policy

Adapting to Climate Change: A Call for Federal Leadership

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Foreword *Eileen Claussen, President, Pew Center on Global Climate Change*

While policy-makers have primarily focused on reducing future emissions of greenhouse gases, there is growing recognition that significant climate change is unavoidable. Although climate mitigation remains critical, we also need to be thinking about and planning for ways to minimize the economic costs and limit the adverse impacts from unavoidable changes in our climate. By taking steps now to adapt to climate change, we will be far better able to limit future damages and their associated costs.

This report highlights the important role of the federal government in reducing the vulnerability and strengthening the resiliency of our economy and natural resources in the face of these changes. In addition to managing a significant amount of land and infrastructure that will be affected by climate change, the federal government is uniquely positioned to provide the necessary leadership, guidance, information, and resources. While many efforts to adapt to climate change will occur at the state and local level, the federal government is a critical player in an effective and coordinated approach to climate change adaptation in the United States.

Drawing on the expertise of local, state, federal, and international leaders in this area, the authors provide concrete proposals for "mainstreaming" climate change adaptation within and across the federal government. They recommend three key components to create a new national adaptation program in the United States:

- **A Strategic Planning Initiative to provide the overarching goals, objectives, and priorities for the program.** Beginning with initial guidance and direction for the program, this initiative would include the development of federal agency adaptation plans, and work to integrate both sector and state level planning processes into a national climate change adaptation strategy.
- **A National Climate Service to provide stakeholders with much needed information on climate change impacts and adaptation options.** All levels of government, the private sector, and other stakeholders need information on climate change impacts on a time and geographic scale useful to them, as well as decision tools to aid in analyzing adaptation options.
- **An Adaptation Research Program to ensure that appropriate emphasis is placed on adaptation research as part of the larger federal climate research effort.** Research related to climate change adaptation is needed to support techniques for developing climate information at a scale useful for decision making and innovations in addressing the various factors that affect adoption and implementation of adaptations.

Adaptation is not an option but a necessity if we are to minimize the economic costs of climate change impacts, protect human health and welfare, and limit harm to infrastructure, ecosystems, and biodiversity. Although coordinated actions will be needed at all levels of government and the private sector, this report focuses on what the federal government could do to lead the way.

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I. Introduction

Climate change poses significant challenges to our society. One of the greatest challenges we face today is substantially reducing global greenhouse gas emissions to help avoid dangerous shifts in the Earth's climate system. The climate is already changing, however, and impacts from such changes are already being experienced. Even ambitious greenhouse gas reduction programs will not prevent additional adverse impacts of climate change, such as droughts, flooding, heat waves, sea level rise, melting glaciers, and coastal storms, that are projected to happen over the decades and centuries to come (Parry et al., 2007; Karl et al., 2009; Solomon et al., 2009).

Average temperature across the United States has increased more than 2°F over the last 50 years and is projected to increase some 4 to 11°F by the end of this century (Karl et al., 2009). Global sea levels rose about 7 inches over the past century and are projected to rise 2 to 6 feet by 2100 (Solomon et al., 2007; Pfeffer et al., 2008).[1] Total precipitation averaged over the United States has increased over the last century and the regional distribution of precipitation has changed as well, with some areas of the nation becoming drier and others wetter. Furthermore, precipitation events have become more intense, leading to more rainfall in a shorter period and more days without rain. Such changes are likely to continue or accelerate as a result of climate change.

Because climate change is already happening and some additional changes are inevitable, society will have to adapt to these changes. In this report, we define adaptation as adjustments in natural or human systems in response to actual or projected climate conditions or extreme events (based on Adger et al., 2007). Adaptation is intended to reduce vulnerability and increase resiliency to the impacts of unavoidable climate change. Adaptation is not an option but a necessity if we are to minimize the economic costs of climate change impacts (see **Box 1**), protect human health and welfare, and limit harm to infrastructure, ecosystems, and biodiversity (e.g., Yohe et al., 2007). Measures will be needed to protect or relocate settlements threatened by sea level rise, floods, and droughts. Where water supplies decrease, new supplies may need to be developed or conservation measures enacted. Farmers and ranchers may need to grow different crops, raise different livestock, or relocate. Vulnerable communities will need protection from extreme heat events, and shifts in disease and insect patterns will require renewed emphasis on such public health measures as increased surveillance and control. A key

Box 1. The Economic Consequences of Climate Variability and Change

How much U.S. economic activity is vulnerable to climate? According to a National Center for Atmospheric Research working paper, between 3% and 4% of the U.S. economy is sensitive to weather variability, which can lead to a variation of $470 billion in gross domestic product (GDP) per year (Lazo et al., 2009). This impact can be more significant when considering all climate impacts and not just weather variability. It can also be more significant for specific regions. For example, the Economics of Climate Adaptation Working Group estimated the potential economic losses from hurricanes in three Florida counties: Palm Beach, Broward, and Miami-Dade. They found that losses could be more than $30 billion by 2030, which would represent nearly 10% of the three counties' GDP. Additionally, they found that if these three counties implemented adaptive measures such as beach nourishment, home improvements, and barriers to water intrusion, they could reduce these losses by about 40% (Climate Works Foundation et al., 2009). The draft California Climate Adaptation Strategy cites $2.5 trillion of real estate assets at risk from extreme weather events, sea level rise, and wildfires, with a projected annual cost of up to $3.9 billion per year over this century (State of California, 2009).

finding in this report is that decisions about how best to adapt to climate change should not be made in isolation, but should be coordinated across relevant levels of government and agencies. In addition, adaptation should be mainstreamed—incorporated as a core factor in the many decisions made across our society that are affected by changes in our climate.

While many adaptations will occur at the state and local levels, the federal government is a critical player in an effective and coordinated approach to climate change adaptation in the United States. The federal government is significant for four primary reasons discussed in more detail in a later section: it owns and manages a significant number of assets and natural resources; its programs affect the ability of others to adapt; it is an important provider of technical, fiscal, and other support; and it plays a crucial role in dealing with impacts that cross geographic or jurisdictional boundaries.

Some municipalities, states, federal agencies, and others have already recognized the importance of addressing climate impacts by initiating climate adaptation plans, commissioning impact or vulnerability assessments, or enacting "no regrets" adaptation actions[2] that improve their communities' climate resilience. Such efforts are making initial strides in tackling adaptation needs, but a dedicated and appropriately focused national program is needed to address the multiple institutions, sectors, and levels of government involved in adaptation as well as the complexity, magnitude, and long time horizon of many climate impacts.

While this report focuses on the organizational structure and role of the federal government to support climate change adaptation in the United States, this focus should not be taken to imply that action by the federal government alone will be sufficient to address the national need for adaptation. In fact, many adaptation efforts can only be carried out at state, municipal, or private sector levels. To be successful, an integrated approach to adaptation is needed.

II. Overview

This report presents analysis and recommendations for creating a National Adaptation Program in the U.S. federal government, including a suggested organizational structure and key federal roles. The recommended program has three major components: an Adaptation Strategic Planning Initiative, a National Climate Service, and an Adaptation Research Program. The main components are described briefly below and in more depth in later sections of this report.

Adaptation Strategic Planning Initiative—This initiative begins with the development of government-wide strategic planning guidance, to include overarching goals, objectives, and initial priorities for the Adaptation Strategic Planning Initiative, roles for federal offices and agencies, as well as guidance about the expected substance and procedures for developing adaptation plans at the federal level. Using this guidance, federal agencies would develop comprehensive adaptation strategic plans. Such planning would include review, modification, and development of existing programs, laws, policies, regulations, and management approaches relevant to adaptation as well as coordination across sectors and with states and appropriate stakeholders. The agency plans could serve as the building blocks for sector adaptation strategic plans and eventually the information collected and lessons learned would be incorporated into a high-level national adaptation strategic plan. The Adaptation Strategic Planning Initiative would be coordinated by a high-level executive office through an interagency Adaptation Coordinating Committee with staff support from an Adaptation Program Office.

National Climate Service—All levels of government, the private sector, and other stakeholders need information on climate change impacts on a time and geographic scale useful to them, as well as decision tools to aid in analyzing adaptation options. A National Climate Service would provide demand-driven and usable climate information, guidance, and other technical resources to end users across sectors, regions, and political jurisdictions. Because of its long track record providing climate information and significant institutional capacity, the National Oceanic and Atmospheric Administration (NOAA) is an appropriate federal agency to coordinate and provide administrative support for an interagency National Climate Service, with oversight by the Adaptation

Coordinating Committee. In addition, a key element of any National Climate Service would be sector-specific, user-driven working groups (e.g., for water resources), coordinated by appropriate federal agencies.

Adaptation Research Program—An Adaptation Research Program would ensure that appropriate emphasis is placed on adaptation research as part of the larger federal climate research effort. The U.S. Global Change Research Program (USGCRP) manages climate science and research across the federal government and should continue to do so, including research on adaptation. Resources devoted to adaptation research, however, need to be increased to enable the USGCRP to effectively support, among other investments in adaptation research, techniques for developing climate information at a scale useful for decision-making and innovations in addressing the various factors that affect adoption and implementation of adaptations. Formal mechanisms, including a biannual report to the USGCRP, should be created to incorporate research, information, and decision support needs identified in the Adaptation Strategic Planning Initiative and the National Climate Service into the research priorities of the USGCRP member agencies.

III. A National Adaptation Program

The United States should develop a National Adaptation Program to provide the nation with the capability to address the magnitude and complexity of climate impacts across vital sectors; and to provide the integration, coordination, and communication needed to enable effective and efficient adaptive responses. An effective adaptation program should be a highly cost-effective response to the impacts of unavoidable climate change.

The proposed recommendations for a National Adaptation Program are based on information gathered through interviews with experts and an analysis of relevant studies, adaptation planning efforts, and proposed legislation (see Appendix A). The recommendations are also premised on a series of principles categorized by approaches to adaptation and organizational matters. These principles are presented in **Box 2**. Based on this information, the principles, and further analysis, the research team developed a framework for a National Adaptation Program and then asked several experts to review and comment on its feasibility and potential effectiveness. This report reflects a synthesis of case study data, analysis, and expert review.

A. Why a National Adaptation Program?

The federal government has a critical role to play in an effective and coordinated approach to climate change adaptation in the United States. The federal government is the most important player for four primary reasons: it owns and manages a significant number of holdings and natural resources; its programs, regulations, and guidelines affect the ability of others to adapt; it is an important provider of technical, fiscal, and other support; and it plays a crucial role in dealing with impacts that cross geographic or jurisdictional boundaries.

Box 2. Guiding Principles

Approaches to Adaptation

Recognize the scales at which decisions are made. Adaptation decisions will have to be made at multiple geographic and decision-making scales, by federal agencies, states, counties, cities, the private sector, nongovernmental organizations, and individuals. A National Adaptation Program should first and foremost support federal adaptation activities such as strategic planning and policy reviews by federal agencies, but it should also enable tribal, state, and local governments; the private sector; and other policy participants to plan for climate change and take adaptive actions. For example, climate-robust land use planning would need to be implemented at the state and local levels, where planning jurisdiction typically resides.

Remove barriers to adaptation. Many existing laws, programs, policies, and management approaches were put in place assuming climate is not changing. As a result, many of these approaches now function as barriers that discourage or prohibit adaptation to a changing climate or promote behavior that increases vulnerability to climate change. Such policies are sometimes referred to as maladaptations (Burton, 1996). Political factors, resource limitations, and other constraints could make it difficult to remove or alter some of these barriers. One notable example is the National Flood Insurance Program. By providing flood insurance for property in flood plains, the program promotes development in vulnerable areas (Platt, 1999). Other barriers such as industry standard construction guidelines that increase climate vulnerability may be easier to change.

Ensure flexibility. Flexibility in the design and implementation of adaptation policies is necessary due to uncertainties regarding the magnitude and the timing of climate changes and because the climate is likely to continue changing for many decades (Solomon et al., 2009). Flexible policies enable adaptations to evolve as the climate and other conditions change.

Learn from experience. Adaptation actions being taken by other countries (e.g., Australia, the United Kingdom), by U.S. regions or sectors (e.g., the Western Governors' Association, the Coastal States Organization), by U.S. states (e.g., Alaska, California, Florida, Maryland), and by U.S. municipalities (e.g., New York City, King County) should be reviewed for lessons learned and policy innovations. A National Adaptation Program should build on these successes as well as identify where federal action would facilitate adaptation.

Mainstream adaptation. Rather than create an entirely new or parallel set of programs and policies to cope with climate change, it would be better to incorporate consideration of climate change into existing decision-making, a concept known as mainstreaming. Many of the natural resources (coastlines, water resources, forests, etc.) and human systems that will be affected by climate change are already heavily managed systems. Decisions made in managing these systems now either assume climate will not change or ignore climate impacts altogether. To build resiliency into these systems, future decisions need to consider changes in climate.

Incentivize the consideration of climate whenever possible. Positive incentives typically generate less opposition and are often more effective than mandates, regulations, or penalties. To the extent possible, an adaptation program should provide the required information, tools, and other resource assistance to aid informed decision-making. Also, the program should reward behavior that reduces vulnerability rather than punish behavior that increases vulnerability.

Organizational Matters

Recognize the need for leadership. Initiating a national program to manage climate impacts must be highly visible, with strong central leadership by the federal government to build awareness of the need for a National Adaptation Program. This will send a strong signal to federal agencies, states, and others of the need to adapt, and provide the focus and resources necessary to make the national program successful.

Establish clear lines of authority. It must be clear who is in charge of the adaptation program and who is in charge of individual program elements. Such transparency promotes responsibility and accountability. For example, in Florida, Governor Crist and the state legislature created a permanent Energy and Climate Commission

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Box 2. Guiding Principles (continued)

in the Executive Office of the Governor to oversee implementation of adaptation and mitigation actions.

Use existing authorities when possible. Where established authorities and institutions are already making many climate-sensitive decisions, they are the best starting point for mainstreaming climate change. Working with existing institutions to integrate climate considerations leverages existing resources, requires minimal political capital to implement, avoids the disruption that reorganization can create, and generates less opposition than creating new institutions. Some new organizations may be necessary, however, to provide appropriate leadership and coordination of existing institutions.

Encourage buy-in by all relevant federal agencies. Many departments and agencies either are managing climate-sensitive resources or activities or have important supporting roles such as providing information or conducting research. All of these agencies need to have a stake in the National Adaptation Program.

Create mechanisms to address impacts that cross jurisdictions. Many climate impacts will cross geographical or organizational jurisdictions such as state lines and different levels of government. A federal adaptation program should include mechanisms to coordinate across these boundaries and with the private sector, nongovernmental organizations, and other stakeholders.

Involve stakeholders. Stakeholder involvement in developing adaptation policies helps ensure that the policies meet the needs of those affected by climate change and that those affected will buy-in to the policies. Stakeholder involvement can also help incorporate regional and other differences into policy design and implementation. This can be accomplished by creating mechanisms that involve regional, sectoral, state, local, public, and private stakeholders in ongoing decision-making, implementation, and monitoring of adaptation activities.

Federal government holdings will be affected by climate change.

The federal government owns or manages a significant amount of land, resources, and infrastructure in the United States. No other single entity approaches the federal government in the breadth of its holdings:

- The federal government manages almost 30% of the entire U.S. land area (Gorte and Baldwin, 1999)
- The federal government owns 476,000 structures such as roads, bridges, and flood control and navigation infrastructure, valued at $723.1 billion (Federal Real Property Council, 2008)
- The federal government owns, leases, or manages $772.8 billion of building space (Federal Real Property Council, 2008).

Many of these holdings will be affected by climate change. For example, federal buildings in coastal areas are vulnerable to storm damage and gradual sea level rise. Much of the forested public land in the West is already feeling the effects of drought, pest infestation, and wildfires. Climate change threatens the biodiversity in many national parks and even the existence and basic character of some parks (e.g., Everglades National Park, Glacier National Park).

Federal programs, regulations, and guidelines can encourage appropriate adaptation measures.

Federal laws, programs, regulations, and guidelines affect the decisions made by individuals, companies, and others outside the federal government. These programs can encourage adaptation measures or can be barriers or maladaptations when they prevent or discourage reductions in climate vulnerability. For example, existing pollution control laws such as the Clean Air Act and the Clean Water Act regulate air and water quality, both of which will be affected by a changing climate. Where such regulations are based on historic climate information, they can serve as a barrier to adaptation if not updated to reflect changing climate conditions. In addition, authorities under the National Environmental Policy Act (NEPA) could require consideration of climate change impacts on all major federal projects.

Federal financial support can encourage adaptation.

The federal government financially supports many activities that will be affected by climate change, including funds for highways and other transportation infrastructure (e.g., Kafalenos et al., 2008), crop subsidies and insurance for farmers, federal flood insurance programs, tax deductions or credits for home building, and funding for research and development. Fiscal policies can support both positive and negative incentives for adaptation. For example, subsidizing flood insurance often encourages building in vulnerable areas, but the right kind of incentives could encourage homeowners to take cost-effective measures to reduce their vulnerability to floods.

Federal technical support is critical to successful adaptation.

The federal government provides technical and research support to help manage climate-sensitive natural resources and human systems. For example, NOAA forecasts weather, tracks hurricanes and other storms, and produces information on droughts; and the U.S. Geological Survey (USGS) develops information on the state of water resources and ecosystems nationwide. This technical support is crucial to organizations addressing adaptation. For example, the state of Alaska drew upon the expertise of the federal government to help navigate the complicated web of overlapping mandates and jurisdictions involving relocating at-risk coastal communities. They also relied on federal technical support to assess protect-in-place alternatives. Without this technical support, state decision-makers would have found it very difficult to make significant progress in protecting or relocating at-risk villages (Alaska Immediate Action Workgroup, 2009).

Federal coordination can reach across jurisdictions.

Many climate impacts affect regions that cross state boundaries. For example, the Colorado River Compact allocates water from the Colorado River Basin among seven western states and Mexico. As drought

reduces water supplies in the West and demand for water increases, the federal government has had to intervene to manage conflict among the states (Secretary of the Interior, 2007). Such pressures on water supply and demand in the Colorado River Basin are likely to increase in the future (e.g., Rajagopalan et al., 2009). In some cases, federal involvement is needed to address climate impacts within a state. **Box 3** describes the importance of coordination across different levels of government in the Florida Everglades.

In addition, significant economies of scale can be realized by acting collectively with federal government coordination. For example, in 2008, the Coastal States Organization, representing the governors of 35 coastal states, territories, and commonwealths, conducted a survey of adaptation information and resource needs for coastal and ocean management. Two of the top three results from the survey pointed to the need for consistent high-resolution coastal mapping and improved federal and state coordination (CSO, 2008). The survey results highlighted the complexity of 35 different jurisdictions trying to work with 15 different federal agencies on similar issues.

The federal government can develop a coordinated approach to such cross-jurisdictional issues and thus ameliorate many fragmented efforts. However, this kind of coordination likely requires significant funding as an incentive and may require involvement by the Office of Management and Budget (OMB) to ensure the success of interagency efforts.

Box 3. Case Study: Coordination in Florida's Everglades Adaptation Effort

Management of the Florida Everglades presents coordination challenges among local, state, tribal, and federal government entities. Ownership of the Everglades is divided between the National Park Service and the state of Florida. The federal Water Resources Development Act (WRDA) of 1992 and 1996 authorized the U.S. Army Corps of Engineers (USACE) to review the Central and South Florida Project and to develop a comprehensive plan to restore and preserve southern Florida's ecosystem, enhance water supply, and maintain flood protection. A team of more than 100 ecologists, hydrologists, engineers, and other professionals; and more than 30 federal, state, tribal, and local agencies drafted the Comprehensive Everglades Restoration Plan, which was approved under the WRDA of 2000 (CERP, 2009).

Established by the WRDA of 1996, the South Florida Ecosystem Restoration Task Force is an example of the need for federal-led coordination to protect a climate-sensitive natural resource. The task force consists of seven federal, two tribal, and five state and local government representatives. Although the task force has been in regular discussions regarding the Florida Everglades and ecosystem restoration, over the last few years these discussions have increasingly taken on climate change adaptation. Because the many task force participants have longstanding relationships with each other, state resource managers, planners, and policymakers coordinate with their federal counterparts to resolve issues and bring the necessary resources to bear on adaptation issues in the Everglades (Jim Murley, Florida Energy and Climate Commission, personal communication, March 5, 2009). Although restoration efforts in the Everglades are still in progress, the Everglades task force is a useful model for coordination on complex adaptation issues.

B. Leadership and Creating a National Adaptation Program

The value of leadership in initiating an adaptation program has been illustrated in a number of the countries, states, and municipalities that have already started adaptation programs (see **Box 4** for examples). Once a chief executive in government makes adaptation a clear priority, it increases attention and resources available to the issue and provides clear policy direction. In many cases, executive leadership is the only way to elevate adaptation as a government priority, but formal organization, funding, or legislative action may be necessary to maintain an adaptation program after the initial leadership push. The sustained leadership necessary to create an adaptation program typically consists of five main components. These components and their implications for a National Adaptation Program are highlighted below:

1. *Clear public commitment by a chief executive.* A public commitment, perhaps in the form of a formal statement to explain the national strategy and program sends a clear signal that adaptation is important.

2. *Executive branch action to formally initiate the program and fund its activities.* Administrative actions can take many forms, including issuing executive orders, leveraging executive authorities (e.g., the federal OMB requiring multiagency budget crosscuts), and creating new executive offices or positions. For example, the Executive Order on reducing greenhouse gas emissions and sustainability by federal agencies signed by President Obama on October 5, 2009, called for federal agencies to "evaluate agency climate-change risks and vulnerabilities to manage the effects of climate change on the agency's operations and mission in both the short and long term" (The White House, 2009). Furthermore, this Executive Order requires agencies to "participate actively in the interagency Climate Change Adaptation Task Force, which is already engaged in developing the domestic and international dimensions of a U.S. strategy for adaptation to climate change" (The White House, 2009). Appendix B presents a draft Executive Order that would build upon existing federal action by establishing a National Adaptation Program.

Box 4. Leadership Examples in Adaptation Program Development

The five elements of leadership were derived, in part, from lessons learned from other climate adaptation programs. This box describes five of these programs. Other reports provide a more exhaustive description of governmental efforts to address climate adaptation (CCAP, 2009; Cruce, 2009; GAO, 2009).

New York City—The Mayor's Office, under the direction of Mayor Bloomberg, has been the catalyst for a comprehensive program in the area of climate change and sustainability for the city. In April 2007, the mayor announced PlaNYC: A Greener, Greater New York City, laying out a long-term vision and setting tangible goals and clear objectives in the areas of land, water, infrastructure, air, energy, and climate change, including adaptation initiatives that cut across these major elements. In announcing his sustainability initiative on Earth Day 2007, the mayor claimed that "as a coastal city, we're on the leading edge of one of the most dramatic effects of global warming: rising sea levels and intensifying storms" (City of New York, 2007a). In his press release, the mayor explained that the intergovernmental task force created to deal with climate impacts and adaptation would "protect our city's vital infrastructure and expand our adaptation strategies beyond the protection of our water supply, sewer, and wastewater treatment systems to include all essential city infrastructure" (City of New York, 2007b). On April 30, 2008, the New York City Council legislatively authorized the Office of Long-Term Planning and Sustainability in the Executive Office of the Mayor to "coordinate and implement policies, programs and actions," ensuring that the funding, resources, and required annual reporting against performance indicators are able to continue to sustain the plan beyond Mayor Bloomberg's tenure.

California—Two executive orders over the last three years were used to develop the state's climate change adaptation program. On November 14, 2008, Governor Schwarzenegger signed Executive Order S-13-08 to initiate California's first statewide climate change adaptation strategy to address sea level rise and other climate impacts. The strategy is organized by key sectors for the state, including infrastructure, public heath, water, and forestry, and involved four state agencies and nine departments. It was coordinated by the state's Resources Agency. The draft report, released in August 2009, is the first state-wide agency adaptation plan in the United States (State of California, 2009). Other adaptation program elements for the state include biennial climate change assessment reports on climate change impacts and adaptation options, state agency plans for sea level rise and other impacts, a state sea level rise assessment, and a transportation vulnerability assessment. In signing Executive Order S-13-08, the governor stated, "We have to adapt the way we work and plan in order to manage the impacts and challenges that California and our entire planet face from climate change." He further elaborated, "Given the serious threat of sea level rise to California's water supply, population and our economy, it's critically important that we make sure the state is prepared when heavy rains cause flooding and the potential for sea level rise increases in future years" (State of California, 2008).

Florida—In 2007, Governor Crist used an Executive Order to create the Governor's Action Team on Energy and Climate Change, charging the team with creating a statewide mitigation and adaptation strategy. As in California and other states creating their statewide adaptation plans, the adaptation team was organized by sector to identify impacts and recommend adaptation strategies. The legislature reinforced this administrative action by creating a permanent Energy and Climate Commission to oversee implementation of the final strategy recommendations (State of Florida, 2008).

Oregon—Governor Kulongski created a Climate Change Integration Group in 2006 to develop adaptation strategies for government agencies, private industry, and the general public. The governor called for both short-term recommendations for areas requiring immediate action and long-term recommendations. The state legislature followed in 2007 by enacting HB 3543, which created a Climate Change Research Institute and a permanent Global Warming Commission to advise the governor and the legislature on both mitigation and adaptation strategies developed by

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Box 4. Leadership in Adaptation Program Development (continued)

state agencies and climate change committees. The commission's 2009 recommendations include incorporating climate change adaptation into state agency plans and developing an integrated water management program.

The United Kingdom (UK)—The Climate Change Act under Prime Minister Gordon Brown became law in November 2008, codifying mitigation policies and three primary adaptation functions: (1) requiring climate risk assessments for the UK every five years; (2) establishing an independent oversight Committee on Climate Change, with a Sub-Committee on Adaptation to provide advice and scrutiny of the government's adaptation efforts; and (3) requiring public bodies (e.g., agencies) and statutory undertakers (e.g., utilities) to conduct a risk assessment of their own programs and assets within their jurisdictions, and develop plans to address those identified risks. For the UK, this represents more than 27,000 entities, because it can extend even to private entities providing a public good. Examples of entities covered under this policy include power generators, rail transport, water companies, fire services, and schools.

3. *Multiagency coordination and participation to carry out the program requirements.* Climate change impacts cut across U.S. political, jurisdictional, and geographic boundaries. Adaptive strategies, plans, and actions sometimes require federal departments and agencies to work together to coordinate areas of shared responsibility. At the federal level, an office in the Executive Office of the President (EOP), such as the Council on Environmental Quality (CEQ) or the Office of Science and Technology Policy (OSTP), would be best positioned to coordinate multiple agencies and encourage participation in the program.

4. *Sustained program support.* After the momentum has been developed to begin a National Adaptation Program, implementation support must be maintained. Adapting to a changing climate will require constant reassessment and adjustment. This requires sustained leadership and program support by an office with appropriate authority, funding, resources, and substantive expertise.

5. *Legislative action to build on the lessons learned, to mandate funding, and to make necessary changes in statutes.* Legislation on adaptation may ultimately be necessary because it builds broader support for the program, makes it permanent across administrations, and provides funding for the program. In some cases, changes to existing legislation may be needed to remove barriers and create incentives for adaptation.

C. National Adaptation Program Structure

The National Adaptation Program should be highly visible, with strong central leadership and clear lines of authority to ensure that functions are effectively carried out and well coordinated, that the efforts of individual federal agencies are effectively managed, and that the policies and interests of states and other stakeholders are integrated into the program. The proposed overall program structure is illustrated in **Figure 1**.

i. National Adaptation Program Organization

The National Adaptation Program would be established within the current management structure for federal climate programs. It would work in conjunction with the two congressionally mandated national climate programs that already exist: (1) the USGCRP, a multiagency program that integrates federal climate research across agencies as authorized by the U.S. Global Change Research Act of 1990; and (2) the Climate Change Technology Program (CCTP), a multiagency program for the development of climate change relevant technologies

Figure 1

Proposed National Adaptation Program **Organziational Chart**

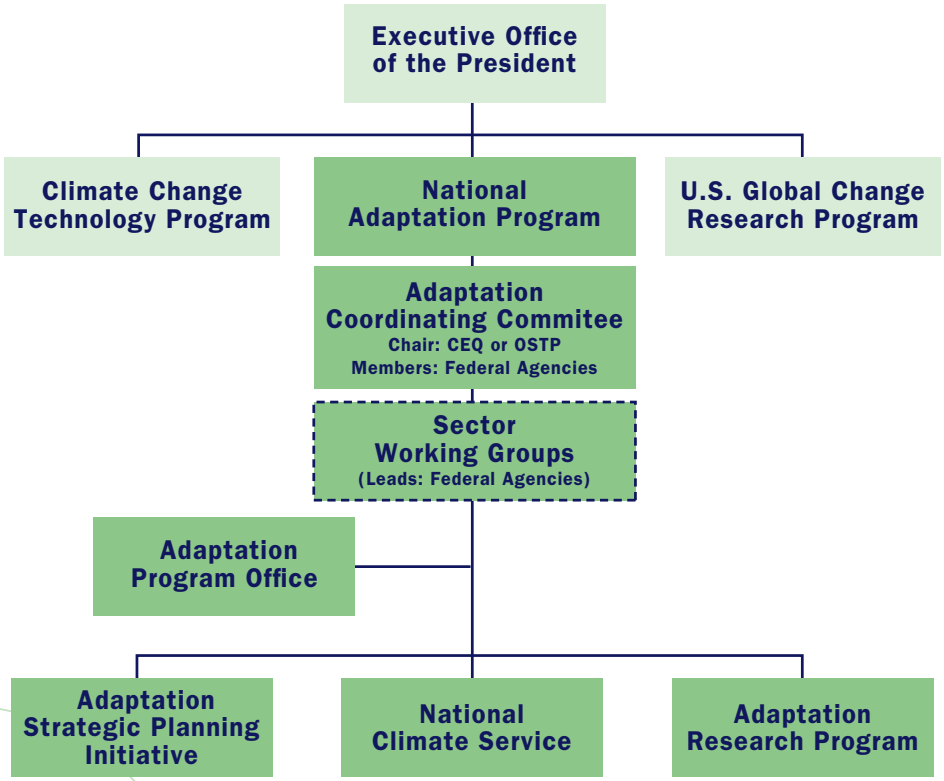


Figure 2

National Adaptation Program Key Functions

Organization	Functions
Adaptation Coordinating Committee (ACC)	• Program strategy and oversight • Program coordination and integration • Planning guidance • Policy development
Sector Working Groups (SWGs)	• Cross-agency coordination and integration • Sector planning support • Sector stakeholder representation
Adaptation Program Office (APO)	• Staff support for National Adaptation Program

authorized by the Energy Policy Act of 2005. Management for all three programs would be coordinated to ensure the efficient use of limited resources and to maximize opportunities for integration among these three programs. The key functions of the National Adaptation Program components are illustrated in **Figure 2**.

ii. Adaptation Coordinating Committee

A multiagency coordinating committee chaired by an office within the EOP should set the strategy for and oversee the development and implementation of the National Adaptation Program. As chair of the coordinating committee, an EOP office can most effectively play a leadership and oversight role to ensure accountability of the program to presidential and congressional priorities. This role could be filled by CEQ, OSTP, or a co-chair arrangement involving both. CEQ has more experience with bringing agencies together to work on environmental and natural resources program and policy issues, and because of the policy coordination needed for climate change adaptation it may be the most appropriate entity to lead the effort. However, OSTP has a strong science and research coordination role, with recent oversight for USGCRP and CCTP. The recent Government Accountability Office (GAO) report on climate change adaptation recommended that "appropriate entities within the Executive Office of the President, such as the Council on Environmental Quality (CEQ) and the Office of Science and Technology Policy (OSTP), in consultation with relevant federal agencies, state and local governments, and key congressional committees of jurisdiction, develop a national strategic plan that will guide the nation's efforts to adapt to a changing climate" (GAO, 2009).

The proposed Adaptation Coordinating Committee should take the lead in developing strategic planning guidance that sets out a vision for the nation as a whole, including identifying overall adaptation goals, objectives, priorities, and required programs and actions by federal entities. This guidance would be used by agencies as they develop their own agency-specific strategic plans for adaptation. The committee should, as appropriate, update and improve the guidance based on lessons learned in carrying out the strategic planning process.

Another vital role of the Adaptation Coordinating Committee is to mediate and develop appropriate policy recommendations where issues that need resolution arise from the development of federal agency or sector adaptation strategic plans, the formation and ongoing evolution of a National Climate Service, and the development and incorporation of adaptation research into the current USCGRP.

The Adaptation Coordinating Committee should include a senior, policy-level representative or their designee from all federal agencies with a major stake in adaptation. This would include, but not be limited to, the Departments of Interior, Agriculture, Commerce (i.e., NOAA), Energy, Transportation, Homeland Security, Health and Human Services, Defense, and State, as well as the U.S. Environmental Protection Agency (EPA), the National Aeronautics and Space Administration, and the National Science Foundation. Participation by policy-level agency officials will be needed for the National Adaptation Program to exercise the authority necessary to adequately address cross-jurisdictional and multi-agency adaptation issues.

Over time, the Adaptation Coordinating Committee should be involved, along with the OMB, in developing cross-agency efforts aimed at facilitating a coordinated approach to budgetary requests for adaptation. Past experience with OMB involvement in the USGCRP indicates that it can serve a constructive purpose through budget crosscuts or other funding oversight mechanisms that ensure that the National Adaptation Program is supported.

There are two directly relevant precedents for coordinating multiagency efforts. USGCRP has 13 participating departments and agencies overseen by the EOP through a committee chaired by the OSTP.[3] USGCRP has dedicated staff support in the form of an Integration and Coordination Office. USGCRP and its program office operate on a distributed cost budget of voluntary contributions by all USGCRP member agencies (which is administered by the National Science Foundation) in proportion to their stated proportion of the overall USGCRP research budget. While this funding arrangement has remained steady over a number of years, a formal funding mechanism could provide additional stability to the National Adaptation Program.

In contrast, the CCTP has 11 participating departments or agencies with the Department of Energy (DOE) as the designated lead agency. DOE has by far the biggest share of climate-related technology research and provides the program director, deputy director, and support staff. Because of the diversity of adaptation issues across the federal government, an EOP coordinated effort, like that of USGCRP, would likely be more effective in coordinating across the many relevant departments and agencies.

iii. Sector Working Groups

Sector Working Groups (SWGs) should be established as sub-committees of the Adaptation Coordinating Committee and should cover major national sectors affected by climate change. A working group might be created for water resources, land management, infrastructure, agriculture, coastal zone management, public health, emergency management, national security and others as deemed necessary by the Adaptation Coordinating Committee. The formation of Sector Working Groups is intended to coordinate federal adaptation planning and climate services for vital U.S. sectors affected by climate change. These working groups could also provide input on adaptation research needs in their respective sectors and serve as a forum for incorporating the perspectives of diverse sector-based stakeholders and experts outside of the federal government.[4]

The most appropriate way to organize Sector Working Groups is by the substantive issue. For example, adaptation in federal land management is an issue that cuts across several agencies, including but not limited to the Forest Service, the Bureau of Land Management, the National Park Service, the U.S. Fish and Wildlife Service (USFWS), the Department of Defense, and the Bureau of Reclamation. A land management working group would develop an integrated sector adaptation strategic plan as well as work with stakeholders such as states and nonprofit organizations to coordinate adaptive responses for land management on federal and non-federal lands.

iv. Adaptation Program Office

A National Adaptation Program would benefit from an office to facilitate coordination of federal agency activities, to staff EOP adaptation efforts, and to coordinate with USGCRP and CCTP. Because EOP offices generally have limited staff, a dedicated Adaptation Program Office could be created in the model of the USGCRP Integration and Coordination Office. A primary responsibility of the program office is to support the Adaptation Coordinating Committee in ensuring the appropriate coordination and support for the three National Adaptation Program components: the Adaptation Strategic Planning Initiative, the National Climate Service, and the Adaptation Research Program. For example, in providing staff support for the Adaptation Strategic Planning Initiative, the program office could develop the strategic planning guidance for use by agencies and could draft the national adaptation strategic plan.

Finally, the office would be responsible for facilitating a periodic assessment and evaluation of the success of the National Adaptation Program, either in conjunction with the Adaptation Coordinating Committee or through an outside party, such as the National Academy of Sciences (NAS) or the National Academy of Public Administration (NAPA).

There are many precedents for the creation of a permanent office or committee tasked with facilitating adaptation programs in states and other countries. For example, Mayor Bloomberg established New York City's Office of Long-Term Planning and Sustainability to implement the PlaNYC vision, and the office was subsequently legislated by the New York City Council in 2008. This office provides leadership and momentum to implement the actions called for in PlaNYC. Other examples include the UK's Committee on Climate Change and its Sub-Committee on Adaptation established by the country's 2008 Climate Act, and Florida's Energy and Climate Commission created by the Florida legislature in 2008. Each of these new entities was created to focus on and sustain policy, planning, and implementation efforts associated with climate change adaptation efforts.

D. Components of a National Adaptation Program

This report recommends three key components within a National Adaptation Program: an Adaptation Strategic Planning Initiative, an National Climate Service, and an Adaptation Research Program (see **Figure 3**). All three components complement each other to ensure the long-term success of the National Adaptation Program.

i. Adaptation Strategic Planning Initiative

The Adaptation Strategic Planning Initiative would enable the federal government to engage in comprehensive strategic planning, policy reviews, and ultimately policy implementation and evaluation. Strategic planning includes high-level scoping of resources and responsibilities as well as more detailed planning on policy and implementation. The strategic planning initiative would also serve as a mechanism to provide overall national direction and to communicate adaptation priorities to other stakeholders. The initiative is intended to encourage federal agencies to "mainstream" climate change into their decision-making processes as well as promote cross-agency coordination.

Figure 3

National Adaptation Program Components and Outputs

Program Components	Outputs
Adaptation Planning Initiative	• Strategic Planning Guidance • Federal Agency Adaptation Strategic Plans • Sector Adaptation Strategic Plans • National Adaptation Strategic Plan • State Adaptation Plans
National Climate Service	• Sector Needs Assessments • Climate Data and Information • Decision Tools and Support
Adaptation Research Program	• Adaptation Research Needs Report

The Adaptation Strategic Planning Initiative could be implemented sequentially as follows:

1. Government-wide Strategic Planning Guidance
2. Federal Agency Adaptation Strategic Plans
3. Sector Adaptation Strategic Plans
4. National Adaptation Strategic Plan
5. State Adaptation Strategic Plans.

Government-wide Strategic Planning Guidance

Strategic planning guidance is needed to provide policy direction to and to ensure consistency across federal agency and sector plans. The Adaptation Coordinating Committee should develop this guidance to set out a vision for the nation as a whole, including overarching adaptation goals, objectives, and priorities. The guidance should set forth roles and responsibilities for agencies and Sector Working Groups as well as provide a clear mandate for the development of federal agency and sector adaptation strategic plans, drawing from the guiding principles highlighted in **Box 2**. Guidelines for the substance of agency and sector plans, public involvement, monitoring and evaluation processes, and timelines should be provided. Additionally, the Adaptation Coordinating Committee should develop a process to coordinate and resolve cross-jurisdictional issues identified by agencies or Sector Working Groups during adaptation plan development. The strategic planning guidance could identify critical cross-agency and cross-sector issues ahead of time for consideration by agencies and working groups.

Federal Agency Adaptation Strategic Plans

To ensure that federal agencies adequately consider the effects of climate change on their operations and responsibilities, each agency should be required to produce an adaptation strategic plan.

Federal agency plans represent the most direct approach to identifying ways to mainstream adaptation across federal programs. Some federal agencies (or parts thereof) have, on their own initiative, developed preliminary strategic plans for climate adaptation [U.S. EPA, 2008; Brekke et al., 2009; USFWS, 2009; U.S. DOI, Undated(a), Undated(b), Undated(c)], but many others have not yet done so. Federal agency adaptation strategic plans should include at a minimum the following elements:

1. *Identify climate-sensitive agency activities and assets.* The end product should be a comprehensive list of significant agency assets, resources, activities, systems, programs, policies, regulations, and projects that could be affected by climate change.

2. *Prioritize vulnerable systems and assets.* After identifying climate-sensitive activities and assets under its direct jurisdiction, agencies should prioritize vulnerabilities for planning and action purposes.

3. *Identify opportunities for and barriers to incorporating climate change into agency decision-making.* Existing legislation, policies, regulations, guidelines, or jurisdictional issues that inhibit or prevent the consideration of climate vulnerability in agency operations or responsibilities should be identified.

4. *Develop adaptive actions and next steps.* Using the outcomes from Steps 1, 2, and 3, each agency should develop and prioritize specific cost-effective actions and next steps for agency implementation.

5. *Establish monitoring and evaluation plans.* Each agency should identify measures of progress against defined objectives for all major agency initiatives to reduce vulnerability. They should be quantitative where feasible and include methods for assessing the effectiveness of adaptive actions while encouraging innovation and experimentation to find new best practices.

6. *Identify coordination needs and agency partners.* Each agency should identify other agencies, state and local organizations, private sector partners, nongovernmental organizations, and other stakeholders that might play a critical role in assessing agency vulnerability or implementing adaptive actions. These stakeholders should be included in the planning process where feasible and appropriate. In addition, mechanisms to effectively engage the participation of these partners should be identified. Cross-cutting issues involving multiple agencies might be recommended for further attention by the relevant Sector Working Group.

7. *Define resource needs.* Each agency should identify what funding, personnel (considering skills and knowledge), decision support tools, data or information, and technological capabilities are needed to implement adaptations and reduce vulnerabilities.

8. *Compile climate-relevant agency services and products.* Each agency should compile a comprehensive list of its current or potential services and products to support adaptation planning and adaptive actions by governmental organizations, public and private nongovernmental organizations, and individuals.

9. *Identify research and information needs.* Each agency should identify specific instances in which additional information is needed to help determine the climate vulnerability of resources managed by the agency or to assess the feasibility, effectiveness, and costs of adaptive actions. The results would be input for the National Climate Service and the Adaptation Research Program.

Several federal agencies or offices have recently developed their own adaptation plans, including the U.S. Department of the Interior, the USFWS, and the EPA Office of Water. **Box 5** briefly describes these plans.

Box 5. Existing Federal Agency Adaptation Strategic Plans

The Department of the Interior. Coinciding with the release of the department's Climate Change Task Force findings in December 2008 [U.S. DOI, Undated(a), Undated(b), Undated(c)], Secretary Kempthorne created the position of Climate Change Coordinator within the department's Office of Environmental Policy and Compliance to serve as the central clearinghouse within the department for questions and practices relating to climate change. The Secretary also created a Climate Change Advisory Council to discuss the impact and response to climate change across the department on a monthly basis and to exchange ideas and suggestions for how best to deal with a changing landscape (U.S. DOI, 2008).

In January 2009, the Secretary issued Order 3226 Amendment 1 requiring department bureaus and offices to "consider and analyze potential climate change impacts when undertaking long-range planning, setting research and investment priorities, and or when making major decisions affecting department resources." In addition, the order calls for bureaus and offices to identify corresponding budget needs, legal barriers, and potential impacts on bureau or office areas of responsibility (including programs, facilities, boundaries, policies, and authorities), and to recommend actions to respond to these identified impacts.

On September 14, 2009, Secretary Salazar issued Secretarial Order 3289, which creates Climate Change Response Councils to improve information sharing, Regional Climate Change Response Centers to integrate climate change information and management strategies in eight regions, and Landscape Conservation Cooperatives to work with states and localities to manage climate change impacts within the eight regions (U.S. DOI, 2009).

U.S. Fish and Wildlife Service. The USFWS began a strategic planning process in 2008 to better manage and sustain America's fish and wildlife given current and projected climatic changes and impacts to resources under its jurisdiction. On September 23, 2009, the USFWS released its Climate Change Strategic Plan and Five-Year Action Plan to guide its efforts to respond to the impacts of climate change on U.S. fish, wildlife, and their habitats (USFWS, 2008a, 2008b). The strategic plan calls for developing specific strategies to adapt to climate change (e.g., creation of Landscape Conservation Cooperatives), implementation strategies (e.g., habitat conservation, habitat connectivity), and meeting priority freshwater needs in refuges.

EPA Office of Water. In early 2008, the EPA Office of Water released the National Water Program Strategy: Response to Climate Change, which describes how to maintain drinking water quantity and quality as well as U.S. water body quality and safety concerns in light of climate change impacts (U.S. EPA, 2008). The strategy calls for changing the National Water Program to identify and develop adaptive responses to the impacts of climate change; expanding EPA's water research agenda both internally and with other agencies or research entities to incorporate climate change; providing educational materials to water program professionals and stakeholders on the impacts of climate change on watersheds, water supply, water infrastructure, and water quality, including information and technical assistance to state, local, and tribal water managers; and developing capacity to monitor EPA's program from a climate change perspective on a sustained basis while more systematically addressing climate change impacts both at regional levels and with other agencies.

Sector Adaptation Strategic Plans

Although federal agency adaptation strategic planning is where federal administrative action on adaptation should get started, many climate impacts and management decisions will cut across agency jurisdictions. For example, in the water resources sector, the Bureau of Reclamation, the USACE, and EPA all play significant and overlapping roles that affect water supplies, drinking water quality, and in-stream flow requirements. Mandates by one agency can contradict mandates by another agency, and such inconsistencies across agencies can make mainstreaming climate change adaptation difficult. Consequently, adaptation planning will also need to be conducted at the sector level to ensure consistency of approaches across agencies.[5]

Sector plans should be organized by the same topics as the Sector Working Groups described earlier in this report (e.g., water resources, land management, infrastructure). Being cross-jurisdictional, sector plans should also seek to effectively integrate needs across a range of stakeholders by engaging representatives from states, municipalities, private sector, nongovernmental organizations, academia, and other sectors. The development of sector plans would be the responsibility of the Sector Working Groups. This serves the purpose of integrating solutions to climate change impacts within a sector across different agencies with jurisdiction or interest in the sector.

This recommendation for sector adaptation strategic plans has two notable precedents: state adaptation plans and the U.S. National Assessment of the Consequences of Climate Variability and Change (National Assessment Synthesis Team, 2001). In many state plans and in the National Assessment, a wide range of experts were convened in working teams organized by sector, region, or both to prioritize vulnerable systems and resources and develop adaptive responses. All 10 states that have started adaptation planning efforts organized their planning teams by sector (see **Figure 4**).

Sector adaptation strategic plans should pay particular attention to the barriers identified in federal agency adaptation strategic plans. By reviewing these barriers in the light of other agencies facing similar climate impacts, Sector Working Groups might identify additional barriers, cross-jurisdictional issues, or other aspects of adaptation that are difficult to identify or resolve at a single agency level.

National Adaptation Strategic Plan

Once agency and sector strategic plans have been developed, a national strategic plan (beyond initial guidance and objectives) should be developed. The national adaptation strategic plan should provide an integrated view of issues cutting across multiple federal agency jurisdictions and on impacts that cross multiple sectors. The plan should also identify the following on a national scale: priorities for climate impacts and adaptive

Figure 4

Sectors Addressed in State-wide Adaptation Planning Efforts

State	Agriculture	Biodiversity/ Ecosystem	Economic Systems	Oceans/ Coastal	Forestry	Emerg Prepared/ Public Health	Infrastructure	Water
AK	✓	✓	✓	✓	✓	✓	✓	
CA	✓	✓		✓	✓	✓	✓	✓
FL		✓		✓		✓	✓	✓
MA		✓	✓	✓		✓	✓	
MD[1]		✓		✓		✓	✓	
NH	✓	✓	✓	✓	✓	✓	✓	
NY[1]		✓		✓				
OR	✓	✓	✓		✓	✓	✓	
VA[2]		✓		✓		✓	✓	✓
WA	✓	✓		✓	✓	✓	✓	✓

1 MD and NY plans are limited to statewide issues associated with the impacts from sea-level rise.
2 VA's plan also addresses the insurance sector.
Source: T.Cruce for the Georgetown Climate Center.

actions over different time periods; information, research, and monitoring needs; resource needs; cross-cutting policies; estimates of the costs and benefits of federal adaptive actions; and the future strategic direction for the Adaptation Strategic Planning Initiative itself.

This plan should provide an integrated view of federal adaptation activities that incorporates the planning efforts of agencies and Sector Working Groups. It should set priorities and give a national vision on adaptation to climate change. In addition, the national plan provides an opportunity to consider the work done by agencies and Sector Working Groups and to address national issues that were not raised in agency or sector plans. After completing the first national plan, the Adaptation Strategic Planning Initiative should be revisited by the Adaptation Coordinating Committee to make improvements based on lessons learned from the first (or initial) federal plans.

State Adaptation Strategic Plans

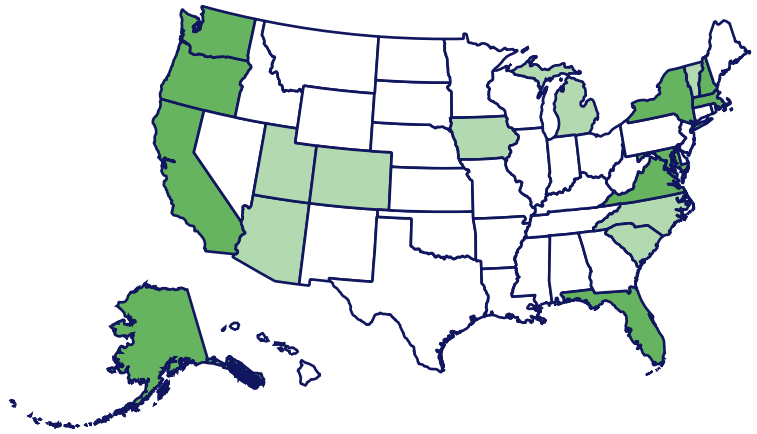
While not the focus of this analysis, state planning efforts are critical and can facilitate strong bottom-up connections between decision-makers on the ground and the Adaptation Strategic Planning Initiative. Such bottom-up connections are needed for a National Adaptation Program to be successful in the long-term. Federal agency adaptation strategic plans as well as federal-led sector adaptation strategic plans can both inform and be informed by these state plans. States often have significant experience integrating policy across sectors, which

could offer policy innovations applicable at the federal level. Leveraging lessons learned from both the top-down and the bottom-up is a vital aspect of a National Adaptation Program. Furthermore, an assessment of state plans could help identify (1) state needs from the federal government such as research, monitoring, surveillance, technologies, decision support, and implementation support; (2) current federal policies that pose barriers to federal, regional, and state level planning; and (3) new federal policies that may be required to enable federal, regional, or state level adaptive actions.

Several states are already developing adaptation strategic plans (see **Figures 4 and 5**), and federal support or incentives to encourage them should be part of the federal program. In practice, state planning could eventually proceed in parallel with federal planning. Ideally, these efforts should be coordinated to maximize their effectiveness. It may be cumbersome to initially integrate state planning into federal adaptation planning. Therefore, the first round of federal planning may need to focus exclusively on federal agencies. Subsequent rounds, however, should integrate state adaptation plans.

Figure 5

State Adaptation Planning Status as of 2009



State Adaptation Plan complete or in-progress

Adaptation Plan recommended in Climate Action Plan

ii. National Climate Service

The second functional area for a National Adaptation Program is a National Climate Service to provide demand-driven and usable climate information, decision support tools, and other technical resources to end users across sectors, regions, and political jurisdictions. State and local governments, natural resource and public utility managers, the private sector, nongovernmental organizations, and others are increasingly looking for climate information and services such as:

1. Downscaled climate projections to the geographic and time scales relevant to their decision-making needs (e.g., Seattle Public Utilities, 2009)

2. Flood plain and elevation mapping (e.g., CSO, 2008)

3. Sector-specific (e.g., Miller and Yates, 2006) or region-specific (e.g., State of Alaska, 2008) climate science and impact projections

4. Decision tools for implementation support (e.g., Snover et al., 2007).

For example, water and wastewater utility organizations as well as individual utilities have begun funding research on the science of climate change and on planning for potential changes in climate (e.g., Barsugli et al., 2009; Lowrey et al., 2009; Means et al., 2009). The availability of guidance manuals for addressing climate change, such as the International Council for Local Environmental Initiatives/King County's *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments,* indicates a strong demand for support services among cities, counties, and states (Snover et al., 2007).

Beyond providing the best information available on climate change at a scale and in a format useful for decision-making, the National Climate Service should also provide technical support, assessment tools, decision-making support, and accommodate other decision-maker needs to support cost-effective actions to reduce climate vulnerability. The provision of information and support should be made available in a manner that is accessible and timely for users. This will require that the National Climate Service ensures that information and technical support is demand-driven, i.e., that the it engages in robust two-way communication with end users. It will also require a particular emphasis on the "customer" and creative outreach, marketing, education, and communication strategies. A number of recent studies have focused on how to structure a National Climate Service with NOAA in the lead in a way that effectively addresses user needs and involves other agencies (Miles et al, 2006; NRC, 2009; SAB, 2009).

One useful precedent for developing a National Climate Service in the United States is the UK's Climate Impacts Programme (see the case study in **Box 6**). Because of its expertise in climate monitoring, data analysis, and projections, the most logical agency to coordinate a National Climate Service is NOAA. The agency has already taken significant steps toward providing this type of service (e.g., Kwok, 2009; Lubchenco, 2009; SAB, 2009) and has developed some important building blocks such as the Regional Integrated Science and Assessments programs (NOAA, 2009c).

While NOAA could provide overall coordination of the National Climate Service and take the lead in climate observations, data analysis, and forecasts, a critical role must be played by other agencies in ensuring sector-specific and end-user needs are identified and met. The National Climate Service should draw on the existing expertise and user networks developed by other agencies in specific sectors (e.g., USGS through its

Box 6. Case Study: United Kingdom Climate Impacts Program

The UK established its United Kingdom Climate Impacts Programme (UKCIP) in 1997 to work "at the boundary between scientific research, policymakers, and stakeholders (people working in the public, private, and voluntary sectors interested in the impacts of climate change)" (UKCIP, 2009). UKCIP originally focused on coordinating scientific research into climate impacts, but has expanded over the years to help organizations and communities adapt to unavoidable impacts from climate change.

In 1996, a Scientific Review of Impact Research found that UK climate impacts research was neither integrated nor well used by the intended audience. UKCIP began to integrate impact assessments and coordinate research, making the research and information products more broadly applicable and usable to system planners and resource managers. UKCIP developed regional partnerships that currently assist in devising the overall research strategy and setting priorities every six months. UKCIP provides a bidirectional linkage between climate science and decision-makers, including surveying adaptations being done around the country and supporting human and social sciences research.

In its early years, UKCIP recognized that just providing decision-relevant impacts information was not enough. UKCIP broadened its mission to provide additional services, including (1) climate change scenarios for use in impacts research and planning; (2) guidance to businesses and organizations to help them assess how they might be affected by climate change; (3) tools and information to help communities with risk assessments, planning, and training; and (4) a compilation of best practice solutions to address the impacts of a changing climate. The process of helping communities adapt is now a requirement for UKCIP to receive government funds.

UKCIP is funded primarily by the Department of Environment Food and Rural Affairs and is based at Oxford University's Environmental Change Institute. For more information, go to www.ukcip.org.uk.

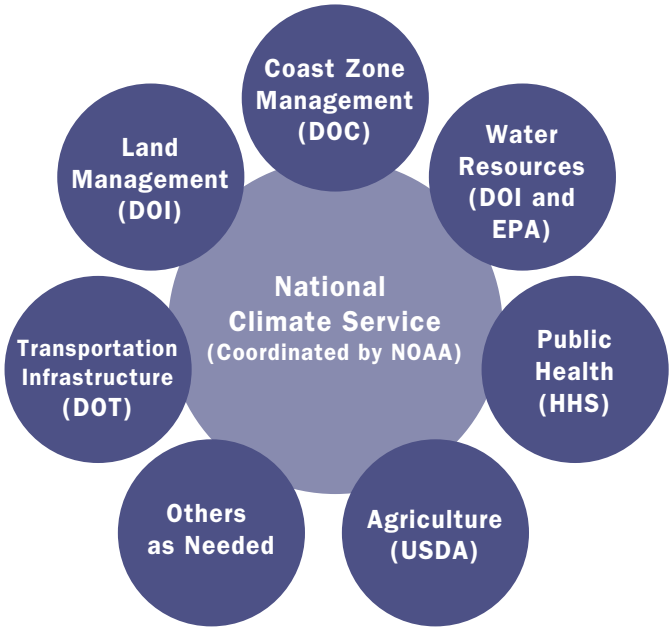
water and biological monitoring systems and the Department of Agriculture through the Cooperative Extension System). Agencies with existing expertise, extension program managers and extension agents in the field, and user networks should be given a leadership role for their sectors, with significant authority and autonomy. Thus a critical element of a National Climate Service should be the key role played by these agencies in directing the sector-specific working groups discussed above. The suggested organizational relationship is illustrated in **Figure 6**; however, the specific sectors and lead agencies represent examples only.

Each Sector Working Group should take the lead in defining and prioritizing sector-specific information and service needs and involve non-federal stakeholders in the process. Furthermore, the working groups would produce reports identifying best practices. To support the National Climate Service, Sector Working Groups should include stakeholders outside the federal government, including the private sector, states, municipalities, nongovernmental organizations, expert citizens, and others. Finally, these working groups could also support other components of the National Adaptation Program by communicating stakeholder-identified policy needs to the Adaptation Strategic Planning Initiative and research needs to the Adaptation Research Program.

Figure 6

Proposed National Climate Service

Sector Working Groups



iii. Adaptation Research Program

The third functional area for a National Adaptation Program is supporting and enhancing adaptation science and research[6] in the form of an Adaptation Research Program. The USGCRP already coordinates climate research and assessments for the federal government and should continue to play this role. Adaptation research, however, has received less attention and resources than it merits. Although the USGCRP is established in statute, there is sufficient flexibility in strategic direction to expand or clarify USGCRP's responsibilities to ensure that adaptation research is a significant component of its research portfolio. In order to ensure the communication and coordination of adaptation research needs with USGCRP, the Adaptation Program Office could prepare a biannual report to the USGCRP Integration and Coordination Office and the Subcommittee on Global Change Research[7] on research needs identified through the Adaptation Strategic Planning Initiative and the National Climate Service.

Adaptation research is use-inspired in that it seeks to understand not just the changes in climate that society will need to adapt to, but how society adapts, and to better understand what conditions, incentives, and information promote or impede adaptation. The federal government can enhance adaptation science and research by coordinating research priorities, funding expanded decision-relevant research, and establishing an integrated communication framework between federal research organizations and the potential users of such research. **Box 7** describes an instructive case study of the Australian government's support for adaptation research.

Additionally, by statute, the USGCRP coordinates national impact assessments. Such assessments are intended to help Congress and other decision-makers understand the risks and opportunities that accompany climate change to empower them to take well-informed policy action. The U.S. Global Change Research Act of

Box 7. Case Study: Australia's Approach to Adaptation Research

In 2008, the Australian government created and funded the National Climate Change Adaptation Research Facility as a partnership with eight universities. Each university has ownership for a vital sector, referred to as a "network," because of the collaborative nature of the effort with up to a $10 million budget per network (all budgets in Australian dollars). For example, Griffith University leads the Water Resources and Freshwater Biodiversity network and RMIT University leads the Disaster Management and Emergency Services network. These research networks and the facility overall are responsible for synthesizing, coordinating, and making relevant the information that meets the geographic and sector needs of decision-makers (Commonwealth of Australia, 2009).

1990 calls for a periodic national assessment[8] no less frequently than every four years to (1) integrate scientific findings of the USGCRP and associated uncertainties, (2) analyze the effect of global change on a range of sectors, and (3) analyze current trends in global change and project those trends for the subsequent 25 to 100 years (USGCRIO, 1990).

National impact assessments should be coordinated with the National Adaptation Program to ensure that they provide useful input to the Adaptation Strategic Planning Initiative and the National Climate Service.

IV. NEPA and Adaptation

Although this report focuses on a framework for a National Adaptation Program as a means to mainstream climate change across federal government policies and activities, other mechanisms exist to enhance adaptation efforts.

Another way of promoting adaptation is to use or develop mechanisms, such as the National Environmental Policy Act (NEPA), that could require the consideration of adaptation across a broad range of climate-sensitive decisions. Such mechanisms complement the National Adaptation Program and thus should be implemented along with the program.

NEPA has received significant attention as a possible mechanism for incorporating climate change into major federal decisions. NEPA requires all federal agencies to assess the environmental consequences of major federal actions. CEQ oversees implementation of NEPA, issues regulations for NEPA procedural requirements, and reviews and approves federal agency NEPA procedures. EPA is responsible for analyzing individual environmental impacts statements developed by other agencies.

CEQ could issue guidance directing federal agencies to consider how changing environmental conditions (including changes in climate) might affect the environmental impacts of major federal actions over time.[9] For example, a railroad being built in a low-lying coastal area should be examined in terms of the impact of sea level rise on the project's location and design. Such a railroad could pose a barrier to inland migration of wetlands as well as put the new infrastructure at risk. The environmental impact statement (EIS) could consider alternatives such as locating the railroad farther inland or altering its design in anticipation of sea level rise.

NEPA provides authority to consider the potential impacts of climate change on federal projects, but there is no direction to consider it or guidance on how to do so (Pyke and Batten, 2008). NEPA has several provisions that can be interpreted to require that climate change be considered in preparing assessments. For example, NEPA provisions require all agencies of the federal government to:

- "Identify and develop methods and procedures…which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decisionmaking along with economic and technical considerations"

- "Include in every recommendation or report…any adverse environmental effects which cannot be avoided should the proposal be implemented"
- "Include in every recommendation or report…the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity."

Although these and other NEPA provisions were written before climate change became an established environmental concern, it is clear that they apply across a broad spectrum of environmental issues. CEQ could issue guidance clarifying that NEPA covers climate change. But CEQ would also need to give federal agencies specific guidance, recommendations, and time to develop analytical tools for integrating climate change into the analyses done under NEPA.

The Chair of the CEQ could convene an interagency task force to develop recommendations for incorporating climate change into EISs and environmental assessments as required under NEPA. The task force would include agencies responsible for preparing a significant number of EISs and any other agency deemed relevant by CEQ, including agencies that provide information used in EIS preparation. The task force would determine how NEPA could be applied to address the environmental impacts of climate change on major federal actions and what guidance, recommendations, and expertise would be necessary to support implementation. The CEQ Chair should issue proposed regulations and guidance documents for agencies to incorporate climate change considerations into the preparation of their EISs.

V. Summary of Recommendations

Mainstreaming adaptation across the federal government in response to unavoidable climate change will require a coordinated federal response, one that could take the following approach:

- Establish a **National Adaptation Program**:
  - Create a multiagency Adaptation Coordinating Committee to manage and oversee the program, including the development of strategic planning guidance, national adaptation policies, and the coordination and integration of federal adaptation activities
  - Create Sector Working Groups chaired by lead agencies that represent the major cross-cutting substantive issues for each sector impacted by climate change
  - Create an Adaptation Program Office in the EOP to support the Adaptation Coordinating Committee and the National Adaptation Program
- Develop **Adaptation Strategic Plans**:
  - Create strategic planning guidance that establishes national adaptation goals, objectives, and priorities as well as substantive and procedural expectations for strategic plans
  - Require the development of federal agency adaptation strategic plans by all agencies with significant responsibility for federal programs or resources either vulnerable to climate change or necessary to promote adaptation
  - Call for sector adaptation strategic plans to be developed by multiagency Sector Working Groups for key U.S. sectors vulnerable to climate change
  - Develop a national adaptation strategic plan that supports national adaptation goals, objectives, and priorities, and provides a clear focus on the resolution of multiagency issues for specific impacts and sectors as well as overall barriers to and recommendations for national adaptation efforts
  - Provide direction and technical support for state adaptation strategic plans

- Establish a multiagency **National Climate Service** to provide demand-driven and usable climate information, guidance, and other technical resources to end users across sectors, regions, and political jurisdictions. The interagency service would be coordinated by NOAA and report to the Adaptation Coordinating Committee. Sector Working Groups reporting to the Adaptation Coordinating Committee, but led by other federal agencies with sector expertise, should involve stakeholders in identifying end-user needs and developing appropriate decision support products and services as a core element of the National Climate Service.
- Direct the USGCRP to evaluate and expand its current research agenda to include adaptation research needs within an **Adaptation Research Program**. The Adaptation Program Office would prepare a bi-annual report to the USGCRP Integration and Coordination Office and the Subcommittee on Global Change Research on research needs identified through the Adaptation Strategic Planning Initiative and the National Climate Service.
- Convene an interagency task force reporting to the Adaptation Coordinating Committee to develop guidance, recommendations, and draft regulations for considering the environmental impacts of climate change on major federal actions in EISs as required under NEPA.

Appendices

A. Method

We used three types of information to inform our conclusions about the appropriate roles and institutional organization for a National Adaptation Program:

- We interviewed leading experts on climate change adaptation and federal government organization (see below). These experts included individuals with experience advising the President and Congress, as well as individuals at high levels within relevant federal agencies. We also interviewed individuals involved with the adaptation programs and actions of countries and states who have been among the leaders in this field: Australia, the UK, Alaska, California, Florida, and Maryland.
- We examined existing documentation, including agency strategic plans addressing climate adaptation; relevant reports and Congressional testimony; state and international legislation, executive orders, and reports; and web resources, including agency, international, state, and other websites reporting on adaptation programs or planning processes.
- We surveyed proposed legislation from the 110th and 111th Congresses with climate change adaptation components to analyze recent proposals on how the federal government should address adaptation.

Individuals Interviewed

Thomas Armstrong, *Senior Advisor Global Change Programs*, U.S. Geological Survey

Peter Backlund, *Director of Research Relations,* National Center for Atmospheric Research

Anthony Brunello, *Deputy Secretary for Climate Change and Energy,* California Natural Resources Agency

Radford Byerly, *Visiting Fellow, Center for Science and Technology Policy Research,* University of Colorado

Keya Chatterjee, *Deputy Director, Climate Change Program,* World Wildlife Fund

Robert Cobbs, *Policy Analyst,* House Committee on Energy and Commerce

Jack Fellows, *Vice President for Corporate Affairs,* University Corporation for Atmospheric Research

Kristen Fletcher, *Executive Director,* Coastal States Organization

David Goodrich, *Senior Advisor for Climate Services, Climate Program Office,* National Oceanic and Atmospheric Administration

Josh Foster, *Adaptation Manager,* Center for Clean Air Policy

Morgan Gray, *Majority Staff Member,* Senate Select Committee on Energy Independence and Global Warming

Larry Hartig, *Commissioner, Department of Environmental Conservation,* State of Alaska

Steve Hatfield-Dodds, *Assistant Secretary, Analysis and Projections Branch,* Australia Department of Climate Change

Mark Howden, *Senior Principal Research Scientist,* CSIRO Australia

Anthony Janetos, *Director,* Joint Global Change Research Institute

Zoe Johnson, *Coastal Planner,* Maryland Department of Natural Resources

Chet Koblinsky, *Director, Climate Program Office,* National Oceanic and Atmospheric Administration

James Mahoney, *Independent Consultant,* Former Deputy Director of National Oceanic and Atmospheric Administration and Director of Climate Change Science Program

Kurt Malchow, *Adaptation Program Manager,* California Natural Resources Agency

Elizabeth McNie, *Assistant Professor of Political Science and Earth & Atmospheric Sciences,* Purdue University

Karen Metchis, *Special Assistant, Office of Water,* U.S. Environmental Protection Agency

Susanne Moser, *Director and Principal Researcher,* Susanne Moser Research and Consulting

Richard Moss, *Vice President and Managing Director for Climate Change,* World Wildlife Fund

James Murley, *Chairman,* Florida Energy and Climate Commission

Jeff Peterson, *Senior Policy Advisor, Office of Water,* U.S. Environmental Protection Agency

Rick Piltz, *Director,* Climate Science Watch

Anne Polansky, *Senior Associate,* Climate Science Watch

Jackie Poston, *Alaska Climate Change Strategy Project Coordinator,* Alaska Department of Environmental Conservation, on detail from the U.S. Environmental Protection Agency

Benjamin Preston, *Research Scientist, CSIRO Division of Marine and Atmospheric Research,* Australia

Jeff Price, *Managing Director, Adaptation, Climate Change Program,* World Wildlife Fund

Gwynne Schultz, *Senior Ocean and Coastal Policy Advisor,* Maryland Department of Natural Resources

Peter Schultz, *Director,* United States Global Change Research Office

Chris Sear, *Head of Climate Science, Climate and Energy Science and Analysis Team,* United Kingdom Department of Energy and Climate Change

Mike Shapiro, *Acting Assistant Administrator, Office of Water*, Environmental Protection Agency

Chris West, *Director,* United Kingdom Climate Impacts Program

Julia Wyman, *Policy Analyst and Chair of the Climate Change Working Group,* Coastal States Organization

B. Draft Executive Order

National Adaptation Program

By the authority vested in me as President by the Constitution and the laws of the United States of America, in order to establish an integrated strategy to adapt to the consequences of climate change in the Federal Government, it is hereby ordered as follows:

Part 1—Policy

To increase our Nation's security, protect our natural resources, protect the interests of taxpayers, and safeguard our environment for this and future generations, the federal government must lead by example. The United States, its citizens, its economy, and its natural resources face significant challenges from climate change, including:

- Increases in the magnitude and frequency of severe weather events
- Increases in erosion in coastal areas and severity of coastal storms
- Declines in water supplies in some regions
- Increases in the severity and frequency of heat waves and droughts
- Geographic expansion of risks of infectious diseases
- Widespread loss of biodiversity and harm to natural resources

While it is imperative to limit greenhouse gas emissions to avoid the worst effects of climate change, adaptation is also necessary to address climate changes already occurring and which will continue over the coming decades regardless of mitigation of greenhouse gas emissions.

It is therefore the policy of the United States that Federal agencies shall incorporate the consideration of climate change into their management of resources, public policies and programs, and other activities. With a dedicated national program focused specifically on climate change adaptation, with adequate resources and funding, the United States will have the capability to cost-effectively address the magnitude and complexity of impacts across our Nation's vital sectors; to provide the integration, coordination, and communication needed to enable effective and efficient adaptive planning; and to protect our national assets, resources, and the American people as we address the impacts of a changing climate.

Part 2—Establish a National Climate Change Adaptation Program

A National Climate Change Adaptation Program is established, hereafter referred to as the National Adaptation Program, for the purposes of:

- Ensuring comprehensive adaptation programs and policy development
- Developing effective and useful climate change information

- Promoting adaptation relevant science and research
- Improving the effectiveness and efficiency of federal adaptation actions
- Improving coordination, communication, and integration of federal adaptation planning and responses across the federal government

Section 201—Adaptation Coordinating Committee

The Adaptation Coordinating Committee (ACC) shall be co-chaired by the Council on Environmental Quality (CEQ) and the Office of Science and Technology Policy (OSTP), with membership comprised of agency heads or designees from each of the federal agencies with responsibilities affected by climate change. These agencies shall at a minimum represent the Departments of Agriculture, Commerce, Defense, Energy, Interior, Health and Human Services, Homeland Security, and Housing and Urban Development; the U.S. Environmental Protection Agency (EPA); the National Aeronautics and Space Administration; and others deemed relevant by the ACC co-chairs. Functions of the ACC include:

1. Providing strategic direction and oversight for the National Adaptation Program
2. Developing, prioritizing, and implementing Administration policy on adaptation
3. Coordinating and integrating federal adaptation activities and resources across agencies and sectors
4. Developing guidelines for federal adaptation strategic plans

Section 202—Sector Working Groups

Sector Working Groups (SWGs) shall be established as sub-committees to the ACC, to represent federal adaptation needs and efforts for vital U.S. sectors. Each SWG shall be led by a federal agency, with representation from agencies with responsibilities to the sector, and with engagement from non-federal, sector-based stakeholders and experts as required to support the National Adaptation Program and each National Adaptation Program component. Functions of the SWGs include:

1. Supporting the coordination and integration of federal adaptation policy development and planning efforts for U.S. sectors affected by climate change
2. Representing sector adaptation research needs to the U.S. Global Change Research Program (USGCRP)
3. As sector-based leadership groups within the National Climate Service (NCS) representing sector-specific, end-user climate information, technology, and other federal support needs from the NCS

Section 203—National Adaptation Program Office

A National Adaptation Program Office (NAPO) shall be established to provide support to the National Adaptation Program. The ACC shall oversee the activities of the NAPO. The NAPO functions include:

1. Supporting the ACC's development of federal adaptation policy
2. Coordinating the Adaptation Strategic Planning Initiative (Part 3), including the identification of priorities for adaptation; identification of agency overlaps or gaps pertaining to adaptation planning and actions; guidelines for agency strategic planning, implementation, and monitoring (Section 301); and the creation of and updates for the National Adaptation Strategic Plan (Section 304)
3. Facilitating information sharing between the National Adaptation Program components: the Adaptation Strategic Planning Initiative (Part 3), an NCS (Part 4), and an Adaptation Research Program (Part 5); as well as between the National Adaptation Program and other federal climate change programs (e.g., Climate Change Technology Program and USGCRP)

Part 3—Adaptation Strategic Planning Initiative

Section 301—Strategic Planning Guidance

Within six months of promulgation, the ACC, with input from its member agencies and the SWGs, shall:

1. Set national adaptation goals, objectives, and priorities
2. Develop guidelines for the content and delivery of federal adaptation plans
3. Develop a process for resolving cross-jurisdictional issues identified by agencies or SWGs during adaptation plan development

Section 302—Federal Agency Adaptation Strategic Plans

Within one year of promulgation, each agency with a representative in the National Adaptation Program shall be responsible for preparing a Strategic Plan for adapting to climate change consistent with the guidelines prepared by the ACC (Section 301). At a minimum, these plans shall:

1. Identify agency policies, regulations, programs, and activities that will be affected by climate change
2. Identify and prioritize assets or resources owned or managed by the agency that are vulnerable to climate change

3. Identify opportunities for and barriers to incorporating climate change into agency decision-making, including changes that would be required to existing legislation, policies, regulations, rules or guidelines, or limits to authority

4. Define options for managing identified vulnerable systems and resources, including specific actionable recommendations for agency implementation, performance objectives, timelines, priorities, resource needs (e.g., technology, information, funding, staff capacity, expertise), other federal and nonfederal stakeholders, and barriers to implementation

5. Identify adaptation research and decision-support needs, considering both regional and sector needs

6. Define monitoring and evaluation mechanisms for adaptive actions

7. Identify where the agency provides or could provide climate-related services or products to enable adaptation planning or action by federal and nonfederal entities and how this information will be disseminated to the public

8. Identify areas of interaction for planning and recommended adaptive actions with other federal agencies and with regional, state, local, and tribal entities, and other stakeholders, with particular attention to cross-jurisdiction and cross-sector dependencies

In preparation of the report, each agency shall develop and implement a plan for obtaining, at an early stage in preparing the report, input from public and private sector stakeholders, and each agency shall seek public comment on a draft of the report before issuing a final report. The draft report shall also be reviewed by the ACC.

Agency strategic plans shall be updated every three years.

Section 303—Sector Adaptation Strategic Plans

The ACC co-chairs, in consultation with committee members, SWGs (for items 4–6), and the National Adaptation Program Office, and using input from the federal agency adaptation strategic plans (Section 302), shall:

1. Identify U.S. sectors that require interagency coordination on adaptation

2. Identify federal agencies that should participate in the development of sector adaptation strategic plans

3. Establish SWGs comprised of appropriate members from federal agencies and, with the engagement of nongovernmental stakeholders and experts (see Section 403)

4. Develop and provide guidelines for the content of and timelines for sector adaptation strategic plans; to include, where appropriate for each sector plan, the synthesis and integration of Items 1 through 8 from federal agency adaptation strategic plans (Section 302) and, additionally, the identification of cross-jurisdictional issues pertaining to recommended adaptive actions

5. Develop mechanisms for prioritizing and resolving cross-jurisdictional issues

6. Develop mechanisms for prioritizing, funding, and implementing sector adaptation strategic plan recommendations

In preparing the sector adaptation strategic plans, each SWG shall obtain input to the plan from other relevant public and private stakeholders.

Sector adaptation strategic plans shall be updated periodically at the discretion of the co-chairs of the ACC.

Section 304—National Adaptation Strategic Plan

Every five years, the ACC shall develop a National Adaptation Strategic Plan. This report shall synthesize the National Adaptation Program findings and actions representing adaptation in the United States and shall at a minimum:

1. Recommend new or modifications to current national adaptation goals, objectives, and priorities

2. Identify key accomplishments and barriers to adaptive action by the federal government, and specifically the National Adaptation Program, and mechanisms to address such barriers

3. Describe federal policy changes needed to enable adaptive actions across the federal government, as well as by state and local governments

4. Identify national adaptation information and services, research, and monitoring needs and priorities

Part 4— National Climate Service[10]

Section 401—Establishing a National Climate Service

The Director of the OSTP and the Chair of the CEQ shall establish an interagency working group to create an NCS with participation by all relevant federal agencies. The working group shall integrate the activities of the National Oceanic and Atmospheric Administration (NOAA) and the SWG in developing a coordinated NCS.

Section 402—The Role of NOAA

Within one year, NOAA, in consultation with SWG federal agency leads and the ACC, shall develop a plan to provide relevant climate data, monitoring and analysis, and climate information and predictions for the user communities.

Section 403—Sector Working Groups

Within one year, the co-chairs from CEQ and OSTP shall identify sector-specific working groups and lead agencies to:

1. Identify relevant stakeholders to each SWG
2. Coordinate and conduct user needs assessments
3. Identify, prioritize, and develop sector-specific information on climate change and impacts, decision-support tools, education, and training, based on completed needs assessments
4. Develop information dissemination methods and methods for maintaining and updating user needs annually
5. Provide policy-relevant guidance and support
6. Identify federal policy barriers to users and the SWG, and provide this information to the Adaptation Strategic Planning Initiative
7. Identify adaptation research needs and priorities, and provide this information to the Adaptation Research Program

The following SWGs could be created along with designated lead agencies:

1. Public Health led by Health and Human Services
2. Water Resources co-chaired by EPA and the Department of the Interior
3. Coastal Zone Management led by Department of Commerce (NOAA)
4. Transportation Infrastructure led by the Department of Transportation
5. Agriculture led by the Department of Agriculture
6. Land Management led by the Department of the Interior
7. National Security led by the Department of Defense
8. Other sectors as identified by the ACC co-chairs

Part 5—Adaptation Research Program

Section 501. The USGCRP has responsibility for coordinating national climate research among participating federal agencies. The USGCRP is directed to evaluate and expand its current research agenda to include adaptation research needs in an Adaptation Research Program, based on findings from federal agency adaptation strategic plans (Section 302), sector adaptation strategic plans (Section 303), the National Adaptation Strategic Plan (Section 304), and user needs assessments (Section 402).

Section 502. The Adaptation Coordination Committee shall prepare a bi-annual report to the USGCRP Integration and Coordination Office and the Subcommittee on Global Change Research on research needs identified through the Adaptation Strategic Planning Initiative and the NCS.

Part 6—Regulations Requiring Consideration of Climate Change Adaptation under the National Environmental Policy Act (NEPA)

1. Not later than 90 days after enactment, the Chairman of the CEQ shall convene an interagency task force for developing regulations and implementation tools for incorporating the impacts of climate change into environmental impact statements (EISs) and environmental assessments as required under NEPA.
2. Members of the task force shall include the CEQ and all agencies responsible for preparing 5% or more of EISs prepared in 2008 and any other agency deemed relevant by CEQ or the ACC. NOAA and any other agencies with a role in providing information that could be used in the preparation of an EIS shall also be a participant.
3. Within six months of enactment, the Chair of the CEQ, after consulting with the task force, shall issue proposed regulations requiring that the consequences of major federal actions on climate as well as the impacts of climate variability, extreme events, and climate change on the environmental impacts of major federal actions be incorporated into NEPA implementing regulations.
4. The Chair of CEQ, in cooperation with the task force, within 12 months of enactment, shall issue a guidance document for agencies to use in incorporating climate change considerations into the preparation of their EISs. This guidance document shall include key methodologies and decision tools that could be used by agencies responsible for preparing EISs. This guidance document shall be reviewed and updated periodically by CEQ.
5. Within 12 months of enactment, the Chair of CEQ shall issue final regulation requiring mitigation of greenhouse gas emissions and adaptation to climate change to be fully considered as part of EISs prepared under NEPA.

Endnotes

1. The sea level rise that is realized at different locations can vary from the global average because some coastal areas are subsiding while others are rising. The most dramatic example in the United States is the Mississippi Delta, which has been subsiding. The "relative" rise in sea level over the past 50 years at Grand Isle, Louisiana, was a rate of approximately 3 feet per century (NOAA, 2009b). In contrast, the relative sea level rise at Lewes, Delaware, for the same time period was about 1 foot per century (NOAA, 2009a).

2. "No regrets" adaptations can be justified even if the climate were not changing. Climate change provides further justification for such adaptations. No regrets adaptations typically reduce vulnerabilities to current climate and also reduce vulnerabilities to climate change.

3. The Subcommittee on Global Change Research coordinates the activities of USGCRP. It is a subcommittee of the Committee on Environment and Natural Resources Research of the National Science and Technology Council, which is a cabinet level council co-chaired by the President and the Director of OSTP.

4. The role of SWGs is likely to differ substantially between components of the National Adaptation Program. For example, senior-level policy staff will likely need to be involved in sector-level strategic planning while more robust stakeholder involvement will be necessary for assessing user needs through a NCS. SWGs should maintain the flexibility necessary to carry out all of these tasks.

5. Note that different legislation, including an agency's organic legislation and/or the agency's interpretation of that legislation, may limit coordination. Statutes for one agency may favor certain outcomes or policies, whereas statutes for another agency may favor different outcomes or policies. Many agencies administer more than one law, and these laws themselves sometime contain internal conflicts that must be addressed at a functional level. Such differences in objectives should be described in the sector plans, and the plans should identify appropriate action, including legislative changes if necessary, to resolve such differences.

6. Adaptation research should be both decision-relevant and use-inspired, such as enhancing or developing techniques for producing location-specific climate information or addressing the psychological and socioeconomic factors that affect adaptation. The NCS will assess end-user needs, but demands for climate information or technical resources that are beyond state-of-the-art require a focused research effort to develop the next generation of climate information, data, tools, guidance, or other technical resources.

7. The Subcommittee on Global Change Research is a subcommittee of the Committee on Environment and Natural Resources Research, which is part of the President's National Science and Technology Council. The subcommittee has oversight authority over USGCRP.

8. Given the enormous resources required to conduct a national climate impact assessment, these efforts should be carefully focused to ensure that they provide timely, relevant, and actionable information. Enough time should pass between assessments to ensure that advances in climate models, understanding of climate impacts, and development of adaptation measures will be significant from one assessment to the next.

9. NEPA may also provide an opportunity to address climate change mitigation issues; however, this is outside the scope of this report.

10. This Draft Executive Order is not intended to encompass all of the provisions of an NCS, but simply provide recommended direction to ensure adaptation is adequately represented in the NCS and that all sectors are adequately and effectively integrated into the Service.

References

Adger, W.N., S. Agrawala, M.M.Q. Mirza, C. Conde, K. O'Brien, J. Pulhin, R. Pulwarty, B. Smit, and K. Takahashi. 2007. Assessment of adaptation practices, options, constraints and capacity. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, Cambridge, UK, pp. 717-743.

Alaska Immediate Action Workgroup. 2009. Recommendations to the Governor's Subcabinet on Climate Change. Available: http://www.climatechange.alaska.gov/docs/iaw_finalrpt_12mar09.pdf. Accessed August 31, 2009.

Barsugli, J., C. Anderson, J.B. Smith, and J.M. Vogel. 2009. Options for Improving Climate Modeling to Assist Water Utility Planning for Climate Change. Final Report. Prepared for Water Utility Climate Alliance. September 17.

Brekke, L.D., J.E. Kiang, J.R. Olsen, R.S. Pulwarty, D.A. Raff, D.P. Turnipseed, R.S. Webb, and K.D. White. 2009. *Climate Change and Water Resources Management—A Federal Perspective.* U.S. Geological Survey Circular 1331. ISBN 978–1–4113–2325–4. Available: http://pubs.usgs.gov/circ/1331/. Accessed March 20, 2009.

Burton, I. 1996. The growth of adaptation capacity: Practice and policy. In *Adapting to Climate Change: Assessments and Issues,* J.B. Smith, N. Bhatti, G. Menzhulin, R. Benioff, M. Budyko, M. Campos, B. Jallow, and F. Rijsberman (eds.). Springer, New York.

CCAP. 2009. Ask the Climate Question: Adapting to Climate Change Impacts in Urban Regions. A Report by the Center for Clean Air Policy, Urban Leaders Adaptation Initiative. Available: http://www.ccap.org/docs/resources/674/Urban_Climate_Adaptation-FINAL_CCAP 6-9-09.pdf. Accessed August 31, 2009.

CERP. 2009. The Journey to Restore America's Everglades. Comprehensive Everglades Restoration Plan. Available: http://www.evergladesplan.org/index.aspx. Accessed August 25, 2009.

City of New York. 2007a. Mayor Bloomberg Delivers PlaNYC: A Greener, Greater New York. April 22. Available: http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pageID = mayor_press_release&catID = 1194&doc_name = http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2007a%2Fpr120-07.html&cc = unused1978&rc = 1194&ndi = 1. Accessed August 3, 2009.

City of New York. 2007b. New York Mayor Unveils Multi-Billion Dollar Green City Plan. April 23. Available: http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pageID = mayor_press_release&catID = 1194&doc_name = http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2007a%2Fpr119-07.html&cc = unused1978&rc = 1194&ndi = 1. Accessed August 3, 2009.

Climate Works Foundation, Global Environment Facility, European Commission, McKinsey & Company, The Rockefeller Foundation, Standard Chartered Bank, and Swiss Re. 2009. *Shaping Climate-Resilient Development. A Framework for Decision-making.* A Report of the Economics of Climate Adaptation Working Group. Available: http://www.swissre.com/resources/387fd3804f928069929e92b3151d9332-ECA_Shaping_Climate_Resilent_Development.pdf. Accessed October 27, 2009.

Commonwealth of Australia. 2009. Support for Climate Change Adaptation Research. Last updated March 4, 2009. Available: http://www.climatechange.gov.au/impacts/research.html. Accessed August 18, 2009.

Cruce, T.L. 2009. Adaptation Planning: What U.S. States and Localities are Doing. Pew Center on Global Climate Change. Available: http://www.pewclimate.org/working-papers/adaptation. Accessed August 31, 2009.

CSO. 2008. The Role of Coastal Zone Management Programs in Adaptation to Climate Change. Second Annual Report of the Coastal States Organization's Climate Change Work Group. Coastal States Organization, Washington, DC. September.

Federal Real Property Council. 2008. FY 2007 Federal Real Property Report. An Overview of the U.S. Federal Government's Real Property Assets. May. GSA Office of Government-wide Policy, Washington, DC.

GAO. 2009. Climate Change Adaptation. Strategic Federal Planning Could Help Government Officials Make More Informed Decisions. Report to the Chairman, Select Committee on Energy Independence and Global Warming, House of Representatives. GAO-10-113. United States Government Accountability Office. October.

Gorte, R.W. and P. Baldwin. 1999. RL30126: Federal Land Ownership: Constitutional Authority; the History of Acquisition, Disposal, and Retention; and Current Acquisition and Disposal Authorities. April 7. Available: http://www.ncseonline.org/NLE/CRS/. Accessed August 2, 2009.

Kafalenos, R.S., K.J. Leonard, D.M. Beagan, V.R. Burkett, B.D. Keim, A. Meyers, D.T. Hunt, R.C. Hyman, M.K. Maynard, B. Fritsche, R.H. Henk, E.J. Seymour, L.E. Olson, J.R. Potter, and M.J. Savonis. 2008. What are the implications of climate change and variability for Gulf coast transportation? In *Impacts of Climate Change and Variability on Transportation Systems and Infrastructure: Gulf Coast Study, Phase I*. M.J. Savonis, V.R. Burkett, and J.R. Potter (eds.). Synthesis and Assessment Product 4.7. U.S. Department of Transportation, Washington, DC, pp. 4–1 to 4F–27.

Karl, T.R., J.M. Melillo, and T.C. Peterson. 2009. *Global Climate Change Impacts in the United States*. Cambridge University Press, New York.

Kwok, R. 2009. US Considers a National Climate Service. Programme Would Merge Climate-change Data from Multiple Agencies. Available: http://www.nature.com/news/2009/090219/full/news.2009.108.html. Accessed July 27, 2009.

Lazo, J.K., M. Lawson, P.H. Larsen, and D.M. Waldman. 2009. United States Economic Sensitivity to Weather Variability. Working Paper. National Center for Atmospheric Research – Societal Impacts Program, Boulder, CO.

Lowrey, J.L., A.J. Ray, and R.S. Webb. 2009. Factors Influencing the Use of Climate Information by Colorado Municipal Water Managers. University of Colorado, Boulder, CO.

Lubchenco, J. 2009. Written Testimony of Dr. Jane Lubchenco under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator. National Oceanic and Atmospheric Administration, U.S. Department of Commerce Hearing on *"Expanding Climate Services at the National Oceanic and Atmospheric Administration (NOAA): Developing the National Climate Service"* before the Subcommittee on Energy and Environment Committee on Science and Technology. U.S. House of Representatives. May 5.

Means III, E.G., M.C. Laugier, and J.A. Daw. 2009. Evaluating Decision Support Planning Methods for Incorporating Climate Change Uncertainties into Water Planning. A Peer-Reviewed White Paper. Final Draft. Prepared by Malcolm Pirnie, Inc., Irvine, CA, for Water Utility Climate Alliance. May 5.

Miller, K. and D. Yates. 2006. *Climate Change and Water Resources: A Primer for Municipal Water Providers.* Jointly sponsored by Awwa Research Foundation, Denver, CO and University Corporation for Atmospheric Research, Boulder, CO. Awwa Research Foundation, American Water Works Association, and IWA Publishing.

Miles, E.L., A.K. Snover, L.C. Whitely Binder, E.S. Sarachik, P.W. Mote, and N. Mantua. 2006. 'An approach to designing a national climate service.' Proceedings of the National Academies of Science. Vol 103 No. 52. December 26, 2006: 19616–19623.

National Assessment Synthesis Team. 2001. *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change.* Report for the US Global Change Research Program. Cambridge University Press, Cambridge UK.

NOAA. 2009a. Mean Sea Level Trend: 8557380 Lewes, Delaware. Available: http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid = 8557380. Accessed October 20, 2009.

NOAA. 2009b. Mean Sea Level Trend: 8761724 Grand Isle, Louisiana. Available: http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid = 8761724. Accessed October 20, 2009.

NOAA. 2009c. Regional Integrated Sciences and Assessments. National Oceanic and Atmospheric Administration, Climate Program Office. Available: http://www.climate.noaa.gov/cpo_pa/risa/. Accessed August 31, 2009.

NRC. 2009. *Informing Decision in a Changing Climate.* National Academies Press, Washington, D.C. Available: http://www.nap.edu/catalog.php?record_id=12626.

Parry, M.L., O. Canziani, J.P. Palutikof, C. Hanson, and P. van der Linden (eds.). 2007. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, New York.

Pfeffer, W.T., J.T. Harper, and S. O'Neel. 2008. Kinematic constraints on glacier contributions to 21st-century sea-level rise. *Science* 321:1340-1343.

Platt, R.H. 1999. *Disasters and Democracy: The Politics of Extreme Natural Events.* Island Press, Washington, DC.

Pyke, C. and K. Batten. 2008. *Full Disclosure— An Executive Order to Require Consideration of Global Warming Under the National Environmental Policy Act.* Center for American Progress, Washington, DC. May.

Rajagopalan, B., K. Nowak, J. Prarie, M. Hoerling, B. Harding, J. Barsugli, A. Ray, and B. Udall. 2009. Water supply risk on the Colorado River: Can management mitigate? *Water Resources Research* 45, W08201, doi:10.1029/2008WR007652.

SAB. 2009. Options for Developing a National Climate Service. A Report from the NOAA Science Advisory Board Developed by the Climate Working Group through the Climate Services Coordinating Committee with option assessments provided by four Tiger Teams. National Oceanic and Atmospheric Administration Science Advisory Board. June 5.

Seattle Public Utilities. 2009. Application of Dynamically Downscaled Climate Model Data to Analysis of Hydrologic Change in Seattle's Urban Creeks—The Thornton Creek Case Study. Northwest Hydraulic Consultants, Seattle, WA. March.

Secretary of the Interior. 2007. Record of Decision. Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead. December.

Snover, A.K., L. Whitely Binder, J. Lopez, E. Willmott, J. Kay, D. Howell, and J. Simmonds. 2007. *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments.* In association with and published by ICLEI – Local Governments for Sustainability, Oakland, CA.

Solomon, S., G. Plattner, R. Knutti, and P. Friedlingstein. 2009. Irreversible Climate Change due to Carbon Dioxide Emissions. Proceedings of the National Academy of Sciences. January 28.

Solomon, S., D. Qin, M. Manning, R.B. Alley, T. Berntsen, N.L. Bindoff, Z. Chen, A. Chidthaisong, J.M. Gregory, G.C. Hegerl, M. Heimann, B. Hewitson, B.J. Hoskins, F. Joos, J. Jouzel, V. Kattsov, U. Lohmann, T. Matsuno, M. Molina, N. Nicholls, J. Overpeck, G. Raga, V. Ramaswamy, J. Ren, M. Rusticucci, R. Somerville, T.F. Stocker, P. Whetton, R.A. Wood, and D. Wratt. 2007. Technical summary. In *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* S. Solomon, D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.). Cambridge University Press, Cambridge, UK and New York.

State of Alaska. 2008. Final Commission Report: Alaska Climate Impact Assessment Commission. Alaska State Legislature. Representative Ralph Samuels, Chairman, Representative Reggie Joule, Vice-Chairman, Juneau, AK. March 17. Available: http://www.housemajority.org/coms/cli/cli_final report_20080301.pdf. Accessed June 12, 2009.

State of California. 2008. Gov. Schwarzenegger Issues Executive Order Directing State Agencies to Plan for Sea Level Rise and Climate Impacts. Press Release. November 14. Available: http://gov.ca.gov/press-release/11035/. Assessed August 3, 2009.

State of California. 2009. 2009 California Climate Change Adaptation Strategy Discussion Draft. CA Natural Resources Agency. August. Available: http://www.climatechange.ca.gov/adaptation/index.html. Accessed August 31, 2009.

State of Florida. 2008. *Florida's and Climate Change Action Plan.* Governor's Action Team of Energy and Climate Change. Available: http://www.flclimatechange.us/ewebeditpro/items/O12F20128.PDF. Accessed August 31, 2009.

The White House. 2009. Executive Order. Federal Leadership in Environmental, Energy, and Economic Performance. October 5. Available: http://www.whitehouse.gov/assets/documents/2009fedleader_eo_rel.pdf. Accessed October 27, 2009.

UKCIP. 2009. About UKCIP. UK Climate Impacts Programme. Available: http://www.ukcip.org.uk/index.php?option = com_content&task = view&id = 18. Accessed July 27, 2009.

U.S. DOI. Undated(a). An Analysis of Climate Change Impacts and Options Relevant to Legal and Policy Issues at the Department of the Interior. Department of the Interior Task Force on Climate Change. Report of the Subcommittee on Law and Policy. U.S. Department of the Interior.

U.S. DOI. Undated(b). An Analysis of Climate Change Impacts and Options Relevant to the Department of the Interior's Managed Lands and Waters. Department of the Interior Task Force on Climate Change. Report of the Subcommittee on Land and Water Management. U.S. Department of the Interior.

U.S. DOI. Undated(c). An Integrated DOI Science Plan for Addressing the Effects of Climate Change on Natural Systems. Department of the Interior Task Force on Climate Change. Report of the Subcommittee on Science. U.S. Department of the Interior.

U.S. DOI. 2008. Secretary Kempthorne Receives Interior's Climate Change Task Force Report, Directs Report to Be Posted Online. U.S. Department of the Interior news release. December 3. Available: http://www.doi.gov/news/08_News_Releases/120308a.html. Accessed August 31, 2009.

U.S. DOI. 2009. Addressing the Impacts of Climate Change on America's Water, Land and Other Natural and Cultural Resources. U.S. Department of the Interior, Secretary of the Interior. September 14.

U.S. EPA. 2008. *National Water Program Strategy Response to Climate Change.* EPA 800-R-08-001. U.S. Environmental Protection Agency, Office of Water, Washington, DC.

USFWS. 2008a. Internal Discussion Report. 5-Year Action Plan for Implementing the Strategic Plan for Responding to Accelerating Climate Change in the 21st Century. U.S. Fish and Wildlife Service. December 12.

USFWS. 2008b. Internal Discussion Report. Rising to the Urgent Challenges of a Changing Climate. Strategic Plan for Responding to Accelerating Climate Change in the 21st Century. U.S. Fish and Wildlife Service. December 12.

USFWS. 2009. *Rising to the Challenge: Strategic Plan for Responding to Accelerating Climate Change.* U.S. Fish and Wildlife Service, Washington DC. September 21.

USGCRIO. 1990. U.S. Global Change Research Act of 1990. Public Law 101-606(11/16/90) 104 Stat. 3096-3104. U.S. Global Change Research Information Office, Washington, DC. Available: http://www.gcrio.org/gcact1990.html. Accessed August 31, 2009.

Yohe, G.W., R.D. Lasco, Q.K. Ahmad, N.W. Arnell, S.J. Cohen, C. Hope, A.C. Janetos, and R.T. Perez. 2007. Perspectives on climate change and sustainability. In *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change,* M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden, and C.E. Hanson (eds.). Cambridge University Press, New York.

This report provides recommendations on the role of the federal government in leading the effort to reduce vulnerability to unavoidable climate change in the United States. The Pew Center on Global Climate Change was established by the Pew Charitable Trusts to bring a new cooperative approach and critical scientific, economic, and technological expertise to the global climate change debate. We inform this debate through wide-ranging analyses that add new facts and perspectives in four areas: policy (domestic and international), economics, environment, and solutions.

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