

CLIMATE CHANGE AND SOUTH CAROLINA’S ECONOMY

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We are now faced with the fact, my friends, that tomorrow is today. We are confronted with the fierce urgency of now. In this unfolding conundrum of life and history, there is such a thing as being too late. Procrastination is still the thief of time. Life often leaves us standing bare, naked, and dejected with a lost opportunity. The tide in the affairs of men does not remain at flood—it ebbs. We may cry out desperately for time to pause in her passage, but time is adamant to every plea and rushes on. Over the bleached bones and

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jumbled residues of numerous civilizations are written the pathetic words, "Too late."¹

I. INTRODUCTION

In early February 2007, the Intergovernmental Panel on Climate Change ("IPCC") issued a report ("IPCC 2007 Report") stating the scientific understanding of human influence on climate has improved to a greater than 90% confidence that human activity is causing climate change.² The IPCC 2007 Report is based on an enormous amount of new and more comprehensive scientific research generated over the past six years.³ The report represents a worldwide scientific collaborative effort including 2500 scientific expert reviewers, 800 contributing authors, and 450 lead authors from 130 countries.⁴ The IPCC found climate change is occurring right now: temperatures in the air and ocean are rising; eleven of the last twelve years have been the warmest on record; there are increasingly more hot periods and fewer cold periods; heat waves have become more frequent; permafrost is thawing; snow pack, glaciers, icecaps and sea ice are melting; sea level is rising; precipitation patterns across the globe are shifting; and storm events, including hurricanes, are increasingly becoming more severe.⁵

¹ Dr. Martin Luther King Jr., *Beyond Vietnam*, Address at Riverside Church, New York City (Apr 4, 1968), transcript available at www.stanford.edu/group/King/publications/speeches/Beyond_Vietnam.pdf.

² Richard B. Alley et al., *Summary for Policymakers*, in INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2007: THE PHYSICAL SCIENCE BASIS OF CLIMATE CHANGE: CONTRIBUTION OF WORKING GROUP I TO THE FOURTH ASSESSMENT REPORT OF THE IPCC 3 (Susan Solomon et al. eds., Cambridge Univ. Press 2007) [hereinafter IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS], available at <http://ipcc-wg1.ucar.edu/wg1/wg1-report.html>.

³ See Ulrich Cubasch, *Historical Overview of Climate Change Science*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 121 (comparing the IPCC 2007 Report to the Third Assessment Report ("TAR") issued by the IPCC in 2001, and stating "much published research and many notable scientific advances have occurred since the TAR, including advances in the understanding and treatment of uncertainty."); see also Press Release, Intergovernmental Panel on Climate Change, Media Advisory, IPCC Adopts Major Assessment of Climate Change Science (Feb. 2, 2007), available at <http://www.ipcc.ch/pdf/press-releases/pr-02february2007.pdf>.

⁴ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, A PICTURE OF CLIMATE CHANGE: THE CURRENT STATE OF UNDERSTANDING 1 (2007), available at <http://www.ipcc.ch/pdf/press-ar4/ipcc-flyer-low.pdf>.

⁵ Alley et al., *Summary for Policymakers*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 5-9.

The National Science Academies of the United States of America, the United Kingdom, Russia, Japan, Italy, India, Germany, France, China, Canada, and Brazil, issued a joint statement in 2005 warning:

[H]uman activities are now causing atmospheric concentrations of greenhouse gases . . . to rise well above pre-industrial levels. . . . Increasing greenhouse gases are causing temperatures to rise

The scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action

We urge all nations . . . to reduce the causes of climate change, adapt to its impacts and ensure that the issue is included in all relevant national and international strategies.⁶

These sentiments have been consistently echoed by other scientific panels to consider human impacts on global climate change. The United States National Research Council Committee on the Science of Climate Change stated in 2001 that “[g]reenhouse gases are accumulating in Earth’s atmosphere as a result of human activities, causing surface air temperatures and subsurface ocean temperatures to rise.”⁷ In 2003, the American Geophysical Union found that “[h]uman activities are increasingly altering the Earth’s climate.”⁸ The American Association for the Advancement of Science issued a message in 2006 stating “[c]limate change is real, humans are responsible for a substantial part of it, [and] it’s taking us in dangerous directions.”⁹ The American Meteorological Society (“AMS”) stated in 2007 that “humans have significantly contributed to [climate] change.”¹⁰ The AMS warned that “[p]rudence dictates extreme care in managing our relationship with the only planet known to be capable of sustaining human life.”¹¹

⁶ NAT’L ACAD., JOINT SCIENCE ACADEMIES’ STATEMENT: GLOBAL RESPONSE TO CLIMATE CHANGE 1-2 (2005), *available at* <http://www.nationalacademies.org/onpi/06072005.pdf>.

⁷ COMM. ON SCI. CLIMATE CHANGE, NAT’L RESEARCH COUNCIL, CLIMATE CHANGE SCIENCE: AN ANALYSIS OF SOME KEY QUESTIONS 1 (Nat’l Acad. Press 2001).

⁸ AM. GEOPHYSICAL UNION, HUMAN IMPACTS ON CLIMATE POSITION STATEMENT (2003), *available at* http://www.agu.org/sci_soc/policy/climate_change_position.html.

⁹ Windows Media Video: John P. Holdren, Am. Assoc. for the Advancement of Sci. President, Climate-Change Message (2006), *available at* http://www.aaas.org/news/press_room/climate_change (follow “John P. Holdren’s Climate-Change Message” hyperlink under “Climate Change News” heading).

¹⁰ AM. METEOROLOGICAL SOC’Y, CLIMATE CHANGE; AN INFORMATION STATEMENT OF THE AMERICAN METEOROLOGICAL SOCIETY, 88 BULL. AMER. METEROLOGICAL SOC’Y 418, 421 (2007).

¹¹ *Id.*

Additionally, other statements acknowledging that human activity is causing climate change have been made by the most well respected and prestigious scientific bodies here and abroad, including: the American Association for the Advancement of Science;¹² the American Physical Society;¹³ the American Institute of Physics;¹⁴ the American Astronomical Society;¹⁵ the American Association of State Climatologists;¹⁶ the International Union of Geodesy and Geophysics;¹⁷ the InterAcademy Council representing Brazil, Chile, China, France, Germany, Hungary, India, Iran, Japan, Malaysia, Turkey, the United Kingdom, and the United States, plus the African Academy of Sciences and the Academy of Sciences for the Developing World;¹⁸ the Network of African Science Academies;¹⁹

¹² AM. ASS'N FOR ADVANCEMENT SCI., AAAS BOARD STATEMENT ON CLIMATE CHANGE 1 (2006), *available at* http://www.aaas.org/news/press_room/climate_change/mtg_200702/aaas_climate_statement.pdf (“The scientific evidence is clear: global climate change caused by human activities is occurring now, and it is a growing threat to society.”).

¹³ AM. PHYSICAL SOC'Y, NATIONAL POLICY: CLIMATE CHANGE (2007), *available at* http://www.aps.org/policy/statements/07_1.cfm (“Emissions of greenhouse gases from human activities are changing the atmosphere in ways that affect the Earth's climate.”)

¹⁴ AM. INST. PHYSICS, AIP ENDORSEMENT OF AMERICAN GEOPHYSICAL UNION CLIMATE CHANGE STATEMENT (2004), *available at* <http://www.aip.org/fyi/2004/042.html> (“The Governing Board of the American Institute of Physics has endorsed a position statement on climate change adopted by the American Geophysical Union (AGU) Council in December 2003.”). The statement by the American Geophysical Union's statement asserts that “[h]uman activities are increasingly altering the Earth's climate.” AM. GEOPHYSICAL UNION, *supra* note 8.

¹⁵ AM. ASTRONOMICAL SOC'Y, AMERICAN ASTRONOMICAL SOCIETY ENDORSEMENT OF AGU STATEMENT ON CLIMATE CHANGE 1 (2004), *available at* <http://www.aas.org/governance/resolutions.php> (follow “Endorsement of AGU Statement on Climate Change” hyperlink under “Resolutions Related to Society” heading) (“The global climate is changing and human activities are contributing to that change.”).

¹⁶ AM. ASS'N STATE CLIMATOLOGISTS, POLICY STATEMENT ON CLIMATE VARIABILITY AND CHANGE 1 (2001), *available at* <http://www.stateclimate.org/publications/files/aasclimatepolicy.pdf> (“The [Association] recognizes that human activities have an influence on the climate system.”).

¹⁷ INT'L UNION GEODESY & GEOPHYSICS, THE URGENCY OF ADDRESSING CLIMATE CHANGE (2007), *available at* <http://www.iugg.org/resolutions/perugia07.pdf> (“Continuing reliance on combustion of fossil fuels as the world's primary source of energy will lead to much higher atmospheric concentrations of greenhouse gases, which will, in turn, cause significant increases in surface temperature, sea level, ocean acidification, and their related consequences to the environment and society . . .”).

¹⁸ INTERACAD. COUNCIL, LIGHTING THE WAY: TOWARD A SUSTAINABLE ENERGY FUTURE, at v (2007), *available at* <http://www.interacademycouncil.net/CMS/Reports/11840/11842.aspx> (“Current patterns of energy resources and energy usage are proving detrimental to the long-term welfare of humanity. The integrity of essential natural systems is already at risk from climate change caused by the atmospheric emissions of greenhouse gases.”).

¹⁹ NETWORK AFR. SCI. ACAD., JOINT STATEMENT BY THE NETWORK OF AFRICAN SCIENCE ACADEMIES (NASAC) TO THE G8 ON SUSTAINABILITY, ENERGY EFFICIENCY AND CLIMATE

the European Academy of Sciences and Arts;²⁰ the European Geosciences Union;²¹ the Royal Meteorological Society;²² the Geological Society of London;²³ and the Canadian Meteorological and Oceanographic Society.²⁴

This parade of statements on climate change is impressive. More compelling yet; there is not a single major scientific body of national or international significance left which rejects the basic finding that climate change has human causes.²⁵ Therefore, this article presupposes that the

CHANGE 1 (2007), available at <http://www.interacademies.net/?id=7907> (follow “Joint Statement by NASAC Members to the G8 on Sustainability, Energy Efficiency and Climate Change” hyperlink) (“A consensus, based on current evidence, now exists within the global scientific community that human activities are the main source of climate change and that the burning of fossil fuels is largely responsible for driving this change.”)

²⁰ EUR. ACAD. SCI. & ARTS, LET'S BE HONEST 1 (2007), available at <http://www.european-academy.at/de/index.html> (follow “Let's Be Honest” hyperlink) (“Human activity is most likely responsible for climate warming. Most of the climatic warming over the last 50 years is likely to have been caused by increased concentrations of greenhouse gases in the atmosphere.”) (emphasis in original).

²¹ EUR. GEOSCIENCES UNION, POSITION STATEMENT ON CLIMATE CHANGE AND RECENT LETTERS FROM THE CHAIRMAN OF THE U.S. HOUSE OF REPRESENTATIVES COMMITTEE ON ENERGY AND COMMERCE 1 (June 2005), available at <http://www.copernicus.org/EGU/egustatement.pdf> (The Union “support[s] the joint science academies’ statement on global response to climate change of June 2005.”) The Joint Science Academies’ statement asserts that “[i]ncreasing greenhouse gases are causing temperatures to rise; the Earth’s surface warmed by approximately 0.6 centigrade degrees over the twentieth century.” NAT’L ACAD., *supra* note 6, at 1.

²² ROYAL METEOROLOGICAL SOC’Y, THE ROYAL METEOROLOGICAL SOCIETY’S STATEMENT ON THE INTER-GOVERNMENTAL PANEL ON CLIMATE CHANGE’S FOURTH ASSESSMENT REPORT 1 (2007), available at <http://www.rmets.org/news/detail.php?ID=332> (“The changes we are seeing now in our climate are the result of emissions since industrialisation and we have already set in motion the next 50 years of global warming—what we do from now on will determine how worse it will get.”).

²³ GEOLOGICAL SOC’Y (LONDON) STRATIGRAPHY COMM’N, GLOBAL WARMING ESSAY 1 (2007), available at <http://www.geolsoc.org.uk/gsl/null/lang/en/page1022.html> (“We find that the evidence for human-induced climate change is now persuasive, and the need for direct action compelling.”).

²⁴ CAN. METEOROLOGICAL & OCEANOGRAPHIC SOC’Y, CONGRESS STATEMENT ON CLIMATE CHANGE 1 (2006), available at <http://www.cfcas.org/pressrelease1June2006.pdf> (“Climate change is happening now, both in Canada and around the world. Most of this change is attributable to human activities that release greenhouse gas into the atmosphere.”).

²⁵ JULIE BRIGHAM-GRETTE ET AL., PETROLEUM GEOLOGISTS’ AWARD TO NOVELIST CRICHTON IS INAPPROPRIATE, 87 EOS 364, 364 (2006), available at <http://www.agu.org/fora/eos/pdfs/2006EO360008.pdf> (stating that the American Association of Petroleum Geologists (“AAPG”) “stands alone among scientific societies in its denial of human-induced effects on global warming”). The article was published in *Eos*, a publication of the American Geophysical Union, in 2006, and since then the AAPG changed its formerly-defiant position on the human influence on climate, stating: “[a]lthough the AAPG membership is divided on the degree of influence that anthropogenic CO₂ has on recent and potential global

worldwide scientific consensus regarding the human influence on climate change is genuine and that the stern warnings from the scientific community are to be taken seriously.

The people of South Carolina have embraced the scientific consensus. As a recent poll revealed, the majority of South Carolina voters from both parties believe action should be taken now to address climate change.²⁶ The state's leaders are acknowledging the issue as well. South Carolina Governor Mark Sanford wrote a piece in the Washington Post discussing his commitment to addressing the climate issue.²⁷ Over two-thirds of the South Carolina House of Representatives and twenty-one State Senators signed open letters from their respective branches to the presidential candidates, calling on them to make "climate change a priority."²⁸ More than 100 South Carolina Mayors, representing more than 1 million South Carolina residents, signed a similar letter.²⁹ Additionally, five of these mayors have pledged to meet certain targets for greenhouse gas reduction in their own municipalities.³⁰ With such political will in South Carolina, the state stands well positioned to take actions to address climate change, show leadership in the Southeast, and take hold of the economic opportunities that are available through greenhouse gas reduction measures.

temperature increases, the AAPG believes that expansion of scientific climate research into the basic controls on climate is important." AM. ASS'N PETROLEUM GEOLOGISTS, CLIMATE CHANGE 1 (2007), available at <http://dpa.aapg.org/gac/statements/climatechange.pdf>. The AAPG also now "supports the pursuit of economically viable technology to sequester CO₂ emissions and emissions of other gases in a continuing effort to improve our environment and enhance energy recovery." *Id.* at 2.

²⁶ Press Release, League of Conservation Voters, New Statewide Poll Shows Majority of South Carolina Primary Voters Believe We Should Take Action Now To Address Global Warming: Strong Agreement Between Republicans and Democrats on Solutions (Apr. 2007), available at http://www.ega.org/news/docs/4_25-SCBallotQuestionRelease2.pdf.

²⁷ Mark Sanford, *A Conservative Conservationist?*, WASH. POST, Feb. 23, 2007, at A19.

²⁸ Letters from Select Members of the South Carolina House of Representatives and South Carolina Senate to Presidential Candidates, *An Open Letter to the Presidential Candidates Visiting South Carolina* (Apr. 24, 2007), available at <http://conservationvotersofsc.org/cvsc/htdocs/downloads/GW%20House%20and%20Senate%20Open%20Letter%20April%2007.doc>.

²⁹ Press Release, League of Conservation Voters, Over 100 South Carolina Mayors Release Bipartisan Open Letter to '08 Presidential Candidates Calling for Leadership on Climate Change (Nov. 02, 2007), available at <http://www.lcv.org/newsroom/press-releases/> (follow "Over 100 South Carolina Mayors Release Bipartisan Open Letter to '08 Presidential Candidates Calling for Leadership on Climate Change" hyperlink). The text of this letter is available through the League of Conservation Voters Web site at <http://www.lcv.org/2008/scletter1102.doc>.

³⁰ See U.S. Conference of Mayors: Mayors Climate Protection Committee Agreement, Cities that Have Signed On, <http://usmayors.org/climateprotection/cities.asp?state=SC> (last visited Apr. 29, 2008).

If we do not change our behavior and continue to produce greenhouse gasses at the projected rates, how can we expect climate change to affect the economy? The overall global risks and costs of unchecked climate change are expected to be the equivalent of losing between 5% and 20% of the global per-capita consumption each year, “now and forever.”³¹ South Carolina is particularly vulnerable to climate impacts.³² This paper examines the potential impacts specific to the state’s economy.

It is important to note that climate change impact predictions are based on different climate scenarios, each created with highly sophisticated computer modeling systems representing different assumptions concerning world population, the global economy, and annual carbon dioxide (“CO₂”) emissions; therefore, all impact predictions contain amounts of uncertainty.³³ However, uncertainty inherent in models and other planning mechanisms does not negate their usefulness, as these powerful tools are often used by industry and the military “for future planning in high-stakes situations.”³⁴ This article is intended to catalyze further discussion as to how South Carolina can move down the path toward addressing climate change.³⁵

³¹ NICHOLAS STERN, *THE ECONOMICS OF CLIMATE CHANGE: THE STERN REVIEW* 161-62 (Cambridge Univ. Press 2006). A pre-publication version of this report is available in electronic form at <http://www.hm-treasury.gov.uk/index.cfm> (follow “Newsroom & speeches” hyperlink; then follow “Independent reviews” hyperlink; then follow “Stern Review on the Economics of Climate Change” hyperlink).

³² JOEL B. SMITH, PEW CTR. ON GLOBAL CLIMATE CHANGE, *A SYNTHESIS OF POTENTIAL CLIMATE CHANGE IMPACTS ON THE UNITED STATES* 22 (2004), available at <http://www.pewclimate.org/docUploads/Pew-Synthesis.pdf> (stating that the Southeast Region “is the most vulnerable to sea-level rise because of its low-lying coast and heavy development in many areas”).

³³ See NAT’L ASSESSMENT SYNTHESIS TEAM, U.S. GLOBAL CHANGE RESEARCH PROGRAM, *CLIMATE IMPACTS ON THE UNITED STATES: THE POTENTIAL CONSEQUENCES OF CLIMATE VARIABILITY AND CHANGE* 4 (Cambridge Univ. Press 2001) [hereinafter NAT’L ASSESSMENT SYNTHESIS TEAM], available at <http://www.usgcrp.gov/usgcrp/Library/nationalassessment/foundation.htm>.

³⁴ *Id.*

³⁵ As a synthesis of the available literature on the subject generated by scientists, economists, researchers and governmental entities relevant to the southeastern region of the United States and to South Carolina, the potential impacts described in this paper are based upon varying climate change scenarios.

II. POTENTIAL IMPACTS

A. Tourism

Tourism is an important part of South Carolina's economy, and will most likely be negatively affected by climate change.³⁶ Travel and tourism brings about 30 million visitors to the state each year,³⁷ generates \$15 billion a year, and "is responsible for 11% of the state's jobs and \$1 billion each year in state and local tax revenue."³⁸ Nearly 60% of this tax revenue comes from the coastal counties of Horry, Charleston and Beaufort.³⁹ Climate change will negatively impact these coastal areas and the tourism industry associated with them.⁴⁰ Tourism relies heavily upon the coast, which is threatened in many possible ways with potential increases in: sea level rise,⁴¹ storm intensity,⁴² storm frequency,⁴³ floods,⁴⁴ number of heat waves,⁴⁵ droughts,⁴⁶ beach erosion,⁴⁷ loss of wetlands,⁴⁸ barrier island deterioration,⁴⁹

³⁶ World Tourism Ass'n, *Climate Change and Tourism*, Proceedings of the 1st International Conference on Climate Change and Tourism, Djerba, Tunisia, 37 (Apr. 9-11, 2003) [hereinafter *Climate Change and Tourism*], available at <http://www.world-tourism.org/sustainable/climate/final-report.pdf>.

³⁷ S.C. DEP'T PARKS, RECREATION, & TOURISM, *ECONOMIC CONTRIBUTION OF TOURISM IN SOUTH CAROLINA* (2008), available at <http://www.scprt.com/files/Research/SC%20Tourism%20Update%203-5-08.pdf>.

³⁸ Jan Collins, *Climate Change: An Environmental and Business Issue*, 53 *BUS. & ECON. REV.* 3, 5 (2006).

³⁹ *Id.*

⁴⁰ *Id.*

⁴¹ Alley et al., *Summary for Policymakers*, in *IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 13 tbl.SPM.3; James G. Titus, *Sea Level Rise and Wetland Loss: An Overview*, in *GREENHOUSE EFFECT, SEA LEVEL RISE AND COASTAL WETLANDS*, EPA-230-05-86-013, 31 (James Titus ed., 1988), available at <http://yosemite.epa.gov/oar/GlobalWarming.nsf/content/ResourceCenter.html> (follow "Publications" hyperlink, then follow "Sea Level Rise Reports" hyperlink).

⁴² WILLIAM D. NORDHAUS, *THE ECONOMICS OF HURRICANES IN THE UNITED STATES* 23 (2006), available at http://nordhaus.econ.yale.edu/hurr_122106a.pdf (showing an increase in hurricane power that appears to follow increases in sea surface temperature).

⁴³ Alley et al., *Summary for Policymakers*, in *IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 8 (indicating an increase in "heavy precipitation events" and stating that it is "very likely" that the frequency of such events will increase in the future).

⁴⁴ *Id.*; see also STERN, *supra* note 31, at 128 ("In the short to medium term, the most costly impacts are expected from coastal flooding and extreme events.").

⁴⁵ Alley et al., *Summary for Policymakers*, in *IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 8 tbl.SPM.2.

⁴⁶ *Id.*; see also JAMES G. TITUS, U.S. ENVTL. PROT. AGENCY, EPA-230-05-89-050, *THE POTENTIAL EFFECTS OF GLOBAL CLIMATE CHANGE ON THE UNITED STATES* 318-19 (1989) [hereinafter *POTENTIAL EFFECTS*], available at www.epa.gov (search for "The Potential

insect populations,⁵⁰ and incidence of disease.⁵¹ Tourism is extremely sensitive to weather, which is of paramount importance for travel decision making.⁵² Tourism patterns may shift as a response to coastal degradation and uncomfortably high temperatures during the peak summer season.⁵³ Global average temperatures are now expected to rise between 3.2° and 7.2° F by the end of the century.⁵⁴ If tourism patterns shift due to increased temperatures, the industry will have to adapt accordingly and will likely face serious economic consequences.⁵⁵

B. Coastal Property

Sea level rise, which is occurring right now,⁵⁶ is caused by increasing ocean temperatures expanding the ocean's volume, and by meltwater being released where it was previously locked up in ice stores such as glaciers and ice shelves.⁵⁷ The exact amount of sea level rise within this century is difficult to precisely predict due to uncertainty surrounding how much meltwater will be released from ice sheets in places like Greenland.⁵⁸ Within this century, the IPCC predicts sea level to rise between 0.18 and 0.59 meters.⁵⁹ This prediction is extraordinarily conservative because it does not

Effects of Global Climate Change on the United States") (addressing a number of the potential impacts of increased droughts in the Southeast).

⁴⁷ Collins, *supra* note 38, at 5-6.

⁴⁸ Titus, *supra* note 41, at 16.

⁴⁹ James G. Titus, *Greenhouse Effect, Sea Level Rise, and Barrier Islands: Case Study of Long Beach Island, New Jersey*, 18 COASTAL MGMT. 65, 65 (1990) [hereinafter *Barrier Islands Case Study*]. A pre-publication version of this study is available through the EPA Web site at www.epa.gov (search for "Sea Level Rise and Barrier Islands").

⁵⁰ OFFICE OF SEA POLICY, U.S. ENVTL. PROT. AGENCY, EPA-236-F-98-007w, CLIMATE CHANGE AND SOUTH CAROLINA 4 (1998) [hereinafter CLIMATE CHANGE AND SOUTH CAROLINA], available at <http://www.epa.gov> (search for "Climate Change and South Carolina").

⁵¹ *Id.* at 2-3.

⁵² Climate Change and Tourism, *supra* note 36, at 22-23 (addressing the impacts of climate change on tourism flows).

⁵³ *Id.* at 25.

⁵⁴ Alley et al., *Summary for Policymakers, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 13 tbl.SPM.3 (predicting a temperature increase of somewhere between 1.8° and 4° C, equivalent to 3.2° and 7.2° F).

⁵⁵ Climate Change and Tourism, *supra* note 36, at 34.

⁵⁶ John C. Field et al., *Potential Consequences of Climate Variability and Change on Coastal Areas and Marine Resources, in NAT'L ASSESSMENT SYNTHESIS TEAM*, *supra* note 33, at 464.

⁵⁷ *Id.* at 467.

⁵⁸ Alley et al., *Summary for Policymakers, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 14.

⁵⁹ *Id.* at 13 tbl.SPM.3.

include “the full effects of changes in ice sheet flow,”⁶⁰ which are considered, with greater than 90% certainty to contribute to sea level rise.⁶¹ Dr. James Hansen, Director of the NASA Goddard Institute for Space Studies and arguably the nation’s top climate scientist,⁶² presents a more dismal prediction finding “it almost inconceivable that ‘business as usual’ climate change will not result in a rise in sea level measured in meters within a century.”⁶³

The direct physical effects of continuing sea level rise will have profound impacts on South Carolina’s Lowcountry.⁶⁴ For the Charleston area alone, sea level rise this century may cost as much as \$2.5 billion, excluding costs associated with saltwater into groundwater, lost economic value from the “near-shore zone,” and impacts from outside of the study area.⁶⁵ Approximately 2,333 square kilometers of South Carolina’s coast are vulnerable to a sea level rise of 1.5 meters, and 2,401 square kilometers are vulnerable to a rise of 3.5 meters.⁶⁶

South Carolina’s barrier islands will also be impacted by rising sea levels, which may go up as much as two feet by 2100.⁶⁷ The use of

⁶⁰ *Id.*

⁶¹ *Id.* at 5 (“[L]osses from the ice sheets of Greenland and Antarctica have *very likely* contributed to sea level rise”) (emphasis in original); *see also* Richard B. Alley et al., *Technical Summary*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 22-23 (explaining that the term “very likely” indicates a level of confidence of at least 90%).

⁶² Catherine Herrick & Bill Owens, *Rewriting the Science*, CBS NEWS, June 30, 2006, <http://www.cbsnews.com/stories/2006/03/17/60minutes/printable1415985.shtml>.

⁶³ James Hansen, *Huge Sea Level Rises are Coming—Unless We Act Now*, NEW SCIENTIST, July 25, 2007, <http://environment.newscientist.com/home.ns> (search for “Huge Sea Level Rises”).

⁶⁴ Michael J. Gibbs, *Economic Analysis of Sea Level Rise: Methods and Results*, in GREENHOUSE EFFECT AND SEA LEVEL RISE: A CHALLENGE FOR THIS GENERATION 165 (Michael C. Barth & James G. Titus eds., Van Nostrand Reinhold Co. 1984) [hereinafter A CHALLENGE FOR THIS GENERATION], *available at* <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenter.html> (follow “Publications” hyperlink; then follow “Sea Level Rise Reports” hyperlink).

⁶⁵ *Id.* at 190 tbl.7-11 (stating that between 1980 and 2075, dollar amounts (1980 dollars) are evaluated at a real discount rate of 3% per year). It is important to note that “[s]altwater intrusion is the most common and serious pollutant of fresh groundwater in coastal [South Carolina] aquifers,” and this pollution will only become more problematic as sea levels continue to rise. Timothy W. Kana et al., *The Physical Impact of Sea Level Rise in the Area of Charleston, South Carolina*, in A CHALLENGE FOR THIS GENERATION, *supra* note 64, at 85.

⁶⁶ JAMES G. TITUS & CHARLIE RICHMAN, U.S. ENVTL. PROT. AGENCY, MAPS OF LANDS VULNERABLE TO SEA LEVEL RISE—ON THE SOUTH ATLANTIC COAST 25 tbl.3 (2000), *available at* <http://www.epa.gov> (search for “Lands Vulnerable to Sea Level Rise”).

⁶⁷ Alley et al., *Summary for Policymakers*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 13 tbl.SPM.3 (.59 meters is equivalent to 1.94 feet).

adaptation measures anticipating sea level rise, however, can dramatically reduce the potential losses from shoreline movement. But associated costs to address a 2-foot rise for just 1 developed island roughly the size of Hilton Head could be significant: \$462 million with no protection; \$285 million to raise the island to meet the rising sea; \$109 million for engineering an entire island retreat towards the mainland; or \$434 million to engineer a levee system.⁶⁸ With a potential sea level rise of 8 feet, the projected costs increase dramatically to: a total economic loss with no protection; \$1.835 billion to raise the island; \$492 million for an island retreat; and \$1.010 billion for a levee system.⁶⁹ Science thus supports the theory that a rigid policy of no protection may eventually lead to the abandonment, destruction, and disappearance of most of South Carolina's barrier islands, representing a total economic loss⁷⁰ with consequential impacts on the mainland due to the loss of storm protection provided by the islands.⁷¹

Storm events can also cause severe damage to the economy. Since 1970, the "destructive power" of tropical storms has more than doubled.⁷² This trend is associated with the warming tropical seas,⁷³ and it is predicted with 66% certainty that the intensity of large storms will continue to increase due to global warming.⁷⁴

South Carolina has already experienced extreme costs from storms. For example, the Great Storm of 1893 took 2,000 lives, left between 20,000 and 30,000 homeless, and created property damage in excess of \$10 million

⁶⁸ *Barrier Islands Case Study*, *supra* note 49, at 78 tbl.3. Although this specific case study was for Long Beach Island in New Jersey, the findings can be roughly translated to similarly developed islands such as Hilton Head. *See id.* at 80.

⁶⁹ *Id.* at 78 tbl.3.

⁷⁰ *Id.*

⁷¹ *See Coastal Barriers in the United States*, in *ENCYCLOPEDIA OF EARTH* (Robert Dunbar ed., 2007), http://www.eoearth.org/article/Coastal_barriers_in_the_United_States (last visited Apr. 29, 2008).

⁷² CTR. FOR HEALTH & THE GLOBAL ENV'T, HARVARD MED. SCHOOL, *CLIMATE CHANGE FUTURES, HEALTH, ECOLOGICAL AND ECONOMIC DIMENSIONS* 19 (Paul R. Epstein & Evan Mills eds. 2005), available at www.climatechange-futures.org/pdf/CCF_Report_Final_10.27.pdf (citing K. Emanuel, *Increasing Destructiveness of Tropical Cyclones*, 436 *NATURE* 686-88 (2005)) (measuring "destructive power" by peak winds and duration and the frequency).

⁷³ Alley et al., *Summary for Policymakers*, in *IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 5 ("[T]he average temperature of the global ocean has increased . . . [and] the ocean has been absorbing more than 80% of the heat added to the climate system.").

⁷⁴ *Id.* at 15; *see also* Alley et al., *Technical Summary*, in *IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 22-23 (explaining that the term "likely" indicates a level of confidence of at least 66%).

(equal to \$119 billion in 1985 dollars);⁷⁵ Hurricane Hazel caused \$27 million in damages in 1954;⁷⁶ and Hurricane Hugo devastated South Carolina in 1989 with \$7 billion in damages.⁷⁷ Nationally, the worst hurricane season on record occurred in 2005 when the Southeast was battered by Hurricane Katrina.⁷⁸ This storm cost \$125 billion, (representing approximately 1.2% of the GDP of the United States),⁷⁹ killed over 1,000 people, and displaced over 1 million people,⁸⁰ out of which 250,000 people now have established permanent residences elsewhere.⁸¹ Such large scale events are a source of uneasiness in the insurance industry.⁸²

In addition to the personal injury and property damage associated with severe storms,⁸³ predicted increases in storm frequency and intensity⁸⁴ will create more beach erosion.⁸⁵ Beach renourishment projects are expensive⁸⁶ and can reach costs in the tens of millions of dollars.⁸⁷ A trust fund has been established to pay for future beach renourishment projects in South

⁷⁵ S.C. State Climatology Office, South Carolina Hurricane Climatology, http://www.dnr.sc.gov/climate/sco/Tropics/hurricanes_affecting_sc.php (last visited Apr. 29, 2008).

⁷⁶ S.C. State Climatology Office, South Carolina Dep't of Natural Res., Hurricanes Affecting South Carolina, http://www.dnr.sc.gov/climate/sco/Tropics/hurricane_tracks_affecting_sc.php (last visited Apr. 29, 2008).

⁷⁷ S.C. DEP'T HEALTH & ENVTL. CONTROL, OCEAN & COASTAL RES. MGMT., COASTAL MANAGEMENT IN SOUTH CAROLINA: COASTAL PROGRAM TIME LINE 2 (2002) [hereinafter COASTAL MANAGEMENT IN SOUTH CAROLINA], available at http://www.scdhec.net/environment/ocrm/pubs/docs/CCF/FS_time.pdf.

⁷⁸ STERN, *supra* note 31, at 131-32.

⁷⁹ *Id.* at 132.

⁸⁰ *Id.*; CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 4.

⁸¹ STERN, *supra* note 31, at 132.

⁸² See *infra* notes 90-97 and accompanying text.

⁸³ See *supra* notes 75-81 and accompanying text.

⁸⁴ Alley et al., *Summary for Policymakers*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 8 tbl.SPM.2 (frequency); NORDHAUS, *supra* note 42, at 23 (intensity).

⁸⁵ Collins, *supra* note 38, at 5-6.

⁸⁶ For example: Myrtle Beach renourishment in 1987 cost \$4.75 million, Hilton Head renourishment in 1990 cost \$9.7 million, Hunting Island renourishment in 1991 cost \$2.87 million, Folly Beach renourishment in 1993 cost \$7.18 million, Edisto Beach renourishment in 1995 cost \$1.5 million, and Pawley's Island renourishment in 1998 cost \$1.3 million. COASTAL MANAGEMENT IN SOUTH CAROLINA, *supra* note 77, at 1-2.

⁸⁷ Grand Strand and Hilton Head renourishments in 1997 cost a combined \$65 million. COASTAL MANAGEMENT IN SOUTH CAROLINA, *supra* note 77, at 1-2.

Carolina,⁸⁸ which will become increasingly more frequent and expensive with sea level rise and predicted increases in storm severity.⁸⁹

C. Insurance

Not all risks are insurable, and the commercial insurance industry accepts or rejects risk coverage based on the nature of each risk.⁹⁰ In 2005 alone, the global insurance industry experienced losses from the hurricane season in excess of \$75 billion.⁹¹ When private insurers decline to insure risk the cost usually shifts to public insurance programs as a result of political pressure, resulting in the creation of programs such as the National Flood Insurance Program.⁹² The changing nature of risk associated with increasing storm intensity may eventually lead to a loss of commercial hurricane insurance in South Carolina, likely shifting the burden of protection to the public sector.

Already, homes categorized as low or moderate risk in 2005 are now categorized as higher risk.⁹³ In July of 2006, South Carolina insurance companies reported that premiums across the state for many customers would be increasing, perhaps substantially.⁹⁴ There was a 15% to 25% increase in premiums along the South Carolina coast in 2006, which now has “nearly \$150 billion in insured value”⁹⁵

Nationally and internationally, climate change is being acknowledged by the insurance industry. AIG, the world's largest insurer, has adopted a policy to manage climate change risks and stated it is “actively seeking to incorporate environmental and climate change considerations across its businesses, focusing on the development of products and services to help AIG and its clients to respond to the worldwide drive to cut greenhouse gas emissions.”⁹⁶ Multinational reinsurers, such as Swiss Re, have taken note of

⁸⁸ Beach Restoration and Improvement Trust Act, S.C. CODE ANN. § 48-40-30 (Supp. 2006).

⁸⁹ Cf. *Barrier Islands Case Study*, *supra* note 49, at 65 (discussing the threats to beaches and coastal towns that are posed by increasing sea level and sever storms).

⁹⁰ CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 97.

⁹¹ AUSTL. BUS. ROUNDTABLE ON CLIMATE CHANGE, THE BUSINESS CASE FOR EARLY ACTION 12 fig.2 (2006), available at <http://www.businessroundtable.com.au/pdf/F078-RT-WS.pdf>.

⁹² CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 97. See generally FEMA: The National Flood Insurance Program, <http://www.fema.gov/business/nfip/> (last visited Apr. 29, 2008) (providing general information about the National Flood Insurance Program).

⁹³ Collins, *supra* note 38, at 6.

⁹⁴ *Id.*

⁹⁵ *Id.*

⁹⁶ *Id.*; see AIG, CARBON CREDIT DELIVERY COVERAGE: SHAPING A SOLUTION FOR A NEW RISK 2 (2006) (“AIG is dedicated to incorporating environmental and climate change

the threat climate change poses to their ability to do business and are expending resources to engage and educate stakeholders on the dangers of current emission levels of greenhouse gasses.⁹⁷

D. Infrastructure

Climate change may also have serious implications for South Carolina's infrastructure, particularly its methods of transportation. Unfortunately, the impacts of climate change on transportation have been largely ignored by virtually all transportation planners across the board and few studies exist focusing on these precise impacts.⁹⁸ Nevertheless, it is easy to see that climate change will require adaptation of the state's infrastructure and transportation planning.

International trade through South Carolina's ports alone brings \$23 billion into the state's economy, generates \$2.5 billion in state and local taxes, provides over 280,000 jobs and pays out \$9.4 billion in wages.⁹⁹ Ports on the water's edge are vulnerable to sea level rise; however, these facilities will likely be rebuilt on a time scale relative to that of any substantial rise in sea level.¹⁰⁰ Trade in South Carolina is not isolated to use of ports, and the changing coastlines and rising sea levels can, over time, require the relocation of roads and rail lines.¹⁰¹ Other adaptation costs could come from retreat measures, land elevation, and construction of dikes.¹⁰²

considerations across its businesses by developing products and services to help AIG and its clients respond to the worldwide drive to cut greenhouse gas emissions.”).

⁹⁷ See generally CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72 (this report was jointly sponsored by Swiss Re and the United Nations Development Programme). Interestingly, the increase of risk associated with climate change has led to changes in lending in the financial sector with long term horizons. Lending institutions such as JP Morgan Chase, Citigroup and the Bank of America are revising their guidelines by taking greenhouse gas emissions into account. *Id.* at 103.

⁹⁸ Jim Titus, U.S. Dep't Transp. Ctr. for Climate Change & Envtl. Forecasting, *Does Sea Level Rise Matter to Transportation along the Atlantic Coast?*, in THE POTENTIAL IMPACTS OF CLIMATE CHANGE ON TRANSPORTATION: WORKSHOP SUMMARY AND PROCEEDINGS 135 (2002) [hereinafter POTENTIAL IMPACTS ON TRANSPORTATION], available at <http://climate.dot.gov/publications/workshop1002/index.html>.

⁹⁹ S.C. State Ports Authority, South Carolina Ports Fact Sheet, http://www.port-of-charleston.com/About_the_Port/statistics/FACT_SHEET_2006.pdf (last visited Apr. 29, 2008).

¹⁰⁰ POTENTIAL IMPACTS ON TRANSPORTATION, *supra* note 98, at 4.

¹⁰¹ See *id.* at 6-8.

¹⁰² See *id.* at 6-10.

Furthermore, climate change will likely produce more intense hurricanes, further burdening infrastructure.¹⁰³ Increased hurricane severity will have major implications for evacuation planning, management of facilities, and safety management of aviation, marine vessels and ground transportation.¹⁰⁴ Just the issuance of a hurricane warning is expensive, costing an average of \$50 million per warning.¹⁰⁵ While these warnings are expensive, they can save lives as evidenced from the early evacuation efforts during Hurricane Hugo (where most of the storm-related deaths happened during the clean up phase).¹⁰⁶ In addition to the hurricane warning, Hurricane Hugo's infrastructure costs included: failure of electric lines caused by fallen trees and broken electric poles; structural impacts to mainland roads and bridges from debris and loss of signs; destruction of marina facilities; and hindered waterway navigation from debris including sunken boats.¹⁰⁷ While these costs did not lead to the collapse of public services, "local governments were faced with either cutting [certain] services at a time when they were needed most, or raising property taxes at a similarly inopportune time."¹⁰⁸

Residential and industrial energy use is extremely sensitive to climate, and rising temperatures¹⁰⁹ will catalyze likely increases in the use of air conditioning and overall electricity.¹¹⁰ Adaptation to changing temperatures will similarly lead to likely adjustments for insulation, heating and cooling equipment, and energy efficiency.¹¹¹ As a result of increased temperature, the annual demand for electricity in the Southeast could rise 11% by 2055 (as compared to demand levels reported in 1989).¹¹²

¹⁰³ NORDHAUS, *supra* note 42, at 23.

¹⁰⁴ Joanne R. Potter, *Workshop Summary*, in POTENTIAL IMPACTS ON TRANSPORTATION, *supra* note 98, at 8.

¹⁰⁵ Mark D. Powell et al., *The Landfall of Hurricane Hugo in the Carolinas: Surface Wind Distribution*, 6 WEATHER & FORECASTING 379, 379 (1991).

¹⁰⁶ U.S. FED. EMERGENCY MGMT. AUTH., LEARNING FROM HURRICANE HUGO: IMPLICATIONS FOR PUBLIC POLICY 9 (1992).

¹⁰⁷ *Id.* at 10-11.

¹⁰⁸ *Id.* at 11 (citing Arthur A. Felts, *The Policy Impacts of Hugo: The View from the Lowcountry*, S.C. FORUM, Apr.-June 1990, at 32-33).

¹⁰⁹ Alley et al., *Summary for Policymakers*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 12-13.

¹¹⁰ THE IMPACT OF CLIMATE CHANGE ON THE UNITED STATES ECONOMY 258 (Robert Mendelsohn & James E. Neuman eds., Cambridge Univ. Press 1999).

¹¹¹ *Id.* at 132.

¹¹² POTENTIAL EFFECTS, *supra* note 46, at 319.

E. Human Health

South Carolina should be able to cope with the potential human health concerns associated with climate change. While the complex nature of infectious disease makes it difficult to predict where outbreaks will occur and at what level,¹¹³ past observations and current trends can be helpful guides. Predicted increases in flooding,¹¹⁴ hurricanes, and coastal storms¹¹⁵ would “put more people at risk of injury or death.”¹¹⁶ Human health is also threatened by temperature increases.¹¹⁷ The increases in temperatures and heat waves¹¹⁸ are expected to cause more heat-related illness and deaths.¹¹⁹ Although South Carolina is less vulnerable to heat-related deaths than northern states because of less seasonal variability in temperatures and widespread use of air conditioning,¹²⁰ heat waves can still cause problems as seen recently in 1998, when a heat wave and drought cost southern states more than \$6 billion and took 200 lives.¹²¹

Human health can also be impacted by certain members of the animal kingdom that are hosts for harmful diseases. Rodent populations, which carry diseases like hantavirus, are sensitive to climate and sudden rains can increase the food supply of these animals.¹²² Mosquito populations are also extremely sensitive to climate:¹²³ warmer and wetter conditions would increase cases of disease spread by mosquitoes (such as malaria).¹²⁴

Finally, emerging and reemerging infectious diseases can increase their range in response to many factors, including climate.¹²⁵ One example is West Nile virus, an emerging disease carried by mosquitoes.¹²⁶ The disease

¹¹³ SMITH, *supra* note 32, at 13.

¹¹⁴ STERN, *supra* note 31, at 128.

¹¹⁵ Alley et al., *Summary for Policymakers, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 8 tbl.SPM.2.

¹¹⁶ SMITH, *supra* note 32, at 13.

¹¹⁷ Virginia Burkett et al., *Potential Consequences of Climate Variability and Change for the Southeastern United States, in NAT'L ASSESSMENT SYNTHESIS TEAM*, *supra* note 33, at 159.

¹¹⁸ Alley et al., *Summary for Policymakers, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 8 tbl.SPM.2.

¹¹⁹ CLIMATE CHANGE AND SOUTH CAROLINA, *supra* note 50, at 2-3.

¹²⁰ See SMITH, *supra* note 32, at 22.

¹²¹ Burkett et al., *Potential Consequences of Climate Variability and Change for the Southeastern United States, in NAT'L ASSESSMENT SYNTHESIS TEAM*, *supra* note 33, at 145 tbl.1.

¹²² CLIMATE CHANGE AND SOUTH CAROLINA, *supra* note 50, at 3.

¹²³ CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 33.

¹²⁴ CLIMATE CHANGE AND SOUTH CAROLINA, *supra* note 50, at 3.

¹²⁵ CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 33.

¹²⁶ *Id.* at 41-42.

was first discovered in Uganda in 1937 and unknown in America until it suddenly appeared in Queens, NY in 1999, where it led to several cases of nervous system injury and death.¹²⁷ West Nile virus first appeared in South Carolina in November, 2006, partially paralyzing an Orangeburg woman.¹²⁸ Total treatment costs for the virus in 1999 were estimated at \$500 million, while subsequent health costs from “screening of blood, community surveillance, monitoring and interventions have continued to affect life and health insurance figures”¹²⁹ Similar viruses like Usutu, which recently emerged in Europe, could appear in the U.S. in the near future.¹³⁰ Although these diseases do pose a meaningful threat to the people of South Carolina (a threat that may be exacerbated by climate change), the state’s public health system will likely expend the resources needed to address any serious human health problems associated with climate change.¹³¹

F. Water Resources

Like other areas of the country, water is a vital resource for South Carolina’s economy and is used in many applications, including: domestic consumption, agriculture, transport, power generation, manufacturing, commercial processes, pollution assimilation, and recreation.¹³² Increased temperatures, evaporation, and heavy rain have all been linked to “[o]utbreaks of waterborne diseases, large freshwater . . . algal blooms, and increased concentrations of agricultural chemicals and heavy metals in drinking water sources.”¹³³ In addition, likely changes in water distribution patterns, which are often taken for granted, can have major economic consequences.¹³⁴ While there is now more than 90% certainty that precipitation patterns will drastically change,¹³⁵ uncertainty about the

¹²⁷ *Id.*

¹²⁸ Press Release, S.C. Dep’t Health & Envtl. Control, First West Nile Virus human case for 2006 confirmed in South Carolina (Nov. 22, 2006), available at <http://www.scdhec.gov/administration/news/2006/nr20061122-01.htm>.

¹²⁹ CTR. FOR HEALTH & THE GLOBAL ENV’T, *supra* note 72, at 43.

¹³⁰ *Id.* at 44.

¹³¹ See SMITH, *supra* note 32, at 13.

¹³² See THE IMPACT OF CLIMATE CHANGE ON THE UNITED STATES ECONOMY, *supra* note 110, at 133.

¹³³ CTR. FOR HEALTH & THE GLOBAL ENV’T, *supra* note 72, at 87.

¹³⁴ See *id.* at 86-88.

¹³⁵ Alley et al., *Summary for Policymakers, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 8 tbl.SPM.2 (stating that it is “very likely” that “heavy precipitation events” will increase in frequency, but that it is also “likely” that the incidence of drought will increase); see also Alley et al., *Technical Summary, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 22-23 (explaining that the term “very likely”

amount of future rainfall in specific areas makes it difficult to calculate the exact impacts of climate change on water resources in South Carolina.¹³⁶

Potential increases in rainfall¹³⁷ could increase the risk of flooding,¹³⁸ erosion, pollution runoff from urban areas, and agricultural runoff.¹³⁹ More rain could move pollution more quickly through aquifers,¹⁴⁰ creating additional water treatment and human health costs. Increased rains combined with buried hazardous wastes could negatively impact groundwater quality, particularly in places like Barnwell County and the area surrounding the Savannah River Plant.¹⁴¹

Conversely, potential decreases in rainfall¹⁴² could “disrupt navigation, drinking water availability, recreation, hydropower, power plant cooling, and dilution of [treated waste water].¹⁴³ In northwestern South Carolina, lower groundwater levels, stream flows, and lake levels may affect the availability of water supplies for municipal, industrial, and recreational uses.¹⁴⁴ At the opposite end of the state, reduced water availability in the Coastal Plain would require increased groundwater pumping in places such as the Hilton Head-Beaufort area and Myrtle Beach, resulting in more saltwater intrusion into freshwater aquifers.¹⁴⁵ These impacts are economically concerning because drought mitigation and response is expensive. Looking at just 1 sector in South Carolina during the summer of 2000, drought decreased tourism revenues by more than \$3 million, with businesses losing between \$30 thousand and \$120 thousand each depending on their relative size.¹⁴⁶ If water resources become scarce in South Carolina and neighboring states, there will be a need for either increased cooperation

indicates a level of confidence of at least 90%, while the term “likely” indicates a level of confidence of at least 66%).

¹³⁶ POTENTIAL EFFECTS, *supra* note 46, at 319.

¹³⁷ Alley et al., *Summary for Policymakers, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 8 tbl.SPM.2.

¹³⁸ POTENTIAL EFFECTS, *supra* note 46, at 319.

¹³⁹ CLIMATE CHANGE AND SOUTH CAROLINA, *supra* note 50, at 3.

¹⁴⁰ *Id.*

¹⁴¹ *Id.*

¹⁴² Alley et al., *Summary for Policymakers, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS*, *supra* note 2, at 8 tbl.SPM.2.

¹⁴³ POTENTIAL EFFECTS, *supra* note 46, at 319.

¹⁴⁴ CLIMATE CHANGE AND SOUTH CAROLINA, *supra* note 50, at 3.

¹⁴⁵ *Id.*

¹⁴⁶ CODY L. KNUTSON & MICHAEL J. HAYES, UNIV. OF COLO. NATURAL HAZARDS RESEARCH & APPLICATIONS INFO. CTR., SOUTH CAROLINA DROUGHT MITIGATION AND RESPONSE ASSESSMENT: 1998-2000 DROUGHT, at SECTION IV.A. (2002), *available at* <http://www.colorado.edu/hazards/research/qr/qr136/qr136.html>.

at the state level or outside decision-maker-driven settlements regarding allocation of water rights.¹⁴⁷

G. Wetlands

South Carolina's wetlands provide many important services, but the benefits generated by wetlands are often not taken into account due to valuation difficulties.¹⁴⁸ These ecological systems provide important benefits to South Carolina, including: processing of treated waste water effluent after release into the environment; removal of excess nutrients and pollutants; mitigation of degraded water; reduction of water purification costs and pollution contamination;¹⁴⁹ protection of local communities from flooding by dampening storm surges from the coast and storing flood waters from rivers;¹⁵⁰ and providing important habitat for fishery stocks and game animals.¹⁵¹

Wetlands are increasingly recognized for their crucial benefits to environmental quality in the climate change context.¹⁵² Healthy wetlands, such as the Congaree Swamp in central South Carolina, filter excess nutrients, sediment, and toxic substances.¹⁵³ Substitution of these benefits through construction of water treatment facilities would cost at least \$5 million for construction alone, not accounting for additional resources to pay for operation and maintenance of the facility.¹⁵⁴ Reports in the literature have estimated the average value provided by coastal zone wetlands to be between \$825 and \$5,673 per acre each year, depending on derived

¹⁴⁷ Katharine Jacobs et al., *Potential Consequences of Climate Variability and Change for the Water Resources of the United States*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 410.

¹⁴⁸ RICHARD F. KAZMIERCZAK, JR., LSU AGRICULTURAL ECONOMICS & AGRIBUSINESS NATURAL RES. & ENV'T COMM., ECONOMIC LINKAGES BETWEEN COASTAL WETLANDS AND WATER QUALITY: A REVIEW OF VALUE ESTIMATES REPORTED IN THE PUBLISHED LITERATURE 3 (2001), available at http://www.agecon.lsu.edu/faculty_staff/FacultyPages/Kazmierczak/SP2001-02_Water_Quality.pdf.

¹⁴⁹ *Id.* at 2.

¹⁵⁰ John C. Field et al., *Potential Consequences of Climate Variability and Change on Coastal Areas and Marine Resources*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 475.

¹⁵¹ *Id.* at 476; Titus, *Sea Level Rise and Wetland Loss: An Overview*, in GREENHOUSE EFFECT, SEA LEVEL RISE AND COASTAL WETLANDS, *supra* note 41, at 1.

¹⁵² Titus, *Sea Level Rise and Wetland Loss: An Overview*, in GREENHOUSE EFFECT, SEA LEVEL RISE AND COASTAL WETLANDS, *supra* note 41, at 1.

¹⁵³ U.S. Environmental Protection Agency, *Economic Benefits of Wetlands*, <http://www.epa.gov/OWOW/wetlands/facts/fact4.html> (last visited Apr. 29, 2008).

¹⁵⁴ *Id.* This estimate is based on 1991 dollars. *Id.*

benefits,¹⁵⁵ and in 1998, South Carolina had an estimated 4.5 million acres of wetlands.¹⁵⁶

Wetlands can be affected by slight changes in hydrology, and the predicted changes in climate could dramatically alter the ability of wetlands to provide these valuable benefits to South Carolina's economy.¹⁵⁷ If sea level rise exceeds the build up of wetlands, coastal and estuarine habitats will begin disappearing.¹⁵⁸ Additionally, freshwater wetlands will be negatively affected by saltwater intrusion.¹⁵⁹ The ability of coastal wetlands to successfully adjust to rising sea levels will depend on "whether human activities prevent new marsh from forming" in inland areas.¹⁶⁰ If levees, seawalls, and/or bulkheads are constructed to protect existing development from sea level rise, as much as 90% of local marshlands (and the ecological functions they perform) may be destroyed.¹⁶¹

H. Fisheries

Recreational and commercial fisheries are important to South Carolina. Total state recreational freshwater and saltwater fishing expenditures reached \$707 million in 1999¹⁶² and commercial fisheries brought in just over \$12.5 million worth of seafood during the 2004-2005 season.¹⁶³

¹⁵⁵ KAZMIERCZAK, *supra* note 148, at 1.

¹⁵⁶ S.C. DEP'T HEALTH & ENVTL. CONTROL, THE FACTS ON WETLANDS 1 (1998).

¹⁵⁷ John Kusler & Virginia Burkett, *Climate Change in Wetland Areas Part I: Potential Wetland Impacts and Interactions*, ACCLIMATIONS, May-June 1999, at 4, 7, available at <http://www.usgcrp.gov/usgcrp/Library/nationalassessment/newsletter/default.htm>.

¹⁵⁸ *Id.* at 7.

¹⁵⁹ *Id.*

¹⁶⁰ Timothy W. Kana et al., *Charleston Case Study*, in GREENHOUSE EFFECT, SEA LEVEL RISE AND COASTAL WETLANDS, *supra* note 41, at 53.

¹⁶¹ *Id.* (explaining that if such structures were constructed to protect existing development in Charleston, S.C. from a 5-foot sea level rise, 90% of the area's wetlands would be destroyed).

¹⁶² S.C. DEP'T PARKS, RECREATION & TOURISM, SPORT FISHING: SOUTH CAROLINA 2001 TOURISM REPORT SERIES (2001), available at http://scprt.com/files/Research/Sport_Fishing.htm.

¹⁶³ This number was calculated by adding together the values for the six predominant commercial fisheries in the state from the 2004-2005 season. Shrimp were valued at \$5.6 million. S.C. DEP'T NATURAL RES., SHRIMP UPDATE 1 (2006). Blue crabs were valued at \$3.41 million. S.C. DEP'T NATURAL RES., BLUE CRAB UPDATE 1 (2006). Oysters were valued at \$1.2 million. S.C. DEP'T NATURAL RES., OYSTER UPDATE 1 (2006). Vermilion Snapper were valued at approximately \$1.1 million. S.C. DEP'T NATURAL RES., VERMILION SNAPPER UPDATE 1 fig.1 (2006). Clams were valued at \$957,704. S.C. DEP'T NATURAL RES., CLAM UPDATE 1 (2006). Finally, black sea bass were valued at approximately \$300,000. S.C. DEP'T NATURAL RES., BLACK SEA BASS UPDATE 1 fig.1 (2006). Each of these updates can be accessed at <http://www.dnr.sc.gov/marine/publications.html>.

Unfortunately, climate change scenarios show serious potential damage to fisheries.¹⁶⁴

Estuaries, where many valuable species spend portions of their juvenile and adult life stages,¹⁶⁵ are extremely productive coastal ecosystems critical to the health of commercial and recreational fisheries.¹⁶⁶ The “virtually certain” increases in temperature¹⁶⁷ will likely create needs for more agricultural use of chemicals and fertilizers.¹⁶⁸ More rainfall¹⁶⁹ will likely raise stream flow and consequently agricultural runoff levels.¹⁷⁰ This process will directly elevate nutrient levels like nitrogen that negatively impact estuaries.¹⁷¹ Estuaries, and therefore fisheries, may be impacted by nutrient loading from runoff as a result of: “more frequent and longer lasting harmful algal blooms, . . . decreased biological diversity, and the loss of fishery resources resulting from [periods of] low oxygen . . .”¹⁷² Warmer temperatures are expected to cause coral bleaching and death, as well as changes in locations of fish habitat.¹⁷³ Additionally, the uptake of CO₂ in the ocean in the form of carbonic acid (the form CO₂ assumes in the ocean) will affect phytoplankton, which may have impacts flowing up the marine food

¹⁶⁴ THE IMPACT OF CLIMATE CHANGE ON THE UNITED STATES ECONOMY, *supra* note 110, at 258.

¹⁶⁵ Sea Grant, Marine Fisheries, <http://www.scseagrant.org/Content/?cid=43> (last visited Apr. 29, 2008).

¹⁶⁶ U.S. Environmental Protection Agency, About Estuaries, <http://www.epa.gov/nep/about1.htm> (last visited Apr. 29, 2008).

¹⁶⁷ Alley et al., *Summary for Policymakers*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 8 tbl.SPM.2.

¹⁶⁸ See Burkett et al., *Potential Consequences of Climate Variability and Change for the Southeastern United States*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 148-51, 159-60 (discussing potential ways for Southeastern farmers to respond to the likely effects of climate change on regional agricultural productivity); see also EVAN BRANOSKY, WORLD RES. INST., AGRICULTURE AND CLIMATE CHANGE: THE POLICY CONTEXT 1-2 (2006), available at http://pdf.wri.org/policynote_agriculture_climate.pdf.

¹⁶⁹ Alley et al., *Summary for Policymakers*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 8 tbl.SPM.2.

¹⁷⁰ See Burkett et al., *Potential Consequences of Climate Variability and Change for the Southeastern United States*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 160.

¹⁷¹ John C. Field et al., *Potential Consequences of Climate Variability and Change on Coastal Areas and Marine Resources*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 475.

¹⁷² *Id.*

¹⁷³ See UNITED NATIONS ENVIRONMENT PROGRAMME, IN DEAD WATER: MERGING OF CLIMATE CHANGE WITH POLLUTION, OVER-HARVEST, AND INFESTATIONS IN THE WORLD'S FISHING GROUNDS 7, 26 (Christian Nellemann et al. eds., 2008), available at http://www.grida.no/_documents/marine-rra/InDeadWater_LR.pdf.

chain to the higher levels.¹⁷⁴ These increases in ocean temperature and acidity will work in concert with existing stresses on our ocean resources such as pollution and over-harvesting.¹⁷⁵

I. Agriculture and Forestry

The 24,000 farms in South Carolina¹⁷⁶ are under intense pressure to increase productivity and reduce production costs in today's highly competitive economic market.¹⁷⁷ The potential impacts of climate change are expected to increase pressures on South Carolina farmers as lands in the North become more favorable for agricultural use and lands in the South become less so.¹⁷⁸ Regulation compliance costs (such as the costs associated with "the off-site consequences of soil erosion, agricultural chemicals, and livestock wastes") will potentially increase with future climate change.¹⁷⁹

Climate change could likewise lower agricultural productivity in the long term for South Carolina due to increasing extreme weather events,¹⁸⁰ pest infestations,¹⁸¹ and a northward shift of optimal production areas.¹⁸² National production, in contrast, may actually benefit due to a combination of factors, including the potential for grain yields in the North to offset decreasing yields in the South.¹⁸³

Predicted extreme periods of dry and wet conditions could negatively affect crop yields.¹⁸⁴ "Water is the most serious limiting factor for all vegetation," and a warmer climate is expected to increase soil moisture evaporation and drought periods.¹⁸⁵ Extreme weather periods such as hot or dry spells may be followed by storms with excess rain causing accelerated erosion, water logging and leaching and water logging in agricultural soils, loss of soil aeration, increased pest infestations, flooding, and crop

¹⁷⁴ *Id.* at 35-36.

¹⁷⁵ *See id.* at 5.

¹⁷⁶ Collins, *supra* note 38, at 6.

¹⁷⁷ John Reilly et al., *Climate Change and Agriculture in the United States*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 383.

¹⁷⁸ SMITH, *supra* note 32, at 10-11.

¹⁷⁹ Reilly et al., *Climate Change and Agriculture in the United States*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 383.

¹⁸⁰ *See* CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 75 tbl.2.3.

¹⁸¹ *See id.* at 74, 75 tbl.2.3.

¹⁸² SMITH, *supra* note 32, at 10.

¹⁸³ *Id.*

¹⁸⁴ CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 70.

¹⁸⁵ *Id.*; *see also* Alley et al., *Summary for Policymakers*, in IPCC 2007 REPORT: THE PHYSICAL SCIENCE BASIS, *supra* note 2, at 8 tbl.SPM.2.

damage.¹⁸⁶ As winters become milder and nights become warmer, insects, diseases, fungi, and weeds may accelerate their life cycles and migrate from lower regions.¹⁸⁷ As a response, South Carolina farmers will be forced to use more pesticides to maintain crop yields.¹⁸⁸ These factors would affect almost every aspect of South Carolina's agricultural sector, from the production of crops to the raising of livestock.¹⁸⁹

Climate change is expected to negatively affect South Carolina's forest products industry. Forest species, over time, will generally move "northward and to higher altitudes" for more suitable climate zones, thereby creating a competitive disadvantage for Southern states.¹⁹⁰ Managed plantations can better adapt to this species migration through management techniques adjusted to account for climate change.¹⁹¹ Forests could become weakened by drought, and trees could be more susceptible to pests like the southern pine beetle.¹⁹² As winter temperatures increase and trees become weaker from drought, pests that benefit from warmer winters could penetrate the trees and reproduce.¹⁹³ These pests can cause major damage. For example, from 1995 to 1996 the southern pine beetle cost South Carolina \$125 million in timber.¹⁹⁴ Finally, wildfires may increase due to drought and dryer forests.¹⁹⁵ Wildfire expenses include the cost of suppression, property damage, property loss, forest damage, and adverse health effects.¹⁹⁶

As demonstrated in this section, the scope of these potential climate change impacts to South Carolina's economic sectors appears problematic. These impacts cover tourism, ramifications for coastal property, insurance coverage, pressures on infrastructure and transportation planning, potential human health consequences, water resource limitations, potential wetlands losses, potential damage to fisheries, and agricultural and forestry production and yield. The following section will briefly explore some

¹⁸⁶ CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 70-71.

¹⁸⁷ *Id.* at 71.

¹⁸⁸ BRANOSKY, *supra* note 168, at 1-2.

¹⁸⁹ Reilley et al., *Climate Change and Agriculture in the United States*, in NAT'L ASSESSMENT SYNTHESIS TEAM, *supra* note 33, at 382.

¹⁹⁰ SMITH, *supra* note 32, at 15.

¹⁹¹ *Id.*

¹⁹² CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 65.

¹⁹³ *Id.*

¹⁹⁴ S.C. Forestry Commission, Southern Pine Beetle Facts, <http://www.state.sc.us/forest/refspb.htm> (last visited Apr. 29, 2008).

¹⁹⁵ CTR. FOR HEALTH & THE GLOBAL ENV'T, *supra* note 72, at 67.

¹⁹⁶ *Id.*

options for addressing South Carolina's contribution to the causes of climate change.

III. ADDRESSING CLIMATE CHANGE

The economic and political realities of climate change are evidenced by shifts in both the marketplace and government. Globally, the Kyoto Protocol is being taken seriously in many nations that are working towards meeting greenhouse gas reduction targets,¹⁹⁷ and regulations and policies are emerging worldwide in non-Kyoto countries.¹⁹⁸

For example, in the United States, businesses across the nation are pushing for climate change regulation to ensure policy certainty and uniformity.¹⁹⁹ Corporations are lobbying for regulation on greenhouse gas emissions, and at least 35% of fortune 500 companies are taking early action in emissions trading.²⁰⁰ Carbon is already being actively traded through the Chicago Carbon Exchange.²⁰¹ In January of 2007, CEOs of major U.S. firms including BP America, DuPont, General Electric, Caterpillar, Lehman Brothers, Alcoa, Florida Power and Light Group and Pacific Gas & Electric publicly urged the White House to implement a mandatory cap on CO₂ emissions.²⁰² There is a growing market in the United States for investment in clean technologies as investors anticipate future costs for greenhouse gas emissions.²⁰³ Federal climate change legislation will soon be a reality,²⁰⁴ and climate change litigation is springing up across the country.²⁰⁵ Recently, the U.S. Supreme Court ruled that the EPA has the authority to regulate CO₂ emissions from tailpipes, and a decision to not regulate must be based on

¹⁹⁷ Dan Bilefsky, *Europe Sets Ambitious Limits on Greenhouse Gases, and Challenges Others to Match It*, N.Y. TIMES, Mar. 10, 2007, at A5.

¹⁹⁸ INNOVEST, CARBON DISCLOSURE PROJECT 2005, at 5 (2005) [hereinafter CARBON DISCLOSURE PROJECT 2005], available at http://www.cdproject.net/download.asp?file=cdp_report3.pdf.

¹⁹⁹ PETER SUOZZO, CITIGROUP GLOBAL MARKETS, INVESTING IN SOLUTIONS TO CLIMATE CHANGE 6 (2006), available at www.earthinstitute.columbia.edu/grocc/documents/Citi-WRClimateReport.pdf.

²⁰⁰ CARBON DISCLOSURE PROJECT 2005, *supra* note 198, at 5-6.

²⁰¹ Chicago Climate Exchange, <http://www.chicagoclimatex.com> (last visited Apr. 29, 2008).

²⁰² Bush "Must Fight Climate Change," BBC NEWS AMERICAS, Jan. 23, 2007, available at <http://news.bbc.co.uk/2/hi/americas/6289367.stm>.

²⁰³ CARBON DISCLOSURE PROJECT 2005, *supra* note 198, at 5.

²⁰⁴ Andrzej Zwaniecki, *Democrats in Congress Push Measures To Curb Global Warming*, AMERICA.GOV, Mar. 13, 2007, available at <http://www.america.gov/> (search for "Democrats Push Measures").

²⁰⁵ CARBON DISCLOSURE PROJECT 2005, *supra* note 198, at 5.

scientific reasoning.²⁰⁶ Additionally, 2008 Presidential candidates are on record supporting a cap and trade system to regulate CO₂ emissions.²⁰⁷

At least thirty-six states have either adopted or are drafting climate action plans.²⁰⁸ South Carolina is taking steps towards addressing climate change, as Governor Mark Sanford has formed a committee looking at appropriate climate policy options for the state.²⁰⁹ South Carolina's Climate, Energy, and Commerce Advisory Committee ("CECAC") is made up of thirty members, representing diverse stakeholder interests, including: tourism, recreation, agriculture, forestry, transportation, insurance, industry, public health, environmental conservation, renewable energy, state and local government, and the general public.²¹⁰ Additionally, more than 800 cities from across the nation, including the South Carolina cities of Charleston, Columbia, Greenville, Sumter, and Rock Hill, have signed the U.S. Mayors' Climate Protection Agreement and are taking their own measures to lower greenhouse gas emissions in their communities.²¹¹

Worldwide, the markets for energy efficiency and renewable energy are significant and rapidly growing.²¹² Areas of these markets that had traditionally been considered too risky are now receiving investment as the trend moves upward.²¹³ The market is sending powerful signals; the carbon-based economy is shifting towards a more diversified approach to meeting energy demand.²¹⁴ In 2006, the renewable energy and energy efficiency sectors in the United States "generated 8.5 million new jobs, nearly \$970 billion in revenue, nearly \$100 billion in industry profits, and more than \$150 billion in increased federal, state and local government tax revenues."²¹⁵

²⁰⁶ *Massachusetts v. EPA*, 127 S. Ct. 1438, 1459-63 (2007).

²⁰⁷ Scott Horsley, *2008 Election Issues: Climate Change*, NPR, Jan. 30, 2008, <http://www.npr.org/news/specials/election2008/issues/climate.html>.

²⁰⁸ PEW CTR. ON GLOBAL CLIMATE CHANGE, *CLIMATE CHANGE 101: STATE ACTION 7-8* (2006), available at http://www.pewclimate.org/docUploads/101_States.pdf.

²⁰⁹ Exec. Order No. 2007-04 (Feb. 16, 2007), available at http://www.scgovernor.com/executive/orders/ex_orders_2007.htm; see Sammy Fretwell, *Sanford Wants S.C. to Lead Global Warming Fight*, THE STATE (Columbia, S.C.), Jan. 29, 2007, at B1.

²¹⁰ Exec. Order No. 2007-04.

²¹¹ U.S. Conference of Mayors, *supra* note 30.

²¹² CHRISTOPHER GREENWOOD ET AL., U.N. ENV'T PROGRAMME & NEW ENERGY FINANCE LTD., *GLOBAL TRENDS IN SUSTAINABLE ENERGY DEVELOPMENT 2007*, at 3 (2007), available at http://www.unep.org/pdf/SEFI_report-GlobalTrendsInSustainableEnergyInvestment07.pdf.

²¹³ *Id.*

²¹⁴ *Id.*

²¹⁵ ROGER BEZDEK, *RENEWABLE ENERGY AND ENERGY EFFICIENCY: DRIVERS FOR THE 21ST CENTURY*, at vii (2007), available at <http://www.ases.org/ASES-JobsReport-Final.pdf>.

South Carolina has vast opportunity for greenhouse gas reduction. The state ranks as the 29th largest producer of greenhouse gasses in the United States with 31.6% of emissions from transportation, 12.4% from industry and 38.3% from electric utilities.²¹⁶ Appropriate options for lowering these emissions while meeting South Carolina's energy needs include energy efficiency, appropriate land use and transportation approaches, and the use of renewable energy.²¹⁷

Energy Efficiency is achieved when less electricity is used to provide the same level of services.²¹⁸ Examples of energy efficiency measures can include: the use of efficient appliances; proper insulation and weatherization; properly insulated and sealed duct work; efficient and appropriately sized HVAC systems; high performance windows; programmable thermostats; and efficient lighting.²¹⁹

The economic potential for energy efficiency is impressive. In 2004, total national investments in the energy efficiency sector produced energy savings equivalent to the energy produced by "40 mid-sized coal-fired power plants," and energy efficiency is expected to produce financial savings of \$77.4 billion by the end of 2008.²²⁰ Energy Efficiency also creates "green collar" jobs because of the need for energy audits, lighting and appliances installation, building systems installation, and materials manufacturing.²²¹

Energy efficiency is a vastly underutilized part of South Carolina's energy resource base.²²² Energy efficiency should be the first consideration

²¹⁶ Data obtained on April 29, 2008, through the Climate Analysis Indicators Tool (CAIT-U.S.), Version 1.0, <http://cait.wri.org>.

²¹⁷ U.S. Department of Energy, Alternative Energy Resources in South Carolina, http://www.eere.energy.gov/states/alternatives/resources_sc.cfm (last visited Apr. 29, 2008).

²¹⁸ KAREN EHRHARDT-MARTINEZ & JOHN A. LAITNER, AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., THE SIZE OF THE U.S. ENERGY EFFICIENCY MARKET: GENERATING A MORE COMPLETE PICTURE, at v (2008).

²¹⁹ See generally FOUND. FOR COMMUNITY ASS'N RESEARCH, BEST PRACTICES REPORT #6: ENERGY EFFICIENCY (2002), available at <http://www.cairf.org/research/bpefficiency.pdf> (providing a list of best practices to improve energy efficiency).

²²⁰ EHRHARDT-MARTINEZ & LAITNER, *supra* note 218, at v.

²²¹ APOLLO ALLIANCE, COMMUNITY JOBS IN THE GREEN ECONOMY 5 (2007), available at http://www.apolloalliance.org/downloads/resources_Community_Jobs_in_the_Green_Economy.pdf.

²²² GDS ASSOC., ELECTRIC ENERGY EFFICIENCY POTENTIAL STUDY FOR CENTRAL ELECTRIC POWER COOPERATIVE, INC. 2 (2007), available at <http://www.ecsc.org/newsroom/EfficiencyStudy.ppt#327>.

in addressing the State's energy demand.²²³ Improving efficiency is more cost effective than building new generation facilities; it is the fastest way to address energy demand; and it is the most important component to solving the climate change issue.²²⁴ An excellent example of an effective energy efficiency program can be found in Austin, Texas; during a growth period for the city where the population doubled and the local economy grew by 46%, energy efficiency measures offset the need for a planned 450-megawatt coal-fired plant.²²⁵

When considering energy efficiency, it is important to distinguish between new construction and existing buildings.²²⁶ New construction make it easier to incorporate energy efficiency measures and new technologies; however new buildings represent a mere 2% to 3% "of the existing building stock in any given year"²²⁷ Our current building stock demands so much energy that it accounts for more than 40% of our nation's total carbon emissions.²²⁸ At least half of these existing buildings will still be standing in 2050.²²⁹ Therefore, the existing building stock presents a key opportunity for energy efficiency gains.²³⁰ This compelling opportunity necessitates that climate change strategies include mechanisms to achieve aggressive energy efficiency retrofit upgrades for our existing buildings. Additionally, policies guiding new construction should incorporate high efficiency standards.

A recent study by the American Council for an Energy-Efficient Economy ("ACEEE") shows that energy efficiency policies in the nearby state of Florida can produce savings of over \$28 billion as compared to the costs for building new power plants within the next 15 years alone.²³¹ While such a study has not been generated for South Carolina, the potential for improved energy efficiency in the state is staggering, as South Carolina was

²²³ See MAGGIE ELDRIDGE ET AL., AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., ENERGY EFFICIENCY: THE FIRST FUEL FOR A CLEAN ENERGY FUTURE, at vi (2008).

²²⁴ See U.S. Department of Energy, *supra* note 217.

²²⁵ U.S. Department of Energy, Alternative Energy Resources in Texas, http://www.eere.energy.gov/states/alternatives/resources_tx.cfm (last visited Apr. 29, 2008).

²²⁶ See MARILYN A. BROWN ET AL., PEW CTR. ON GLOBAL CLIMATE CHANGE, TOWARDS A CLIMATE-FRIENDLY BUILT ENVIRONMENT 11 (2005), available at http://www.pewclimate.org/docUploads/Buildings_FINAL.pdf.

²²⁷ *Id.*

²²⁸ *Id.* at ii.

²²⁹ *Id.* at 11.

²³⁰ *Id.*

²³¹ R. NEAL ELLIOT ET AL., AM. COUNCIL FOR AN ENERGY-EFFICIENT ECON., POTENTIAL FOR ENERGY EFFICIENCY AND RENEWABLE ENERGY TO MEET FLORIDA'S GROWING ENERGY DEMANDS, at viii (2007), available at <http://www.aceee.org/pubs/e072.htm>.

rated the 5th largest electricity user in the nation per person in 2005.²³² Although South Carolina uses only approximately 36% of the total electricity used in Florida,²³³ the much higher per-capita-usage by South Carolina citizens suggests that, as the state's population grows,²³⁴ demand for electricity may rise at a roughly-similar rate.²³⁵ By improving energy efficiency rather than constructing new generation facilities, it stands to reason that South Carolina (like Florida) could reduce "peak demand for electricity," "slow future electricity demand," and possibly reap very large economic benefits.²³⁶

The basic business model of returns on investments in energy efficiency is already working in South Carolina.²³⁷ For example, the City of Charleston contracted with an energy service company to supply the upfront capital necessary to implement an energy efficiency program.²³⁸ The initial loan of nearly \$10 million will be recovered with guaranteed savings of over \$834,000 annual energy and operational savings.²³⁹

Likewise, private investment can be leveraged to fund large scale energy efficiency programs in the commercial and residential sectors as well.²⁴⁰ For

²³² California Energy Commission, U.S. Per Capita Electricity Use by State in 2005, http://www.energy.ca.gov/electricity/us_per_capita_electricity_2005.html (last visited Apr. 29, 2008).

²³³ *Id.*

²³⁴ S.C. BUDGET & CONTROL BD. OFFICE OF RESEARCH & STATISTICS, SOUTH CAROLINA STATE AND COUNTY POPULATION PROJECTIONS 2000-2035 SUMMARY, *available at* <http://www.ors2.state.sc.us/population/proj0035.php>.

²³⁵ According to the U.S. Census Bureau, Florida's population is growing at a faster rate than South Carolina's (approximately 5.8% faster). *See* U.S. Census Bureau, State Population Estimates and Demographic Components of Population Change: April 1, 1990 Census to April 1, 2000 Estimate, <http://www.census.gov/popest/eval-estimates/national-regional-state/ST-2000-2.txt> (last visited Apr. 29, 2008). However, the average South Carolina citizen uses 6,470 more kilowatt hours per year than the average Florida citizen. California Energy Commission, *supra* note 232. As a result, future demand for electricity in the two states may be somewhat proportional. Granted, this is not exact science, but it does suggest that South Carolina may be able to take advantage of many of the same benefits identified in ACEEE's study of Florida.

²³⁶ *See* ELLIOT ET AL., *supra* note 231, at ii-iii.

²³⁷ *See, e.g.*, David Slade, *Charleston Going Greener*, POST & COURIER (Charleston, S.C.), Dec. 25, 2007, *available at* http://www.charleston.net/news/2007/dec/25/charleston_going_greener25822/?print.

²³⁸ *Id.*

²³⁹ Johnson Controls Int'l, Presentation to the City of Charleston Green Committee Energy Subcommittee: City of Charleston and Johnson Controls, Partners in Sustainability (Feb. 20, 2008).

²⁴⁰ *See, e.g.*, Press Release, Cambridge Energy Alliance, NSTAR Partners With City of Cambridge, State and Community Organizations to Create \$100+ Million Energy Initiative

example, the City of Cambridge, Massachusetts has begun an aggressive energy efficiency program with a revolving fund of more than \$100 million, 80% of which is to be sourced from private investment.²⁴¹ The fund will supply the upfront capital necessary to achieve meaningful energy efficiency gains.²⁴² This innovative financing mechanism takes advantage of the unique role cities play in confronting the climate challenge.²⁴³ The emerging market in energy efficiency represents one of the most innovative economic opportunities for states, counties and municipalities and one of the most promising solutions to climate change.

Vehicle energy efficiency is another area with enormous potential for carbon emission reductions, and this capacity is already being addressed through changes in auto design.²⁴⁴ While more efficient cars are an important part of addressing greenhouse gasses from the transportation sector, unless we also address land use policies any technological improvements we make in our vehicles will be offset by the amount of miles that these vehicles will travel.²⁴⁵ Since World War II, we have become increasingly dependent on the automobile and, as a result, "land is being consumed for development at a rate almost three times faster than population growth," causing carbon emissions to rise while reducing the amount of forested land available for carbon absorption.²⁴⁶ In order to address this issue, we must change our approach to land use and encourage "smart growth" principals incorporating higher density mixed-use development, an interconnected street network, and a variety of transportation options including mass transit, biking and walking.²⁴⁷ Where such development tools are used, people tend to drive 20% to 40% less.²⁴⁸ Nationally, there is a demand shift in the market favoring these types of developments.²⁴⁹

(Mar. 29, 2007), *available at* <http://www.cambridgeenergyalliance.org> (follow "News" hyperlink; then follow "Press Releases" hyperlink).

²⁴¹ *Id.*

²⁴² *Id.*

²⁴³ *Id.*

²⁴⁴ SUOZZO, *supra* note 199, at 12-13.

²⁴⁵ REID EWING ET AL., URBAN LAND INST., GROWING COOLER: THE EVIDENCE ON URBAN DEVELOPMENT AND CLIMATE CHANGE 11 (2007), *available at* <http://www.smartgrowthamerica.org/documents/growingcoolerCH1.pdf>.

²⁴⁶ *Id.* at 2-3.

²⁴⁷ *Id.* at 4-5.

²⁴⁸ *Id.* at 4.

²⁴⁹ *Id.* at 8-9.

In addition to addressing energy efficiency, transportation and land use, there is opportunity for renewable energy market growth in South Carolina.²⁵⁰ A recent report by the Renewable Energy Policy Project shows the potential for over 22,000 new green manufacturing jobs in South Carolina in wind, solar, geothermal and biomass.²⁵¹ The state could potentially have the wind resources necessary for large-scale wind turbines.²⁵² Offshore wind energy resources in South Carolina, which are currently being explored, are believed to offer much potential for power generation in the state.²⁵³ Additionally, the solar industry is projected to increase nationally with \$34 billion in investments expected by 2015,²⁵⁴ and South Carolina is well suited for solar applications with flat-plate collector use.²⁵⁵ Other sources of renewable energy are also at play in South Carolina. For example, the biofuels industry has attracted some interest in the state.²⁵⁶

Geothermal, while not an energy source, is a powerful energy savings tool when used for direct heat or heat pumps.²⁵⁷ Fuel cells are likewise currently being researched by the University of South Carolina.²⁵⁸ Carbon sequestration through no-till farming practices might be able to offer viable income to South Carolina's farmers, as a farmer with 1,000 acres could generate more than \$13,000 annually through conversion to no-till farming.²⁵⁹ Furthermore, South Carolina has potential geologic sinks suitable for carbon sequestration through capture, transport and underground

²⁵⁰ See BLUE GREEN ALLIANCE, SOUTH CAROLINA'S ROAD TO ENERGY INDEPENDENCE: BUILDING ON JOB GROWTH IN RENEWABLE ENERGY COMPONENT MANUFACTURING 1-2 (2007), available at http://www.crest.org/articles/static/1/binaries/SC_BG_Report.pdf (analyzing the potential for South Carolina to create new jobs and economic opportunities by making a commitment to development of clean energy alternatives).

²⁵¹ *Id.* at 2.

²⁵² U.S. Department of Energy, *supra* note 217.

²⁵³ See Matthew Gregory, *South Carolina Enters Global Wind Race*, S.C. BUS., Aug. 2007, available at http://findarticles.com/p/articles/mi_qa5306/is_200708/ai_n21295085/print.

²⁵⁴ N.C. CLIMATE STEWARDSHIP TASK FORCE, ECONOMIC OPPORTUNITY IN ADDRESSING GLOBAL WARMING: THE SILVER LINING FOR NORTH CAROLINA IN A LOWER CARBON ECONOMY, at v (2005).

²⁵⁵ U.S. Department of Energy, *supra* note 217.

²⁵⁶ See John Kelly & Nicholas Rigas, *S.C. Has Resources to Offset Oil Imports*, POST & COURIER (Charleston, S.C.), July 12, 2007, available at http://www.charleston.net/news/2007/jul/12/sc_has_resources_offset_oil_imports/?print.

²⁵⁷ U.S. Department of Energy, *supra* note 217.

²⁵⁸ University of South Carolina, Center for Fuel Cells, <http://www.che.sc.edu/centers/PEMFC/index.html> (last visited Apr. 29, 2008).

²⁵⁹ See N.C. CLIMATE STEWARDSHIP TASKFORCE, *supra* note 254 (stating that farmers in all three geographic regions of North Carolina can recognize such gains by conversion to no-till farming).

storage,²⁶⁰ with possible offshore sequestration options that have yet to be fully explored.²⁶¹

IV. CONCLUSION

Taking into account the clear scientific consensus regarding climate change, South Carolina now stands at a crossroads. The state must make a decision to accept the challenge and grasp the opportunity climate change offers. Inaction is no longer an option. Globally, inaction is expected to result in economic costs equivalent to losing between 5% and 20% of the annual global GDP, "now and forever,"²⁶² and South Carolina is a particularly vulnerable state.²⁶³ The potential social, environmental, and economic costs associated with inaction are tremendous and threaten to negatively affect critical resources, including: tourism, real estate, insurance, infrastructure, human health, water resources, wetlands, fisheries, agriculture and forestry. While the cost of doing nothing is great, the economic opportunity is tremendous. Climate action will protect South Carolina's people, places, and economy while the state takes advantage of new markets and creates significant economic development opportunities.

Fortunately, it is not too late to avoid the most extreme climate impacts, assuming an appropriate response.²⁶⁴ Through a comprehensive approach of climate change regulation,²⁶⁵ business interest and investment,²⁶⁶ and utilization of emerging markets,²⁶⁷ South Carolina can rise to meet the challenge. Moving forward, the state should aggressively act to implement appropriate strategies for adaptation to, and mitigation of, the impacts of greenhouse gas emissions. South Carolina has an enormous opportunity to develop its energy efficiency markets, which should be the first option when addressing energy demand. After exhausting this most cost-effective

²⁶⁰ REBECCA C. SMYTH ET AL., GULF COAST CARBON CTR., POTENTIAL SINKS FOR GEOLOGIC STORAGE OF CARBON DIOXIDE GENERATED IN THE CAROLINAS 11-12 (2007), available at http://www.beg.utexas.edu/enviroq/ty/co2seq/pubs_presentations/CarolinasSummary_16April07.pdf.

²⁶¹ *Id.* at 5 ("The sinks identified offshore from the Carolinas are not . . . well characterized . . . and would require investigation to determine suitability and to refine capacity estimates.").

²⁶² STERN, *supra* note 31, at x.

²⁶³ See SMITH, *supra* note 32, at 22 ("The Southeast appears to be relatively more vulnerable to climate change across most affected sectors [and] . . . the region is the most vulnerable to sea-level rise because of its low-lying coast and heavy development in many areas.").

²⁶⁴ STERN, *supra* note 31, at vi.

²⁶⁵ See Zwanecki, *supra* note 204.

²⁶⁶ See CARBON DISCLOSURE PROJECT 2005, *supra* note 198.

²⁶⁷ See Chicago Climate Exchange, *supra* note 201.

resource, renewable energy resources should be explored. The state must also address land use and transportation issues in order to lower emissions. The path is clearly laid out before South Carolina, and it is one of action, opportunity, and leadership.