has the meaning provided in section 1016(e) of the USA Patriot Act of 2001 (42 U.S.C. 5195c(e)), namely systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on national security, national economic security, national public health or safety, or any combination of those matters.

The term “all threats, all hazards” means a threat or an incident, natural or manmade, that warrants action to protect life, property, the environment, and public health or safety, and to minimize disruptions of Government, social, or economic activities. It includes, but is not limited to: natural disasters, cyber incidents, industrial accidents, pandemics, acts of terrorism, sabotage, supply chain disruptions to degrade critical infrastructure, and disruptive or destructive activity targeting critical infrastructure.

The term “resilience” means the ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions.

The term “Federal departments and agencies” means any authority of the United States that is an “agency” under 44 U.S.C. 3502(1), other than those considered to be independent regulatory agencies, as defined in 44 U.S.C. 3502(5).

The term “national security systems” means those systems as defined as NSS in 44 U.S.C. 3552(b)(6), as well as all other DOD and IC systems, as described in 44 U.S.C. 3553(e)(2) and 3553(e)(3).

The term **“**Sector Risk Management Agency” has the meaning provided in Public Law 117–263 (6 U.S.C. 650), namely a Federal department or agency, designated by law or Presidential directive, with responsibility for providing institutional knowledge and specialized expertise of a sector, as well as leading, facilitating, or supporting programs and associated activities of its designated critical infrastructure sector in the all-hazards environment in coordination with DHS.

The term “Federal Mission Resilience” means, as defined by the Federal Mission Resilience Strategy, the ability of the Federal executive branch to continuously maintain the capability and capacity to perform essential functions and services, without time delay, regardless of threats or conditions, and with the understanding that adequate warning of a threat may not be available.

The term “cross-sector” means relationships and interdependencies between critical infrastructure sectors that necessitate integrating and coordinating security and resilience activities.

The term “Defense Critical Infrastructure” means DOD and non-DOD networked assets and facilities essential to project, support, and sustain military forces and operations worldwide. Non-DOD owned Defense Critical Infrastructure consists of assets from relevant critical infrastructure sectors and subsectors, including as defined by statute.

The term “supply chain” refers to a linked set of resources and processes between multiple tiers of developers that begins with the sourcing of products and services and extends through the design, development, manufacturing, processing, handling, and delivery of products and services to the acquirer.

The term “risk assessment” is defined as risk identification, analysis, and evaluation, designed to inform risk management.

The term “assets” means a person, structure, facility, information, material, equipment, network, or process, whether physical or virtual, that enables an organization’s services, functions, or capabilities.

The term “criticality” means an attribute of an asset, system, or service that reflects its degree of importance or necessity to stated goals, missions or functions, or continuity of operations as they apply to national security (including national defense and continuity of Government), national economic security, or national public health or safety.

The term “sector” means a collection of assets, systems, networks, entities, or organizations that provide or enable a common function for national security

(including national defense and continuity of Government), national economic security, national public health or safety, or any combination thereof.

The term “subsector” means a subset of a sector comprised of critical infrastructure grouped by common resources, common equities, or common functions.

The term “systems” means a combination of personnel, structures, facilities, information, materials, equipment, networks, or processes, whether physical or virtual, integrated or interconnected for a specific purpose that enables an organization’s services, functions, or capabilities.

The term “intelligence” has the meaning provided in the National Security Act of 1947, as amended.

The term “intelligence sharing” in the context of this memorandum refers to the timely sharing of intelligence, including credible and specific threat information, assessments, data, or analysis for the purpose of enhancing overall United States national and homeland security and resilience, in accordance with applicable classification handling and intelligence sharing policies and procedures.

The term “information sharing” in the context of this memorandum refers to the bi-directional sharing of timely and relevant information concerning risks to United States critical infrastructure. In the context of this memorandum only, intelligence sharing is an element of information sharing.

The terms “coordinate” and “in coordination with” mean a consensus decision-making process in which the named coordinating department or agency is responsible for working with the affected departments and agencies to achieve consensus and a consistent course of action.

The term “collaboration” means the process of working together to achieve shared goals.

The term “national essential functions” means that subset of Government functions that are necessary to lead and sustain the Nation before, during,

and in the aftermath of an emergency.

The term “primary mission essential functions” means those Government functions that must be performed in order to support or implement the performance of the national essential functions before, during, and in the aftermath of an emergency.

General Provisions

This memorandum rescinds and replaces Presidential Policy Directive 21 of February 12, 2013 (Critical Infrastructure Security and Resilience).

(a) Nothing in this memorandum shall be construed to impair or otherwise affect:

(i) the authority granted by law to an executive department or agency, or the head thereof; or
(ii) the functions of the Director of the Office of Management and Budget relating to budgetary, administrative, or legislative proposals.

(b) This memorandum shall be implemented consistent with applicable law and subject to the availability of appropriations.

(c) This memorandum is not intended to, and does not, create any right or benefit, substantive or procedural, enforceable at law or in equity by any party against the United States, its departments, agencies, or entities, its officers, employees, or agents, or any other person.

JOSEPH R. BIDEN JR.

Simona Clausnitzer
In the Eye of the Storm
(2020, Linocut Print)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.

2024

U.S. Biennial Transparency Report

First Biennial Transparency Report of the United States of America

U.S. Biennial Transparency Report

Chapter 4:

Information Related to Climate Change Impacts and Adaptation

under Article 7 of the Paris Agreement

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Introduction

Human activities have dramatically altered the world's climate, ocean, land, ice cover, and ecosystems, resulting in impacts on human health, agriculture, infrastructure, natural resources, and other sectors of the economy. Across the United States, climate change is accelerating the frequency and fueling the severity of extreme weather events, both acute and chronic, resulting in tragedies and new realities that once seemed unimaginable. From record-shattering heat waves across the Midwest and Northeast, extended drought in the West, devastating flooding in Iowa and Minnesota, raging wildfires in New Mexico, Oregon, and California, to hurricanes in the Southeast, communities in every corner of the country are being directly impacted by the effects of climate change.[1,2,3,4,5] In addition to posing direct threats to lives and livelihoods, weather and climate events – which are becoming increasingly extreme due to the warming climate – have had significant economic impacts. Last year's record 28 individual billion-dollar extreme weather and climate disasters caused more than $90 billion in aggregate damage.[6]

In the face of these perils, Americans are not standing idle; they are rising to confront the risks and challenges of climate change in extraordinary and inspiring ways. Communities are restoring natural infrastructure, such as marshes and wetlands, to defend against flooding; installing solar panels and battery storage to limit the strain on the grid and function as back-up power; and adopting climate-informed forest management practices, including those based on Indigenous Knowledge, to reduce the risk of catastrophic wildfires. The United States has scaled up actions that enhance the resilience of communities, infrastructure, and natural resources to the impacts of climate change domestically. The United States also supports partners around the world in building resilience to climate change – further information on these programs can be found in Chapter 5.

The global goal on adaptation, established by the Paris Agreement, contains three elements: enhancing adaptive capacity, strengthening resilience, and reducing vulnerability to climate change. In 2023, Parties adopted in decision 2/CMA.5, the United Arab Emirates (UAE) Framework for Global Climate Resilience (the "UAE Framework"), which is intended "to guide the achievement of the global goal on adaptation and the review of overall progress in achieving it." Paragraph 9 of decision 2/CMA.5 includes seven thematic targets relating to: (a)

water, (b) food/agriculture, (c) health, (d) ecosystems and biodiversity, (e) infrastructure, (f) livelihoods, and (g) cultural heritage. Additionally, paragraph 10 identifies four targets: (a) risk and vulnerability assessment, (b) planning, (c) implementation, and (d) monitoring and evaluation.[7] The adoption of this critical framework has helped specify the actions Parties can take to contribute to building global climate resilience by making progress toward the targets in a manner consistent with their national priorities and circumstances. The United States is taking action to make progress toward these targets through a variety of policies, programs, and workstreams. Actions contributing toward one or more of the targets in the UAE Framework are denoted throughout this chapter with parenthetical references to the relevant target or targets.

This chapter includes the following sections:

A. National circumstances, institutional arrangements, and legal frameworks;
B. Impacts, risks, and vulnerabilities;
C. Adaptation priorities and barriers;
D. Adaptation strategies, policies, plans, goals, and actions to integrate adaptation into national policies and strategies;
E. Progress on implementation of adaptation;
F. Monitoring and evaluation of adaptation actions and processes; and
G. Cooperation, good practices, experience, and lessons learned.

This chapter also serves as the United States' second Adaptation Communication under the Paris Agreement.

A. National Circumstances

Biogeophysical Characteristics

With its biogeophysical diversity, the United States is exposed to many different types of climate impacts, including droughts and wildfires, inland and coastal flooding, extreme heat, loss of permafrost and sea ice, ecosystem and biodiversity loss, and more. Chapter 3, Section A: Climate Profile outlines some of the changes in temperature and precipitation already experienced in the United States, and further details on U.S. biogeophysical characteristics are noted in Chapter 3, Section A: Geographic Profile.

Demographics

U.S. population estimates are noted in Chapter 3, Section A: Population Profile. As of July 2023, 5.5 percent of the population are under the age of 5, 21.7 percent of the population is under the age of 18, and 17.7 percent is 65 years and over. In terms of race, 75.3 percent of the population is White alone, 13.7 percent is black or African American alone, 1.4 percent is American Indian and Alaska Native alone, 6.4 percent is Asian alone, 0.3 percent is Native Hawaiian and Other Pacific Islander alone, and 3.1 percent is two or more races. Regarding Hispanic origin, 19.5 percent is Hispanic or Latino[1], and 58.4 percent is White alone, not Hispanic or Latino.[8]

Vulnerabilities are spread widely, but unevenly, across the United States. Climate change exacerbates long-standing social inequities experienced by underserved and overburdened communities, contributing to persistent disparities in the resources needed to prepare for, respond to, and recover from climate impacts. Low-income communities and communities of color face higher risks of illness and death from extreme heat, climate-driven floods, air pollution, and wildfire smoke compared with White people, and often lack access to climate resilient infrastructure, green spaces, safe housing, and protective resources.[9] Future climate change is expected to further disrupt many areas of life, exacerbating existing challenges posed by aging and deteriorating infrastructure, stressed ecosystems, and economic inequality.

The impacts are especially acute on Indigenous Peoples as interconnected social, physical, and ecological systems are disrupted. Many Tribes rely on, but face institutional barriers to, self-determined management of water, land, other natural resources, and infrastructure that will be increasingly impacted by changes in climate. These institutional barriers include limited access to traditional territory and resources, which severely limits their adaptive capacities.

Economy

Climate change is projected to reduce U.S. economic output and labor productivity across many sectors, with effects differing based on local climate and the industries unique to each region. Climate-driven damages to local economies especially disrupt heritage industries (e.g., fishing traditions, trades passed down over generations, and cultural heritage-based tourism) and communities whose livelihoods depend on agricultural and natural resources. For example, as fish stocks in the Northeast move northward and to deeper waters in response to rapidly rising

[1] Hispanics may be of any race, so also are included in applicable race categories

ocean temperatures, important fisheries like scallops, shrimp, and cod are at risk. In Alaska, climate change has already contributed to fishery disasters due to increased water temperature and extreme weather events.[10]

Climate change poses occupational threats to worker's health and safety, largely through increased heat morbidity and mortality. The Southeast and U.S. Caribbean face high costs from projected labor losses and heat health risks to outdoor workers, and small businesses are already confronting higher costs of goods and services and potential closures as they struggle to recover from the effects of compounding extreme weather events.[11]

There were 28 weather and climate disasters in 2023, surpassing the previous record of 22 in 2020, tallying a price tag of at least $92.9 billion. The South, Central, and Southeast regions of the United States, including the Caribbean U.S. territories, have suffered the highest cumulative damage costs from weather disasters, reflecting the severity and widespread vulnerability of those regions to a variety of weather and climate events.[12]

With every additional increment of global warming, costly damage is expected to accelerate. For example, 2°F (1.1°C) of warming is projected to cause more than twice the economic damage compared to the damages associated with 1°F of warming.[13] Damage from additional warming poses significant risks to the U.S. economy.

Infrastructure

Climate change threatens vital infrastructure that moves people and goods, powers homes and businesses, and delivers public services. Many infrastructure systems across the country are at the end of their intended useful life and were not designed to cope with additional stress from climate change. For example, extreme heat causes railways to buckle, severe storms overload drainage systems, and wildfires result in roadway obstruction and debris flows. Risks to energy, water, healthcare, transportation, telecommunications, and waste management systems will continue to rise with increased climate change, with many infrastructure systems at risk of failing.

In coastal areas, sea level rise threatens permanent inundation of infrastructure, including roadways, railways, ports, tunnels, and bridges; water treatment facilities and power plants; and hospitals, schools, and military bases. More intense storms also disrupt critical services like access to medical care, as seen after Hurricanes Irma and Maria in the U.S. Virgin Islands and Puerto Rico. Hurricanes Helene and Milton significantly damaged power and water services across the Southeast.[14]

At the same time, climate change is expected to place multiple demands on infrastructure and public services. For example, higher average temperatures and more intense heatwaves will heighten electricity and water demand, while wetter storms and intensified hurricanes will strain wastewater and stormwater management systems. In turn, these compounded events can also lead to increased demand on related services like healthcare systems. In the Midwest and other regions, aging energy grids are expected to be strained by disruptions and transmission efficiency losses from climate change.[15]

Adaptive Capacity

The United States has relatively high adaptive capacity to address the multifaceted impacts of climate change, driven by its robust governance systems, technological innovation, and legal and regulatory frameworks. Diverse adaptation activities are occurring across the United States and are increasingly moving from awareness and assessment to planning and implementation, though with limited advancement toward monitoring and evaluation. To date, adaptation across the United States has been incremental in nature, and given the expected future pace of climate change, more action is needed at greater rates and larger scales, across more sectors, and in context-specific ways. Historically, actions to adapt often have not centered equity and were not designed using a systems-oriented, regional, or collaborative approach for transformation.

Adaptation researchers and practitioners are starting to track the number of actions, assess the adaptation effectiveness of those that have occurred, and evaluate the long-term sufficiency of adaptation projects. However, frameworks, monitoring, indicators, and evaluations that assess adaptation practices, co-benefits, equality, and implementation at appropriate levels of granularity are still under development. With the lack of consistent tracking and evaluation of adaptive capacity and how effectively society and ecosystems are adapting to climate change, it is challenging to measure progress in adaptive capacity and its changes over time.

Institutional Arrangements and Governance

Since its 2022 biennial report, the United States has increased the uptake of adaptation actions to address the impacts of climate change, in part supported by the Bipartisan Infrastructure Law (BIL) and the Inflation Reduction Act (IRA), discussed below. Transformative adaptation, which involves more fundamental shifts in systems, values, and practices, will be necessary in many cases to adequately address the risks of current and future climate change.[16] New

monitoring and evaluation methods will also be needed to assess the effectiveness and sufficiency of adaptation and to address equity. Additional information on adaptation efforts is provided further below.

National Climate Task Force

Comprised of Cabinet Secretary-level representatives from more than 25 Federal agencies, the National Climate Task Force was established to ensure a coordinated, whole-of-government response to the many different dimensions of the climate crisis. Within the Task Force, there are several subgroups focused on priority climate resilience themes, including wildfire resilience, flooding, extreme heat, drought, coastal resilience, and support of community-driven relocations. While coordinating U.S. government efforts, the Task Force also works to design, empower, and support whole-of-society responses to climate change.

U.S. Global Change Research Program (USGCRP)

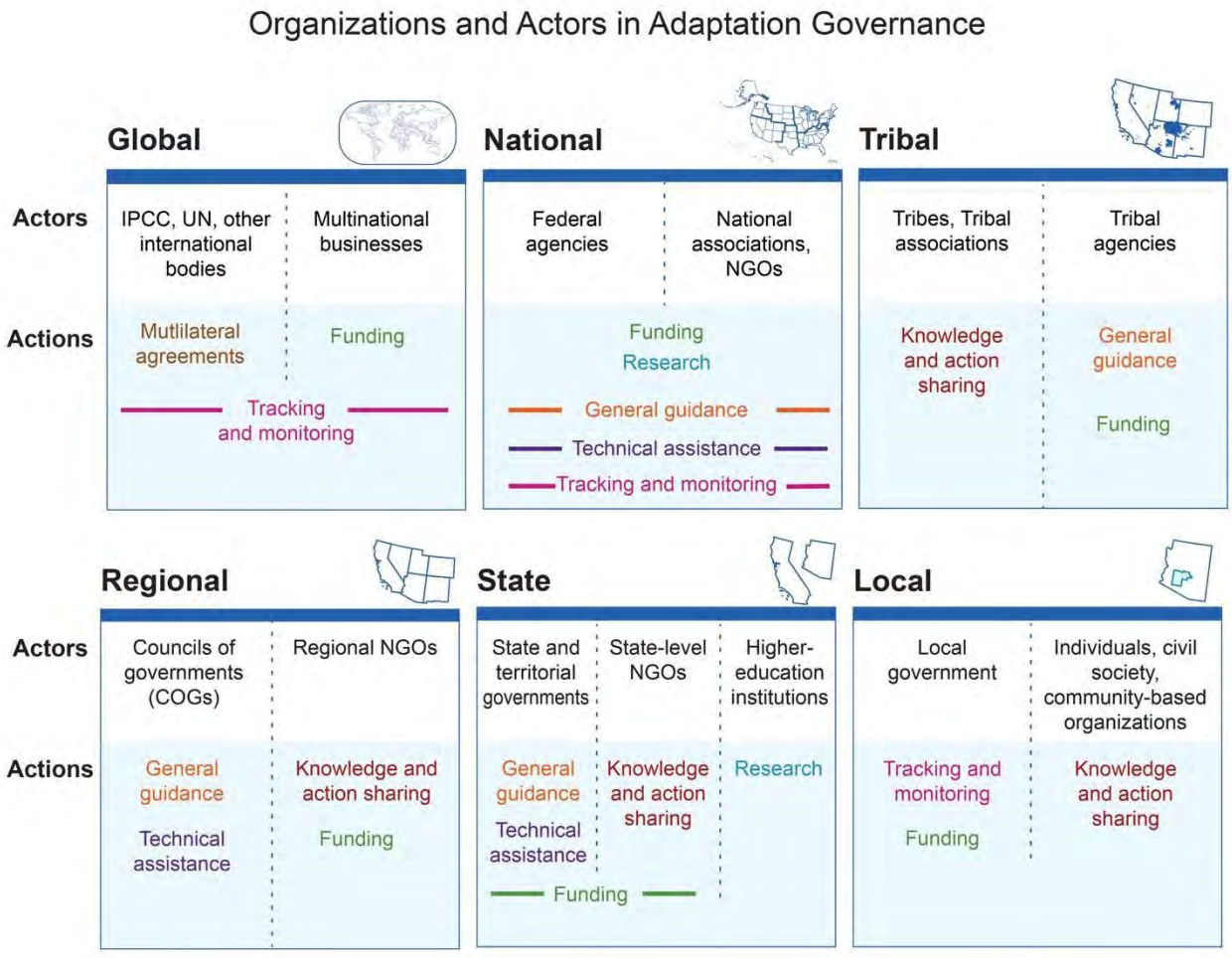
The National Science and Technology Council (NSTC) established an interagency Fast Track Action Committee (FTAC) on Climate Services. In March 2023, the FTAC produced *A Federal Framework and Action Plan for Climate Services* that recommended that the existing USGCRP[17] provide national leadership for coordination and strategic planning of climate services. In response, the National Science and Technology Council established a new subcommittee under USGCRP – the Subcommittee on Climate Services (SCS). SCS is working to improve interagency coordination of Federal climate services, better linking both producers and users of climate data, tools, information, and technical assistance in order to facilitate improved decision-making and disaster preparedness efforts.

USGCRP also coordinates the interagency Federal Adaptation and Resilience Group (FARG), which brings together nearly 200 experts from bureaus and agencies across the Federal Government. The FARG helps to share information and experience, produce publications, and support co-investment and co-development of tools and information resources to help agencies align their climate adaptation strategies and priorities. In 2024, the group held workshops on the array of climate adaptation programs being funded under recent legislation, aligning Federal agencies' online resources for adaptation, and Federal agency approaches to monitoring and evaluating climate adaptation investments.

Institutions Outside the Federal Government

In the United States, many types of organizations make decisions about adaptation, including Federal, state, territorial, Tribal, and local governments; businesses; nonprofits; households; and individuals—all with varying and overlapping jurisdictions. While some adaptation decisions are made unilaterally, most decisions involve multiple organizations. Adaptation networks have become more sophisticated in the last decade, involving a greater number of actors from more diverse organizational backgrounds, as seen in Figure 4-1. The actors involved often have distinct (and at times divergent) views of the problem, risk tolerance levels, priorities, preferred solutions, and ideal futures.

Figure 4-1: Climate adaptation involves numerous actions by different actors at multiple jurisdictional scales



Source: United States Fifth National Climate Assessment[18]

Effective and equitable adaptation governance also benefits from intentional engagement and coordination between all involved actors over a sustained period. For example, following multiple wildfires and postfire floods, the Tribal community of Santa Clara Pueblo collaborated with multiple Federal agencies, the State of New Mexico, and several other Tribes to restore their watershed and to build resilience against future floods. In Oregon, following a deadly 2021 heat dome event, the state's legislature funded its Medicaid program to provide air conditioners and funding for utility costs to vulnerable residents in partnership with community-based organizations, furnishing 4,400 air conditioners in 2022 and 3,000 in 2023.[19] These kinds of collaborations are particularly effective when a single government agency leads coordination of an interorganizational group to oversee adaptation activities. Alternatively, coordinating hubs can help bridge activities of disparate actors; having well-defined roles and responsibilities can avoid duplicated efforts.

Well-functioning, multilevel governance helps in adaptation strategy development. For example, California, Florida, and other states have used informal regional collaborations (e.g., Southeast Florida Regional Climate Compact, Alliance of Regional Collaboratives for Climate Adaptation) to share resources and develop adaptation strategies that serve regional needs. The Coastal Zone Management Act, which requires Federal, state, territorial, Tribal, and local coordination in a single review of newly developed laws beyond borders to protect and develop coasts, is a potential model for encouraging greater cross-scale actions. Vertical linkages between governance levels can help bridge the gap between community-based and national-level adaptation efforts and enhance horizontal linkages across public and private actors and institutions. Horizontal network linkages enable diffusion of information and resources across similar organizations; for example, horizontal connections between community groups facilitate selective adoption of context-specific adaptations and the scaling out of successful adaptation.[20]

Further, there are collaborations amongst government and other stakeholders. For example, the United States Geological Survey National and Regional Climate Adaptation Science Centers (CASCs) is a partnership driven program that teams scientists with natural and cultural resource managers and local communities to help fish, wildlife, water, land, and people adapt to a changing climate.[21]

Another example can be found with the Urban Sustainability Directors Network (USDN), which brings local government sustainability practitioners together to learn, collaborate, and accelerate the work of local sustainability. By providing knowledge, resources, and partnerships, USDN helps advance change locally in member communities as well as across the field of practice.[22]

Legal & Policy Frameworks

The Bipartisan Infrastructure Law and Inflation Reduction Act

These two landmark pieces of legislation together invest more than $50 billion in Federal activities, programs, and grants to communities and state, local, Tribal, and territorial governments to advance climate resilience. Investments are in areas where climate change strongly affects community resilience and sustainability such as wildfire defense, coastal and inland flooding resilience, water infrastructure and drought monitoring systems, protections against extreme heat, and rehabilitating watersheds.

The National Climate Resilience Framework

Recognizing that addressing the projected risks and impacts of climate change would require an all-hands-on-deck effort, coordinated across the Federal Government, with all levels of subnational government, and with a wide range of non-governmental institutions, President Biden directed the creation of a first-ever National Climate Resilience Framework to identify key values, priorities, and objectives to help expand and accelerate nationally-comprehensive, locally-tailored, and community-driven adaptation and resilience strategies.

The National Climate Resilience Framework,[23] published in September 2023, lays out the U.S. Government's vision for advancing climate resilience, designed to guide and align climate resilience investments and activities by the Federal Government and its partners.

The Framework identifies six core objectives – supported by specific actions – that are critical to strengthening U.S. protections against the impacts of climate change; that make communities safe, healthy, equitable, and economically strong; and that can and should be a focus of climate resilience efforts at all levels. The objectives are detailed in Section C: Domestic priorities.

The Fifth National Climate Assessment

The Global Change Research Act of 1990 mandates that USGCRP deliver a report to Congress and the President not less frequently than every four years that "integrates, evaluates, and interprets the findings of the Program and discusses the scientific uncertainties associated with such findings; analyzes the effects of global change on the natural environment, agriculture, energy production and use, land and water resources, transportation, human health and welfare, human social systems, and biological diversity; and analyzes current trends in global

change, both human-induced and natural, and projects major trends for the subsequent 25 to 100 years."[24]

Published in 2023, the *Fifth National Climate Assessment* (NCA5) "fulfills that mandate by delivery of this Assessment and provides the scientific foundation to support informed decision-making across the United States." By design, much of the development of NCA5 built upon the approaches and processes used to create the *Fourth National Climate Assessment* (NCA4), with a goal of continuously advancing an inclusive, diverse, and sustained process for assessing and communicating scientific knowledge on the impacts, risks, and vulnerabilities associated with a changing global climate.[25] NCA5 includes a chapter on Climate Adaptation which includes many economic and societal benefits from adaptation. *(Target 10(a))*

Adaptation-Related Executive Orders and Memoranda

Executive Orders (EO) and Memoranda released by the Office of the President since 2021 have directed Federal agencies to assess and expand adaptation capacity in efforts to build just and sustainable global resilience against the climate crisis. A non-exhaustive selection of EOs and Memoranda are included below.

- Tackling the Climate Crisis at Home and Abroad (January 20, 2021): EO 14008 places the climate crisis at the center of foreign and domestic policy. Domestic adaptation directives include aligning the management of Federal procurement and real property, public lands and water, and financial programs to support robust climate action (Section 204) and empowering workers to build sustainable infrastructure and a clean energy economy (Sections 212 and 213). EO 14008 also establishes the President's ambitious environmental justice agenda, including Presidential initiatives like the Justice40 Initiative, the Environmental Justice Scorecard, and the Climate and Justice Economic Screening Tool.[26] *(Target 10(b))*
- Rebuilding and Enhancing Programs to Resettle Refugees and Planning for the Impact of Climate Change on Migration (February 4, 2021): EO 14013 orders U.S. policy, reporting, and visa practices, in association with United States Refugee Admission Program (USRAP), to adapt to meet the humanitarian needs required by the impacts of climate change.[27] *(Target 9(e))*
- Climate-Related Financial Risk (May 20, 2021): EO 14030 adopts a government-wide financial strategy to mitigate climate risks and its drivers, while accounting for and addressing disparate impacts on disadvantaged communities and communities of color. Financial adaptation measures include Section 3: "Assessment of Climate-Related

Finance Risk," Section 4: "Resilience of Life Savings and Pensions," and Section 6: "Long-Term Budget Outlook."[28] *(Targets 9(f) and 10(b))*

- Directing Implementation of the Infrastructure Investment and Jobs Act (November 15, 2021): EO 14052 directs U.S. infrastructure investment nation-wide to advance environmental justice through priority implementation and task force management. This will be accomplished through investing public dollars equitably, including through the Justice40 Initiative.[29] *(Targets 9(e) and 10(b))*
- Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability (December 8, 2021): EO 14057 outlines a coordinated, whole-of-government approach, along with individual agency goals and actions, to transform Federal procurement and operations to reduce greenhouse gas (GHG) emissions and environmental impacts and secure a transition to clean energy and sustainable technologies. EO 14057 builds upon EO 14008 and emphasizes the importance of the Federal Government's strategic planning, governance, financial management, and procurement to ensuring climate resilient operations.[30]
- Strengthening the Nation's Forests, Communities, and Local Economies (April 22, 2022): EO 14072 details ambitious mitigatory and adaptive goals through policy, restoration and conservation, stopping international deforestation, and deploying nature-based solutions (NBS). The United States aims to meet 2030 collective global goals to end natural forest loss and restore at least an additional 200 million hectares of forests and other ecosystems, while showcasing new economic models that reflect the services provided by critical ecosystems around the world.[31] *(Targets 9(d) and 10(c))*
- Implementation of the Energy and Infrastructure Provisions of the Inflation Reduction Act of 2022 (September 12, 2022): EO 14082 establishes the White House Office on Clean Energy Innovation and Implementation, and aims to improve public health and advance environmental justice and economic opportunity for communities who disproportionately bear the brunt of cumulative exposure to industrial and energy pollution (Section 1c); expand research and accelerate innovation in the development of clean energy, climate, and related technologies (Section 1g); and build sustainable, resilient communities (Section 2i).[32]
- National Security Memorandum (NSM) on Strengthening the Security and Resilience of United States Food and Agriculture (November 10, 2022): NSM-16 details U.S. government policy and coordination in developing risk mitigation strategies including more frequent data collection and threat assessment analysis, promotion of efforts towards security of national infrastructure, and agricultural research towards climate-resilient technologies.[33] *(Targets 9(b), 10(a), and 10(b))*

- Revitalizing Our Nation's Commitment to Environmental Justice for All (April 21, 2023): EO 14096 details U.S. policy commitment to environmental justice, with the recognition that it requires investing in and supporting culturally vibrant, sustainable, and resilient communities in which every person has safe, clean, and affordable options for housing, energy, and transportation.[34] *(Targets 9(c) and 10(b))*
- Memorandum on Advancing Climate Resilience through Climate-Smart Infrastructure Investments and Implementation Guidance for the Disaster Resiliency Planning Act (November 29, 2023): M-24-03 provides climate-smart infrastructure best practices to Federal agencies for Federal financial assistance programs infrastructure and provides guidance on incorporating natural hazard and climate risk information.[35] *(Targets 9(e) and 10(a))*
- National Security Memorandum on Critical Infrastructure Security and Resilience (April 30, 2024): NSM-22 advances U.S. efforts to strengthen and maintain resilient critical infrastructure.[36]

Federal Climate Adaptation Plans

In 2014, Federal agencies first developed Climate Adaptation Plans (CAPs), which have subsequently been revised in 2021 and in 2024, reflecting the increasing maturity and expertise of Federal agencies to address climate risks to their operations and management and better serve their stakeholders in a changing climate, through changes in their policies and programs. Federal agency CAPs align with the government-wide approach to adaptation and resilience set forth in the Executive Orders described above, particularly EOs 14008, 14030, and 14057, as well as the objectives of the National Climate Resilience Framework. Key elements of the 2024-2027 CAPs include *(Targets 10(a), 10(b), 10(c), and 10(d))*:

- Combining historical data and projections to assess exposure of assets to climate-related hazards including extreme heat and precipitation, sea level rise, flooding, and wildfire;
- Expanding the operational focus on managing climate risk to facilities and supply chains to include Federal employees and Federal lands and waters;
- Broadening the mission focus to describe mainstreaming adaptation into agency policies, programs, planning, budget formulation, and external funding;
- Linking climate adaptation actions with other priorities, including advancing environmental justice and the Justice40 Initiative, strengthening engagement with Tribal Nations, supporting the America the Beautiful initiative, scaling up NBS, mobilizing the next generation of climate resilience workers through the American Climate Corps, and addressing the causes of climate change through climate mitigation; and

- Adopting common progress indicators across agencies to assess the progress of agency climate adaptation efforts.[37]

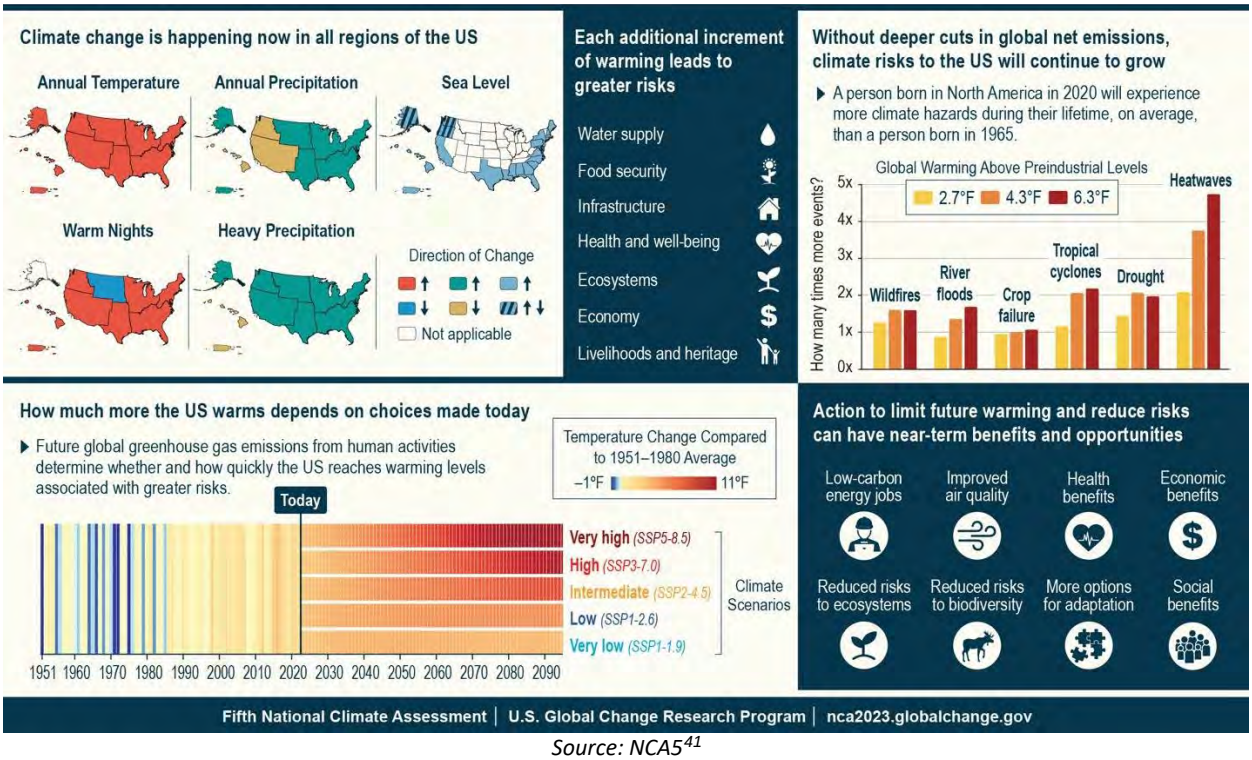
B. Impacts, Risks, and Vulnerabilities

Current and projected climate trends and hazards

In the United States, climate change is making it harder to maintain safe homes and healthy families, reliable public services, a sustainable economy, and strong communities. Many of the extreme events and harmful impacts that people are already experiencing will worsen as warming increases and new risks emerge.[38] Observations show an increase in the severity, extent, and/or frequency of multiple types of extreme events, as detailed in Figure 4-2. Heatwaves have become more common and severe in the West since the 1980s. Drought risk has been increasing in the Southwest over the past century, while at the same time rainfall has become more extreme in recent decades, especially east of the Rockies. Hurricanes have been intensifying more rapidly since the 1980s, with heavier rainfall and higher storm surges. More frequent and larger wildfires have been burning in the West in the past few decades due to a combination of climate factors, societal changes, and policies.[39]

Human activities—primarily emissions of greenhouse gases from fossil fuel use—are affecting climate system processes in ways that alter the intensity, frequency, and/or duration of many weather and climate extremes, including extreme heat, extreme precipitation and flooding, agricultural and hydrological drought, and wildfire.[40] The more the planet warms, the greater the impacts—and the greater the risk of unforeseen consequences. The impacts of climate change increase with warming, and warming is virtually certain to continue if emissions of carbon dioxide do not reach net zero. Rapidly reducing emissions would very likely limit future warming and the associated increases in many risks. The United States is actively mitigating emissions, including through a transition to zero emission vehicles, renewable energy sources, and the Federal Buy Clean initiative.

Figure 4-2: Climate Change Risks and Opportunities in the United States



Source: NCA5[41]

Observed and potential impacts of climate change, including sectoral, economic, social and/or environmental vulnerabilities

Climate impacts are occurring and are expected to intensify on every economic sector, demographic group, and region of the United States, but the effects will not be evenly distributed. Major areas of consideration for climate change in the United States include the below. *(Target 10(a))*

Energy

Energy supply and delivery are threatened by extreme weather, sea level rise, droughts, wildfires, and other climate-related hazards. These changes damage infrastructure and have profound effects on human lives and livelihoods, with already-overburdened communities bearing a disproportionate share of the risk. Efforts to enhance energy system resilience are underway, but significant investments will be required to achieve a resilient and decarbonized energy future.[42]

Agriculture and Food Security

Shifts in precipitation, air temperature, and soil moisture are disrupting agricultural production and food systems and are projected to reduce the availability and affordability of nutritious food. Climate change also compounds stressors on the marine ecosystem, which can create conditions that lower species abundance and exacerbate food insecurity and economic vulnerability for communities that rely heavily on fisheries and aquaculture. Impacts to food systems are distributed unevenly, with increased risks to the livelihoods and health of communities that depend on agriculture, fishing, and subsistence lifestyles, including Indigenous Peoples reliant on traditional food sources. Climate change also disproportionately harms food accessibility and the nutrition of women, children, older adults, and low-wealth communities.[43]

Human Health

Climate change is harming physical, mental, spiritual, and community health and well-being. There are increasing cases of infectious and vector-borne diseases and declines in food and water quality and security. Health impacts of climate change are felt disproportionately by communities and people who have been marginalized, including BIPOC (Black, Indigenous, and People of Color), low-wealth individuals, and sexual and gender minorities. Women, and particularly women of color, are more likely to live in communities of low wealth, which is associated with food insecurity, and exposure to particulate matter, extreme heat, and climate-related disasters. Further, a review of more than 30 million U.S. births revealed that women's heat exposure during pregnancy increased rates of low birth weight, preterm delivery, and stillbirth. Climate-related hazards will continue to grow, increasing morbidity and mortality across all U.S. regions.[44] These hazards put additional stress on health care facilities directly and indirectly (e.g., grid failures, road closures), jeopardizing access to care during and after events that may lead to negative health outcomes.

Coastal Changes

Coastal counties of the United States are home to 129 million people, or almost 40 percent of the total population.[45] The severity and risks of coastal hazards across the country are increasing, driven by accelerating sea level rise and changing storm patterns, resulting in increased flooding, erosion, and rising groundwater tables. Between 2000 and 2021, 38 tropical cyclones caused over $1 trillion in losses (in 2022 dollars) and 6,200 deaths. Between 2020 and 2050, coastal sea levels along the contiguous U.S. coasts are expected to rise about 11 inches (28 cm), or as much as the observed rise over the last 100 years. In response, coastal flooding will occur 5–10 times more often by 2050 than 2020 in most locations, with damaging

flooding occurring as often as disruptive "high tide flooding" does now if action is not taken. This is affecting the resilience of coastal ecosystems and communities. The impacts of climate change and human modifications to coastal landscapes, such as through seawalls, levees, and urban development, are both limiting the capacity of coastal ecosystems to adapt naturally and are compounding the loss of coastal ecosystem services.[46]

Ecosystems

The interaction of climate change with other stressors is causing biodiversity loss, changes in species distributions and life cycles, and increasing impacts from invasive species and diseases, all of which have economic and social consequences. These risks are projected to grow with additional degrees of warming, as well as with increased atmospheric carbon dioxide, which contributes to the acidification of marine ecosystems.[47]

Water

Changes to the water cycle pose risks to people and nature. Alaska and northern and eastern regions of the United States are seeing and expect to see more precipitation on average, while the Caribbean, Hawai'i, and southwestern regions of the United States are seeing and expect to see less precipitation. Heavier rainfall events are expected to increase across the United States which, combined with changes in land use and other factors, is leading to increasing flood damage. Drought impacts are also increasing, as are flood- and drought-related water quality impacts. All communities will be affected, but in particular many Black, Hispanic, Tribal, Indigenous, and socioeconomically disadvantaged communities, face growing risks from changes to water quantity and quality due to the proximity of their homes and workplaces to hazards and limited access to resources and infrastructure.[48]

Approaches, methodologies and tools, and associated uncertainties and challenges

The observed and projected impacts of climate change are being tracked through a variety of climate information tools.[49,50,51,52] Climate information tools allow us to track not only the changes themselves, but also the impacts we are seeing today, and those that we can expect in the future. Tools like these are rapidly evolving from scientific exercises developed by and for technical experts, to more accessible information portals that allow non-experts to find and use information that they need.[53] While there is uncertainty in all forms of information, the Federal Government works hard to identify and describe the sources and levels of uncertainty in the

climate data it produces. Federal laws, including the Information Quality Act, and the Evidence Act provide guidance and rules for the transparency and reliability of government data. Federal climate information is provided with high levels of documentation and transparency.

C. Adaptation Barriers and Priorities

Domestic priorities and progress towards those priorities

The United States developed the National Climate Resilience Framework to expand and accelerate climate change adaptation and resilience. This Framework identifies six core objectives that were developed by eight entities within the Executive Office of the President and more than 20 Federal agencies, informed by listening sessions with stakeholders and resilience experts from outside the government, and reports by the U.S. Government Accountability Office (GAO), the President's Council of Advisors on Science and Technology, and others.

The United States developed the National Climate Resilience Framework to identify key values, priorities, and objectives to help expand and accelerate nationally comprehensive, locally tailored, and community-driven climate change adaptation and resilience strategies. This Framework identifies six core objectives as critical to strengthening U.S. resilience to climate change impacts and making communities safer, healthier, more equitable, and more economically strong.

The United States has made unprecedented progress on each of the objectives. The following section presents a non-comprehensive list of recent actions taken and investments made by the Federal Government under each objective of the Framework.

Objective 1: Embed climate resilience into planning and management

Multiple studies show the benefits of proactively accounting for and building resilience to climate impacts.[54,55,56] Embedding climate resilience into planning and management reduces the adverse impacts of climate change, saves lives, and reduces the costs of damages. Research conducted by the National Institute of Building Sciences found that on average, every $1 spent by the Federal Government on disaster mitigation returns $2 to $13 in economic benefits.[57]

Recent actions and investments under Objective 1 (Target 10(c)):

- As described above, in June 2024, twenty-four U.S. Federal agencies released updated CAPs for 2024-2027 that expanded efforts to integrate considerations of adaptation and resilience into their operations and mission-delivery.[58,59] Some Federal agencies, including the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Agriculture (USDA), have developed sub-agency strategies to strengthen implementation and integration of adaptation and resilience into policies and programs.
- The U.S. Fire Administration works directly with communities in fire prone areas to help them become fire adapted. A fire-adapted community collaborates to identify its wildfire risk and works collectively on actionable steps to reduce its risk of loss.[60] The strategy is to have communities work with their local fire departments to create a written assessment of identified risks using a Community Wildfire Protection Plan (CWPP). A CWPP strategically documents local risks and creates an action plan to help everyone understand how making improvements to their home and the area around their home can create a more favorable outcome in the event of a wildfire.[61]
- The Federal Flood Risk Management Standard (FFRMS), reinstated by EO 14030 in 2021, helps to ensure investments are flood resilient. FFRMS applies to projects where Federal funds are used for new construction, substantial improvement, or repairs to address substantial damage. This can include projects such as critical infrastructure, affordable housing developments, renewable energy, or broadband internet projects. It also requires agencies to consider future flood risks, including those associated with climate change, when approving Federally funded projects.[62]

Objective 2: Increase resilience of the built environment to both acute climate shocks and chronic stressors

The built environment shapes the way people live, work, recreate, and interact. From housing, commercial buildings, and industrial facilities to transportation, power and water utilities, and public spaces and parks, every community's unique built environment is a significant determinant of quality of life. A resilient built environment—one that is constructed to the latest building codes, renovated to high-performance resilience standards, and located away from hazard zones where possible, while ensuring there is an adequate and affordable housing supply—protects people from climate impacts, supports quicker recovery from disruptions, and helps communities thrive.

Recent actions and investments under Objective 2 (Targets 9(e) and 10(c)):

- The Federal Emergency Management Agency's (FEMA) Building Resilient Infrastructure and Communities (BRIC) Program[63] and other hazard mitigation assistance programs

have been supported and expanded by the BIL. Additionally, FEMA guidance[64] published in 2022 made clear that BRIC funds may be available to cover the cost of extreme heat mitigation plans, climate-smart buildings (retrofits, heating/cooling systems), resilience hubs, and other projects with heat-reduction co-benefits.

- The BIL is providing the Bureau of Reclamation $8.3 billion to enhance the resilience of water infrastructure across the West to drought and climate change, which directly supports community resilience.[65]
- The Mitigation Framework Leadership Group established the National Initiative to Advance Building Codes (NIABC) to help communities adopt the latest consensus building and energy codes and standards; improve climate resilience; and reduce energy costs. In 2023, the NIABC Best Practices Document was developed to enhance hazard risk reduction.[66]
- DOE's Grid Deployment Office is administering a $10.5 billion Grid Resilience and Innovation Partnerships (GRIP) Program to enhance grid flexibility and improve the resilience of the power system against growing threats of extreme weather and climate change. In August 2024, DOE announced the latest investment of $2.2 billion in the grid for eight projects that will protect against growing threats of extreme weather events, lower costs for communities, and catalyze additional grid capacity to meet load growth.[67]
- The Department of Health and Human Services (HHS) Low Income Home Energy Assistance Program (LIHEAP) provides Federally funded assistance to reduce the costs associated with home energy bills, energy crises, weatherization, and minor energy-related home repairs. HHS has issued guidance on using LIHEAP funds to protect communities from extreme heat and wildfire smoke, including by allowing grantees to distribute or loan efficient air conditioning units. In Fiscal Year 2024, the LIHEAP Program issued over $4.13 billion to grant recipients.[68]
- The Office of Management and Budget (OMB) provided guidance, for the first time, to executive branch agencies to consider NBS when designing resilient infrastructure. OMB emphasized that NBS should not be an afterthought in the climate fight, but rather a starting point for building resilience, to ensure communities benefit from investments for decades to come.[69]
- The U.S. Army Corps of Engineers is evaluating suppliers' locations, infrastructure, and vulnerability to climate-related risks, including identifying critical supply chain nodes vulnerable to climate change impacts, such as ports, warehouses, and transportation routes.[70]

Objective 3: Mobilize capital, investment, and innovation to advance climate resilience at scale

There is tremendous opportunity to further harness U.S. innovation capacity towards climate resilience. Building a climate-resilient country will require development, improvement, and scaling of advanced water treatment systems and drought-tolerant crops, efficient cooling technologies and building materials that reflect heat and insulate, forecasting and surveillance systems to track extreme events and impacts, and myriad other solutions. Mobilizing capital, investment, and innovation in climate resilience will help the United States better prepare for climate impacts and position the country at the forefront of a global climate resilience market that could be worth as much as $2 trillion per year by 2026.[71]

Recent actions and investments under Objective 3 (Targets 10(b) and 10(c)):

- The BIL has provided $3.5 billion to FEMA's Flood Mitigation Assistance grant program to proactively improve community flood resilience and elevate at-risk homes and buildings above flood levels.[72]
- Through the IRA, the National Oceanic and Atmospheric Administration (NOAA) is investing $2.6 billion to improve resilience of coastal communities and marine resources.
- The Bureau of Indian Affairs at the Department of the Interior is investing $220 million for Tribal climate adaptation and resilience, including Youth Service Corps projects and the National Seed Strategy Keystone Initiative.[73]
- In July 2024, the United States released the first-of-its kind Climate Resilience Game Changers Assessment. The Assessment identifies 28 critical technologies, management practices, and institutional and financial tools that can drive transformative positive impacts on our nation's climate resilience while creating good-paying jobs, improving community well-being, and advancing environmental justice.[74]
- The U.S. EPA's $14 billion National Clean Investment Fund will deploy clean technology and NBS to combat climate change, while also delivering benefits such as flood and urban heat mitigation, job training, and brownfield redevelopment to communities.[75]
- Leveraging the power of the private sector, a $1 billion commitment was made from private sector investors to make climate progress through agroforestry, sustainable water management and other NBS.[76]
- The U.S. Department of Homeland Security Science and Technology Directorate in collaboration with the U.S. Fire Administration deployed 200 Alpha phase wildfire sensors throughout the United States to provide early fire alerts and warnings. Since 2020, the sensors have collected over 1,000,000 hours of data in the field to enhance the Artificial Intelligence (AI) learning algorithms now being deployed in the Beta

version, which requires less solar power to recharge, is equipped with wind sensors to increase the accuracy of wildfire location prediction and has better ability to operate in areas with limited cellular coverage. Two hundred additional beta wildfire sensors were deployed in 2024 to high-risk areas across the United States for operational testing and evaluation, including the 80 sensors across the Hawaiian Islands.[77]

- The Department of Defense (DOD)'s Tyndall Air Force Base is working with local, state, and national partners to build an "Installation of the Future," which includes using updated building codes that capture future conditions and constructing living shorelines adjacent to the base to preserve water quality, enhance overall ecosystem health, and strengthen flood resilience.[78]
- In 2023, USDA expanded its Hurricane Insurance Protection-Wind Index Endorsement with a Tropical Storm Option after working directly with farmers to improve coverage.[79]
- FEMA's BRIC national competition selected 124 projects across 115 communities, including the installation of new sewer mains in Detroit's Jefferson Chalmers neighborhood to protect over 600 homes from flooding, and making storm drainage improvements in Greenville, North Carolina to reduce flood risk for 90 homes.[80]
- EPA's Environmental & Community Change Grants are funding $2 billion in IRA investments for environmental and climate justice activities to benefit disadvantaged communities through projects that reduce pollution, increase community climate resilience, and build community capacity to respond to environmental and climate justice challenges.[81]
- The Department of the Interior announced $120 million in 2024 to fund climate resilience projects for 102 Tribes and nine Tribal organizations. The program is part of a nearly $560 million investment for Tribal climate resilience programs through the Department's Bureau of Indian Affairs, funded through the Bipartisan Infrastructure Law, Inflation Reduction Act, and annual appropriations. In addition to the Tribal Climate Resilience Program, the Volunteer Community-Driven Relocation Program was launched with $115 million of funding plus $17 million from FEMA and $2 million from the Denali Commission. This funding is part of more than a collective $50 billion invested by the President's Investing in America agenda to advance climate adaptation and resilience across the nation, including in communities that are most vulnerable to climate impacts.[82,83]
- HHS educates safety net health care providers about funds for resilience investments like microgrids, onsite renewable energy generation, and energy efficiency improvements made available through the Inflation Reduction Act. These funds have helped support numerous projects, including a first-of-its-kind pilot program at Boston Medical Center that provides solar energy credits to patients who report difficulty affording household utility payments.[84]

Objective 4: Equip communities with information and resources needed to assess their climate risks and develop the climate resilience solutions most appropriate for them

There is no one-size-fits-all approach to building climate resilience; communities experience climate change in different ways and respond according to their unique capabilities and cultures. A key objective of climate resilience efforts should therefore be to ensure that communities are equipped to assess their risks and prepare accordingly. Central to this approach is providing communities with evidence-based and easy-to-use information, tools, and services.

Recent actions and investments under Objective 4 (Targets 10(a) and 10(c)):

- The NCA Atlas, published with NCA5, is a resource to help Americans anticipate how changing climate conditions might affect their homes and businesses.[85]
- EPA offers a variety of technical and outreach materials to raise public awareness to help policymakers make informed decisions about climate change impacts.[86]
- NOAA invested $12.7 million to advance its Climate Smart Communities Initiative (CSCI). CSCI supports communities in identifying and using climate science data and tools to understand their exposure to climate-related hazards, and to use that information to create and implement climate resilience plans.[87]
- NOAA is dedicated to improving climate projections and advancing research, modeling, prediction, information dissemination, and service delivery for disasters such as wildfires, drought, floods, and heat. This includes $50 million to collect and disseminate actionable, placed-based climate information, $35 million to improve projections, predictions, and models, and $85 million to use “proving grounds” to develop and test products and services for the private sector to improve delivery of climate data and services.[88]
- FEMA produces flood maps and risk assessments to help communities know which areas have the highest risk of flooding.[89]
- The U.S. Department of Housing and Urban Development (HUD)’s Community Resilience Toolkit has been curated to help recipients of HUD Community Planning and Development funds identify ways to use their funding to mitigate the impacts of natural hazards, with key sections dedicated to increasing temperatures and extreme heat, wildfire, and drought.[90]
- In 2024, the United States launched multiple resources to support agencies and their partners in implementing the FFRMS, including the Federal Flood Standard Support Tool and the FFRMS Floodplain Determination Job Aid.[91]

- NOAA is providing $4.9 million for the agency's labs and research partners to improve drought monitoring and prediction in the American West.[92]
- NOAA is using $5 million in IRA funding to establish two virtual research centers – the Center for Community Climate and Health Observations, Monitoring, and Evaluation and Center for Climate and Health Assessments, Policy, and Practice – to provide technical assistance and other support to local communities and governments on improving resilience to extreme heat.[93]
- NOAA and the Center for Disease Control and Prevention created the National Integrated Heat Health Information System (NIHHIS) as an interagency information system to develop and provide actionable, science-based information to help decision-making and protect people from heat.[94]
- The Climate Mapping for Resilience and Adaptation (CMRA) helps people assess their local exposure to climate-related hazards. It also helps communities identify potential Federal funding opportunities that can be used to plan and implement climate resilience plans.[95]
- In March 2024, DOE announced a $90 million in funding to support building energy code adoption, training, and technical assistance at the state, Tribal, and local level.[96]
- August 2024, the U.S. Fire Administration developed and launched two new geospatial tools to improve wildfire awareness and prevention messaging in communities. The Wildland Urban Interface (WUI) Fire Property Awareness Explorer and the WUI Fire Community Awareness Explorer provide an initial data-informed basis for residents to "Know Where You Live" in proximity to the location of the WUI and fire-prone areas. This knowledge helps individuals learn to reduce combustible fuels around their home and create defensible space in fire prone areas.[97]
- The NOAA Climate Adaptation Partnerships (CAP) is an applied research and engagement program that expands society's regional capacity to adapt to climate impacts in the United States. The CAP program supports sustained, collaborative relationships that help communities build lasting and equitable climate resilience.[98]

Objective 5: Sustainably manage lands and waters to enhance resilience while providing numerous other benefits

U.S. lands, waters, and oceans and the many important services that they provide to nature and society, are at increasing risk due to climate change. Agricultural production has been affected by increases in temperatures affecting farmworker health and more occurrences of heat stress in livestock, as well as more frequent extreme weather events that include drought and flooding that reduce crop yield. Critical ocean habitats, like California's kelp forests and

Florida's coral reefs, have declined by 90 percent in less than 10 years due to above normal ocean temperatures and increased ocean acidification.[99,100] Forests are experiencing more frequent and intense wildfires often turning them from an important tool in the fight against climate change (a carbon sink) into the opposite (a carbon emission source). Water temperatures in freshwater lakes and rivers are warming, creating breeding grounds for the spread of invasive species. Climate impacts not only affect biodiversity, but are also altering the way humans, animals, and environments interface, contributing to disease spread and outbreaks among vulnerable species. Investments in nature through conservation and restoration are critical for managing these impacts and are equally integral as solutions to the climate crisis.

Recent actions and investments under Objective 5 (Targets 9(a), 9(d), 10(a), 10(b), 10(c)):

- The Bureau of Reclamation at the Department of the Interior made available up to $125 million to support the relaunch of a System Conservation Pilot Program, a voluntary conservation program in the Upper Colorado River Basin.[101]
- The Department of the Interior's (DOI) WaterSMART Initiative invested over $427 million for 127 projects across all seven Colorado River Basin states in fiscal year 2022 to help farmers and ranchers conserve water and build drought resilience in their communities. WaterSMART partnered with the USDA's Natural Resources Conservation Service (NRCS) to coordinate investments in priority areas and help accelerate water conservation in individual communities to make a bigger impact where it is needed most.[102]
- In 2023, USDA announced the Western Water and Working Lands Framework for Conservation Action, a comprehensive, multi-state strategy under USDA NRCS to address key water and land management challenges across 17 Western states. The Framework includes guidelines for identifying vulnerable agricultural landscapes and 13 strategies to help NRCS state leaders, water resource managers, and producers respond to priority challenges.[103]
- In January 2022, USDA's Forest Service launched a robust, 10-year strategy to address the wildfire crisis in the places where it poses the most immediate threats to communities. The strategy, titled "Confronting the Wildfire Crisis: A Strategy for Protecting Communities and Improving Resilience in America's Forests," combines a historic investment of congressional funding with years of scientific research and planning into a national effort that will dramatically increase the scale and pace of forest health treatments over the next decade.[104] Through the strategy, USDA's Forest Service will work with states, Tribes, and other partners to address wildfire risks to critical infrastructure, protect communities, and make forests more resilient.

- In July 2024, USDA NRCS announced $90 million from the IRA for Conservation Innovation Grants that include over 50 projects to develop new tools, practices, and technologies that advance natural resource conservation on private lands, including a range of projects that support adaptation and resilience.[105]
- In June 2024, NOAA announced over $16 million in awards to drive innovation in marine science and technology—including investments in critical climate adaptation technologies that address ocean acidification and enhance monitoring of the ocean and marine biodiversity.[106]
- In May 2024, the Department of the Interior announced $179 million to fund innovative drought resilience projects, including water recycling and groundwater recharge that will meet the average annual water needs of hundreds of thousands of people.[107]
- The Wildland Fire Mitigation and Management Commission, co-chaired by USDA, DOI, and FEMA, released its 2023 report outlining a comprehensive, consensus-based set of recommendations to Congress to address the nation's wildfire crisis.[108]
- USDA's Forest Service's Urban and Community Forestry Grants are investing $1 billion in nearly 400 projects across the country—in partnership with community organizations, state, local, Tribal, and territorial partners, public colleges and universities, and nonprofits—working to provide equitable access to nature and their benefits to urban communities.[109]
- USDA's Forest Service Community Wildfire Defense Grant Program is a $1 billion grant program intended to help at-risk local communities and Tribe's plan for and reduce wildfire risk. Projects include nearly $10 million for the Cherokee Nation in Oklahoma to get needed equipment to reduce wildfire risk; nearly $6 million to Wasco County, Oregon to create fuel breaks and defensible space to protect communities; and nearly $9.9 million to The Nature Conservancy in Colorado to protect communities and watersheds in Archuleta County.[110]

Objective 6: Help communities become not only more resilient, but also more safe, healthy, equitable, and economically strong

A community's climate resilience is closely linked to its economic, social, and physical wellbeing. Communities with diverse economies, strong civic engagement, food and water security, and access to essential services like equitable transportation, affordable housing and health care will be more resilient to climate threats. For example, investments in a community's health care system—including in medical supply chains, health care facilities, and outreach networks—will improve not just the overall health and well-being of community members during normal operations, but also their capacity to mitigate, adapt to, and recover from the impacts of

extreme weather events, long-term climate stresses, and other compounding factors. Moreover, individuals with underlying health conditions tend to be more vulnerable to extreme weather events, such as heat waves, meaning that certain measures that improve community health can also improve climate resilience.

Recent actions and investments under Objective 6 (Targets 9(c), 10(a), 10(b), 10(c), 10(d)):

- USDA provided nearly $680 million in Emergency Relief Program funding for agricultural producers impacted by natural disasters, including drought, in the seven Colorado River Basin states in 2020 and 2021, as well as nearly $180.9 million in payments for livestock producers impacted by drought in 2020 and 2021 through the Emergency Livestock Relief Program.[111]
- NOAA's NIHHIS Urban Heat Island Mapping Campaign[112] launched heat island mapping campaigns in an additional 154 communities across 14 states, adding to a growing list of over 70 communities that have measured higher heat stress.[113]
- HHS and NHTSA's Emergency Medical Services (EMS) HeatTracker is helping to track EMS responses to heat-related emergencies.[114]
- In 2022, HHS published a Dear Colleague Letter[115] making clear that Community Services Block Grant (CSBG) Program funding can be used for summer crisis assistance and disaster response to mitigate the effects of heat stress and extreme heat events. In 2024, HHS published another Dear Colleague Letter exploring CSBG flexibilities to support communities responding to the impacts of wildfires, including outdoor workers like farmworkers. HHS CSBG funding is approximately $750 million annually.[116]
- In 2024, HHS announced that the Quality Improvement Organization Program will, for the first time, offer funding for climate change and emergency preparedness work, totaling $63 million for this technical assistance. The Quality Improvement Organization Program is dedicated to improving health quality for people with Medicare.[117]
- In 2023, the HHS announced $65 million to strengthen hurricane response and emergency preparedness at health centers and ensure communities in hurricane-prone areas have continuous access to primary care services during future emergencies.[118]
- In June 2024, the Department of Commerce and NOAA announced $60 million in funding to help train and place people in jobs that advance a climate-ready workforce for coastal and Great Lakes states, Tribes, and territories.[119]
- The BIL provides more than $135 million to support voluntary, community-led transition and relocation for Tribal communities severely threatened by climate change and accelerating coastal hazards.[120]
- A total of $75 million in funding from FEMA was awarded to support community driven Tribal relocation efforts in Alaska (Newtok Village and Native Village of Napakiak) and Washington (Quinault Indian Nation).[121]

- The Occupational Safety and Health Administration (OSHA)'s National Emphasis Program on Outdoor and Indoor Heat was launched in March 2021 to protect millions of workers from heat illness and injuries. Through the program, OSHA conducts heat-related workplace inspections.[122]
- In September 2024, the HHS Centers for Disease Control and Prevention National Institute for Occupational Safety and Health published its first-ever Hazard Review on wildland fire smoke. The draft Hazard Review presents evidence-based recommendations to protect outdoor workers, including farmworkers, construction workers, oil and gas workers, park rangers, emergency responders, and others from the adverse health effects of occupational exposure to wildland fire smoke.[123]

Adaptation challenges, and gaps and barriers to adaptation

Although adaptation is occurring across the United States, barriers remain. These barriers can be addressed with financial, cultural, technological, legislative, or institutional changes. More actors are adapting to climate change, including government, private industry, and civil society, and each sector and group has unique needs and expectations that require differing approaches and focus. Further, there is a growing recognition of the need to consider and plan for compound and complex conditions with multiple stressors.

It is also important to distinguish between planning for adaptation and actually implementing adaptation strategies; there is still more of the former than the latter. The ability to adapt is uneven and inequitable: communities or businesses with means, wealth, or access to resources are more able to adapt, while those with fewer means or opportunities are less able to adapt. The gap between planning and action could also reflect the ease of tracking adaptation plans compared to tracking evidence of systems, people, or environments that are adapting, which can take years to show progress. Without monitoring and evaluation of adaptation investments and adaptive capacity, it is challenging to measure progress, continually improve, and understand the overall impact of adaptation actions and investments.

Few regulatory requirements focus directly on adaptation. Existing environmental and disaster policies, frameworks, and governance systems are not yet designed to handle the long-term, widespread transformative changes needed to adapt to climate change; tend to be reactive rather than proactive; and assume fixed rather than dynamic environments. While significant progress has been made on methodologies and tools to assess climate risks and adaptation options, users often struggle to determine the best tool or find actionable information tailored to their needs. Clear pathways for sharing datasets and tools among multiple actors and

jurisdictions are lacking, as are streamlined and transparent processes for integrating local, traditional, and Indigenous Knowledge.

The diversity of values and goals held by different public entities and organizations, as well as differentiated responsibilities across levels of government or types of organizations, can create challenges in developing shared goals. Effective adaptation governance requires coordination across government agencies at all scales and with diverse actors.

Adaptation that does not explicitly address uneven vulnerability, and the social processes that drive these disparities, can exacerbate social inequities and climate impacts.[124] While progress is being made, barriers still exist to centering justice and equity in domestic adaptation. In many settings, there is not a widely accessible forum for local participation, particularly of Indigenous and rural communities living in remote and vulnerable locations. Social hierarchies and structures can prevent overburdened groups from sharing their opinions, preventing achieving equitable adaptation. Frontline communities are hit first and worst by climate change, and oftentimes adapting to climate change may not be their immediate concern. Intentionally centering equity in adaptation solutions in partnership with frontline communities has the potential to improve some systemic issues such as inequality, discrimination, and limited access to essential resources and opportunities.

Finally, adaptation requires additional investment and funding. Communities with the highest climate vulnerability do not have adequate and equitable access to available adaptation funding. Organizations often do not understand potential returns on investment in adaptation, so there is less appetite for expensive measures.[125] Investment in adaptation can also be challenging to justify in an environment of competing priorities and limited resources. This can be exacerbated by the temporal misalignment between the costs and benefits of adaptability. For example, purchasing a sufficient real estate footprint around a levee to allow for later levee raises as sea levels change is a present-day cost, but its benefit is not incurred until after sea levels rise and the levee is raised. Comparing heavily discounted future benefits against undiscounted present-day costs can reduce the economic incentive for adaptation under traditional cost-benefit analysis.

D. Adaptation Strategies, Policies, Implementation, and Monitoring

Implementation of adaptation actions in accordance with the global goal on adaptation as set out in Article 7, paragraph 1, of the Paris Agreement

The United States is currently advancing climate adaptation and resilience across the country, including in communities that are the most vulnerable to climate impacts. These actions aim to enhance adaptive capacity by mobilizing investments to scale climate resilience and embedding climate resilience into strategic planning and management; strengthening resilience by fortifying the built environment to climate and weather events and chronic stressors as well as protecting and sustainably managing lands and waters to enhance resilience; and reducing vulnerability to climate change by equipping communities with information and resources needed to assess their climate risks and develop appropriate climate resilience solutions and helping communities become safer, healthier, more equitable, and more economically strong. Section C: Domestic Priorities enumerates many of the adaptation actions that are currently being implemented.

Adaptation goals, actions, objectives, undertakings, efforts, plans (e.g. national adaptation plans and subnational plans), strategies, policies, priorities (e.g. priority sectors, priority regions or integrated plans for coastal management, water and agriculture), programmes and efforts to build resilience

The United States is in the process of implementing an array of programs and projects supported by the Federal Government that shape and prioritize national climate resilience. Many are detailed in Section C: Domestic priorities. The BIL and IRA represent over $85 billion in Federal support for national and subnational adaptation efforts; select efforts are listed below. Through these plans, the United States sets priorities to expand climate management

for coastal and vulnerable communities, water-related infrastructure, agriculture and energy resilience, and much more. *(Target 10(b))*

Bipartisan Infrastructure Law

Transportation and infrastructure

This $30 billion investment includes extensive funding toward rehabilitation and adaptation of infrastructure, flood management, evacuation planning and support, and other community resilience measures to ensure sustainable and justice-oriented climate development. Notably, the BIL includes $8.7 billion for the Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) program to support resilience of transportation infrastructure in at-risk coastal communities. These efforts align with the United States' climate adaptation goals by prioritizing the development of resilient infrastructure that can withstand extreme weather events and climate impacts. Through the BIL, the United States prioritizes building resilience in vulnerable regions by providing the needed support for national and subnational adaptation plans, integrated coastal management strategies, and water resource management policies.

Energy and Grid Resilience

This $26 billion investment includes significant efforts towards enhancing the resilience of the electric grid and the reliability of the U.S. energy supply. BIL dedicates funding to national and subnational programs, projects, and agencies to prevent outages, upgrade grid infrastructure, and support innovative approaches to energy storage and distribution. Additionally, it covers wildfire management strategies, energy efficiency programs, and initiatives to improve energy reliability in rural and remote areas. These actions are crucial for achieving the United States' climate adaptation objectives by ensuring a stable and resilient energy supply for all communities. By supporting national adaptation plans, energy policies, and resilience-building programs, the United States can best prepare itself for the risks posed by climate change to the energy sector.

Environmental and Ecosystem Restoration

This $10.5 billion investment includes wide-ranging measures to restore and protect ecosystems, improve water and air quality, and advance U.S. adaptation efforts through NBS. Key initiatives prioritize the impacts of climate change on vulnerable communities through the enhancement of natural landscape resilience, investing in habitat restoration for coastal resilience, support for conservation and revegetation projects, and mitigating wildfires. The United States sees these efforts as integral to its climate adaptation strategies, as they promote

the health and resilience of ecosystems that provide critical services and protection against climate impacts. The initiatives aim to be integrated and align with national and subnational adaptation plans, conservation policies, and streamlined approaches to managing water, agriculture, and coastal regions, thereby contributing to overall resilience of the environment and communities.

The Inflation Reduction Act

The IRA allocates $20.5 billion towards various initiatives aimed at mitigating drought, reducing air pollution, making renewable energy and energy storage technologies available to communities, improving ecological integrity, expanding data collection and availability, enhancing coastal and community resilience, and building the capacity of disadvantaged communities to engage with state and Federal decision-making process. Key allocations include drought mitigation in the Colorado River Basin, urban tree canopy projects, sustainable retrofits for HUD-assisted housing, collaboration with private forest landowners, and significant support for Tribal climate resilience planning.

Ocean Climate Action Plan

In March of 2023, the first-ever Ocean Climate Action Plan (OCAP) was released to harness the power and capacity of the ocean to address the climate crisis. Since the release of the OCAP, Federal agencies have advanced ocean actions that align with the plan's three goals: (1) create a carbon-neutral future, without emissions that cause climate change and harm human health, (2) accelerate NBS, and (3) enhance community resilience to ocean change by developing ocean-based solutions that help communities adapt and thrive in our changing climate.

Accomplishments include the release of the first ever Ocean Justice Strategy; investment of $2.6 billion to enhance coastal community resilience and restore marine resources, including nearly $400 million for Tribal priorities; establishment of a Marine Carbon Dioxide Removal Fast Track Action Committee, and the release of the U.S. Ocean Acidification Action Plan.

How best available science, gender perspectives and Indigenous, traditional, and local knowledge are integrated into adaptation

U.S. climate adaptation strategies are Federally initiated and supported but incorporate a diverse range of perspectives and are guided by the local knowledge of the communities and peoples that are implementing national efforts to build resiliency. At every level, the United States works to ensure that the best available science holds together the fabric of the multiplicity of actors that work together to advance adaptation through both national and subnational policy and development. In January of 2021, a series of EOs and memorandums were released with the aim of reinforcing scientific power and integrity throughout the U.S. government *(Target 9(c), 9(f), 9(g), and 10(b))*:

- EO 13990 on Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis;[126]
- EO 14007 establishing the President's Council of Advisors on Science and Technology;[127]
- Memorandum on Restoring Trust in Government Through Scientific Integrity and Evidence-Based Policymaking.[128]

U.S. adaptation actions are guided by and seek to empower the communities they serve, this includes taking a gender-responsive approach to climate adaptation. The United States recognizes that gender-responsive climate action is necessary to achieve our climate goals. This is demonstrated, for example, through the National Strategy on Gender Equity and Equality, which calls for people of all genders to be fully empowered as leaders at all levels to advance climate goals, including climate adaptation strategies and climate disaster response.[129]

Indigenous and Traditional Knowledge has played a large role in the development of national climate adaptation strategy. The United States continues to dedicate significant resources towards collaboration with and empowerment of Tribal climate resiliency. Not only is Indigenous expertise critical to the success of their adaptation goals, but for many Indigenous Peoples and Tribal Nations, stewardship of lands and waters is integral to their cultural identity. Such perspectives lead to different adaptation options with emphasis on active management designed to maintain reciprocal relationships with their ecosystems. For example, the Hopi Tribe have been adapting agricultural strategies to the impacts of drought for over 2,000 years.[130] Their soil-moisture techniques enable plants to adapt and grow in extreme conditions.

Collaboration and inclusion of Indigenous perspectives spans across adaptation efforts related to agriculture, forestry, and many other resiliency efforts. Examples of U.S. adaptation measures that have been guided by Indigenous Knowledge and values include:

- The Department of State and EPA, with guidance from DOI, launched a new interagency initiative in 2022, the Indigenous Peoples' Conservation Advisory Network (IPCAN), to support and uplift the leadership of Indigenous Peoples and their Knowledge in conservation, restoration, and sustainable management efforts in terrestrial, coastal, and ocean ecosystems. IPCAN is developed through robust consultation with global Indigenous stakeholders and facilitates a global, Indigenous-led network supporting Indigenous Peoples' stewardship of lands and waters that addresses the climate and biodiversity crises.
- In December 2022, the White House Council on Environmental Quality and the White House Office of Science and Technology Policy jointly, released government-wide guidance and an accompanying implementation memorandum for Federal agencies on recognizing and including Indigenous Knowledge in Federal research, policy, and decision making.[131]
- In 2022, the White House hosted two virtual roundtables with Native American Tribal and Alaskan Native leaders to discuss how the Administration will deliver for Tribal communities, including by providing resources from the BIL.[132]
- NOAA is using Climate and Equity Pilot Project funds to establish a Director of Tribal Climate Change Initiatives position at the Alaska Native Tribal Health Consortium, a non-profit Tribal health organization serving Alaska Native and American Indian people in Alaska. The director will lead a landscape assessment of Tribal climate change adaptation activities in Alaska and establish a baseline understanding of Tribal climate change challenges and responses.[133]

Development priorities related to climate change adaptation and impacts

The United States is making significant progress towards achieving the six objectives identified by the National Climate Resilience Framework, which encompass development priorities. A non-comprehensive list of recent actions and investments made by the Federal Government can be found in Section C: Domestic Priorities under each objective.

Any adaptation actions and/or economic diversification plans leading to mitigation co-benefits

U.S. climate strategies for adaptation and mitigation are in many ways symbiotic. While U.S. greenhouse gas emissions are falling, the current rate of decline is not sufficient to meet national and international climate commitments and goals. Adaptation actions will continue to play a critical role in benefitting mitigation efforts to bring the United States and the world closer to the goal of limiting warming to 1.5°C.

Adaptation measures can help to protect the globe's natural carbon sinks and reduce the amount of GHG in the atmosphere. The implementation of NBS is especially effective in this manner. For example, the protection of forests and adaptive management of vegetation can both enhance natural carbon sinks and help to reduce the risk of wildfires. The restoration of coastal wetlands can both buffer coastal communities from storms and enhance carbon storage and sequestration. Adaptation actions such as these are integrated into national and subnational policy, initiatives and programs. The historic investment into U.S. climate initiatives from the BIL and IRA is supporting projects that advance both adaptation and mitigation.

Efforts to integrate climate change into development efforts, plans, policies and programming, including related capacity-building activities

Climate change is integrated into U.S. development efforts through national and subnational strategic planning, legislation, international cooperation, capacity-building, research, community engagement, financial investment, and monitoring. Key initiatives include the National Climate Resilience Framework and Federal Climate Adaptation Plans, which primarily focus on proactive climate adaptation and enhancing climate resilience. The IRA and BIL provide significant investments in clean energy and climate resilience projects, as well as the various initiatives mentioned in Section C: Domestic priorities.

Internationally, the United States aims to support climate adaptation and mitigation in developing countries and the global community. Agencies, such as the U.S. Agency for International Development (USAID), play a crucial role in capacity-building through the provision of technical assistance and training to enhance local resilience and reduce emissions. Research institutions develop new technologies and advance our understanding of climate change to inform policy and improve understanding.

Community engagement is fostered through public-private partnerships and community-based programs, ensuring that local stakeholders are involved in climate resilience planning and implementation. Financial investments, including climate finance and resilience funds, support both domestic and international climate projects. Monitoring and evaluation systems are being developed and established to track the effectiveness of these efforts and help ensure continuous improvement.

Overall, U.S. strategy is composed of a multi-faceted and integrated approach to addressing climate change, promoting sustainable development, and building resilience both at home and abroad.

Nature-based solutions to climate change adaptation

NBS are essential strategies that utilize natural processes and ecosystems to advance successful climate adaptation and mitigation efforts. In the United States, these solutions are integrated into efforts to enhance resilience, reduce greenhouse gas emissions, and provide a variety of benefits for biodiversity and human well-being. Recognizing the need to unlock the potential of NBS, the United States released the Nature-based Solutions Roadmap in 2022. This roadmap provides five strategic recommendations for Federal agencies to integrate NBS and other actions to pave the way.[134] *(Targets 9(d), 10(b), and 10(c))*

1. Update policies: Agencies should update Federal policies and guidance to make it easier to consider and use NBS.
2. Unlock funding: Federal agencies can rapidly reduce emissions and promote community resilience by integrating NBS into financial assistance and incentive programs.
3. Lead with Federal facilities and assets: Federal agencies have begun focused efforts to improve resilience in their facilities, operations, and programs. Federal facilities standards should require use of NBS, where appropriate, and standards should be updated as knowledge about NBS evolves.
4. Train the workforce: The next wave of good jobs can come from training an equitable, NBS workforce. Key skills are needed in planning, designing, building, and maintaining NBS.
5. Prioritize research, innovation, knowledge, and adaptive learning: Federal agencies can review existing research to identify gaps in understanding the effectiveness of NBS. Agencies should also develop interagency best practices for monitoring the full suite of NBS, including how best to measure and verify climate benefits.

Other key initiatives include ecosystem restoration and conservation, such as reforestation, afforestation, and wetland restoration, which help sequester carbon and improve air and water quality. Sustainable land management practices like agroforestry and soil conservation techniques are also employed to enhance soil health and increase carbon storage.

Coastal and marine initiatives, such as mangrove restoration and coral reef protection, play a crucial role in shielding coastal areas from storm surges and supporting marine biodiversity. Furthermore, conservation and restoration of marine and coastal ecosystems could capture and store enough atmospheric carbon each year to offset about 3 percent of emissions.[135] Urban green infrastructure, including green roofs, walls, and urban parks, helps mitigate urban heat islands, manage stormwater, and improve air quality. Watershed management practices, like establishing riparian buffer zones and integrated water resource management, aim to protect water quality and stabilize ecosystems. Of NBS investments, there are high returns on efforts to restore coastal ecosystems in particular, since U.S. coral reefs provide estimated adaptation benefits of more than $1.8 billion annually (dollar year not provided).[136]

Community-based conservation efforts engage local communities in managing natural resources, ensuring culturally appropriate and sustainable solutions. Incorporating Indigenous Knowledge into conservation practices further enhances the effectiveness of these initiatives. Policy and financial support, through incentive programs and regulatory frameworks, encourage the adoption and scaling of NBS. They are a vital component of the U.S. strategy to integrate climate change into development efforts, promoting resilient and sustainable environments that can adapt to and mitigate the effects of climate change.

While NBS offer specific benefits for climate mitigation and adaptation, including carbon sequestration and a degree of self-adaptability, successful NBS implementation should also recognize the particular vulnerabilities of these systems in a changing climate. Increased heat, fire, drought, invasive species, and altered water salinity and acidity can all be expected in a warming world, and all can negatively impact living and hybrid systems. Planning NBS with careful consideration of potential future hazards can help ensure success, as can investment in monitoring and maintenance.

Examples of U.S. policies, plans, and reports referenced in this report that integrate NBS into adaptation action are included below.

- Opportunities to Accelerate Nature-Based Solutions
- National Climate Resilience Framework
- Federal Climate Adaptation Plans
- Inflation Reduction Act
- Bipartisan Infrastructure Law

- National Climate Assessment
- USAID Climate Strategy
- Green Climate Fund Contributions
- Conservation Reserve Program
- Environment Quality Incentives Program
- Urban Green Infrastructure Initiatives
- America the Beautiful Initiative

Stakeholder involvement, including subnational, community-level and private sector plans, priorities, actions and programmes

U.S. climate adaptation efforts involve numerous stakeholders, including subnational actors, community-level organizations, and the private sector. Subnational stakeholders (including state, territorial, Tribal, local, and private entities) play a crucial role in implementing climate policies and initiatives at regional and local levels. Many of these subnational stakeholders, such as cities and municipalities, have developed their own climate action plans that align with national goals but are tailored to local conditions and priorities. These plans often include NBS, renewable energy projects, and resilience-building measures. Additionally, subnational entities often collaborate through regional initiatives, such as the Regional Greenhouse Gas Initiative, to collectively address climate change and share best practices.

Community-level stakeholders are essential to ensure climate initiatives are culturally appropriate, sustainable, and effective. Local communities are engaged in managing and conserving natural resources through stewardship programs that incorporate Indigenous and traditional ecological knowledge and practices. Community members are involved in the planning and implementation of climate resilience projects, ensuring that local needs and priorities are addressed. Community organizations also conduct education and awareness campaigns to inform residents about climate change impacts and encourage sustainable practices.

The private sector is a key partner in driving innovation, investment, and implementation of climate solutions. Public-private partnerships facilitate collaborations between government agencies and private companies to develop and implement climate solutions, such as renewable energy projects, energy efficiency programs, and green infrastructure. Many companies have adopted sustainability goals and practices, such as reducing carbon footprints, investing in renewable energy, and supporting conservation projects. Private sector companies

also invest in research and development of new technologies for renewable energy, energy storage, carbon capture, and other climate solutions.

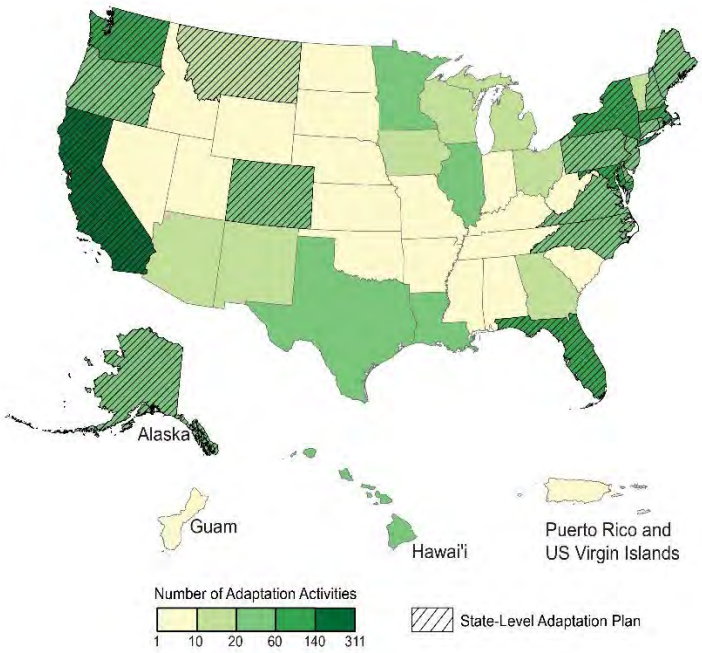
E. Progress on Implementation of Adaptation

Implementation of the actions identified in Section D above

The United States has made significant strides in ramping up climate adaptation efforts as identified in Section D above, signaling an increased commitment to addressing the growing threats posed by climate change. Through the development of institutional frameworks such as the National Climate Resilience Framework and the enactment of major legislation such as the IRA and BIL, the U.S. government has substantially expanded its climate resilience efforts. These actions represent a pivotal shift in the scale and ambition of adaptation measures, with notable progress seen in the number of initiatives launched, funding allocated, and communities engaged in building resilience to climate impacts.

Efforts to adapt to climate change and reduce net greenhouse gas emissions are underway in every U.S. region and have expanded in recent years. Actors, stakeholders, and rights-holders – from individuals and organizations to companies, communities, and government entities across all levels, regions, and sectors – are already investing in adaptation measures to reduce the harms caused by climate change and leverage new opportunities to enhance their ability or capacity to adapt as seen in Figure 4-3.

Figure 4-3: Number of Publicly Documented Adaptation Activities (2018-2022)



Source: NCA5[137]

Steps taken to formulate, implement, publish, and update national and regional programmes, strategies and measures, policy frameworks (e.g. national adaptation plans), and other relevant information

Many state governments and organizations have individual sustainability, resilience, or adaptation plans. Eighteen states have climate adaptation plans, and another six states have plans underway. Thirty-two states lack a public adaptation plan, a select few U.S.-based companies have disclosed adaptation-related actions they are taking, and very few jurisdictions have adaptation plans co-designed between the public and private-sectors. Across jurisdictions, plans are developed for different reasons such as climate impacts, investor requests, regulatory requirements. As required in Executive Orders 14008 and 14057, more than 20 Federal agencies have prepared and updated climate adaptation plans.[138] *(Target 10(b))*

Climate adaptation-related congressional legislation is becoming more prevalent, often embedded within other topics (e.g., infrastructure, disaster relief, water).

Other actions, including national and regional programs, strategies and measures, and policy frameworks are detailed in Section A, C, and D of this chapter.

Implementation of adaptation actions identified in current and past adaptation communications, including efforts towards meeting adaptation needs, as appropriate

In 2021, the United States submitted its first Adaptation Communication (AC) outlining U.S. major domestic and international climate adaptation initiatives. Since its submission, the United States has made substantial progress in the implementation of the adaptation actions identified in the AC. The breadth of efforts towards meeting adaptation needs is detailed in Section C and D of this chapter.

Coordination activities and changes in regulations, policies and planning

Federal agencies are incorporating consideration of climate impacts and adaptation actions in Federal policies and guidance, where relevant. For example, USDA's Forest Service is updating or proposing climate-informed revisions to guidance and policies related to silviculture practices, beneficial uses of forest restoration byproducts, recreation, and designated areas planning, habitat and water resource management, and forest-level land management planning. The Department of Veterans Affairs is integrating health, demographic, and climate change information to anticipate the effects of climate change on Veterans' health and plan for adjustments to their program delivery in the future. EPA is integrating consideration of climate risks into multiple actions as appropriate and where consistent with its statutory authorities such as in the development of rules, policy and guidance; permitting and environmental reviews; in monitoring, enforcement, and compliance activities; and in grant making.

For examples of further coordination activities, please refer to Section A: Institutional Arrangements and Governance.

F. Monitoring and evaluation of adaptation actions and processes

Establishment or use of domestic systems to monitor and evaluate the implementation of adaptation actions

Systems to monitor and evaluate the implementation of adaptation actions at different scales are still in development or are relatively new. In the most recent update of Federal Climate Adaptation Plans, agencies responded to a common set of indicators and process metrics, to improve assessment and communication of climate resilience efforts across the Federal Government. For international-facing climate adaptation and resilience activities, the Federal Government is periodically reporting on progress within the framework of the President's Emergency Plan for Adaptation and Resilience (PREPARE) initiative. At the state level, states like Washington, Massachusetts, and California, are developing and implementing systems of metrics to monitor implementation of adaptation actions.[139]

The U.S. Government also maintains a variety of systems to track and monitor Federal government spending, including USASpending.gov,[140] SAM.gov,[141] the Federal Audit Clearing House,[142] the GAO,[143] and Grants.gov.[144] When Federal funding for contracts is awarded, robust systems are typically in place to track and monitor implementation to confirm that agreed-upon work has been completed. *(Target 10(d))*

Achievements, impacts, resilience, review, effectiveness and results

Over the past few years, transformative funding has been awarded for resilience and adaptation projects across the country—much of it through the BIL and IRA. Many of these projects are collected and highlighted on Federal websites such as Invest.gov,[145] Cleanenergy.gov,[146] and Conservation.gov.[147] Proposed and final regulations are generally tracked and published on www.regulations.gov. Individual agencies also typically announce major grants, loans, policies, and publications on their websites. *(Target 10(d))*

In 2023, FEMA announced 656 project selections for $1 billion in climate adaptation and resilience funding.[148] The top three funded project types are:

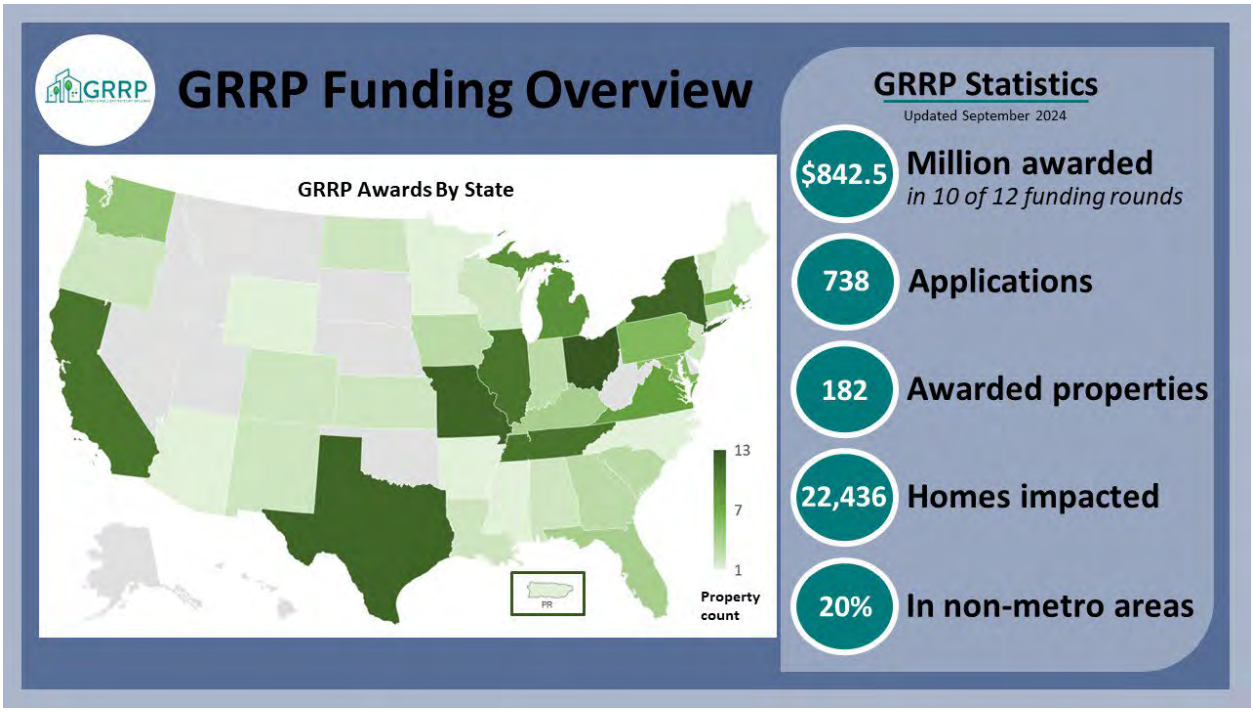
- Flood control for $395 million across 28 projects, designed to eliminate or reduce flood damage;

- Utility and infrastructure protection for $237 million across 30 projects, like elevating pumping stations, enhancing power poles, strengthening water towers and floodproofing utility plants;
- Building code-related projects for $55 million across 129 projects for enforcement and adoption of more modern, hazard-resistant building codes. This is the greatest number of projects FEMA has ever selected for building code-related activities in a grant cycle. These funds were reserved as a non-competitive set-aside for states, Tribes and territories, resulting in a 180 percent increase in requests for adoption and enforcement funding.

Below is a sample of projects that increase the resilience of communities across the United States *(Targets 10(c) and 10(d))*. More examples of the achievements, impacts, results, effectiveness can be found in Section C: Domestic priorities.

- The Eastwick Near-Term Flood Barrier Project, led by the Philadelphia Office of Sustainability and funded by FEMA with over $2 million, will construct barriers to reduce flooding.[149]
- A FEMA-funded project in Washington, D.C. will install 20 shaded bus shelters in Washington, D.C. to mitigate the effects of extreme heat.
- Safety net health care providers are leveraging Inflation Reduction Act tax credits to invest in renewable energy, energy storage technologies, and charging stations, resulting in building resilience and community benefits (e.g., sharing of solar energy credits, free charging stations).[150]
- A blend of NBS and infrastructure improvements will boost flood resilience along the Big Ditch stream corridor in the city of Goldsboro, North Carolina. The FEMA-funded project will upgrade road culverts and expand a restored floodplain. This will make homes safer from flooding as well as improve water quality and provide new wildlife habitat and more equitable access to recreational resources.[151]
- NOAA's Climate Resilience Regional Challenge grant program awarded $575 million in funding for 19 projects that will invest in holistic, collaborative approaches to coastal resilience at regional scales. Funds will support climate resilience and adaptation actions that are appropriate to the plan, place, and people, and supported by NOAA technical assistance.[152]
- HUD's Green and Resilient Retrofit Program (GRRP)[153] has awarded $842.5 million in funding and up to $4 billion in loan authority from the IRA to provide funding to properties with the highest need for climate resilience and utility efficiency upgrades. Figure 4-4 details GRRP's funding status.

Figure 4-4: HUD's GRRP Funding Status Map



Source: HUD[154]

Approaches and systems used, and their outputs

In the United States, climate resilience and adaptation policy are a whole-of-government, agency-wide risk management activity.[155] Following legislation by Congress, policymaking takes place within agencies to implement and enforce laws, including through agency notice-and-comment rulemaking with opportunities for public input. The White House coordinates, oversees, sets priorities, and facilitates partnerships in collaboration with Federal agencies, including through EOs and interagency working groups. Unified approaches to climate resilience and adaptation policy (and relevant pieces thereof) are set forth in a variety of keystone documents, including the National Climate Resilience Framework.[156]

As per the National Climate Resilience Framework, the Federal Government uses the following principles to guide activities and investments to strengthen climate resilience at all levels.

- **Proactive**. Implement solutions that anticipate and address climate threats and impacts before damages occur. Prioritize activities and investments through risk-based approaches, including approaches that account for complex risks, like cascading impacts and concurrent events, as well as approaches that account for differences in vulnerability and response capabilities within and across communities.
- **Whole-System**. Consider the ways in which communities and natural systems are interconnected, including recognizing that risks and impacts from climate change are borderless. Strive both to leverage synergies (e.g., when increased resilience of one

community contributes to the resilience of others) and to avoid maladaptive activities (e.g., when efforts to increase resilience in one community impose harms on another).

- **Equitable and Just**. Pursue solutions that address, and do not exacerbate, disparities between and within communities. Ensure that strategies respond to the needs of underserved and marginalized communities that have historically borne a disproportionate share of climate impacts and costs.
- **People-Centered**. Position the well-being of individuals, families, communities, and society at the center of goals and solutions. Consider the needs and perspectives of all community members, including those that are most vulnerable and have been historically marginalized or disadvantaged.
- **Collaborative and Inclusive**. Work across sectors to identify and pursue shared goals. Create pathways for all community members to be meaningfully involved in decision-making, and conduct active outreach to raise awareness of these pathways and address barriers to participation.
- **Durable**. Implement solutions that serve current and future needs. Ensure that there is continuity of technical expertise and leadership as needed, including by enhancing or building community capacity to sustain and adapt solutions for the long term.\

How adaptation increased resilience and reduced impacts

As noted in NCA5, systematically developing, measuring and tracking metrics for climate resilience investments is challenging. However, as the Climate Resilience Game Changers Assessment[157] describes, non-governmental research consistently indicates that adaptation investments return benefits several times greater than the initial investments—including research from the National Institute for Building Sciences,[158] the U.S. Chamber of Commerce,[159] and the Boston Consulting Group.[160]

Federal work continues to develop metrics to track the benefits of adaptation actions to long-term resilience and in reduced impacts. As noted in NCA4, the U.S. Department of Housing and Urban Development's 2014 National Disaster Resilience Competition required applications to conduct benefit–cost analysis including qualitative and difficult-to-quantify co-benefits, such as economic revitalization and other social benefits.[161]

When adaptation is not sufficient to avert impacts

Through reports such as the NCA5, and experiences of communities who have experienced the impacts of extreme weather events, it is understood that not all adaptation efforts have been sufficient to avert impacts. To date, adaptation across the United States has been incremental in nature, and given the expected future pace of climate change, more action is needed at

greater rates and larger scales, across more sectors, and in context-specific ways. Future adaptation practices may require not only more adaptation efforts (more actions, scaled up, across a wider range of actors, sectors, and systems) but also more transformative adaptation: actions that involve persistent, novel, in-depth changes that shift the fundamental traits of institutions, behaviors, values, or technologies across multiple sectors and scales.

There is also a need and opportunity to better center equity in adaptation planning and actions and to use a systems-oriented, regional, or collaborative approach for transformation. As acute and chronic climate impacts increase, adaptation efforts are rapidly progressing in terms of attention, investment, financing, and monitoring. The United States is also working to enhance the resilience of communities through recovery and rebuilding processes when damages occur from extreme weather events, to minimize future damages and risks.[162]

How effective implemented adaptation measures are

This topic is covered in Section F: How adaptation increased resilience and reduced impacts.

Transparency of planning and implementation

Planning

Federal agencies are required to periodically publish CAPs and report on their progress (further information can be found in Section C: Domestic priorities).

Implementation

Implementation updates from the BIL and IRA are tracked across a wide range of Federal government websites, listed in Section F: Establishment or use of domestic systems. Several executive branch agencies, components, and programs, such as the U.S. Climate Resilience Toolkit, also maintain internal tracking mechanisms for Federal investments, regulations, programs, and policies relevant to implementation of resilience funding. These include BIL and IRA funding and project trackers and reporting.[163,164,165] A number of private sector and non-governmental organizations also track government spending and implementation progress, particularly with respect to Federal funding and programs from the BIL and IRA. This includes the IRA Tracker,[166] Climate Wins Here map,[167] and other project trackers.[168,169,170] Several states and local governments also maintain public tracking mechanisms for their own resilience actions, such as the Commonwealth of Massachusetts[171] and the City of San Diego.[172]

How support programmes meet specific vulnerabilities and adaptation needs

To protect all communities in harm's way, the United States has placed environmental and economic justice at the center of its climate resilience agenda.

A good example of this is the Justice40 Initiative. For the first time in U.S. history, the Federal Government has made it a goal that 40 percent of the overall benefits of certain Federal climate, clean energy, affordable, and sustainable housing, and other investments flow to disadvantaged communities that are marginalized by underinvestment and overburdened by pollution. Categories of investment include climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure. As reported on Phase Two of the Environmental Justice Scorecard, through the Investing in America agenda and other sources, the United State has allocated approximately $613 billion in funds from Fiscal Years 2022-2027 for programs that are part of the Justice40 Initiative.

In order to track progress, all Federal agencies are required to identify and transform their programs covered under the Justice40 Initiative. In January 2023, additional guidance to Federal agencies was released on how to use the Climate and Economic Justice Screening Tool, which is a mapping tool that helps identify disadvantaged communities. All Justice40-covered programs are required to engage in stakeholder consultation and ensure opportunities for local community members to be meaningfully involved in determining program benefits.[173]

The Ocean Justice Strategy provides a framework to fully integrate environmental justice principles into Federal ocean activities, including ocean climate activities. The Strategy was motivated by the recognition that many communities that live near the ocean, depend on marine resources, or are part of the ocean economy face unique circumstances that exacerbate their existing challenges and prevent equitable access to the benefits the ocean provides.

Other examples, such as EO 14096, can be found in Section A: Legal and policy frameworks.

How adaptation actions influence other development goals

Examples of implementation on how adaptation actions influence other development goals can be found in Section C: Domestic priorities.

Good practices, experience and lessons learned from policy and regulatory changes, actions and coordination mechanisms

The National Climate Resilience Framework articulates the following best practices and lessons learned, derived from interagency consultation and experience.

The U.S. Government will and must serve as an active, flexible, coordinated, and committed partner with these entities in helping design and implement resilience strategies that meet the vision and needs of every community. In order to serve in this partner role, the Federal Government will need to have a continued focus on reforming and modernizing Federal programs and policies in ways that strengthen climate resilience – for example, embedding environmental justice into the DNA of Federal departments and agencies, or doubling down on making science, resources, and technologies accessible to everyone. The U.S. Government must also center effective Tribal consultation, respect for sacred sites, and recognition of Tribal sovereignty as important components of climate resilience planning and hazard response.[174]

Ownership, stakeholder engagement, alignment of adaptation actions with national and subnational policies, and replicability

The United States prioritizes stakeholder engagement, as demonstrated through examples in Section D: How best available science and Section C: Domestic priorities. However, the ability of individuals and institutions to engage in adaptation is affected by their access to resources, which is unevenly distributed and mediated by factors such as income, race, ethnicity, and gender. Federal or state resources for adaptation are often available to individuals, communities, and Tribes only if they navigate bureaucratic systems or success in competitions. Rural or less populous towns, for example, may have fewer professionals to dedicate time to grant applications, fewer resources to meet Federal cost-share requirements, or difficulty in proving that adaptation would be effective. To address this challenge, Federal agencies have been providing technical assistance to potential applicants. An example is EPA's Community Change Grants Equitable Resilience Technical Assistance, which offered free design assistance, community engagement, and partnership development workshops to develop shovel-ready climate resilience projects and supportive coalitions eligible for Community Change Grant funding. Alignment of national and subnational policies is noted in Section D: Stakeholder involvement.

The United States seeks to enhance replicability by providing standardized, authoritative sources of information to inform adaptation (see, for example CMRA, NCA Atlas, U.S. Sea Level Change[175]); by capturing case studies (see NCA5); and through ongoing efforts to include forward-looking climate information into Federal decision-making processes (see FFRMS-CISA).

The results of adaptation actions and the sustainability of those results

Assessments of the effectiveness of adaptation actions have generally been limited to project-specific performance against a limited set of extreme events or climate conditions. Adaptation researchers and practitioners have begun to track the number of actions that have occurred across the United States and to evaluate adaptation projects in a limited manner. However, efforts to assess trade-offs, effectiveness, sufficiency, and long-term consequences of incremental and transformative adaptation actions are still largely theoretical and will need more work to implement and consistently track over time. Metrics will need to be granular enough to observe disparities among communities to reduce potential inequities. One challenge is that implementation of adaptation actions typically occurs at the local, place-based level and is often embedded in other efforts, versus being standalone, and across a diversity of sectors (e.g. infrastructure design and implementation, land and water management). The wide diversity of potential adaptation actions also means a wide diversity of potential desired outcomes and co-benefits. This complexity makes it difficult to develop standardized metrics that can be tracked at the national scale, while providing useful information and insights. *(Target 10(d))*

The sustainability of actions taken today to enhance adaptation will best be evaluated in the long-term. Sustainability is a key consideration in the design, selection, and funding of Federal adaptation actions and programs.

Cooperation, Good Practices, Experience, and Lessons Learned

As the United States reduces and manages the impacts of climate change domestically, it is also committed to enhancing international cooperation on adaptation and supporting vulnerable countries. Launched in 2021, PREPARE unites the diplomatic, development, and technical expertise of the U.S. Federal Government with a goal of helping more than half a billion people in vulnerable developing countries adapt to and manage the impacts of climate change by 2030. Through PREPARE, the United States works with international partners to advance progress on the global goal on adaptation, helping countries and communities to enhance

adaptive capacity, strengthen resilience, and reduce vulnerability and contribute to the targets in the UAE Framework for Global Climate Resilience. PREPARE supports efforts to share information, good practices, experience and lessons learned across three pillars: PREPARE Knowledge, PREPARE Plans and Programs, and PREPARE Resources.

The following sections include illustrative examples of how the United States, across multiple Federal departments and agencies, is supporting developing countries with adaptation planning and implementation. Paragraphs from the modalities, procedures, and guidelines (Decision 18/CMA.1) are denoted.

PREPARE Knowledge – Supporting scientific research and knowledge, improving climate information services, including early warning systems, and promoting science-informed policy relevant to adaptation: Through PREPARE, the United States is strengthening climate information services and early warning systems in over 80 countries to equip people and institutions with information to identify and implement the plans, policies, and actions needed to effectively adapt to climate change. Under PREPARE, the U.S. government is supporting climate information services chains in vulnerable countries. This includes support for weather and climate observation and data collection, the development and delivery of climate information services, and technical training for partners to enhance their ability to provide and use climate information services to improve decision making.

- **Observations and Data Collection (para. 116(a)(i) and para. 116(b)(i-iii)):** Through PREPARE, since 2022, the United States has joined 12 other donors to support over 60 climate-vulnerable countries through the Systematic Observations Finance Facility (SOFF), which aims to close existing weather and climate observation gaps. SOFF provides funding to install, rehabilitate, and maintain observation infrastructure and to develop human and institutional capacity for weather and climate observation; this is critical for improving weather forecasts, early warning systems, and climate information services. (Target 10a)
- **Development and Delivery (para. 116(a)(i) and para. 116(b)(i-iii)):** The U.S. government supports the co-development and delivery of climate information services through PREPARE. USAID's Famine Early Warning Systems Network (FEWS NET) delivers long-lead early warning of climate emergencies, including the unprecedented five-season 2020-2022 drought in the eastern Horn of Africa, ensuring that national governments and aid agencies plan for and deploy timely humanitarian assistance. FEWS NET also uses climate information services to inform its early warning information and analysis of current and future acute food insecurity. In 2024, FEWS NET launched an Interactive Heat Exposure Projections Map to help policy makers, donors, and other stakeholders better understand and plan for extreme heat. Decision-makers can identify a population's extreme heat exposure as experienced in the recent past and projected to 2050 to understand the evolution and scale of extreme heat threats. (Target 9b, 10a)

- **Training and Capacity Strengthening (para. 116(a)(i) and para. 116(b)(i-iii)):** PREPARE strengthens the capacity of governments and institutions to implement and utilize climate information services. For example, in July 2024, the State Department and NOAA kicked off new support for the Pacific Islands through a multi-hazard climate forecasting and early warning training workshop for forecasters from nine Pacific countries. Immediately after the forecaster training, NOAA piloted a Climate Early Warning Stakeholders workshop for the Meteorological Services of Fiji, Kiribati, and the Solomon Islands. The workshop focused on tracking the impacts of climate change and seasonal weather patterns, such as the El Niño Southern Oscillation, on prolonged droughts and excessive rainfall across the Pacific Islands, and integrating these forecasts into outlook bulletins for stakeholders. Workshops like these help communities and decision makers effectively prepare for climate impacts, reduce losses, and save lives.

PREPARE – Plans & Programs: Supporting policy innovation, integration of adaptation at different levels, improving the durability and effectiveness of adaptation actions, enhancing monitoring, learning and evaluation of adaptation actions: Pillar 2 of PREPARE aims to partner with vulnerable countries and communities to plan for climate impacts and mainstream adaptation into broader decision making that protects lives, livelihoods, and the natural environment from the impacts of climate change. Pillar 2 includes focused action in infrastructure, food security, water, and health.

- **Integration of adaptation into planning at different levels (para. 116(a)(iii)):** USAID, through its Comprehensive Action for Climate Change Initiative (CACCI), is helping over 17 countries and three regional entities to develop strong nationally determined contributions and national adaptation plans (NAPs) that integrate climate considerations with development and economic growth objectives. USAID Guatemala, in the Western Highlands, worked with Rafael Landivar University and local water user associations to create 11 sustainable watershed management plans which unlocked public financing to preserve 2,300 hectares of forest land critical for farmers and people downstream. The State Department supports the NAP Global Network, which builds capacity in least developed and developing country governments to understand their country's climate risks and make decisions to protect their key development sectors from climate change through national adaptation planning. With U.S. funding, NAP Global Network has provided technical assistance to 24 countries for national adaptation planning processes since 2021. For example, in 2023, NAP Global Network supported the development of water sector indicators, analysis procedures, and developing reports for Vietnam's NAP monitoring and evaluation system. In addition, NAP Global Network supports sustained peer learning and exchange on NAP planning and action, including the launch of a new peer-learning cohort in Central America to build a community of practice to address shared adaptation priorities and challenges.

- **Promoting effective adaptation by helping developing countries identify adaptation practices, needs, priorities, and challenges and gaps (para. 116(a)(vii)):** The State Department is strengthening the capacity of leaders, decision makers, and practitioners to implement effective adaptation and resilience strategies through programs like the Resilience and Adaptation Mainstreaming Program (RAMP). Implemented by the World Resources Institute and University of London's School of Oriental and African Studies, RAMP partners with local universities to build the capacity of ministries of finance to integrate adaptation into national level budgets, plans and processes. Since it was launched in 2022, RAMP has worked with local universities to develop 12 core curricula and, in February 2024, trained 93 faculty of economics and finance to deliver these courses. Working with faculty, RAMP is delivering country-tailored workshops for ministries of finance. In July 2024, it held in-depth training for 35 government officials in Uganda to strengthen fundamental skills such as analyzing economic and financial impacts of climate change, conducting cost benefit analyses for adaptation investments, and integrating climate change into national planning and budgeting processes. RAMP is currently being implemented in eight pilot countries across Africa. PREPARE is also working to elevate locally led approaches to adaptation. USAID endorsed the Principles for Locally Led Adaptation at COP26 and is implementing this work in line with the Localization Approach and Local Capacity Strengthening Policy. The State Department is supporting the Least Developed Countries (LDCs) Initiative for Effective Adaptation and Resilience (LIFE-AR), which is an LDC-led initiative intended to achieve a low-carbon, climate resilient future by focusing on locally led adaptation efforts in LDCs. Through LIFE-AR, LDC front-runner countries are integrating climate resilience and adaptation into national and local development objectives; developing strong climate finance architecture to ensure that at least 70 percent of finance supports locally led climate action by 2030; and building capacity and strengthening governance to develop more effective and inclusive climate decisions.
- **Policy Innovation (para. 116(a)(ii)):** In 2022, the United States announced a policy stating that the United States will not challenge maritime zones and baselines that have been established consistent with international law and that are not subsequently updated despite sea-level rise caused by climate change. For the many countries that derive substantial income from the resources found within their exclusive economic zone, this policy helps preserve access to critical sources of revenue. In support of this policy, the United States is exploring opportunities to collaborate with countries and regional organizations to support their efforts to determine and publish their coastal baselines.
- **Improving the durability and effectiveness of adaptation action, including monitoring, evaluation, and learning (MEL) (para. 116(a)(vi)):** With U.S. support, the NAP Global Network most recently supported Vietnam and Namibia with enhancing their MEL systems. Responding to a request from the Vietnamese government, the NAP Global

Network provided support in the development of a set of indicators for the M&E system for the NAP in the Water sector combining top-down and bottom- up approaches, and developing the procedures for analyzing databases, applying indicators, developing the M&E report for the water sector at local and national levels. Similarly, in Namibia, the NAP Global Network is supporting the government to establish an adaptation MEL system, focusing on building on the adaptation priorities identified in Namibia's adaptation communication and revised nationally determined contribution.

PREPARE – Resources: Supporting pilot and demonstration projects, innovating types of cooperation, in different areas and at different scales: Pillar 3 of PREPARE aims to accelerate financing of adaptation measures by strengthening capacity of partner countries to access finance for adaptation, developing bankable investments, promoting innovation, mobilizing private sector capital, and supporting the development of climate risk finance strategies.

- **Supporting pilots and demonstration projects (para 116(a)(ii)):** Small and medium sized enterprises are critical to a thriving economy and play an important role in innovating adaptation solutions. But often, these technologies are only available or tested in developed economies, and not the communities that most need access to them. To accelerate technology transfer, the State Department is funding a technical assistance facility under the Climate Resilience and Adaptation Finance & Technology (CRAFT) fund, a first-of-its-kind growth equity climate resilience-focused fund. Through this facility, PREPARE has supported the deployment of a new hydropanel technology that produces clean drinking water from sunlight and air. Working in partnership with the Ministry of Education in Vanuatu and a utility company in Tonga, CRAFT's TA Facility is helping pilot a pay-per-liter local service in freshwater-scarce communities that are increasingly relying on imported drinking water.
- **Cooperating across different scales (para 116(a)(iii-iv)):** The United States has helped the African Union's flagship Africa Adaptation Initiative (AAI) to launch the AAI Food Security Accelerator, which is designed to dramatically speed-up and scale-up private sector investments in climate resilient food security in Africa. With U.S. support, the Accelerator is helping to identify, structure and de-risk a pipeline of transformative adaptation investments in innovative food security solutions, ranging from cold storage logistics to post harvesting processes, all while building the capacity of African-owned small and medium sized enterprises.
- **Promoting innovative approaches to adaptation (para 116(a)(v)):** To promote the incubation and development of innovative financing instruments to drive investment to adaptation, the State Department created the inaugural adaptation window in the Global Innovation Lab three years ago. Most recently, the lab helped develop a women-led investment fund in Mexico that is creating a project pipeline for the regeneration of Mexican ecosystems. Funding supports NBS implementation by rural companies and a

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Jillian Pelto
Replanting Resilience (Diptych)
(*2022, Watercolor and Colored Pencil*)

This piece is part of the Art x Climate gallery, the first art gallery to be featured in the National Climate Assessment. The U.S. Global Change Research Program issued a call for art with the understanding that, together, art and science move people to greater understanding and action. The call received more than 800 submissions, and the final collection features the work of 92 artists. Their work, which represents all 10 NCA regions, offers a powerful depiction of climate change in the United States—its causes and impacts, as well as the strength of our collective response.