

Chapter 8

Adaptation Strategies

Among the topics considered by the Governor's Action Team on Energy and Climate Change, adaptation is quite distinct from mitigation. Not only is adaptation about coping with the consequences of climate change rather than trying to prevent or limit them, but adaptation itself is a very broad topic, covering the many sectors that may be affected by global climate change. This includes infrastructure; the built environment; coastal resources; water resources; extreme climate events (and emergency response); marine, freshwater, and terrestrial ecosystems; and human health. Adaptation to climate change will be addressed by many state agencies, regional and local entities, non-profit organizations, the private sector, and individuals, thus making adaptation diffuse and diverse. This complicates adaptation policy development and implementation. Accordingly, the approach taken by the Action Team was to review the myriad resources and associated policies that are affected or could be affected by climate change to ensure their robustness and resilience in the face of climate change.

The Adaptation Technical Work Group (TWG) addressed a wide variety of topics in its deliberations. The work of the TWG also is unique among the six TWGs because there is no common metric for measuring success of adaptation measures. GHG reductions can be compared based on such common metrics as dollars per ton of carbon dioxide equivalent. There is no parallel outcome on adaptation. Some adaptations concern human life, others property, and still others are about reducing impacts of climate change on ecosystems and threatened or endangered species.

Science and Impacts of Climate Change¹

Florida, because of its low-lying topography and geographical location in the sub-tropics, is especially vulnerable to sea level rise and extreme weather.

The Intergovernmental Panel on Climate Change (IPCC) projected a warming in the southeastern United States of approximately 4 to 6°F (2 to 3°C) for a medium scenario of greenhouse gas emissions². Higher emissions scenarios, which are quite possible, would result in larger temperature increases. Temperatures are projected to rise more in the summer than in the winter.

¹ This section is a summary of Florida Atlantic University, "Florida's Resilient Coasts" (Murley et al., 2008)

² Christensen, J.H., B. Hewitson, A. Busuioc, A. Chen, X. Gao, I. Held, et al. 2007. "Regional Climate Projections." In: Solomon, S., D. Qin, M. Manning, M. Marquis, K. Averyt, M.M.B. Tignor, et al., eds. Intergovernmental Panel on Climate Change (IPCC). 2007. *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. New York: Cambridge University Press.

The IPCC also projected that precipitation patterns will change. It is difficult to confidently predict precipitation changes on a scale as small as Florida, but the climate models tend to project decreased precipitation over the Southeastern United States. The models show a tendency toward reductions in summer precipitation³.

The IPCC also projected a sea level rise (SLR) of at least 9 inches to 23 inches by the end of the 21st Century⁴. This projection was based on published reports through 2005 and did not account for dramatically increased rates of land-based glacial melting observed in Greenland and Antarctica since the publication of the latest IPCC assessment⁵. Many scientists have stated that increases in melt rates in Greenland and Antarctica will make significant contributions to sea level rise beyond that projected in the IPCC Assessment⁶. For example, the Science and Technology Committee of the Miami-Dade County Climate Change Advisory Task Force projected a SLR of at least 1.5 feet in the coming 50 years and at least 3-5 feet by the end of the century⁷.

In general, elevations of barrier islands are only minimally above sea level and much of Florida's barrier islands have been subject to extensive development of high value oceanfront real estate. These areas are at significant risk from SLR and increased intensity of hurricanes. Beach erosion, which already costs Florida more than \$600 million per year,⁸ is likely to increase. Coastal wetlands could be inundated by sea level rise. The Everglades represent the largest and most important of Florida's coastal wetlands. As sea levels rise, brackish waters will extend further inland and dramatically change these and other freshwater ecosystems. Unconfined coastal aquifers, such as the Biscayne Aquifer in South Florida, will become more saline because of sea level rise.

Florida was hit by 10 named storms in 2004 and 2005 and, to date, has been hit by several large hurricanes and tropical storms in 2008. The intensity of hurricanes is projected to increase,⁹ although there is disagreement in the scientific community about whether the hurricane intensity has changed as a result of climate change. It is documented that wind speeds in the most powerful hurricanes have increased since the mid-1980s.¹⁰

³ Christensen, J.H., B. Hewitson, A. Busuioc, A. Chen, X. Gao, I. Held, et al. 2007. "Regional Climate Projections."

⁴ Solomon, S., D. Qin, M. Manning, M. Marquis, K. Averyt, M.M.B. Tignor, et al., eds. 2007. (IPCC). Intergovernmental Panel on Climate Change. 2007. *Climate Change 2007: The Physical Science Basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. New York: Cambridge University Press.

⁵ Pfeffer, W.T., J.T. Harper, and S. O'Neil. 2008. "Kinematic Constraints on Glacier Contributions to 21st Century Sea-Level Rise." *Science*. 321:1340-43.

⁶ Oppenheimer, M., B.C. O'Neil, M. Webster, and S. Agrawala. 2007. "The Limits of Consensus." *Science* 317: 1505-06.

⁷ Murley, J., N. Bolman, and B. Heimlich. 2008. "Florida's Resilient Coasts." Florida Atlantic University.

⁸ *Ibid.*

⁹ *Ibid.*

¹⁰ Elsner, J. B., J.P. Kossin, and T.H. Jagger. 2008. "The increasing intensity of the strongest tropical cyclones." *Nature* 455: 92-95.

Even if hurricanes do not change, higher sea levels alone will result in higher storm surges. More intense hurricanes will likely lead to even higher storm surges and more damaging wind speeds.

According to Florida Atlantic University's study "Florida's Resilient Coasts," Murley et al. 2008 states:

In addition to sea level rise and hurricanes, there are numerous other potential effects of global warming that could affect Florida's communities and environment physically, economically and socially, including:

- Prolonged drought affecting water supplies, agriculture, and habitat;
- More wildfires due to excessive drought and heat;
- More flooding due to more torrential rains;
- More frequent and lengthy heat waves creating increased energy demands and health hazards to young children, elderly, and infirm;
- Potential insect infestation and insect-borne diseases resulting from increased temperatures combined with increased flooding due to storms;
- Bleaching of coral reefs and adverse effects on marine life and fisheries;
- Ecological changes in the Everglades and other natural systems affecting plant ecology, wildlife, the marine estuaries and coast, and tourism; and
- Economic, environmental, and social impacts.

Framework for Action and Goals

Based on the knowledge about the risks from climate change, the TWG developed a framework of adaptation topics and identified goals and strategies to address each topic. The framework and major objectives are:

ADP-1. Advancing Science Data and Analysis for Climate Change

Scientific data, analyses, and predictive modeling are needed to understand how Florida's climate is likely to change, the consequences of change, and possible solutions.

ADP-2. Comprehensive Planning

Florida's local, state, and regional comprehensive plans should be amended based on the best available data, include goals, objectives, and policies that will prepare the state for adapting to the future impacts of climate change, such as SLR. Future policies should use

incentives to encourage desired actions, including encouragement not to repeat past decisions that will leave new development exposed to SLR and other climate change consequences.

ADP-3. Protection of Ecosystems and Biodiversity

Florida's ecosystems should be managed for resiliency by enhancing their ability to naturally adapt to the stresses of climate change and other pervasive threats, including invasive exotic species. In addition, climate change should be incorporated into all aspects of the beach management and coastal construction regulatory programs.

ADP-4. Water Resources Management

In order for Floridians to have adequate water supply available to meet their basic reasonable and beneficial needs while meeting the requirements of natural systems, state and local governments need to pursue intense conservation of all water uses and alternative water sources, and include stakeholder involvement in statewide and regional water supply planning processes. Climate change may impact existing sources due to many factors including altered rainfall patterns and salt water intrusion into coastal aquifer systems. Methods to quantify and plan for uncertainties and risks related to population growth, climate change, and environmental regulations will be needed.

ADP-5. Built Environment, Infrastructure and Community Protection

The reduction of potential damage to the built environment from the impact of natural hazards, especially from those hazards caused or exacerbated by climate change, should be a high priority for all levels of government and the private sector in Florida.

ADP-6. Economic Development

Policies, programs, and implementation mechanisms should be developed to support the ability of Florida's economy to adapt to climate change.

ADP-7. Insurance

Insurance rates should reflect risks from climate and climate change and be equitable and affordable. In addition, policies should discourage high risk development, particularly along the coast.

ADP-8. Emergency Preparedness and Response

Florida's future emergency preparedness and response functions should build on the excellence gained through past experience to ensure sufficient capacity and efficacy in protecting public health and welfare against the risks from climate change such as more intense hurricanes and floods and potential spread of disease and heat stress.

ADP-9. Human Health Concerns

Florida's health plan should incorporate considerations of climate change to protect the health of its citizens.

ADP-10. Social Effects

Issues of social justice should be addressed. Food, water, and housing security should be protected and behavioral responses to extreme events and climate change need to be better understood.

ADP-11. Organizing State Government for the Long Haul

A single point of focus within state government should be created that can continue assessing the risks posed by climate change, develop increasingly informed adaptation planning, and adjust adaptation planning in Florida as events on the ground change. The Legislature created the Florida Energy and Climate Commission, which appears at present to have sufficient scope, powers, and resources to accomplish the intent of this element of adaptation planning. However, it will be important to assess the effectiveness of the commission in addressing adaptation.

ADP-12. State Funding and Financing

Florida should be prepared to fund the protection of human health and critical infrastructure, as well as address other impacts of climate change, where feasible, within a framework of protection, accommodation – and, in some cases, retreat.

ADP-13. Coordination with Other Regulatory and Standards Entities

Functional collaborative relationships between the State of Florida and selected federal government agencies entities, other states and countries, and key professional societies should be developed on climate change issues of mutual interest. Research agendas and funding sources should be aligned to address common interests and priorities.

ADP-14. Education

Florida should become a national and international leader in the dissemination of climate change information in the process of educating a broad diversity of constituents with cutting-edge and successful public education programs.

Recommended Early Action Items

The following recommendations were identified as Early Action Items for consideration by Florida's policymakers:

- Research
 - Foster and support a climate science research agenda for Florida with broad priorities. Institute a scientific advisory council on climate change to advise state government on this research agenda. Identify and establish long-term funding to support research. Funding should be protected from short-term economic or political cycles.
 - Conduct research needed to support incorporation of climate change into the protection of Florida's ecosystems and biodiversity.
 - Enhance support for mapping, monitoring, and modeling, all of which will be necessary to provide information to support policy-making. In addition, effective monitoring programs are needed to detect impacts of climate change; modeling is also needed to project impacts with more accuracy.
- Comprehensive Planning
 - State and regional agencies should provide financial and technical assistance to local governments to ensure timely updates of local plans.
 - Local governments should review their coastal management elements to determine necessary amendments to make their coastal areas (especially the coastal high-hazard area) resilient to the future impacts of climate change, including sea-level rise.
 - Florida statutes, regulations, policies, and the Florida Administrative Code should be reviewed by the Florida Attorney General to determine potential conflicts between private property rights and the state and local governments' responsibility to protect communities.
- Protection of Ecosystems and Biodiversity
 - Ensure that a representative portfolio of Florida's terrestrial, freshwater, and marine natural communities with redundant representation of habitats and species and connecting corridors is protected and managed in a manner that maximizes the health and resilience of these communities when facing climate change impacts.
 - Reduce and discourage future reliance on bulk-heading/hardening to stabilize estuarine and beach shorelines. Shoreline hardening should be considered only after a full and cumulative assessment of short- and long-term impacts to coastal resources and coastal ecosystems. Establish policies and regulations that clearly define when, how, where, and under what circumstances emergency beach stabilization is allowed.
 - The vulnerability of Florida's fish and wildlife to climate change impacts should be assessed, the most vulnerable species should be identified, and plans prepared to enhance their chances of survival where there is a reasonable likelihood that the species will survive over the next 50 years.
- Water Resources Management

- Identify and quantify the potential effects of differing climate change scenarios on the vulnerabilities and reliability of existing water supplies with emphasis on source water availability and quality.
- Built Environment
 - Require that the Florida Building Code incorporate building design criteria for resisting future loads that may result from the impact of climate change-exacerbated hazards during a minimum service life of 50 years.
 - Develop required training provisions to educate professionals in relevant fields (such as architecture, engineering, and construction management) on the need to incorporate adaptation to climate change as a basis for establishing design criteria for new infrastructure. Completion of such required training provisions would be a condition for licensing.
- Public Education and Outreach
 - Provide immediate training on climate change adaptation.
 - Initiate a major public education campaign.