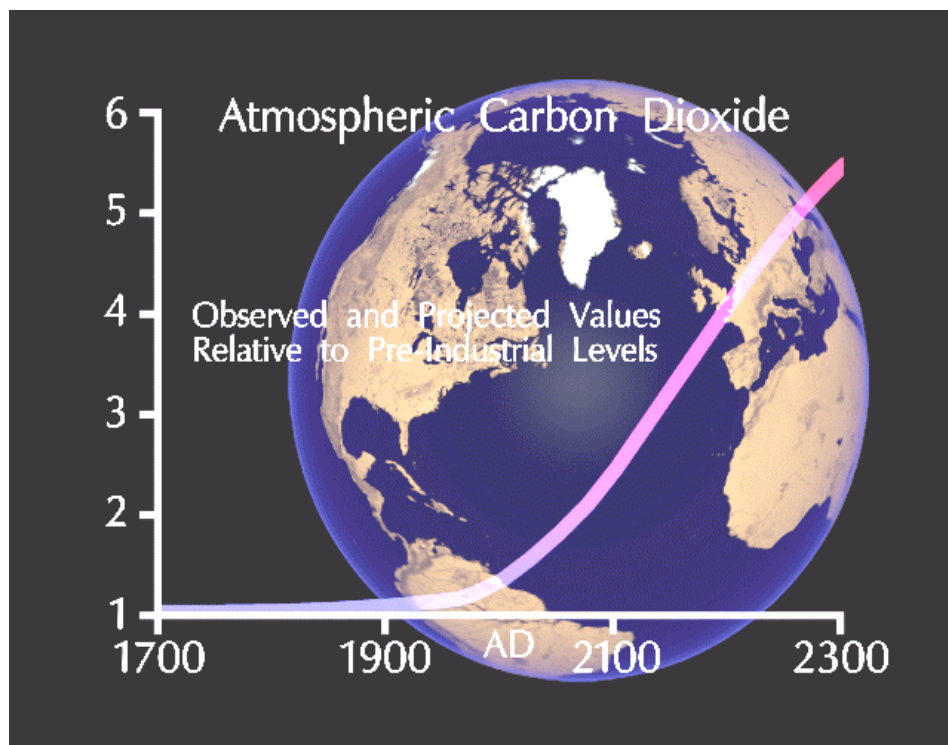


Carbon Dioxide (CO₂) Emissions Reduction Strategies for North Carolina

(Pursuant to North Carolina's Clean Smokestacks Act of 2002)



North Carolina
Department of Environment and Natural Resources
Division of Air Quality

September 1, 2005
(Includes editorial changes through September 20, 2005)

The Requirement: Excerpted from the Clean Smokestacks Act

[Title: **An Act to Improve Air Quality in the State by Imposing Limits on the Emission of Certain Pollutants from Certain Facilities that Burn Coal to Generate Electricity and to Provide for Recovery by Electric Utilities of the Costs of Achieving Compliance with Those Limits**]

SECTION 13. The Division of Air Quality of the Department of Environment and Natural Resources shall study issues related to the development and implementation of standards and plans to implement programs to control emissions of carbon dioxide (CO₂) from coal-fired generating units and other stationary sources of air pollution. The Division shall evaluate available control technologies and shall estimate the benefits and costs of alternative strategies to reduce emissions of carbon dioxide (CO₂). The Division shall annually report its interim findings and recommendations to the Environmental Management Commission and the Environmental Review Commission beginning 1 September 2003. The Division shall report its final findings and recommendations to the Environmental Management Commission and the Environmental Review Commission no later than 1 September 2005. The costs of implementing any air quality standards and plans to reduce the emission of carbon dioxide (CO₂) from coal-fired generating units below the standards in effect on the date this act becomes effective, except to the extent that the emission of carbon dioxide (CO₂) is reduced as a result of the reductions in the emissions of oxides of nitrogen (NO_x) and sulfur dioxide (SO₂) required to achieve the emissions limitations set out in G.S. 143-215.107D, as enacted by Section 1 of this act, shall not be recoverable pursuant to G.S. 62-133.6, as enacted by Section 9 of this act.

GENERAL ASSEMBLY OF NORTH CAROLINA - SESSION 2001 – (SENATE BILL 1078)

Ratified the 19th day of June 2002. (Ch. SL 2002-4 S.13)

Marc Basnight - President Pro Tempore of the Senate

James B. Black - Speaker of the House of Representatives

Michael F. Easley - Governor

Carbon Dioxide (CO₂) Emissions Reduction Strategies for North Carolina

(Pursuant to North Carolina's Clean Smokestacks Act of 2002)

September 2005: Final Report

**North Carolina
Department of Environment and Natural Resources
Division of Air Quality**

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North Carolina Department of Environment and Natural Resources

Michael F. Easley, Governor

William G. Ross, Jr., Secretary

September 1, 2005

TO: Environmental Review Commission
Environmental Management Commission

FROM: William G. Ross, Jr.

Global climate change refers to changes in temperatures, weather, sea levels and other environmental factors due to both natural and man-made influences including impacts from emissions of water vapor, carbon dioxide, and other greenhouse gases and particles. Air temperature rises when heat radiated from Earth is trapped by these gases instead of escaping to space.

North Carolina has much at stake from the effects of climate change. For example, we have an expanse of coastal lands that would be subject to flooding from rising seas and increases in the number and severity of storms. Global climate change is expected to cause some plants and animals to become extinct; some to increase in population, and others to migrate to areas with more favorable conditions. Concerns for impacts of these gases and particles from coal-fired power plants led the General Assembly, in the 2002 Clean Smokestacks Act, to include requirements for the Division of Air Quality (DAQ) to study these emissions and recommend what steps should be taken to reduce them. This report is the last of a series of three (2003, 2004 and 2005) reports to the Environmental Management Commission and the Environmental Review Commission in fulfillment of that requirement.

Climate change continues to be a concern, and must be addressed, at local, state, regional, national and international levels, through effective and coordinated leadership. The 2005 General Assembly has continued to express these concerns and to show leadership by establishing a Global Warming Study Commission to address challenges and opportunities that arise from climate change.

Each resident of the state is a part of the problem, and the solution. Consequently, each of us must consider how we can reduce greenhouse gas emissions in ways that may be individually small, but collectively huge, and thus respond to threats posed by global climate change. Individuals can make important contributions to reduced emissions through such things as energy conservation: carpooling; riding the bus; setting thermostats higher in the summer; avoiding open burning and planting more trees to absorb carbon dioxide from the atmosphere.

Many individuals have already helped in the quest for solutions by providing comments in public meetings held by the DAQ. We appreciate the assistance and interest of every individual who participated in this process and their efforts in preparing these reports. DAQ is inviting continued efforts from stakeholders and expects to be working with many of the same individuals to develop a Climate Action Plan for North Carolina. I believe that, working together we can define a set of policies and actions that can contribute to a healthy planet and a healthy economy.

As Eileen Claussen from the Pew Center on Global Climate Changes has stated, "Our generation's challenge will be addressing global climate change while sustaining a growing global economy." Let's work together to give every citizen of our state, now and in the future, a reasonable opportunity to live a happy, healthy, and prosperous life.
enclosure

cc: Governor Michael F. Easley
Secretary Gwynn T. Swinson, DOA

Preface

Congress finds that—

- (1) greenhouse gases accumulating in the atmosphere are causing average temperatures to rise at a rate outside the range of natural variability and are posing a substantial risk of rising sea-levels, altered patterns of atmospheric and oceanic circulation, and increased frequency and severity of floods and droughts;*
- (2) there is a growing scientific consensus that human activity is a substantial cause of greenhouse gas accumulation in the atmosphere; and*
- (3) mandatory steps will be required to slow or stop the growth of greenhouse gas emissions into the atmosphere.¹*

Scientists seem to agree that Earth has had a tendency to naturally get warmer and colder across the eons. A delicate and ever-changing balance between solar radiation, cloud cover, volcano eruptions, heat-trapping gases and other such natural events influence long-term swings from ice ages to warmer climates. Accredited experts in the field have indicated that a substantial increase in this global warming since the beginning of the Industrial Revolution can be traced to human activity, namely the combustion of carbon fuels and the release of carbon dioxide - CO₂ (or equivalents- CO₂e).

In June 2002, the North Carolina Division of Air Quality (DAQ), in the Department of Environment and Natural Resources (DENR), entered a new arena, that of CO₂ emissions and global warming. Up to this time, DAQ was primarily charged with implementing the federal Clean Air Act and related North Carolina laws and rules that address air pollutants for which there are National Ambient Air Quality Standards (NAAQS), federal hazardous air pollutant (HAP) standards and North Carolina's toxic air pollutant (TAP) standards. This new charge thrust DAQ onto a steep learning curve regarding the issues, major sources, proposed and/or implemented potential remedies, and perhaps most pointedly, the role for CO₂ controls for "coal-fired power plants and other stationary sources."

Since CO₂ does not lend itself to a simple removal and disposal by a scrubber, other means must be considered. In the quest for knowledge and direction on what recommendations would be appropriate for this report, DAQ quickly observed that the issues involved more than CO₂ from coal-fired power plants. Thus, basic decisions were made to address the larger issues and not just the literal charge in the Clean Smokestacks Act. Therefore, this report addresses greenhouse gases (GHG) other than just CO₂ [i.e., methane (CH₄), nitrous oxide (N₂O), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs) and hydrofluorocarbons (HFCs)] and addresses related sources and issues. This context gives a better understanding of the relative role and significance of coal fired power plants in the quest for solutions.

DAQ notes that a huge amount of work in the area has already been done in North Carolina by the State Energy Office (SEO) and by the Energy Center at Appalachian State University (ASU). Their work has been relied upon extensively to prepare this report and much credit is due them for their efforts. If we are to come to grips with some claims that we may need as much as 60 to 80 percent reductions in GHG before we can return to a "human-neutral,"

¹ Energy Policy Act of 2005, SEC. 1612, SENSE OF THE SENATE ON CLIMATE CHANGE July 29, 2005

status of global climate equilibrium (or “dis-equilibrium,” as the case may be), we will need to employ means beyond those discussed in this report. Just as the previous work has been used as a base for development of this information and recommendations, this expansion must continue with further steps beyond this particular report to meet the challenges. This is a complex and sometimes emotion-charged issue, and solutions won’t likely be simple to implement or perhaps define.

Across the nation, states and other jurisdictions are taking actions and developing climate action plans to reduce emissions of carbon dioxide and other GHG. The common theme among these plans is that actions can be taken in a manner that will not only minimize the economic impacts on the citizenry, but can actually provide enhanced economic benefits while achieving a carbon-reduced fuel supply and reduced global warming. The climate action plan for North Carolina that DAQ intends to pursue will be designed to provide an opportunity for all major stakeholders (private, government, environmentalists and “the public”) in this State’s economy and energy use sectors to help devise and implement policies and plans that will achieve these mutually compatible goals of reduced greenhouse gases with positive economic impacts.

U.S. CO₂e (GHG expressed as equivalent CO₂) emissions continued upward by almost two percent in 2004, according to the U.S. Department of Energy, Energy Information Administration, and the increases were primarily (>80%) due to energy consumption. We must continue boldly to find ways to economically reverse this trend. Continued efforts by each of us will be required and each of us will, no doubt, be affected in some way, whether appropriate actions are taken, or not. As reported in previous reports in this series, and as updated later in this report, other states are taking aggressive steps to deal with this problem already. The time to act in North Carolina, in the U.S. and around the globe is now.

Acronyms Used in This and Related Reports

AEO2005 – U.S. DOE, Energy Information Administration’s Annual Energy Outlook 2005
ASU – Appalachian State University (Part of the UNC system)
BOC – U.S. Bureau of Census
CAA – Clean Air Act – Primary federal statute governing clean air requirements
CAFO – Concentrated (or Confined) Animal Feeding Operation
CAIR – Clean Air Interstate Rule
CAIT – Climate Analysis Indicators Tool
CAPA – Clean Air Planning Act – Carper Bill
CCAR – California Climate Action Registry
CCSP – Climate Change Science Program
CEM – Continuous Emission Monitoring
CFCs – Chlorofluorocarbons
CH₄ – Methane
CHP – Combined Heat and Power
CO₂ – Carbon Dioxide – the major global warming gas
CO₂e – Carbon Dioxide equivalent
CPA – Clean Power Act
CSA – North Carolina Clean Smokestacks Act
DAQ – North Carolina Division of Air Quality
DENR – North Carolina Department of Environment and Natural Resources
DOA – Department of Agriculture (US or NC)
DOE – US Department of Energy
EIA – DOE Energy Information Administration
EMC – Environmental Management Commission (NC)
EPA – U.S. Environmental Protection Agency
EPC – Energy Policy Council (NC)
EPICI – Electric Power Industry Climate Initiative
EPRI – Electric Power Research Institute
EPS – Environmental Portfolio Standard
ERC – Environmental Review Commission (NC)
FS – United States Forest Service (also USFS)
GDP - Gross Domestic Product
GHG – Greenhouse Gas (es)
GSP – Gross state product
GWP – Global Warming Potential
HFC’s - Hydrofluorocarbons
HPMS – Highway Performance Monitoring System
HVAC – Heating, Ventilation and Air Conditioning
ICTA - International Center for Technology Assessment
IGCC – Integrated Gasification Combined Cycle
IPCC - Intergovernmental Panel on Climate Change-international authority on climate
IPPs – Independent Power Producers
kWh – Kilowatt hour (1000 watts for one hour)
LFGT – Landfill gas collection system and landfill-gas-to-energy
LMOP – Landfill Methane Outreach Program

Acronyms (Continued)

LNG – Liquefied natural gas
LoGESO – Local Government Energy Savings Organization
LPG – Liquefied petroleum gas
MMt – Million Metric tons
MOU – Memorandum of Understanding
MW – Mega-watt; millions of watts
Mt - Metric ton (equivalent to 1.102 short tons)
MTBE – Methyl Tertiary Butyl Ether
N₂O – Nitrous Oxide
NAAQS – National Ambient Air Quality Standards
NAS - National Academy of Science
NASA – National Aeronautics and Space Administration
NASEO – National Association of State Energy Officials
NASS – National Agricultural Statistics Service (U.S. DOA)
NCSU – North Carolina State University
NCUC – North Carolina Utilities Commission
NESCAUM - Northeast States for Coordinated Air Use Management
NHCPS – New Hampshire Clean Power Strategy
NICCR – DOE’s National Institute for Climate Change Research
NOAA – National Oceanic and Atmospheric Administration
NO_x – Oxides of Nitrogen, including NO₂, the primary nitrogen species from combustion
NRC – National Research Council
NSF – National Science Foundation
OPS – U.S. Office of Pipeline Safety
PBF – Public Benefit Fund
PFC’s – Perfluorocarbons
PTC – Production Tax Credit
REC – Renewable Energy Credit
RGGI – Regional Greenhouse Gas Initiative (NESCAUM)
RPS – Renewable Portfolio Standard
SEO – State Energy Office (NC)
SEP – State Energy Plan (NC)
SERC – Southeastern Electric Reliability Council
SF⁶ – Sulfur Hexafluoride
SGIT – State Greenhouse Gas Inventory Tool
SO₂ – Sulfur Dioxide
SO_x – Oxides of Sulfur, including SO₂, the primary combustion product of sulfur
SUV – Sport Utility Vehicle
tpd – tons per day
UNC – University of North Carolina
UNFCCC - United Nations Framework Convention on Climate Change
VMT – Vehicle-miles Traveled
VACAR – Virginia-Carolinas Reliability Group
WMO - World Meteorological Organization

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Executive Summary

Introduction

The Clean Smokestacks Act (CSA) was passed and signed into law in June of 2002 by the North Carolina General Assembly and Governor Easley, respectively. This act requires the North Carolina Division of Air Quality (DAQ) to complete studies and make specific recommendations to the North Carolina Environmental Management Commission (EMC) and the North Carolina Environmental Review Commission (ERC) by September of 2003, 2004 and 2005 regarding control of CO₂ emissions from coal-fired power plants and other stationary sources. DAQ provided the first interim report to these two bodies in September of 2003 as a “state of the science” report. A second interim report spelling out potential options was submitted by September 2004.

This is the third and final report to complete DAQ’s requirements under the CSA, though actions related to this effort are to continue. This report updates some information in the earlier reports and provides DAQ’s findings and recommendations. DAQ plans to continue development of additional options and to hold more extensive discussions through a facilitated stakeholder process. Additional recommendations will likely be made later, dependent upon stakeholder and other input as well as actions of the General Assembly.

Since DAQ had little history and internal expertise on this topic when first given the responsibility to prepare this series of reports on CO₂ in 2002, much of the information presented in these reports has come from the literature, discussions with other states and agencies, and review of information provided by stakeholders, national experts and other interested parties. The intent of this third report is not to repeat and duplicate those earlier reports, but to communicate the final findings and recommendations of the DAQ. Updates of information from actions and activities that have taken place throughout the past year since the release of the September 2004 report are also included.

This Executive Summary only highlights the options and recommendations from DAQ. The intent is for this Executive Summary to provide sufficient information for the reader to review options, recommendations and other areas in an overview, even cursory, manner to give an overall understanding of what is in other Chapters of this report and in the previous two documents leading up to this report.

Review of Role of CO₂ and Other Greenhouse Gases in Global Warming.

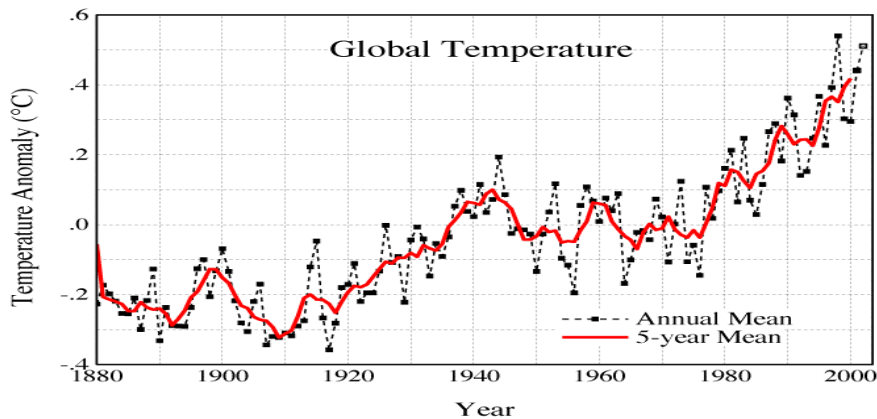
Global warming and cooling have been occurring over millions of years through a normal cycle as evidenced by geological and other physical evidence analyzed by scientists. In the mid 1950’s, scientists observed that CO₂ concentrations were rising and soon made an association with temperature. Subsequent research and observations have prompted the world’s leading scientists and organizations that are authorities in the area, to conclude that much of the increase in atmospheric levels of CO₂ is man made and correlated to combustion emissions since the beginning of the Industrial Revolution. Scientists have also surmised that the increases in temperature are likely to cause significant environmental damage over the next several decades. The case for these conclusions is documented in more depth and detail in the 2003 and 2004 reports, as well

as the many references and the bibliographies of those reports and further discussions below. Though these authorities have made rather clear and convincing arguments, there are still skeptics who discount the level of problems anticipated.

There is strong evidence of scientific consensus that increasing emissions of carbon dioxide and other greenhouse gases (GHG) are affecting Earth's climate. That consensus is most convincingly expressed by the works of the Intergovernmental Panel on Climate Change (IPCC), a body established by the World Meteorological Organization (WMO) and the United Nations to assess scientific, technical and socio-economic information relevant for the understanding of climate change, its potential impacts, and options for adaptation and mitigation. The IPCC's most recent assessment² concluded that most of the observed warming over the last 50 years is likely due to increase in GHG concentrations. These increased concentrations are largely attributable to human activities that result in emissions of carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), halogenated fluorocarbons (HCFCs), ozone (O₃), perfluorinated carbons (PFCs), and hydrofluorocarbons (HFCs). Aerosols, including sulfate particles and black carbon (soot), and water vapor also contribute to global warming. The next assessment is due in 2007. The U.S. National Academy of Sciences reviewed and endorsed the IPCC's work in 2001 in a report posted at <http://www.ipcc.ch/>. Other documents, such as Climate Change Science: An Analysis of Some Key Questions (2001), from the Commission on Geosciences, Environment and Resources (CGER), (found at <http://books.nap.edu/books/0309075742/html/1.html>) also addresses common questions on the topic.

Figure E-1, produced by NASA,³ provides graphic evidence constructed by various measured and retrospective methods, that the global temperature is increasing, even though the increments of change may seem small.

Figure E – 1 Global Temperature Plot 1880-2000



² Joint Science Academies' Statement: Global Response to Climate Change, June 2005,

<http://www.royalsoc.ac.uk/displaypagedoc.asp?id=13618>

³ National Aeronautics and Space Administration, Goddard Institute for Space Studies, *Global Temperature Trends: 2002 Summation*, 2004,

<http://www.giss.nasa.gov/research/observe/surftemp/>

Climate change simulations for the period of 1990 to 2100 based on IPCC scenarios for future GHG emissions yield a globally averaged surface temperature increase by the end of the century of 2.5°F to 10.4°F relative to 1990, with a mid-range prediction of 5.4°F. Uncertainty remains in understanding how the climate system varies naturally and reacts to emissions of greenhouse gases and aerosols, thus current estimates of the magnitude of future warming will be subject to future adjustments.

If the magnitude of global warming is consistent with the mid- or upper-range of the IPCC simulations, serious and damaging societal and ecological impacts are likely to result. Higher latitudes may experience greater temperature increases than lower latitudes, especially during winter and spring. The IPCC predicts rising sea levels, increased rainfall rates and heavy precipitation events (especially over the higher latitudes), and higher evaporation rates that would accelerate the drying of soils following rain events. With higher sea levels, coastal regions could face increased wind and flood damage, and some models predict an increase in the intensity of tropical storms. Even if temperature increases are in the lower-range of the IPCC scenarios, temperatures and sea levels will continue to rise well beyond the end of this century. Thus, the eventual impacts may be delayed, but not avoided.

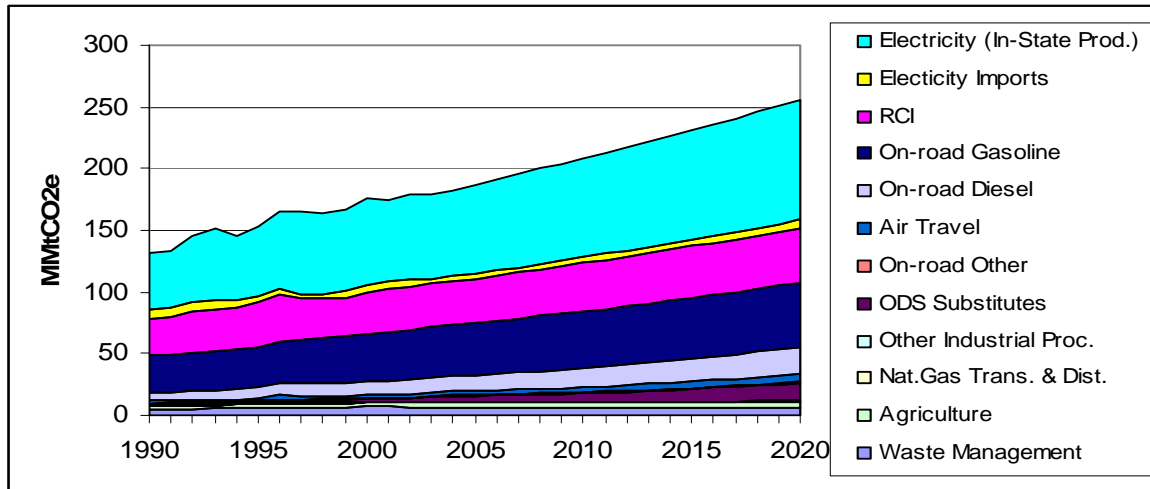
Eileen Claussen, President of the Pew Center on Global Climate Change, gave a talk in April 2004 on “Global Climate Change and Coal’s Future.”⁴ In this talk, she said, “Warming by itself, of course, is not proof of global warming. Climate conditions vary naturally, as we all know, and I am sure you have heard arguments that such natural variability, whether caused by volcanoes or the sun, can account for the climate change we’ve seen in recent decades. But when scientists actually take a look at the relative importance of natural vs. human influences on the climate, they consistently come to the same conclusion. And that is this: observed climate change, particularly that of the past 30 years, is outside the bounds of natural variability.”

Emissions in North Carolina

As may be seen from the implications of available data graphed in Figure E-2, the emissions of GHG in North Carolina continue to grow rapidly in response to economic and fuel-consuming activities. To achieve reductions that would reflect a complete return to “pre-industrial revolution” levels, a significant reversal of this curve would be required worldwide. This figure is from a draft report to support developing this report and a future climate action plan, and thus will likely be further refined as further information is available over the next several months. The reference document is expected to be on DAQ’s web very shortly as a draft for comment and readers are welcome to provide feedback and other information.

⁴ Eileen Claussen, 2004 Spring Coal Forum, American Coal Association, April 23, 2004, Phoenix, AZ

Figure E-2. Gross North Carolina GHG Emissions by Sector, 1990-2020: Historical and Projected⁵



Potential Impacts of Global Warming in North Carolina

As numerous organizations have recently pointed out in many reports, and as have been referenced in the earlier DAQ reports for the CSA, many changes can be expected in North Carolina due to the cumulative effects of emissions of CO₂ and other GHG. These include:

- Rise in ocean levels, threatening and gradually covering the Outer Banks, becoming noticeable and then of serious impact within the next 30 to 100 years
- Changes in growth rates and migration of several notable species of vegetation
- Changes in climate cause conditions that make it difficult to continue to grow current primary farm crops
- Increases in extreme weather events and storms and their impact upon the area
- Greater water loss due to increased evaporation, resulting in reductions and shifts in water supplies
- Increase in number of wildfires
- Higher energy costs for cooling in the summer, and greater risk of heat-related illnesses
- Disruptions to natural habitats and ecosystems (bark beetle infestation, for example)

The North Carolina General Assembly has recognized that global warming poses a threat to North Carolina and that burning of massive amounts of carbon fuel (wood, coal, oil, natural gas, etc.) also contributes to this continued warming, as evidenced by the inclusion of Section 13 (and the requirement for this report) in the CSA. A new act by the 2005 legislature also provides for a legislative commission to study the related issues.

⁵ Tom Peterson, K. Hausker, R Strait, S. Roe, H. Lindquist, M. Ma, Y. Hsu, M. Mullen, E. Williams, *Draft North Carolina Greenhouse Gas Inventory and Reference Case Projections*, The Center for Climate Strategies

Summary of Findings and Recommendations From DAQ

North Carolina can take a number of steps to reduce GHG emissions, especially reducing the use of energy. A number of efforts are already underway or planned and are mentioned below as “Plans of Action,” while others are presented as “Recommendations.” The recommendations are briefly summarized below. Additional details, background, basis, implementation justification, and rationale appear in more detail in Chapter II of this report, which should be referred to for completeness and clarity.

DAQ Plans of Action

These Plans of Action are to be implemented by DAQ without further discussion and debate except as may involve the EMC and Air Quality Committee (AQC) as is standard practice.

1. **DAQ Plan of Action # 1:** DAQ will immediately undertake development of a more detailed and complete North Carolina Climate Action Plan.
2. **DAQ Plan of Action # 2:** Pending completion of the Climate Action Plan above, the DAQ will also initiate activities to assist in the development of a Southeastern Regional Climate Action Plan involving other states, particularly those that share an Atlantic or Gulf coastline.
3. **DAQ Plan of Action # 3:** DAQ will, within three years, institute a required baseline point source inventory-reporting requirement for GHG emissions from facilities holding an air permit from DAQ.
4. **DAQ Plan of Action # 4:** DAQ will continue to review rules and evaluate means to stimulate improvement of efficiencies of existing and future proposals for coal-fired units to the extent they are complementary.
5. **DAQ Plan of Action # 5:** DAQ intends to continue to evaluate and include GHG reducing measures in its State Implementation Plan (SIP) for ozone and particulate to the extent that they are mutually complementary.
6. **DAQ Plan of Action # 6:** The North Carolina DAQ will use the definition “CO₂” to mean equivalent CO₂ (CO₂e), and thus include other greenhouse gases (GHG), and recommend that others do likewise.
7. **DAQ Plan of Action # 7:** DAQ will continue to explore and develop the concept of using CO₂ emission credits or a fee to provide funding to support the GHG inventory and climate change planning process.
8. **DAQ Plan of Action # 8:** DAQ commits to work with and assist, the Legislative Commission formed by the 2005 General Assembly to further evaluate a North Carolina Climate Action Plan and emission limits and related analysis.

DAQ Recommendations

Administrative & Regulatory

These recommendations are made with the expectation and understanding that no additional legislation is required, but may involve rule making or other administrative steps on the part of DAQ and/or other state agencies. They are believed to be sensible and in the interest of the state taking a leadership role in mitigation of GHG. See further discussions in Chapter II for more details.

1. **Recommendation A-1:** DAQ recommends that North Carolina State government increase its leadership role and intensify efforts currently outlined in the State Energy Plan to reduce energy use in, and emissions of CO₂e from all government owned or leased buildings, and equipment.
2. **Recommendation A-2:** DAQ recommends that clean coal technologies and non-combustion energy/electricity sources such as Integrated Gas Combined Cycle (IGCC), wind, solar, hydro and other emerging low-emission technologies be strongly considered when new power generation capacity is initiated.
3. **Recommendation A-3:** DAQ recommends that every five years (starting in 2010), a report on the “state of the science and practical application” of energy efficient power generation technologies (such as IGCC) and technologies to remove and sequester CO₂ from coal-fired power plants, be prepared.
4. **Recommendation A-4:** Subsequent or in parallel to DAQ’s development of a GHG point source inventory, a registry of GHG reductions that requires state and private participation in a carbon market should be instituted with guidance and resources for third party verification.
5. **Recommendation A-5:** The General Assembly and all agencies of the State should intensify actions to establish this state as a major GHG technology and information center to include educational, consulting resources, manufacturing expertise and sale of equipment on/for the world market.
6. **Recommendation A-6:** The North Carolina General Assembly and Executive Branch should use their formal and informal powers and influences with national and international bodies to make a statement of support to assure strong and sustainable reductions of GHG.
7. **Recommendation A-7:** DAQ recommends that the various educational components of state government incorporate information on GHG, climate change, and steps for mitigation into their standard curriculum.

Longer Term Recommendations Requiring More Study and Efforts

Recommendations in this group will require additional effort and work to refine and institute. They will generally be included in the discussions and stakeholder process to be undertaken by DAQ over the next several months to develop a North Carolina Climate

Action Plan. Further details are included in the Appendix D to this report as preliminary analysis preparatory to that stakeholder process.

1. **Recommendation LT-1:** DAQ recommends continued implementation and refining of the State Energy Plan to facilitate incorporation of GHG and climate action steps as may result from development of a climate action plan.
2. **Recommendation LT-2:** DAQ recommends that the General Assembly establish a leadership center within the University System and fund Agricultural and Forestry programs throughout State government to undertake and continue programs to maximize permanent (or long term) CO₂ sequestration and to develop and utilize the State's vast bio-fuel potential, with partial cost recovery from sale of carbon credits on the international carbon market.
3. **Recommendation LT-3:** DAQ recommends that efforts be undertaken to assist new systems and technologies being implemented to treat animal wastes as an energy resource be provided with economic and technical assistance to get the Smithfield Agreement's results initiated.
4. **Recommendation LT-4:** DAQ recommends that development of Renewable Portfolio Standards (RPS) and Environmental Portfolio Standards (EPS) be supported and implemented at the earliest possible time.
5. **Recommendation LT-5:** DAQ recommends that a Public Benefits Fund be established to assist in the adoption and implementation of energy reduction projects that will also reduce emissions of GHG from various private and public operations.
6. **Recommendation LT-6:** DAQ recommends that North Carolina government agencies continue to work with county, municipal, other state, national, international, and private organizations to insure that North Carolina is able to develop a more energy efficient and less emitting transportation sector.
7. **Recommendation LT-7:** DAQ recommends that a planning group or commission be established to evaluate needed steps and develop a long-range climate disaster recovery plan.

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CHAPTER I INTRODUCTION AND BACKGROUND

North Carolina's CSA and Climate Change

Brief History

This chapter is primarily to provide a short update and reference to other reports to provide the reader a roadmap to other information as well as a preface to the recommendations.

Previous Reports & Efforts in North Carolina Before CSA

Prior to the CSA of 2002, concerns for GHG and global climate change had already received significant attention in North Carolina. However, the state's strategy for addressing these issues has perhaps lacked a clear focus and emphasis throughout state government as may be necessary to accomplish a viable and sustainable program. Earlier in the development of national programs to assess the scope and effects of GHG (early 1990s), the EPA began several efforts to gather data and information on its sources and potential mitigation approaches. One of the initial projects was to develop a pilot or template of consistent methods and procedures to inventory these emissions on a state or national basis. They selected Appalachian State University's (ASU) Department of Geography and Planning to complete this groundbreaking effort. The project report was coordinated with several departments and organizational components of North Carolina state government. The DAQ had a role as a commenter on approaches and as a reviewer on the draft and final reports⁶.

Following the ground-breaking inventory effort, an initial plan for reducing GHG in North Carolina was sponsored and developed by a group of individuals and organizations and was also channeled through ASU. This "Sensible Strategies" plan⁷ was issued in January 2000 and has been cited and drawn upon for resource information and results in the DAQ's 2003 and 2004 interim reports to the EMC and the ERC, as required by the CSA.

DAQ's Reports and Other Activities Since CSA's Passage in 2002

The CSA, Session Law 2002-4 (aka Senate Bill 1078)⁸ was passed and signed into law by Governor Easley in June 2002. The CSA's primary requirements established reductions of SO₂ and NO_x emissions from major coal-fired power plants within the State. Section 13 (the text of Section 13 appears on the inside of the cover page of this report) also required DAQ to study and make recommendations to these bodies regarding any further actions needed for control of CO₂ from coal-fired power plants and "other stationary sources." The reader may wish to review the First and Second Interim Reports

⁶ Appalachian State University, Department of Geography and Planning, 1996. *The North Carolina Greenhouse Gas Emissions Inventory for 1990, Vol. 1 and 2*, Appalachian State University Boone, NC.

⁷ Appalachian State University, Department of Geography and Planning, 2000, *North Carolina's Sensible Greenhouse Gas Reduction Strategies*. Appalachian State University, Boone, NC.

⁸ Clean Smokestacks Act (CSA), North Carolina Session Law 2002-4, June 2002, Raleigh, NC.

(September 2003 and 2004) for further background, discussions of the “state of the science,” and discussions of the range of available options for recommendations for this report (respectively) that are not necessarily repeated in this final 2005 report. The reports are available from DAQ’s web page at <http://daq.state.nc.us/news/leg/>.

When DAQ received the requirement for development of these reports, little CO₂-related activity had been carried out within the DAQ other than the participation in the guidance and review of the earlier ASU reports mentioned above. The DAQ has historically focused exclusively on state and federal “Clean Air Act” requirements that do not include mention or designation of the GHG pollutants. Development of background knowledge and preparation of these reports and recommendations has necessarily heavy reliance on work done by others. No major analysis efforts or resources were available for the first two reports to update emissions, and thus the emissions assessments and economic analyses relied on the work already done by others. Some original efforts have recently begun that will result in additional data and analyses.

To maximize the efficiency of information collection and exchange, DAQ held a public workshop April 19-21, 2004, to solicit the latest available information (including mercury), and provide a forum for discussion among stakeholders and others, and exchange of technical and policy ideas. A wide variety of speakers, leading national and international experts in their field, provided presentations and DAQ continues to appreciate the assistance each of these individuals has provided. The visual presentations from this workshop are provided on DAQ’s web page: http://daq.state.nc.us/news/leg/cleanst_hg_co_prov.shtml.

This 2005 Final Report

Information in this third, and final, CSA report on CO₂ supplements and updates, but does not necessarily repeat, information in the September 2003 and 2004 CSA reports. The focus of this report is on recommendations and further options for subsequent consideration, study and follow-up. DAQ has continued earlier stakeholder involvement to engage interested and knowledgeable partners in an exchange of ideas. This stakeholder process has broadened with DAQ soliciting and considering input from a wide variety of organizations and individuals. Recommendations from those stakeholder meetings have been reflected, but they are not summarized or presented individually here. DAQ expects to continue soliciting input from stakeholders and partners in the further development and implementation of any recommendations that are its responsibility and venue. During this process, however, DAQ has continued to recognize its responsibility and authority from the legislature to make final recommendations and maintain the rights to include, exclude, or revise the final documents to reflect its best judgment of facts, science and objectivity.

In many cases throughout this series of reports, because of time and resource constraints, text from public domain (generally government) references have occasionally been extracted, summarized or repeated *verbatim*. Where this has occurred, a sincere attempt has been made to reference the source to give proper credit and use only public (copyright unrestricted) sources. The authors/DAQ’s intent is not to take credit for the work of others or disregard copyrights. The authors and editors of this report express their gratitude for all contributors, stakeholders, reviewers and other interested parties who made it possible to produce this work.

Assumptions Made Preparing This Report

Although there was a clear mandate in the CSA for DAQ to prepare reports to the EMC and the ERC, several technical considerations and assumptions had to be made to prepare these reports. Some of these are listed below:

- Global warming and climate change, and man's role therein, are accepted as fact by the General Assembly, as evidenced by their prescribing these CO₂ report requirements upon DAQ.
- CO₂ was intended by the General Assembly to be inclusive of all GHG. The CSA language only includes the specific "chemical entity" of CO₂. However, DAQ has assumed that "CO₂e" was implied. CO₂e includes other CO₂-equivalent (but more "greenhouse potent") compounds, such as methane, nitrous oxide and other generally less abundant compounds.
- Global warming mitigation must be an international and national priority, but in absence of clear national leadership, North Carolina must recognize its responsibilities to plan, develop and implement reasonable steps to result in substantial reductions in GHG.
- DAQ determined it prudent and responsible public policy to include all sources of GHG in the effort to provide an overall perspective of relative importance and to facilitate a means to consider a more holistic approach to potential mitigation and solutions to the problem.

Summaries of Previously Reported Findings

Some major points of findings from the 2003 and 2004 reports are listed below. To read the full reports,⁹ you may download them at <http://daq.state.nc.us/news/leg/>.

Findings - First (2003) DAQ/CSA "State of the Science" Report

- CO₂ is only one of the several recognized GHG. The text of the CSA directs the DAQ to study CO₂, which is by mass or volume, the largest quantity of GHG emitted by coal-fired utilities. CO₂ is also the largest effective component of the inventory of GHG emitted from all sources. However, other GHG, such as methane, N₂O, halofluorocarbons, and others, contribute to warming of the oceans and Earth's atmosphere, with substantially more warming effectiveness per molecule than CO₂. For example, methane is about 21 times more potent than CO₂. Other major contributors to atmospheric warming often overlooked and not addressed in these discussions are water vapor and particulate matter, "black carbon," in particular.¹⁰ The term also used often in the literature is "CO₂e" which is the "sum of the cumulative "equivalent carbon" represented from the net effect of all the included substances on global warming.
- Leading national and international science and governmental authorities, including the current administration, have concluded that man-made emissions

⁹ North Carolina Division of Air Quality, DENR, CO₂ Emission Reduction Options for Coal-fired Electrical Utility Boilers and Other Stationary Sources, First Interim Report, September 2003 and Second Interim Report, September 2004.

¹⁰ Intergovernmental Panel on Climate Change, Climate Change 2001: The Scientific Basis, http://www.grida.no/climate/ipcc_tar/wg1/

contribute to climate change and that it is prudent to take rapid steps to reduce those emissions.

- The Bush Administration's "US Climate Action Report 2002"¹¹ accepts and supports the conclusions of the National Academy of Sciences report identified above.
- Despite the strong and growing scientific consensus, many still debate the severity of impacts from increased GHG, including CO₂,¹² and what should be done in response to rising GHG levels.
- Climate change is a concern at all levels, from local to global, and must be addressed at local, state, regional, national and international levels, with coordinated leadership.
- According to data from the U.S. Environmental Protection Agency (EPA), North Carolina ranks 14th among the states in total CO₂ emissions.¹³
- Our state's CO₂ output has grown steadily (typical of a growing economy) along with rises in energy consumption, increasing by more than 30 percent since 1990,¹⁴ and the electric utility sector continues to be a growing contributor.¹⁵
- End-of-Stack solutions, such as scrubbers that control or reduce NO_x or SO₂ emissions are not effective in significantly reducing CO₂ from power plants or other stationary sources. However, several DOE (and other) research projects aim to:
 - Increase efficiency of electricity production [such as Integrated Gasification Combined Cycle (IGCC)].
 - Capture CO₂ from stacks through new technologies
 - Sequester CO₂ by new and innovative methods (such as injection of captured stack effluent into deep underground coal seams or brine pools).

These technologies have not yet been demonstrated as commercially available and economically viable technologies that warrant immediate adoption as strategies. This may happen in the next few years. (*The \$14.6 billion Energy Policy Act, passed July 29, 2005, provides substantial funding for such research and development for such technologies.*)

- Leading options for reducing GHG emissions include conservation, process changes, development and adoption of new technologies and other approaches at all levels of society.
- The emissions of CO₂ in North Carolina from known sources have been quantified adequately for purposes of initial problem assessment, but for use in potential future emission trading systems or other policy regimes are inadequate.
- Currently more than 70 percent of North Carolina's energy comes from fossil fuels.¹⁶
- Residential energy consumption is expected to increase by about 50 percent by 2020.¹⁷

¹¹ **Climate Action Report**, US Department of State, Washington, DC, May 2002,

<http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsUSClimateActionReport.html>

¹² **Status of the Kyoto Protocol**; The United Nations Framework Convention on Climate Change, July 2003.

¹³ US EPA, *States Ranked By Total Carbon Dioxide Emissions*,

<http://yosemite.epa.gov/globalwarming%5Cghg.nsf/EIAStatesRankedbyTotalEmissionsAll?openview&count=52>

¹⁴ US EPA, <http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsStateEnergyCO2Inventories.html>

¹⁵ **North Carolina State Energy Plan**, June, 2003,

¹⁶ Energy Information Administration, Department of Energy, *Energy Expenditures in North Carolina, 1999; State Energy Profile*, www.eia.doe.gov/emeu/sep/nc/frame.html

- A recognized, very effective way to “control” CO₂ is to reduce or refrain from burning carbon-based fuels.
- Agricultural and forestry practices and policies can have a substantial effect on the amount of carbon that is sequestered in the soil and wood products.
- Currently, substantial reductions in the growth of emissions of CO₂ are expected to come from energy efficiency improvements and other measures to reduce fuel consumption, as identified in the State Energy Plan.
- Economic costs of inaction to address climate change for North Carolina are projected to be significant.
- There are potential benefits to various sectors of North Carolina’s economy if the State is adequately prepared for the potential carbon marketplace, subject to the timing and structure of national carbon caps.
- A number of states and other governments (*discussed later in this chapter*) continue to take action on climate change in the absence of federal legislation. There continues to be little effective federal policy action, (*except as addressed in newly passed Energy Policy Act, July 29, 2005, but that does not really address immediate emission reductions for climate change actions directly in an extensive manner*).
- There are also significant potential economic paybacks for non-utility sectors of the economy. Investments in development of an infrastructure to reduce carbon combustion (and other GHG equivalents) in other sectors will also help to assure that North Carolina is a leader in development and manufacture of new technologies. In so doing, industry and other institutions can be prepared to provide research, equipment, expertise and services to facilitate these needed changes occurring statewide, nationally and globally.
- Efforts and developments in the national, regional state and global arenas continue and will necessarily influence choices of the next best and sensible steps for North Carolina.

Options - Second (September 2004) Interim Report - Alternative Approaches

Many, including North Carolina’s legislators, have taken actions and made statements that indicate North Carolina must prepare its economy and its people for a carbon-constrained world. CO₂ and other GHG emissions can be reduced by an array of solutions, including end-of-pipe technologies (now being researched), increased energy efficiency (such as encouraged in the State Energy Plan), greater use of renewable energy, carbon sequestration in trees and agricultural lands, and incentives for lower emitting vehicles. Many of these steps can be implemented now. Some may need to be addressed later. Some potential solutions will likely need to be accomplished by adoption of new governmental policies; some with new state rules based on existing authorities; and, others may require new legislation. Policy and legislative changes (Energy Policy Act) recently passed by the U.S. Congress will likely have important impacts on efforts and steps in North Carolina.

¹⁷ North Carolina Energy Division, *North Carolina Energy Outlook, 2003*, Appendix Table, p. 92. Increase estimated from a 2000 baseline.

Categorical options included in the Second Interim Report in September 2004 are shown below:

- A. Take no action and default to potential federal and international actions to address the problem of requiring and defining means to achieve “CO₂ controls” (i.e. reductions) at some undetermined time in the future, ignoring the potential economic benefits, and taking a risk of losing advantages of being a leader and having established infrastructure in place.
- B. Commit to future actions, but only after further studies. This option would require the state to first undertake and complete additional studies and pursue more detailed analyses (requires new funding and other resources) involving multiple state agencies and academic institutions to further refine the options and actions.
- C. Take a moderately more aggressive approach of accounting and reductions that would be designed with a combination of voluntary and required steps to maximize reductions in GHG, in conjunction with energy efficiency measures that result in a minimum of cost impacts.
- D. Develop aggressive plans and take actions to set a cap on all GHG emissions with reference and focus toward CO₂ from coal-fired boilers, other stationary sources (combustion-centered, primarily) and transportation sources. This option would involve a significant mandatory reporting and accounting system that would guarantee North Carolina does its share of leading and attaining international goals, using established national and internationally accredited protocols and data storage capabilities.
- E. A combination of either, or both, of the two previous options, but developed and implemented as part of an integrated multi-state energy and carbon emission reduction (Climate Action) plan.

The recommendations below are largely developed from components of the above, the “Tier 1 and Tier 2” (on the DAQ web page) lists developed to stimulate feedback and further discussed at the stakeholder meetings in April and May of 2005 and further discussions since those meetings.

Developments Since 2003 and 2004 Reports

Please refer to the earlier 2003 (state of science) and 2004 (options) reports as needed for further details and background, because not all such details and discussions in those reports are repeated here. The collections of topics and statements that follow should be viewed as updates to those earlier reports.

International Developments

The 25 largest-emitting countries in the world emit 83 percent of global GHG emissions.¹⁸ Seventeen of these are also among the world’s most populous countries and 22 are among those with the highest Gross Domestic Products (GDP). These data strongly support the view that the international climate effort must include the large-

¹⁸ Elliot Diringer, Pew Center On Global Climate Change, Before the Committee on Environment and Sustainable Development, House of Commons, May 31, 2005, Ottawa, Canada.

emissions countries. The group includes nearly an equal number of developed and developing countries, as well as other economies in transition.

International developments since the 2004 report have been important. The most noteworthy may be those regarding the Kyoto Protocol and the G-8 Summit, both of which are discussed further below.

Kyoto Protocol

The Kyoto Protocol came into force on February 16, 2005 following ratification by Russia and changed the motivation of many countries and companies around the world, particularly in Europe. The Protocol sets emission targets for nearly all industrialized countries for the period 2008-2012, with the exceptions of the U.S. and Australia (both countries having reversed their earlier support for the process). GHG emissions trading is allowed under the Protocol and a trading market has emerged. Many multinational U.S. companies are participating in these markets or looking closely at how they may take advantage of the related business opportunities. Many U.S. companies without overseas operations see mandatory limits on GHG emissions as likely in the future, and are gaining experience in the GHG market through voluntary programs. Some state, county and municipal governments are showing similar interest. At the same time, the lack of emission targets in the post-2012 period creates substantial uncertainty for players in the emerging GHG market.

With carbon markets beginning to result in substantial increases in the price of a “ton of CO₂e not emitted,” the forces of commerce are leading to serious consideration of the economic benefits of participating in this market. The pressures also suggest that “non emitting” energy sources such as windmills, solar energy, hydrogen, or other non-carbon alternatives, will be experiencing growth and research intensity that will likely lead to additional breakthroughs. North Carolina can be a leader in these developments.

G-8 Summit

In July of 2005, the world’s eight major industrial nations (the “Group of Eight” or “G-8”) held its annual meeting, and climate change was a major item on the agenda. The U.S. is the only member of the G-8 that has not supported emissions targets in the Kyoto Protocol. The G-8 nations (United States, Britain, Canada, France, Germany, Italy, Japan and Russia) agreed to take “immediate steps to curb global warming” and they gave a limited endorsement of mandatory carbon emissions cuts and language linking global warming to human activity, indicating a slight shift in the U.S. position. The G-8 also adopted a plan identifying a range of activities to promote research, information exchange and cooperation on energy efficiency, renewable and clean energy sources, and logging operations.

The G-8 statement indicates that, although some uncertainties about climate change remain, “we know enough to act now and to put ourselves on a path to slow, and, as science justifies, stop and then reverse the growth of greenhouse gases.”¹⁹ It also acknowledges “human activities contribute in large part to increases in greenhouse gases associated with the warming of our earth surface, welcome its entry into force and will work to make it a success.” It also states that the G-8 countries will act with resolve and

¹⁹ G8 Gleneagles 2005, *Climate Change, Clean Energy and Sustainable Development*, <http://www.number-10.gov.uk/output/Page7881.asp>.

urgency to meet shared and multiple objectives of reducing GHG emissions. The countries each reaffirmed their commitment to the U.N. Framework Convention on Climate Change and its objective of stabilizing GHG concentrations at a level that prevents dangerous anthropogenic interference with climate.

Developments in Individual Countries (see Appendix A)

Other Significant International Developments (see Appendix A)

Developments in the United States

Energy Policy Act and Climate Change Bills in U.S. Congress

The \$14.6 billion Energy Policy Act, of July 29, 2005, includes a climate title and many provisions that could affect U.S. GHG emissions. Key provisions of the climate title aim to:

- Create a national strategy to promote the deployment and commercialization of GHG intensity-reduction technologies and practices;
- Provide a public inventory and evaluation guide to technologies that help reduce GHG intensity; and
- Provide assistance to developing countries specifically for projects to reduce GHG intensity.

Other provisions of the Energy Policy Act promote and/or subsidize various energy sources, but the net impact on GHG emissions will be difficult to determine.

Also, the Senate rejected the McCain-Lieberman bill for a second time. It would establish mandatory limits on GHG emissions. Congressional interest in climate change appears to remain high, however.

DOE's 1605 (b) Registry

Since 1994, DOE's 1605(b) Voluntary GHG Reporting Program (see the 2004 CSA report) has tracked GHG reduction and carbon sequestration efforts by companies choosing to participate. There were 2,188 "projects" (representing 234 companies – almost 40 of which are in North Carolina) included in 2003 estimates, up from 2,055 in 2002. DOE estimates that U.S. GHG emissions reached 6,936 million metric tons of CO₂e in 2003. About half (126 firms) provided entity-level reports that include emissions for their entire operations, rather than specific reduction projects. Companies reporting released an estimated total of 889 million metric tons of CO₂e, or about 14 percent of U.S. greenhouse gas emissions in 2003. They reported CO₂e cuts of 372 million metric tons, with 268 million tons from specific reduction efforts, 7 million tons from carbon sequestration projects and 16 million metric tons from unspecified reductions²⁰, likely due to manufacturing cuts.

DOE proposed changes to the General Guidelines of the 1605 (b) Reporting Program in December 2003 and held public workshops in January 2004. DAQ submitted comments in February 2004. The Interim Final General Guidelines and Draft Technical

²⁰ **Voluntary Reporting of Greenhouse Gases 2003**, DOE/EIA-0608 (2003); Energy Information Administration, Office of Integrated Analysis and Forecasting, U.S. Department of Energy, February 2005, Washington, DC, www.eia.doe.gov/oiaf/1605/vrpt/index.html.

Guidelines were released in March 2005 and DAQ submitted additional comments in June 2005.

The 1605 (b) Reporting Program has been criticized for several reasons, one of which is that it is voluntary and thus does not provide a complete and verifiable inventory of emissions from all sources. Currently third party verification is not required, which is needed before a carbon market (cap and trade) can develop. The current program serves as a basic voluntary public emissions reductions reporting mechanism for participants in EPA's *Climate Leaders* and DOE's *Climate VISION* programs and for incidental reporting by others. A comprehensive mandatory federal program is necessary for it to be effective. The 1605 (b) satisfies limited purposes of providing a baseline format and an organizational framework for multiple users. Opinions vary widely on its utility and effectiveness.

Federal Court Case on CO₂ As a Pollutant

On July 15, 2005 the U.S. Circuit Court of Appeals for the District of Columbia rendered a decision that EPA was not required by the Clean Air Act (CAA) to regulate CO₂ emissions from motor vehicles. An appeal to the Supreme Court has been filed.

Major Private Companies Indicate Support and/or Changes in Policies

On May 9, 2005, General Electric announced "Ecomagination," an initiative to develop and market technologies to help customers meet environmental challenges. GE committed to reduce its GHG emissions by 1 percent by 2012 and the intensity of its GHG emissions 30 percent by 2008 (compared to 2004). A number of other companies, including Cinergy, DuPont and United Technologies, have also made recent major declarations in support of taking new or renewed actions on climate change mitigation. Additional information can be found at the links below:

http://gehealthcare.com/usen/about/social_perform.html,

<http://www.icta.org/about/index.cfm>,

www.house.gov/science/hearings/full05/june8/index.htm

Actions in Other States

Actions of other states and jurisdictions may provide insights as to what effects various actions and developments might have on North Carolina. Such developments were covered extensively in the 2004 report. Of primary interest are actions underway in the past few months in Arizona, California, Colorado, Connecticut, Iowa, Maine, New Mexico, North Dakota, Oregon, Pennsylvania and Washington. Several developments since the 2004 report are summarized in Appendix B. For a complete picture, the reader may wish to do additional research as information is changing rapidly.

Multi-State, Regional and Other Multi-Jurisdictional Approaches (see Appendix B)

Major New Developments in North Carolina

NC Legislative Developments

Several significant bills have been introduced and acted upon by the 2005 General Assembly. As this document is being finalized, some of the bills are still not clearly resolved, and may not be resolved during the 2005 session. The summary here is primarily to note those actions and recognize that other changes may occur on this topic during or after the finalization and delivery of this report. Not all related bills or actions are included, but a more complete and up-to-date record may be accessed on the General Assembly's web pages or through one of the tracking organization's summaries, such as the North Carolina Sustainable Energy Association's (NCSEA) site (with commentaries). These may be found at: <http://www.ncleg.net/> or <http://www.ncsustainableenergy.org/>, respectively.

North Carolina Global Warming/Climate Change Bill (HB 1191/SB 1134)

The North Carolina 2005 Session of the General Assembly passed the Global Climate Change Act. This act establishes a new Legislative Commission on Global Climate Change, charges the commission to develop and recommend a GHG reduction goal and to establish a process for developing a statewide climate action plan. The act (<http://ncleg.net/Session/2005/Bills/Senate?PDF/S1134v3.pdf>) requires firm plans and actions for mitigation of GHG emissions in North Carolina. The act also makes it clear that North Carolina government and businesses should be making plans to cut GHG in a manner that can also result in economic development and financial benefits as it facilitates entry of North Carolina into a carbon market where carbon credits may be bought and sold.

Renewable Energy Portfolio Standard (S 936/H 1511)

This proposed Legislative action would require ten percent of the electricity (<http://www.ncleg.net/Sessions/2005/Bills/House/PDF/H1511v1.pdf>) from the major utilities in the state to come from renewable sources by 2016. Though this may not have direct reductions on the quantity of CO₂ entering the air, it would likely have significant impact on electric generation in the state. Renewable Portfolio Standards (RPS) and related concepts are discussed further later in this report. The proposed bill was moved into a studies act late in the 2005 session and is pending at the completion of this report

Climate Change/State Agency Reports/Funds (H1600)

Of the several other bills under consideration, one that may be more germane to this report is House Bill H1600, which would require nine departments and the NC Utilities Commission within state government to annually evaluate and report their activities and research related to GHG emissions and climate change. The bill is a funding bill that would possibly help facilitate the implementation of baseline inventory and registry participation by state agencies. Status is unclear as of this writing.

Updates to State Energy Plan

North Carolina's General Assembly established the North Carolina Energy Policy Council (EPC) in 1975 as a means of addressing statewide energy issues and concerns. That body directs the preparation of The North Carolina *State Energy Plan* (SEP). The

State Energy Office (SEO) of the NC Department of Administration completed the latest full update of the SEP in June 2003, with major assistance from the Appalachian State University (ASU) Energy Center. That plan was again reissued in January 2005 to reflect further revisions in 15 action items, and raising the priority of an additional five from the 2003 report, as resulted from actions of the SEO and the EPC. Since energy efficiency and fuel combustion for energy production are strongly correlated with emissions of GHG, the SEP is integral and parallel with this report. The revised (2005) recommendations are quoted in Appendix C of this report for completeness and convenience. The entire plan, with updates, may be viewed on the SEO web site at: http://www.energync.net/sep/docs/sep_12-04.pdf.

Duke Energy CEO Endorses a Carbon Cap

On April 7, 2005, Paul Anderson, Chairman of Duke Energy, one of the two major utilities in the state covered by the provisions of the CSA, announced that his company will support a tax on CO₂ emissions as a means to reduce fossil fuel consumption and begin dealing with global warming. In this announcement, he was quoted by the Associated Press: “Personally, I feel the time has come to act—to take steps as a nation to reduce the carbon intensity of our economy, and it’s going to take all of us to do it.” He also concluded that a national carbon tax would likely mean higher utility bills and prices at the gas pump, but that long-term outcomes could be even worse if business doesn’t show leadership and take action. He pointed to the unsavory option of having 50 states implementing different sets of complex rules, as an example.

Another significant development at Duke Energy was its merger with Cinergy Corporation, a major Midwestern energy company whose officials have frequently vocalized its efforts to be identified as a leader in the energy efficiency, air quality and global warming efforts. The frequent spokesperson over the past few years, James Rogers has become an icon for his role. This purchase/merger is not expected to have much direct influence on operations in North Carolina, but will likely change the structure, staff and operations of the company over time.

Opportunities for Stakeholder Feedback on CSA Reports and Options

DAQ hosted several open meetings from 2003 – 2005 to allow stakeholders to input their thoughts and ideas to the outlines, expected content, and major topics covered in its reports. The scope of these meetings ranged from a three-day workshop at McKimmon Center on the North Carolina State University campus to smaller and mostly informal meetings at DAQ’s conference rooms or the DENR Hearing Room. A wide section of stakeholders were identified and invited to these meetings. There were three such meetings held regarding this third and final report. The first meeting presented a general overview and opportunity for comments and feedback from those stakeholders who desired to speak. The second and third meetings were then provided in response to requested additional opportunities from specific individuals and groups.

The informal stakeholder interest list has been constantly amended and all on that list have been notified of meetings by email. Participants represented a wide range of interests and opinions/stakes. As a focus for discussion of options, two such options lists were developed and circulated at the meetings and on the DAQ web that were labeled Tier I and Tier II. The Tier I list included things that were viewed as likely more easily

accomplished and without necessarily needing approval of the General Assembly or additional stakeholder involvement. The Tier II list included a longer list of concepts that needed additional analysis and focus before they could become full-fledged recommendations. Evolution from those lists resulted in the recommendations in Chapter II of this report. The basic recommendations will likely be recognizable to most stakeholders, but have evolved substantially.

One issue with strong feedback initiated by the stakeholders was that DAQ make recommendations regarding the future of nuclear energy (i.e., new plants) in the state. Though it had already been observed in the 2004 report that nuclear electric generators do not emit SO₂, NO_x, CO₂ nor significant quantities of particulate matter, they are also subject to a whole different set of regulatory processes and requirements. Since DAQ does not have any regulatory authority for these plants, DAQ does not judge it appropriate to make any statement in favor of or against them at this time. Future hearing and licensing processes will possibly request/require some feedback from DAQ. However, a formal request for such a unit to be approved by the North Carolina Utility Commission, the federal nuclear licensing authorities or others, has not been made. Thus, it is DAQ's opinion that it would not be appropriate to make any statements on the matter until such official actions are initiated.

CHAPTER II NC DIVISION OF AIR QUALITY RECOMMENDATIONS

North Carolina provides only a small part of the global emissions of GHG, (about 200 million tons of a 25 billion ton global total) making it obvious that this state cannot solve the global problems alone. It would be best if national efforts and the international community could develop and utilize a common and accepted currency for exchange and record keeping. Ideally, such efforts should not impose unnecessary or unfair hardships on emitting facilities. Sources should be provided with maximum avenues to take advantage of the carbon market and potential economic opportunities that are likely.

The energy/global warming quandary as summarized by Eileen Claussen of the Pew Center for Global Climate Change in a recent speech, boils down to three questions. First can we find enough energy to meet our needs from sources that are secure? Second, can we provide the energy we need in ways that do not harm the climate? Third, can we meet our energy needs in affordable ways that will allow us to continue to grow our economy? Looking across these three issues, it is clear that we need policies that are both climate and economy-friendly. Some elements of these policies will be similar, but we need to think about how best to achieve the goals of protecting the climate and meeting America's energy needs affordably in the coming decades.²¹ The recommendations in this report are aimed at maintaining that balance and addressing the needs of North Carolina as an international partner in the process to preserve the global economy and physical well-being.

Ways to reduce GHG and establish North Carolina as a truly important part of the global solution are not simple, nor can such efforts be successful if done in isolation. Development of an integrated multi-department, regional and state approaches to address climate change, air quality and energy will help formulate credible solutions. Such planning and implementation will require strong support from top levels of state governments, appropriate resources, motivated stakeholder involvement and time, leadership and patience. Three recent reports referenced here provide additional insights, guidance and information on experiences and how such large-scale options can be exercised.^{22, 23, 24} The further development of these concepts will harmonize well with development of a comprehensive North Carolina Climate Action Plan as mentioned later in this report and a similar regional plan.

Basis for DAQ Recommendations

Primary Objectives

Options outlined in the 2004 DAQ report to the EMC and ERC have been further assessed. The general conclusion has been reached that the seriousness and scope of

²¹ Eileen Claussen, Pew Center on Global Climate Change, *Energy Efficiency, Climate Change and Our Nation's Energy Future*, June 16, 2004, Washington, D.C.

²² Southern Alliance for Clean Energy, Southern Environmental Law Center and Environmental Defense, Jointly authored *Blueprint for Breathing Easier, Southeast Energy Strategy for Clean Air*, 2002.

²³ *State Policy Solutions to Climate Change: Midwest Workshop Proceedings*, Pew Center on Global Climate Change, November 4-5, 2003.

²⁴ Tom Peterson, Center for Clean Air Policy, *Climate Change Mitigation: Process and Policy Options for State Greenhouse Gas Plans*, November 26, 2003, www.ccap.org.

global warming is sufficient that North Carolina should adopt and follow the general guiding principles below and:

- Make recommendations with definite options that combine voluntary and required steps to maximize reductions in GHG, and result in minimum cost impacts, at the earliest reasonable time.
- Develop plans for short and long-term actions that will ultimately support a cap and subsequent reductions of GHG emissions, including CO₂ from coal fired boilers, other stationary sources and transportation.
- Develop a mandatory reporting and accounting process to facilitate participation in carbon trading.

General Guiding Principles

The North Carolina EMC and the ERC are recommended to formally recognize that:

- Leading national and international scientists, and the U.S. Congress, have concluded that global warming is occurring, and is heavily influenced by human activities, especially through the burning of fossil fuels.
- North Carolina is particularly vulnerable to the effects of global warming, such as sea level rise, increased numbers and intensity of hurricanes, mosquito-borne diseases, potential tourism and recreational impacts, degraded productivity of agriculture and forestry and health and environmental impacts. State government should take aggressive action to reverse these impacts.
- Past and projected emissions of GHG indicate that the climate will continue to warm. The more emissions released, the higher the economic and environmental impacts will likely be.
- Reductions in GHG emissions also could create jobs and economic opportunities for North Carolina as the world transitions to a lower carbon economy. A carbon market is emerging and North Carolina should be poised to take advantage.
- Reducing North Carolina's GHG emissions could help promote expansion and recruitment of renewable energy technologies that cause less pollution and generate jobs within the state.
- North Carolina can benefit from leading efforts to stabilize and reduce global concentrations of carbon dioxide (and equivalents), while furthering the state's economic development.

DAQ's Plans and Recommendations

Plans and recommendations presented here were refined primarily from options discussed in the September 2004 Report and the Tier I and Tier II option lists utilized by DAQ in stakeholder meetings. Some of these formulations have been restated as *Plans of Action* that DAQ intends to pursue, and others remain as recommendations that have been revised based on new information, further development, and consideration of comments and suggestions received from stakeholders. The DAQ plans generally address things that can be addressed in a fairly straightforward manner with limited or no additional legislation. They also include items already being done as related to the SEP (e.g. energy efficiency) and other elements that support sustainability and good steps for the environment, though not necessarily a direct reduction in CO₂e emissions. Perhaps the most significant recommendation is *Plan of Action #1*, which presents DAQ's intent to

initiate a more formalized stakeholder process to develop a North Carolina Climate Action Plan.

DAQ Plans and Intentions for Continuing Actions

The list of items immediately following describes a series of plans that DAQ intends to initiate or continue without further delay. They are activities that do not necessarily require additional authorization from the General Assembly. Several will likely involve the approval and input from the EMC.

Plan of Action # 1: Continued Facilitated Stakeholder Process to Result in A Formalized North Carolina Climate Action Plan

DAQ intends to continue developing a North Carolina Climate Action Plan through a formalized stakeholder process. This process has already begun through initial development of baseline technical information. Formation of stakeholder groups is to begin in 2005 building upon results and information in this report.

The development of a Climate Action Plan will also be coordinated with the Legislative Commission on Global Climate Change, as passed as House Bill 1191 of the 2005 Session of the General Assembly.

Background and Basis for Recommendation

A climate action plan (CAP) provides comprehensive information regarding issues, options, steps and recommendations to be undertaken to reduce emissions and determine associated economic impacts. In addition, the CAP will set priorities for actions needed by the various entities, public and private, within a state, region or other jurisdictions. A North Carolina CAP is expected to provide benefit/cost information on a wide range of GHG reduction options. Economic benefits, including jobs from implementing these options, will be presented for multiple sectors, including agriculture, forestry and high technology industries. These economic advantages to the state citizenry will be a major focus of the plan.

Several states/jurisdictions such as Arizona, Connecticut, Maine, Massachusetts, New Mexico and Puget Sound (Washington), have recently developed specific plans using a facilitated stakeholder process with various levels of oversight groups and technical working groups, similar to what is envisioned here. Those plans contain a series of interconnected recommendations, supporting statistics and economic assessments that let governing bodies and managers assess the viability of each recommendation. Generally, the facilitators in charge of documentation are a paid outside organization skilled and experienced in this type of process, with no direct stake in the outcome.

One of the actions of the 2005 General Assembly was to adopt an Act that authorizes a *Legislative Commission on Global Climate Change* (House Bill 1191). This Commission will have more than 30 members representing various interests. The Commission's work would extend until November 2006, allowing time for consideration of their results by the 2007 General Assembly. A primary focus of this effort is to assess the impacts of climate change on North Carolina, the need for setting a GHG emissions cap, and what such a goal might be. DAQ has begun efforts to establish a facilitated stakeholder process to develop a North Carolina CAP as a continuing action related to

Section 13 of the Clean Smokestacks Act of 2002. The efforts of DAQ and this Commission are expected to be concurrent and interactive, but not interdependent, so that resources are optimized and results are coordinated. This process is expected to result in definitive and consistent plans.

Further details and discussions of the process, options, preliminary analysis efforts and recommendations to be developed in the Climate Action Plan are provided in Chapter III of this report.

Plan of Action # 2: Develop a Regional Climate Action Plan

DAQ intends to initiate coordination to develop a regional climate action plan, primarily with other Southeastern states. This Atlantic and Gulf Coasts Climate Action Plan would build upon the results of a North Carolina Climate Action Plan. This effort will likely begin in mid-2006 with a workshop to explore common interests and options among other Southeastern states.

Background and Basis for Recommendation

The same climatic forces and sea level changes affect all the Atlantic and Gulf Coast states. Thus, a common bond exists among these states to develop a coordinated set of actions and policies of mutual benefit. The *Southern Air Principles*, as signed by the governors of four Southeastern states serves as a precedent for such regional cooperation. These principles also recognize a common bond with the energy sector, thus serving as a launch pad for discussions and potential actions. Since North Carolina is a leader in the Southeast on air quality measures and related activities, the state is well suited to help initiate, coordinate and lead such an effort.

Duke University, Nicholas School of the Environment and Natural Resources, Center on Global Change, recently announced a new role in coordinating research and funding for the DOE National Institute for Climate Change Research (NICCR). The new role of Duke University for the Southeastern states for this Institute may provide new opportunities to cooperate in making this regional action plan concept possible. However, this Institute is so new that initial discussions of potential proposals and directions have not yet occurred.

Implementation Issues and Next Steps

Several actions will facilitate development of a regional climate action plan. These actions range from adopting a resolution to initiate such a process or similar steps by the General Assembly, and/or through establishing such an implementing body by the Governors of these states, starting with those who signed the Southern Air Principles (namely North Carolina, Tennessee, Georgia and South Carolina, all but Tennessee having a significant coastal interest). The General Assembly or external grant funding bodies would likely need to provide a relatively minimal level of funding to initiate and support such continuing efforts, but the cost for a single state should not be considerable to provide a facilitated effort for these states if they join forces and develop a set of related plans on which to focus for the mutual good.

Other states to fold into this group would most likely include the Gulf States of Florida, Alabama, Mississippi, Louisiana and Texas. In addition, there may be interest from Virginia, Maryland and Delaware that are not currently active in the NESCAUM

efforts, further up the East Coast. There is no reason to exclude other Southeastern states from the regional analysis, but those with coastlines may be more likely to be interested initially.

After initial discussions and development, and the active implementation of the activities to complete the North Carolina CAP, a joint workshop to discuss the issues and next steps will likely be logical and productive, with further sessions over time to facilitate continuing dialogue and coordination.

Plan of Action # 3: Required GHG Emissions Inventory Reporting for North Carolina Permitted Point Sources

Within three years, North Carolina DAQ intends to develop and implement a required baseline emissions inventory for greenhouse gases. Initially, it will be for Calendar Years 2002, 2005 and annually thereafter for Title V permitted facilities. Under this plan, all state agencies and point sources holding an air permit would estimate and report their greenhouse gas emissions as a supplement to their existing routine emissions inventories.

This GHG reporting will also support the development of a complimentary GHG Reductions Tracking Registry, a separate, closely related recommendation in this report. Efforts to track and validate GHG emission reductions would help North Carolina sources in future carbon market trading, which can be adopted at a later date, pursuant to future state or federal developments.

Background and Basis for Recommendation

Currently, North Carolina does not inventory or track emissions of GHG other than standard EPA and EIA filings for electricity generating units and the DOE 1605 (b) program, which is voluntary and lacks both rigor and consistency. As North Carolina moves forward to address climate change, it is essential to have the ability to track the effects of such actions. Thorough inventories of GHG emissions are necessary, therefore, to establish baselines and to determine continuing emission trends for the state. This will allow the state and others to evaluate effectiveness of steps taken. Using a baseline year, such as either CY 1990 (where possible) and/or CY 2002 (most likely), participants can record their GHG emissions, and have a basis for claiming reductions below their baseline in a Registry. When requirements are finalized, Calendar Year (CY) 2002 is expected to be important for carbon trading purposes.

DAQ has initiated the development of an updated North Carolina inventory, exclusive of expansion and tracking of individual point sources to be added in the future. The first draft of this updated inventory will be placed on the DAQ web in September of 2005. When this effort is advanced, DAQ will develop and provide general guidance to affected facilities on how to quantify GHG emissions (i.e., what to estimate/measure, how to do so, documentation required and certification requirements). At a minimum, the program should account for all (carbon) fuel combustion and GHG emissions from industrial processes. Reporting requirements for larger sources of emissions will likely be more detailed than those for smaller sources. Emissions from larger coal-fired utility boilers are already determined on an annual basis by utility companies and reported to EPA as a mandatory part of the federal Acid Rain Program. These facilities are by far the

largest single (point source) sector accounting for these emissions. For smaller facilities, and those that only use electrical energy, the reporting of these emissions may likely be reportable as CO₂e by the utility companies, based on metered electricity.

As part of the State Energy Plan and national and international efforts, several voluntary and mandatory approaches have been proposed for mitigation. Some states have undertaken GHG reduction efforts through executive orders or other mechanisms. Such actions focus public and legislative attention and debate on the important issue of climate change and lay the groundwork for carbon trading scenarios. A comprehensive GHG mitigation plan (Climate Action Plan) for North Carolina, now in an initial stage of development, is expected to be further developed and discussed over the next several months. The plan will likely encapsulate many ideas and concepts outlined elsewhere and further define a set of concrete steps for statewide actions.

The interests of North Carolina sources – and those in other states that ultimately may participate in an emissions trading program – would be best served by regional and national consistency in inventory methods and practices. Consistency would broaden the market, and enhance the credibility and liquidity of its currency. Accordingly, efforts with other states in the Southeast, including the Atlantic and Gulf coasts are contemplated and perhaps unity with other regional efforts.

Implementation Issues and Next Steps

North Carolina legislation is not necessarily required to authorize DAQ to supplement existing emissions reporting requirements for federally defined air pollutants to include GHG. However, addition of GHG requirements will require resources over a multi-year period for the initial development effort and periodic supplements or updates in future years (estimated to be annually at first with 3 to 5-year intervals thereafter). Such resources would preferably come from a carbon emission fee. Future actions to authorize collection of such a fee may likely be necessary from the General Assembly. The results of this effort would be useful to DENR and the State Energy Office and would help track performance of programs and assess future priorities. In addition, it will provide a basis for individual companies to take advantage of carbon trading programs.

Plan of Action # 4 - Measures to Increase Utility Generation Efficiency

DAQ will continue to review and explore any latitude allowed under the Clean Air Act and associated North Carolina statutes and rules to encourage improved efficiencies at coal-fired electric utility units, in a manner that will not compromise efforts to maintain adherence to federal and state laws and policies and pollutant reductions.

Background and Basis for Recommendation

Coal-fired boilers are by nature energy inefficient. Many coal-fired boilers in North Carolina were built between 1950 and 1980, with an expected lifetime of 30 to 50 years. Thus, the population of boilers is aging. Many units are already beyond their originally expected useful life. Meanwhile, a number of design and technology advances could potentially improve efficiencies if applied to existing facilities. For new units, new technologies and controls are already required. Improvements to existing units, although

small on first glance, could be significant in the economics of running a large power generation unit constantly for several years. Increases in design efficiency generally allow more production of electricity with less fuel and with fewer emissions. Due to the costs and the complexity of the regulations (such as new source review and prevention of significant deterioration regulations), many sources have avoided making these improvements and refinements. Some efficiency improvements on generation units can be made, but they require consideration of such projects under EPA's new source review (NSR) regulations and applicable state rules.

Implementation Issues and Next Steps

DAQ will need to continue to assess whether any changes in rules and statutes could facilitate upgrades at utility units without resulting in violations of New Source Review and other regulations. These changes will also need to take into consideration any resulting impacts on the speed of adopting newer low-emission, high-efficiency technologies instead of, or in addition to, unit upgrades.

Plan of Action #5: Refine Ozone (O₃) and Particulate Matter (PM_{2.5}) State Implementation Plans

DAQ will evaluate and incorporate appropriate energy efficiency and GHG-friendly policies into the State Implementation Plans (SIPs) for Ozone (O₃) and particulate matter (PM_{2.5}).

Background and Justification

Ozone, the main component in urban smog, is unhealthy for humans and can damage trees and crops. Ozone is formed when nitrogen oxides react with reactive organic compounds in the air on hot, sunny days with little wind. The main sources of the pollutants that cause ozone are cars and trucks, coal-fired power plants and other industry. Ozone is North Carolina's most widespread air quality problem. Parts of North Carolina are affected by elevated ozone during the warmer months, with levels exceeding the national standard in 12 of the 33 counties where the DAQ operates monitors.

Particulate matter (or PM_{2.5}, also known as "fine particles") can penetrate deeply into the lungs and be absorbed into the bloodstream, causing or aggravating heart and lung diseases. Persons most susceptible to particle pollution include those with heart and respiratory conditions, the elderly, and young children. In extreme cases, particle pollution can cause heart attacks and premature death. A wide range of sources contribute to particle pollution, including power plants and other industry, cars and trucks, wood stoves and outdoor fires. Unlike ozone, which occurs in the warmer months, high levels of particulate matter can occur throughout the year.

North Carolina already has taken substantial steps to control fine particles, ozone and other pollutants. The 2002 Clean Smokestacks Act requires coal-fired power plants to reduce their nitrogen oxide (NO_x) and sulfur dioxide (SO₂) emissions by about three-fourths over the next five to 10 years. NO_x and SO₂ contribute to the formation of ozone and fine particles in the atmosphere. The legislature also has passed bills that enhance and expand the auto emissions testing program from nine to 48 counties by 2006.

The EPA uses the designation of so-called non-attainment areas as a key step in the development of strategies for reducing ground-level ozone and PM2.5. The non-attainment designations require the state to develop State Implementation Plans (SIPs) that outline strategies and controls to reduce the levels of ozone and PM2.5 pollution and meet federal air quality standards within a prescribed period of time. The North Carolina ozone and PM2.5 SIPs will include specific measures to reduce emissions from cars, trucks, industries and power plants. Some of these measures could have the added benefit of reducing GHGs. The DAQ should ensure that a suite of energy efficient and GHG-friendly measures be incorporated into the ozone and PM2.5 SIPs.

Implementation Issues and Next Steps

A number of the recommendations to reduce GHG outlined in this report and in the 2003 (Revised January 2005) North Carolina SEP will also result in improvements in ozone and PM2.5 levels. DAQ will strive to incorporate as many of these measures as possible into the ozone and PM2.5 SIPs to help achieve co-benefits in GHG reductions. Here are just a few examples of such dual recommendations:

- Increase the use of alternative fuels. Use of renewable fuels such as biodiesel, produced from agricultural feedstock, helps reduce multiple pollutants including volatile organic compounds, nitrogen oxides, sulfates and particulate matter and our reliance on foreign oil.
- Require improved fuel mileage to result in a more efficient fleet of vehicles owned by the state and develop measures to encourage the private sector to do so also.
- Reduce vehicle miles traveled (VMT) by state employees through increased teleworking, staggered 4 x 10 work weeks and other similar innovations.
- Require black carbon particulate traps for diesel trucks and truck stop electrification.
- Implement/require higher efficiency standards for new and existing state buildings.
- Convert illumination in state buildings to high efficiency fluorescent systems on a timely phased schedule and develop/implement measures to encourage the private sector to do likewise.
- Develop and include GHG reduction policies in all planning functions related to VMT reductions and transportation planning.

Plan of Action #6 - CO₂/GWG Emissions Definition/Conventions

DAQ announces its intent to interpret “CO₂” as meaning “equivalent CO₂ (CO₂e),” such that methane, N₂O and other greenhouse gases (GHG) as defined by the Intergovernmental Panel on Climate Change (IPCC) are clearly included. This convention should be followed wherever needed in legislation and other regulation or references.

Background and Basis for Recommendation

The Clean Smokestacks Act of 2002 specified actions and concerns specifically for carbon dioxide, the major GHG, and the measure of reference for other greenhouse gases. Methane and nitrous oxide (N₂O) are also potentially emitted in some lesser quantity from coal-fired power plants. These and other pollutants contribute to greenhouse effects and climate change. The Intergovernmental Panel on Climate Change (IPCC) has defined a common equivalence or global warming potential (GWP) of other such substances, based on scientific testing, with CO₂ as a point of reference. Methane,

for example has been determined to be about 23 times more potent than CO₂ in its impact on the global warming process.

With this information, one can compare and add together the contributions of various substances to the greenhouse effect by multiplying the quantity of each individual gas by its GWP factor, usually on a time-scale of a hundred years (GWP100). In other words, GWP factors can be used to convert emissions of different greenhouse gases to carbon dioxide equivalents. To allow for a proper and thorough examination of causes and potential remedies for global warming, all GHG must be included. To only include CO₂ addresses part of the problem and distorts the effects. Therefore, DAQ intends to address global warming issues in terms of CO₂e in the future and include the full range of contributing emissions. The General Assembly should follow this convention in future legislation as well as other state agencies in their routine business.

Table II-1 provides a summary of the most recent information on relative impact of the various major GHG. Water vapor, also a major factor in the warming of the atmosphere is not included.

Table II-1
Global Warming Potential (GWP) of Various GHG:
 (CO₂ = 1.0)

Comparison of 100-Year GWP Estimates from the IPCC's Second (1996) and Third (2001) Assessment Reports

Gas	1996 IPCC GWP	2001 IPCC GWP
Methane	21	23
Nitrous Oxide	310	296
HFC-23	11,700	12,000
HFC-125	2,800	3,400
HFC-134a	1,300	1,300
HFC-143a	3,800	4,300
HFC-152a	140	120
HFC-227ea	2,900	3,500
HFC-236fa	6,300	9,400
Perfluoromethane (CF ₄)	6,500	5,700
Perfluoroethane (C ₂ F ₆)	9,200	11,900
Sulfur Hexafluoride (SF ₆)	23,900	22,200

Sources: UNFCCC, Second Assessment Report (1996) and Third Assessment Report (2001).

Implementation Issues and Next Steps

Upon acceptance of this recommendation, it is up to the General Assembly to agree to this intent and incorporate it into any future legislation and discussions. Meanwhile, the Division of Air Quality will adopt this convention and move forward accordingly in future actions and communications.

Plan of Action #7 – Evaluation of CO₂e Emission Credits Potential as a Funding Mechanism

DAQ intends to analyze and evaluate the pending carbon market to determine if it might be possible to use it as a means to fund the program that will support it in this state. If the concept proves positive, a proposal would be prepared for legislative consideration.

Background and Basis for Recommendation

The advent of a carbon credit market will mean that there may be opportunity for the state to participate in the process to recoup some of the costs of making that program work and be viable for the various industries and other entities within the state. For example, each trading participant will need some source of third party verification of emissions. The state could possibly provide this function and receive payments in the form of carbon credits that could then be sold on the carbon market to recoup the costs of the verification efforts and fund the personnel that are required, either in-house or through an outside enterprise. In addition, the state is an energy user, CO₂ emitter itself and intends to inventory those emissions and make reductions. These reductions, if sold on a carbon market, could potentially also help offset the costs of the program and could be used to fund further energy improvements or the personnel that are required to make the program work.

Implementation Issues and Next Steps

This is a concept at this point. Further discussions with representatives of the carbon markets, other state agencies and with legal representatives to determine whether it would be allowed by existing law has not been done at this point. This will be explored and discussed further in the next several months and potentially included as a concept for discussion in the development of the state Climate Action Plan.

Plan of Action #8 – Assisting the recently formed Legislative Commission

DAQ intends to assist and support the activities of the Global Warming Study Commission recently established by the 2005 General Assembly.

Background and Basis for Recommendation

As stated elsewhere, the 2005 General Assembly passed legislation to form the Global Warming Studies Commission to discuss and formulate key directions that climate change actions should take in the state. The Commission is directed to consider and integrate the results of this work under the Clean Smokestacks Act. The DAQ will work with and support that activity.

Implementation Issues and Next Steps

The Commission will first need to be appointed and an infrastructure determined. At the point that Commission is available for discussions, presentations and other interactions, the DAQ will assist.

Administrative and Regulatory Recommendations

This group of recommendations can be initiated and implemented in a fairly straightforward and rapid fashion either by additional regulatory efforts that may need to be addressed by DAQ and other agencies.

Recommendation A-1: Increases of State's Leadership in Energy Efficiency and GHG Reductions for State-Owned Facilities and Equipment

State government should maintain and increase its role as a leader and example in reduction of energy use and GHG emission reductions. Priorities and plans toward reducing energy use and GHG emissions from state-owned or leased facilities, equipment and services should be frequently reviewed and intensified where possible. Plans and intended efforts such as defined in the State Energy Plan (SEP) should continue to be evaluated and revised with increased consideration and priority being to efforts that will result in greater reductions in GHG emissions, such as the following proposals:

- *Revise current SEP Action Item Exec-11 for reductions in energy use in state buildings. Currently, the SEP has a goal to reduce energy from 20% from current baselines by 2008 and 4% per year for the next 5 years. This revised proposal is to add a criteria of a 50% reduction by 2016 and declare intent to maintain that level indefinitely through continued reevaluation of goals and follow-up actions such as:*
 - *Require Silver LEED standards, or better, for all new construction, including schools, starting with all buildings that have not yet completed the design stage. (Initiating this requirement on all school construction built with funding from the new lottery would likely speed the energy improvements and take maximum advantage of the opportunities.)*
 - *Make mandatory, the recommended metering requirements in related Action Item Exec-12.*
 - *Develop capability and plans to record and establish carbon credits for these cost and energy savings to qualify them for sale on the carbon market with proceeds going to fund the program and/or other added efficiencies.*
- *Add a plan to use solar and wind power for all state-owned applications that can be satisfied by such energy supplies:*
 - *Where the cost to benefit ratio does not exceed 1.25,*
 - *Implemented over a 5 year period,*
 - *Starting with remote locations where line loss savings should be used as an added credit.*
- *Commit the state to the purchase of NC GreenPower electricity for state owned and leased facilities with a commitment of at least 10 percent of such electric purchases to be GreenPower by 2008; 25 percent by 2010, 75 percent by 2015 and 100% by 2020.*
- *Commit to replacement of all incandescent light fixtures (where feasible) with high efficiency fluorescent fixtures and bulbs, starting with highest energy users and completing the conversion within 5 years.*

- *Make additional efforts in the motor vehicle/transportation area as defined later in Recommendation LT-6.*
- *Make other related (for state-government) recommendations in SEP mandatory through development of suggested language for the General Assembly to use in future law making efforts.*

Background and Basis of Recommendation

State government is one of the larger energy users and GHG generators in North Carolina. The State Energy Office and its programs, many put in place by the SEP, have begun to make significant inroads in energy efficiency and energy-use reductions in facilities owned or used by the state. However, these programs were not necessarily developed to accomplish GHG emissions reductions. The state needs to review those considerations and intensify efforts to reduce its own GHG emissions and set a good example. Reductions subsidized by the sale of resulting carbon credits will help offset costs and favorably influence the payback analysis. Early efforts will be critical to provide a basis for future improvements and lessons learned, and to provide positive examples for use by the private sector.

The proposal for North Carolina to reduce electricity consumption in state-owned buildings by 20% in 2008 and 50% in 2016 will also lead to reductions in GHG emissions. These reductions, relative to the reference forecast of consumption in state-owned buildings, would result in a 560 GWh reduction in 2008 (0.43% reduction in total electricity demand in North Carolina) and a 1,760 GWh reduction in 2016 (1.18% total reduction). Reductions in state building electricity consumption will lead to reductions in criteria air pollutants and, health costs associated with those pollutants. Reductions in electricity demand also should lead to lower electricity costs for all consumers in North Carolina.

Implementation Issues and Next Steps

This recommendation is included in this section because it can substantially be implemented within the powers and authorities of the Executive Branch of state government, without necessarily requiring added legislative actions. As with other recommendations in this report, this recommendation is made on the basis that it will be reviewed and acted upon by the SEO, EPC and General Assembly as appropriate. They are made with the intent that they will blend with continuing efforts underway, such that GHG emissions aspects of the efforts receive increased consideration and priority. Upon submittal of this report to the EMC and ERC, copies will be supplied to the SEO and the EPC for their use and consideration. Additional supporting economic and option assessments are continuing and will be made available for discussion and decision-making support.

Specific measures that can be used to achieve this goal are to: 1) design new buildings to need as little electric lighting and space heating/cooling as possible through green design principles to take advantage of natural lighting, heating and cooling; 2) meet or exceed EPA Energy Star specifications for all new equipment in buildings; 3) retrofit old, inefficient or ineffective components, such as windows, space heating/cooling equipment, and refrigerators; 4) and install or replace boilers with new combined heat and power systems and distributed generation from renewables, wherever possible.

Appendix D contains preliminary (partially reviewed) analysis results for selected climate policy options including a “State Facilities Electricity Reduction Goal.” The GHG impacts and costs in that analysis are suggestive of what NC should expect from the recommendations outlined above for state buildings.

Recommendation A-2: Promote the use of clean coal technologies, non-combustion energy/electricity sources and other emerging low-emission technologies

DAQ recommends that clean coal technologies, such as Integrated Gas Combined Cycle (IGCC) and non-combustion energy/electricity sources, such as hydro, wind, solar and other emerging low-emission technologies be considered as alternatives to conventional coal and gas combustion when new power generation capacity is being planned for North Carolina.

This recommendation promotes adopting policies and evaluation techniques to give equal and favorable consideration to such technologies. Action on this recommendation would apply to the utilities, the North Carolina Utility Commission, the State Energy Office, the Division of Air Quality and others in the planning, design, review and approval process for electricity production.

Background and Basis of Recommendation

Current coal-fired boilers use technologies that have been in use for decades. However, newer advanced technologies exist, continue to be developed and are being applied in other areas, that lead to much higher energy efficiencies. The utilities should be challenged to make a maximum effort to adopt these technologies and reduce their energy consumption. Technologies such as IGCC, for example, are being used in other locations and North Carolina utilities should be challenged to begin to apply such technologies in this state. The state’s approval process should be modified to require the utilities to evaluate these new technologies when addressing the requirements of the Utility Commission and other regulatory agencies. Also, the state should develop programs and policies to help make these new approaches both economically and technically attractive. It is through such changes in policies that progress toward lowering energy consumption and related emissions of CO₂e and other air pollutants will be achieved to meet the global challenges we face. Application of such technologies often leads to additional breakthroughs and opportunities for further economic gains on the behalf of the organization taking the challenge, and the general citizenry.

Recommendation A-3: Periodic Assessment of Direct Removal and Sequestration of CO₂ from Coal-Fired Utility Boilers and Other Improved Technologies

DAQ recognizes that technologies for CO₂ capture and sequestration from coal-fired utility units and other fuel-burning equipment are not yet commercially available and economically practical. However, DAQ recommends that an evaluation and reassessment of these technologies and options be prepared at least every five years after issuance this report.

These reports should review and inform the General Assembly about the state of science and engineering status of U.S. DOE and other research efforts to develop

and commercialize such technologies. These efforts should be coordinated with the DAQ, the State Energy Office, the Utility Commission, and any other Departments with responsibilities and resources for continuing GHG actions in the state.

Upon a positive assessment, such technologies should be strongly considered in analysis of requirements for all new and existing units within a feasible time period.

Background and Basis of Recommendation

The passage of the (federal) Energy Policy Act on July 29, 2005, directed several billions of dollars in new funding toward continuing and intensifying energy research. These technologies are within the bounds of that legislation, will likely provide more rapid development, and increase their application by an earlier date. The developments need to be monitored on a regular basis to assure that they can be adopted in North Carolina as soon as possible. Such adoption would require identification of an appropriate storage location in the state that meets the requirements.

Capture. Several methods to capture emissions directly from the stacks of fossil-fuel power plants (primarily coal) have been proposed and continue to be researched by the U.S. DOE. These processes were discussed in limited detail in the 2003 DAQ report. Capture is expensive, with as much as one third of the power generated being required to run the removal process. Except for the amine absorption processes, all CO₂ capture technologies are basically at the experimental level. Some such processes may be useful in the future, but are not ready for practical application. Based on lab results, several vendors (e.g. Carbozyme, ARI) are claiming projected full-scale cost performances on the order of \$5-15/ton CO₂. These and other potential breakthrough CO₂ capture technologies warrant further investigation and research investments, but do not provide immediate answers.

The DOE Global Climate Change Initiative's²⁵ stated goal is to achieve a 90 percent CO₂ capture with less than a 10 percent increase in cost of energy services (net of any value-added benefits, e.g., CO₂ credit trading, etc.). This can be adopted as a criterion for assessing the practicality of various technologies available or under development. Discussion here is not intended to imply that any of these technologies are likely to be available in the near term.

Geological Sequestration. Once captured, CO₂-laden waste streams can be injected into underground strata of depleted coal mines, oil fields and/or brine-laden geological strata. There they become permanently sequestered and also may serve to enhance methane production from coal seams and enhance production from oil strata. Eastern North Carolina possibly has some limited deep-brine pools near the northeast coast, but the state has no mines that would likely provide an opportunity for using this technology. If such disposal formations exist, and sequestration would otherwise prove technically feasible, there are currently no coal-fired utility boilers in that area of the state. Thus, additional transport costs would be required. Such technologies might, however, influence location of future power generation units. Even with such an alternative available, the costs of

²⁵ Bob Kane, USDOE, Climate Challenge Program, *The Administration's Global Climate Change Initiative And Enhanced Opportunities for Carbon Sequestration On Mined Lands*, USDOE, , <http://www.mcrc.osmre.gov/PDF/Forums/MarketBasedReforest/1-1.pdf> .

collection and disposal would remain high and would result in large reductions in the efficiency and generation capability of useful power at any such plant.²⁶

Implementation Issues and Next Steps:

The General Assembly should be kept informed of new developments in CO₂ capture technologies on a timely basis, and an agency should be charged with the responsibility for periodic assessments of those technologies and funded accordingly. Funds necessary for such assessments would likely be minimal and accomplished with a literature review similar to that done to meet the CO₂ and Mercury requirements under the Clean Smokestacks Act. The time and costs could probably be kept under \$50,000 if no new economic or other direct technical assessments are required. At the pace that technology is likely to develop, a five-year cycle would likely be adequate.

Recommendation A-4: Develop a Greenhouse Gas Registry

After required reporting of baseline and continuing updates of GHG emissions are established for larger air permitted sources within the state, and the associated baseline inventory is determined (within approximately 3 years), the state should implement a comprehensive system for sources to document, verify and register reductions in their emissions over time. This would facilitate their ability to secure credit for such reductions in any future carbon market/trading system.

To the extent that North Carolina can join with other jurisdictions (states) in such a GHG registry mechanism, this effort is encouraged for both cost and market development reasons. If no satisfactory mechanism is otherwise available, North Carolina should develop its own GHG registry.

Background and Basis for Recommendation

Currently, North Carolina does not have a mechanism to track GHG emissions other than the DOE 1605 (b) program, which is voluntary, lacks quantitative rigor and consistency and doesn't cover all sources. Once mandatory reporting of GHG emissions by point sources is implemented in North Carolina (consistent with Action Plan #3 in this report), such sources should have the opportunity to register with the state their verified actions to reduce GHG emissions. Such a GHG registry would help companies and organizations with operations verify their reductions, and historic emissions against which future GHG emission reduction requirements might be applied – thus providing them with baseline protection. Further, a registry will encourage participants to increase energy efficiency and decrease energy use because GHG reductions could be registered for future credit. North Carolina, in turn, would ensure that participants receive appropriate consideration for their early actions in the event of future state, federal or international GHG regulatory requirements. If a state program is implemented, it should be to provide a means to verify reductions so carbon credits could be sold or traded in carbon markets.

²⁶Kevin Johnson, *Some Projected Add-On Control Options for CO₂ Reductions at a Coal-Fired Generating Unit*, URS Corporation, DAQ Mercury and CO₂ Workshop, Raleigh, NC, April 21, 2004 (see Appendix A).

Concurrent with mandatory GHG emissions reporting for point sources, DAQ recommends pursuit of supplemental program efforts to account for all other carbon-based fuel combustion and emissions from non-industrial sectors, including transportation, residential, commercial and governmental.

The General Assembly previously has indicated a need for a GHG registry. With the advent of a carbon credits markets, the state and its GHG emission sources may find it productive (i.e., profitable) to establish a state GHG registry or to pursue greater economies of scale by joining with the regional GHG registry development efforts now underway. For instance, the state has been monitoring discussions concerning the Regional Greenhouse Gas Registry (RGGR) in the Northeastern U.S. (now under development at NESCAUM) to learn from their efforts. If appropriate, the state could become an official RGGR participant in the future. It would be in the state's interest to be part of a larger registry and to spend its efforts on education, assistance to facilities, monitoring, or providing third-party validation and other such programs that may prove productive.

Implementation Issues and Next Steps

Without a baseline inventory and mandatory GHG reporting, a registry of reductions has far less integrity and less commercial application. Each annual inventory provides a basis from which to judge and audit future reductions. After the inventory is in place, additional legislation and appropriations may not be required to allow the state to initiate a registry. However, legislation would be helpful, especially to authorize funding or a self-funding mechanism for third party validation. To facilitate development and operation of carbon markets, the state would be well served to facilitate quantification and trading, to assist the business community and market participants.

Due to the nature of inherent biases that may be involved, facilities most affected by this action may need to be made aware of the advantages they could derive from a registry. Thus, this recommendation includes an educational and public outreach component to provide information that helps inform sources of the potential advantages of registering GHG emission reductions.

Recommendation A-5: Promote and Support Efforts to Establish North Carolina as a World Leader in GHG, Non-Carbon Fuels and Energy Efficiency Technologies

Offices responsible for GHG reductions and related applications, the University of North Carolina System, the Department of Commerce, the Department of Administration and others with a stake in development and promotion of technologies should aggressively expand their efforts, to ensure that North Carolina becomes a major U.S. and world leader in technologies for GHG reductions, carbonless fuel alternatives and energy efficiency, as reflected in the State Energy Plan.

This recommendation would include establishing North Carolina as a major leader in educational, consulting and manufacturing on the world market netting increases in jobs and economic returns.

Background and Basis for Recommendation

North Carolina has established a framework to address the issue of climate change. As highlighted in the SEP, North Carolina already has started taking a leadership role in GHG reductions and energy efficiency. The state must continue to make improvements in delivery of government services, such as making wastewater treatment plants more energy efficient, gradually converting government fleets to alternative fueled and more efficient vehicles, continuing to upgrade government buildings for energy efficiency and converting lighting in those buildings to more efficient bulbs. Such actions will help establish the state as a major leader in this field. The state must also more aggressively implement the recommended policies and programs designed to reduce GHG emissions and improve energy efficiency as outlined in the SEP and approved by the state's leadership.

Governor Easley and other members of the Southern Governors' Association have already endorsed aggressive energy policies through initiatives such as the (December 3, 2001) "Southern Air Principles." The Energy Report which was drafted as part of the requirements of the Principles, encouraged southeast states to do their part to:

- Develop a strong green power network by pursuing financial incentives that encourage growth and investment in green power technologies, encouraging investor-owned, public and rural electric cooperative utilities to offer green power pricing programs, and promoting use of green power by state governments, commercial and residential entities.
- Adopt the new International Energy Code and find means to encourage compliance with energy-efficient construction standards, such as providing financial incentives to local governments responsible for codes implementation and enforcement.
- Place special emphasis on reducing energy expenditures in public education through energy audits, design and technical assistance, training for school officials and building designers, and adequate capital financing to secure the needed energy improvements for both new and renovated buildings.
- Institute a comprehensive and aggressive energy efficiency program for state facilities and universities that will yield a minimum increase of 30 percent.
- Expand, broaden and enhance existing state energy efficiency programs for industry. This is expected to result in significant reductions in air pollution and cost savings to industry to assist them to better compete in a growing global market.
- Pass legislation to create a public benefits fund to finance state energy efficiency, renewable energy and low-income energy programs.
- Develop aggressive plans and participation in efforts to develop a carbon-less fuel economy, such as hydrogen, through research and participation in development and demonstration projects.

On March 3, 2004, DENR reiterated its commitment to become an exemplary model and issued a policy memo on sustainable and green building practices implementing the state's initiatives for responsible environmental stewardship. The policy memo cited Executive Order Number 156, General Statute 143-64.12 and a 2001 State Construction Office report which all address energy conservation.

Furthermore, since high-energy costs continue to plague businesses as they struggle to keep their competitive edge in the global market, NC should be proactive in

developing programs to provide energy efficiency education, training, and technical assistance to businesses in the State. As evidenced with recent weather disasters, the state and nation need to take dramatic further steps to become less dependent on not just foreign sources of energy, but different forms of energy in general.

By actively implementing such initiatives, this state will reduce GHG emissions, reduce energy costs and enhance air quality, public health, the economy and the environment.

Implementation Issues and Next Steps

The Energy Policy Council has recommended that the state act on a number of key legislative, regulatory and administration policies to place it in a better position to address GHG emissions reductions and energy efficiency efforts. These efforts should more aggressively address the GHG reduction aspects in addition to the energy efficiency aspects. The university system will need to extend their efforts in GHG technologies, and additional funding may be necessary.

Recommendation A-6: General Assembly and Executive Branch To Support, Influence and Encourage Stronger National Policies

North Carolina should use every opportunity to take leadership and promote a stronger national program, whether through official statements, resolutions or expression of a general attitude. The state cannot solve the global warming issue alone and the need for solid national teamwork should be made.

Background and Basis for Recommendation

The cuts in emissions that must be made to solve the global warming issue cannot be made by North Carolina alone. The United States collectively accounts for a large portion of the global emissions and must aggressively step forward. The Energy Policy Act of 2005 is a beginning, but alone will not adequately reduce emissions in the short term and is not sufficient for the long term either. Additional efforts to reduce and adopt lower emitting policies are in the strong interest of North Carolina and that position must be clearly articulated.

Implementation Issues and Next Steps

This recommendation is made to point out the need for stronger national efforts and that other states and nations must be equally committed to change in a major manner for this effort to be successful. No effort is intended for follow up by DAQ on this point, but the recommendation is here to make the simplistic point that more is needed.

Recommendation A-7: Public Education

DAQ recommends partnering with the State Energy Office, the Department of Public Instruction, the Museum of Natural Science, other state agencies, and private entities, to develop and promote an aggressive public awareness campaign on climate change, ways to reduce CO₂e emissions and the benefits of doing so.

Background and Basis for Recommendation

Since human activity plays a dominant role in current climate risks, solutions will require changes in individual behaviors and active engagement by all sectors. The state's envisioned Climate Action Plan must be made public and available through an aggressive community and awareness strategy that includes:

- Broad-based climate education for both K-12 schools and the general public;
- Media advertising that offers the general public information about their contributions to climate change and suggestions for lifestyle and purchasing changes that will help minimize that contribution;
- Outreach partnerships with schools and other institutions;
- Programs to educate the public about the need to save energy and to stimulate consumer demand for using energy efficient products and services;
- Programs designed to highlight new energy efficiency and renewable energy technologies and to promote their use;
- Targeted education and advocacy for specific audiences to implement high-priority GHG reduction strategies.

The goal of education and outreach would be to influence changes in behavior that can lead to a cleaner environment, energy conservation, economic savings and improvements in public health.

Many entities within the state have already started to develop educational materials about climate change, its impacts and mitigation options. Therefore, this recommendation is focused on providing additional resources to enhance what is already being done. Once specific strategies are identified, part of the implementation can be done through existing environmental stewardship infrastructures such as the North Carolina Education Alliance, the DAQ Air Awareness Program, Science House at NC State University, the Museum of Life and Science, Solar House and the Energy Xchange.

Implementation Issues and Next Steps

A number of the recommendations outlined in the State Energy Plan address the need for a strong education and outreach program. Collaboration and coordination between DAQ, SEO, the Department of Public Instruction and other participants will help ensure that resources are optimized. DAQ will initiate efforts and respond to other efforts in this direction.

Longer Term Recommendations Requiring More Study & Efforts

This general category of recommendations will require longer times for additional analysis and necessary development of details and strategies and may be more likely to require legislative involvement.

Recommendation LT-1: Continue Vigorous Implementation and Refining of State Energy Plan

DAQ recommends recognition of the fact that CO₂ emissions and energy use are substantially equivalent. Thus, reductions in energy use result in nearly proportional reductions in CO₂ emissions.

Consequently, the State Energy Plan should be consistently and enthusiastically supported, and intensified where possible. Increased funding must be provided to continue and expand these efforts, track the results and to publicize how energy-saving programs save individuals, companies and other organizations substantial energy costs. Such savings also result in economic benefits directly and can provide further benefits in the future through sale of carbon credits.

Background and Basis for Recommendation

The State Energy Office (SEO) and the Energy Policy Council (EPC), in conjunction with the NC Energy Research Center at Appalachian State University, developed the State Energy Plan (SEP) and last updated it in January of 2005. This plan spells out a plethora of steps that relate to essentially all sectors of energy use and CO₂ emissions. However, in the past several months, the price of oil has gone up approximately 50 percent (~<\$40/barrel to ~\$70+/barrel) while usage has still increased over 1 percent. A similar situation exists with coal and electricity generation. Additional steps must be taken to reverse the energy use and subsequent generation of GHG emissions.

For practical purposes, reduction of CO₂ and energy usage are synonymous. The most obvious way to reduce CO₂ emissions is to burn less carbon-based fuels. This is essentially one of the major goals of the SEP. Thus, the SEP is closely related to the development and implementation of action plans for reductions of GHG. The SEP provides most of the information discussed in this section. These measures, in the form of policy and program recommendations, include the following sectors:

- Energy Use in the Residential Sector
- Energy Use in the Commercial Sector
- Energy Use in the Industrial Sector
- Energy Use in the Transportation Sector

Residential. In 2000, residences in North Carolina accounted for 23 percent of the total energy consumption in the state. Between 1990 and 2003, residential CO₂ emissions grew by 28 percent (1.9 percent per year). This increase was driven by population growth of 17 percent (1.2 percent per year) and residential electricity demand growth of 39 percent (2.6 percent per year). Between 2002 and 2003, residential CO₂ emissions grew by 2.5 percent as housing stock was up by 1.1 percent and heating

degree-days were up by 3.8 percent. Thus, the residential sector provides tremendous opportunity for each citizen to participate in reducing energy use.

Fortunately, energy efficiency measures are usually cost-effective and provide other payback advantages directly to the owner such as improved comfort and increased home durability and value. Some also provide broad benefits such as reduced air emissions, lower fuel imports and the economic benefits of direct expenditures for energy-saving products. New homes with greater energy efficiency typically cost marginally more than comparable less efficient homes, but help reduce overall ownership costs.²⁷

Commercial. Between 1990 and 2003, commercial sector CO₂ emissions grew by 33 percent (2.2 percent per year). This increase was driven by commercial employment growth of 32 percent (2.1 percent per year) and commercial electricity sales growth of 46 percent (2.9 percent per year), again as stated in the DOE report referenced in the SEP. Between 2002 and 2003, commercial electricity sales rose 0.4 percent and CO₂ emissions grew 1.3 percent as the economy grew by 3.1 percent and commercial employment rose 0.3 percent.

Industrial. Between 1990 and 2003, energy-related industrial sector CO₂ emissions declined by 0.9 percent (-0.1 percent per year), while total industrial output grew by 44 percent and manufacturing output grew by 53 percent. Between 2002 and 2003, the index of total industrial output increased by only 0.2 but *industrial energy-related* CO₂ emission estimates were unchanged. By 2003, energy-intensive primary metals output was 1 percent below 1990 levels, while basic chemicals output was 6 percent below 1990 levels.

Transportation. Between 1990 and 2003, transportation CO₂ emissions grew 19 percent (1.3 percent per year). Between 1990 and 2002, highway vehicle-miles-traveled grew by 32 percent (2.4 percent per year).²⁸ Annual emissions growth from petroleum sources averaged 1.1 percent (1990 to 2003), annual emissions growth averaged 1.3 percent from coal and 1.0 percent from natural gas. In 1999, transportation-related CO₂ emission estimates overtook industrial emission estimates and remain the largest source of energy-related CO₂. Between 2002 and 2003, estimated transportation CO₂ emissions grew 0.5 percent. Gasoline demand was up 1 percent.

Implementation Issues and Next Steps

The State Energy Plan already addresses these issues to a large extent. The General Assembly has several upcoming decisions on budget and other aspects related to the future and intensity of these efforts. The energy use and energy efficiency have been highlighted in most of the past efforts, but future added consideration should be given to the reductions in GHG and the potential economic benefits to be realized through reductions and sale of credits on the carbon market.

²⁷ *State Energy Plan*, North Carolina State Energy Policy Council/State Energy Office, <http://www.energync.net/State%20Energy%20Plan%2003.pdf>, June 2003.

²⁸ *North Carolina State Energy Plan*, June 2003, Revised January 2005.

Recommendation LT -2: Increased GHG Sequestration From Agriculture and Forestry

DAQ recommends that a major new effort on the behalf of agricultural and forestry interests be developed with goals of increasing long term carbon sequestration in North Carolina (or anywhere on the globe) in these sectors by 50 percent by 2015.

Such efforts should be developed under the leadership of North Carolina State University and its extension and other field units being given the charge to implement sequestration projects that are now known to work and to develop new ones.

The goal of these efforts should be to develop and implement additional methods that will sequester carbon in agricultural and forestry products semi-permanently, and develop methods that will add carbon back to the soil and sub-soil strata for the long term.

The General Assembly and the University System should fund and establish a research and implementation (leadership) center to guide and carry out these efforts.

Background and Basis for Recommendation

Growth of plants and other organisms that utilize CO₂ in their natural metabolic processes, removes CO₂ from the atmosphere. If this were not the case, the atmospheric concentrations would be much higher. As discussed by Dr. Schlesinger of Duke University in his presentation at the April 2004 DAQ workshop,²⁹ forests increase their growth when exposed to elevated levels of CO₂. Thus, the growth of any forest or crop is likely to increase uptake, just “because it is there.” However, this increase in uptake is not sufficient to offset the rate of increase of release of CO₂ that is encountered globally today.

Increases in biomass and organic matter in all U.S. forests over the past 40 years have only offset about one fourth of the national emissions during that period.³⁰ However, these emissions can be offset to a more significant degree.³¹ Therefore, many proposals have been advanced to increase the sequestering ability of crops and forests that can uptake and provide “sequester-able” carbon in the form of wood for paper, building materials or fuel. One must be careful to maintain a separate accounting for sequestered carbon that will again be burned or otherwise oxidized and that which will likely remain in the unburned state for decades or even centuries, thus effectively removing that carbon from circulation permanently.

One of the most significant threats of climate change to North Carolina is the loss of the state’s rich biodiversity. Policies to sequester, decrease or offset CO₂ emissions must be evaluated with consideration for biodiversity protection consistent with other environmental programs and policies. Storage and sequestration of carbon in forests can provide North Carolina an additional productive mechanism to sequester CO₂. Existing North Carolina forests currently store roughly 416 million tons of aboveground carbon.

²⁹ William H. Schlesinger, Dean, Nicholas School of the Environment and Earth Sciences, *The Global Carbon Cycle and the Duke Forest Free-Air CO₂ Enrichment (FACE) Project*, Presentation at the DAQ Mercury and CO₂ Workshop, April 21, 2004, Raleigh, NC. (See Appendix E).

³⁰ USDA, Forest Service, Southern *Forest Resource Assessment* 2002, p: 444-447, <http://www.srs.fs.usda.gov/sustain/products/>.

³¹ The Washington Advisory Group, LLC, *Sequestering Carbon Emissions in the Terrestrial Biosphere* May 2002, <http://www.theadvisorygroup.com/PDF2/publications/Carbon%20Sequestration%20Paper.pdf>.

Planting new forests could sequester substantial additional carbon.^{32, 33} Programs for added permanent carbon sequestration through forestry thus provide a serious option to mitigate CO₂ emissions from power plants and other sources.

Harvesting forests releases carbon into the atmosphere for many years. In fact, after a forest stand is harvested, the land serves as a carbon source for the next 15 or so years.³⁴ In addition, some 53% of the carbon in harvested wood is lost through emissions and energy use.³⁵ Wood that is used in permanent construction provides the net sequestration, creating positive entries in the carbon balance ledger. Sequestered carbon that is then burned does not add to the net sequestration.

Agriculture and forestry go hand-in-hand and are often handled by the same government institutions. However, agriculture and forestry do not stand alone without interconnections to the various other sectors of the economy and everyday life. Land development in the United States and elsewhere has greatly increased pressures on the agricultural and forest sectors. As these lands are developed, their capability to convert CO₂ to agricultural and wood products decreases, resulting in a diminished sequestration value. Also, you could also make a converse statement that as the productive land diminishes; the ability to use it for future temporary or long-term sequestration also diminishes. In addition, the carbon stored deeply in the soil cannot be replenished for use for additional sequestration.

Pressures and opportunities continue to increase for more production of biofuels such as soybean biodiesel, alcohol to replace gasoline and other such fuels and more vehicles are available that readily accept them. The rising price of petroleum is resulting in major investments in the areas of ethanol from corn, diesel from soy, etc.

Appendix D contains an example preliminary analysis (not yet fully reviewed) of selected climate policy options including “Soil Carbon Sequestration in Agricultural Soils”, “Forestland Protection”, and “Afforestation and Forestland Restoration.” The GHG impacts and costs in those analyses are suggestive of what NC could expect from the recommendation outlined above.

Next Steps

This concept and steps for implementation will be further developed during the process of developing a state Climate Action Plan with appropriate stakeholders and experts representing the agriculture and forestry communities in the state.

Recommendation LT-3: Continue to Expand Efforts to Recover Energy Value from Animal Waste

DAQ recommends that recently developed “best technologies” for treatment of animal waste from swine and poultry operations that result in making these waste products usable as a (renewable) fuel be fully supported for aggressive implementation.

Consideration of low-cost loans, subsidies, grants and other incentives should be made so that this latent resource can be utilized as an energy source and pollution reduction mechanism, to provide a larger pay back (in energy and environmental

³² Mark Brown, *Forest Statistics for North Carolina, 2002*, Table 9.

³³ USDA Forest Service, *Southern Forest Resource Assessment*, p. 45, Table 18.4.

³⁴ SFRA, p. 443.

³⁵ SFRA, p. 446.

benefits that would have otherwise been lost) to the citizens of the state and the general economy.

Background and Basis for Recommendation

North Carolina has approximately ten million swine (ranked second in the U.S.) and similarly large populations of poultry (turkeys and chickens). These animals produce many thousands of tons of waste each year, resulting in a major waste disposal problem and a source of odors, ammonia (a particulate matter precursor) and other air contamination. Efforts have been underway at North Carolina State University at the Animal and Poultry Waste Research Center for some time as the result of the “Smithfield Foods Agreement” to develop and assess promising technologies that can be implemented, particularly on pig farms. These studies are finishing and some of the technologies that are expected to emerge will likely provide means to treat these waste streams as a source of solid or gaseous fuel. Although the cost impacts are not immediately clear, nor strictly competitive with the cost of the existing lagoons used by most such operations, options to develop these fuel resources outweigh the alternatives.

Thus, this recommendation is to recognize the economic and environmental advantages of closing the chapter on lagoon technologies in the state and moving on to more advanced technologies that will allow the use of the waste as a fuel. In using this resource, there would be carbon emissions, but no fossil fuels and foreign oil and coal would be displaced. Thus, there is advantage to the State for this to happen in spite of absolute values of the economics to the farmers themselves. The immediate economic advantages may not immediately make this alternative viable or attractive to them without incentives or penalties.

A system of assistance to make the technologies happen would thus be in the interest of the state and could be structured such that the animal operations would not be getting a “windfall” from the state but be provided with sufficient incentive to make the implementation at least an economic break even or perhaps enhance the ability to make a profit from such operations. Consideration should be given (for example) for underwriting a central processing system by several nearby farm waste streams would be considered in ways to make innovative and systematic changes to make it possible take advantage of these new technologies. This would reduce the quantity of fuels that would otherwise be burned resulting in production of added greenhouse gases.

Next Steps

This concept and steps for implementation will be further developed during the process of developing a state Climate Action Plan with appropriate stakeholders and experts representing the animal waste communities in the state. Appendix D contains preliminary analysis of selected climate policy options including “Farm Waste to Energy Conversion,” as will be further discussed in the development of the state’s Climate Action Plan. The GHG impacts and costs in that analysis are suggestive of what NC could expect from some of the actions outlined above on animal waste.

Recommendation LT-4: Continue to Establish and Expand Efforts to Formulate and Adopt Renewable Portfolio Standards and Environmental Portfolio Standards

DAQ recognizes existing efforts on the part of the State Energy Office, the North Carolina Solar Center, the North Carolina State University and the General Assembly to dialogue and begin the process to develop Renewable Portfolio Standards and Environmental Portfolio Standards and recommends that such standards be defined and authorized as quickly as possible with strong consideration of the GHG emission reductions.

Background and Defense of Recommendation

Renewable Portfolio Standards (RPS) and Environmental Portfolio Standards are not a new concept but are recently being implemented in many states around the country. They are closely associated with Public Benefit Funds, and are all a means to address making the consideration of renewable and GHG-type concerns a consideration in addition to profit motives for the generation of electricity.

Renewable Portfolio Standard

A renewable portfolio standard (RPS) is a requirement that load-serving entities (LSEs) must supply a certain percentage of electricity from renewable energy sources. For example, a RPS of 5% would mean that for every 100 kWh that a LSE supplies to end users, 5 kWh must be generated from renewable resources. A RPS differs from an Environmental Portfolio Standard (EPS) in that a RPS is a requirement specifically for renewables, while an EPS is broader and includes energy efficiency. LSEs can meet their requirements by purchasing or generating renewable-based electricity or by purchasing renewable energy credits (RECs). By giving LSEs the flexibility to purchase RECs, a market in these credits can emerge that will provide an incentive to companies that are best able to generate renewable energy. By creating a substantial market in renewable generation, an EPS can significantly reduce GHG emissions.

The RPS scenario considered in this report was developed by Appalachian State University and assumes a mix of renewables that includes biomass, wind, landfill gas, hydro, solar thermal and solar PV. No RPS program is currently in operation in North Carolina. However, the NC GreenPower program is in operation. This program provides the option to consumers to purchase green power, but it is not a requirement to generate renewables, as a RPS would be.

Types of Ancillary Benefits and or Costs: Reductions in overall energy consumption and the shift from fossil fuel generation as a result of a RPS will lead to reductions in criteria air pollutants and, consequently, health costs associated with those pollutants. While much of the RPS requirement would come from low-cost renewables such as wind and biomass, meeting the requirement may lead to a small increase in overall direct system cost. At the same time, though, investment in new technologies would likely spur economic development in North Carolina.

Environmental Portfolio Standard

An environmental portfolio standard (EPS) defines a requirement that load serving entities (LSEs) must supply a certain percentage of electricity from

environmentally-friendly sources. For example, an EPS of 5% would mean that for every 100 kWh that a LSE supplies to end users, 5 kWh must be from environmentally friendly sources. An EPS differs from a Renewable Portfolio Standard (RPS) in that an EPS gives the added option of meeting the requirement by means of “negawatts” generated through verified energy efficiency projects in addition to renewable generation. If a large industrial customer with a current demand of 35,000 MWh per year invests in energy efficiency that reduces demand by 20% or 7,000 MWh, and this investment and reductions are verified by an independent auditor, then the customer would have 7,000 MWh of clean energy credits to sell to a LSE. LSEs can meet their requirements by purchasing or generating environmentally friendly electricity or by purchasing clean energy credits. By giving LSEs the flexibility to purchase clean energy credits, a market in these credits will emerge that will provide an incentive to companies that are best able to generate clean energy, either through energy efficiency or renewables.

No EPS program is currently in operation in North Carolina. The EPS scenario examined in this report (see Appendix D) has a requirement of 15% clean energy by 2010, 10% by 2015, and 15% by 2020. The scenario assumes that only a certain level of energy efficiency, despite the low or even negative cost, will be used to fulfill the EPS requirements simply because of the transaction costs associated with verifying the reductions. The amount of energy efficiency was derived from *Powering the South, A Clean and Affordable Energy Plan (2002)*, written by the Renewable Energy Policy Project and Synapse Energy, which estimates that North Carolina can reduce demand by 14% in 2010 and 23% in 2020 at an average cost of 2.6 cents/kWh. This is based on assumptions that the energy efficiency contribution to the EPS would come only from the industrial and commercial sectors, which have lower transaction costs for verification of energy efficiency projects than the residential sector. Also assumed was that $\frac{3}{4}$ of the industrial sector reduction and $\frac{1}{2}$ of the commercial sector reduction from *Power the South* could be applied toward the EPS. This level of energy efficiency amounted to approximately $\frac{1}{5}$ th of the EPS requirement. The remainder of the EPS was fulfilled by roughly equal shares of biomass, wind, landfill gas and hydro.

By creating a substantial market in energy efficiency and renewable generation, an EPS can significantly reduce GHG emissions. Reductions in overall energy consumption and the shift from fossil fuel generation as a result of an EPS can lead to reductions in criteria air pollutants and, consequently, health costs associated with those pollutants. While much of the EPS requirement can come from zero or low-cost (even negative cost) energy efficiency and low-cost renewables such as wind and biomass, meeting the requirement may lead to a small increase in overall direct system cost. At the same time, though, investment in new technologies resulting from the EPS can spur economic development in North Carolina.

Appendix D contains preliminary analysis of selected climate policy options including “Renewable Portfolio Standard” and “Environmental Portfolio Standard.” The GHG impacts and costs in those analyses are suggestive of what NC could expect from these two policies as outlined above. The Public Benefits Fund is also covered in the next recommendation and in the same appendix.

Next Steps

These concepts and steps for their implementation are already under further development in discussions of various parties and the General Assembly. Action appears to be delayed until the next session and input from the development of the Climate Action Plan will likely be helpful to provide further forum for discussions and recommendations of details. Appropriate stakeholders and experts representing the energy communities in the state are expected to participate in these discussions so that the 2006 legislature will have additional information with which to make decisions.

Recommendation LT-5: Develop a Public Benefits Fund

The state should adopt a Public Benefits Fund and utilize the proceeds from the fund to assist in adoption and implementation of energy reductions projects that will also reduce emissions of GHG from various sources.

Public Benefit Fund Description

A public benefit fund (PBF) is a state fund dedicated to support energy efficiency (EE) and renewable energy (RE). Nineteen states have implemented PBF programs. A small charge rate, typically in the 2 to 5 mils per kWh range, is applied to electricity sales in the state and collected by the PBF manager. Funds are typically used to support EE and RE in a number of ways, such as through public education, R&D, demonstration projects, direct grants, buy downs or tax credits to subsidize advanced technologies and low interest revolving loans. Funding goes to the residential, commercial and industrial sectors. Fund managers decide which technologies to support based on criteria such as GHG reduction potential, cost-effectiveness, co-benefits, etc. By spurring investment in energy efficient technologies and small-scale renewable generators, PBF programs reduce the need for generation from fossil fuel plants, which can lead to reductions in GHG emissions. No PBF program is currently in operation in North Carolina.

Reductions in energy consumption as a result of a PBF program will also lead to reductions in criteria air pollutants. Because the demand for electricity falls with a PBF program, the price of electricity also goes down, benefiting all electricity consumers, not only those receiving direct benefits from the PBF.

Next Steps:

This concept and steps for implementation will be further developed during the process of developing a state Climate Action Plan with appropriate stakeholders and experts representing the energy efficiency and utility communities in the state. Appendix D contains preliminary analysis of how the PBF will effect selected climate policy options. Multiple scenarios are to be analyzed before the State's Climate Action Plan is completed, such as the impact of a fund based on a 2 mil charge rate and a 5 mil charge.

Recommendation LT-6: Expand GHG Efforts to Include Transportation Source Reductions

The state should comprehensively review transportation policies, examining options that affect vehicle technologies and efficiencies, fuel types and demand for transportation services and formulate additional aggressive means to cut combustion of carbon fuels.

Background and Basis for Recommendation

The CSA does not specifically mention transportation sources, but they account for approximately one-third of GHG emissions in the state. To develop a plan that makes a substantial difference, the state must address the transportation sector: motor vehicles, commercial vehicles, air, rail and marine. In developing the North Carolina plan, actions taken by other states should be considered. These include a rich array of options such as:

- Requirements for improved fuel mileage and/or procurement of efficient fleet vehicles by the state;
- Low-fossil fuels for state fleets and private vehicles (e.g., biodiesel), alternative fuel infrastructure development (e.g. hydrogen, CNG, cellulosic ethanol and p-ZEV vehicles);
- Measures that reduce vehicle miles traveled (VMT), such as programs to decrease driving by state employees; transit-oriented development; Smart Growth planning; improved transit options; bike and pedestrian infrastructure, etc.;
- Adoption of California tailpipe GHG emission standards;
- Measures that will improve the fuel efficiency of off-road engines such as requirements for improved fuel efficiency and/or procurement of efficient fleet off-road equipment by the state (e.g., construction equipment);
- Measures related to freight transportation, e.g., black carbon particulate traps for diesel trucks and truck-stop electrification.

Implementation Issues and Next Steps

The state will undertake a comprehensive review of these aspects in the formalized stakeholder process described in Chapter III. Appendix D contains preliminary analysis of selected climate policy options including “State Vehicle Efficiency Improvements” and “VMT Reduction Portfolio.” The GHG impacts and costs in those analyses are suggestive of what NC could expect from some of the actions in the transportation sector.

Recommendation LT-7: Long Range Climate Change Disaster Recovery Plan

DAQ recommends that a Long Range Climate Change Recovery Planning Committee be formed to assess alternative strategies and priorities to allow the State to plan for facing impending crisis situations resulting from a global failure to withdraw from over-emission of carbon and the subsequent rise in sea level, increases in violent storms, loss of beach front (including possible loss of the Outer Banks), changes in favorable crop ranges, changes in insect and disease ranges and other such impacts and conditions.

Background and Basis for Recommendation

In spite of best efforts, climate change may be occurring anyway. Projections are that in as little as 30 years, there may be serious sea level rise to endanger the Outer Banks and increased activity from a tendency for more frequent and violent storms. Other changes may occur at the same time or more slowly. For example, it may take several decades for conditions to change such that the ideal growth belts for various farm crops may shift; insects migrate in a northward direction, etc. The purpose of this proposed Committee or Commission is to analyze what actions can be taken in the long term to plan for adjusting to meet and recover from these changes. Elements of such a group might include planning for steps to take and not to take in the onslaught of a rising sea level; how would property ownership be effected and what insurance liabilities are to be assessed and adjusted; how do vector control measures need to be adjusted; how does the Emergency Management support activities need to begin to evolve so that they can adjust to future increases or decreases in use, and such long term planning questions. The recent disaster in the Louisiana and Mississippi area can serve as a template from which to work.

Implementation Issues and Next Steps

The immediate issue is hopefully how to avert or soften the rate of an approaching disaster that might be caused by climate change from global warming. This is based on an expectation that something can be done that will be effective. However, if one assumes that the changes will occur anyway, the legislative commission needs to consider a longer term alternative and establish a movement for the General Assembly to appoint such a group to develop an alternate plan of how to react.

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CHAPTER III CONTINUING STAKEHOLDER PROCESS AND CLIMATE ACTION PLAN

General Goals and Process Steps

DAQ has prepared three (including this one) reports on CO₂ as required by the CSA. These reports have identified a need for North Carolina to develop a response process, plans to facilitate wider recognition of the problem and solutions to satisfy the needs, among other issues. As indicated earlier, development of a North Carolina Climate Action Plan (CAP) through a formalized stakeholder process has begun and is in the initial stages. This plan is intended to result in further information and recommendations regarding the issues, options and decisions regarding steps to be undertaken, with a sense of priority of actions needed by the various entities, public and private, within the State.

A North Carolina CAP will provide benefit and cost information on a wide range of GHG reduction options for the state. These will include detailed economic benefits analyses, to predict jobs to be generated, from implementing these options. These analysis and recommendations will be presented for multiple sectors, including transportation, residential, commercial, industry, agriculture, forestry and others that the stakeholder process may identify as important. The final plan is expected to contain a series of interconnected recommendations, supporting statistics and assessments to allow governing bodies and managers to be able to understand the viability and consequences of each recommendation. This plan is expected to enhance understanding and enable the state to prepare and meet significant approaching requirements and situations, both physically and economically, in a coming “carbon-constrained world.” This effort will provide a situation ideal for using a stakeholder process to further examine the needs and to prepare recommendations, guidance and plans. These plans will enable various components of the State’s economy to learn more about the critical issues and provide a platform from which to formulate future actions, as have already been developed in several other states.

The goals of this effort include formulation and implementation of a stakeholder process to provide public input, and to complete additional studies to supplement those already initiated. These efforts will be organized with direct support and advice from a Cabinet Level Oversight Group. The stakeholder process will be initiated and led by the DAQ, with DENR Secretary Bill Ross and a panel of other cabinet members providing overall guidance and critical review. Through this process, the state will explore options for CO₂ and other GHG mitigation from all sectors and identify the desired results and the most cost effective and acceptable policies for North Carolina. The effort will formulate recommendations that maximize these mitigation benefits, in consonance with enhanced economic development, wise and prudent energy policy and facilitation of other aspects of enhanced environmental quality such as air quality, public health, water quality and land conservation. Further recommendations from this process will be provided to the Governor, the Legislature and various leadership forums and groups throughout the state.

Opportunities for public input will be provided where direct individual participation through stakeholder and technical work groups is not possible. Stakeholder and technical work group participants will be requested to fully support the process and regularly attend meetings. The process shall define the range of potential options applicable to the State of North Carolina, initial priorities for analysis and, ultimately, specific policy recommendations that will be based on informed and facilitated judgments by stakeholders and working groups. The process shall consider policy options for all sectors, all GHG's, important potential co-benefits (including economic) and a variety of implementation mechanisms, including administrative and legislative actions.

The stakeholder process will be advisory and non-binding. It will seek, but not mandate consensus. The process shall be fully transparent and inclusive. The facilitator will develop ground rules in coordination with DAQ and present these to stakeholders, with final DAQ approval. These will include a system of formal consensus determination based on proposed decision criteria (such as those already posted by North Carolina DENR Secretary Bill Ross in his September 1, 2004 letter to the Environmental Review Commission) and rules for voting. Through this process, the State will explore options for mitigation of CO₂ and other greenhouse gases (GHG's) from all sectors and identify the desired results and the most cost-effective and acceptable policies for North Carolina to attain them. This continuation effort (beyond this CSA report) will result in recommendations that maximize mitigation benefits, in consonance with enhanced economic development, wise and prudent energy policy, and to facilitate other aspects of enhanced environmental quality such as air quality, public health, water quality and land conservation.

A number of significant issues may be raised by stakeholders and addressed by technical work groups and consultants in these efforts, including:

- Articulation of the connection between GHG and impacts on human and economic systems in North Carolina, and potential mitigation actions.
- Consideration of regional policy efforts.
- Exploration of market based instruments and economic incentives for GHG reductions.
- Assessment of requirements and adoption of procedures for GHG emissions banking.
- Means to prioritize and implement Renewable energy policies that reduce GHG through use of solar, wind, biomass and waste energy recapture.
- Methods to prioritize choices, supplement and implement viable energy efficiency and conservation measures, already identified in the *State Energy Plan, and the State Action Plan for Reducing Greenhouse Gas Emissions For North Carolina* to reduce demand for electricity and use of carbon fuels.
- Considerations for enhancement of carbon sequestration, coupled with sustainable use of forest/agricultural resources to store carbon and reduce emissions long term.
- Ways to improve the efficiency of passenger and freight transport and reform policies that affect transportation and land use demand.
- Reduction of waste with improved recovery for energy used by industry and government.

- Steps for State owned/controlled facilities to reduce their carbon and GHG impact.
- Viability assessment and expansion of industrial efficiency programs.
- Exploration of other policies to optimize economic and energy benefits in conjunction with GHG emission reductions.
- Needs for and efficient development GHG emission inventories
- Lists of potential mitigation options
- Initial priorities for analysis
- Initial quantification of GHG impacts and cost effectiveness.
- Quantification of GHG impacts, cost effectiveness and related issues as needed (in consultation with the state, technical work groups and stakeholders).
- Advanced and continuing economic modeling of key sectors, as necessary (in consultation with the State, technical work groups and stakeholders), including energy and macroeconomic modeling, pending available funds.

Modeling options will likely include:

- Energy sector modeling to develop policy forecasts and test scenarios for the heat and power sector for plant and technology-specific calibration.
- Economic development impacts (labor and secondary economic effects) of alternative energy supply technologies.
- Analysis of options in the forestry sector to be conducted through adaptation of the US Forest Service forest carbon model and collaborative work
- Forestry and land use options will be conducted through adaptation of the USDA and other state and regional databases for land use forecasting.
- Evaluation of black carbon emissions issues with specialized analysis of elemental carbon particular to North Carolina.
- Assessment of energy policy and price change effects on the economy of North Carolina using a macroeconomic model such as the REMI model.

Other analyses and modeling needs may be evaluated throughout the processes.

The 2005 Session of the General Assembly created (final agreement in Committee is tentative at the time of the preparation of this report) a *Legislative Commission on Global Climate Change* through passage of House Bill 1191. This Commission will have about 30 members from various interests within the state, with a deadline for completion of their charge by November 2006. This will allow time for consideration of their results by the 2007 General Assembly. A primary focus of their effort is expected to be the assessment of impacts of climate change on North Carolina, the need, and level, for setting a GHG emissions cap. Concurrently, the DAQ/DENR stakeholder process to develop a climate action plan is proceeding as a continuation of work initiated under the CSA. The two efforts are expected to be concurrent and interactive, such that use of resources is optimized and so that there is a clear coordinated result that links with a set of future plans.

Inventory And Forecast Of North Carolina GHG Emissions

DAQ, through a consultant, has initiated an update of the existing databases for estimation of GHG emissions in North Carolina. All sectors determined to be significant sources of these emissions will be reviewed and the existing inventory updated to a more current status. A projection of emissions with a do-nothing option will be used as the baseline from which to evaluate and later track implementation of recommendations that are adopted by the process. The inventory and projections will be completed under the auspices of DAQ and the stakeholder technical working groups that are to be formed.

Climate Action Policy Analysis, Recommendations And Results by Sector

As an integral part of the expected Climate Action Plan, many options will be analyzed, evaluated and recommendations made. Many of these will be on a sector basis following the template of plans developed in other areas. A standardized set of categories will be used to the extent that they apply to North Carolina and fit the situations here. These categories are summarized below with some comment and further explanations of expectations.

Agriculture And Forestry

Forests, especially when managed appropriately, can store or sequester carbon (both in tree biomass and surrounding organic matter in soils), thereby capturing carbon that might otherwise be emitted to the atmosphere as CO₂. Well-managed forestlands can also make biomass available for wood products or energy production, to further store carbon and reduce the need for fossil fuel-based energy sources. Urban-forested areas, including parks and stands of trees on or near residential lots, can provide additional climate and energy efficiency benefits such as summer cooling and winter warming. Forestland protection (or conversion) patterns can also work in concert with other land use-oriented actions, and influence vehicle travel demand and VMT. Managing and protecting these natural resources is certainly important from a climate protection standpoint and strongly supports local governments, land owners, developers, environmental groups, and others to take specific steps to adopt management techniques that maximize carbon sequestration. The process to analyze these benefits will emphasize actions related to: (1) efficient development location and patterns to maximize tree retention and forest biomass; (2) reduced building footprints to reduce forest clearing per unit to allow greater protection of sequestered carbon; and (3) on-site timber management to protect forest carbon and maximize carbon storage and energy displacement benefits of wood products and biomass energy.

Similarly, agricultural practices can be modified to provide maximum support and augment GHG reduction and sequestration strategies. Forest and agriculture practices must go hand in hand to

- Restore and maintain the ecology of riparian areas in industrial forests.
- Enhance urban tree and forest resources by protecting existing healthy trees in urban residential areas.

- Increase street planting and maintenance.
- Protect forest remnants threatened with development.
- Manage small private forests by replacing hardwoods on an optimum share of forested tracts with softwoods that have higher carbon sequestration rates.
- Provide technical assistance and support to landowners to ensure forest health.
- Increase the supply of biomass from forests and other energy crops for electric power production.
- Install centralized manure digester(s) for farm waste to reduce CH₄ emissions and to capture and convert it to electric power and/or liquid natural gas.

Thus, North Carolina practices will be examined to this level of detail and additional practices and steps defined to assist in responding to the problem. Appendix D contains preliminary analysis of selected climate policy options including “Farm Waste to Energy Conversion,” “Biofuels Development,” “Fertilizer Management for N₂O Reduction,” “Soil Carbon Sequestration in Agricultural Soils,” “Forestland Protection,” “Afforestation and Forestland Restoration,” and “Support Local Farming/Buy Local.” The GHG impacts and costs in those analyses are suggestive of what NC could expect from actions in these sectors.

Energy Supply and Demand

Further steps need to be taken to analyze current energy supply and to use this information to develop programs that can provide motivation for the electric utilities to have an active interest in reducing their production needs through internal and external efficiencies. The Renewable Portfolio Standards (RPS), Environmental Portfolio Standards (EPS) and Public Benefits Fund (PBF) concepts provide a means to do some of these analyses and accomplish desired goals, as well as reducing energy demand in a cost-effective manner. The three major sectors constituting electrical demand are reviewed below:

Residential. In 2000, residences in North Carolina accounted for 23 percent of the total energy consumption in the state. Between 1990 and 2003, residential CO₂ emissions grew by 28 percent (1.9 percent per year). This increase was driven by population growth of 17 percent (1.2 percent per year) and residential electricity demand growth of 39 percent (2.6 percent per year). Between 2002 and 2003, residential CO₂ emissions grew by 2.5 percent as housing stock was up by 1.1 percent and heating degree-days were up by 3.8 percent. Thus, the residential sector provides tremendous opportunity for each citizen to participate in reducing energy use.

The efforts here will be toward analyzing North Carolina baselines further and providing analysis of energy efficiency measures that are usually cost-effective and provide other payback advantages directly to the owner, such as improved comfort and increased home durability and value. Some also provide broad benefits such as reduced air emissions, lower fuel imports and the economic benefits of direct expenditures for energy-saving products. New homes with greater energy efficiency typically cost

marginally more than comparable less efficient homes, but help reduce overall ownership costs.³⁶

Commercial. Between 1990 and 2003, commercial sector CO₂ emissions grew by 33 percent (2.2 percent per year). This increase was driven by commercial sector employment growth of 32 percent (2.1 percent per year) and commercial sector electricity sales growth of 46 percent (2.9 percent per year), again as stated in the DOE report referenced in the SEP. Between 2002 and 2003, commercial sector electricity sales rose 0.4 percent and CO₂ emissions grew 1.3 percent as the economy grew by 3.1 percent and commercial employment rose 0.3 percent. The further analyses here will determine appropriate and acceptable recommendations that can work in North Carolina and provide added benefits to the commercial establishments involved.

Industrial. Between 1990 and 2003, energy-related industrial sector CO₂ emissions declined by 0.9 percent (-0.1 percent per year), while total industrial output grew by 44 percent and manufacturing output grew by 53 percent. Between 2002 and 2003, the index of total industrial output increased by only 0.2 but *industrial energy-related* CO₂ emission estimates were unchanged. By 2003, energy-intensive primary metals output was 1 percent below 1990 levels, while basic chemicals output was 6 percent below 1990 levels. Further analysis in this category will provide some general and plant clusters of facilities that can make modifications and increase energy savings at increases in output and productivity. Appendix D contains preliminary analysis of selected climate policy options including “Renewable Portfolio Standard,” “Environmental Portfolio Standard,” “Public Benefit Fund,” and “State Facilities Electricity Reduction Goal.” The GHG impacts and costs in those analyses are suggestive of what NC could expect from these policies.

Transportation and Land Use

The Clean Smokestacks Act requires that primary attention be given to reductions of CO₂ from coal-fired power plants, other stationary sources and then other alternatives necessary to achieve needed reductions in emissions. Emissions of GWG from the transportation sector are of the same order of magnitude as those from coal-fired power plants and must be addressed accordingly. Passenger automobiles dominate these emissions. To address the CO₂/GHG issues without including the transportation sources would be a major omission and one that has to be aggressively addressed by the North Carolina Climate Action Plan. Stakeholders on the technical working groups to address these issues will be chosen to represent the various interests involved from State/local governments, planning agencies, and the automotive industry.

Appendix D contains preliminary analysis of selected climate policy options including “State Vehicle Efficiency Improvements” and “VMT Reduction Portfolio.” The GHG impacts and costs in those analyses are suggestive of what NC could expect from some of the actions in this sector.

³⁶ *State Energy Plan*, North Carolina State Energy Policy Council/State Energy Office, <http://www.energync.net/State%20Energy%20Plan%202003.pdf>, June 2003.

Cross Cutting Issues

Principal issues typically included as cross cutting issues include (a) reporting by sources of GHG emissions which, taken together, form the basis of ongoing emissions inventories; (b) GHG registries and the roles, requirements, and functions associated with eligible sources and reductions; and (c) public education and awareness. Each of these issues has been addressed strongly and affirmatively by the DAQ in the course of its Declarations and Recommendations in this report. As part of the planned continuing stakeholder process and climate action plan, however, additional insights or opportunities associated with these issues may be identified. In fact, entirely new cross cutting issues may arise. DAQ remains open to improvements upon its treatment of cross cutting issues as reflected in this report and welcomes any new insights, opportunities, or issues that may result from the comprehensive stakeholder process.

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APPENDIX A - RECENT INTERNATIONAL DEVELOPMENTS

Several international developments in climate change activities were significant since the 2004 report. Some of these are covered in summary in the main body of this report. More detail on some of the most significant activities are provided below.

Individual Countries

Canada

Climate Change Plan

Canada ratified the United Nations Framework Convention on Climate Change in 1992 and its subsequent Kyoto Protocol in 2002, committing to reduce its GHG emissions by 6 percent below 1990 levels in 2008-2012. Prime Minister Paul Martin pledged during the 2004 national election campaign to develop a new plan to meet Canada's Kyoto target. Canada is the world's eighth largest GHG emitter.

On April 13, 2005, the government released a new national climate change plan entitled, "Moving Forward on Climate Change: A Plan for Honoring our Kyoto Commitment." The plan combines regulatory, negotiated, and incentive-based approaches. It anticipates mandatory emission intensity caps for major GHG-producing sectors but also relies heavily on government-funded purchases of emission reductions, both domestically and through the Kyoto Protocol's market-based mechanisms. Key elements of the plan include:

- Auto manufacturers agreement to reduce CO₂, methane, nitrous oxide, and HFC (a fluorocarbon used in air conditioners) emissions from light duty passenger cars and trucks by 6 percent below business-as-usual by 2010 (toward an earlier government move to achieve a 25% efficiency improvement).
- Through a new *Climate Fund*, the government plans to purchase up to 40 percent of the required reduction credits needed for 2008-2012, with domestic reductions from farmers, forestry companies, municipalities as high priority.
- A new *Partnership Fund* will support government-to-government agreements at the federal, provincial, and territorial levels for emission reduction projects, including climate change technology investments and infrastructure.
- A quadrupling of the *Wind Power Production Incentives* will provide \$200 million over the next five to achieve a projected 4,000 MW increase in wind generating capacity.
- The *Renewable Power Production Incentive* is expected to provide \$97 million over the next five years to increase capacity from small hydroelectric, biomass, tidal, and other renewable sources by a projected 1,000 MW.
- Other incentives include increasing the capital cost allowance to 50 percent for highly efficient cogeneration equipment and other renewable technologies. Incentives, tax measures, and related provincial measures are expected to result in a 15 metric mega tonnes (Mt) annual reduction in 2008-2012. (All dollars in this section are Canadian).

Joining With International Effort To Cut Methane Emissions

On July 14, 2005, Canada became the 16th member of EPA's *Methane to Markets Partnership*, an international initiative that promotes the recovery and use of methane, and thereby reduces greenhouse gas emissions and provides valuable sources of clean energy to communities, businesses and industry. By 2015, EPA expects the program to deliver annual reductions of up to 50 million metric tons (CO₂e), through recovery of 500 billion cubic feet of natural gas. The Partnership targets three major sources of methane: landfills, underground coal mines and natural gas/oil systems. Other countries participating in the program include Argentina, Australia, Brazil, China, Colombia, India, Italy, Japan, Mexico, Nigeria, Russia, South Korea, Ukraine, the United Kingdom and the United States. For more information: <http://www.epa.gov/methanetomarkets/>.

China

China's growth in the past few years has certainly made the prophecy of it being a "sleeping dragon" come true in many ways. Industry and fuel use have grown exponentially. China appears to have gone on a global hunt to quench its thirst for energy. The June 2005 takeover bid for Unocal, made clear that the 1.3 billion Chinese people want more of the world's energy. The Chinese government seems, however, to recognize the heavy levels of pollution it has unleashed through heavy growth and high-energy use, and that they may have limits. According to an EPA summary, China's latest efforts in pollution control and energy reductions may be successful (http://www.veccepa.org.cn/eng/news/news_detail.jsp?newsid=04488). For example:

- The Chinese government is proposing to penalize high emission cars by added vehicle taxes. China's effort to establish a new strategic oil reserve is expected to have oil flowing, by the end of 2005.
- Maple, the Shanghai-based unit of China's biggest privately owned carmaker, Geely Automobile, has said that it will develop hybrid-powered cars by 2008, working jointly with Tongji University.
- Beijing recently issued a set of regulations to improve traffic control. The regulations nail down the hiring procedures, work assessment, education and training, equipment and the responsibilities of traffic control assistants.
- China has also adopted motor vehicle fuel efficiency standards that exceed US CAFE standards (<http://www.detnews.com/2004/autosinsider/0410/08/autos-298010.htm>).
- The country is in the process of adopting the world's most aggressive Renewable Energy Portfolio Standard (RPS). For more information on this, see the URL that follows:

http://www.renewableenergyaccess.com/assets/download/China_RE_Law_05.doc.

Chinese President Hu Jintao recently challenged developed and developing countries to promote cooperation through technology exchanges and funding to tackle the problem of climate change. China is also a member of EPA's *Methane to Markets Partnership*, discussed earlier.

Russia

Russia ratified the Kyoto Protocol in January 2004. This triggered provisions of the protocol based on countries accounting for a cumulative 55% of world emissions signing the treaty. Thus, the treaty went into effect on February 16, 2005, and changed the motivation of many countries and companies around the world, particularly in Europe. In a substantial portion of the world, carbon-trading markets (including “buy and sell”) have now begun to expand and trade more intensely. U.S. companies are either beginning to participate or to look closely at how they may take advantage of the related business opportunities. Even though the U.S. did not ratify the treaty after being an original signor, many companies will likely be able to take advantage of the trading markets it triggers and make substantial economic gains.

Other International Developments

Arctic Studies & Reports

A recent Arctic Climate Impact Assessment³⁷ effort organized by the Arctic Council and the International Arctic Sciences Commission warned of major effects on humans, plants, animals and national economies from rapid Arctic warming. Some 300 scientists and other participants studied the data and apparent changes taking place in the Arctic. The resulting 1,200-page report purports to state a consensus, understanding and knowledge of the group on consequences of climate change over the Arctic. They concluded that effects of climate changes are being experienced particularly intensely in the Arctic and that average temperatures have risen at almost twice the rate as the rest of the world in the past few decades. Widespread melting of glaciers and sea ice and rising permafrost temperatures present additional evidence of arctic warming. The group projects an acceleration of these climatic trends during this century due to ongoing increases in concentrations of GHG in the earth’s atmosphere. While GHG emissions do not primarily originate in the Arctic, they are projected to bring wide-ranging changes and impacts to the Arctic. These changes are projected to impact the whole planet. The very lengthy, detailed (and viewed as significant) research report distilled the main findings into 10 key summary statements:

1. Arctic climate is now warming rapidly and much larger changes are projected;
2. Arctic warming and its consequences have worldwide implications;
3. Arctic vegetation zones are very likely to shift, causing wide-ranging impacts;
4. Animal species' diversity, ranges and distribution will change;
5. Many coastal communities and facilities face increasing exposure to storms;
6. Reduced sea ice is very likely to increase marine transport and access to resources;
7. Thawing ground will disrupt transportation, buildings and other infrastructure;
8. Indigenous communities are facing major economic and cultural impacts;
9. Elevated ultraviolet radiation levels will affect people, plants, animals
10. Multiple influences interact to cause impacts to people and ecosystems.

37 Dr. Robert W. Corell, Chair, Arctic Climate Impact Assessment, Organized by the Arctic Council and the International Arctic Sciences Committee and Senior Fellow, American Meteorological Society, presented to the Committee on Commerce, Science, and Transportation, United States Senate, November 16, 2004.

Over 50 International Cities Sign Urban Environmental Accords

On June 5, 2005, representatives of over 50 cities from around the globe commemorated the United Nations World Environment Day with their mayors or designees signing Urban Environmental Accords that include commitments to reduce GHG emissions and improve air quality. The accord lists 21 actions, with cities committing to implement as many of them as possible between now and World Environment Day 2012 and at least three actions per year.

Actions include: adopting city-wide GHG reduction plans to reduce the emissions by 25 percent by 2030; implementing systems for accounting and auditing GHG emissions; establishing an Air Quality Index to provide a simplified view of air pollution levels; setting a goal of reducing, by 10 percent in seven years, the number of days categorized in the AQI range as unhealthy or hazardous; and, implementing a policy to reduce the percentage of commute trips by single occupancy vehicles by ten percent. <http://www.wed2005.org/3.1.php>

Science Academies of 11 Countries

In a notable show of unity in the scientific community timed to send a message to the G-8 meeting, the science academies of eleven countries (Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, the United Kingdom and the U.S.) issued a joint statement on global warming on June 7, 2005 declaring that the “scientific understanding of climate change is now sufficiently clear to justify nations taking prompt action” and calling for specific action on global warming by world leaders. In 2004, the Arctic Council and the International Arctic Sciences Commission, made up of 300 scientists and other participants, issued a report documenting the pronounced warming occurring in the Arctic region and warning of major effects on humans, plants and animals and national economies from rapid Arctic warming.

APPENDIX B - ACTIONS IN OTHER STATES SINCE 2004 REPORT

Actions of other jurisdictions may provide insights, or perhaps clues, as to where these directions may take us, at least in context to what is done in North Carolina related to these other jurisdictions. This topic was covered in more detail in the 2004 report. However, basic actions and developments since the 2004 report are summarized below. For a complete picture, the reader may wish to first read the related discussions in the 2004 report and do additional research as information changes constantly.

Specific State Discussions

Arizona

Climate Change Advisory Group

On February 2, 2005, Governor Janet Napolitano of Arizona created a Climate Change Advisory Group by Executive Order. This action was aimed at developing recommendations to reduce Arizona's GHG, through a Climate Change Action Plan to be developed by June 2006. The facilitated advisory and stakeholder groups are composed of representatives from state government, industry, tourism, and several non-governmental organizations. The plan is now actively under development (see www.azclimatechange.us).

Energy Requirements of State Buildings

The Governor also signed a second executive order on February 11, 2005 that requires new state-funded buildings to derive at least 10% of their energy from renewable sources, either directly or through the purchase of renewable energy credits. This Executive Order requires new state buildings to meet the "silver" level of the Leadership in Energy and Environmental Design (LEED) standards.

Appliance Standards

In April 2005, Governor Napolitano signed a law for efficiency standards for 12 appliances. Read the Arizona law (pdf) at: <http://www.swenergy.org/legislative/arizona/HB%202390%20Engrossed%20Bill%20Language.pdf>.

California

State Emissions Targets

Governor Arnold Schwarzenegger of California has indicated that he wants to drastically cut GHG emissions, vastly increase the use of solar energy and import more (coal-fired) power from distant states. He signed an executive order on June 1, 2005, establishing aggressive emissions targets for the state. The order directs state officials to develop plans to reduce California's GHG emissions by 11% below current levels over the next five years, 25% by 2020, and 80% by 2050. (These targets are equivalent to reaching 2000 GHG emissions levels by 2010 and 1990 levels by 2020). In collaboration with a variety of state agencies, the Secretary of the California Environmental Protection Agency will develop strategies to achieve the targets.

In a separate action on May 31, 2005, the State Assembly approved a bill http://www.aroundthecapitol.com/billtrack/billview.html?bill=AB_1365 that would set more stringent emissions targets for California. The bill sets a target of reducing emissions 7% below 1990 levels in 2010, and 10% below 1990 levels by 2020.

Automobile Standards

On September 24, 2004 the California Air Resources Board (CARB) voted to issue regulations implementing legislation passed in 2002. The legislation directs the CARB to adopt regulations that would achieve the "maximum feasible and cost-effective reduction of GHG from motor vehicles." The standard will require that tailpipe greenhouse gas emissions from new vehicles be reduced by 22 percent by the 2012 model year and 30 percent by the 2016 model year.

The measures identified include discrete variable valve lift, dual cam phasing, turbo charging with engine downsizing, automated manual transmissions and cam-less valve actuation which are estimated to add about \$1000 to the cost of a new car in 2014. Increased up-front costs are expected to be offset by decreased operating costs. The changes will apply to model years 2009 and later. The standards will enter into effect January 1, 2006, and regulations are subject to legislature review and modification, if they deem it necessary.

Connecticut, Maine, Massachusetts, New Jersey, New York, Rhode Island, Vermont and Washington (at least) currently follow the California vehicle emission standards, and may opt to either adopt the new regulations, or fall back to federal standards. New York, Massachusetts, and Connecticut have already indicated that they will follow California's GHG standard, and the other states are expected to do so as well. However, pending litigation by auto manufacturers must be resolved before this can take place.

Carbon Adder for Electric Utility Plans

On December 16, 2004, the California Public Utilities Commission (CPUC) approved a requirement that a "carbon adder" be included in resource plans for three of California's utilities. The carbon adder explicitly takes into account the social cost of carbon emissions from electricity generation facilities when comparing prices of fossil fuel and renewable generation, as well as demand-side management investments. The carbon adder will be used for utility planning purposes and not be assessed to consumers. Taking the cost of carbon into account will mean that a power source is considered more cost effective if the cost of avoiding a ton of CO₂ emissions is \$8 to \$25, based on a number of studies, including the Idaho Power Company's 2004 resource planning process, which assessed a carbon adder of \$12.30 per ton of CO₂. Read the press release at the URL below for more details:

http://www.cpuc.ca.gov/PUBLISHED/NEWS_RELEASE/42334.htm .

Consumer Products

In March, 2005, the California Energy Commission set standards for 17 energy efficient consumer products, and estimates these regulations will save consumers \$3 billion over 15 years.

Colorado

Voters Approve Renewable Energy Standard

On November 2, 2004, Colorado residents approved Amendment 37, a ballot initiative creating a Renewable Portfolio Standard (RPS). Under the new standard, utilities with over 40,000 customers must provide an increasing percentage of electricity from renewables, reaching 10 percent by 2015. The Colorado RPS defines renewables as including all solar, wind, geothermal, and biomass, and small hydroelectricity systems (of 10 megawatts or less). Currently, renewable energy supplies 2% of Colorado's electricity demand. The amendment also established net-metering standards and mandated rebates for customer photovoltaic systems. It also capped residential rate increases due to investments in renewables at 50 cents per month. Colorado is the only state to approve an RPS through a ballot initiative. Proponents of the measure cited energy supply diversity and rural job creation as the major impetus for the legislation. Colorado was the 17th U.S. state to adopt a RPS.

Connecticut

The State of Connecticut has been widely recognized for its groundbreaking work in developing and implementing plans to reduce emissions of GHG. These efforts began with the 2001-2002 development and adoption of a regional agreement by the New England Governors and Eastern Canadian Premiers (NEG/ECP) to reduce GHG emissions to 1990 levels by 2010 and to 10 percent below that level by 2020.

In 2005, Connecticut released its Climate Change Action Plan, which contains 55 recommended actions in five major areas: transportation and land use, residential, commercial and industrial energy; agriculture, forestry and waste; electricity generation; and education and outreach.

In February 2005, this plan received endorsement from the Connecticut Legislature and their approval of several of the recommended actions. Although implementation of many of the recommended actions are still in the planning stages, Connecticut has already:

- Become the first state to delineate how it would meet the NEG/ECP target
- Instituted tax incentives for hybrid vehicles (PA 04-231, PA 05-06)
- Developed and funded a strong Clean Energy Fund
- Formally adopted :
 - NEG/ECP target in statute (PA 04-252)
 - Mandatory reporting of GHG emissions (PA 04-252)
 - A regional GHG Registry (PA 04-252)
 - Energy efficiency standards for appliances (PA 04-85)
 - California's clean cars program (Pavley/LEV-II) (PA 04-84)
 - New requirements for and support of energy efficiency, renewable energy, combined heat and power and distributed generation (PA 05-1)

- Requirements for the state to purchase environmentally preferable products (PA 04-252)
- Requirements for the state to purchase renewable energy (EO 32)
- Provided support for locally grown food (PA 04-222)
- Provided support for local agriculture and open land preservation (PA 05-228)
- Proposed a Natural Gas Conservation Fund, and
- Proposed an Oil Conservation Fund.

Iowa

Efficiency and Renewable Energy

On April 22, 2005, Governor Thomas Vilsack signed an [executive order](#) instructing state agencies to increase their operational energy efficiency and renewable energy use. The order mandates:

- A 15% improvement in energy efficiency at state facilities by 2010, and
- The procurement of hybrid or alternative-fuel vehicles for non-law enforcement state vehicles
- State agencies to purchase equipment with the lowest life-cycle cost when possible, and
- State agencies to purchase 10% of their electricity from renewable sources.

Iowa is the nation's top producer of ethanol, one of the fuels that can be used by alternative-fueled vehicles. Iowa also has over 600 MW of wind capacity, in part due to a RPS that the state passed in 1999.

Maine

Climate Action Plan

On December 1, 2004, Maine released its Climate Action Plan to reduce the state's GHG emissions. The plan, developed by the state's Department of Environmental Protection, addresses or defines a set of 54 actions designed to enable Maine to achieve its emissions targets. These targets follow the New England Governors' and Eastern Canadian Premiers' climate agreement, as defined in the 2004 plan, aimed at reducing Maine's GHG emissions to 1990 levels by 2010 and to 10% below those levels by 2020. Both the targets and the development of the plan are a result of a law enacted by Maine in 2004. Maine's plan proposes increasing sequestration of carbon through new forestry practices, creating incentives for more efficient vehicles, and trading emission reduction credits. In assessing the costs of the plan, the Maine Department of Environmental Protection predicted that almost half of the actions would reduce emissions at little or no cost. You may download the plan at <http://maineghg.raabassociates.org/finalplan.asp>.

New Mexico

Suite of Energy Bills

In March 2005, the New Mexico legislature passed three bills to promote energy efficiency and renewable energy investments in the state.

- The **Energy Efficiency and Renewable Energy Bonding Act** allows the sale of \$20 million in bonds to support energy efficiency and solar projects in existing public buildings with an estimated savings to the state of \$46 million in electricity costs over the 20-year life of the bonds.
- The **Efficient Use of Energy Act** encourages public gas and electric utilities to invest in energy efficiency. The act directs utilities to explore cost-effective efficiency investments, in order to reduce electricity consumption, the associated emissions, and the flow of money to out-of- state electricity generators.
- The **Natural Resources Conservation Bids Act** facilitates energy efficiency upgrades to public buildings.

These legislative initiatives were developed in part by Governor Richardson’s Clean Energy Task Forces created last year. The Task Forces were created in response to an executive order declaring New Mexico the Clean Energy State.

New Mexico is also in the initial stages of developing a Climate Action Plan (see www.nmclimatechange.us). The **Energy Efficiency and Renewable Energy Bonding Act** may be read at <http://www.swenergy.org/legislative/newmexico/HB%200032%20Bill.pdf>, and the **Efficient Use of Energy Act** at <http://www.swenergy.org/legislative/newmexico/HB 0619 Bill.pdf>.

North Dakota

Wind and Bioenergy

On April 28, 2005, North Dakota Governor John Hoeven signed into law a legislative package that encourages wind power, ethanol, and biodiesel. North Dakota will now allow renewable energy credits (RECs) from in-state generation to be sold to out-of-state buyers, and will lower the barriers to siting wind power and investing in new transmission. The Legislature authorized continued funding for the ethanol incentives, as well as tax breaks for the purchase and production of both ethanol and biodiesel. The governor also established an Office of Renewable Energy in the North Dakota Commerce Department to assist public and private renewable energy and energy efficiency projects.

Oregon

Adoption of the California Vehicle Standards

In April 2005, Oregon Governor Ted Kulongoski formed a task force to adopt the California motor vehicle emission standards. Due to prior agreements, this also fulfilled a condition which allowed Washington to pass legislation to become the tenth state intending to follow California’s standard.

Pennsylvania

Clean Energy Portfolio Standard

On December 16, 2004, Governor Edward Rendell signed Pennsylvania’s Clean Energy Portfolio Standard legislation. The standard embodied requires qualified clean energy power sources to provide 18% of Pennsylvania’s electricity by 2020. Electric generation and distribution companies may use two tiers of qualified sources to comply.

<http://www.legis.state.pa.us/WU01/LI/BI/BT/2003/0/SB1030P1973.HTM>

- Tier 1 sources, which must make up 8% of the portfolio, include wind, solar, coal mine methane, small hydropower, geothermal, and biomass. The Tier 1 standard also specifies that solar sources provide 0.5% of generation by 2020, the most solar power mandated by any state.
- Tier 2 sources make up the remaining 10% of the portfolio, and include waste coal, demand side management, large hydropower, municipal solid waste, and coal integrated gasification combined cycle (IGCC).

The Pennsylvania Public Utilities Commission is charged with developing a system of clean energy credits that can be traded to facilitate utility compliance with the standard.

Washington

LEED Standards for Public Buildings

On April 8, 2005, Washington Governor Christine Gregoire signed a bill mandating that all new public buildings in the state meet the US Green Building Council's LEED Silver standards. Washington is the first state in the country to mandate that new public buildings meet "green building" standards of energy efficiency, water conservation and other environmental benchmarks. The law applies to new public facilities over 5,000 square feet, including school buildings receiving state funding, and major renovation projects. A building can achieve a LEED standard by earning points based on energy efficiency, use of sustainable materials, and other environmental attributes.

The new buildings will not only help protect the environment, but also produce considerable savings in operating costs. The Washington Middle School project, for instance, will help the Olympia School District:

- Save more than 500,000 gallons of water each year.
- Provide healthier air quality for students by using natural ventilation in classrooms. An added bonus will be saving \$1,200 a year in lieu of conventional air conditioning.
- Use natural lighting and lighting controls to produce an energy saving of 50 cents per square foot, or \$25,000 over a 30-year period. Studies have also shown that properly designed day-lit classrooms have increased student learning and test scores.

According to the State Board of Education and Superintendent of Public Instruction's office, use of sustainable building designs result in:

- 20% annual savings in energy costs
- 20% reduction in water costs
- 38% in waste water production
- 22% reduction in construction waste
- A potential reduction in student absenteeism
- A potential 5% decrease in teacher turnover rates, and
- A potential 5% to 26% improvements in standardized test scores

Read the bill at <http://www.leg.wa.gov/pub/billinfo/2005-06/Htm/Bills/Senate20Passed%20Legislature/5509-S.PL.htm> .

Renewable Incentives

May 9, 2005, Governor Christine Gregoire signed two bills that will increase both supply and demand for renewable energy generation.

- On the supply side, SB 5111 offers tax breaks to Oregon companies that manufacture and sell solar equipment.
- On the demand side, SB 5101 offers the first state feed-in credit for solar and wind energy production. A feed-in credit provides performance-based tax breaks for small-scale renewable energy generation to feed electricity into the grid.

Vehicle Standards

Governor Gregoire also signed HB 1397 (passed April 13, 2005) that adopted California's vehicle GHG emissions standards for Washington (conditional on Oregon's adoption of a similar standard, which also occurred in April).

Appliance Standards

Washington also joined Maryland, Connecticut, Arizona, New Jersey and California in adopting efficiency standards for 12 types of appliances.

Multi-State, Regional and Other Multi-jurisdictional Approaches

Northeast States

Nine Northeast states (CT, DE, MA, ME, NH, NJ, NY, RI, and VT) have initiated significant efforts toward developing a cap-and-trade program to limit CO2 emissions from power plants through their Regional GHG Initiative (RGGI). A model rule for this program is now in development. Besides the nine states officially participating as members in this effort, two states are official observers (MD and PA) and others have been invited. North Carolina is an unofficial observer. More information is available at www.rggi.org.

NESCAUM's Regional Greenhouse Gas Registry (RGGR)

The 2003 and 2004 reports discussed the actions and plans of the North East States for Coordinated Air Use Management (NESCAUM) to develop a greenhouse gas registry. Several other states are participating in this effort in addition to NESCAUM members. North Carolina is an unofficial observer and participant in this process. The process is designed to develop means to establish and maintain a registry as well as to establish related policies to achieve GHG reduction goals. A full description and update on these activities is not presented here, but the group is working aggressively to accomplish the stated goals of the program. The reader may get updated information at <http://www.rggr.us/#overview> and related web pages.

West Coast States

The West Coast Governors' Global Warming Initiative was announced in September 2003, by Governors Schwarzenegger, Kulongoski, and Locke (of California, Oregon and Washington, respectively) to indicate their commitment to act collaboratively and individually to reduce GHG emissions. On November 18, 2004, the Governors collectively approved staff recommendations on climate change.

These recommendations also discussed by individual state in this report, included setting emissions targets for state vehicle fleets, and other transportation targets, creating goals and incentives for renewable energy, alternative fuels, developing efficiency standards for appliances not regulated by the federal government, general energy efficiency improvements and greenhouse gas emissions inventories. The staffs in these states continue to follow up on opportunities to define and implement other regional collaboration. For the information on California, go to <http://www.calepa.ca.gov/>; for Oregon, http://governor.oregon.gov/Gov/press_111804.shtml and for Washington, go to <http://sow.ciber.net/sow/match.asp?query=Western+Governors+Climate>.

Puget Sound Climate Action Plan

The Puget Sound (covering multiple counties, headquartered in Seattle, Washington) Air Pollution Control Agency was directed by the Puget Sound Clean Air Agency Board of Directors to convene a stakeholder process to assist in developing a Climate Protection Program. The goal of the stakeholder process is to provide direction to the Clean Air Agency, the Puget Sound region and Washington State on climate protection strategies. The plan is now developed and its objectives include:

- A set of stakeholder-endorsed recommendations to reduce GHG emissions. Strategies focus on energy supply, energy demand, transportation, forestry and solid waste,
- Providing stakeholders with comprehensive, credible cost/benefit analyses to fully inform their discussions and recommendations,
- Evaluation of assumptions and methods for the cost-benefit analyses with technical consultants and technical experts from the region, and
- Definition of a (GHG) reduction target or goal for the Puget Sound region.

The process was completed and the plan approved by the Board on July 1, 2005.

U.S. Conference of Mayor's Initiative

Mayor Greg Nickels of Seattle put together an initiative that became a formalized agreement among mayors within a very short time, indicating high interest in global warming at local levels across the country. The initiative resulted in the U.S. Conference of Mayors adopting the "U. S. Mayors Climate Protection Agreement," whereby over 167 cities from at least 37 states agreed (June 2005) to attempt to meet Kyoto Protocol requirements, even though the United States is not a ratified party to the treaty. This agreement calls for cities to reduce GHG emissions by seven percent of 1990 levels by 2012 - the same standard to which the United States would have been held under the Kyoto treaty. The agreement also addresses curtailing urban sprawl and endorses passage of the McCain-Lieberman climate change bill. Durham, North Carolina is one of the participants in this initiative.

Some Typical Examples of State Action/Implementation Documents

The documents on the following pages were chosen from the several available documents, as examples of implementation tools that have been used. The specific language may not be appropriate for North Carolina, but are provided here so that the reader may see what kinds of detail and language may be involved.

Arizona

Executive Order 2005-02

Climate Change Advisory Group

WHEREAS, the Western Governors Association has recognized that, “Climate variability has impacted the West in recent years, including very significant droughts across much of the region;” and

WHEREAS, Arizona and other Western States have particular concerns about the impacts of climate change and climate variability on our environment, including the potential for prolonged drought, severe forest fires, warmer temperatures, increased snowmelt, reduced snow pack and other effects; and

WHEREAS, the Western Governors Association has recognized that, “The failure to take appropriate actions to address global climate change risks economic, environmental and societal damage;” and

WHEREAS, scientific consensus has developed that increasing emissions of carbon dioxide (CO₂), methane and other greenhouse gases released to the atmosphere are affecting the Earth’s climate; and

WHEREAS, there is growing interest in the United States in state-level actions to address the effects of climate change and greenhouse gas emissions; and

WHEREAS, a number of states are addressing climate change and greenhouse gas emissions on an individual and/or regional basis, including through the West Coast Governor’s Climate Change Initiative, the Regional Greenhouse Gas Initiative and other collaborations; and

WHEREAS, actions to reduce greenhouse gas emissions, including increasing energy efficiency, conserving natural resources and developing renewable energy sources, may have multiple benefits including economic development, job creation, cost savings, and improved air quality; and

WHEREAS, a stakeholder process to address climate change and greenhouse gas emissions in Arizona can build upon the work of, and further address issues raised by, the Energy Efficiency/Renewable Energy Working Group, the Essential Services Task Force, the Forest Health Advisory and Forest Health Oversight Councils, the Drought Task Force, the Governor’s Efficiency Review and other efforts of the State;

NOW THEREFORE, I, Janet Napolitano, Governor of the State of Arizona, by virtue of the powers vested in me by the Constitution and laws of this State, do hereby order the following actions to address climate change and greenhouse gas emissions in Arizona:

1. The Climate Change Advisory Group is established and charged with the development of recommendations to the Governor to reduce greenhouse gas emissions in Arizona, recognizing Arizona’s interests in continued growth, economic development and energy security.

2. The Climate Change Advisory Group shall be organized and coordinated by the Arizona Department of Environmental Quality.
3. The Climate Change Advisory Group shall not exceed 36 members each of whom shall be appointed by, and serve at the pleasure of the Governor. Commission members should represent the scope and diversity that this issue holds for Arizona. They should include representatives from some or all of the following sectors:
 - A. Electric Power Generation
 - B. Fossil Fuel Industry
 - C. Manufacturing/Mining
 - D. Agriculture/Forestry
 - E. Construction/Building
 - F. Tourism/Recreation
 - G. Health Care
 - H. Non-Governmental Organizations
 - I. Indian Tribes
 - J. State and Local Government
 - K. General Public
4. The Climate Change Advisory Group shall produce an inventory of greenhouse gas emissions in Arizona and their sources by June 30, 2005.
5. The Climate Change Advisory Group shall produce a Climate Change Action Plan with recommendations for reducing greenhouse gas emissions in Arizona, to be submitted to the Governor by June 30, 2006.

IN WITNESS WHEREOF, I have hereunto set my hand and caused to be affixed the Great Seal of the State of Arizona.


GOVERNOR

DONE at the Capitol in Phoenix on this 2 day of February in the Year Two Thousand Five and of the independence of the United States of America the Two Hundred Twenty-Ninth.

ATTEST:


SECRETARY OF STATE



Arizona - Continued

Executive Order 2005-05

IMPLEMENTING RENEWABLE ENERGY AND ENERGY EFFICIENCY IN NEW STATE BUILDINGS

WHEREAS, development of renewable energy and promotion of energy efficiency can significantly improve Arizona's energy reliability and security, economic development, and environment; and

WHEREAS, as a state with abundant sunshine, Arizona has the opportunity to achieve national and global leadership in research, design, construction, manufacturing and development of renewable energy; and

WHEREAS, Arizona's dense forests pose both a fire hazard and an economic opportunity to develop thermal energy using forest biomass; and

WHEREAS, developing thermal energy using forest biomass also creates economic incentives for responsible and necessary commercial thinning of our forests; and

WHEREAS, supporting responsible use of Arizona's naturally renewable energy resources and increasing energy efficiency is important to the State, and the national economy;

NOW, THEREFORE, I, Janet Napolitano, Governor of Arizona, by virtue of the authority vested in me by the Constitution and laws of this State, hereby order as follows:

1. All Executive Branch agencies shall implement to the extent practicable the following standards in all new state-funded facilities:
 - A. Renewable Energy** – All new state funded-buildings constructed after the date of this Executive Order shall be designed and constructed to derive at least 10 percent (10%) of their energy from a renewable resource. A renewable resource may include: solar, wind, or the use of thermal energy from biomass fuels for heating and or cooling. This goal may also be met through the purchase of renewable energy credits (as defined by the Department of Commerce Energy Office) from an energy producer.
 - B. Energy Efficiency** – The design for all state-funded buildings constructed after the date of this Executive Order shall include energy efficiency standards consistent with Arizona Revised Statutes § 34-451 and Executive Order 2003-14.

- C. LEED Standard** – All state-funded buildings constructed after the date of this Executive Order shall meet at least the “silver” Leadership in Energy & Environmental Design (LEED) standard.
2. The Arizona Department of Administration, Arizona Department of Transportation and Arizona School Facilities Board, shall submit a report to me (as well as to the Director of the Department of Administration) in writing via electronic submission, by August 1, 2005, and annually thereafter, summarizing:
a) actions taken to achieve the renewable and energy efficiency goals of this Order; b) the extent to which the goal has been achieved; and c) if the goal was not achieved, an explanation why it was not achieved and an assessment of what can be done to achieve the goal.
 3. All other branches of state government are also encouraged to review and comply with the design standards set forth in this Executive Order.

IN WITNESS WHEREOF, I have hereunto set my hand and caused to be affixed the Great Seal of the State of Arizona.


GOVERNOR

Signed at the Capitol in Phoenix this 11th day of February Two Thousand Five and of the Independence of the United States of America the Two Hundred and Twenty-Ninth.

ATTEST:


SECRETARY OF STATE



California

Emission Reduction Targets, etc.

EXECUTIVE ORDER S-3-05

WHEREAS, California is particularly vulnerable to the impacts of climate change; and
WHEREAS, increased temperatures threaten to greatly reduce the Sierra snowpack, one of the State's primary sources of water; and

WHEREAS, increased temperatures also threaten to further exacerbate California's air quality problems and adversely impact human health by increasing heat stress and related deaths, the incidence of infectious disease, and the risk of asthma, respiratory and other health problems; and

WHEREAS, rising sea levels threaten California's 1,100 miles of valuable coastal real estate and natural habitats; and
WHEREAS, the combined effects of an increase in temperatures and diminished water supply and quality threaten to alter micro-climates within the state, affect the abundance and distribution of pests and pathogens, and result in variations in crop quality and yield; and

WHEREAS, mitigation efforts will be necessary to reduce greenhouse gas emissions and adaptation efforts will be necessary to prepare Californians for the consequences of global warming; and

WHEREAS, California has taken a leadership role in reducing greenhouse gas emissions by: implementing the California Air Resources Board motor vehicle greenhouse gas emission reduction regulations; implementing the Renewable Portfolio Standard that the Governor accelerated; and implementing the most effective building and appliance efficiency standards in the world; and

WHEREAS, California-based companies and companies with significant activities in California have taken leadership roles by reducing greenhouse gas (GHG) emissions, including carbon dioxide, methane, nitrous oxide and hydrofluorocarbons, related to their operations and developing products that will reduce GHG emissions; and

WHEREAS, companies that have reduced GHG emissions by 25 percent to 70 percent have lowered operating costs and increased profits by billions of dollars; and

WHEREAS, technologies that reduce greenhouse gas emissions are increasingly in demand in the worldwide marketplace, and California companies investing in these technologies are well-positioned to profit from this demand, thereby boosting California's economy, creating more jobs and providing increased tax revenue; and

WHEREAS, many of the technologies that reduce greenhouse gas emissions also generate operating cost savings to consumers who spend a portion of the savings across a variety of sectors of the economy; this increased spending creates jobs and an overall benefit to the statewide economy;

and NOW, THEREFORE, I, ARNOLD SCHWARZENEGGER, Governor of the State of California, by virtue of the power invested in me by the Constitution and statutes of the State of California, do hereby order effective immediately:

- That the following greenhouse gas emission reduction targets are hereby established for California: by 2010, reduce GHG emissions to 2000 levels; by 2020, reduce GHG emissions to 1990 levels; by 2050, reduce GHG emissions to 80 percent below 1990 levels; and
- That the Secretary of the California Environmental Protection Agency ("Secretary") shall coordinate oversight of the efforts made to meet the targets with: the Secretary of the Business, Transportation and Housing Agency, Secretary of the Department of Food and Agriculture, Secretary of the Resources Agency, Chairperson of the Air Resources Board, Chairperson of the Energy Commission, and the President of the Public Utilities Commission; and
- That the Secretary shall report to the Governor and the State Legislature by January 2006 and biannually thereafter on progress made toward meeting the greenhouse gas emission targets established herein; and
- That the Secretary shall also report to the Governor and the State Legislature by January 2006 and biannually thereafter on the impacts to California of global warming, including impacts to water supply, public health, agriculture, the coastline, and forestry, and shall prepare and report on mitigation and adaptation plans to combat these impacts; and
- That as soon as hereafter possible, this Order shall be filed with the Office of the Secretary of State and that widespread publicity and notice be given to this Order.

IN WITNESS WHEREOF I have hereunto set my hand and caused the Great Seal of the State of California to be affixed this first day of June 2005.

ARNOLD SCHWARZENEGGER
Governor of California

Washington

Sample Appliance Efficiency Law

State of Washington 59th Legislature 2005 Regular Session

By House Committee on Technology, Energy & Communications

(originally sponsored by Representatives Morris, Hudgins and Chase;

by request of Governor Locke)

READ FIRST TIME 02/07/05.

1 AN ACT Relating to energy efficiency; adding a new chapter to Title
2 19 RCW; and prescribing penalties.

3 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF WASHINGTON:

4 NEW SECTION. **Sec. 1.** The legislature finds that:

5 (1) According to estimates of the department of community, trade,
6 and economic development, the efficiency standards set forth in this
7 act will save nine hundred thousand megawatt-hours of electricity,
8 thirteen million therms of natural gas, and one billion seven hundred
9 million gallons of water in the year 2020, fourteen years after the
10 standards have become effective, with a total net present value to
11 buyers of four hundred ninety million dollars in 2020.

12 (2) Efficiency standards for certain products sold or installed in
13 the state assure consumers and businesses that such products meet
14 minimum efficiency performance levels thus saving money on utility
15 bills.

16 (3) Efficiency standards save energy and reduce pollution and other
17 environmental impacts associated with the production, distribution,
18 and use of electricity and natural gas.

p. 1 ESHB 1062.SL

1 (4) Efficiency standards contribute to the economy of Washington by
2 helping to better balance energy supply and demand, thus reducing
3 pressure for higher natural gas and electricity prices. By saving
4 consumers and businesses money on energy bills, efficiency standards
5 help the state and local economy, since energy bill savings can be
6 spent on local goods and services.

7 (5) Efficiency standards can make electricity systems more reliable
8 by reducing the strain on the electricity grid during peak demand
9 periods. Furthermore, improved energy efficiency can reduce or delay
10 the need for new power plants, power transmission lines, and power
11 distribution system upgrades.

12 NEW SECTION. **Sec. 2.** The definitions in this section apply
13 throughout this chapter unless the context clearly requires otherwise.

14 (1) "Automatic commercial ice cube machine" means a factory-made
15 assembly, not necessarily shipped in one package, consisting of a
16 condensing unit and ice-making section operating as an integrated
17 unit with means for making and harvesting ice cubes. It may also include
18 integrated components for storing or dispensing ice, or both.

19 (2) "Ballast" means a device used with an electric discharge lamp
20 to obtain necessary circuit conditions, such as voltage, current,
21 and waveform, for starting and operating the lamp.

22 (3) "Commercial clothes washer" means a soft mount horizontal or
23 vertical-axis clothes washer that: (a) Has a clothes container
24 compartment no greater than 3.5 cubic feet in the case of a
25 horizontal-axis product or no greater than 4.0 cubic feet in the case of a
26 vertical-axis product; and (b) is designed for use by more than one
27 household, such as in multifamily housing, apartments, or coin
28 laundries.

29 (4) "Commercial prerinse spray valve" means a handheld device
30 designed and marketed for use with commercial dishwashing and
31 warewashing equipment and that sprays water on dishes, flatware, and
32 other food service items for the purpose of removing food residue
33 prior to their cleaning.

34 (5)(a) "Commercial refrigerators and freezers" means refrigerators,

35 freezers, or refrigerator-freezers designed for use by commercial or
36 institutional facilities for the purpose of storing or merchandising
37 food products, beverages, or ice at specified temperatures that: (i)
ESHB 1062.SL p. 2

1 Incorporate most components involved in the vapor-compression cycle
2 and the refrigerated compartment in a single cabinet; and (ii) may be
3 configured with either solid or transparent doors as a reach-in
4 cabinet, pass-through cabinet, roll-in cabinet, or roll-through
5 cabinet.

6 (b) "Commercial refrigerators and freezers" does not include: (i)
7 Products with 85 cubic feet or more of internal volume; (ii) walk-in
8 refrigerators or freezers; (iii) consumer products that are federally
9 regulated pursuant to 42 U.S.C. Sec. 6291 et seq.; (iv) products
10 without doors; or (v) freezers specifically designed for ice cream.

11 (6) "Compensation" means money or any other valuable thing,
12 regardless of form, received or to be received by a person for
13 services rendered.

14 (7) "Department" means the department of community, trade, and
15 economic development.

16 (8) "High-intensity discharge lamp" means a lamp in which light is
17 produced by the passage of an electric current through a vapor or
18 gas, and in which the light-producing arc is stabilized by bulb wall
19 temperature and the arc tube has a bulb wall loading in excess of three
20 watts per square centimeter.

21 (9) "Illuminated exit sign" means an internally illuminated sign
22 that is designed to be permanently fixed in place to identify a
23 building exit and consists of an electrically powered integral light
24 source that illuminates the legend "EXIT" and any directional
25 indicators and provides contrast between the legend, any directional
26 indicators, and the background.

27 (10)(a) "Low-voltage dry-type distribution transformer" means a
28 distribution transformer that: (i) Has an input voltage of 600 volts
29 or less; (ii) is air cooled; (iii) does not use oil as a coolant;
30 and (iv) is rated for operation at a frequency of 60 hertz.

31 (b) "Low-voltage dry-type transformer" does not include: (i)
32 Transformers with multiple voltage taps, with the highest voltage
33 tap equaling at least twenty percent more than the lowest voltage tap; or
34 (ii) transformers, such as those commonly known as drive
35 transformers, rectifier transformers, auto transformers,
36 uninterruptible power system transformers, impedance transformers,
37 regulating transformers, sealed and nonventilating transformers, machine
tool transformers, welding

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1 transformers, grounding transformers, or testing transformers, that are
2 designed to be used in a special purpose application and are unlikely
3 to be used in general purpose applications.

4 (11) "Metal halide lamp" means a high-intensity discharge lamp in
5 which the major portion of the light is produced by radiation of metal
6 halides and their products of dissociation, possibly in combination
7 with metallic vapors.

8 (12) "Metal halide lamp fixture" means a light fixture designed to
9 be operated with a metal halide lamp and a ballast for a metal halide
10 lamp.

11 (13) "Pass-through cabinet" means a commercial refrigerator or
12 freezer with hinged or sliding doors on both the front and rear of the
13 unit.

14 (14) "Probe-start metal halide ballast" means a ballast used to
15 operate metal halide lamps which does not contain an igniter and which
16 instead starts lamps by using a third starting electrode "probe" in the
17 arc tube.

18 (15) "Reach-in cabinet" means a commercial refrigerator or freezer

19 with hinged or sliding doors or lids, but does not include roll-in or
20 roll-through cabinets or pass-through cabinets.
21 (16)(a) "Roll-in cabinet" means a commercial refrigerator or
22 freezer with hinged or sliding doors that allow wheeled racks of
23 product to be rolled into the unit.
24 (b) "Roll-through cabinet" means a commercial refrigerator or
25 freezer with hinged or sliding doors on two sides of the cabinet that
26 allow wheeled racks of product to be rolled through the unit.
27 (17)(a) "Single-voltage external AC to DC power supply" means a
28 device that: (i) Is designed to convert line voltage alternating
29 current input into lower voltage direct current output; (ii) is able to
30 convert to only one DC output voltage at a time; (iii) is sold with, or
31 intended to be used with, a separate end-use product that constitutes
32 the primary power load; (iv) is contained within a separate physical
33 enclosure from the end-use product; (v) is connected to the end-use
34 product via a removable or hard-wired male/female electrical
35 connection, cable, cord, or other wiring; and (vi) has a nameplate
36 output power less than or equal to 250 watts.
37 (b) "Single-voltage external AC to DC power supply" does not
38 include: (i) Products with batteries or battery packs that physically
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1 attach directly to the power supply unit; (ii) products with a battery
2 chemistry or type selector switch and indicator light; or (iii)
3 products with a battery chemistry or type selector switch and a state
4 of charge meter.

5 (18) "State-regulated incandescent reflector lamp" means a lamp
6 that is not colored or designed for rough or vibration service
7 applications, that has an inner reflective coating on the outer bulb
8 to direct the light, an E26 medium screw base, and a rated voltage or
9 voltage range that lies at least partially within 115 to 130 volts,
10 and that falls into one of the following categories:

11 (a) A bulged reflector or elliptical reflector bulb shape and which
12 has a diameter which equals or exceeds 2.25 inches;

13 (b) A reflector, parabolic aluminized reflector, or similar bulb
14 shape and which has a diameter of 2.25 to 2.75 inches.

15 (19) "Torchiere" means a portable electric lighting fixture with a
16 reflective bowl that directs light upward onto a ceiling so as to
17 produce indirect illumination on the surfaces below. "Torchiere" may
18 include downward directed lamps in addition to the upward, indirect
19 illumination.

20 (20) "Traffic signal module" means a standard (a) 8-inch or 200 mm
21 or (b) 12-inch or 300 mm traffic signal indication, consisting of a
22 light source, a lens, and all other parts necessary for operation.

23 (21) "Transformer" means a device consisting of two or more coils
24 of insulated wire and that is designed to transfer alternating
25 current by electromagnetic induction from one coil to another to change the
26 original voltage or current value.

27 (22)(a) "Unit heater" means a self-contained, vented fan-type
28 commercial space heater that uses natural gas or propane, and that
29 is designed to be installed without ducts within a heated space.

30 (b) "Unit heater" does not include any products covered by federal
31 standards established pursuant to 42 U.S.C. Sec. 6291 et seq. or any
32 product that is a direct vent, forced flue heater with a sealed
33 combustion burner.

34 **NEW SECTION. Sec. 3.** (1) This chapter applies to the following
35 types of new products sold, offered for sale, or installed in the
36 state: (a) Automatic commercial ice cube machines; (b) commercial
37 clothes washers; (c) commercial prerinse spray valves; (d) commercial
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1 refrigerators and freezers; (e) illuminated exit signs; (f) low-
2 voltage dry-type distribution transformers; (g) metal halide lamp fixtures; (h) single-voltage

3 external AC to DC power supplies; (i) state-regulated incandescent reflector lamps;
4 (j) torchieres; (k) traffic signal modules;
5 and (l) unit heaters. This chapter applies equally to
6 products whether they are sold, offered for sale, or installed as a
7 stand-alone product or as a component of another product.
8 (2) This chapter does not apply to (a) new products manufactured in
9 the state and sold outside the state, (b) new products manufactured
10 outside the state and sold at wholesale inside the state for final
11 retail sale and installation outside the state, (c) products installed
12 in mobile manufactured homes at the time of construction or (d)
13 products designed expressly for installation and use in recreational
14 vehicles.
15 NEW SECTION. **Sec. 4.** The legislature establishes the following
16 minimum efficiency standards for the types of new products set forth
17 in section 3 of this act.
18 (1)(a) Automatic commercial ice cube machines must have daily
19 energy use and daily water use no greater than the applicable values
20 in the following table:
21 Table not shown here
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4 (b) For purposes of this section, automatic commercial ice cube
5 machines shall be tested in accordance with ARI 810-2003 test method
6 as published by the air-conditioning and refrigeration institute.
7 Ice-making heads include all automatic commercial ice cube machines
8 that are not split system ice makers or self-contained models as
9 defined in ARI 810-2003.
10 (2) Commercial clothes washers must have a minimum modified energy
11 factor of 1.26. For the purposes of this section, capacity and
12 modified energy factor are defined and measured in accordance with
13 the current federal test method for clothes washers as found at 10
14 C.F.R. Sec. 430.23.
15 (3) Commercial prerinse spray valves must have a flow rate equal to
16 or less than 1.6 gallons per minute when measured in accordance with
17 the American society for testing and materials' "Standard Test Method
18 for Pre-rinse Spray Valves," ASTM F2324-03.
19 (4)(a) Commercial refrigerators and freezers must meet the
20 applicable requirements listed in the following table:
Table Omitted
34 (b) For purposes of this section, "pulldown" designates products
35 designed to take a fully stocked refrigerator with beverages at 90
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1 degrees F and cool those beverages to a stable temperature of 38
2 degrees F within 12 hours or less. Daily energy consumption shall be
3 measured in accordance with the American national standards
4 institute/American society of heating, refrigerating and air-
5 conditioning engineers test method 117-2002, except that the back-
6 loading doors of pass-through and roll-through refrigerators and
7 freezers must remain closed throughout the test, and except that the
8 controls of all appliances must be adjusted to obtain the following
9 product temperatures.
10 Product or compartment type Integrated average product temperature in degrees Fahrenheit
11 Refrigerator 38 + 2
12 Freezer 0 + 2
13 (5) Illuminated exit signs must have an input power demand of five
14 watts or less per illuminated face. For the purposes of this
15 section, input power demand is measured in accordance with the
16 United States Environmental Protection Agency's Energy Star exit
17 sign program's conditions for testing, version 3.0. Illuminated exit
18 signs must meet all applicable building and safety codes.
19 (6)(a) Low-voltage dry-type distribution transformers shall have
20 efficiencies not less than the applicable values in the following

21 table when tested at thirty-five percent of the rated output power:
Table Omitted
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3 (b) For the purposes of this section, low-voltage dry-type
4 distribution transformer efficiency is measured in accordance with
5 the national electrical manufacturers association TP 2-1998 test
6 method. (7) Metal halide lamp fixtures designed to be operated with
7 lamps rated greater than or equal to 150 watts but less than or equal
8 to 500watts shall not contain a probe-start metal halide lamp
9 ballast. (8)(a) Single-voltage external AC to DC power supplies shall
10 meet the requirements in the following table:
Table omitted

19 (b) For the purposes of this section, efficiency of single-voltage
20 external AC to DC power supplies shall be measured in accordance
21 with the United States environmental protection agency's "Test
22 Method for Calculating the Energy Efficiency of Single-Voltage
23 External AC to DC and AC to AC Power Supplies", by Ecos Consulting
24 and Power Electronics Application Center, dated August 11, 2004.
25 (9)(a) State-regulated incandescent reflector lamps that are not 50
26 watt elliptical reflector lamps must meet the minimum efficacies in
27 the following table: (Omitted)
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2 (b) Lamp efficacy must be measured in accordance with the
3 applicable federal test method as found at 10 C.F.R. Sec. 430.23.
4 (10) Torchieres may not use more than 190 watts. A torchiere is
5 deemed to use more than 190 watts if any commercially available lamp
6 or combination of lamps can be inserted in a socket and cause the
7 torchiere to draw more than 190 watts when operated at full brightness.
8 (11)(a) Traffic signal modules must have maximum and nominal
9 wattage that do not exceed the applicable values in the following
10 table: Omitted

20 (b) For the purposes of this section, maximum wattage and nominal
21 wattage must be measured in accordance with and under the testing
22 conditions specified by the institute for transportation engineers
23 "Interim LED Purchase Specification, Vehicle Traffic Control Signal
24 Heads, Part 2: Light Emitting Diode Vehicle Traffic Signal Modules."
25 (12) Unit heaters must be equipped with intermittent ignition
26 devices and must have either power venting or an automatic flue damper.
27 **NEW SECTION. Sec. 5.** (1) On or after January 1, 2007, no new
28 commercial prerinse spray valve, commercial clothes washer, commercial
29 refrigerator or freezer, illuminated exit sign, low-voltage dry-type
30 distribution transformer, single-voltage external AC to DC power
31 supply, state-regulated incandescent reflector lamp, torchiere, traffic
32 signal module, or unit heater may be sold or offered for sale in the
33 state unless the efficiency of the new product meets or exceeds the
34 efficiency standards set forth in section 4 of this act. On or after
35 January 1, 2008, no new automatic commercial ice cube machine or metal
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1 halide lamp fixtures may be sold or offered for sale in the state
2 unless the efficiency of the new product meets or exceeds the
3 efficiency standards set forth in section 4 of this act.
4 (2) On or after January 1, 2008, no new commercial prerinse spray
5 valve, commercial clothes washer, commercial refrigerator or freezer,
6 illuminated exit sign, low-voltage dry-type distribution transformer,
7 single-voltage external AC to DC power supply, state-regulated
8 incandescent reflector lamp, torchiere, traffic signal module, or
9 unit heater may be installed for compensation in the state unless the
10 efficiency of the new product meets or exceeds the efficiency
11 standards set forth in section 4 of this act. On or after January 1,

12 2009, no new automatic commercial ice cube machine or metal halide
13 lamp fixtures may be installed for compensation in the state unless
14 the efficiency of the new product meets or exceeds the efficiency
15 standards set forth in section 4 of this act.
16 (3) Standards for metal halide lamp fixtures and state-regulated
17 incandescent reflector lamps are effective on the dates in
18 subsections (1) and (2) of this section.
19 NEW SECTION. **Sec. 6.** The department may recommend updates to the
20 energy efficiency standards and test methods for products listed in
21 section 3 of this act. The department may also recommend
22 establishing state standards for additional non-federally covered products.
In
23 making its recommendations, the department shall use the following
24 criteria: (1) Multiple manufacturers produce products that meet the
25 proposed standard at the time of recommendation, (2) products
26 meeting the proposed standard are available at the time of
27 recommendation, (3) the products are cost-effective to consumers on a
28 life-cycle cost basis using average Washington resource rates, (4) the
utility of the energy
29 efficient product meets or exceeds the utility of the comparable
30 product available for purchase, and (5) the standard exists in at
31 least two other states in the United States. For recommendations
32 concerning commercial clothes washers, the department must also consider the
33 fiscal effects on the low-income, elderly, and student populations.
34 Any recommendations shall be transmitted to the appropriate committees
35 of the legislature sixty days before the start of any regular
36 legislative session.
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1 NEW SECTION. **Sec. 7.** (1) The manufacturers of products covered by
2 this chapter must test samples of their products in accordance with
3 the test procedures under this chapter or those specified in the
4 state building code.
5 (2) Manufacturers of new products covered by section 3 of this act,
6 except for single-voltage external AC to DC power supplies, shall
7 certify to the department that the products are in compliance with
8 this chapter. This certification must be based on test results unless
9 this chapter does not specify a test method. The department shall
10 establish rules governing the certification of these products and
11 may coordinate with the certification programs of other states and
12 federal agencies with similar standards.
13 (3) Manufacturers of new products covered by section 3 of this act
14 shall identify each product offered for sale or installation in the
15 state as in compliance with this chapter by means of a mark, label,
16 or tag on the product and packaging at the time of sale or installation.
17 The department shall establish rules governing the identification of
18 these products and packaging, which shall be coordinated to the
19 greatest practical extent with the labeling programs of other states
20 and federal agencies with equivalent efficiency standards.
21 (4) The department may test products covered by section 3 of this
22 act. If products so tested are found not to be in compliance with
23 the minimum efficiency standards established under section 4 of this
24 act, the department shall: (a) Charge the manufacturer of the product for
25 the cost of product purchase and testing; and (b) make information
26 available to the public on products found not to be in compliance
27 with the standards.
28 (5) The department shall obtain in paper form the test methods
29 specified in section 4 of this act, which shall be available for
30 public use at the department's energy policy offices.
31 (6) The department shall investigate complaints received concerning
32 violations of this chapter. Any manufacturer or distributor who
33 violates this chapter shall be issued a warning by the director of
34 the department for any first violation. Repeat violations are subject to

35 a civil penalty of not more than two hundred fifty dollars a day.
36 Penalties assessed under this subsection are in addition to costs
37 assessed under subsection (4) of this section.
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1 (7) The department may adopt rules as necessary to ensure the
2 proper implementation and enforcement of this chapter.

3 (8) The proceedings relating to this chapter are governed by the
4 administrative procedure act, chapter 34.05 RCW.

5 NEW SECTION. **Sec. 8.** If any provision of this act or its
6 application to any person or circumstance is held invalid, the
7 remainder of the act or the application of the provision to other
8 persons or circumstances is not affected.

9 NEW SECTION. **Sec. 9.** Sections 1 through 8 of this act constitute
10 a new chapter in Title 19 RCW.

Passed by the House April 21, 2005.

Passed by the Senate April 6, 2005.

Approved by the Governor May 6, 2005.

Filed in Office of Secretary of State May 6, 2005.

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APPENDIX C - JANUARY 2005 REVISIONS TO THE SEP

The text here is from the revised SEP and included for convenience of the reader.

Energy, Economic, and Environmental Issues

Exec-1 *The North Carolina Department of Commerce and the State Energy Office should encourage and support economic development of energy-related enterprises whose products are intended to increase energy efficiency or use renewable resources, such as providers of specialized insulation and window products, heating and air conditioning equipment and controls, distributed generation equipment, solar and wind energy equipment, biofuels, and fuel cells.*

Exec-2 *The State Energy Office should communicate the energy research, development, demonstration, and deployment projects being performed in the state to the North Carolina Department of Commerce for its recruiting and economic development strategy.*

Exec-3 *North Carolina should prepare its economy for the emerging national and international greenhouse gas marketplace so North Carolina companies are prepared to win in a greenhouse gas trading system. Establishing baseline greenhouse gas emissions and setting state objectives are two ways that the state can begin to prepare for this new market.*

Alternative Fuels from Biomass

Exec-4 *North Carolina should support the development of an alternative fuel industry through dedicated funding and grant matching of promising alternative fuel projects. These efforts should include agricultural waste processing facilities, biodiesel and ethanol refineries, and fueling stations for alternative-fueled vehicles, production incentives for farmers and refiners, incentives for highly efficient or alternative-fueled vehicles, distribution credits for biofuels distributors, buy down program for incremental costs of purchasing biofuels, and education and awareness programs. Developmental efforts should focus on raising feedstock production levels and insuring 35 publicly accessible refueling stations in the state have alternative fueling infrastructure by 2007. In particular, the Energy Policy Council supports a state mechanism to pay for alternative fuels development via special fees, tax credits, and other sources.*

Exec-5 *Based on the results of ongoing research and development studies, the North Carolina General Assembly should pursue strategies that convert animal waste into environmentally sound energy sources.*

Alternative Energy Sources

Exec-6 *The General Assembly should consider adopting net metering for application to all electric utilities in the state.*

Exec-7 *The General Assembly should evaluate a renewable portfolio standard (RPS) that complements the NC GreenPower program and fosters the development of a renewable electricity market. The RPS would require that all electric utilities increase the percentage of total distributed electricity that comes from renewable sources, such as hydroelectric, wind, solar, waste-derived fuels, and agricultural fuels.*

Exec-8 *The General Assembly should reexamine existing legislation and regulations as pertains to barriers and strategies to develop wind energy while still protecting North Carolina's natural beauty.*

Exec-9 *The State Energy Office should assess and propose incentives and regulatory or administrative measures for development of renewable electricity generation facilities, solar water heating, passive and active solar space heating, and daylighting.*

Exec-10 *The General Assembly should require that all electric utilities in North Carolina provide generation disclosure of fuel mix percentages and emissions statistics on sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury annually by bill insert and via website. The disclosure information should clarify to the consumer the environmental impact of residential electricity use.*

Energy Use in the Public Sector

Exec-11 *State agencies and universities, with coordination by the North Carolina Department of Administration, should reduce energy consumption in existing state buildings to save 20% by 2008, 4% per year or more for the next 5 years. The State Energy Office should submit an annual report to the Energy Policy Council, the Governor's Office, the State University System and other major energy users in North Carolina that provides data on energy saved in state buildings and universities by source and cost, energy efficiency activities undertaken in these buildings, the approximate investment in energy efficiency measures, and the overall economic costs and benefits of the program.*

Exec-12 *Working in conjunction with the State Construction Office and the State Property Office, the State Energy Office should analyze available data, and report on the energy savings attributable to the new requirements on life-cycle cost analyses of the \$3.1 billion higher education building program currently underway across the state, as well as future projects. The State Construction Office should recommend that new and existing buildings are individually metered for electricity, natural gas, steam, chilled water, and water, to facilitate studies of building energy use and allow comparison with existing buildings not subject to life-cycle cost analysis. Benchmarks for energy intensity, Million BTUs per Gross Square Feet, for various asset types should be used, as well as Energy Star ratings for offices, dormitories, and hospitals. The State Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer lifecycle cost procedure to the extent possible with available building utility data.*

Exec-13 *North Carolina should facilitate efforts of local governments to finance energy efficiency and renewable energy projects; specifically, allow bundling of multi-jurisdictional energy efficiency projects to achieve economies of scale and improve opportunities for financing, restructure the underwriting provisions of the State Energy Office's low-interest energy loan program, and provide training in energy efficiency measures to building managers in local government buildings.*

Energy Use in the Residential Sector

Exec-14 *North Carolina State Government should continue to support a strong low-income weatherization program. The state should review the effectiveness of energy conservation programs conducted through the weatherization program and analyze opportunities for improvements. The State Energy Office should develop programs, in addition to weatherization, to address energy-efficient housing in the low-income sector.*

The State Energy Office should investigate technologies, incentives, financing options, and regulatory issues regarding minimum efficiency requirements for manufactured housing and promote Energy Star manufactured homes.

Funding for Energy Programs

Exec-15 *The General Assembly should review options, such as a Public Benefits Fund (PBF) or other means, to enable funding of the recommendations in the State Energy Plan.*

(SEP) Recommendations Moved Up to Action Items (September 16, 2004)

Exec-16 *(formerly 10-1 plus commercial reference) The State Energy Office should increase funding appropriate agencies in the state to expand technical assistance and analysis efforts to reduce energy use by the industrial sector and, when funds are available, to the commercial sector in North Carolina. Funding should also be provided for follow-up efforts to facilitate implementation of cost effective technologies, including making contacts with vendors to procure bids, assisting with performance contractors, developing sample specifications, and providing other technical assistance. The State Energy Office should investigate and analyze alternative incentives to increase the implementation of efficiency and renewable energy measures, including low interest loans, performance contracts, and incentive payments. The outreach and technical assistance program should support ongoing efforts to reduce water usage in industrial and municipal operations and, if funds are available, to commercial operations.*

Exec-17 *(formerly 11-2 and 11-3) State agencies should convert at least 10% of their entire fleet to high efficiency (over 40 miles per gallon) or alternative-fueled vehicles by 2005 and 20% by 2010. The North Carolina Department of Transportation should provide supporting fueling infrastructure.*

Exec-18 *(formerly 12-9) The State Energy Office should support development of a comprehensive information outreach program for consumer questions about saving energy and using renewables in their homes and businesses; information hotline via a toll-free telephone number; informative Web Page containing a wide array of publications available on-line; resources that include up-to-date information on renewables and energy efficient buildings, industrial facilities, and vehicles, as well as data on energy sources in the state; information on energy-producing facilities; environmental information related to energy consumption; and other energy-related information.*

Exec-19 *(formerly 12-13) North Carolina should require that K-12 students learn about energy. Energy issues should be incorporated into the end-of-grade tests. The SEO should provide educational materials, training, and activities for current classroom teachers and K-12 students.*

Exec-20 *(formerly 8-4) The State Energy Office should organize a statewide effort to develop criteria for a residential high performance building program to reduce the life cycle cost of new and existing buildings. The criteria should utilize provisions from other successful high performance programs, including Energy Star, programs developed by Advanced Energy Corporation, NC Healthy Built Home, Southface Energy Institute's Earthcraft Home, U.S. Department of Energy's Building America, and others.*

The recommendations in the SEP are definitely compatible with and complimentary to recommendations that can be made regarding climate change/global warming aspects and the EPC and SEO are to be congratulated on the depth and coverage of their recommendations. The plan challenges each program to continue to evolve and develop even further details and ways to be more efficient and to reduce GHG emissions at the same time.

APPENDIX D - PRELIMINARY ANALYSIS OF SELECTED POLICY OPTIONS

Overview

This appendix contains preliminary analysis of selected climate mitigation policy options developed by a DAQ support consultant. The constrained time and resources available for this report limited the depth, breadth, and detail of the analysis performed and any in-depth review by DAQ staff. The results below should be taken as suggestive of the magnitudes of impacts one might expect from various policy options. These results can be refined and updated in the future in the course of the stakeholder process the DENR aims to conduct. In many cases, better data, and data more specific to NC will be developed.

Selected options were analyzed in three sectors: agriculture and forestry; energy supply and demand; and transportation and land use. Effort was made to provide the following information for each option:

- Policy description
- Description of existing “Business As Usual” (BAU) Policies/Programs
- Types(s) of GHG benefit(s)
- Ancillary benefits and/or costs
- Estimated GHG savings and costs per ton CO₂e
- Data sources, methods and assumptions
- Key uncertainties
- Estimation of ancillary (non-GHG) benefits and costs:
- Feasibility issues

However, in many cases, the authors had to simply put “TBD (to be determined)” where some information fell beyond the scope of the analysis at this time.

Agriculture and Forestry

Farm Waste to Energy Conversion

Policy Description: This policy incorporates a wide range of farm waste conversion options. Options could include developing incentives or mandating the use of animal waste or crop waste for energy production purposes. Energy production may include production of electricity, fuel for process heat, or fuel for space heat. The policy reduces CO₂e in two ways: direct reductions in methane (CH₄) emissions from farm waste; and offsetting the use of fossil fuels from the energy produced. Production of liquid biofuels is handled in a separate policy option: Biofuels Development.

For this example, the focus is on reducing CH₄ from hog farms. The policy would require hog farms with >250 head to adopt manure management strategies that allow for capture of emissions from waste management systems. The policy would also promote the use of the captured methane for energy production (in this example, electricity). Costs and benefits are based on anaerobic digestion of hog waste followed by energy recovery of biogas using internal combustion engines.

BAU Policies/Programs: TBD.

- **Types(s) of GHG Benefit(s):** CH₄ reduction from each facility >250 head. For facilities that utilize energy capture, reduced CO₂e emissions from displaced energy needed for electricity generation, space heating, or other energy use. Approximately 9.9 million head of hogs in NC produce about 4.05 MMtCO₂e.

Ancillary Benefits and or Costs: Reduction of ammonia and VOC emissions. Reduction of odors. Increase in NO_x emissions from combustion sources.

- **Estimated GHG Savings and Cost per Ton CO₂e:** Reductions for this example action are initially estimated here at 3.3 MMtCO₂e for the CH₄ reductions. Another 0.45 MMtCO₂e are reduced by offsetting 801 GW-hr of fossil fuel-based electricity. Costs were not estimated at the state level, but have been estimated based on an example project (see next section). A net cost savings is expected.

Data Sources, Methods and Assumptions:

- **Data Sources:** These estimates are based on a presentation by Leonard Bull of North Carolina State University,³⁸ and a case study data from the Midwest Combined Heat and Power Application Center³⁹.
- **Quantification Methods:** Used estimates on manure production, heat content, and electrical conversion efficiency to estimate the amount of electricity produced and CH₄ reduced via anaerobic digestion and electricity production from biogas. Cost information for an example project (see below) came case study cited above.
- **Key assumptions:** 90% of hogs are on farms with >250 head. Anaerobic digestion and electricity production is technically feasible at all facilities >250 head. No farms >250 head are currently controlling emissions. 90% of manure heat content converted to biogas. 90% of biogas generated is captured.
 - **Cost estimate for an example project:** Costs are based on a similar project constructed in Colorado⁴⁰. At a 5,600 head sow farrow to wean operation, an anaerobic digester and combined heat and power plant was constructed. Methane from the digester was routed to a reciprocating engine and generator (80kW). Thermal energy from the engine was recovered and used to heat the anaerobic digester. Total capital costs were

³⁸ Leonard Bull, *Animal and Poultry Waste-to-Energy*, PowerPoint presentation, North Carolina State University, 2005.

³⁹ Midwest CHP Application Center, *Colorado Pork LLC, 80 kW CHP Application*, 2005.

⁴⁰ *Op. cit.*

\$375k. The equipment produced an annual savings of \$48.7k (\$38.7k in reduced electricity costs; and \$10k reduction in lagoon clean-out costs). A 30 kW micro turbine has also recently been added to the operation; however the additional costs/benefits of this system are not included here.

Based on the cost data above, a 7% interest rate, and a 15 year equipment life, an annualized cost of -\$6,827 was calculated. Emission reductions for this project are estimated to be 2,300 MTCO₂e. Therefore, the cost effectiveness is -\$2.91/MTCO₂e, i.e., a net savings to the farmer.

Key Uncertainties:

- **Benefits:** 3.3 MMtCO₂e reduced assumes that no farms currently control emissions; technology is technically and economically feasible at all farms >250 head.
- **Costs:** Assume that costs associated with the Colorado project are representative of what could be achieved at any farm >2,500 head in NC.

Estimation of Ancillary Benefits and Costs:

- **Benefits:** co-reduction of ammonia, VOC and odors; production of electricity, steam or space heat.
- **Costs:** Costs for ancillary benefits not quantified; however they would also be negative, since the project results in a cost savings.

Description of Feasibility Issues: TBD.

Biofuels Development

Policy Description: Institute programs to expand the production of biofuels in NC. Liquid fuels made from biomass are referred to as biofuels. The two most common biofuels used in the United States today are ethanol and biodiesel. While they can each be used as alternative fuels, both are more frequently used as additives to conventional fuels (gasoline and diesel). Commercial biodiesel fuel is typically a mixture of conventional diesel fuel and 20% biodiesel by volume (referred to as B20); however 100% biodiesel can also be used in both onroad and nonroad diesel equipment.

Ethanol is often blended with gasoline (at up to 10% by volume) to increase the oxygen content of the fuel and reduce emissions of carbon monoxide. Ethanol is most often produced from corn or other starches. Technologies are currently being developed to economically produce ethanol from other biomass, including crop residues and wood waste. There is still a lot of debate in the scientific community about the net CO₂ benefits of ethanol fuels (due to the amount of energy needed to produce ethanol).

GHG emissions are reduced by offsetting the use of petroleum-derived gasoline and diesel. The costs and benefits for this policy description are based on the production of a specific volume of biodiesel from vegetable oils, waste vegetable oil, and other feed stocks. Note that Smithfield Farms has also developed a large-scale plant in Utah to convert hog waste into methanol, which is then used in biodiesel production. Also, two biodiesel plants have been proposed in NC: Blue Ridge Biofuels in Asheville and Grain Growers Cooperative in Mount Olive. Proposed plants are those biodiesel companies who are in the process of raising equity, permitting or construction for their facility but are not yet actively producing biodiesel.⁴¹

BAU Policies/Programs: TBD.

Types(s) of GHG Benefit(s): Reduction in CO₂ emissions by offsetting fossil fuel-derived diesel use.

Ancillary Benefits and or Costs: Lower criteria pollutant emissions (NO_x, potentially PM). For users of biodiesel, some evidence of better engine performance due to better lubricity of biodiesel fuels.

Estimated GHG Savings and Cost per Ton CO₂e: A single 15 million-gallon/yr facility would produce enough biodiesel to offset 0.15 MMTCO₂e. The costs to produce biodiesel in a facility of this size are estimated to be between \$1.48 - \$1.85/gallon suggesting that biodiesel is cost-competitive with ordinary diesel, especially given current trends in world oil prices (these estimates are comparable to current diesel fuel prices, when taxes and transportation costs are taken into account). Costs per ton CO₂e are to be determined, and must take into account a lifecycle analysis.

Data Sources, Methods and Assumptions:

- **Data Sources:** University of Georgia (UGA) study.⁴²
- **Quantification Methods:** Standard CO₂ emission factor for diesel fuels; cost information from UGA study.
 - UGA study estimated that a biodiesel plant with a capacity of 15 million gallons/year and feedstock costs of \$0.15-\$0.20/lb could produce biodiesel at a cost of \$1.48 - \$1.85/gallon (capital costs estimated at \$9.6 million). Diesel fuel has a CO₂ emission factor of 10.05 kg/gallon.
 - Costs to produce biodiesel in smaller plants (e.g., 0.5 – 3 million gallons/yr) were estimated to be about 10 to 40% higher than the 15 million gallon facility. A 30 million gallon/yr facility was not much more cost efficient than the 15 million gallon/yr facility.

⁴¹ National Biodiesel Board, *Current and Proposed Biodiesel Plants*, www.biodiesel.org/buyingbiodiesel/producers_mapeters/ProducersMap-existingandpotential.pdf.

⁴² G.A. Shumaker, J. McKissick, C. Ferland, and B. Doherty, *A Study on the Feasibility of Biodiesel Production in Georgia*, University of Georgia, date unknown.

- A 15 million gallon/yr facility would produce enough biodiesel to offset 0.15 MMTCO₂e.
- **Key assumptions:** Cost information provided from UGA is applicable to NC and still valid.

Key Uncertainties:

- **Benefits:** TBD.
- **Costs:** Degree to which UGA cost information is appropriate for NC. Costs are based on the annualized costs of building and running the biodiesel plant, not the costs to the state or local area in incentives designed to promote building the plant.

Estimation of Ancillary Benefits and Costs:

- **Benefits:** TBD.
- **Costs:** TBD.

Description of Feasibility Issues: Biodiesel needs to be cost competitive with conventional diesel fuel in order to be marketable (without subsidies). The UG study indicated that this is feasible. Diesel fuel costs are currently about \$2.33 in the Southeast.⁴³ After subtracting 27% of this cost for taxes and distribution/marketing (average for the U.S.), the conventional diesel price is \$1.71/gallon. For comparison to the UGA study, another estimate indicated that the estimated cost of conventional biodiesel production at that time was about \$2.50/gallon (no details on plant size or feedstock costs), and that a new process (lab scale demonstration) was capable of producing biodiesel at less than \$0.70/gallon.⁴⁴

It is worthy to note that NC is currently one of the larger users among U.S. states of biodiesel, although none is currently produced in the state.⁴⁵ Current annual statewide usage estimates are 5 million gallons of B20 (1 million gallons of biodiesel). The usage has jumped more than 10-fold since 2001.

Fertilizer Management for N₂O Reduction

Policy Description: Improve efficiency of synthetic fertilizer and manure application. A portion of the nitrogen applied to the soil is subsequently emitted as N₂O (a GHG) through denitrification. Therefore, a reduction in the quantity of fertilizer applied, measures that improve nitrogen uptake, or measures that increase nitrogen in the soil can reduce N₂O emissions. The exact measure needed varies by climate, crop, soil type, and other factors. Examples include substituting one type of fertilizer for another (e.g., ammonium-based fertilizers for nitrate fertilizers), altering the timing or number of

⁴³ Energy Information Administration, *Gasoline and Diesel Fuel Update*, 2005.

⁴⁴ "Production of a cost-competitive biodiesel fuel alternative to petroleum diesel", *Environmental Science & Engineering*, May 2001.

⁴⁵ Tobin Freid, Triangle J Council of Governments, personal communication with S. Roe, E.H. Pechan & Associates, Inc., August 2005.

applications, altering cover crops and rotational schemes, providing adequate drainage, and by increasing soil testing to improve efficiency (and reduce unnecessary applications).

The policy could be carried out by requiring farmers producing crops covering a certain acreage threshold or applying fertilizers in excess of a certain amount to prepare and submit a Fertilizer (or Nutrient) Management Plan (NMP). Implementation would occur through local Agricultural Extension Offices. Estimates of the costs and benefits of this measure are based on fertilizer (nitrogen) application reductions.

BAU Policies/Programs: Current policies focus on limiting nitrogen loadings to surface waters. Policies currently in place include the Neuse Agricultural Rule which mandates that all persons engaging in agricultural operations in the Neuse River Basin shall collectively achieve and maintain a 30% net nitrogen loading reduction by 2003. This reduction is to be achieved by a combination of standard best management practices that include riparian buffers, nutrient management plans, and water control structures.⁴⁶

Types(s) of GHG Benefit(s): Reduction in N₂O emissions through lower nitrogen application rates or other management practice.

Ancillary Benefits and or Costs: Lower ammonia emissions; less N run-off to surface waters; lower fertilizer costs to farmers.

Estimated GHG Savings and Cost per Ton CO₂e: The Neuse River Crop Management Project (NRCMP) at North Carolina State University estimated that NMPs could reduce N application rates by 10-20%.⁴⁷ N₂O reductions are assumed to be directly proportional to lower nitrogen application (via better uptake by crops). From EPA's SGIT, N₂O emissions from agricultural soils associated with fertilizer application were about 0.55 MMTCO₂e in 2000 (note that emissions average nearly twice this amount from 1990 to 1999; much lower fertilizer application is shown in the SGIT default data in 2000).

10 to 20% reductions in fertilizer application rates statewide could reduce N₂O emissions by 0.05 to 0.11 MMTCO₂e/yr, if the policy is applied to all farmers. The estimate does not take into account any growers that currently use NMPs and that have already achieved reductions as a result.

NRCMP also estimates that the costs of implementing Nutrient Management Plans are negligible and are offset by lower fertilizer usage.⁴⁸ The NC Cooperative Extension or the federal Natural Resources Conservation Service will verify the plan at no charge. The NC Department of Agriculture will provide a free soil test. For the purposes of this analysis, the time required by the farmer to prepare the plan is assumed to be offset by lower fertilizer costs. Therefore, the costs are assumed to be \$0. This assessment does

⁴⁶ Neuse River Crop Management Project, North Carolina State University, information obtained from website accessed August, 2005.

⁴⁷ *Op. cit.*

⁴⁸ Neuse River Crop Management Project, North Carolina State University, *Cost and Benefits of Best Management Practices to Control Nitrogen in the Piedmont*, accessed August 2005

not quantify the additional emissions and costs associated with multiple fertilizer applications (from a baseline of a single application), if those are called for in the Nutrient Management Plan.

Data Sources, Methods and Assumptions:

- **Data Sources:** Information from NRCMP was used to provide this initial estimate of reductions and costs;
- **Quantification Methods:** Emissions were taken from the EPA State Greenhouse Gas Inventory Tool.⁴⁹ Reductions are assumed to be equal to the reduction in fertilizer application (10-20%) achieved by implementing a Nutrient Management Plan;
- **Key assumptions:** Policy is implemented by all growers. Costs are negligible and completely offset by reduced fertilizer application.

Key Uncertainties:

- **Benefits:** N₂O emission reductions are equivalent to reductions in nitrogen application rates. Amount of cropland where NMPs are already used to manage fertilizer application.
- **Costs:** Costs for implementing NMPs are negligible.

Estimation of Ancillary Benefits and Costs:

- **Benefits:** 10-20% reductions in ammonia emissions would also occur, if fertilizer application rates are reduced. Reductions in N runoff to surface waters can not be estimated based on available information.
- **Costs:** To be determined.

Description of Feasibility Issues: TBD.

Soil Carbon Sequestration in Agricultural Soils

Policy Description: Cultivation practices that result in less disruption of the soil or that increase soil organic carbon content (stock) through carbon deposition can reduce its rate of loss (flux) to the atmosphere. These cultivation practices are often referred to as conservation tillage. By definition, conservation tillage leaves at least 30 percent of the soil covered by crop residues.⁵⁰

A specific implementation program for conservation tillage is not identified here. Instead, a recommended program goal of 500,000 acres of cropland brought into new management practices, which results in a total per acre soil carbon storage rate

⁴⁹ See www.epa.gov/ttn/chief/conference/ei12/green/choate.pdf.

⁵⁰ Mary Peet, *Conservation Tillage*, North Carolina State University, October 4, 2001, information obtained from website, accessed August 2005.

improvement of 2 percent over a 10 year time period. Implementation would occur through local Agricultural Extension Offices.

BAU Policies/Programs: Conservation tillage has been already been adopted for at least some crops in North Carolina (corn, wheat, soybeans, vegetables); however the level of penetration is still under investigation.

Types(s) of GHG Benefit(s): Reduction in CO₂ emissions through lower carbon flux from agricultural soils.

Ancillary Benefits and or Costs: Potential for lower GHG emissions through lower intensity tillage practices, which lower fuel consumption. Data needed to quantify these reductions have not been identified. Less soil erosion and run-off to surface waters (including associated nitrogen). In the first few years, 5 to 10% lower yields might be experienced by some growers.⁵¹ More information on benefits/dis-benefits can be found on the North Carolina State University Sustainable Practices website.⁵²

In conservation tillage, the new crop is planted into the stubble from the previous crop or into small strips of tilled soil. In some practices weeds are controlled with cover crops or herbicides rather than by cultivation. Hence, a higher dependence on herbicides could result in certain cases.⁵³

Estimated GHG Savings and Costs per Ton CO₂e: In 2004, roughly 3 million acres were planted in corn, soybeans, wheat, and vegetables.⁵⁴ Assuming that 37% of these acres are already cultivated using conservation tillage practices (equal to the average for the U.S. as a whole⁵⁵), that leaves about 1.9 million acres. It is further assumed that at least 25% of these acres can adopt conservation tillage practices (leaving around 500,000 acres). The table below provides a summary of assumptions and results for the estimated carbon sequestration associated with conservation tillage practices.

Acres of cropland converted - potential	500,000
Acres of cropland converted per year	50,000
Potential percent increase in soil organic matter	2.00%
Potential percent increase in organic carbon	1.20%
Pounds soil per acre (top 12 inches) ^a	2,000,000
Initial soil organic matter content ^b	0.50%
Pounds soil organic matter per acre	10,000
Percent SOM that is Organic Carbon ^c	60.00%
Potential annual rate of SOM increase	0.20%
Pounds OC sequestered per acre per year	2400
Total lbs OC sequestered Year 1	120,000,000
MMTCO ₂ e sequestered per year (year 1)	0.20

⁵¹ Holly Wagner, "No-Till Farming Offers a Quick Fix to Help Ward Off Host of Global Problems", Ohio State University Research News, April 15, 2004.

⁵² Mary Peet, *op. cit.*

⁵³ *Op. cit.*

⁵⁴ North Carolina Department of Agriculture & Consumer Services (NCDOA), *Annual Summary: Crop Estimates, North Carolina, 2002-2004.*

⁵⁵ Holly Wagner, *op. cit.*

Total MMTCO _{2e} sequestered after 10 years	20.0
No Till cost per acre - avg (ERS) ^d	\$ 28.00
No Till cost per acre - high (ERS) ^d	\$ 98.00
Annual Cost per Ton CO _{2e} - avg. Year 1	\$ 7
Annual Cost per Ton CO _{2e} - high Year 1	\$ 25

^a Source: MEDEP, 2004.

^b Assumed.

^c Assumed based on a ratio of 1:1.7 organic carbon to organic matter used in the literature.

^d Source: USDA Economic Research Service, Environmental Quality Incentives Program, Farm Service Agency database. Average cost per acre is for “residue management – no till and strip till” for all states in the database. High cost is the value for North Carolina, which is much higher than for other reported states. Further research could illuminate the reason for the high cost.

Data Sources, Methods and Assumptions:

- Data Sources:** The analysis conducted for the Maine Department of Environmental Protection⁵⁶ provided information on the amount of potential increase in soil organic matter content, soil density, and cost data (cost data taken from the U.S. Department of Agriculture Economic Research Service; USDA ERS). Data on total crop land in NC came from the NC Department of Agriculture.⁵⁷ Assumptions on the amount of cropland where conservation tillage was not currently practiced was based on a national estimate. The fraction of the remaining cropland (where conventional tilling is assumed) that can be cultivated using conservation tilling practices (25%) is assumed.
- Quantification Methods:** Develop an estimate on the acreage of cropland, where conservation tillage practices can be implemented. Estimate the initial amount of organic material present in the top foot of soil. Estimate the amount of organic material present after conservation tillage has been practiced for 10 years. Calculate the increase in organic material mass. Convert organic material to organic carbon. Convert organic carbon to CO_{2e}.
- Key assumptions:** Amount of cropland where conservation tillage is already practiced; amount of remaining cropland where conservation tillage can be practiced; 2% increase in soil organic matter over 10 years is attainable.

Key Uncertainties:

- Benefits:** See key assumptions above.
- Costs:** Cost data from the USDA ERS on conservation tillage are representative of costs that would be incurred in NC.

⁵⁶ Maine Department of Environmental Protection, 2004. *Maine Greenhouse Gas Action Plan Development Process, Review Draft, May 27, 2004.*

⁵⁷ NCDOA, *op. cit.*

Estimation of Ancillary Benefits and Costs:

- **Benefits:** Reduced soil erosion, potential lower yields in initial years. Increases/decreases in CO₂e associated with different equipment usage/activity levels in conservation tillage versus conventional tillage practices. None of these benefits/dis-benefits have been quantified.
- **Costs:** TBD.

Description of Feasibility Issues: TBD.

Support Local Farming/Buy Local

Policy Description: Increased purchase of locally grown produce can potentially reduce emissions associated with the transport of agricultural products by ground or airfreight. Modification of haul distances and freight modes (air to ground) can reduce diesel fuel use. This policy builds on the BAU programs described below to expand purchases of locally grown products. Limited resources did not allow for the formulation of a proposal for this option, and the below calculations are offered as a sample, placeholder assumption for further discussion. It is based on an Iowa study that evaluated shifting ten percent of produce to local grown sources, and has been adjusted by population factor to North Carolina.

BAU Policies/Programs: The purpose of the USDA Resource Conservation and Development (RC&D) program is to accelerate the conservation, development and utilization of natural resources, improve the general level of economic activity, and to enhance the environment and standard of living in designated RC&D areas. These programs can, potentially, be used to encourage local farming.

The North Carolina Department of Agriculture and Consumer Services (NCDOA) started the “Goodness Grows in North Carolina” program in 1985 as a way to market homegrown commodities.⁵⁸ Any producer or processor in North Carolina may join the program free of cost and use the “Goodness Grows” logo as long as their product meets the following requirements:

- Product must be top quality (must meet all local, state and federal requirements)
- Product must be produced or processed in North Carolina.
- If the item is processed, it must contain North Carolina agricultural products when available.

The Center for Environmental Farming Systems (CEFS)⁵⁹ has developed a model Community Supported Agriculture (CSA), which serves to educate, promote, and facilitate the consumer-farmer CSA model in North Carolina. Through this program,

⁵⁸ NCDOA, “Goodness Grows in North Carolina”, accessed at: www.ncagr.com/markets/gginc/ .

⁵⁹ See www.cefs.ncsu.edu/organic.htm.

CEFS is working to develop a network of CSA's across the state and to connect local farmers to companies and institutional food buyers.

Types(s) of GHG Benefit(s): Reduction in CO₂ emissions by reducing gasoline, diesel, and jet fuel use.

Ancillary Benefits and or Costs: Reduced transportation would also lead to reduced criteria and toxic air pollutants. Increased sales of local products would benefit the local economy.

Estimated GHG Savings and Cost per Ton CO₂e: The table below is based on a study that partially evaluated dynamic effects of shifting production location and transportation demand. It is not a full market simulation.

Variable	Data
Gallons of fuel annually saved Iowa/10% policy	8,800,000
Pounds CO ₂ saved	172,480,000
MMTCO ₂ e reduced from fuel savings	0.078
Iowa population 2003	2,944,062
North Carolina population 2003	7,036,927
Population adjusted NC MMTCO ₂ e savings	0.19
Costs per MTCO ₂ e	TBD

Data Sources, Methods and Assumptions: All data sources, methods and assumptions are based on an Iowa State University study,⁶⁰ and were scaled to North Carolina using state population adjustments. The study analyzed the feasibility and effects of shifting transportation distance and mode.

Key Uncertainties:

- Percent of food categories that can be shifted to locally grown
- Relative mix of food categories in NC compared to Iowa
- Travel distance of food under present (conventional) circumstances
- Cost of growing food locally vs. elsewhere (as determined by market)
- Incentive system required to make producer and consumer shifts viable

Estimation of Ancillary Benefits and Costs:

- **Benefits:** TBD.
- **Costs:** TBD.

⁶⁰ Richard Pirog et al, *Food, Fuel, and Freeways: An Iowa perspective on how far food travels, fuel usage, and greenhouse gas emissions*, Leopold Center for Sustainable Agriculture, Iowa State University, June 2001, <http://www.leopold.iastate.edu/pubs/staff/ppp/>.

Description of Feasibility Issues: North Carolina is a major production area for fruits and vegetables, producing over 25 major fruit and vegetable crops. However, a significant portion of the produce consumed in the state is imported from other states or other countries. There is significant potential for shifting of imported produce to locally grown fruits and vegetables.

Forestland Protection

Policy Description: Protection of 58,800 acres per year of North Carolina forestland cover over 14 years, starting in 2006 and ending in 2020, consistent with the current proposed DENR initiative to protect 1 million acres of natural land targeted primarily to forestland. This policy focuses on the use of implementation mechanisms targeted to lands at risk of conversion using growth neutral implementation that reduce net land clearing without affecting total residential or commercial starts.

BAU Policies/Programs: The state loses 58,800 acres of forest cover per year on average to permanent conversion of forest to developed land uses (2002 USDA Natural Resource Inventory (NRI)). Current activities by the state and private land trust community, including the Clean Water Management Trust Fund, reduce this trend to some extent below even higher levels that otherwise might result. As a result of continued losses of natural lands DENR recently began development of a statewide initiative to protect 1 million acres of natural land from conversion. This proposal is not yet adopted, and is the basis of this proposal.

Types(s) of GHG Benefit(s): Forestland protection GHG savings result from C sequestration from protection of biomass stocks, reduced CO₂ emissions from avoided land clearing, and reduced petroleum use and related CO₂ emissions from travel demand reductions (depending on the configuration of land protection programs).

Types of Ancillary Benefits and or Costs: Forestland protection and increased retention of forestland cover improves watershed function, wildlife habitat, air quality, travel needs, housing location efficiency, natural heritage, and economic opportunities on working lands.

Estimated GHG Savings and Cost per Ton CO₂e:

Forest Land Protection

Forest Savings

Total DENR program acres saved over 14 years	1,000,000
Annual DENR program acres saved over 14 years	71,429
Annual acres forestland lost per year 1982-1997	58,800
Targeted annual acres forestland by DENR program 2006-2020	58,800
MTC per acre saved forest biomass (nonsoil)	73.96
MTC per acre forest soil saved	9.25
MTCO ₂ e per acre saved forest (nonsoil)	270.694

MTCO ₂ e per acre saved forest (soil)	33.837
MTCO ₂ e saved per acre per year total	304.530
MTCO ₂ e total acres saved per year total biomass and soil	17,906,381.64
MTCO ₂ e credit for wood products & landfills	-3,311,248.09
MTCO ₂ credit from building materials substitution	-1,009,901.02
MTCO ₂ displaced electric power	-2,645,281.97

Annual GHG Forest Cover and Soils Savings MMTCO₂e 10.94

Transportation Savings

Annual acres saved over 14 years	58,800
Housing units affected (3 home per acre LC average)	43,881
Density increases resulting from land conservation	144.12%
VMT per household before	22,000
VMT per household after	20,900
Gallons fuel reduction per HH from land conservation	51
MTCO ₂ e avoided per HH from land conservation/VMT annual	0.455267
MTCO ₂ e avoided all HH from land conservation/VMT annual	19977.39
Annual GHG Transportation Savings MMTCO₂e	0.02

Option Total Net GHG Savings MMTCO₂e 10.96

Cost per acre forest retention standard (low scenario)	-\$2,000.00
Cost per acre permanent conservation easement (high scenario)	\$2,700.00
Annual Cost/MMTCO₂e 2006-2020 (low scenario)	-\$8.64
Annual Cost/MMTCO₂e 2006-2020 (high scenario)	\$3.02

Data Sources, Methods and Assumptions:

- Forestland carbon densities and acreage figures are provided by the USDA Forest Service FORCARB inventory system, based on state level Forest Inventory Assessments (FIA) by the USFS using a series of permanent sample plots. Statewide forest carbon levels average 73.96 metric tons per acre. Land use and land cover change data are provided by FORCARB as well as the USDA Natural Resource Inventory (NRI) based on state level collection of land cover data using a series of permanent sample plots. Statewide forest cover conversion to urban land uses averaged 58,800 acres per year from 1982-97. The disposition of harvested biomass is provided by the US Forest Service HARVCARB model. Energy displacement of wood products building materials is provided by the CORRIM model. Housing densities were calculated using the 1997 and 1999 American Housing Surveys of the US Department of Housing and Urban Development and Census Bureau. Average annual travel mileage and gasoline consumption for households was obtained from the US DOT survey data. Estimates of travel demand reductions were obtained from the Connecticut Climate Change Stakeholder Dialog and related transportation demand evaluations. The cost of land clearing (and the benefit of avoided land

clearing) was provided by a NOAA Coastal Zone Management study at \$2,000 per acre. The cost of land protection mechanisms is provided by the North Carolina Clean Water Management Trust Fund program for permanent conservation easements.

- **Quantification Methods:** A full life cycle net impact analysis was used, including impacts of the conversion of biomass to combustion or decay as a result of land clearing, minus the positive impacts of biomass recovery for harvested wood products storage and energy recapture. Potential transportation demand savings are included. The FORCARB carbon stock inventory system allows detailed measurement of carbon stocks prior to and after conversion for above and below ground biomass stocks. Soil carbon impacts were estimated with FORCARB soil carbon equations. The net carbon impacts of conversion of post harvest biomass to harvested wood products and energy recapture was estimated based on field study results from the HARVCARB model (for wood products and associated waste recovery for energy) and CORRIM model (for building materials substitution). Estimated fractions of harvested biomass solely for energy recapture are provided by the US Forest Service at a regional level. Energy displacement values are based on current NEMS modeling by CCS for the energy supply sector. Travel demand and petroleum use calculations were based on the differential impacts of conventional large lot development (typically associated with significant land clearing) versus location efficient housing (typically associated with conservation design or limited impact development that reduces land clearing). Costs were calculated as the positive cost of reducing land clearing through conservation easements or regulatory mechanisms, minus the negative cost (the savings) associated with avoided land clearing. No discounting of benefits was used.
- **Key assumptions:** Implementation mechanisms are assumed to focus effectively on lands at risk of permanent conversion and use growth neutral mechanisms that do not result in movement of housing or commercial starts to areas outside the state that are not subject to the policy. As a result, it is assumed that reductions in average forestland cleared per new housing or commercial start do not reduce the number of building starts in the state (the same number of units are built on smaller lots or with higher rates of forest cover retention) but they do result in less land cleared per unit. On forested lots cleared for development, which average two acres for single family housing, two thirds of the acreage is typically cleared of forest cover and one quarter acre experiences subsurface disturbance and complete loss of soil carbon. Based on USDA Forest Service data, forest soils were estimated at maturity to hold about 50 percent as much carbon as above ground stocks (based on statewide average stand mix). Following conversion of forestland to developed uses, cleared acreages lose 25 percent of soil carbon and do not accumulate or lose additional biomass or soil carbon beyond that point. Biomass removed from cleared lands is assumed to be used commercially at the statewide average for harvested wood products and energy recapture. Cost calculations assumed a high cost pathway requiring permanent conservation easements (\$2,700 per acre based on from the Clean Water Management Trust Fund), and a low cost pathway assuming no net increased cost associated with

tree retention standards that do not increase development costs. In both cases total costs were adjusted with the added benefit of \$2,000 per acre saved from avoided land clearing. No co-benefits were assumed.

Key Uncertainties:

- **Benefits:** The level of benefits is dependent primarily on the quality of implementation assumptions, such as the efficacy of programs targeted to lands at risk of conversion and use of growth neutral mechanisms that ensure net reductions in land clearing, as well as the programmatic feasibility of launching and funding a program as needed during the 2006-2020 time period. Otherwise, none of the major variables affecting biomass carbon dynamics are significantly uncertain over the range of potential variation due to issues with data sources, methods or technical assumptions.
- **Costs:** The cost of regulatory standards to increase forest cover retention during development is not well known, and can, theoretically, vary from zero (or negative) to the full cost of a permanent conservation easement. Conservation design, new urbanist, targeted infrastructure, and other location and site design approaches appear to perform equally as well if not better than conventional housing and commercial development in terms of costs and financial returns from development, so there is some reason to believe that cost neutral mechanisms are possible. The cost and efficacy of permanent conservation easements is well known.

Description of Ancillary Benefits and Costs:

- **Benefits:** TBD.
- **Costs:** TBD.

Description of Feasibility Issues: An in depth analysis of programmatic effectiveness and feasibility issues is beyond the scope of this analysis at this time, but within the scope of future planning and analysis.

Afforestation and Forestland Restoration

Policy Description: Active afforestation of 300,000 acres of former tobacco land over 14 years, or 21,429 acres per year starting in 2006, consistent with currently proposed state initiatives. Ensure incremental afforestation at these levels above business as usual using active management and protection techniques as appropriate for site and geography.

BAU Policies/Programs: North Carolina has a number of state and federal cost share and technical assistance programs to assist private nonindustrial land owners with afforestation that are administered through the Division of Forestry and State Extension Service. Current market incentives drive high levels of reforestation and afforestation on industrial lands and many nonindustrial lands. Afforestation levels are typically lower on nonindustrial lands due to risk, cost, and lack of information and assistance. Natural afforestation occurs at significant levels on farmlands that are withdrawn from

production, but may face significant ecological and development risk if not adequately protected and managed.

Types(s) of GHG Benefit(s): GHG savings result from C sequestration.

Types of Ancillary Benefits and or Costs: Forestland cover improves watershed function, wildlife habitat, air quality, travel needs, housing location efficiency, natural heritage, and economic opportunities on working lands.

Estimated GHG Savings and Cost per Ton CO₂e:

Afforestation of former tobacco lands

Acres over 14 years	300,000
Annual acres afforested	21,429
Average stand age 2006-2050	35
MTC per acre biomass nonsoil age 35	33.67
MTCO ₂ e per acre biomass nonsoil age 35	123.23
Option Total GHG Savings 2006-2020 MMTCO₂e	2.64
Cost per acre initial treatment	\$120.00
Cost per Ton CO₂e 2006-2020 + 2050	\$0.97

Data Sources, Methods and Assumptions:

- **Data Sources:** Tree growth rates provided by the USDA Forest Service, Richard Birdsey, 1996. An average figure at age 35 was calculated using a simple average of all nine stand types provided by the USFS based on earliest age of average harvest by the North Carolina Agricultural Extension Service. Acreage figures and per acre costs were provided by the North Carolina Agricultural Extension Service. Cost figures are for a one-time treatment of land with no additional management.
- **Quantification Methods:** Biomass carbon was calculated over 35 years to represent one full generation of tree growth (likely to underestimate some stand types). The benefits of growth in years after the end of the project period (2020) were added and levelized to calculate an annual carbon benefit. The starting condition of the land is assumed to be fallow farmland. No risk is assumed for stand establishment, growth or conversion to nonforest cover. No discounting of benefits was used.
- **Key assumptions:** Stands were assumed to mature at 35 years and start with no above ground carbon. Soil carbon levels were assumed to have no change over the period. No risks were assumed. Costs for all establishment and stand types were assumed to be the same as the level required for establishment of a pine plantation.

Key Uncertainties:

- **Benefits:** Risks of land conversion, drought and other damage are potentially high for some lands. The period of biomass growth following 2020 is driven by ecological and

market conditions, as well as arbitrary assumptions about the end of the quantification period. If discounting of benefits is not used, these variables have significant impacts on project performance.

- **Costs:** Risk management may involve added costs that require further study. In the extreme this might include permanent conservation easements, for instance, and would raise costs per acre significantly.

Description of Ancillary Benefits and Costs:

- **Benefits:** None at this time.
- **Costs:** None at this time.

Description of Feasibility Issues: An in depth analysis of programmatic effectiveness and feasibility issues is beyond the scope of this analysis at this time, but within the scope of future planning and analysis.

Energy Supply and Demand

Overview of Energy Supply and Demand Options

Four energy supply policy options are analyzed below using the National Energy Modeling System (NEMS) from the US Energy Information Administration. Some of these options incorporate energy efficiency provisions which are examined by modeling the effects of demand reduction scenarios.

Any analysis of state-level policies using NEMS should be weighed carefully. NEMS is a national model that consists of 13 regions. State policies cannot be implemented explicitly within NEMS, and the state-specific impacts cannot be known explicitly. Although we have crafted a methodology that approximates the impact of a policy implemented at the state level, the methodology is not perfect. Because the absolute levels of change that are appropriate at the state level may be small at the regional level, the results of those small changes may not be entirely accurate. The larger the policy – the more demand reduction or the more renewables or both – the more confidence we have in the result. Because NEMS is an optimization model, small changes can lead to unrealistic responses. For example, a small reduction in demand can change the investment decision for new capacity within the model because the model is aware of that small change. In reality, independent actors in the electricity market making investment decisions may not be able to detect a small change in demand and, even if they did, may not have the certainty to act on that change; these actors are unlikely to alter investment decisions the way the model would. On the other hand, real actors would be more likely to be aware of and act upon a larger change in demand.

The results of this analysis are preliminary and should not be considered final numbers on which to base policy decisions. The NEMS reference case scenario is the EIA's best guess at the forecast of activities in the electricity market for the Southeastern Electric

Reliability Council (SERC) region containing North Carolina and for the United States as a whole. In developing this reference case, the EIA consults experts who believe that the market will follow a certain path, and then the EIA builds those assumptions into the model.

For example, the EIA assumes that there will be no new generating capacity in the SERC region from 2007 through 2014. All growth in demand during this period is satisfied either by imports from other regions or by existing capacity within the region. All of the scenarios, which are based on the reference case, show little reductions (and some small increases) in CO₂ emissions before 2015 because many of the resulting changes are taking place outside the region, as reflected through reductions in imports. Scenarios that are only demand reductions show either increased generation of fossil fuels (state facilities target) or larger decreases in natural gas generation compared to coal (PBF scenarios) in the region. Even though generation from fossil fuels declines slightly in both of the PBF cases, the change in how units are operated (e.g. more units are in cycling mode in which they burn fuel but do not generate electricity) leads to a slight increase in the consumption of fossil fuels and therefore CO₂ emissions from 2007 through 2014.

After 2014, the state facilities target and the PBF 2 mils scenarios both lead to reductions in generation from coal and to increases in generation from natural gas and oil units. The net result is a decline in CO₂ emissions, but an increase in cost because natural gas units are more expensive to build and operate than coal. The PBF 5 mils scenario results in a decrease in generation from coal and natural gas units and an increase in generation from oil units; the demand reduction is sufficient to obviate the need for frequently run units like coal steam and natural gas combined cycle. But the reserve margin must be maintained, so more lower-cost capacity – oil-fired combustion turbines – is installed. The result is a decrease in CO₂ emissions and costs.

Prior to 2015, scenarios that force renewables into the region lead to less fossil-based generation from existing capacity within SERC and to corresponding reductions in CO₂ emissions. These scenarios, after 2015, lead to a reduction in new fossil fuel capacity compared to the reference case, which also leads to emission reductions.

The reference case projection for the state of North Carolina, which was developed independently from the reference case in NEMS, assumes that new coal-fired units will be constructed in North Carolina prior to 2015 based on recent announcements by major utilities within the state. The NEMS reference case precedes this information, and the time available for this analysis precluded an update. If the NEMS reference case were updated to reflect the addition of new coal capacity before 2015, policy runs would result in lower emissions as well as a lower cost per ton for those emissions. By using the current NEMS reference case, we have provided a conservative estimate for emission reductions and costs in North Carolina.

Renewable Portfolio Standard

Policy Description: A renewable portfolio standard (RPS) is a requirement that load serving entities (LSEs) must supply a certain percentage of electricity from renewable energy sources. For example, an RPS of 5% would mean that for every 100 kWh that an LSE supplies to end users, 5 kWh must be generated from renewable resources. An RPS differs from an Environmental Portfolio Standard (EPS) in that an RPS is a requirement specifically for renewables, while an EPS is broader and includes energy efficiency. LSEs can meet their requirements by purchasing or generating renewable-based electricity or by purchasing renewable energy credits (RECs). RECs are tradable credits that are part of an RPS policy. RECs are created for every kWh of eligible and verified renewable electricity produced. Anyone can build an eligible renewable facility and earn RECs for the electricity that is generated. Anyone with RECs can sell them to a utility that needs to meet its RPS requirement. In this way, utilities themselves do not need to build and operate renewable generating facilities. By giving utilities the flexibility to purchase RECs, the market in these credits will provide an incentive to companies that are best able to generate renewable energy.

The RPS scenario considered in this report was developed by Appalachian State University and assumes a mix of renewables that includes biomass, wind, landfill gas, hydro, solar thermal, and solar PV. The RPS requirement is assumed to ramp up between 0.5% in 2006 and 10% in 2015 and to remain at 10%.

BAU Policies/Programs: No RPS program is in operation in North Carolina. However, the GreenPower program is in operation.⁶¹ This program provides the option to consumers to purchase green power, but it is not a requirement to generate renewables as an RPS would be.

Types(s) of GHG Benefit(s): By creating a substantial market in renewable generation, an RPS can significantly reduce fossil fuel use in power generation and thus reduce GHG emissions.

Types of Ancillary Benefits and or Costs: The shift from fossil fuel generation as a result of an RPS will lead to reductions in criteria air pollutants and, consequently, health costs associated with those pollutants. While much of the RPS requirement will come from low-cost renewables such as wind and biomass, meeting the requirement leads to a moderate increase in direct costs to LSEs implementing the RPS policy and a small increase in overall electricity system cost for the SERC region. At the same time, though, investment in new technologies resulting from the RPS can spur economic development in North Carolina if in-state capital/labor/fuel replaces out-of-state fuel (a likely outcome).

⁶¹ GreenPower is a voluntary program that adds green electricity generation in North Carolina. For example, residential electricity customers can opt to pay an additional \$4 per month for a block of 100 kWh of green power. For more information, see: <http://www.ncgreenpower.org>

Estimated GHG Savings and Cost per Ton CO_{2e}:

	MMtCO ₂				
	2005	2010	2015	2020	2025
Reference	76	81	90	100	110
RPS	76	81	89	92	94
Reduction	0	0.0	1.4	7.8	16.2
Percent Reduction	0.0%	0.0%	1.5%	7.8%	14.7%

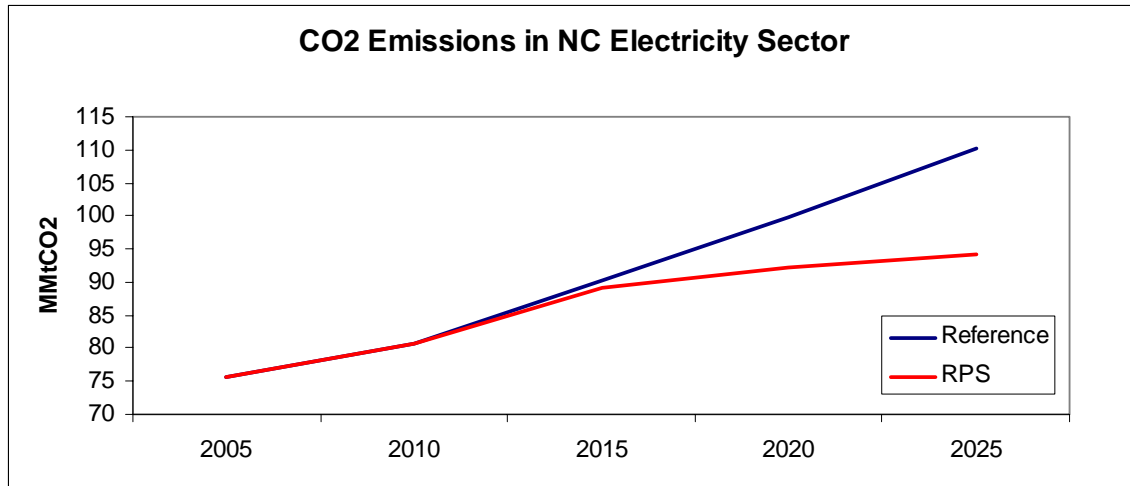
2005 = 2005, 2010 = average of 2006 - 2010, 2015 = average of 2011 - 2015 and so on

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Cumulative CO ₂ Reduction (MMtCO ₂) to 2025	126.6	1706	6.9%	\$0.88	\$0.00	\$0.88	\$7.0	\$0.61	\$1.49	\$11.8
				Direct incremental cost of policy out to 2025 ¹	Direct incremental benefits of policy out to 2025 ²	Net Direct Policy Cost (\$ NPV billions)	\$/ton CO ₂ (Direct Cost)	SERC System Incremental Cost (\$ NPV billions)	System + Direct Cost (\$ NPV billions)	\$/ton CO ₂ (SERC System Cost)
CO ₂ reductions as a result of policy	Reference case emissions (1833 MMtCO ₂) - (a)		(a) / (b)	Direct incremental cost of policy out to 2025 ¹	Direct incremental benefits of policy out to 2025 ²	(d) - (e)	(f) * 1000 / (a)	Difference between policy and reference SERC region system cost out to 2025 ³	(d) + (h)	(i) * 1000 / (a)

¹ For example, renewable costs are total costs of renewables - total cost of equivalent amount of new fossil capacity. Direct Policy Costs are seen by the implementor of the policy

² For example, difference between the cost of efficiency and either the cost of generation (EPS) or the cost to the end user (Government Target). Direct Policy Benefits are seen by the implementor of the policy

³ Implicit in Incremental System Costs are Policy Benefits. Incremental System Costs represent the impact of the policy on the total cost of the electricity system within SERC, but do not reflect the Direct Policy Cost



2005 = 2005; 2010 = average of 2006 – 2010; 2015 = average of 2011

Data Sources, Methods and Assumptions:

Most data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes *Assumptions to the Annual Energy Outlook* that details key assumptions in the current version of the model.⁶² EIA also publishes NEMS model documentation.⁶³

The specific mix and levels of renewable capacity in RPS policy were developed using the North Carolina Energy Economic Model written by Skip Laitner for the North Carolina State Energy Office and maintained at Appalachian State University. The RPS policy analyzed here is consistent with the RPS policy being analyzed by Appalachian State University to determine the indirect economic impact in North Carolina. All renewable plant characteristics were based on new plants defined within the NEMS model.

The RPS was analyzed by forcing the NEMS model to build renewable plants as defined by the RPS policy. Total system costs, carbon dioxide emissions, and other outputs were compared with a reference case NEMS run. Because the NEMS model is a national model with multi-state regions (North Carolina is within the Southeastern Electric Reliability Council or SERC), the policy was implemented within the SERC region at a level for North Carolina. We make the assumption that the change in outputs in the entire region is attributed wholly to the policy in North Carolina. This assumption is reasonable given that the electricity market operates at a regional and even inter-regional level. Although we can collect data within state bounds, any change in the electricity system within a given state will reverberate within the surrounding region and beyond.

⁶² The document can be found here: [http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554\(2005\).pdf](http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554(2005).pdf)

⁶³ NEMS documentation can be found here: [http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581\(2003\).pdf](http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581(2003).pdf)

For the direct policy costs, we analyzed the RPS from the perspective of utilities implementing the policy. These costs are the incremental costs incurred by building renewables rather than the average mix of generation in the reference case plus the cost of investing in energy efficiency (the incremental cost of efficient rather than typical equipment).

The system cost, which is an output of the NEMS model, represents the increment in the total cost of the system (including capital, operating and maintenance, fuel, transmission and distribution) that results from the EPS. But the NEMS output does not include the direct policy cost, so we add it to the system cost to approximate the full cost to society.

One of the key assumptions of the RPS analysis is that higher cost renewables, such as solar thermal and solar photovoltaic, would be built to satisfy part of the RPS requirement. This assumption is based on the RPS containing a specific provisions requiring minimum levels of solar or other high-cost, but socially important, renewables. ASU made key assumptions regarding the mix of other renewables. An RPS may lead to a different mix than the mix assumed here. One source may be dominant under an RPS, particularly if additional policies are enacted that encourage one over the others. For example, if subsidies to biomass were put into place, then the biomass share would likely increase.

The last key assumption is that we forced NEMS to build enough capacity such that it would generate enough electricity to meet the RPS requirement based on standard capacity factors. Once the capacity is in the system, NEMS will choose to operate that capacity in a way to minimize costs. If the renewable plant is run more or less than was assumed in developing the capacity levels, then it would generate more or less electricity than what is needed for the RPS.

Key Uncertainties:

As with any assessment of the future, the RPS analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions. If those assumptions are incorrect, then the results would change. Other key uncertainties are the ability of the NEMS model to give credible results for the SERC region and for the resulting changes in the SERC region to be fully attributable to policies implemented in North Carolina. Other uncertainties are the forecast of the price of fossil fuels, the cost, availability and operating characteristics of new power plants in the future, and the growth in the demand for electricity.

Description of Ancillary Benefits and Costs:

The RPS policy analyzed here would result in reductions of criteria air pollutants as follows:

SO ₂ :	789,000 tons (cumulative through 2025) or 41,470 tons (average per year)
NO _x :	152,000 tons (cumulative through 2025) or 8,000 tons (average per year)
Mercury:	1.7 tons (cumulative through 2025) or 193 pounds (average per year)

Most reductions would occur later in the period, between 2015 and 2025.

The RPS results in a net 0.30% increase in overall electricity system costs (on a NPV basis) compared to the reference case. Although the RPS leads to a net increase in costs, the change in the distribution of those costs should lead to more economic development in the state by shifting resources that were going to purchase fuel to funding North Carolina jobs and businesses. The RPS results in a \$1.74 billion (NPV) increase in capital expenditures in the electricity system, resulting in new engineering and construction jobs and business for North Carolina suppliers of power plant equipment. Operating and maintenance expenses increase by \$0.46 billion (NPV), translating into North Carolina jobs. Purchases of fuel, much of which comes from out of state, decrease by \$0.63 billion (NPV). The EPS also leads to \$0.10 billion (NPV) less in transmission costs, but \$0.03 billion more in distribution costs.

Description of Feasibility Issues:

North Carolina has more than enough renewable resources to meet the EPS, and verification of renewable generation is quite feasible and easy to administer by the state.

Environmental Portfolio Standard

Policy Description:

An environmental portfolio standard (EPS) is a requirement that load serving entities (LSEs) must supply a certain percentage of electricity from environmentally friendly sources. For example, an EPS of 5% would mean that for every 100 kWh that an LSE supplies to end users, 5 kWh must be from environmentally friendly sources. An EPS differs from a Renewable Portfolio Standard (RPS) in that an EPS gives the added option of meeting the requirement by means of “negawatts” generated through verified energy efficiency projects in addition to renewable generation. If a large industrial customer with a current demand of 35,000 MWh per year invests in energy efficiency that reduces demand by 20% or 7,000 MWh, and this investment and reduction are verified by an independent auditor, then the customer would have 7,000 MWh of clean energy credits to sell to an LSE. LSEs can meet their requirements by purchasing or generating environmentally friendly electricity or by purchasing clean energy credits. By giving LSEs the flexibility to purchase clean energy credits, a market in these credits will emerge that will provide an incentive to companies that are best able to generate clean energy, either through energy efficiency or renewables.

The EPS scenario examined in this report has a requirement of 5% clean energy by 2010, 10% by 2015, and 15% by 2020. The scenario assumes that only a certain level of energy efficiency, despite the low or even negative cost, will be used to fulfill the EPS requirements simply because of the transaction costs associated with verifying the reductions. The amount of energy efficiency was derived from *Powering the South, A Clean and Affordable Energy Plan* (2002), written by the Renewable Energy Policy Project and Synapse Energy, which estimates that North Carolina can reduce demand by 14% in 2010 and 23% in 2020 at an average cost of 2.6 cents/kWh. We assumed that the energy efficiency contribution to the EPS would come only from the industrial and

commercial sectors, which have lower transaction costs for verification of energy efficiency projects than the residential sector. We also assumed that $\frac{3}{4}$ of the industrial sector reduction and $\frac{1}{2}$ of the commercial sector reduction from *Powering the South* could be applied toward the EPS. This level of energy efficiency amounted to approximately $\frac{1}{5}$ th of the EPS requirement. The remainder of the EPS was fulfilled by the maximum potential of landfill gas and roughly equal shares of biomass, wind, and hydro.

BAU Policies/Programs: No EPS program is in operation in North Carolina.

Types(s) of GHG Benefit(s):

By creating a substantial market in energy efficiency and renewable generation, an EPS can significantly reduce fossil fuel use in power generation and thus reduce GHG emissions.

Types of Ancillary Benefits and or Costs:

Reductions in overall energy consumption and the shift from fossil fuel generation as a result of an EPS will lead to reductions in criteria air pollutants and, consequently, health costs associated with those pollutants.

While much of the EPS requirement will come from zero or low-cost (even negative cost) energy efficiency and low-cost renewables such as wind and biomass, meeting the requirement leads to a moderate increase in direct costs to LSEs implementing the EPS policy and a small increase in overall electricity system cost for the SERC region. At the same time, though, investment in new technologies resulting from the EPS can spur economic development in North Carolina if in-state capital/labor/fuel replaces out-of-state fuel (a likely outcome).

Estimated GHG Savings and Cost per Ton CO₂e:

	MMtCO ₂				
	2005	2010	2015	2020	2025
Reference	76	81	90	100	110
EPS	76	81	89	94	99
Reduction	0	-0.1	1.6	5.4	11.5
Percent Reduction	0.0%	-0.1%	1.7%	5.4%	10.4%

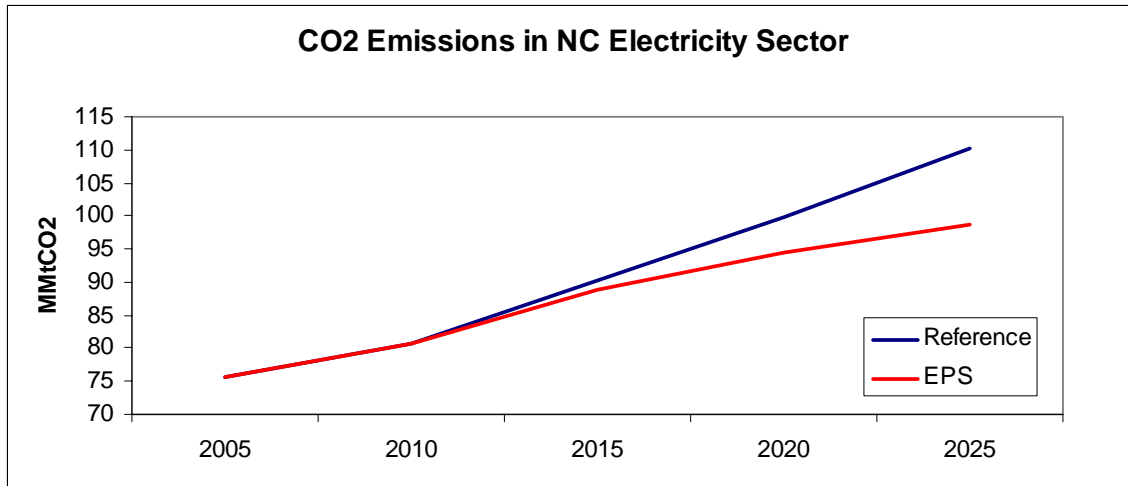
2005 = 2005, 2010 = average of 2006 - 2010, 2015 = average of 2011 - 2015 and so on

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
	Cumulative CO ₂ Reduction (MMtCO ₂) to 2025	Cumulative NC CO ₂ Emissions (MMtCO ₂) to 2025 with Policies	Percent Reduction	Direct Policy Cost (\$ NPV billions)	Direct Policy Benefits (\$ NPV billions)	Net Direct Policy Cost (\$ NPV billions)	\$/ton CO ₂ (Direct Cost)	SERC System Incremental Cost (\$ NPV billions)	System + Direct Cost (\$ NPV billions)	\$/ton CO ₂ (SERC System Cost)
EPS	91.8	1741	5.0%	\$1.01	\$0.71	\$0.30	\$3.2	(\$0.81)	\$0.20	\$2.2
NOTES:	CO ₂ reductions as a result of policy	Reference case emissions (1833 MMtCO ₂) - (a)	(a) / (b)	Direct incremental cost of policy out to 2025 ¹	Direct incremental benefits of policy out to 2025 ²	(d) - (e)	(f) * 1000 / (a)	Difference between policy and reference SERC region system cost out to 2025 ³	(d) + (h)	(i) * 1000 / (a)

¹ For example, renewable costs are total costs of renewables - total cost of equivalent amount of new fossil capacity. Direct Policy Costs are seen by the implementor of the policy

² For example, difference between the cost of efficiency and either the cost of generation (EPS) or the cost to the end user (Government Target). Direct Policy Benefits are seen by the implementor of the policy

³ Implicit in Incremental System Costs are Policy Benefits. Incremental System Costs represent the impact of the policy on the total cost of the electricity system within SERC, but do not reflect the Direct Policy Cost



2005 = 2005; 2010 = average of 2006 – 2010; 2015 = average of 2011

Data Sources, Methods and Assumptions:

Most data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes *Assumptions to the Annual Energy Outlook* that details key assumptions in the current version of the model.⁶⁴ EIA also publishes NEMS model documentation.⁶⁵

The specific levels of renewable capacity and energy efficiency that make up the EPS policy were developed using a combination of sources. For energy efficiency, the level of energy efficiency investment was derived from *Powering the South*.⁶⁶ The potential for landfill gas was developed using projections derived from the EPA Landfill Methane Outreach Program (LMOP) database. The levels of biomass, wind and hydro were assumed to be roughly equal and sufficient to fulfill the EPS requirement. All renewable plant characteristics were based on new plants defined within the NEMS model.

The EPS was analyzed by forcing the NEMS model to build renewable plants as defined by the EPS policy and by lowering the demand for electricity in the commercial and industrial sectors by an amount equal to the level of energy efficiency assumed by the EPS. Total system costs, carbon dioxide emissions, and other outputs were compared with a reference case NEMS run. Because the NEMS model is a national model with multi-state regions (North Carolina is within the Southeastern Electric Reliability Council or SERC), the policy was implemented within the SERC region at a level for North Carolina. We make the assumption that the change in outputs in the entire region is attributed wholly to the policy in North Carolina. This assumption is reasonable given that the electricity market operates at a regional and even inter-regional level. Although we can collect data within state bounds, any change in the electricity system within a given state will reverberate within the surrounding region and beyond.

⁶⁴ The document can be found here: [http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554\(2005\).pdf](http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554(2005).pdf)

⁶⁵ NEMS documentation can be found here: [http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581\(2003\).pdf](http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581(2003).pdf)

⁶⁶ Powering the South can be found here: <http://www.poweringthesouth.org/report/>

For the direct policy costs and benefits, we analyzed the EPS from the perspective of utilities implementing the policy. These costs are the incremental costs incurred by building renewables rather than the average mix of generation in the reference case plus the cost of investing in energy efficiency (the incremental cost of efficient rather than typical equipment). The direct policy benefits are the savings of the cost of generation resulting from energy efficiency.

The system cost, which is an output of the NEMS model, represents the increment in the total cost of the system (including capital, operating and maintenance, fuel, transmission and distribution) that results from the EPS. But the NEMS output does not include the direct policy cost, so we add it to the system cost to approximate the full cost to society. We do not need to add the direct policy benefits because those are already reflected in incremental system cost that comes out of NEMS.

Key assumptions of the EPS analysis are that only a portion of the available energy efficiency as characterized in *Powering the South* would be used to satisfy the EPS requirement under the assumption that the transaction costs associated with verifying energy reductions would limit the amount of energy reduction. Another key assumption is that biomass, wind and hydro would be used in equal shares. One source may be dominant if an EPS were actually implemented, particularly if additional policies are enacted that encourage one over the others. For example, if subsidies to biomass were put into place, then the biomass share would likely increase. The last key assumption is that we forced NEMS to build enough capacity such that it would generate enough electricity to meet the EPS requirement based on standard capacity factors. Once the capacity is in the system, NEMS will choose to operate that capacity in a way to minimize costs. Because demand reductions are also part of the EPS, if a renewable plant that was built as a result of the EPS is on the margin in the dispatch order, it will not run because of the demand reduction. Similarly, if the renewable plant is able to run more hours than was assumed in developing the capacity levels, then it would generate more electricity than what is needed to meet the RPS. The actual output of the renewable plants in practice may not equal the requirement of the RPS.

Key Uncertainties:

As with any assessment of the future, the EPS analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions. If those assumptions are incorrect, then the results would change. Other key uncertainties are the ability of the NEMS model to give credible results for the SERC region and for the resulting changes in the SERC region to be fully attributable to policies implemented in North Carolina. Other uncertainties are the forecast of the price of fossil fuels, the cost, availability and operating characteristics of new power plants in the future, and the growth in the demand for electricity.

Description of Ancillary Benefits and Costs:

The EPS policy analyzed here would result in reductions of criteria air pollutants as follows:

- SO₂: 468,000 tons (cumulative through 2025) or 24,600 tons (average per year)
- NO_x: 24,400 tons (cumulative through 2025) or 1,290 tons (average per year)
- Mercury: 0.18 tons (cumulative through 2025) or 20 pounds (average per year)

Most reductions would occur later in the period, between 2015 and 2025.

The EPS results in a net 0.04% increase in overall electricity system costs (on a NPV basis) compared to the reference case. Although the EPS leads to a net increase in costs, the change in the distribution of those costs should lead to more economic development in the state by shifting resources that were going to purchase fuel to funding North Carolina jobs and businesses. The EPS results in a \$1.16 billion (NPV) increase in capital expenditures in the electricity system, resulting in new engineering and construction jobs and business for North Carolina suppliers of power plant equipment. Operating and maintenance expenses increase by \$0.15 billion (NPV), translating into North Carolina jobs. The EPS causes \$0.49 billion in purchases of energy efficient equipment. Purchases of fuel, much of which comes from out of state, decrease by \$1.29 billion (NPV). The EPS also leads to \$0.32 billion (NPV) less in transmission and distribution costs.

Description of Feasibility Issues:

The only significant feasibility issue is the process of verifying energy reductions to be used to satisfy the EPS requirement. North Carolina has more than enough renewable resources to meet the EPS, and verification of renewable generation is quite feasible and easy to administer by the state.

Public Benefit Fund

Policy Description:

A public benefit fund (PBF) is a state fund dedicated to support energy efficiency (EE) and renewable energy (RE). To date, nineteen states have implemented PBF programs. A small charge rate, typically in the 2 to 5 mils per kWh range, is applied to electricity sales in the state and collected by the PBF manager. Funds are typically used to support EE and RE in a number of ways, such as through public education, R&D, demonstration projects, direct grants/buydowns/tax credits to subsidize advanced technologies, and low-interest revolving loans. Funding goes to the residential, commercial and industrial sectors. Fund managers decide which technologies to support based on criteria such as GHG reduction potential, cost-effectiveness, co-benefits, etc.

The two PBF scenarios analyzed here differ by assumed charge rates. One scenario examines the impact of a fund based on a 2 mil charge rate, and the other assumes a 5 mil charge.

BAU Policies/Programs: No PBF program is in operation in North Carolina.

Types(s) of GHG Benefit(s):

By spurring investment in energy efficient technologies and small-scale renewable generators, PBF programs reduce the need for generation from fossil fuel plants, which can lead to a significant reduction in GHG emissions.

Types of Ancillary Benefits and or Costs:

Reductions in overall energy consumption and the shift from fossil fuel generation as a result of a PBF will lead to reductions in criteria air pollutants and, consequently, health costs associated with those pollutants. Much of the investment made by the PBF will go into zero or low-cost (even negative cost) energy efficiency and small-scale renewables, and the PBF program will more than pay for itself through cost-effective investments. Nevertheless, the impact on the larger electricity system of the PBF program can lead to a small increase in overall electricity system cost for the SERC region (see modeling discussion below).

Estimated GHG Savings and Cost per Ton CO₂e:

	MMtCO ₂				
	2005	2010	2015	2020	2025
Reference	76	81	90	100	110
PBF (2 mils)	76	81	91	96	101
Reduction	0	-0.4	-0.8	4.4	9.5
Percent Reduction	0.0%	-0.5%	-0.9%	4.4%	8.6%
PBF (5 mils)	76	81	91	97	102
Reduction	0	-0.3	-0.3	2.8	8.6
Percent Reduction	0.0%	-0.3%	-0.3%	2.8%	7.8%

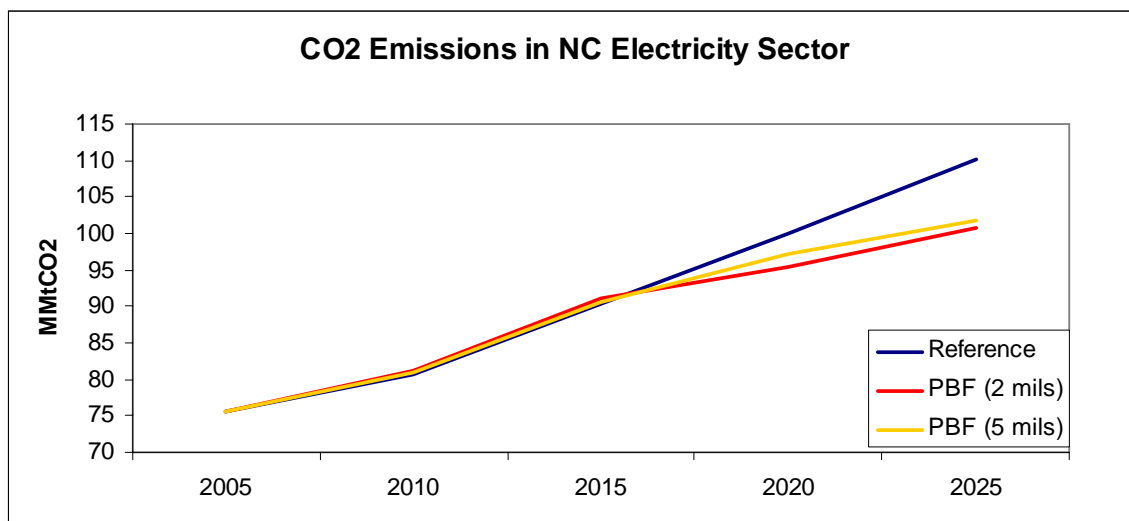
2005 = 2005, 2010 = average of 2006 - 2010, 2015 = average of 2011 - 2015 and so on

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Cumulative CO ₂ Reduction (MMtCO ₂) to 2025	62.7	1770	3.4%	\$0.15	\$0.49	(\$0.33)	(\$5.3)	\$0.34	\$0.49	\$7.8
PBF (2 mils)	53.8	1779	2.9%	\$0.49	\$1.29	(\$0.80)	(\$14.9)	(\$0.54)	(\$0.05)	(\$1.0)
PBF (5 mils)										
NOTES:	CO ₂ reductions as a result of policy	Reference case emissions (1833 MMtCO ₂) - (a)	(a) / (b)	Direct incremental cost of policy out to 2025 ¹	Direct incremental benefits of policy out to 2025 ²	(d) - (e)	(f) * 1000 / (a)	Difference between policy and reference SERC region system cost out to 2025 ³	(d) + (h)	(i) * 1000 / (a)

¹ For example, renewable costs are total costs of renewables - total cost of equivalent amount of new fossil capacity. Direct Policy Costs are seen by the implementor of the policy

² For example, difference between the cost of efficiency and either the cost of generation (EPS) or the cost to the end user (Government Target). Direct Policy Benefits are seen by the implementor of the policy

³ Implicit in Incremental System Costs are Policy Benefits. Incremental System Costs represent the impact of the policy on the total cost of the electricity system within SERC, but do not reflect the Direct Policy Cost



2005 = 2005; 2010 = average of 2006 – 2010; 2015 = average of 2011

Data Sources, Methods and Assumptions:

Most data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes *Assumptions to the Annual Energy Outlook* that details key assumptions in the current version of the model.⁶⁷ EIA also publishes NEMS model documentation.⁶⁸

The specific levels of energy efficiency and renewables achieved as a result of the PBF policy were developed using the North Carolina Energy Economic Model written by Skip Laitner for the North Carolina State Energy Office and maintained at Appalachian State University. The PBF policy analyzed here is consistent with the PBF policy being analyzed by Appalachian State University to determine the indirect economic impact in North Carolina. A small amount of renewable generation is part of the PBF policy, but since this capacity is assumed to be owned and operated by residential, commercial and industrial electricity customers, it was modeled within NEMS as a demand reduction.

The PBF was analyzed by lowering the demand for electricity in the residential, commercial and industrial sectors by an amount equal to the level of energy efficiency investment assumed by the PBF. Total system costs, carbon dioxide emissions, and other outputs were compared with the NEMS reference case. Because the NEMS model is a national model with multi-state regions (North Carolina is within the Southeastern Electric Reliability Council or SERC), the policy was implemented within the SERC region at a level for North Carolina. We make the assumption that the change in outputs in the entire region is attributed wholly to the policy in North Carolina. This assumption is reasonable given that the electricity market operates at a regional and even

⁶⁷ The document can be found here: [http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554\(2005\).pdf](http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554(2005).pdf)

⁶⁸ NEMS documentation can be found here: [http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581\(2003\).pdf](http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581(2003).pdf)

inter-regional level. Although we can collect data within state bounds, any change in the electricity system within a given state will reverberate within the surrounding region and beyond.

For the direct policy costs and benefits, the PBF was analyzed from the perspective of the PBF fund administrators and electricity customers participating in the PBF program. These costs are the total costs incurred by ratepayers who must contribute to the PBF program and the incremental private investment (the additional cost to the customer of energy efficient equipment rather than typical equipment) of the costumers who participate. The direct policy benefits are the cost savings to PBF participants associated with avoiding the purchase of electricity resulting from energy efficiency investments.

The system cost, which is an output of the NEMS model, represents the increment in the total cost of the system (including capital, operating and maintenance, fuel, transmission and distribution) that results from the PBF. But the NEMS output does not include the direct policy cost, so we add it to the system cost to approximate the full cost to society. We do not need to add the direct policy benefits because those are already reflected in incremental system cost that comes out of NEMS.

Key assumptions of the PBF analysis are that the PBF funds would generate the assumed level of private investment in energy efficiency through public education, R&D, demonstration projects, direct grants/buydowns/tax credits to subsidize advanced technologies, and low interest revolving loans.

Key Uncertainties:

As with any assessment of the future, the PBF analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions. If those assumptions are incorrect, then the results would change. Other key uncertainties are the ability of the NEMS model to give credible results for the SERC region and for the resulting changes in the SERC region to be fully attributable to policies implemented in North Carolina. Other uncertainties are the forecast of the price of fossil fuels, the cost, availability and operating characteristics of new power plants in the future, and the growth in the demand for electricity.

Description of Ancillary Benefits and Costs:

The PBF 2 Mils policy analyzed here would result in reductions of criteria air pollutants as follows:

- SO₂: 732,000 tons (cumulative through 2025) or 38,500 tons (average per year)
- NO_x: 4,500 tons (cumulative through 2025) or 240 tons (average per year)
- Mercury: 3.1 tons (cumulative through 2025) or 361 pounds (average per year)

The PBF 5 Mils policy analyzed here would result in reductions of criteria air pollutants as follows:

- SO₂: 693,000 tons (cumulative through 2025) or 36,400 tons (average per year)
- NO_x: 2,200 tons (cumulative through 2025) or 115 tons (average per year)
- Mercury: 6.1 tons (cumulative through 2025) or 704 pounds (average per year)

Most reductions would occur later in the period, between 2015 and 2025.

The PBF 2 Mils policy results in a net 0.10% increase in overall electricity system costs (on a NPV basis) compared to the reference case. The PBF 5 Mils policy results in a 0.01% decrease. Unlike scenarios that involve mandatory builds of renewable capacity, neither level of PBF program shifts the system costs in a way that necessarily leads to economic development in North Carolina. Both scenarios result in lower capital investment (-\$0.21 for PBF 2 Mils and -0.16 for PBF 5 Mils) than in the reference case. Both scenarios have lower operating and maintenance expenses (-\$0.31 billion and -\$0.27 billion respectively). Fuel expenses go up relative to the reference case for both PBF scenarios (\$0.93 billion and \$0.20 billion). For the PBF 2 Mils scenario, transmission and distribution costs decrease by a total of \$0.07 billion, and in the PBF 5 Mils case, transmission and distribution costs decrease by \$0.32 billion. The direct cost of the PBF 2 Mils scenario amounts to \$0.15 billion, and the direct cost of the PBF 5 Mils scenario costs \$0.49 billion.

Description of Feasibility Issues:

The implementation of a PBF program requires that an administrator be designated or created. The administrator is typically a new or existing state agency or a new or existing non-profit organization. As with any government or quasi-government agency, there will be costs associated with running the program. But many other states have such programs and have demonstrated that they are administratively feasible.

State Facilities Electricity Reduction Goal

Policy Description:

North Carolina intends to reduce electricity consumption in State-owned buildings by 20% in 2008 and ramping up to 50% in 2016. These reductions, relative to the reference forecast of consumption in State-owned buildings, would result in a 560 GWh reduction in 2008 (0.43% reduction in total electricity demand in North Carolina) and a 1,760 GWh reduction in 2016 (1.18% total reduction). Specific measures that can be used to achieve this goal are 1) design new buildings to use as little electric lighting and space heating/cooling as possible through “green design” principles that take advantage of natural lighting, heating and cooling; 2) to meet or exceed EPA energy star specifications for all new equipment in buildings; 3) to retrofit old inefficient or ineffective components, such as windows, space heating/cooling equipment, and refrigerators; 4) and to replace boilers with or install new combined heat and power systems and distributed generation, included distributed renewables, wherever possible.

BAU Policies/Programs: TBD.

Types(s) of GHG Benefit(s): Reducing the demand for electricity and fuel in government buildings should lead to modest reductions in fossil fuel use and thus reduce GHG emissions.

Types of Ancillary Benefits and or Costs:

Reductions in overall energy consumption and the shift from fossil fuel generation as a result of the state facilities reduction goal will lead to reductions in criteria air pollutants and,

consequently, health costs associated with those pollutants. Much of the investment made as a result of the reduction goal will go into zero or low-cost (even negative cost) energy efficiency, which will more than pay for itself. Nevertheless, the impact on the larger electricity system of the state facilities target can lead to a small increase in overall electricity system cost for the SERC region.

Estimated GHG Savings and Cost per Ton CO₂e:

	MMtCO ₂				
	2005	2010	2015	2020	2025
Reference	76	81	90	100	110
State Facilities Target	76	81	91	96	102
Reduction	0	-0.7	-0.9	3.9	8.0
Percent Reduction	0.0%	-0.9%	-1.0%	3.9%	7.2%

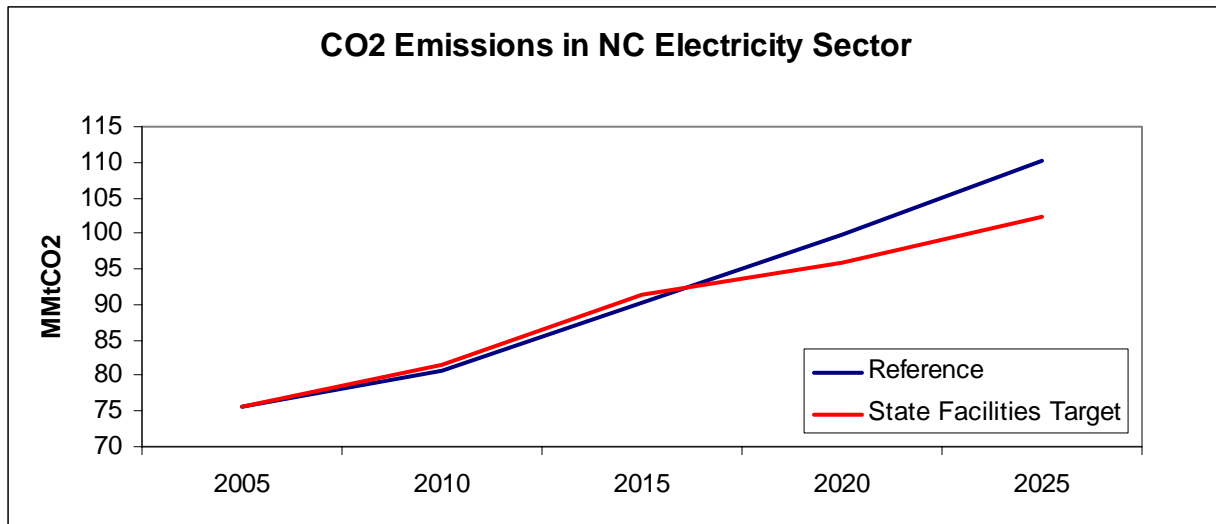
2005 = 2005, 2010 = average of 2006 - 2010, 2015 = average of 2011 - 2015 and so on

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
Cumulative CO ₂ Reduction (MMtCO ₂) to 2025	50.8	1782	2.8%	\$0.14	\$0.33	(\$0.18)	(\$3.6)	\$0.64	\$0.78	\$15.4
State Facilities Target										
CO ₂ reductions as a result of policy		Reference case emissions (1833 MMtCO ₂) - (a)	(a) / (b)	Direct incremental cost of policy out to 2025 ¹	Direct incremental benefits of policy out to 2025 ²	(d) - (e)	(f) * 1000 / (a)	Difference between policy and reference SERC region system cost out to 2025 ³	(d) + (h)	(i) * 1000 / (a)

¹ For example, renewable costs are total costs of renewables - total cost of equivalent amount of new fossil capacity. Direct Policy Costs are seen by the implementor of the policy

² For example, difference between the cost of efficiency and either the cost of generation (EPS) or the cost to the end user (Government Target). Direct Policy Benefits are seen by the implementor of the policy

³ Implicit in Incremental System Costs are Policy Benefits. Incremental System Costs represent the impact of the policy on the total cost of the electricity system within SERC, but do not reflect the Direct Policy Cost



2005 = 2005; 2010 = average of 2006 – 2010; 2015 = average of 2011

Data Sources, Methods and Assumptions:

Most data for the electricity modeling done in this analysis comes from the US Energy Information Administration (EIA) and can be found within the National Energy Modeling System (NEMS). Data in NEMS includes representation of the existing generation, transmission and distribution system down to the unit level. NEMS also includes data that characterizes new plants that the model can choose to build to meet projected demand growth. EIA publishes *Assumptions to the Annual Energy Outlook* that details key assumptions in the current version of the model.⁶⁹ EIA also publishes NEMS model documentation.⁷⁰

The specific levels of energy efficiency that are invested in as a result of the government policy were derived from state data on electricity consumption in state facilities⁷¹ and the stated goal reduction goal in the State Energy Plan: 20% reductions from current baselines by 2008 and 4% per year for the next 5 years to include a 50% reduction by 2016 and maintenance of that level indefinitely. The cost of energy efficiency was based on costs for North Carolina in *Powering the South*.⁷²

The state facilities target was analyzed by lowering the demand for electricity in the commercial sector, which includes government, by an amount equal to the level of energy efficiency investment assumed by the state reduction goal. Total system costs, carbon dioxide emissions, and other outputs were compared with a reference case NEMS run. Because the NEMS model is a national model with multi-state regions (North Carolina is within the Southeastern Electric Reliability Council or SERC), the policy was implemented within the SERC region at a level for North Carolina. We make the assumption that the change in outputs in the entire region is attributed wholly to the policy in North Carolina. This assumption is reasonable given that the electricity market operates at a regional and even inter-regional level. Although we can collect

⁶⁹ The document can be found here: [http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554\(2005\).pdf](http://www.eia.doe.gov/oiaf/aeo/assumption/pdf/0554(2005).pdf)

⁷⁰ NEMS documentation can be found here: [http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581\(2003\).pdf](http://www.eia.doe.gov/oiaf/aeo/overview/pdf/0581(2003).pdf)

⁷¹ Personal communication from Leonard Hoey of the North Carolina State Energy Office.

⁷² Powering the South can be found here: <http://www.poweringthesouth.org/report/>

data within state bounds, any change in the electricity system within a given state will reverberate within the surrounding region and beyond.

For the direct policy costs and benefits, we analyzed the state facilities target from the perspective of the North Carolina government. These costs are the total costs incurred by the state in order to meet the reduction goal. The direct policy benefits are the cost savings to the state associated with avoiding the purchase of electricity resulting from energy efficiency investments.

The system cost, which is an output of the NEMS model, represents the increment in the total cost of the system (including capital, operating and maintenance, fuel, transmission and distribution) that results from the PBF. But the NEMS output does not include the direct policy cost, so we add it to the system cost to approximate the full cost to society. We do not need to add the direct policy benefits because those are already reflected in incremental system cost that comes out of NEMS.

Key assumptions of the state facilities target analysis are that the general efficiency investment assumed in the Powering the South study can be applied to state facilities. Most likely, the direct cost of reductions would be lower than the 2.6 cents per kWh assumed for this analysis.

Key Uncertainties:

As with any assessment of the future, the state facilities target analysis has many uncertainties. Key uncertainties are, first, related directly to the key assumptions. If those assumptions are incorrect, then the results would change. Other key uncertainties are the ability of the NEMS model to give credible results for the SERC region and for the resulting changes in the SERC region to be fully attributable to policies implemented in North Carolina. Other uncertainties are the forecast of the price of fossil fuels, the cost, availability and operating characteristics of new power plants in the future, and the growth in the demand for electricity.

Description of Ancillary Benefits and Costs:

The state facilities target analyzed here would result in reductions of criteria air pollutants as follows:

- SO₂: 757,000 tons (cumulative through 2025) or 39,800 tons (average per year)
- NO_x: 7,600 tons (cumulative through 2025) or 400 tons (average per year)
- Mercury: 2.3 tons (cumulative through 2025) or 270 pounds (average per year)

Most reductions would occur later in the period, between 2015 and 2025.

The state facilities target results in a net 0.16% increase in overall electricity system costs (on a NPV basis) compared to the reference case. Unlike scenarios that involve mandatory builds of renewable capacity, the state facilities target does not shift the system costs in a way that necessarily leads to economic development in North Carolina. This scenario results in lower capital investment (-\$0.17) than in the reference case. It has lower operating and maintenance expenses (-\$0.25). Fuel expenses go up relative to the reference case (\$1.07 billion). For this

scenario, transmission costs increase by \$0.02 billion, and distribution costs decrease by \$0.03 billion. \$0.14 billion is invested in energy efficiency equipment.

Description of Feasibility Issues:

The implementation of a state facilities reduction target is quite simple in that the state has only to decide to act. Plenty of opportunities for reduction can be found in state facilities at a low cost or even negative cost to the state.

Transportation and Land Use

State Vehicle Efficiency Improvements

Policy Description: This portfolio includes measures to procure efficient vehicles for the motor vehicle fleets owned by the State. The analysis examines three scenarios of increased efficiency of vehicles owned by the State: a 25 mile per gallon fuel economy of new vehicles purchased by the State, a 30 mile per gallon scenario, and a 35 mile per gallon scenario. These fuel economy values are applied to the fraction of new vehicles assumed to be state vehicle purchases starting with model year 2006 and continuing each model year through 2020. The values are applied to both passenger cars and light-duty trucks purchased by State agencies.

BAU Policies/Programs: TBD.

Types(s) of GHG Benefit(s): By spurring the use of energy efficient vehicles in the State, vehicle efficiency programs reduce the motor vehicle fuel consumptions, thereby leading to a reduction in CO2 emissions.

Types of Ancillary Benefits and or Costs: Reductions in fuel consumption as a result of the improved vehicle efficiency also leads to reductions in criteria air pollutants as well as reduced fuel costs to the consumer (in this case, the state government).

Estimated GHG Savings and Cost per Ton CO₂e: The benefits of increased fuel economy in the State vehicle fleet, as well as the estimated annual fuel cost savings, are summarized in the table below:

Year	Scenario	Fuel Economy		Reduction in Gasoline Consumption		Reduction in CO ₂ Emissions MTCO ₂ e	Annual Fuel Cost Savings (million \$)	
		Miles per Gallon	per Year	Billion Btu	Million Gallons		At \$2.00/gal	at \$2.50/gal
2010	1	25		157	1.255	11,020	2.51	3.14
	2	30		238	1.904	16,715	3.81	4.76
	3	35		296	2.367	20,782	4.73	5.92
2020	1	25		348	2.779	24,401	5.56	6.95
	2	30		533	4.260	37,411	8.52	10.65
	3	35		665	5.319	46,704	10.64	13.30

Incremental costs for obtaining vehicles with fuel economies of 25 mpg, 30 mpg, or 35 mpg above that of a baseline vehicle could not be quantified at this time.

Data Sources, Methods and Assumptions:

- **Data Sources:** Number of State fleet vehicles purchased in 2003 by make and model were provided by NC DAQ. Annual mileage accumulation rates by vehicle age for LDGVs and LDGTs were obtained from EPA's MOBILE6 emission factor model defaults.
- **Quantification Methods:** The number of miles driven annually by each of these higher efficiency vehicles was calculated first, based on adding an additional 658 higher efficiency LDGVs and 600 LDGTs each model year. The number of vehicles was multiplied by the assumed mileage accumulated by each vehicle, depending upon its age. The difference in fuel economy between a baseline LDGV (at 24 mpg) or LDGT (at 16 mpg) was then calculated and this fuel consumption was then converted to CO2 emissions.
- **Key assumptions:** This analysis assumes a constant number of State vehicles purchased each model year, starting in 2006, based on number purchased in 2003. After vehicles have reached their useful life for the State, these vehicles are sold and remain in use within North Carolina. The mileage accumulation rates for State vehicles was assumed to be the same as the national fleet average.

Key Uncertainties:

- **Benefits:** The number of vehicles purchased by the State may be underestimated. The number of vehicles included here may not include vehicles purchased by NCDOT.
- **Costs:** Gasoline costs are currently highly unstable. Depending upon future increases in the price of gasoline, the benefit of this policy may well outweigh the incremental purchase price of a more efficient vehicle.

Description of Ancillary Benefits and Costs:

Benefits: TBD.

Costs: TBD.

Description of Feasibility Issues: It should be noted that a majority of the NC 2003 light-duty vehicle purchases were flexible-fueled vehicles that can use either gasoline or up to a mixture of 85 percent ethanol and 15 percent gasoline. These purchases have been made in fulfillment of NC's EAct requirements. In general, these vehicles have lower fuel economy values than comparable gasoline-only vehicles. The feasibility of implementing an increased vehicle efficiency requirement on top of these EAct requirement needs to be further investigated.

VMT Reduction Portfolio

Policy Description: There are a variety of policies states can adopt that reduce vehicle miles traveled. Sometimes this portfolio is labeled "smart growth" or "anti-sprawl." This portfolio includes measures such as the following:

- Develop conservation and development plans with associated capital investment goals and strategies that meet regional needs and are consistent with the broad concepts of efficient land use planning and management.
- Redevelop brownfields, taking full advantage of federal monies available for these programs
- Promote transit-oriented development.

- Identify methods and techniques that integrate local and regional land use planning and economic development strategies with multi-modal transportation planning and investment
- Protect open space and agricultural lands
- Improve existing transit services and new transit services
- Promote pedestrian scale streetscapes and give priority to pedestrian and bike access at all major developments
- Create more and expand existing pedestrian facilities linking neighborhoods with schools, employers, commercial areas, etc.
- Create longer and interconnected bike paths

The emission reductions from these policies are difficult to measure and accrue slowly.

A VMT reduction portfolio was analyzed using NC data and integrating experience in other states and localities. Reductions in growth in VMT of 1%-10% are possible.

BAU Policies/Programs: TBD.

Types(s) of GHG Benefit(s): Direct reduction in vehicle activity leading to significant reduction in GHG emissions.

Types of Ancillary Benefits and or Costs:

Reductions in VMT growth will lead to direct corresponding reductions in emissions from criteria and hazardous air pollutants from light duty vehicles and trucks. The reductions in VMT will also lead to reductions in fuel consumption as a result of the reduced travel, which will reduce total fuel costs.

Estimated GHG Savings and Cost per Ton CO₂e:

The table below summarizes the total reductions CO₂, CH₄, and N₂O resulting from the reduced VMT growth rates. The low VMT reduction scenario assumes that the rate of VMT growth from 2005 to 2010 is reduced by 5 percent and that the rate of VMT growth from 2005 to 2020 is reduced by 10 percent. The high VMT reduction scenario assumes that the rate of VMT growth from 2005 to 2010 is reduced by 10 percent and that the rate of VMT growth from 2005 to 2020 is reduced by 25 percent. These reductions are assumed to come from light-duty gas vehicles (LDGVs), light-duty gas trucks (LDGTs), light-duty diesel vehicles (LDDVs), light-duty diesel trucks (LDDTs), and motorcycles. This table also shows the total VMT reductions achieved in these scenarios. The costs associated with these scenarios have not been estimated at this time due to the large variability in costs associated with the wide variety of measures that could be used towards achieving these VMT reductions. However, a portion of the costs would be offset by the reduction in fuel consumption costs associated with the reduced VMT.

Scenario	Year	Total Reduction in VMT (million miles per year)	Total Reduction in GHG Emissions (MMTCO ₂ E per year)
Low VMT Reduction	2010	719	0.3467
	2020	6,933	3.4963
High VMT Reduction	2010	1,434	0.6917
	2020	16,801	8.4729

Data Sources, Methods and Assumptions:

- **Data Sources:** Information on projection year fuel economy values was obtained from MOBILE6 data.
- **Quantification Methods:** These estimates were calculated by first estimating the total rate of growth in VMT in the baseline projections from 2005 to 2010 and 2020 from LDGVs, LDGTs, LDDVs, LDDTs, and motorcycles. The annual baseline growth rate from 2005 to 2010 was 2.6 percent per year and the annual baseline growth rate from 2005 to 2020 was 3.1 percent per year. Total VMT from these vehicle categories was then recalculated after reducing the VMT growth rate by the amount specified for each scenario. The resulting total VMT was then distributed by vehicle category using the same mix as in the baseline 2010 and 2020 VMT estimates. Emission reductions of CH₄ and N₂O were calculated by multiplying the baseline projected emissions by each of the five light-duty vehicle categories by the ratio of the VMT reduced for that vehicle category to the baseline VMT for that vehicle category in the specified year. To calculate CO₂ emission reductions, the VMT reductions were converted to fuel consumption reduction estimates. The CO₂ emission reductions were then calculated using the same equations as the baseline CO₂ emission projections, but based on the fuel consumption reduced rather than total fuel consumption.
- **Key assumptions:** The VMT growth rate reduction percentages were selected to be representative of what could possibly be achieved using some combination of the VMT reduction strategies listed above. To convert the VMT reductions to fuel consumption reductions, the following fuel economy values were assumed: 24 mpg for LDGVs; 16 mpg for LDGTs; 32 mpg for LDDVs; 20 mpg for LDDTs; and 50 mpg for motorcycles.

Key Uncertainties:

Benefits: The actual VMT reductions that can be achieved with each of the measures listed above are difficult to quantify. However, it is expected that some combination of these measures could achieve the modeled VMT growth rate reductions.

Costs: Since specific VMT reduction measures were not modeled, the cost associated with achieving these VMT growth rate reductions has a wide range of uncertainty.

Description of Ancillary Benefits and Costs:

- **Benefits:** Exhaust emissions from criteria and hazardous air pollutants would also be reduced in direct proportion to the VMT reductions from the light-duty vehicles and trucks. The low VMT reduction scenario leads to a 0.6 percent VMT reduction from LDVs and LDTs in 2010 and a 4 percent reduction in 2020. Under the high VMT reduction scenario, LDV and LDT VMT is reduced by 1 percent in 2010 and 11 percent in 2020. Exhaust LDV and LDT emissions from criteria and hazardous air pollutants would be reduced by roughly these same percentages.
- **Costs:** The costs for achieving these ancillary emission reductions would be the same as the costs or savings that would be incurred to obtain the GHG emission benefits. No additional costs would need to be incurred to obtain the criteria and hazardous air pollutant emission reductions.

Description of Feasibility Issues: TBD.

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