

The Faces of Climate Change Adaptation: *The Need for Proactive Protection of the Nation's Coasts*

Coastal States Organization's Climate Change Work Group

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The Faces of Climate Change Adaptation

What does climate change mean for the coastal states?

Coastal areas are particularly vulnerable to climate change. Socioeconomic and environmental impacts of climate change are projected to be most significant in coastal areas of the United States.ⁱ The nation relies on the oceans and the coasts for food, recreation, jobs, wildlife habitat, transport of goods, and climate control. The coasts also provide homes to the majority of Americans: in 2003, it was estimated that 153 million people, or 53%, of the population of the United States lived in coastal counties.ⁱⁱ This significant percentage of the American population is at risk to the impacts of climate change, including accelerated sea level rise and lake level changes, shoreline erosion, increased storm frequency or intensity, changes in rainfall, and related flooding. Additionally, impacts such as changes in chemical (ocean acidification) and physical characteristics (thermal stratification) of marine systems, saltwater intrusion into groundwater aquifers, increased harmful algal blooms, spread of invasive species, habitat loss (especially coastal wetlands), species migrations, and changes in population dynamics among marine and coastal species, will increase as the climate continues to change. As the impacts of climate change multiply, states must proactively protect against the effects of climate change.

Some states have begun to take action to adapt their coasts to climate change. Other states have begun to explore how they can react to the changes they are facing on their coasts.ⁱⁱⁱ To understand how climate change is impacting the nation's coastal states, it is necessary to examine the specific impacts it is having across the nation. To understand how coastal states can adapt to climate change, it is necessary to examine initiatives that some states have taken to respond to the impacts of climate change. This white paper will examine the impacts of climate change on three states: Florida, Texas, and Ohio. While each state faces different threats, the challenges that each encounter will serve as an overview of the types of problems that will increase across the nation as climate change continues. Then, this white paper will examine what some coastal states have done proactively to protect against these threats. Looking specifically at the states of Maryland, Massachusetts, and California, this paper will explore how different

approaches to adaptation can be successful in different environments. Lastly, this paper will discuss how coastal states can learn from states that have led the charge against climate change, and what is needed, such as federal funding, for other states to follow suit.

Climate Change Impacts Vary from State to State

Florida

Florida is a unique state in that it is surrounded by both the Atlantic and Gulf coasts. In fact, no point in the state is more than 75 miles from saltwater.^{iv} With 8,426 miles of shoreline, Florida's coastline generates a huge portion of its gross domestic product (GDP); in fact, in 2006, the coastal economy of Florida generated almost \$562 billion, or 86% of the GDP.^v Of Florida's 20 major population centers, 15 are located in coastal counties.^{vi} While Florida reaps the benefit of coasts: lovely sandy beaches, easy access for shipping and travel on the seas, plentiful seafood, and a booming tourist industry, Florida is also experiencing the devastating impacts of climate change. Specifically, Florida is facing sea level rise, coastal erosion, and increased storm intensity and frequency.

The changing climate is causing sea levels to rise in two ways: warmer ocean waters take up greater volume and melting glaciers and ice fields increase the aggregate quantity of waters in the oceans.^{vii} While globally there has been an increase in sea level rise, the amount of relative sea level rise experiences along different parts of the United States coasts depends on the changes in elevation of the land that occur as a result of subsidence or rising.^{viii} Over the past 50 years, significant portions of the Atlantic coast and Gulf of Mexico coast have experienced significantly higher rates of relative sea level rise than the global average due to land subsidence.^{ix} In Florida, a state whose highest point is only 345 feet above sea level, a 35-55 inch sea level rise by 2100 would result in an annual property and revenue loss of up to \$345 billion.^x

Rising sea level, along with flooding and powerful ocean waves, also contributes to erosion on the coasts. Erosion wears away beaches and bluffs along the shorelines, undermining waterfront homes, businesses, and public infrastructure and facilities, eventually rendering them uninhabitable or unusable.^{xi}

This is particularly troubling for a state like Florida, which houses the majority of its residents and facilities on its coasts. The Federal Emergency Management Agency (FEMA) estimates that by 2060, coastal erosion will threaten nearly 87,000 homes and other buildings in coastal areas in the nation, 53,000 of which are on the Atlantic coast and 13,000 of which are on the Gulf of Mexico coast.^{xii} In fact, erosion is particularly severe on the Atlantic coast, where beaches retreat two to three feet per year on average, and the Gulf of Mexico coast, where the overall annual erosion rate is six feet per year.^{xiii} In Florida this means that 59%, or 485 miles, of Florida's beaches are eroding.^{xiv}

Sea level rise and warming seas may also increase hurricane intensity and frequency.^{xv} Since hurricanes need a sea-surface temperature of at least 79 degrees Fahrenheit to form, an increase of sea-surface temperatures above this threshold will result in more frequent and more intense hurricanes.^{xvi} Reputable scientific studies demonstrate that hurricanes will become increasingly stronger as the climate warms.^{xvii} Hurricanes are the costliest natural events in the United States, causing approximately \$1 billion in property damage each.^{xviii} Hurricane property damage is greatest on the coasts where hurricanes make landfall, causing storm surge, severe beach erosion, inland flooding, and wind-related casualties for both societal and natural resources.^{xix} In Florida, since 2000, several strong hurricanes have hit the coasts, including hurricanes Charley, Jeanne, Dennis, Katrina, Wilma, and Ivan. Due to its unique location surrounded by coasts, Florida is experiencing intensified effects of climate change. As climate continues to transform, more and more states will experience impacts similar to Florida.

Texas

Texas is another state that is reliant on its coasts for a vital economy. In fact, Texas is a state that depends greatly on its manufacturing, commerce, and tourism in the coastal regions. Texas depends on the coasts for shipping domestic and international cargo, as well as commercial and recreational fishing.^{xx} Additionally, the coasts of Texas are home to many Texans, since 1960 housing more than 25 % of the Texas population.^{xxi} This percentage is increasing, with the population living directly on the state's shoreline more than doubling between 1960 and 2010.^{xxii} However, as the attraction of the Texas coasts

increases, so, too are the risks associated with climate change, endangering the very thing that makes Texas such an attractive place for many to live.

As seas get warmer, so, too, will the increased intensity, duration, and extent of harmful algal blooms.^{xxiii} Texas has begun to see damaging harmful algal blooms; in 1996, about two-thirds of the Texas coastline was closed to shellfish harvesting because of contamination by an unusually large bloom of marine algae known as “red tide.”^{xxiv} Texas has also begun to see disappearance of its marshy coast. With a coastline over 1,400 miles long and comprised of tidal flats, sandy marshes, fresh water marshes, salt marshes, and beaches, Texas shores provide homes to more than just humans.^{xxv} The sandy marsh shoreline provides critical habitat for shorebirds, wading birds, endangered brown pelicans, and other birds.^{xxvi} In fact, approximately 75 % of the ducks and geese in the United States move through the Texas coastal wetlands.^{xxvii} The salt marsh shoreline provides homes for oysters and clams, as well as serves as nursery grounds for young shrimp, crab, and fish. Additionally, the salt marsh protects the shorelines from erosion and act as a purification system by filtering out many pollutants. Saltwater intrusion into fresh water marshes has already occurred on a large scale on the upper Texas coast due to relative sea level rise and coastal flooding from hurricanes.^{xxviii} As the seas rise, these crucial barriers will erode and place the natural environment, the built environment, and humans at great risk.

In the coastal city of Galveston, sea level is already rising by 25 inches per century, and it is likely to rise another 38 inches by 2100.^{xxix} One of the ways that Texas has been reacting to erosion is by sand renourishment along the beaches.^{xxx} The process of sand renourishment, which is literally replacing lost beach with sand brought in from other locations, is a substantial financial investment. It is estimated that the cumulative cost of sand renourishment to protect the Texas coast from a 20-inch sea level rise by 2100 is estimated to cost between \$4.2 and \$12.8 billion.^{xxxi} As changes in climate continue to impact the coasts, costs to maintain the shorelines the nation depends on for economic vitality will continue to rise.

Ohio

Climate change does not only impact the sea coasts of the United States, it also greatly impacts the Great Lakes. Lake levels in the Great Lakes are projected to decline in the summer due to increased evaporation caused by higher temperatures, and also in winter due to a decrease in lake ice.^{xxxii} The greatest declines are expected for Lake Huron and Lake Michigan.^{xxxiii} Under the lower-emissions scenario, water levels in Lake Erie are projected to fall less than one foot toward the end of the century, but almost 1.5 feet under the higher-emissions scenario.^{xxxiv} A decline of this magnitude can have significant economic, aesthetic, recreational, and environmental impacts, such as significantly lengthening the distance to the lakeshore, affecting beach and coastal ecosystems, exposing toxic contaminants, and impairing recreational boating and commercial shipping. In addition to lower lake levels, the Great Lakes region will also see increased flooding as a result of precipitation change. Heavy rains also increase runoff that only washes pollutants into waterways, and in cities like Cincinnati and Columbus, cause raw sewage to spill from sewers into rivers.^{xxxv} Additionally, climate change could cause a loss of wetlands that would be devastating to Ohio. Between 1700 and 1980 Ohio lost 90% of its wetlands, primarily due to industrialization development.^{xxxvi} Climate change could further threaten remaining wetlands, particularly ecosystems within the Lake Erie drainage. If the level of Lake Erie falls, the wetland habitats that depend on inundation of freshwater from the lake would be adversely affected.^{xxxvii}

Economically, the Great Lakes states will suffer in the face of climate change. A survey by the United States Fish and Wildlife Services reported that about \$2.96 billion was spent through fishing, hunting, and wildlife recreation activities in Ohio in 2006.^{xxxviii} Increasing temperatures in Ohio would result in range shifts and altered habitat for fish, which could significantly affect the recreational and commercial fishing in the state. In fact, a report by the Union of Concerned Scientists states that Lake Erie's world famous walleye fisheries could be affected by projected climate changes in the region. Certainly, all coastal states, and the nation as a whole, will feel the environmental and economical effects of climate change.^{xxxix}

What can be done to combat climate change? What are some states already doing?

As all states begin to realize the impacts that climate change will have on their unique lands, oceans, and lakes, some states are beginning to adapt to climate change. All coastal states can learn from these states on the forefront of adaptation on the challenges and rewards of adaptation planning.

Maryland

Maryland is one of the most progressive states in adapting to climate change. In August of 2008, Maryland released its *Climate Action Plan*, detailing the steps necessary for Maryland to adequately cope with its changing climate. The *Climate Action Plan* aimed to answer three key questions: 1) What can the state's best scientists tell the state about how and when climate change will affect Maryland's citizens and natural resources?; 2) What can Maryland do to adapt to the consequences of climate change?; and 3) What can Maryland do to reduce emissions of green house gases (GHGs) and the state's carbon footprint to begin reversing global warming trends? To best address these questions, the *Climate Action Plan* examined the likely consequences of the changing global climate to Maryland's agriculture industry, forestry resources, fisheries resources, freshwater supply, aquatic and terrestrial ecosystems, and human health. The *Climate Action Plan* focused on the science of these changes through a *Comprehensive Climate Change Impact Assessment*, Chapter 2 of the *Climate Action Plan*, undertaken by the Commission's Scientific and Technical Working Group (STWG), and based on extensive literature review and model projections. To project future conditions in Maryland, the STWG used Supercomputer models to estimate climate responses to increased GHG concentrations. Specifically, the STWG examined analysis in: water resources and aquatic environments; farms and forests; coastal vulnerability; Chesapeake Bay and coastal ecosystems; human health; and mitigation and adaptation.

As part of the *Climate Action Plan*, the Commission's Adaptation and Response Working Group (ARWG) developed a *Comprehensive Strategy for Reducing Maryland's Vulnerability to Climate Change*, Chapter 5 of the *Climate Action Plan*. This strategy aimed to: promote programs and policies aimed at the avoidance and/or reduction of impact to the existing built environment, as well as to future

growth and development in vulnerable coastal areas; shift to sustainable economies and investments, and avoid assumption of the financial risk of development and redevelopment in highly hazardous coastal areas; enhance preparedness and planning efforts to protect human health, safety and welfare; and protect and restore Maryland's natural shoreline and its resources, including its tidal wetlands and marshes, vegetated buffers, and Bay Islands, that inherently shield Maryland's shoreline and interior. To adequately address this strategy, the ARWG suggested that policies in the following areas be implemented: reduction of impact to existing and future growth; financial and economic well-being; protection of human health, safety and welfare; natural resource protection; adaptation and response toolbox; and future steps and directions.

The Maryland *Climate Action Plan* also examined the importance of mitigation in a climate policy. The Commission, based upon the recommendations of its Greenhouse Gas and Carbon Mitigation Working Group (MWG) in the *Comprehensive Greenhouse Gas and Carbon Footprint Reduction Strategy*, Chapter 4 of the Plan, recommended that Maryland implement forty-two GHG reduction strategies to begin to reduce global warming. Based on those goals, the Commission established: 10 % reduction by 2012; 15 % reduction by 2015; 25 – 50 % reduction by 2020; and 90 % reduction by 2050. To achieve these goals, Maryland has already taken a proactive approach, instituting the Healthy Air Act, The Clean Cars Act, EmPower Maryland Program, and the Commission on Climate Change.^{x1} Currently, the state agency leads are beginning the implementation process for each of the forty-two mitigation strategies and nineteen adaptation strategies through the development of implementation plans for each.^{xii}

Massachusetts

In recognition of the scope and magnitude of the threat posed by global climate change, on August 13, 2008, Governor Patrick signed the Global Warming Solutions Act. Enacted by the Massachusetts legislature and Senate Committee on Global Warming and Climate Change, the Act affirms the Commonwealth's leadership in clean energy and environmental stewardship by requiring reductions in GHG emissions from 1990 levels by 80 % by 2050 and up to 25 % by 2020. Among other

components, the Act also contains a section focused on meeting the threats and challenges posed by climate change. Section 9 of the Act charged the Secretary of Energy and Environmental Affairs with convening and chairing an advisory committee “to analyze strategies for adapting to the predicted impacts of climate change in the commonwealth.” To ensure expansive and diverse input, membership on the advisory committee was prescribed to be broad, with experts from a range of sectors:

- transportation and built infrastructure;
- commercial, industrial, and manufacturing activities;
- low-income consumers;
- energy generation and distribution;
- land conservation;
- water supply and quality;
- recreation;
- ecosystem dynamics;
- coastal zone and ocean;
- rivers and wetlands; and
- local government.

The Act also required the advisory committee to submit a report of its findings and recommendations regarding strategies for adapting to climate change to the legislature. The Climate Change Adaptation Advisory Committee is expected to present its report to the Legislature in spring 2010.

Additionally, specifically for the coastal areas of Massachusetts, the StormSmart Coasts program was established by the Massachusetts Office of Coastal Zone Management and launched in 2008. The program was designed to better assist coastal communities with the challenges arising from erosion, coastal storms, flood events, sea level rise, and climate change, and provides a menu of tools for successful coastal floodplain management.

One of the foundations of the StormSmart Coasts program is the *No Adverse Impact* (NAI) approach to coastal land management. NAI was first articulated by the Association of State Floodplain Managers. NAI examines coastal land management with a “do no harm” approach when planning, designing, and evaluating public and private projects. By following the NAI approach, communities can protect people, property, and municipal budgets. It involves planning, regulation and development standards, mitigation and shore development, infrastructure, emergency services, and education and outreach.

The Massachusetts StormSmart Coasts program offers a comprehensive website designed to help different agencies and stakeholders gather valuable information on adapting coastal areas to climate change.^{xlii} Some of these agencies and stakeholders include: Board of Health; Board of Selectmen; Building Department; Conservation Commission; Department of Public Works; Planning Board; and Zoning Board of Appeals. The website informs each stakeholder of its responsibilities, and provides relevant information on the changing coasts and contact information for other stakeholders for collaboration. The StormSmart Coasts website provides information on funding sources for communities seeking to proactively adapt to climate change. StormSmart Coasts also seeks to educate the community about the impacts of climate change. StormSmart Coasts directs readers to specialized (and often free) training for local officials, and general printed information for citizens.

In 2009, StormSmart Coasts initiated five pilot projects with seven communities – Boston, Hull, Falmouth, Oak Bluffs, and the three-town team of Duxbury, Kingston, and Plymouth – to “test drive” local, pro-active implementation of StormSmart Coasts tools. The results are successful transferable coast-wide models and enhanced partnerships with regional, state, and federal agencies; conservation organizations; academia; and the private sector to better serve coastal communities in Massachusetts.

California

The east coast is not the only coast that has begun to examine climate change adaptation. California is also on the frontlines for experiencing, and adapting to, climate change. In December of 2009, the California Natural Resources Agency in conjunction with multiple state agencies released the 2009 California Climate Adaptation Strategy. The Strategy summarizes the best known science on climate change impacts in seven specific sectors and provides recommendations on how to manage against those threats. The Strategy was a direct response to Governor Schwarzenegger's November 2008 Executive Order S-13-08, that specifically asked the Natural Resources Agency to identify how state agencies can respond to rising temperatures, changing precipitation patterns, sea level rise, and extreme natural events.^{xliii} The report focuses on sectors that include: public health; biodiversity and habitat;

ocean and coastal resources; water management; agriculture; forestry; and transportation and energy infrastructure.

The California Climate Adaptation Strategy emphasizes that climate adaptation and mitigation must complement each other and efforts within and across sectors must be coordinated. The California Climate Adaptation Strategy was developed using the following set of guiding principles: use the best available science in identifying climate change risks and adaptation strategies; understand that data continues to be collected and that knowledge about climate change is still evolving. As such, an effective adaptation strategy is “living” and will itself be adapted to account for new science; involve all relevant stakeholders in identifying, reviewing, and refining the state’s adaptation strategy; establish and retain strong partnerships with federal, state, and local governments, tribes, private business and landowners, and non-governmental organizations to develop and implement adaptation strategy recommendations over time; give priority to adaptation strategies that initiate, foster, and enhance existing efforts that improve economic and social well-being, public safety and security, public health, environmental justice, species and habitat protection, and ecological function; when possible, give priority to adaptation strategies that modify and enhance existing policies rather than solutions that require new funding and new staffing; understand the need for adaptation policies that are effective and flexible enough for circumstances that may not yet be fully predictable; and ensure that climate change adaptation strategies are coordinated with the California Air Resources Board’s AB 32 Scoping Plan process when appropriate, as well as with other local, state, national, and international efforts to reduce GHG emissions.

The preliminary recommendations outlined in the adaptation strategy were developed by the California Natural Resources Agency staff, Climate Adaptation Working Groups, the California mitigation processes, and from public comment. The public comments provided substantive feedback, drawing on the expertise of many organizations and numerous individuals providing a wide variety of perspectives on effective approaches to climate adaptation. Many comments focused on the need for strong coordination and guidance, funding opportunities, and public outreach. All comments were kept

on record for future consideration as updates are made to the Strategy.^{xliv} The Strategy outlines near-term actions that will be completed by the end of 2010 and long-term actions to be developed over time.

How can coastal states use this information, both information on impacts of climate change and how states are proactively protecting against climate change, to better equip the nation's coasts for climate change?

Climate change is impacting the coastal states. Florida and Texas have seen an increase in storm frequency and intensity. This, in turn, has caused increased erosion in coastal areas. Increased storminess and erosion impacts the natural and built environment, the local and tourist economies of the states, and the livability of some of the nation's most populated areas. The Great Lakes are also experiencing the effects of climate change: increased flooding, lake level changes, and loss of wetlands. These changes will have a devastating effect on commercial fisheries, industry, tourism, and recreational fishing. While the news of climate change can be quite somber, the knowledge that states are gaining about its impacts can be empowering. With science-based expertise, the states can take this information and better equip their coasts for future climate challenges.

Many states, such as Maryland, Massachusetts, and California, have begun to take information and create climate change adaptation strategies and plans. States that have not yet formalized adaptation efforts can use these models to guide their processes. Maryland, Massachusetts, and California have all made their reports and plans widely available for public use. Additionally, all three states have been very open about their planning processes and are available to discuss strategies used to create and implement plans.

One of the greatest challenges that coastal states face in adapting to climate change is the need for funding. While funding on the local and state levels has helped many states work toward climate change adaptation plans, there is a strong need for federal funding to help all states achieve climate change adaptation plans and implement strategies. For the nation to successfully adapt to climate change there needs to be federal-state coordination and dedicated federal funding.^{xlv}

ⁱ COASTAL STATES ORGANIZATION, 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 1-3 (2008).

ⁱⁱ KRISTEN M. CROSSETT ET AL., NAT'L OCEANIC AND ATMOSPHERIC ADMINISTRATION, POPULATION TRENDS ALONG THE COASTAL UNITED STATES: 1980-2008 (2004).

ⁱⁱⁱ *Supra* note i.

^{iv} Press Release, University of Miami Rosenstiel School of Marine and Atmospheric Science, *Scientists Unveil Florida Ocean and Coastal Economics Report* (June 13, 2008), available at <http://www.rsmas.miami.edu/pressreleases/20080613-focc.html> (last visited May 5, 2010).

^v JUDITH KILDOW ET AL., NATIONAL OCEAN ECONOMICS PROGRAM, FLORIDA'S OCEAN AND COASTAL ECONOMIES REPORT 9 (2008).

^{vi} *Id.* at 11-16.

^{vii} JOHN T. HOUGHTON ET AL., EDS, CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS: CONTRIBUTION OF WORKING GROUP I TO THE THIRD ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 641-43 (2001).

^{viii} U.S. GLOBAL CLIMATE CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 37 (2009).

^{ix} *Id.*

^x ELIZABETH STANTON & FRANK ACKERMAN, FLORIDA AND CLIMATE CHANGE: THE COSTS OF INACTION 17 (2007) (citing Kerry Emanuel, *Increasing Destructiveness of Tropical Cyclones over the Past 30 Years*, 436 NATURE 686-88 (2005)).

^{xi} THE H. JOHN HEINZ III CENTER FOR SCIENCE, ECONOMICS AND THE ENVIRONMENT, EVALUATION OF EROSION HAZARDS, REPORT BRIEF 2 (2000).

^{xii} THE H. JOHN HEINZ III CENTER FOR SCIENCE, ECONOMICS AND THE ENVIRONMENT, EVALUATION OF EROSION HAZARDS SUMMARY 5 (2000).

^{xiii} *Id.*

^{xiv} KILDOW, *supra* note v, at 60.

^{xv} Richard A. Anthes et al., *Hurricanes and Global Warming – Potential Linkages and Consequences*, 87(5) BULLETIN OF THE AMERICAN METEOROLOGICAL SOCIETY 623-28 (2006).

^{xvi} ELIZABETH STANTON & FRANK ACKERMAN, FLORIDA AND CLIMATE CHANGE: THE COSTS OF INACTION 17 (2007) (citing Kerry Emanuel, *Increasing Destructiveness of Tropical Cyclones over the Past 30 Years*, 436 NATURE 686-88 (2005)).

^{xvii} Kerry Emanuel, *supra* note x, at 686-88.

^{xviii} CENTER FOR INTEGRATIVE ENVIRONMENTAL RESEARCH, THE U.S. ECONOMIC IMPACTS OF CLIMATE CHANGE AND THE COSTS OF INACTION 20 (2007), available at

<http://www.cier.umd.edu/documents/US%20Economic%20Impacts%20of%20Climate%20Change%20and%20the%20Costs%20of%20Inaction.pdf> (last visited Sept. 30, 2009).

^{xix} U.S. GLOBAL CLIMATE CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 115 (2009).

^{xx} UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, CLIMATE CHANGE AND TEXAS (1997) 1-4.

^{xxi} AUGUSTINE REDWINE, ECONOMIC VALUE OF THE TEXAS COAST (2006), available at

http://gbic.tamug.edu/gbeppubs/T1/gbnepT1_01-06.pdf.

^{xxii} *Id.*

^{xxiii} *Supra* note xx.

^{xxiv} *Id.*

^{xxv} *Id.*

^{xxvi} *Id.*

^{xxvii} *Id.*

^{xxviii} *Id.*

^{xxix} *Id.*

^{xxx} *Id.*

^{xxxi} *Id.*

^{xxxii} UNION OF CONCERNED SCIENTISTS, CONFRONTING CLIMATE CHANGE IN THE U.S. MIDWEST: OHIO (2009)

^{xxxiii} UNIVERSITY OF MARYLAND, A REVIEW AND ASSESSMENT CONDUCTED BY THE CENTER FOR INTEGRATIVE ENVIRONMENTAL RESEARCH, ECONOMIC IMPACTS OF CLIMATE CHANGE IN OHIO (2008) 6-9.

^{xxxiv} *Id.*

^{xxxv} *Id.*

^{xxxvi} UNITED STATES ENVIRONMENTAL PROTECTION AGENCY, CLIMATE CHANGE AND OHIO (1998) 1-4.

^{xxxvii} *Id.*

^{xxxviii} CENTER FOR INTEGRATIVE ENVIRONMENTAL RESEARCH, ECONOMIC IMPACTS OF CLIMATE CHANGE IN OHIO (2008).

^{xxxix} *Supra* note xxxii.

^{xi} The Healthy Air Act was adopted as state law in 2006. The Act included a provision for Maryland to join the Regional Greenhouse Gas Initiative (RGGI). The Maryland allocation in RGGI is expected to reduce carbon emissions by approximately 8.7 million tons by 2020. The Clean Cars Act was adopted as state law in 2007, requiring implementation of the California Clean Cars program. EmPower Maryland Program was launched by Governor O'Malley in July 2007 and codified by the General Assembly in its 2008 Session, and is designed to reduce per capita electricity use by Maryland consumers by 15 % in 2015. The program could possibly reduce GHG emissions by about 7 million tons in 2020. The Commission on Climate Change was established by executive order in April 2007 to advise the Governor and General Assembly on matters related to climate change and to develop a *Climate Action Plan*.

^{xli} For more information on the Maryland Climate Action Plan:

<http://www.mde.state.md.us/air/climatechange/index.asp>.

^{xlii} For more information on the Climate Change Adaptation Advisory Committee:

<http://www.mass.gov/dep/public/committee/ccaac.htm>. For more information on StormSmart Coasts:

<http://www.mass.gov/czm/stormsmart/index.htm>.

^{xliii} Press Release, Arnold Schwarzenegger, *Gov. Schwarzenegger Issues Executive Order Directing State Agencies to Plan for Sea Level Rise and Climate Impacts* (November 14, 2008), available at <http://www.gov.ca.gov/press-release/11035/> (last visited May 5, 2010).

^{xliiv} Public comments can be accessed: www.climatechange.ca.gov/adaptation/.

^{xlv} See PEW CENTER ON GLOBAL CLIMATE CHANGE, ADAPTING TO CLIMATE CHANGE: A CALL FOR FEDERAL LEADERSHIP (2010). The report examines, in depth, why federal leadership and funding is needed to adequately cope with the nation's changing climate.