

*An edited version of this paper appeared in  
8 Sustainable Development Law & Policy 61, Fall 2007*

# Preparing for the Day After Tomorrow: Frameworks for Climate Change Adaptation

*Ira R. Feldman and Joshua H. Kahan*

Ira R. Feldman is president and senior counsel of Greentrack Strategies, an independent think tank and consultancy focusing on strategic environmental management and sustainability policy issues. Mr. Feldman is past chair of the ABA/SEER Sustainable Development, Ecosystems and Climate Change Committee and is adjunct professor at Washington College of Law where he teaches environmental regulatory innovation. Joshua Kahan is an environmental consultant and researcher with an expertise in ecosystem services. Mr. Kahan is a recent graduate of the Masters in Environmental Studies program at the University of Pennsylvania.

## INTRODUCTION

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To date, the international community has dealt with climate change, the quintessential sustainability issue of our time, principally by promoting the mitigation of greenhouse gases (“GHGs”). The rationale for such mitigation efforts, simply stated, is that if GHG concentrations are stabilized or reduced, ultimately the severity of climate change can be alleviated. While there is no doubt that mitigation activities are necessary to the long-term well-being and stability of the global environment, the level of attention paid to mitigation-oriented science, technology, methodology, and policy serves to obscure the pressing need to seriously address the inevitable question of adaptation to climate change.

The overwhelming focus on GHG mitigation overshadows the adaptation half of the climate change equation. The reality is that, even if the most optimistic mitigation plans are adopted and all GHGs were stabilized immediately, residual GHG concentrations within the atmosphere will continue to create adverse consequences well into the future. The challenge is not successfully “managing a transition from one equilibrium to another,” as mitigation does, “but rather, adapting to a far more uncertain climatic future.”<sup>ii</sup> At best, mitigation of anthropogenic sources of GHGs can attempt to minimize long-term climate change impacts, but cannot halt or avoid all impacts. Therefore, adapting to the adverse impacts of climate change is a reality, and in some instances the need is immediate.

The Intergovernmental Panel on Climate Change (“IPCC”) defines climate change adaptation as “an adjustment in ecological, social, or economic systems in response to actual or expected climatic stimuli and their effects or impacts.”<sup>iii</sup> Adaptive measures are needed because adverse consequences are expected to occur globally on unprecedented levels. The IPCC states with high confidence<sup>iii</sup> that many natural systems are being affected by regional climate changes, particularly temperature increases. Global data assessments show that it is likely<sup>iv</sup> that anthropogenic warming impacts many physical and biological systems and other effects of regional climate change on natural and human environments are emerging.<sup>v</sup> The current knowledge of climate change associated impacts, has led the global community to the conclusion that “adaptation will be necessary to address impacts from the warming which is already unavoidable due to past emissions.”<sup>vi</sup>

Because climate change is an immediate threat it is imperative to develop and implement strategies for climate change adaptation. This Article explores the concepts behind climate change adaptation, discusses accomplishments to date and addresses the next step of how to implement adaptation strategies in an effective and sustainable manner. This Article outlines the international commitment to address climate change adaptation, introduces the concepts central to an adaptation framework, and details recent domestic developments in adaptation policy and planning.

## CLIMATE CHANGE ADAPTATION IN IPCC AND KYOTO PROCESSES

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### *UNFCCC/ Kyoto Processes*

Although the Kyoto Protocol is largely directed towards mitigation, adaptation is recognized as part of the Kyoto framework. The United Nations Framework Convention on Climate Change (“UNFCCC”)<sup>vii</sup> makes direct reference to adaptation measures in a number of key Articles.<sup>viii</sup> In all, ten provisions discuss climate change adaptation, “with particular attention having been given to issues relating to Article 4.8<sup>ix</sup> and Article 4.9<sup>x</sup>, and to scientific and technical aspects under the relevant Subsidiary Body for Scientific and Technological Advice agenda item on adaptation.”<sup>xi</sup>

The Kyoto process recognizes that adaptation is integral through the Adaptation Fund. While this fund is not currently operational, it “will fund concrete adaptation measures, to be financed from a share of proceeds from the clean development mechanism and other voluntary sources.”<sup>xii</sup> The Adaptation Fund will support and promote measures such as vulnerability and adaptation assessment, capacity building, technical training, and technology transfer, pilot programs, and strengthening and developing early warning systems for extreme weather events.<sup>xiii</sup>

At the UNFCCC Third Conference of the Parties held in Kyoto, Japan, it was requested that the Convention Secretariat “continue its work on the synthesis and dissemination of information on environmentally sound technologies and know-how conducive to mitigating, and adapting to, climate change.”<sup>xiv</sup> In response, the UNFCCC Secretariat in 1999 released a report organizing the technical and theoretical knowledge on adaptation based on the sector model approach to vulnerability and discussing the options and tools available to evaluate and implement adaptation schemes.<sup>xv</sup> In 2005, the UNFCCC released the revised final draft report retaining the primary goal of conveying available adaptation tools and methods without the use of a sector-based approach for data organization.<sup>xvi</sup> The data was reorganized in a more efficient manner without recommending any specific tools or methods.

### *IPCC and Adaptation*

The IPCC also is active in basic adaptation research and discussions. The IPCC published a series of reports that includes discussions on adaptation.<sup>xvii</sup> The most recent IPCC report, *Climate Change 2007: Impacts, Adaptation, and Vulnerability* re-emphasizes that climate change and adverse impacts are likely, and discusses the urgency and need to enhance the consideration of adaptive measures. The report notes that adaptation will be necessary to address impacts resulting from warming unavoidable from banked GHG

concentrations and that a portfolio of adaptation and mitigation measures can diminish the risks associated with climate change.<sup>xviii</sup> The IPCC details a wide array of adaptation options (see Table 1), however, the IPCC noted that more adaptation is necessary to reduce vulnerability of future climate change.

**Table 1**  
**Potential adaptation responses and examples<sup>xix</sup>**

Utilizing known technologies	i.e. Sea defenses
Behavioral modifications	i.e. Altered food and recreational choices
Managerial modifications	i.e. Altered farm practices
Policy development	i.e. Planning regulations

## BASIC ADAPTATION CONCEPTS: VULNERABILITY AND SUSTAINABILITY

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### *Vulnerability Analysis*

Vulnerability is a central concept for climate change adaptation policy and planning, and can be seen as the connecting thread that links all the adaptation modalities. Climate change vulnerability can be defined as “the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and adaptive capacity.”<sup>xx</sup> Vulnerability is multi-disciplinary in nature, because social, economic, and environmental systems can all be vulnerable to climate change.

Vulnerability is associated both with the state of a system prior to a hazardous event, and the system’s ability to effectively handle the hazardous event.<sup>xxi</sup> Vulnerability analysis is defined in terms of impact, with a focus on physical hazard, exposure, and a system’s sensitivity to hazard.<sup>xxii</sup> Climate change vulnerability is distinguished through hazard exposure, represented in biophysical vulnerability, and coping with a hazard, represented in social vulnerability.<sup>xxiii</sup> Climate change vulnerability occurs at the intersection of social and biophysical vulnerability, where one is a function of the other.

Although vulnerability is site-specific, there are certain characteristics that can generally influence vulnerability, regardless of geographical and socio-political contexts. Such characteristics are called “generic determinants of vulnerability” and are primarily developmental focused, including: poverty, health status, economic inequality, and elements of governance, technology, education, infrastructure, and dependence on agriculture.<sup>xxiv</sup> Generic determinants of vulnerability are associated with adaptive capacity, which refers to “the ability or capacity of a system to modify or change its characteristics or behavior so as to cope better with existing or anticipated external stresses.”<sup>xxv</sup> Adaptive capacity is a determining factor of vulnerability because, given the generic determinants of vulnerability in addition to site-specific vulnerabilities, adaptive capacity is represented in terms of a system’s ability and/or capacity to potentially adapt.

Generic determinants of vulnerability can be found globally in both developed and developing nations, however, due to developing nations’ circumstances of transition, all developing nations possess some form of generic vulnerabilities.<sup>xxvi</sup> The acknowledgment that developing nations are substantially more vulnerable raises issues of equity and fairness on a number of levels.<sup>xxvii</sup> While issues and questions continue to accumulate and answers are slow to surface, due to a recent sense of urgency, interest, and concern, the relationship of vulnerability, adaptation, and developing nations generates considerable attention. The global community has begun to recognize how vulnerability and adaptation are closely linked, and vulnerability is becoming the focus of research, analysis, and discussion for future adaptation considerations.

### *Aligning Adaptation and Sustainability*

Due to the varying scope and scale at which adaptive measures will be required, effective policy implementation presents the challenge of “linking climate change policy to policy normally seen as outside the scope of climate change, including livelihood enhancement, poverty alleviation, education, and improved institutional arrangements.”<sup>xxviii</sup> Fortunately, integrating the goals of sustainability and climate change adaptation presents an effective avenue of integrating diverse policy goals. Adaptation and sustainability are complementary and “can yield synergistic efficiencies and benefits that advance the goals of both agendas . . . for a society that is made more climate resilient through proactive adaptation to climate variations, extremes and changes is one in which development achievements and prospects are less threatened by climate hazards and therefore more sustainable.”<sup>xxix</sup> For the integration to occur, adaptation must be included and considered in the process of “policy formulation, planning, program management, project design, and project implementation.”<sup>xxx</sup> Aligning adaptation with sustainability is a policy option that could be used in both developed and developing nations to create win-win scenarios that foster sustainable development and strengthen climate resilience.

Policy decision-makers at varying scales face the challenge of pursuing and achieving multiple goals with limited resources requiring tradeoffs to achieve priority goals. However, by integrating sustainable development and adaptation, a tradeoff does not have to occur, for development will achieve its policy goals while reinforcing the adaptation

infrastructure. More so, several goals of sustainable development are complementary to adaptation, including:

development that targets highly vulnerable populations, diversifies economic activities, provides for livelihoods that are less climate sensitive, improves natural resource management, directs development away from highly hazardous locations towards less hazardous ones, and invests in expanding knowledge and creating technology that is relevant to reducing climate risks.<sup>xxxix</sup>

The integrated process can foster a top-down and a bottom-up strategy. A top-down strategy implies action taken at larger scales, such as national and regional levels, to foster sustainable development and adaptation at the smaller scales, such as the community and local levels. For instance, national, regional, and state governments can “create incentives, enforce regulations, assist with capital financing and implement large projects that go beyond the means of the local authorities to create a climate proof society.”<sup>xxxix</sup> National, regional, and state level support would create a number of beneficial outcomes, such as fostering development away from at-risk locations, constructing homes that can withstand climate variabilities, provide insurance, encourage and implement better land use, and construct infrastructure to help adapt to climate variability.<sup>xxxix</sup>

### *Developments in Adaptation*

Because GHG mitigation has been the focal point of most climate change research and discussions, early adaptation research was geared towards informing mitigation policy.<sup>xxxix</sup> Such considerations are viewed as first generation adaptation assessments and attempted “to understand how climate might change and what would be the likely impacts based on models and climate scenario methods.”<sup>xxxix</sup> In contrast, second generation assessments examine the relationship of vulnerability, adaptive capacity, and climate change to identify where and what adaptive measures are needed, and ultimately integrate such considerations into associated decision making processes and policy goals.

The first generation assessments typically followed a seven step approach: (1) define the problem; (2) select the method of assessments most appropriate to the problems; (3) test methods/conduct sensitivity analysis; (4) select and apply climate change scenarios; (5) assess biophysical and socioeconomic impacts; (6) assess autonomous adjustments; and (7) evaluate adaptation strategies.<sup>xxxix</sup> This approach proved largely ineffective because it analyzed climate change from a big picture perspective. However adaptation is site specific and each location has different needs and situations. First generation assessments assume adaptation can be implemented with a broad stroke and paid little attention to implementation challenges, including social, behavioral, or cultural obstacles.<sup>xxxix</sup> Moreover, stakeholders were typically not involved and a top-down approach was used. Since adaptation needs are site specific, local knowledge and customs are invaluable tools in developing effective and sustainable adaptation projects.<sup>xxxix</sup> The shortfalls of first generation adaptation assessments prompted the global community to re-evaluate the adaptation approach.

While the second generation adaptation assessments are works in progress, certain parameters can already be discerned. New assessment methods present a restructured approach that is solely focused on adaptation, places vulnerability and adaptation in the center of the assessment, engages stakeholders in the process, and attempts to strengthen country-level information and data to promote informed policy decisions. Such assessments attempt to determine the relationship of vulnerability and climate change by posing certain research questions: “how and why vulnerabilities differ for different populations within a region, and how vulnerabilities may change over time as a result of climate changes and other factors.”<sup>xxxix</sup>

## CLIMATE CHANGE ADAPTATION INITIATIVES AT THE INTERNATIONAL LEVEL

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### *Adaptation in the USCSP Program*

Prior to the Earth Summit in Rio de Janeiro in 1992, the United States announced the formation of the U.S. Country Studies Program (“USCSP”). This program, no longer in existence, was coordinated with the Global Environment Facility (“GEF”), IPCC, the Subsidiary Bodies to the FCCC, and other international organizations, to expand upon initial IPCC reports published in the early 1990’s.<sup>xi</sup> The goal of the program was to assist developing countries and economies in transition in assessing their climate change sensitive sector vulnerability and explore opportunities for adaptation.<sup>xii</sup> Participating nations were required to develop and list adaptation needs and vulnerabilities, take inventories of greenhouse gas emissions, formulate climate change action plans, and assess technological capabilities. The USCSP was intended to support the goals of the UNFCCC by compiling general baseline data to initiate discussion and potential action within the international community.

The USCSPs primary contribution was capacity building in developing countries to assess potential climate impacts.<sup>xiii</sup> However, there is a need for caution in drawing sweeping conclusions about the vulnerability of developing and transition countries to climate change.<sup>xliii</sup> Consistent with first generation projects, the USCSP studies tended to focus on identifying system sensitivities and adaptability was assessed mainly for coastal resources.<sup>xliiv</sup> However, it is difficult to draw firm conclusions without also thoroughly considering underlying socioeconomic changes, integrated impacts, and adaptability in all sensitive sectors.<sup>xliv</sup>

## *National Adaptation Programs of Action*

The guidelines for National Adaptation Programs of Action (“NAPA”) strategies were set forth by the UNFCCC at the seventh Conference of the Parties held in Marrakech, Morocco in 2001. The principal goal of the program is to assist the least developed countries (“LDCs”) in identifying activities to respond to urgent climate change adaptation needs and fund them through the LDC Fund, in the order of priority while considering urgency and cost-effectiveness. The program is not a structured framework of assessment or implementation. Instead, the NAPA process creates a document identifies priority adaptation actions.<sup>xlvi</sup>

For instance, Tuvalu, a small island nation confronting rising sea levels, submitted a NAPA in May 2007 identifying key adaptation areas. These areas include *inter alia*, coastal zones, which are vulnerable to sea level rise and sea temperature change; soils, which are vulnerable to saltwater intrusion and salinization; water resources, which are impacted by sea level rise and salinization; agriculture, which is impacted by sea level rise and intrusion; and public health.<sup>xlvii</sup> The report identifies seven priority projects, with desired outcomes and activities within each key adaptation area. One project will seek to increase the resilience of coastal areas and settlement to climate change through activities such as training local Kaupule people and government personnel on constructing coastal defenses such as channel breakers, planting a green belt, and increasing public awareness.<sup>xlviii</sup> Another project in Tuvalu would introduce a salt-tolerant pulaka species, thus increasing the production of a native locally-grown nutritious root that has been damaged by salinity intrusion into local soil.<sup>xlix</sup>

Generally, the NAPA strategies prepared to date utilize a bottom-up approach relying on grassroots, local knowledge to lay the groundwork for site-specific adaptation priorities and solutions.<sup>1</sup> Such a process is fostered through community-level support, recognizing that grassroots communities are the main stakeholders. A majority of the data used and analyzed is extrapolated from established local social and environmental systems to ultimately identify gaps in adaptive capacity. This approach represents a change in methodology utilizing local knowledge, moving away from a reliance on scenario based modeling<sup>ii</sup> to assess future vulnerability and long term policy at the state level. For instance, the Sudanese NAPA utilized stakeholder consultations to reveal a number of actions and decisions that should be undertaken by relevant authorities, along with some policy reform suggestions.<sup>iii</sup>

The overall effectiveness of NAPAs has yet to be determined, however a new report discusses the lessons learned in preparing NAPAs in Eastern and Southern Africa and concludes that there is a need for increased funding sources.<sup>liii</sup> The same study suggested that the momentum generated from the NAPA process must be used to make the transition to implementing substantive adaptation projects.<sup>liv</sup>



## *Assessments of Impacts and Adaptations to Climate Change*

The Assessments of Impacts and Adaptations to Climate Change (“AIACC”) program was developed in collaboration with the IPCC as an assessment tool designed to build an information base for developing countries adapting to climate change. The program had three specific mandates: (1) advancing scientific understanding of climate change impacts, adaptations and vulnerabilities in developing country regions; (2) building and enhancing scientific and technical capacity in developing countries; and (3) generating and communicating information useful for adaptation planning and action.<sup>lv</sup>

The AIACC approach was largely research driven and produced numerous country and regional reports. AIACC took the stakeholder engagement process a step further by encouraging scientists, academics, and students within the host countries to participate in, and continue, the research and conclusions generated by the country reports. In total, 235 developing country scientists and more than 60 graduate and undergraduate students participated in the studies.<sup>lvi</sup>

## *UNDPs Adaptation Policy Framework*

The Adaptation Policy Framework (“APF”) is intended to integrate climate change adaptation into developing countries policies. The United Nations Development Programme (“UNDP”) and the Global Environment Facility (“GEF”) developed the APF with support from the Swiss, Canadian and Dutch governments.

APF is a structured approach to creating strategies, policies, and measures for climate change adaptation.<sup>lvii</sup> The APF framework is considered a roadmap to assess, plan, and implement climate change adaptation supporting sustainable development.<sup>lviii</sup> This framework is consistent with other second generation projects and assessments, in that APF places adaptation in the center of the framework, strengthens local knowledge, and promotes a local, bottom-up information gathering and use. Importantly, APF focuses on practice rather than theory to more effectively inform the policy making process. This framework makes use of the vulnerability information that countries have to initiate a shift in the way risk, vulnerability and climate change are viewed. By utilizing synergies and intersecting themes, the APF approach can ultimately lead to a more informed policy-making process.<sup>lix</sup>

## *Linking Climate Adaptation Project*

The Linking Climate Adaptation (“LCA”) project was intended to “ensure that poor people benefit from adaptation processes rather than bearing burdens by, for example, having the risks caused by climate change shift on their direction.”<sup>lix</sup> The research focused on policy and institutional frameworks that could help support community-led adaptation, in addition to laying out the long-term research agenda and questions for community-led adaptation. The research drew upon a variety of sources including Fourth Assessment of the IPCC and the UNFCCC Conference of Parties meetings and ‘side events’, in addition to the

views of the stakeholders from various sectors. Thus far, the project has resulted in “the establishment of the LCA Network which aims to link geographically dispersed communities undertaking adaptation at the local level with each other as well as with those engaged in formal scientific and policy responses to climate change .”<sup>lxi</sup>

The project has generated useful research questions, including: (1) Who is vulnerable and how do sources of vulnerability change over time in response to multiple stressors? (2) What are the costs and benefits of adaptation to climate change?; and (3) How can climate change adaptation be integrated into development/disaster risk reduction at multiple levels of governance?<sup>lxii</sup> Nonetheless, the LCA laments the lack of a “coherent body of policy-relevant knowledge about the changing dimensions and sources of vulnerability and the effectiveness of systemic approaches to vulnerability reduction.”<sup>lxiii</sup>

### *United Kingdom Climate Impacts Programme*

The United Kingdom Climate Impacts Program (“UKCIP”) was established in 1997 and published the report titled *Climate adaptation: Risk, uncertainty and decision-making*<sup>lxiv</sup> in conjunction with the UK Climate Impacts Program, Department for Environment Food and Rural Affairs, and the Environment Agency. The report focuses on guiding, managing, and improving the decision-makers ability to judge associated climate change risks, when compared to other risks, to make informed adaptive choices. However, the UKCIP differs from previously discussed assessment tools in that it is not solely intended for developing countries. It is a framework that can be utilized by any governing body facing a myriad of choices and uncertainty, regardless of scale or focus.

## CLIMATE CHANGE ADAPTATION ACTION IN THE UNITED STATES

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### *Adaptation at the State Level*

Until recently GHG mitigation has dominated climate change discussions and planning considerations at the state level in the United States mirroring national and international developments. However, several U.S. state governments are expressing an awareness of adaptation are in the early phases of identifying vulnerabilities. Specifically, states are creating adaptation commissions or committees with the intent to complement mitigation efforts and integrating adaptation into state climate action plans, which largely address the reducing and eliminating GHG emissions.<sup>lxv</sup> Presently, thirty five states have or are in the process of creating climate action plans and fourteen additional plans are anticipated in late- 2007 or 2008.<sup>lxvi</sup> Of those thirty five states, a number incorporate

adaptation considerations into the scope of their climate action plan including Alaska, Arkansas, Arizona, California, Colorado, Hawaii, Illinois, Maryland, Minnesota, North Carolina, New Hampshire, Oregon, Vermont, and Washington. Only a handful of states have developed plans, commissions, and/or reports to specifically address adaptation considerations, including Alaska, Arizona, California, Maryland, Oregon, and Washington.<sup>lxvii</sup>

### *U.S. Local Initiatives*

At the U.S. local level, climate change adaptation activities have received a boost from recent initiatives by International Council on Local Environmental Initiatives -Local Governments for Sustainability (“ICLEI”). In 2005, ICLEI initiated the adaptation-focused Climate Resilient Communities Program, with funding from the National Oceanic and Atmospheric Administration (“NOAA”), to assist local governments throughout the United States in identifying and assessing vulnerabilities, while improving their resiliency to associated climate change impacts. Early partners in this program included localities such as diverse as Keene, New Hampshire, Fort Collins, Colorado, Anchorage, Alaska, and Miami-Dade County, Florida..

In 2007, ICLEI in conjunction with King County, Washington, published *Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments*, a guidebook offering a detailed description of the methods and concepts needed to assist localities in implementing, updating, and evaluating climate change preparedness measures.<sup>lxviii</sup> The guidebook offers a useful five- part checklist for governments to better prepare for climate change. The checklist is divided into milestones involving: (1) conducting a climate resiliency study and securing political and institutional support to prepare for climate change and building a climate preparedness team; (2) identifying and prioritizing planning areas for action through conducting and interpreting a climate resiliency study, climate change vulnerability assessment, and climate change risk assessment; (3) setting preparedness goals and plan, establishing a vision and guiding principles for a climate resilient community, and developing, selecting and prioritizing preparedness actions; (4) implementing the preparedness plan, and ensuring the right implementation tools; and (5) measuring progress and updating the plan.<sup>lxix</sup>

Regional adaptation activities — with concomitant transboundary legal, regulatory, and economic implications — will likely grow in importance since ecosystems rather than political boundaries will define the scope of such initiatives. Early evidence of this regional orientation is emerging. For instance, a conference entitled *Climate Change in the Great Lakes Region: Decision Making Under Uncertainty* convened by Michigan State University in March 2007 to explore the relationship of climate change, the Great Lakes region, decision making under uncertainty, and adaptation. The conference recognized that dealing with climate change presents complex challenges and instills a sense of uncertainty when dealing with the various effects of climate change on vital elements of ecosystems, infrastructure and economy in the Great Lakes region. In response, Michigan State’s Environmental Science and Policy Program and the National Science Foundation (“NSF”)

will initiate “a process that will help identify the kinds of research that needs to be done and the best ways to provide the results so they are as useful as possible to decision makers.”<sup>lxx</sup>

## U.S. FEDERAL GOVERNMENT ADAPTATION ACTION

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While the states have led the way in climate change adaptation considerations, adaptation has begun to appear on the U.S. federal government’s radar in a substantive manner. Federal-level discussions and considerations are preliminary, however collectively they do represent a much needed first step in implementing adaptation on the national scale. For instance, in May 2007, the House Appropriations Subcommittee on Interior, Environment, and Related Agencies approved increasing EPA’s fiscal year budget to \$8.1 billion for a temporary commission on adaptation and mitigation to review scientific questions on how to best adapt to a “warming planet” and identify the scientific investment needed to address this reality.<sup>lxxi</sup> The commission would include officials from EPA, NOAA, the NSF, the Department of Energy, and the Forest Service, and would be responsible for the allocation of funds to governmental agencies to conduct adaptation research. Depending on the temporary commission’s findings, the EPA would allocate \$45 million to itself and other agencies over the next two years.<sup>lxxii</sup>

The commission has yet to be officially created however the bill’s framework has two potential far reaching implications: (1)“the call for significant funding on adaptation could represent a new direction for EPA and other agencies to address the impacts of climate change, by going beyond the science of global warming or studies on policies to control [GHGs];”<sup>lxxiii</sup> and (2) The commission’s ability to “direct specific amounts of money toward a problem, rather than only making general recommendations” enables research “to begin immediately without having to wait for another appropriations cycle.”<sup>lxxiv</sup>

While the formation of the commission and its potential implications on adaptation research is promising, more consistent and widespread action is required. A 2007 Government Accountability Office (“GAO”) report confirms this: the report concludes that

*federal agencies that manage the nation’s parks, forests, oceans, and monuments are unprepared to deal with climate change...resource managers within the Agriculture, Interior, and Commerce departments have limited guidance about whether or how to address climate change-without such guidance, their ability to address climate change and effectively manage resources is constrained.*<sup>lxxv</sup>

The report elaborates on the evidence that climate change impacts “600 million acres of public lands and 150,000 square miles of waters managed by federal agencies—ranging from melting glaciers in Glacier National Park to rising sea levels in the Florida Keys.”<sup>lxxvi</sup>

The GAO report as issued includes responses from several federal departments as appendices; the Agriculture, Interior, and Commerce departments submitted comments on the GAO conclusions and recommendations. The federal agencies “generally agreed with the [GAO] recommendations,” noted the importance of climate change consideration and additionally highlighted climate change programs, initiatives, plans, and/or policies that the GAO report omitted.<sup>lxxvii</sup> The comments from all three agencies indirectly reaffirm the GAO conclusions: although climate change considerations may be an identified priority, there is an overall lack of consistent site-specific implementation guidance.

For instance, the Department of Agriculture agrees that the adaptation plan for Chugach National Forest, discussed in the GAO report, does not specifically address the effects of climate change on programs and resources, but noted that the GAO report did not accurately represent the activities that are being pursued. The department notes that the “examination of one national forest. . . is inadequate as a proxy for an agency that manages diverse ecosystem across 193 million acres for multiple objectives . . . where a broader evaluation would have revealed [twelve] National Forest Plans specifically consider the effects of climate change on existing programs and local resource values.”<sup>lxxviii</sup> However, the comments do not address if, or the extent to which, the National Forest Plans discuss site-specific adaptation concerns.

The Department of Interior recently initiated a task force to take “affirmative steps to assess the effects on our public lands arising from climate change and develop a process for anticipating and addressing these effects.”<sup>lxxix</sup> However, as noted in the comments, the department is currently exploring how new science can be focused to provide targeted information that its resource managers need.

The Department of Commerce noted their involvement in the effort to “expand both observation systems and modeling capabilities” within ocean and coastal monitoring systems, integrated drought systems, and regional ecosystem planning. In addition, the department is expecting to release a *Preliminary Review of Adaptation Options for Climate Sensitive Ecosystems and Resources* by the end of 2007.<sup>lxxx</sup>

### *U.S. Environmental Protection Agency*

In 2004 the EPA, in collaboration with other federal agencies,<sup>lxxxi</sup> initiated a process for the *Preliminary Review of Adaptation Options form Climate-Sensitive Ecosystems and Resources* to “review management options for adapting to climate variability and change in the United States, and to identify characteristics of ecosystems and adaptation responses that promote successful implementation and meet resource managers’ needs.”<sup>lxxxii</sup> The report is being completed in response to SAP 4.4<sup>lxxxiii</sup> of *The Strategic Plan of the U.S. Climate*

*Change Science Program* (“CCSP”) which calls for the completion of “21 synthesis and assessment products to support policy making and adaptation decisions across the range of issues addressed by the CCSP,” to ultimately provide NGOs, individuals, federal, state, and local governments and agencies with adaptation options and information.<sup>lxxxiv</sup> The assessment will focus primarily on climate sensitive ecosystem and resources located within federally protected and managed areas, including: national parks, national wildlife refuges, wild and scenic rivers, marine protected areas, national forest systems, and the national estuary program.

Consistent with the second generation assessments being conducted globally, the EPA project is implementing a process that is open to the public and engages stakeholders to provide valuable information about local systems. With diverse, multi-disciplinary participation, the assessment is posing the following questions: (1) What are the management goals in the selected systems, upon what ecosystem characteristics do these goals depend, what are the stressors of concern, what are the management methods currently being used to address those stresses, and how could climate variability and change affect attainment of management goals? (2) For selected case studies, what is the current state of knowledge about management options that could be used to adapt to the potential impacts of climate variability and change? (3) Looking across the case studies, what are the factors that affect the successful implementation of management actions to address impacts from climate variability and change? (4) For each case study, how should we define and measure the environmental outcomes of management actions and their effect on the resilience of ecosystems to climate variability and change?<sup>lxxxv</sup> The report is expected in December 2007, and has the potential to lay the groundwork for future action by federal agencies, and will perhaps address concerns raised by the 2007 GAO report.

In March 2007, the EPA launched “an effort to assess and respond to the effects of global warming on water resources and regulators’ ability to meet requirements of numerous water related laws,” while specifically focusing on “development strategies to adapt to climate change, rather than on plans for limiting resources.”<sup>lxxxvi</sup> This new effort will be primarily adaptation—focused within the context of water resources and the ability to meet Clean Water Act Requirements “in a changing environment.” Implementation will be fostered through a Climate Change Workgroup and plan, expected to be released by the end of 2007.<sup>lxxxvii</sup> The plan will emphasize that “despite uncertainty on the scope and timing of climate change effects, EPA’s water program and its partners should take prudent steps now to assess emerging information, evaluate potential impacts of climate change on water programs, and to identify appropriate response actions.”<sup>lxxxviii</sup>

## NEXT STEPS: IMPLEMENTING ADAPTATION

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Thus far, climate change adaptation efforts have been primarily focused on gathering and synthesizing data to lay the groundwork for further studies and future implementation. Most initiatives are serving in a catalyst capacity — they are attempting to stimulate research, collaboration, discussion, and awareness. While excellent work has been done to identify vulnerabilities along with research and adaptive capacity gaps, little action has been taken based on the results of the reports. It is now imperative to move to the next step of the transition, an operational phase to implement adaptation considerations as a policy response.

### *A Balance of Reactive and Proactive Adaptation*

The various vulnerability assessments conducted are intended to locate vulnerabilities to implement action. Such actions represent sound political will and good intentions. However, transitioning from the research and information gathering phase to the implementation phase presents complex political and economic dilemmas that are familiar to climate change discussions. Particularly, the idea of allocating present resources to long term contextual conditions to anticipate and prevent potential future impacts versus waiting for impacts to occur and reacting to the situation.

Conceptually, the difference between the two policy responses is represented in reactive and proactive adaptation. Reactive adaptation is the “ability to react to and deal with climate change” after an event and impacts have occurred, and is represented in the act of coping.<sup>lxxxix</sup> Proactive adaptation is represented in the act of anticipation, taking action to prevent and/or reduce future impacts. Choosing between the two in terms of policy responses presents complex challenges; however, we believe that elements of both proactive and reactive adaptation responses are necessary to effectively address adaptation to climate change.

Historically, policy choices tended to lean towards reactive adaptation to climatic events, for in practice, “policy decisions are often easier to implement once a crisis has occurred than in anticipation of a crisis.”<sup>xc</sup> Reactive adaptation uses present resources to cope with events at the time they occur, however, such “coping may not be sufficient to fully restore the status quo because of irreversibilities.”<sup>xcii</sup> For instance, “losses that are technically impossible to restore (such as sceneries, irreversible biodiversity losses or disappearance of unique cultural artifacts) or economically too costly to restore . . . can be referred to as ‘remaining ultimate damages.’”<sup>xciii</sup> In addition, it is noted that reactive responses, when used without proactive measures, tend to have higher long term costs because the low costs of preventive action, or anticipative adaptation, are likely to dominate the higher costs of

deferred action, or reactive adaptation, appropriately discounted.<sup>xciii</sup>

Although it is known that climate change impacts will happen and studies have estimated and located vulnerabilities, the details of future scenarios, in terms of timing, scale, and severity, cannot be known with certainty. The “degree of uncertainty” argument has typically been used as a barrier to proactive adaptation, emphasizing the need to delay action until more certain data can be developed. However, even without precise knowledge of future events, proactive policy planning for climate change adaptation improves the overall preparedness by integrating adaptation considerations into the decision making process. More so, “experience suggests that, typically, proactive adaptation requires a greater initial investment but is more effective at reducing future risk and cost.”<sup>xciv</sup>

Proactive and reactive adaptation should be viewed as complements and not conflicting options. For example, “rapid response teams need to be constituted, trained, and set up in advance (proactive adaptation) so that they can be deployed when an extreme weather event occurs (reactive adaptation).”<sup>xcv</sup> In other contexts, proactive adaptation can occur through the construction of dikes and levees, irrigation systems, the building of more resilient homes in ‘at risk’ locations, and the construction of buffer zones, with reactive adaptation dealing with the remaining variabilities that proactive action did not effectively manage.

The key here is that proactive and reactive actions will not eliminate all associated impacts, but rather an optimal mix will attempt to minimize impacts wherever possible. It is necessary to implement the most educated proactive action, and to react and adapt to the variabilities. Decision makers must realize that adaptation to climate change is a manifestation of systems thinking and a process of active learning; we need to appreciate both proactive and reactive responses as we learn the new rules of game.

### *Utilize and Expand Existing Methods*

Adaptation considerations do not need to be developed from scratch. A large body of management procedures, processes, and applications exist in many different capacities and scales, both in developed and developing nations. It is necessary to evaluate how populations currently manage climate risks and hazards, and build and expand upon existing measures where possible. The need for action is especially acute in developing nations, since the scale at which climate change will impact the vulnerable populations is unprecedented, and traditional methods of adaptation lack the necessary scale and capacity. In many developed countries, stakeholder participation is a common practice where the lines of communication are open for local communities to voice their opinions across governmental scales, and be somewhat included in the decision process. On the other hand, many developing countries lack the political infrastructure to implement such a process; in the absence of developed political regimes, many second generation projects and programs are providing the means for local communities to be included in the adaptation and development process by sharing their knowledge and revealing their developmental and adaptation gaps.



Adaptation to climate change is not only a concern for developing countries. Developed economies and societies are hardly immune to the anticipated impacts of climate change. While adaptation to climate change in developed countries will be facilitated because some of the infrastructure and basic tools are in place to deal with climate variability's and associated hazards, there will clearly be a need to expand and build upon the preexisting management tools to deal with new hazards on varying scales. Such expanded considerations include: (1) with the threat of new disease and health risks, greater investment in health care systems; (2) enhancement of hazard forecasting systems; (3) creation of networks to facilitate participation of local organizations in the development of plans to identify and manage the impacts of climate change on communities; (4) worse case contingency planning by businesses and municipalities; and (5) improving communications between communities and government regarding the impacts of climate change on livelihoods.<sup>xvii</sup> Pervasive adjustments in policy and regulation, as well as the emergence of new processes and institutions for governance, should be anticipated as we adapt to climate change.

## CONCLUSION

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It is clearly necessary to continue to pursue GHG mitigation strategies as aggressively as possible, but we must begin to implement adaptation strategies as a complement to mitigation efforts. Fortunately a dialogue on an adaptation and mitigation mix or “portfolio” has begun. For example, the *IPCC Fourth Assessment Report-Climate Change 2007: Impacts, Adaptation, and Vulnerability* suggests “a portfolio of adaptation and migration can diminish the risks associated with climate change.”<sup>xviii</sup> The report recommends that a portfolio of strategies should include mitigation, adaptation, technological development, and research. This portfolio could combine policies with incentive-based approaches, and actions at multiple scales, from the individual to national governments and international organizations.<sup>xviii</sup>

Researchers and scholars are beginning to explore, given the limited resources in terms of funding, time, and manpower, the contents of an adaptation portfolio “that is justifiable from a social, environmental, and economic perspective.”<sup>xix</sup> But this is no longer an academic question. More enlightened business leaders already understand that the climate change equation includes both mitigation and adaptation components. As James E. Rogers, Duke Energy’s CEO and Chairman, stated in August 2007, “mitigation of climate change is not going to happen fast enough. That is the reality. We need to think in a broad sense about both adaptation [to climate change] and mitigation [of it].”<sup>c</sup> Adaptation and mitigation are complementary and ought to be inextricably linked as we plan for a carbon-constrained future.

**Table 2**  
States pursuing separate adaptation plans

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**Alaska**

The Climate Impact Assessment Commission is responsible for developing adaptation considerations. The commission is a legislative body that is “tackling adaptation issues, specifically associated with the protection or relocation of villages in the state at risk from coastal erosion and wave surges or flooding.” The commission is currently analyzing the relationship of climate change and adaptation to a variety of multi-disciplinary issues, including communities, infrastructure, fish, wildlife, forests, agriculture, disease, pests, and financing. A rural relocation report is expected to be completed by the end of 2007.

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**Arizona**

Arizona developed a Climate Change Adaptation Strategy, which recommends that the Governor appoint a task force or advisory group to develop recommendations for the state climate change adaptation strategy. Moreover, the Governor should direct state agencies and other appropriate institutions to identify and characterize potential current and future risks in Arizona to human, natural, and economic systems, including potential risks to water resources, temperature sensitive populations and systems, energy systems, transportation systems, vital infrastructure and public facilities, and natural lands (e.g., forests, rangelands, and farmland).”<sup>cii</sup>

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**California**

The California Energy Commission published a statewide assessment of climate change impacts and adaptation measures in the 2005 report *Climate Change Impacts and Adaptation in California*. In addition, the California Climate Change Center has been conducting ongoing impact and adaptation studies within three main areas: (1) agriculture and forestry- including identification and analysis of vulnerable species; (2) Water resources - with particular attention placed upon stressors such as growing population and development; and (3) Public health- with the acknowledgment that and increased frequency of extreme weather events such as will impact human health.<sup>ciii</sup>

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**Maryland**

The Maryland Commission on Climate Change formed the Adaptation and Response Working Group which will recommend strategies for reducing Maryland’s climate change vulnerability, with attention paid to public health and the most vulnerable population segments.<sup>civ</sup> An updated plan of action, preliminary

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recommendations, implementation time tables, and draft legislation is expected in November 2007.

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## Washington

The Washington State Department of Ecology formed the Preparation/Adaptation Working Groups with a primary task is to make recommendations to the Governor on how Washington can prepare and adapt to climate change impacts with respect to five sectors: Agriculture, Forestry Resources, Human Health, Water Resources & Quality, and Coastal Infrastructure. Additionally, the working groups will identify vulnerabilities, recommend adaptive strategies, and note areas requiring additional research.<sup>cv</sup>

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## Oregon

The Climate Change Integration Group will prepare a preliminary report on adaptation to the impacts of climate change with initial recommendations to the Governor by the end of the year 2007.<sup>cvi</sup>

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<sup>i</sup> Ian Burton, Elliot Dringer & Joel Smith, *Adaptation to Climate Change: International Policy Options*, Pew Center on Global Climate Change (2006), at 5, available at [http://www.pewclimate.org/docUploads/PEW\\_Adaptation.pdf](http://www.pewclimate.org/docUploads/PEW_Adaptation.pdf) (last visited Nov. 1, 2007) [hereinafter *Pew Adaptation*].

<sup>ii</sup> Intergovernmental Panel on Climate Change, Third Assessment Report, Climate Change 2001: Impacts, Adaptation & Vulnerability, 881 (2001), available at [http://www.grida.no/climate/ipcc\\_tar/wg2/index.htm](http://www.grida.no/climate/ipcc_tar/wg2/index.htm) (last visited Nov. 1, 2007) [hereinafter IPCC 2001].

<sup>iii</sup> See INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: IMPACTS, ADAPTATION & VULNERABILITY (2007), available at <http://www.ipcc-wg2.org/> (last visited Nov. 1, 2007) [hereinafter IPCC 2007] (“High Confidence” is a term used by the IPCC to describe the accuracy of the conclusions. High confidence equals an eight out of ten chance of accuracy confidence, where the highest possible is “very high confidence” which equals a nine out of ten chance of being accurate).

<sup>iv</sup> IPCC 2007, *id.* at 5 (citing a sixty six to ninety percent probability).

<sup>v</sup> IPCC 2007, *id.* at 5.

<sup>vi</sup> IPCC 2007, *id.* at 19.

<sup>vii</sup> See United Nations Framework Convention on Climate Change, May 9, 1992, 31 I.L.M. 849, available at [http://unfccc.int/essential\\_background/convention/background/items/2853.php](http://unfccc.int/essential_background/convention/background/items/2853.php) (last visited Nov. 1, 2007) [hereinafter UNFCCC].

<sup>viii</sup> UNFCCC commitments include, *inter alia*, art. 2 (“Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change”); art. 4.1(b) (“Formulate, implement, publish and regularly update national and, where appropriate, regional programs concerning...measures to facilitate adequate adaptation to climate change”); art. 4.1(3) (“Cooperate in preparing for adaptation to the impacts of climate change”); 4.1(f) (“Take climate change considerations into account, to the extent feasible, in their relevant social, economic and environmental policies and actions, and employ appropriate methods, for example...measures undertaken by them to mitigate or adapt to climate change”); and art. 4.4 (Requiring the developed country parties and other developed parties included in Annex II to also assist the developing country parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects).

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- <sup>ix</sup> UNFCCC website, *Adaptation*, available at [http://unfccc.int/adaptation/adverse\\_effects\\_and\\_response\\_measures\\_art\\_48/items/2535.php](http://unfccc.int/adaptation/adverse_effects_and_response_measures_art_48/items/2535.php) (last visited Oct. 29, 2007) [hereinafter UNFCCC website] (stating art. 4.8 of the Convention calls on Parties to “consider actions, including those related to funding, insurance and the transfer of technology, to meet the specific needs and concerns of developing countries in this regard, listing categories of countries (e.g. small island countries and countries whose economies are highly dependent on fossil fuels) that may be particularly affected”).
- <sup>x</sup> UNFCCC website, *id.* (stating “Article 4.9 of the Convention refers specifically to the specific needs and special situations of the least developed countries (LDCs) concerning funding and transfer of technology.”).
- <sup>xi</sup> UNFCCC website, *id.*
- <sup>xii</sup> UNFCCC website, *id.*
- <sup>xiii</sup> UNFCCC, *Conference of the Parties: Report of the Conference of the Parties on its Seventh Session, Held at Marrakech from 29 October to 10 November 2001, United Nations* (Jan. 2002), available at <http://unfccc.int/resource/docs/cop7/13.pdf> (last visited Oct. 19, 2007).
- <sup>xiv</sup> UNITED NATIONS, COMPENDIUM ON METHODS AND TOOLS TO EVALUATE IMPACTS OF, AND VULNERABILITY AND ADAPTATION TO, CLIMATE CHANGE, FINAL DRAFT REPORT, 1 (2005), available at [http://unfccc.int/adaptation/methodologies\\_for/vulnerability\\_and\\_adaptation/items/2674.php](http://unfccc.int/adaptation/methodologies_for/vulnerability_and_adaptation/items/2674.php) (last visited Nov. 1, 2007).
- <sup>xv</sup> STRATUS CONSULTING INC., COMPENDIUM OF DECISION TOOLS TO EVALUATE STRATEGIES FOR ADAPTATION TO CLIMATE CHANGE, STRATUS CONSULTING INC., prepared for UNFCCC, (May 1999), available at [http://www.aiaccproject.org/resources/ele\\_lib\\_docs/adaptation\\_decision\\_tools.pdf](http://www.aiaccproject.org/resources/ele_lib_docs/adaptation_decision_tools.pdf) (last visited Nov. 1, 2007).
- <sup>xvi</sup> UNFCCC, COMPENDIUM ON METHODS AND TOOLS TO EVALUATE IMPACTS OF, AND VULNERABILITY AND ADAPTATION TO CLIMATE CHANGE (2005), available at [http://unfccc.int/adaptation/methodologies\\_for/vulnerability\\_and\\_adaptation/items/2674.php](http://unfccc.int/adaptation/methodologies_for/vulnerability_and_adaptation/items/2674.php) (last visited Nov. 1, 2007).
- <sup>xvii</sup> See generally IPCC, IPCC SPECIAL REPORT: IPCC TECHNICAL GUIDELINES FOR ASSESSING CLIMATE CHANGE IMPACTS AND ADAPTATIONS WITH A SUMMARY FOR POLICY MAKERS AND A TECHNICAL SUMMARY (1994); IPCC, IPCC SECOND ASSESSMENT REPORT: CLIMATE CHANGE 1995: IMPACTS, ADAPTATIONS AND MITIGATION OF CLIMATE CHANGE: SCIENTIFIC-TECHNICAL ANALYSES (1995), available at <http://www.ipcc.ch/pub/reports.htm> (Nov. 1, 2007); see also IPCC 2001, *supra* note 2 (concluding: (1) many human systems are sensitive to climate change, and some are vulnerable; (2) adaptation is a necessary strategy at all scales to complement climate change mitigation efforts; and (3) adaptation has the potential to reduce adverse impacts of climate change and to enhance beneficial impacts).
- <sup>xviii</sup> See IPCC 2007, *supra* note 3.
- <sup>xix</sup> IPCC 2007, *supra* note 3
- <sup>xx</sup> IPCC 2001, *supra* note 2, at 2.4.
- <sup>xxi</sup> Nick Brooks, *Vulnerability, risk and adaptation: A conceptual framework*, Tyndall Centre for Climate Research, Working Paper 38, at 4 (Nov. 2003), available at [http://www.tyndall.ac.uk/publications/working\\_papers/wp38.pdf](http://www.tyndall.ac.uk/publications/working_papers/wp38.pdf) (last visited Nov. 1, 2007).
- <sup>xxii</sup> Brooks, *id.* at 4.
- <sup>xxiii</sup> Brooks, *id.* at 4-5.
- <sup>xxiv</sup> Nick Brooks, W. Neil Adger & P. Mick Kelly, *The determinants of vulnerability and adaptive capacity at the national level and implications for adaptation*, 15 GLOBAL ENVTL. CHANGE 151, 153 (2004).
- <sup>xxv</sup> Brooks 2003, *supra* note 21 at 5.
- <sup>xxvi</sup> For example, developing countries face more climate vulnerability because they are at lower latitudes where impacts are more pronounced and their economies are dependent on climate sensitive sectors. Additionally, developing countries generally face lower per capita incomes, weaker institutions, and have less access to technology, credit, and international markets. See Pew *Adaptation*, *supra* note 1, at 5.

<sup>xxvii</sup> See Jouni Paavola & W. Neil Adger, *Fair adaptation to climate change*, 56 *ECOLOGICAL ECON.* 594, 599-600 (2006).

<sup>xxviii</sup> James Ford et al., *Reducing Vulnerability to Climate Change in the Arctic: The Case of Nunavut, Canada*, Arctic Institute of North America of the University of Calgary (2007).

<sup>xxix</sup> Neil Leary et al., *A Stitch in Time: Lessons for Climate Change Adaptation from the AIACC Project*, AIACC Working Paper No. 48, at 12 (2007), available at [http://www.aiaccproject.org/working\\_papers/Working%20Papers/AIACC\\_WP48\\_Leary\\_et.al.pdf](http://www.aiaccproject.org/working_papers/Working%20Papers/AIACC_WP48_Leary_et.al.pdf) (last visited Nov. 1, 2007).

<sup>xxx</sup> Leary, *id.*

<sup>xxxi</sup> Leary, *id.* at 14.

<sup>xxxii</sup> Leary, *id.* at 19.

<sup>xxxiii</sup> See Leary, *supra* note 29.

<sup>xxxiv</sup> Ian Burton et al., *From Impacts Assessment to Adaptation Priorities: the Shaping of Adaptation Policy*, 2 *CLIMATE POL'Y* 145 (2002).

<sup>xxxv</sup> About AIACC, Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors website, <http://www.aiaccproject.org/about/about.html> (last visited Nov. 1, 2007).

<sup>xxxvi</sup> Burton, *supra* note 34.

<sup>xxxvii</sup> Burton, *supra* note 34.

<sup>xxxviii</sup> Burton, *supra* note 34.

<sup>xxxix</sup> AIACC, ASSESSMENTS OF IMPACTS AND ADAPTATIONS TO CLIMATE CHANGE IN MULTIPLE REGIONS AND SECTORS 2, available at [http://www.aiaccproject.org/meetings/Trieste\\_02/trieste\\_cd/CD\\_INTRO/AIACCSummary.doc](http://www.aiaccproject.org/meetings/Trieste_02/trieste_cd/CD_INTRO/AIACCSummary.doc) (last visited Nov. 1, 2007).

<sup>xl</sup> Robert K. Dixon, *U.S. Activities with Developing Countries to Cope with Global Climate Change*, *LINKAGES J.*, Oct. 26, 1998, available at <http://www.iisd.ca/journal/dixon.html> (last visited Oct. 19, 2007).

<sup>xli</sup> See generally UNFCCC COMPENDIUM ON METHODS AND TOOLS TO EVALUATE IMPACTS OF, AND VULNERABILITY AND ADAPTATION TO, CLIMATE CHANGE (Jan. 2005), available at [http://unfccc.int/adaptation/methodologies\\_for/vulnerability\\_and\\_adaptation/items/2674.php](http://unfccc.int/adaptation/methodologies_for/vulnerability_and_adaptation/items/2674.php) (last visited Nov. 19, 2007) [hereinafter UNFCCC COMPENDIUM].

<sup>xlii</sup> Joel B. Smith & Jeffrey K. Lazo, *A Summary of Climate Change Impact Assessments from the U.S. Country Studies Program*, 50 *CLIMATE CHANGE* 1 (2001).

<sup>xliii</sup> Smith & Lazo, *id.*

<sup>xliv</sup> Smith & Lazo, *id.*

<sup>xlv</sup> Smith & Lazo, *id.*

<sup>xlvi</sup> U.N. National Adaptation Programmes of Action (NAPAs), UNFCCC website, <http://unfccc.int/adaptation/napas/items/2679.php> (last visited Nov. 19, 2007).

<sup>xlvii</sup> TUVALU DEPARTMENT OF ENV'T, TUVALU'S NATIONAL ADAPTATION PROGRAMME OF ACTION 19 (May 2007), available at <http://unfccc.int/resource/docs/napa/tuv01.pdf> (last visited Nov. 19, 2007) [hereinafter TUVALU PROG.].

<sup>xlviii</sup> TUVALU PROG., *id.* at 41.

<sup>xliv</sup> TUVALU PROG., *id.* at 43.

<sup>1</sup> BALGIS OSMAN-ELASHA AND THOMAS E. DOWNING, EUROPEAN CAPACITY BUILDING INITIATIVE LESSONS LEARNED IN PREPARING NATIONAL ADAPTATION PROGRAMMES OF ACTION IN EASTERN AND SOUTHERN AFRICA (2007), available at [www.napa-pana.org/private/modules/knowledgebox/io/file.php?entry=707&field=26](http://www.napa-pana.org/private/modules/knowledgebox/io/file.php?entry=707&field=26) (last visited Nov. 19, 2007) [hereinafter LESSONS LEARNED].

<sup>li</sup> See UNFCCC COMPENDIUM, *supra* note 41.

<sup>lii</sup> SUDAN MINISTRY OF ENVIRONMENT AND PHYSICAL DEVELOPMENT, NATIONAL ADAPTATION PROGRAMME OF ACTION 28 (July 2007), available at <http://unfccc.int/resource/docs/napa/sdn01.pdf> (last visited Nov. 19, 2007).

<sup>liii</sup> LESSONS LEARNED, *supra* note 50.

<sup>liiv</sup> LESSONS LEARNED, *supra* note 50.

<sup>liv</sup> AIACC, Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors, available at

[http://www.aiaccproject.org/meetings/Trieste\\_02/trieste\\_cd/CD\\_INTRO/AIACCSummary.doc](http://www.aiaccproject.org/meetings/Trieste_02/trieste_cd/CD_INTRO/AIACCSummary.doc) (last visited Nov. 20, 2007).

<sup>lvi</sup> For instance, an AIACC final report concludes “[a]s a result of our AIACC project, young researchers from the participating institutions with strong and almost exclusive background in agricultural science, started to work with climate change scenarios and assessing climate related risks resulting in strengthened research capabilities for further investigations of climate change. See AGUSTIN GIMENEZ, AIACC FINAL REPORTS, CLIMATE CHANGE AND VARIABILITY IN THE MIXED CROP/LIVESTOCK PRODUCTION SYSTEMS OF THE ARGENTINEAN, BRAZILIAN AND URUGUAYAN PAMPAS (2006), available at [http://www.aiaccproject.org/Final %20Reports/Final%20Reports/FinalRept\\_AIACC\\_LA27.pdf](http://www.aiaccproject.org/Final%20Reports/Final%20Reports/FinalRept_AIACC_LA27.pdf) (last visited Oct. 19, 2007).

<sup>lvii</sup> See UNEP-GEF, ADAPTATION POLICY FRAMEWORKS FOR CLIMATE CHANGE: DEVELOPING STRATEGIES, POLICIES AND MEASURES (Cambridge Univ. Press, 2004), available at [http://www.undp.org/gef/undp-gef\\_publications/undp-gef\\_publications.html#adaptation](http://www.undp.org/gef/undp-gef_publications/undp-gef_publications.html#adaptation) (last visited Nov. 19, 2007) (informing and guiding practitioners on implementation).

<sup>lviii</sup> UN DEV. PROGRAMME, ADAPTATION POLICY FRAMEWORK FOR CLIMATE CHANGE: DEVELOPING POLICIES, STRATEGIES, POLICIES, AND MEASURES, (Bo Lim and Erika Spanger Sigfried eds., Cambridge Univ. Press, 2004) available at [http://www.undp.org/gef/undp-gef\\_publications/undp-gef\\_publications.html#adaptation](http://www.undp.org/gef/undp-gef_publications/undp-gef_publications.html#adaptation) (last visited Nov. 19, 2007) [hereinafter APF].

<sup>lix</sup> APF, *id.*

<sup>lx</sup> Farhana Yamin et al., *Linking Climate Adaptation: A Research Agenda*, IDS Bulletin 36.4: Vulnerability, Adaptation and Climate Disasters.

<sup>lxi</sup> Yamin et al., *id.*

<sup>lxii</sup> Yamin et al., *id.*

<sup>lxiii</sup> Yamin et al., *id.*

<sup>lxiv</sup> UKCIP, CLIMATE ADAPTATION: RISK, UNCERTAINTY AND DECISION-MAKING (May, 2003) available at [http://www.ukcip.org.uk/resources/publications/pub\\_dets.asp?ID=4](http://www.ukcip.org.uk/resources/publications/pub_dets.asp?ID=4) (last visited Nov. 19, 2007).

<sup>lxv</sup> PEW CENTER ON GLOBAL CLIMATE CHANGE, ADAPTATION PLANNING-WHAT STATES AND LOCALITIES ARE DOING, available at [http://www.pewclimate.org/docUploads/State\\_Adapation\\_Planning\\_final8%2008%2007tcredits%20\(2\).pdf](http://www.pewclimate.org/docUploads/State_Adapation_Planning_final8%2008%2007tcredits%20(2).pdf) (last visited Nov. 1, 2007) [hereinafter ADAPTATION PLANNING].

<sup>lxvi</sup> ADAPTATION PLANNING, *id.*

<sup>lxvii</sup> ADAPTATION PLANNING, *id.*

<sup>lxviii</sup> CENTER FOR SCIENCE IN THE EARTH SYSTEM ET AL., PREPARING FOR CLIMATE CHANGE: A GUIDEBOOK FOR LOCAL, REGIONAL, AND STATE GOVERNMENTS (Sept. 2007), available at <http://www.iclei.org/index.php?id=7066> (last visited Nov. 1, 2007) [hereinafter GUIDEBOOK].

<sup>lxix</sup> GUIDEBOOK, *id.*

<sup>lxx</sup> Climate Change in the Great Lakes Region, Michigan State University’s Environmental Science & Policy’s website, <http://www.environment.msu.edu/climatechange/> (last visited Nov. 1, 2007).

<sup>lxxi</sup> Environmental Policy Alert, *House Spending Bill for E.P.A. Creates Panel on Climate Adaptation*, Inside Washington Publishers, June 6, 2007 [hereinafter Policy Alert].

<sup>lxxii</sup> Policy Alert, *id.*

<sup>lxxiii</sup> Policy Alert, *id.*

<sup>lxxiv</sup> Policy Alert, *id.*

<sup>lxxv</sup> Lauren Morello & Dan Berman, *U.S. Resource Managers Lack Direction on Warming*-GAO, GREENWIRE, Sept. 6, 2007.

<sup>lxxvi</sup> Morello & Berman, *id.*

<sup>lxxvii</sup> GAO, CLIMATE CHANGE: AGENCIES SHOULD DEVELOP GUIDANCE FOR ADDRESSING THE EFFECTS ON FEDERAL LAND AND WATER RESOURCES, REPORT TO CONGRESSIONAL REQUESTERS, at 59, GAO-07-863 (Aug. 2007) [hereinafter GAO CLIMATE CHANGE].

<sup>lxxviii</sup> GAO CLIMATE CHANGE, *id.* at 46.

<sup>lxxix</sup> GAO CLIMATE CHANGE, *id.* at 59.

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<sup>lxxx</sup> GAO CLIMATE CHANGE, *id.*

<sup>lxxxi</sup> These agencies include Department of Agriculture, Department of Energy, U.S. Geological Survey, National Aeronautics and Space Administration, and National Oceanic and Atmospheric Administration

<sup>lxxxii</sup> Adaptation Homepage, U.S. Environmental Protection Agency website, <http://www.epa.gov/climatechange/effects/adaptation.html> (Nov. 1, 2007) [hereinafter Adaptation Homepage].

<sup>lxxxiii</sup> See EPA, SAP-4.4 PROSPECTUS FOR PRELIMINARY REVIEW OF ADAPTATION OPTIONS FOR CLIMATE-SENSITIVE ECOSYSTEMS AND RESOURCES,, (July, 2006), *available at* <http://www.climatescience.gov/Library/sap/sap4-4/sap4-4prospectus-final.htm> (last visited Nov. 1, 2007) [hereinafter SAP PROSPECTUS].

<sup>lxxxiv</sup> SAP PROSPECTUS, *id.*

<sup>lxxxv</sup> Adaptation Homepage, *supra* note 82.

<sup>lxxxvi</sup> Carbon Control News, *E.P.A. Water Office to Draft GHG Strategy Emphasizing 'Adaptation,'* Inside Washington Publishers, Mar. 12, 2007 [hereinafter *Strategy*].

<sup>lxxxvii</sup> *Strategy, id.*

<sup>lxxxviii</sup> *Strategy, id.*

<sup>lxxxix</sup> Chris Ward, *July 2007 Monthly Update: Vulnerability and Adaptation to Climate Change in Developing Countries*, World Resource Institute (July 30, 2007), *available at* <http://earthtrends.wri.org/updates/node/225> (last visited Nov. 1, 2007).

<sup>xc</sup> Frank Lecocq & Zmarak Shalizi, *Balancing Expenditures on Mitigation of and Adaptation to Climate Change: an Exploration of Issues Relevant to Developing Countries* 7 (World Bank Group, Policy Research Working Paper No. 4299 2007), *available at* [http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2007/08/02/000158349\\_20070802095523/Rendered/PDF/wps4299.pdf](http://www-wds.worldbank.org/external/default/WDSContentServer/IW3P/IB/2007/08/02/000158349_20070802095523/Rendered/PDF/wps4299.pdf) (last visited Nov. 1, 2007) [hereinafter *Balancing Expenditures*].

<sup>xc</sup> *Balancing Expenditures, id* at 7.

<sup>xcii</sup> *Balancing Expenditures, id* at 7.

<sup>xciii</sup> *Balancing Expenditures, id* at 8.

<sup>xciv</sup> *Pew Adaptation, supra* note 1 at 5.

<sup>xcv</sup> *Balancing Expenditures, supra* note 90.

<sup>xcvi</sup> Ford, *supra* note 28.

<sup>xcvii</sup> IPCC 2007, *supra* note 3.

<sup>xcviii</sup> IPCC 2007, *supra* note 3.

<sup>xcix</sup> Richard J.T. Klein, E. Lisa. F. Schipper & Suraje Dessai, *Integrating mitigation and adaptation into climate and development policy: three research questions*, 8 *Env'tl. Sci. & Pol'y* 579 (2005).

<sup>c</sup> Fareed Zakaria, Editorial: *Energy official performs balancing act*, NEWSWEEK, Aug. 14, 2007, at 4A.

<sup>ci</sup> ADAPTATION PLANNING, *supra* note 65.

<sup>cii</sup> ADAPTATION PLANNING, *supra* note 65.

<sup>ciii</sup> ADAPTATION PLANNING, *supra* note 65.

<sup>civ</sup> Maryland Commission on Climate Change website, [www.mde.state.md.us/air/mccc/](http://www.mde.state.md.us/air/mccc/) (last visited Oct. 19, 2007).

<sup>cv</sup> ADAPTATION PLANNING, *supra* note 65.

<sup>cvi</sup> ADAPTATION PLANNING, *supra* note 65.