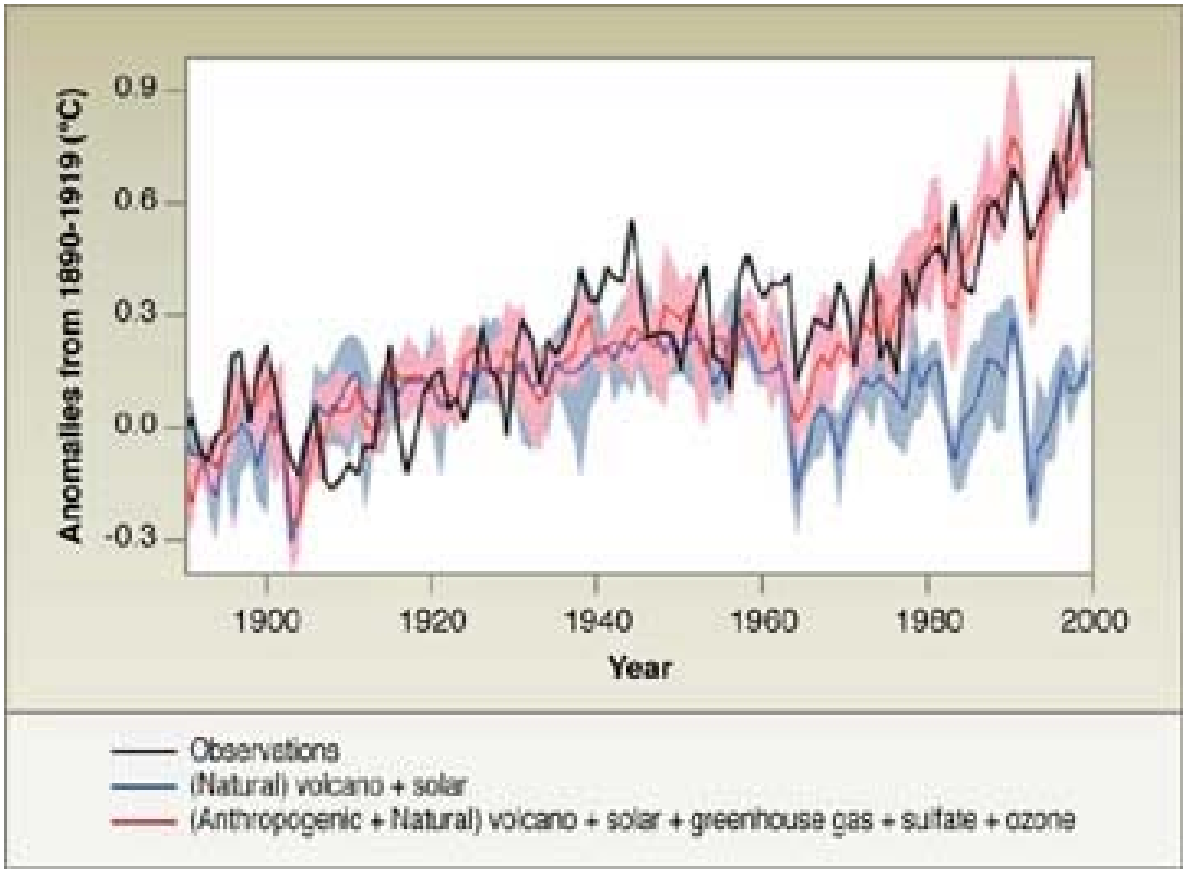
CO_2 Emission Reduction Options For Coal-fired Electrical Utility Boilers and Other Stationary Sources

September 1, 2004
Second Interim Report Pursuant to Clean Smokestacks Act



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

The Requirement: Excerpted from the 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 (CO_2) 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 (CO_2). 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 (CO_2) 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 (CO_2) is reduced as a result of the reductions in the emissions of oxides of nitrogen (NOx) and sulfur dioxide (SO_2) 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

CO_2 Emission Reduction Options For Coal-fired Electrical Utility Boilers and Other Stationary Sources

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September 2004: Second Interim Report

Pursuant to the Clean Smokestacks Act of 2002

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

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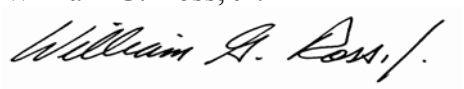
An Invitation from Secretary Ross

TO: Environmental Review Commission
Environmental Management Commission

FROM: William G. Ross, Jr.



DATE: September 1, 2004

SUBJECT: Mercury and CO_2 Reports Required by Clean Smokestacks Act

On March 23, 2004, the United States Environmental Protection Agency recognized North Carolina and the Clean Smokestacks Act for outstanding, innovative efforts in improving air quality through regulatory and policy innovations and presented our state with a Clean Air Excellence Award. I had the privilege of saying a few words at the award ceremony in Washington, D.C., on behalf of our state, Governor Easley, and all the other partners who played vital roles in the passage of the law. It was a pleasure for me to describe the story of the Clean Smokestacks Act as a story about the power of innovation, partnerships, teamwork, and leadership.

The act, in addition to providing for major reductions in $S0_2$ and NO_X emissions from NC's 14 coal-fired power plants, directed our Division of Air Quality, over a three year period, to study and make recommendations concerning emissions of mercury and carbon dioxide.

As you know, these are important, controversial issues. For example, Donald Kennedy, the Editor of *Science*, has called climate change "the most serious issue" we face.

Last year, 2003, the Division, working with a broad group of interested parties, put together reports reviewing and summarizing the state of scientific research on mercury and carbon dioxide emissions. This year, 2004, the Division has updated the review of research, and has inventoried options for the recommendations we must make next year (2005). We now ask all interested parties to read this year's report and give us their views, questions and suggestions about it.

> In the upcoming year, as we consider what to recommend, we will evaluate options for action with a number of criteria and principles in mind. As a starting point for those criteria and principles, we plan to use ones suggested in a report of a November, 2003 Aspen Institute policy dialogue chaired by Eileen Claussen and Robert W. Fri. The title of the report is: *A Climate Policy Framework: Balancing Policy and Politics*. As adapted for use in the task that the General Assembly has given us, the criteria and principles are as follows:

1. Environmental effectiveness: How effective is the option in meeting its environmental and public health and welfare target, whether that target is public awareness, information collection and evaluation, or emission reduction?
2. Cost effectiveness: Will the option design allow cost-effective compliance? How will it affect the ability of business to compete?
3. Administrative feasibility: Can the option be administered and does it minimize administrative and transaction costs?
4. Distributional equity: Is the burden of compliance with the option fairly apportioned?
5. Political acceptability: Are there elements of option design that affect its political acceptability?
6. Technology development and diffusion: Will the option help provide a platform for technology development and diffusion?
7. Adaptability: Will the option be able to adapt to changing circumstances and incorporate new information?
8. Monitoring and counting: Will the option include things that can be monitored and are verifiable?
9. Encouraging long term success: Will the option encourage long-term progress and success?

As I mentioned above, we invite your input with respect to whether these are the appropriate criteria and principles and how the various options for recommendations come out when judged against the appropriate criteria and principles. Also, we invite you to suggest options that are not in our inventory and to tell us why such options should be considered.

In the interest of giving every citizen of our State, now and in the future, a reasonable opportunity to live a happy, healthy, and prosperous life, we solicit your input and appreciate your help.

Preface

The North Carolina Clean Smokestacks Act (CSA), Session Law 2002-4 (aka Senate Bill 1078), was passed and signed into law in June 2002. This Act's primary requirements established reductions of SO_2 and NOx emissions from coal-fired power plants within the State. There were also two sections of the Act which require the Division of Air Quality (DAQ) to provide reports to the Environmental Management Commission (EMC) and the Environmental Review Commission (ERC) by September of 2003, 2004 and 2005, regarding the effects of these controls on mercury and CO_2 emissions. These sections also require DAQ to study and make recommendations to these bodies regarding any further actions needed for these two substances. The first reports (first interim) under this requirement were provided in 2003 and are available from DAQ's web page on the Internet at http://daq.state.nc.us/news/leg/. A summary of some of the main findings of that report follows this page.

The information in this Second Interim Report on CO_2 supplements and updates the information in the September 2003 report and attempts to define a range of options for future consideration (and should not be considered recommendations). Recommendations from DAQ will be addressed in the September 2005 report. The DAQ will continue the stakeholder process through the preparation of that final (September 2005) report. It continues to solicit input from stakeholders and all comments will be seriously considered. However, DAQ recognizes that it is responsible for all final recommendations, and reserves the rights to include, exclude, or revise the final documents to reflect its best judgment of facts, science and objectivity.

DAQ held a public workshop April 19-21, 2004 as a means of soliciting the latest available information, providing a forum for their discussion among stakeholders and others, and to generally exchange ideas on both CO_2 and mercury. A wide variety of speakers, many of whom are leading experts in their field, provided presentations. The presentation slides of the main points are provided on DAQ's web page and listed in Appendix A of this report. To view them, go to: http://daq.state.nc.us/news/leg/cleanst_hg_co_prov.shtml on your web browser and this will link you to those resentations. DAQ recognizes each of these speakers for their work and expresses its appreciation to each of them for their time and efforts to make these presentations and share their expertise.

Please note that in a few cases, text from some public domain (government) references may be repeated *verbatim* in this report for efficiency, expediency and accuracy. These situations are indicated. The intent is to give proper credit and use only public (copyright unrestricted) sources in these instances. If any errors or deviations to this intent are found, please immediately bring these situations to the attention of the authors. It is not the intent of the authors or DAQ 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.

Selected Conclusion Statements Extracted From First Interim Report

(See 2003 Report for further details at http://daq.state.nc.us/news/leg/)[1]

- Leading national and international science and governmental authorities, including the current administration, have concluded that man-made emissions 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"[2] accepts and supports the conclusions of the NAS report alluded to above.
- Despite the strong and growing scientific consensus, many still debate the severity of impacts from increased GHG, including CO_2[3], 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.
- Options for reducing GHG emissions include conservation, process changes, development and adoption of new technologies and other approaches at all levels of society.
- CO_2 is only one of several (usually identified as five major[4]) greenhouse gases that affect the climate, but the CSA could be interpreted to only address CO_2.
- The emissions of CO_2 in North Carolina from known sources have been quantified by multiple studies. These studies provide data that are acceptable for purposes of problem assessment. However, for emission trading purposes, the protocols and documentation standards required may cause these estimates to be less than fully adequate.

Other energy savings programs exist that contribute, or have the potential to contribute, to the reduction of GHG emissions. For example, the proposed **NC Energy Plan** is closely aligned and based on similar principles and objectives.

- Currently, substantial reductions in emissions of CO_2 are expected to come from energy efficiency improvements and other measures to reduce fuel consumption, as identified in the State Energy Plan.
- The recognized most effective way to "control" CO_2 is to reduce or refrain from burning of carbon-based fuels.
- Scrubbers that control or reduce NOx or SO_2 emissions are not effective in significantly reducing CO_2 and
- Several DOE (and other) research projects aim to
    - increase efficiency of utility boilers
    - capture/sequester CO_2 from stacks, and
    - control these gases by new and innovative methods (such as injection of captured stack effluent into deep underground coal seams or brine pools).

However, these have not yet been proven fully successful or economically viable.

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[1] North Carolina Division of Air Quality, DENR, *CO_2 Emission Reduction Options for Coal-fired Electrical Utility boilers and Other Stationary Sources, First Interim Report,* September 2003.

[2] Climate Action Report, http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsUSClimateActionReport.html, US Department of State, Washington, DC, May 2002.

[3] Status of the Kyoto Protocol; The United Nations Framework Convention on Climate Change, July 2003.

[4], US DOE, Energy Information Administration, Washington, DC ,*Emissions of Greenhouse Gases in the United States 2001*, DOE/EIA-0573, December 2002.

Acronyms Used in This Report

AEFL - Amine-Enhanced Flue Lean Gas Reburn
CAA – Clean Air Act – Primary federal statute governing clean air requirements
CAFO – Confined Animal Feeding Operation
CAIR – Clean Air Interstate Rule
CAPA – Clean Air Planning Act – Carper Bill
CCAR – California Climate Action Registry
CCSP – Climate Change Science Program
CEM – Continuous Emission Measurement
CHP – Combined Heat and Power
CO_2 – Carbon Dioxide – the major global warming gas
CPA – Clean Power Act - Jeffords-Waxman Bill
CSA – North Carolina Clean Smokestacks Act (See inside cover for full text and title)
CSI – Clear Skies Initiative (or Act) – Proposal for revised CAA legislation by the Bush Administration (also recently referred to as synonymous with the CAIR)
DAQ – North Carolina Division of Air Quality
DENR – NC Department of Environment and Natural Resources
DOA – Department of Agriculture (US or NC)
DOE – The US Department of Energy
EPC – Energy Policy Council
EMC – Environmental Management Commission (NC)
EPICI – Electric Power Industry Climate Initiative
ERC – Environmental Review Commission (NC)
EPA – US Environmental Protection Agency
GHG – Greenhouse Gas(es)
GWP – Global Warming Potential
HFC's - Hydroflurocarbons
HVAC – High Volume Air Conditioning
IGCC – Integrated Gasification Combined Cycle
IPCC - Intergovernmental Panel on Climate Change, international authority on climate change
kWh – Kilowatt hour (1000 watts for one hour)
LNB – Low NOx Burner
LoGESO – Local Government Energy Savings Organization
NAAQS – National Ambient Air Quality Standards
NAS - National Academy of Science
NASA – National Air and Space Administration
NASEO – National Association of State Energy Officials
NC – North Carolina
NCCA – North Carolina Climate Action (Registry)
NCSU – North Carolina State University
NESCAUM - Northeast States for Coordinated Air Use Management
NHCPS – New Hampshire Clean Power Strategy
NSF – National Science Foundation
MOU – Memorandum of Understanding

MW – Mega-watt; millions of watts
NOAA – National Aeronautics and Space Administration
NOx – Oxides of Nitrogen, including NO_2, the primary nitrogen species from combustion
OFA – Overfire Air
PFC's - Perfluorocarbons
PTC – Production Tax credit
RGGI – Regional Greenhouse Gas Initiative (NESCAUM)
ROFA – Rotating Opposed-Fired Air
ROTAMIX – Injection of Ammonia to further reduce NOx (Used in combination with ROFA)
RPS – Renewable Portfolio Standard
SCR – Selective Catalytic Reduction
SCRUB – Wet scrubber for SOx
SEO – State Energy Office of NC
SEP – State Energy Plan of NC
SNCR – Selective Non-Catalytic Reduction
SO_2 – Sulfur Dioxide
SOx – Oxides of Sulfur, including SO_2, the primary combustion product of sulfur
SUV – Sport Utility Vehicle
TFS2000 – Combination Low-NOx Burner/Overfire Air
tpd – tons per day
UNFCCC - United Nations Framework Convention on Climate Change
WIR - Underfire Air

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CHAPTER I 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 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 CO_2 emissions from coal-fired power plants and other stationary sources. DAQ provided the First Interim Report to these two bodies in September of 2003. This Second Interim Report updates, and expands upon, the information presented in that report and begins to outline options that might be considered for recommendations in the 2005 report. Much of the information presented in this report was gained through additional literature searches and reviews and from information presented in a workshop held with stakeholders, national experts and interested parties in April 2004 (See Appendix A). DAQ continues to be open to new ideas and solicits your continuing input.

This Executive Summary is intended to list and highlight the range of options available from which to develop possible recommendations from which to choose for inclusion in the final report in 2005. This report does not make such choices this time. The process for reaching these decisions will include a continuing stakeholder process, expected to be reconvened in the spring of 2005. The remainder of this report provides additional discussion, details and highlights of options available. The intent is for the reader to use this Executive Summary to identify options and areas that they may wish to explore in more detail in other Chapters.

Main Findings in This *Second(2004) Interim Report*:

Some main points or findings summarized in this report are:

- According to the EPA, North Carolina ranks 14th among the states in total CO_2 emissions.[5]
- Our state's CO_2 output has grown steadily along with rises in energy consumption, increasing by more than 30 percent since 1990.[6]
- Currently more than 70 percent of North Carolina's energy comes from fossil fuels[7], and
- Residential energy consumption is expected to increase by about 50 percent by 2020.[8]
- Other GHG continue to be considered important in addition to CO_2.
- "End of Stack" solutions are not viable and practical for removal of CO_2 from stacks of power plants or other stationary sources at this time, but may be available over a longer term of several years.
- Costs of inaction to address climate change for North Carolina are projected by scientists and many others to be significant.

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[5] US EPA, *States Ranked By Total Carbon Dioxide Emissions*, http://yosemite.epa.gov/globalwarming%5Cghg.nsf/EIAStatesRankedbyTotalEmissionsAll?openview&count=52.

[6] US EPA, http://yosemite.epa.gov/oar/globalwarming.nsf/content/EmissionsStateEnergyCO2Inventories.html.

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

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

- A number of other states continue to take action on climate change in the absence of federal legislation. However, as this document was being finalized, the Bush administration made announcements regarding new affirmation that man's actions are definitely a part of the global climate change problem and that increased efforts to make reductions are appropriate. This announcement may spur new federal actions.
- 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.
- 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 state-wide, nationally and globally.
- It is likely feasible to take positive actions to develop North Carolina procedures and processes that will result in a climate change registry process whereby the State will become part of a global solution with relatively minor impact upon public resources.
- Efforts and developments in the national, regional state and global arenas continue, (almost daily) and will necessarily influence choices of the next best and sensible steps for North Carolina.

Potential Option Levels for Satisfying the CSA Requirements

In light of the global and national momentum, and because of the risks and opportunities climate change poses for our state, many are convinced that North Carolina must prepare its economy and its people for a carbon-constrained world. Carbon dioxide and other greenhouse gas (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 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 that are under consideration for the U.S Congress nationally will also likely have important impacts on efforts and steps in North Carolina, especially as needed to avoid redundancy and confusion.

This second interim report examines a wide range of options for reducing our State's GHG emissions and working with others to reduce the U.S. and global emissions. This report is thus intended to serve as an information source to aid DAQ, and stakeholders in developing recommendations for the North Carolina ERC and the EMC, as required by the CSA. Following submittal of this second interim report, the Division will begin developing an initial draft final report outlining proposed recommendations for North Carolina. That draft report is expected to be ready to begin stakeholder review by Spring 2005. Final revisions of that report, including final recommendations, will then follow by September 2005. The final recommendations will likely be developed from the list of options, or combinations thereof highlighted below, under five main groupings:

A. Take no action and default to potential federal and international actions to address the problem of requiring and defining means to achieve "CO_2 controls" (i.e. reductions) at some undetermined time in the future.

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 CO_2 from coal fired boilers, other stationary sources (combustion-centered, primarily) and transportation sources. This option would involve a significant mandatory reporting and accounting system to would guarantee that North Carolina does its share of leading and attainment of 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.

Some Candidate Actions to Achieve the Major Options Outlined Above:

The items listed below is not necessarily complete, but helps define a range of actions and programs that may be considered for components of the larger overall options outlined above to develop the final recommendations for September 2005:

1. Develop/implement caps for reducing emissions all GHG pollutants (expressed in carbon equivalents) from all major sectors in the State
2. Develop/implement requirements for improved fuel mileage from motor vehicles owned both by the State and by the public
3. Institute a program and target for across the board reductions in use of energy use by State government in North Carolina, with credits for these reductions being quantified and used for possible "cap and trade" programs within the State
4. Initiate a program and policy resulting in an incremental movement toward shifting all electricity purchased by the State government to be through the NC GreenPower renewable resources program
5. Develop and incorporate applicable GHG-friendly policies and requirements in to the State Implementation Plan revisions for ozone and particulate matter (PM 2.5) to the maximum level that is feasible
6. Develop processes and policies to implement new technologies such as IGCC at the earliest possible stage to maximize reductions and maximize efficiencies over the longer term, especially before anticipated replacement of existing power generation capacity in North Carolina
7. Develop/implement a meaningful and detailed emission registration requirement, eventually with third party verification and salable and tradable carbon credits, including strict tracking and accounting of all areas covered by the State Energy Plan, and including consideration for a sector for quantifying natural emissions
8. Develop policies, incentives and systems/programs to encourage complete conversion for using waste from animal operations to its maximum as an energy resource
9. Develop/implement innovative policies that encourage reductions in utility generation and emissions while providing incentives for utility companies to endorse and aggressively assist in achieving such reductions.
10. Maximize the application and effects of the State Energy Plan with tracking of each sector
11. Develop more extensive plans, policies and incentives for use of forest resources for sequestration and for renewable energy (while avoiding double counting)
12. Revisions in net metering limitations and support of passage of new net metering laws
13. Expand study and potential development of renewable and non emitting energy sources and policies related thereto for such categories as:
    a. NC GreenPower in both private and government sectors
    b. Solar
    c. Wind and "geo-power"
    d. Bio fuels, etc.

14. Develop and participate in implementation of significant multi-state energy and carbon emission reduction (Climate Action) plans, involving stakeholder processes where possible
15. Fund and otherwise encourage programs at North Carolina universities to develop energy efficient and carbon-minimized technologies for North Carolina and world markets
16. Aggressively pursue development and nurturing of energy and carbon minimization technology research and manufacturing developments, along with promoting these research programs and manufacturing industries in the state
17. Develop a North Carolina Climate Action Registry that involves mandatory reporting and targets, recognizes existing reporting avenues, and includes reporting by the State sources, all using State guidance and requirements for submittals, but with the DOE 1605 (b) registry being the depository (with a minimal reporting requirement for largest sources only – not geared toward a "State-run" trading system)
18. Develop a basis for an emission credits (trading) program to be administered by private sector resources and motivation
19. Develop further options and plans to integrate IGCC technologies into future planning for energy generation in the state with a future option for geological sequestration
20. Make major recommendations to the North Carolina General Assembly regarding how to potentially alter the utility planning process to allow or provide for earlier input with the earliest possible identification of opportunities for potential encouragement or requirement of new technologies
21. And other similar policies and processes that may be identified.

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If a man will begin with certainties, he shall end in doubts, but if he will be content to begin with doubts, he shall end in certainties. - Sir Frances Bacon

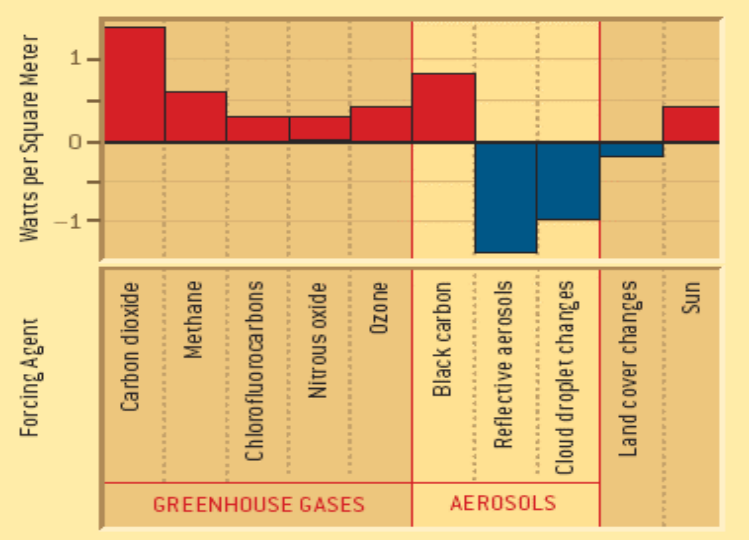
CHAPTER II BACKGROUND - NORTH CAROLINA'S CSA AND CLIMATE CHANGE

The text of the Clean Smokestacks Act (CSA) Section 13 appears on the inside of the cover page of this report, for convenience. The reader may also wish to review the First Interim Report (September 2003) or the summary on page v of this report, for further background and "state of the science" discussions not repeated in this report.

Pollutant Definitions and Other Terminology

The text of the CSA directs the Division to study CO_2, which is by mass or volume, the largest quantity of greenhouse gas (GHG) emitted by coal-fired utilities. It is also the largest effective component of the inventory of GHG emitted from all sources. However, as discussed in the First Interim Report other GHG, such as methane, N_2O, halocarbons, and others exist throughout the atmosphere and are contributory to warming of the oceans and Earth's atmosphere, with substantially more "warming effectiveness" per molecule than CO_2. For example, methane is 21 times more "potent" than CO_2. Other major contributors to atmospheric warming often overlooked and not addressed in these discussions are water vapor and particulate matter. Recent information provides evidence that "black carbon" particulate matter and nitrogen oxides, such as emitted from diesel vehicles, make significant contributors to climate change.[9] The Intergovernmental Panel on Climate Change (IPCC)[10] suggests that the effects of one ton of black carbon could equal that of about 200 to 600 tons of carbon dioxide when translated to temperature impacts. Although this document uses other GHG terms in places, the distinct identity and focus on CO_2 has also been retained for reference and completeness. Figure II-1 provides a pictorial representation of the relative impact of the various major GHG.

Figure II - 1[11]



[9] J. E. Hansen and Miki, Sato. *Trends of measured climate forcing agents*. Proc. Natl. Acad. Sci. 98, 14778-14783, 2001

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

[11] James E. Hansen, *Climate Forcings, 1850 – Present*, Scientific American, March 2004.

A related terminology question also exists regarding global warming gases, GHG or "climate change gases." The terms are sometimes used almost interchangeably though there are variations in meaning. ["**Climate change**" specifically refers to changes in long-term trends in the average climate, such as changes in average temperatures. Depending on usage, it may mean changes due to natural factors and variability, or as a result of human activity. "**Global Warming"** refers to the progressive gradual rise of the Earth's average surface temperature thought to be caused, in part, by increased concentrations of GHG in the atmosphere.][12] In this document, we use the term "GHG" for convenience, though the more applicable term might be "Climate Change Gases."

In most sections, the CSA is specifically applicable to coal fired power plants. However, in the language of Section 13, the scope includes "other stationary sources." Therefore, the scope of this report and study effort is not limited solely to the utility industry and discussions refer to other major sources generating GHG, such as motor vehicles (which, of course, are not stationary).

Review of Concerns About Global Warming and Climate Change

As was stated in the First Interim Report, evidence has been accumulating that the Earth is warming and that this warming is occurring in close parallel to the levels of CO_2 in the atmosphere.[13]. Man made emissions of CO_2 have been increasing at a significant rate since the Industrial Revolution when the combustion of fossil fuels and other carbon fuels began to accelerate at a very rapid rate. Recent measurements show that atmospheric concentrations of CO_2 have been rising, and continue to rise at a rapid rate. Figure II-2 shows a plot of actual ambient concentrations of CO_2 at one of the most representative sites in the world at a high elevation in Hawaii. Similar relationships have been established with levels of CO_2 and temperature, as discussed in the First Interim Report.

Internationally, scientists have been discussing the growth of the CO_2 and other GHG in the atmosphere for many years and have been drawn into two camps regarding the effects of man made changes to a historic cycle of global warming and cooling. Various international scientific bodies and the National Academy of Sciences have concluded however, that the concerns for the impact of man-made emissions are warranted and that governments must take immediate actions to reduce these emissions. We must consider both the shorter term and the long term impacts of our actions and practices. These concerns and considerations have prompted efforts all over the globe to do something but it has not been well coordinated or orchestrated for these actions to be universal and consistent. It is likely that a leadership role by North Carolina could help make a transition to a more aggressive set of reduction policies and actions, albeit not necessarily focused exclusively on the coal-fired electric power generation units. Even as this document was being prepared for final publication, the President announced additional information and agreement among scientists that man's role in the climate change phenomenon must be revised and further steps taken to mitigate the

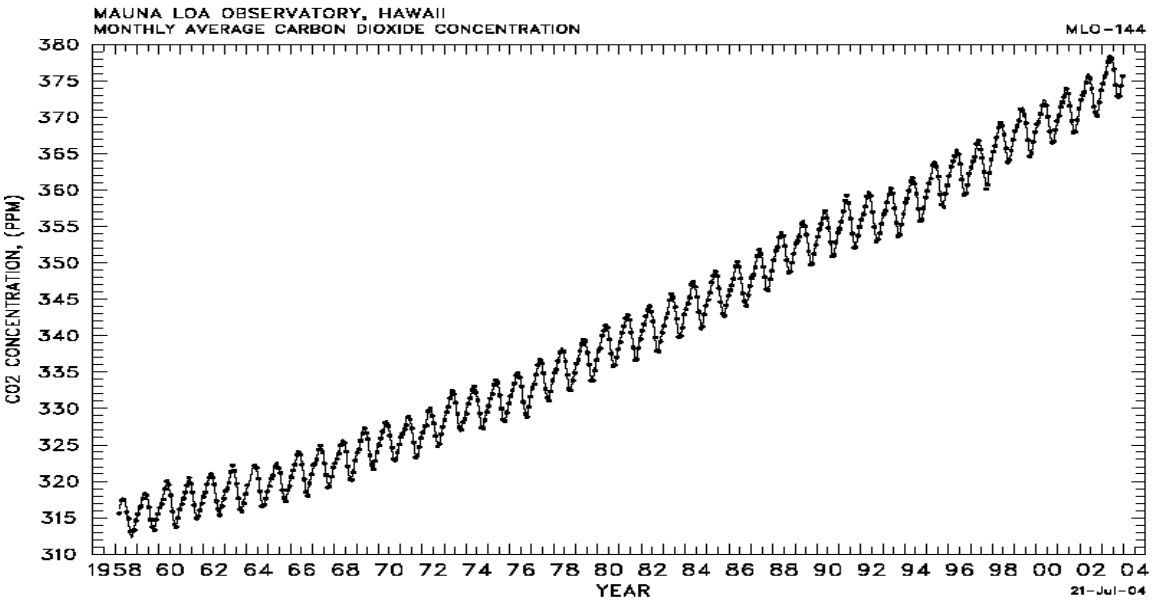
[12] The Pew Climate Change Center, *Global Warming Basics*, http://www.pewclimate.org/global-warming-basics/

[13] Wiley Barbour, *History and Transitions of Global Warming Programs and Policies,* Environmental Resources Trust, Inc., NC DAQ CO_2 and Mercury Workshop, Raleigh, NC, April 19, 2004 (See Appendix A).

emissions of GHG.[14] In addition, new reports out of Europe have also defined more evidence of the changes taking place there and around the globe.[15]

Figure II-2

Atmospheric CO_2 Measurements from Mauna Loa Observatory (Since 1958)



A article by Leonard David, Senior Space Writer with NASA, recently summarized and commented on a National Research Council report: "Abrupt climate changes in the last few thousand years generally have been less severe and affected smaller areas than some of the changes further back in the past. Nonetheless, evidence shows that rapid climate changes have affected societies and ecosystems substantially, especially when the changes that brought persistent droughts occurred in regions with human settlements, there is no reason to believe that abrupt climate changes will not occur again."[16] The NRC report also underscored the importance of not being fatalistic about the threats posed by abrupt climate change. "Societies have faced both gradual and abrupt climate changes for millennia and have learned to adapt through various mechanisms, such as moving indoors, developing irrigation for crops, and migrating away from inhospitable regions." The study group added: "Nevertheless, because climate change is likely to continue and may even accelerate in the coming decades, denying the likelihood or downplaying the relevance of past abrupt changes could be costly. Societies can take steps to face the potential for abrupt climate change."[17] Figure II-3 below (also see

[14] U.S. Climate Change Science Program, *Our Changing Planet*; a Report by the Climate Change Science Program and the Subcommittee on Global Change Research, Washington, DC, July 2004.

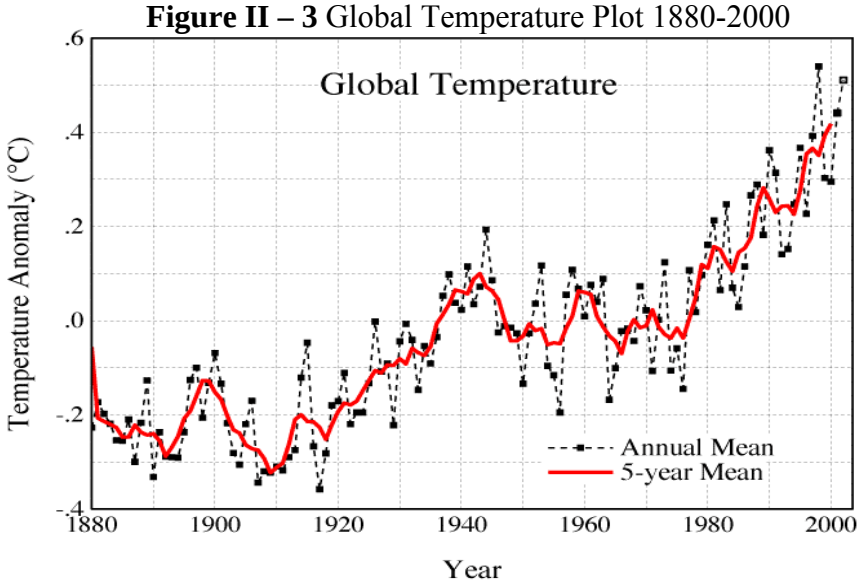
[15] European Environment Agency, *Impacts of Europe's changing climate,* August 18, 2004. http://reports.eea.eu.int/climate_report_2_2004/en/tab_abstract_RLR

[16] Leonard David, Senior Space Writer, NASA, June 2004, http://www.space.com/scienceastronomy/geoengineering_040601.html

[17] *Ibid.*

similar graph on cover), produced by NASA,[18] provides convincing evidence that the global temperature is increasing, even though the increments of change may seem small.

Figure II – 3 Global Temperature Plot 1880-2000



Eileen Claussen, President of the Pew Center on Global Climate Change, recently gave a talk on "Global Climate Change and Coal's Future." 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. Atmospheric concentrations of carbon dioxide are more than 30 percent higher now than they were just a century ago. Despite what you may hear, this increase in carbon dioxide is undeniably human in origin, and it is the only way to explain the recent trends in the global climate."

Review of Sources of CO_2 in the U.S. and in North Carolina

For about a thousand years before the Industrial Revolution, the amount of greenhouse gases in the atmosphere remained relatively constant. Since then, the concentration of various greenhouse gases has increased dramatically. The amount of CO_2, for example, has increased by more than 30 percent since pre-industrial times and is still increasing at a rate of about 0.4 percent per year, mainly due to the combustion of fossil fuels and deforestation. Although natural emissions of CO_2 are significant, we know that this increase is anthropogenic because the changing isotopic composition of the atmospheric CO_2 betrays the fossil origin of the

[18] National Aeronautics and Space Administration, Goddard Institute for Space Studies, *Global Temperature Trends: 2002 Summation*, 2004. http://www.giss.nasa.gov/research/observe/surftemp/

increase. The concentrations of other natural radiatively active atmospheric components, such as methane and nitrous oxide (N_2O), are increasing due to agricultural, industrial and other activities. The concentrations of other nitrogen oxides (NO and NO_2) and of carbon monoxide (CO) are also increasing. Although the latter gases are not directly identified normally as GHG, they play an important role in atmospheric chemistry and GHG concentrations.[19]

Nationally, man-made emissions of GHG continue to grow, in spite of efforts and rhetoric to the contrary[20] (with residential leading the way with a 2.5 % annual growth in emissions). Although Duke Energy and Progress Energy, and other participants in voluntary GHG reduction programs, have proactively reduced their emissions substantially (from what they "would have been"), and are contributing to known reduction scenarios of over 266 tons/year,[21] these reductions do not offset growth. It is obvious that the reduction of statewide emissions in North Carolina will require actions for both transportation and electric generation and other sectors, to achieve success in reversing the slope of the North Carolina emissions trend line. Even then, it is important that the rest of the world follow the same pathways. Due to the large rates of growth of GHG emissions, immediate reductions to former "base case" conditions are not possible without application of new technologies or serious efforts to curtail the consumption (combustion) of fossil fuels. Other sources alone would not be able to achieve reductions on the order needed to reverse the growth trend to the level of 1990 or some earlier date or benchmark. To further exacerbate the situation, countries such as China are growing very rapidly and increasing their usage of, and emissions from, fossil fuels at a very rapid pace and their emissions contribute equally to global increases on a molecule by molecule basis.

Two of the largest source categories of man-made CO_2 in North Carolina are also coal fired power plants and transportation (automobiles, trucks, etc).[22] These two categories each make up in the neighborhood of 30 per cent of the total anthropogenic emissions, and both continue to grow.[23]

According to a recently released report from the DOE, U.S. energy-related CO_2 emissions in 2003 were up 0.9 percent from 2002 levels - from 5,736 to 5,788 million metric tons (MMT) of CO_2. Between 2002 and 2003, energy demand rose by 0.6 percent because high natural gas prices in 2003 resulted in a shift to higher carbon fuels, such as coal and petroleum, and a colder winter than the previous year, with a 3.8-percent increase in heating degree days, required more fuel (primarily natural gas) for home heating. CO_2 emissions in 2003 were below the 2000 level having fallen in 2001 by 1.8 percent and having grown by only 0.8 percent in 2002. [24]

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[19] Intergovernmental Panel on Climate Change (IPCC), *Climate Change 2001:Working Group I: The Scientific Basis,* 2001, http://www.grida.no/climate/ipcc_tar/wg1/index.htm .

[20] Andrew Freedman, Greenwire - EIA Report,, *U.S. CO_2 Emissions Continue Rise on Strong Residential Growth* , July 2, 2004.

[21] The Center for Energy and Economic Development (CEED), *NC DENR Interim Report on CO_2 - Comments, August 2004.*

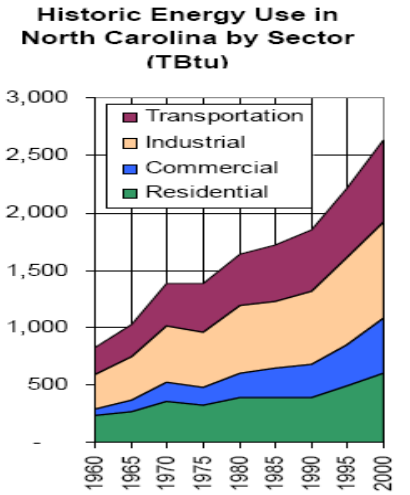
[22] North Carolina State Energy Plan, June, 2003, http://www.energync.net/State%20Energy%20Plan%2003.pdf .

[23] Appalachian State University , Department of Geography and Planning, North Carolina's *$ensible Greenhouse Gas Reduction $trategies*, Boone, NC 28608, January 2000, **http://www.geo.appstate.edu .**

[24] U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis & F orecasting, *U.S. Carbon Dioxide Emissions from Energy Sources 2003 Flash Estimate*, June 2004, http://www.eia.doe.gov/oiaf/1605/flash/flash.html

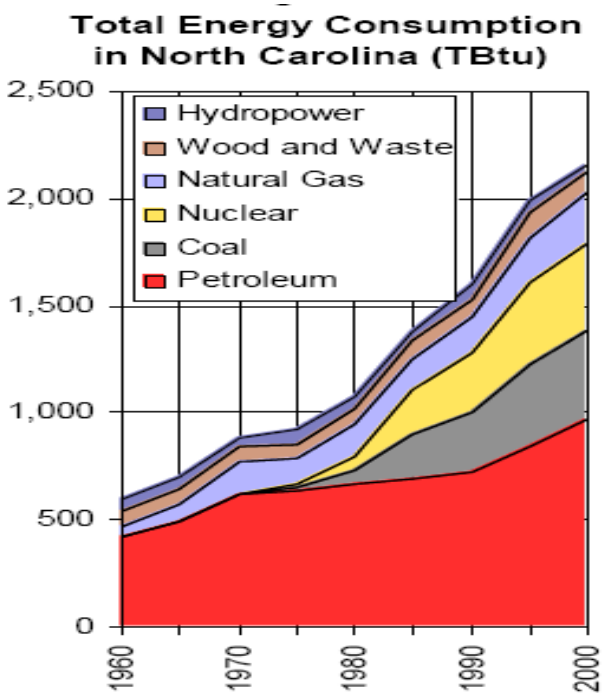
Figures II-4 and II-5 from the State Energy Plan provide graphic presentations of the distribution of energy consumption in North Carolina.

Figure II-4:



The largest single sector in terms of total energy use (including the energy consumed to generate electricity for the sector) is industrial at 31% of the total. Transportation is second largest with 28% of total energy use. The residential (23%) and commercial (18%) sectors, if combined, would demonstrate that the largest energy use in the state is in buildings at 41%.

Figure II-5



[25]

U.S. Energy-Related Carbon Dioxide Emissions

This report also shows that while coal produces the most CO_2 per unit of energy, petroleum produces a greater portion of the U.S. CO_2 emissions due to its larger consumption levels (transportation is a major component). 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 CO_2 emissions overtook industrial emissions and remain the largest source of energy-related CO_2. Between 2002 and 2003, transportation CO_2 emissions grew 0.5 percent. Gasoline demand was up 1 percent, but a 35-percent increase in ethanol consumption helped to moderate direct emissions in the transportation sector. Between 1990 and 2003, transportation CO_2 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).

Between 2002 and 2003, residential CO_2 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. Between 1990 and 2003, residential sector CO_2 emissions grew by 28 percent (1.9 percent per year).

[25] North Carolina State Energy Plan, June, 2003, http://www.energync.net/State%20Energy%20Plan%2003.pdf .

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, CO_2 emissions from the commercial sector grew 1.3 percent as the economy grew by 3.1 percent and commercial employment rose 0.3 percent. Between 2002 and 2003, commercial sector electricity sales rose 0.4 percent, but CO_2 emissions rose 1.3 percent due to the higher carbon intensity of generation. Between 1990 and 2003, commercial sector CO_2 emissions grew by 33 percent (2.2 percent per year). This increase was driven by commercial sector employment growth of 32 percent (2.1percent per year) and commercial sector electricity sales growth of 46 percent (2.9 percent per year), again as stated in the DOE report referenced.

Between 2002 and 2003, *industrial energy-related* CO_2 emissions were unchanged; the index of total industrial output increased by only 0.2 percent. Between 1990 and 2003, energy-related industrial sector CO_2 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. By 2003, energy-intensive primary metals output was 1 percent below 1990 levels, while basic chemicals output was 6 percent below 1990 levels.

The energy quandary, as summarized by Eileen Claussen of the Pew Center for Global Climate Change in a recent speech, boils down to three questions. The first is energy supply (and therefore security) - can we find enough energy to meet our needs from sources that are secure? The second issue is climate change - can we provide the energy we need in ways that do not harm the climate? Last, but not least is the issue of cost or price - 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 a climate-friendly energy policy on the one hand and an economy-friendly climate policy on the other. Some elements of these policies will be the same, but the important point is that we need to think broadly about how best to achieve the related goals of protecting the climate and meeting America's energy needs affordably in the decades ahead.[26]

For the electric generation sector, despite a 0.2 percent decline in generation, emissions increased by 44 MMT of CO_2 (2.0 percent) in 2003. Higher natural gas prices caused generators to switch to other, higher carbon fuels. Coal-powered emissions increased by 64 MMT (3.5 percent), while emissions from petroleum increased by 19 MMT (24.7 percent), and natural gas-powered emissions fell by 39 MMT (12.8 percent).

Of course, national statistics and conclusions do not translate on a one to one basis with the specifics for North Carolina, but the general trend and inclinations are similar. The emissions in the country as a whole affect the situation and conditions in North Carolina and the rest of the globe, though not necessarily on a straight line relationship. Figure II-

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

6 illustrates the relative importance of electric power to total CO_2 emissions in the U.S. Figure II-7[27] summarizes the overall fuel use trends for the U.S.

Figure II-6.

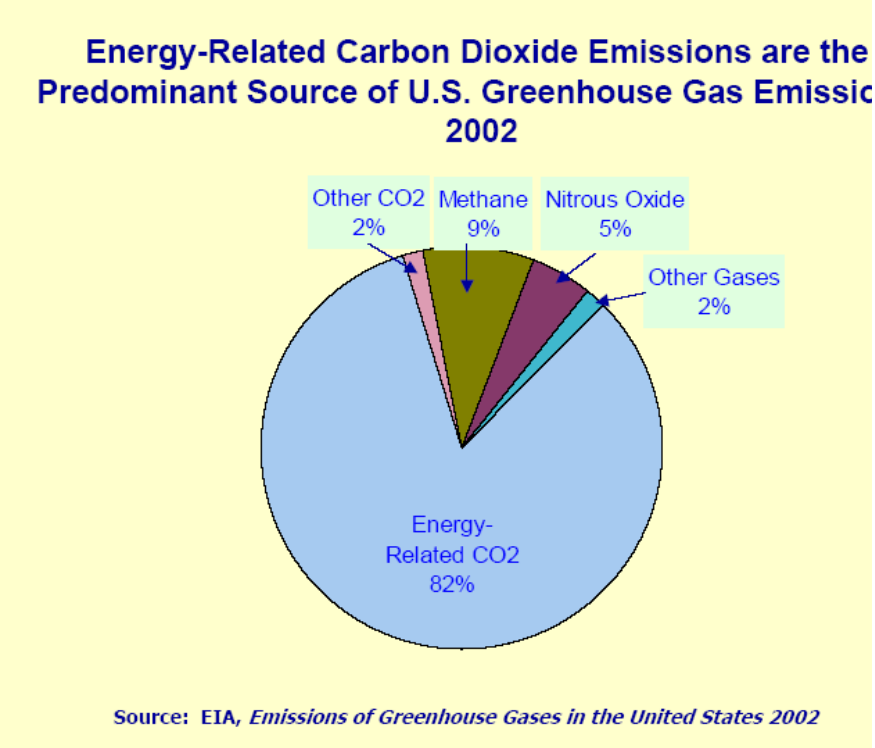
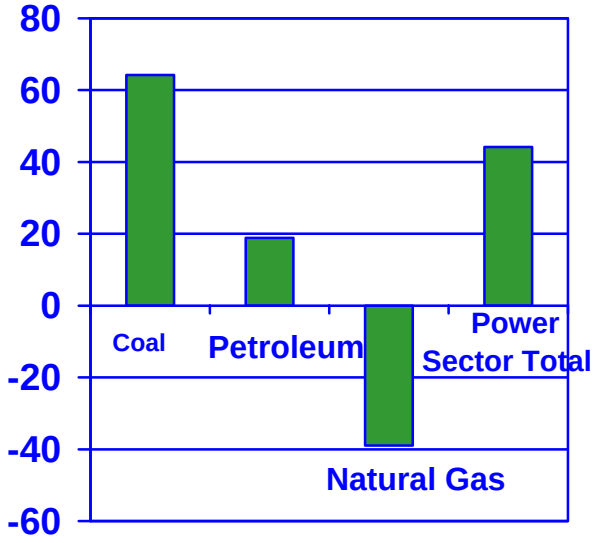


Figure II-7

Change in Electric Power CO2 Emissions by Fuel for the Total Power Sector, 2002 to 2003 in Million Metric Tons of CO_2



[27] U.S. Department of Energy, Energy Information Administration, Office of Integrated Analysis & Forecasting, *U.S. Carbon Dioxide Emissions from Energy Sources- 2003 Flash Estimate*, June 2004, http://www.eia.doe.gov/oiaf/1605/flash/flash.html

Weather and Climate Trends in the Southeast

Many climate changes have occurred over geologic history. Evidence of these trends exists in ice cores and other tools used by scientists to look back into the past. Analyses of recent data have shown[28] that temperature trends in the Southeast vary between decades, with a warm period during the 1920s through1940s, followed by a cooling trend through the 1960s. According to the cited reports, since the 1970s, temperatures have been increasing, with the decade of the1990's temperatures being as warm as the peaks in the 1920s and 30s. Annual rainfall trends show very strong increases of 20-30% or more over the past 100 years across Mississippi, Arkansas, South Carolina, Tennessee, Alabama, and parts of Louisiana, with mixed changes across most of the remaining area. There has been a strong tendency for more wet periods in the Gulf Coast states, and a moderate tendency in most other areas. Obviously, not all of these changes are due to human intervention. Changes in climate, by definition, occur over long periods of time, discounting year-to-year variations.

The cited report also summarizes that the Southeast is prone to frequent natural weather disasters that affect human life and property. Over half of the nation's costliest weather-related disasters of the past 20 years have occurred in the Southeast, costing the region over $85 billion in damages, mostly associated with floods and hurricanes. Across the region, intense precipitation events have increased over the past 100 years and this trend is projected to continue. The southern heat wave and drought of 1998 resulted in damages in excess of $6 billion and at least 200 deaths, not to imply that it was the result of or only the result of climate change from global warming.

Human health concerns arise from projected increases in maximum temperatures and heat index in the region. These concerns are particularly great for lower income households that lack sufficient resources to improve insulation and install and operate air conditioning systems. Air quality degradation in urban areas is also a concern associated with elevated air temperatures and increased emissions from power generation, which can increase ground-level ozone. The higher the temperatures, the more air conditioning that is used, further aggravating the situation. Increased flooding in low-lying coastal counties is also likely to adversely impact human health. Floods are the leading cause of death from natural disasters in the region and nationwide.

North Carolina Climate and Perspectives

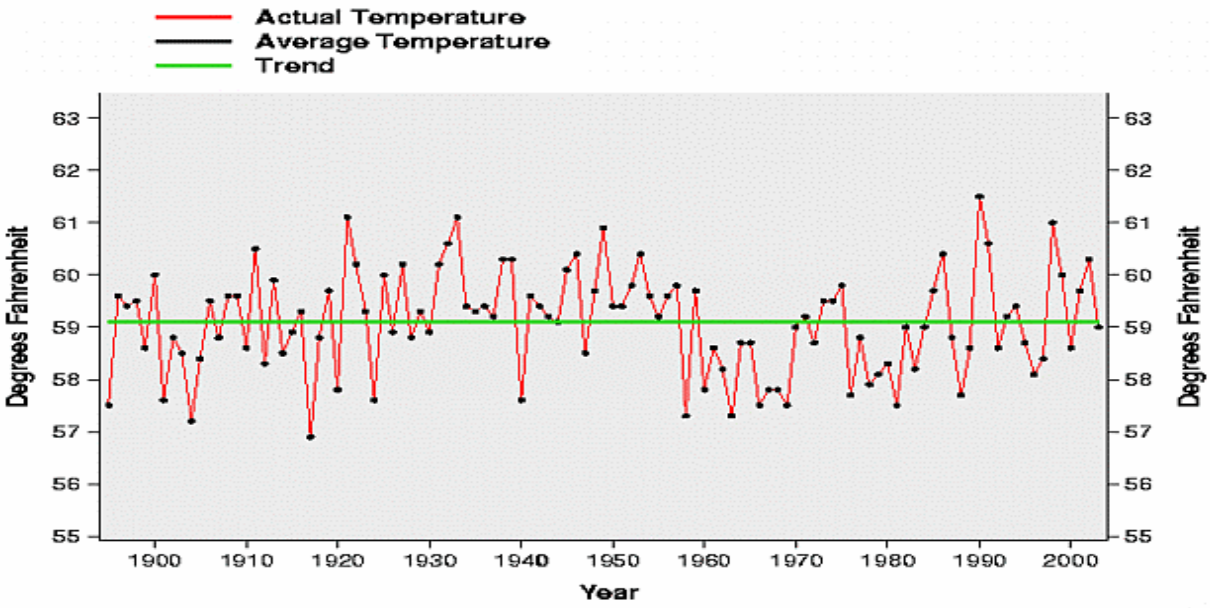
The State Climate Office at North Carolina State University has studied changes in the state, and in DAQ's April 2004 workshop session, information was provided indicating that they have concluded that changes do occur that are due to human intervention and activities.[29] Even surface reflectivity modification activities such as paving of highways and parking lots cause changes in atmospheric temperature, as do changes in crops and the vegetative cover from agriculture and forestry practices. Actions all over the globe impactson the climate in North Carolina. Conversely, actions in North Carolina similarly

[28] Ezra Millstein, *The Potential Impacts of Global Warming on the Southeast*, World Wildlife Fund, from the First National Assessment of the Potential Consequences of Climate Variability and Change, http://www.climatehotmap.org/impacts/florida.html

[29] Bryan Boyles, Presentation to DAQ Mercury & CO_2 Workshop, April 19, 2004, Raleigh, NC (See Appendix A).

contribute to changes around the world. Very little association between real time changes in North Carolina emissions will be reflected in immediate and traceable change in the state, and little changes relative to the whole problem in the global sense. A 100+-year plot of temperatures in North Carolina from the National Climatic Center database (Asheville, NC) is shown in Figure II-8, showing a trend upward in recent years. Equally important are land use patterns, development, urbanization and changes in GHG.

Figure II-8
Statewide Average Temperature for North Carolina (1885-2004)
Source National Weather Records Center[30]



Implementing the CSA will result in reductions in sulfur dioxide (SO_2), and thus, the reduction of atmospheric sulfates. These sulfates result in formation of small particles in the air that also contribute to the greenhouse effect. As the CSA-required scrubbers are put on line and the reductions in SO_2 occur, the greenhouse effect is expected to be reduced somewhat by this effect. It is not possible to make this relationship quantitative, however.

The State Climate Office also indicates that there are good science reasons for North Carolina to begin to make reductions in GHG, including CO_2, and that it should start now.[31] The known science is represented through models, but the models are not sufficiently refined to be able to reflect all situations. However, the evidence and associations are strong. On the other hand, models and records allow for tracking of global changes over the past several years. These models don't make reliable predictions for the next 100 years, but can be accepted as directionally correct. They also do not do a

[30] National Climatic Data Center, *Climate at a Glance, North Carolina*, http://climvis.ncdc.noaa.gov/cgi-bin/cag3/hr-display3.pl.
[31] Bryan Boyles, Presentation to DAQ Mercury & CO_2 Workshop, April 19, 2004, Raleigh, NC (See Appendix A).

good job on local patterns, but are better for global changes. Precision is not good but general changes are directionally good. The projected numbers will likely continue to change over the next several years and decades.

North Carolina will be most vulnerable in the coastal areas if projections come true. Other changes may occur if warming and climate changes cause a migration of the "sweet spot" for growing various crops and natural vegetation. Some researchers[32] even project an increase in poison ivy, but again, this is speculation and not necessarily agreed to by all scientists and evidence.

If the global community does not reduce emissions of GHG significantly, some project that North Carolina will likely be left with a climate similar to that of central Florida,[33] a dramatically different coastline due to sea-level rise and subsequent inundation[34], an increased occurrence of heat-related asthma and death,[35] and hundreds of millions of dollars in losses from severe weather events.[36] However, it is argued that if sufficient reductions are implemented quickly, and globally, the costs associated with these impacts can be alleviated. At the same time, these actions can stimulate the State's economy, according to some advocates. Innovative, business-oriented policies that create a market for GHG, or equipment for their reduction will potentially align environmental goals with business goals and generate revenue is a strong argument for action.

[32] William H. Schlesinger, Duke University, Nicholas School of Environment and Earth Sciences, Panel Presentation at the May 2004 NC Climate Education Partnership.
[33] *Ibid*.
[34] Union of Concerned Scientists, *Impacts of Climate Change in the US*, October 2003, http://www.climatehotmap.org/impacts/florida.html. .
[35] Physicians for Social Responsibility, "*Death By Degrees: The Health Impacts of Climate Change in North Carolina*," March 2001.
[36] National Weather Service, Office of Climate, Water, and Weather Services, "*State Summary Statistics 2003*."

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CHAPTER III IMPACTS AND ECONOMICS OF CLIMATE CHANGE

It is not possible to provide an original, complete, authoritative discussion and analysis of all physical and economic impacts for North Carolina within the confines and limitations of this report and the information available. However, some general tendencies and observations can be made. That is the purpose and intent of this chapter.

A Backdrop of Growth in Southeastern States

The Southeast "sunbelt" continues to be a rapidly growing region with population increasing by more than 30 percent between 1970 and 1990. Much of this growth occurred in coastal counties with expectation that this growth will continue for the several years. The number of farms in the region decreased 80 percent between 1930 and 1997, but still produces roughly one quarter of US agricultural crops. The Southeast has become America's "wood basket," producing about half of America's timber supplies. The region also produces a large portion of the nation's fish, poultry, tobacco, oil, coal and natural gas. Prior to European settlement, the landscape was primarily forests, grasslands, and wetlands, but by 1920, most of the native forests were converted to managed forests and agricultural lands. Although much of the landscape has been altered, a wide range of ecosystem types exist and overall species diversity is high.[37]

Projected Climate Change Impacts

The United Nation's Intergovernmental Panel on Climate Change (IPCC) projects that, because of elevated concentrations of GHG in the atmosphere, the rate of sea level rise for the next 100 years is likely to be at least double the rate that we have experienced over the last century. The IPCC estimates that sea levels in the Atlantic Ocean are likely to rise 19 inches by 2100, and could rise by as much as 36 inches in the same period if GHG emissions go unchecked. If these projections are experienced, by 2030, there could be a 10-inch sea level rise along the North Carolina coast. The effects of potential further melting of the Greenland and Antarctic ice sheets are not included in these scenarios. Recent research suggests that this melting could have a faster and even more serious impact on sea-level rise than previously thought.[38, 39, 40] Of course, not all scientists are in agreement with these conclusions or projections, but the consensus continues to grow.

Tools such as climate models are often used to integrate the complex interactions and effects to provide a basis for conclusions. Such climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next century. Two commonly used models are the Hadley Model and the Canadian model.[41] Results of such models, though often challenged, are generally accepted as the best available basis for

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[37] Ezra Millstein, *The Potential Impacts of Global Warming on the Southeast*, World Wildlife Fund, from the First National Assessment of the Potential Consequences of Climate Variability and Change, http://www.climatehotmap.org/impacts/florida.html

[38] H.J. Zwally, Abdalati, W., Herring, T., Larson, K., Saba, J., and Steffen, K., *Surface melt induced acceleration of Greenland ice-sheet flow*, **Science**- 297, 218-222, 2002.

[39] J. Hansen, *Defusing the global warming time bomb*, **Sci. Amer.**, 290, no. 3, 68-77, 2004.

[40] Quirin Schiermeier,. *A Rising Tide*, **Nature**, 421, 114-115, 2004.

[41] Ezra Millstein, *The Potential Impacts of Global Warming on the Southeast*, World Wildlife Fund, from the First National Assessment of the Potential Consequences of Climate Variability and Change, http://www.climatehotmap.org/impacts/florida.html .

projections and have been endorsed by the National Academy of Science.[42] Both of the principal climate models were used in the National Assessment project,[43] and both indicated warming in the Southeast, but at different rates. The Canadian model shows the Southeast experiencing a high degree of warming, which further translates into lower soil moisture as higher temperatures increase evaporation. The Hadley model simulates less warming and a significant increase in precipitation (about 20 percent). Some models suggest that rainfall associated with El Niño and the intensity of droughts during La Niña phases will be intensified as atmospheric CO_2 increases.

In addition to seal level rise, many areas along the North Carolina coast are believed to be sinking by about 7 inches per century. This means that some areas of coastal North Carolina may likely experience an accelerated rate of inundation, regardless of climate effects. A sea level rise (or sinking of the land mass) of less than 14 inches would likely inundate about 770 square miles of the North Carolina coast, an area nearly the size of Great Smoky Mountains National Park.[44] The State's coastal wetlands and other low-lying areas could be flooded, and the Albemarle and Pamlico sounds could become open waters. The North Carolina coastal areas are already some of the most vulnerable to extreme weather events in the U.S., and even low-intensity storms create billions of dollars in damage.[45] The combined effects of rising seas and sinking lands could drastically change much of our coastline and barrier islands, increase vulnerability to storms, and put billions of dollars of coastal property at risk.

Assuming these projections are fulfilled, traditional approaches such as flood levees, elevated structures, and building codes, will not be adequate alone to prevent or even manage damage in the coastal zone as sea level rise would continue to increase the threat of storm-surge flooding in virtually all Southeastern coastal areas. Improvements in risk assessment, coastal and floodplain management, linkage of insurance to policies for mitigating flood damage, and local mitigation planning might help decrease potential economic impact. Changes in climate and sea-level must be integral parts of coastal communities develop strategies for hazard preparedness and mitigation.[46]

Potential Economic Impacts Associated with Climate Inaction

Associating "real" economically defensible costs with any particular inaction is difficult and speculative at best. However, according to a report prepared for the United Nations Environment Program, "Worldwide economic losses due to natural disasters appear to be doubling every ten years, and have reached almost $1 trillion over the past 15 years. If current trends persist, the annual loss amounts as estimated by UNEP, will come close to US $150

[42] Climate Change Impacts on the United States: *The Potential Consequences of Climate Variability and Change,* A Report of the National Assessment Synthesis Team, U.S. Global Change Research Program, www.usgcrp.gov/ .
[43] U.S. Global Change Research Program , *Climate Change Impacts on the United States: The Potential Consequences of Climate Variability and Change,* A Report of the National Assessment Synthesis Team, www.usgcrp.gov/.
[44] Ben Poulter, Duke University, and Sam Pearsall, *The Nature Conservancy*, 2003.
[45] D.H. Levinson and Waple, A.M, *State of the Climate in 2003*, Bulletin of the American Meteorological Society Vol. 85, No. 6 June 2004.
[46] , U.S. Global Change Research Program, Climate Change Impacts on the United States: *The Potential Consequences of Climate Variability and Change,* A, Report of the National Assessment Synthesis Team, www.gcrio.org/NationalAssessment/.

billion within the next decade.[47] North Carolina's share of this estimate would also be difficult to assess. However, according to one report, in 2002, North Carolina experienced more than $678 million in weather-related losses and government expenditures.[48] This is not to imply a direct relationship with climate change, but there is certainly an expected connection.

Tourism has definite potential for economic impacts if the climate projections hold true, especially with regard to a rising sea level. In 2001, tourism in North Carolina's 20 coastal counties generated an economic impact of nearly $1.8 billion. Accelerated sea-level rise would threaten this revenue and billions of dollars worth of property.[49] The costs of health, agriculture and other related costs would likewise be large.

However, there are also potential benefits and opportunities associated with development of renewable energies, improvements in energy efficiency and related technologies in the state. According to California studies, renewable energy development can generate even more jobs than fossil fuel-based energy production on a common basis of megawatt delivered.[50]

Nothing affects the business climate of a company as much as making a profit, or not. That is a basic reason why the company exists and is in business. If the environmental, such as greenhouse mitigation, effort generate additional income, this tends to get the attention of the management of the company and is likely to lead to further rewarding experiences.

Weather-related Stresses on Human Populations

The US experienced 42 weather-related disasters over the past 20 years that resulted in extensive damage and costs in excess of $1 billion each; 23 of these occurred in the Southeast, mostly in the form of floods and hurricanes. Projected sea-level rise could increase the risk from flooding to low-lying coastal counties from the Carolinas to Texas, which could adversely impact human health, threaten lives and cause extensive economic damage. Heat waves also take their toll; the southern drought of 1998 resulted in damages in excess of $6 billion. The same year, a combination of an unusually wet winter, dry summer and high heat led to wildfires in Florida that burned roughly 500,000 acres of land. Heat waves increase the risks of heat related illness and mortality and increase ozone production affecting primarily the elderly, the young and those who are already suffering from respiratory or other illnesses. While these are natural occurrences, climate induced changes to them can likely increase similar effects.[51] Such increases cause individuals to experience increased economic loss, increased stress from concern and worry over their physical plight and subsequent or related economic security.

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[47] *Climate Change and the Financial Services Industry: Module 1 – Threats and Opportunities*, United Nations Environmental Program and Innovest, http://www.innovestgroup.com/.

[48] Beth Lander, *The Costs of Inaction*, US PIRG Education Fund, 2003.

[49] *The Coastal Zone Management Act in North Carolina*, National Oceanic and Atmospheric Administration, US Department of Commerce, 2003.

[50] Karen Rindge, *Renewable Energy: Good for NC's Economy*, Carolina Sun, Summer, 2004

[51] Ezra Millstein, *The Potential Impacts of Global Warming on the Southeast*, World Wildlife Fund, from the First National Assessment of the Potential Consequences of Climate Variability and Change, http://www.climatehotmap.org/impacts/florida.html.

Climate Change Effects Projected for Southeastern Forests

Evidence from long term monitoring indicates that climate change would likely affect individual growth rates directly by way of overall warming or change in regional moisture balance. Information presented at DAQ's April 2004 Workshop indicates an increased growth rate in trees and other vegetation will occur due to such changes.[52] Climate shifts will also likely affect tree mortality and recruitment rates by altering the frequency and intensity of stand disturbances. Results suggest that disturbance effects are stronger and quicker than growth effects. Because individual trees grow quickly and the species involved are not particularly long-lived, responses to climatic change could be relatively rapid. In natural area preserves, Chinese tallowtree and other non-native woody species (including poison ivy) may become more important if disturbances increase. In commercially managed forests, increasing disturbance rates may result in higher timber losses.

The variety of spatial and temporal influences on forest processes, coupled with uncertainties associated with climate prediction, makes difficult the assessment of the effects of changes in climate on forest dynamics at the ecosystem level. Nevertheless, research at Rice University not only identifies specific climatic effects on particular life stages or processes, but it also provides critical information for improving our understanding of the context within which these effects are likely to occur.[53]

Background on Emissions Trading Programs

In the last two decades, emissions' trading has emerged as a favorable policy mechanism to reduce air pollution. This market-based approach can often cost-effectively reduce selected air pollutants by allowing businesses to buy, trade and sell their "rights to emit" specific pollutants. If companies reduce their emissions below the limits set by government caps, they can sell their surplus reductions to companies who face higher on-site reduction costs. Businesses are thus given financial incentive to reduce emissions, under an overall umbrella of region-wide reduction totals. Such a trading market system already exists for sulfur dioxide (SO_2) and nitrogen oxides (NO_x) under the federal Clean Air Act's Acid Rain Program.[54] CO_2, being a gas, readily mixes globally. A CO_2 molecule emitted anywhere has an effect on climate everywhere. This makes CO_2 an ideal candidate for national and state emissions trading within a scale of an international market place. A national carbon market, which will require national carbon caps, provides a promise to stimulate innovation in the private sector and enable society to make reductions in more cost-effective ways.

Options exist to use the current "lead time" before the caps are established, to begin preparing for such a national and international global carbon marketplace through pilot programs and

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[52] William H. Schlesinger, *The Global Carbon Cycle and the Duke Forest Free-Air CO_2 Enrichment (FACE) Project*, Duke University, Nicholas School of Environment and Earth Sciences, Presentation to DAQ Mercury & CO_2 Workshop, Raleigh, NC; April 21, 2004 (See Appendix A).

[53] Paul A. Harcombe, Rice University, Department of Ecology and Evolutionary Biology, *Effects of Climate Change on Southeastern Forest,* USGS http://www.nwrc.gov.

[54] U.S. EPA, *Acid Rain Program Web Page*, http://www.epa.gov/airmarkets/arp/ , August 2004.

other means. Many sectors throughout the state will then more likely have opportunities and motivation to develop greater and more incentives for reducing their greenhouse gas emissions in a more timely fashion.

The Currency of a Carbon Market: Carbon Credit$

The tradable commodity in a carbon marketplace is CO_2 equivalents (tons) or "carbon credits." These carbon credits may be earned by companies and landowners who reduce CO_2 and other greenhouse gas pollutants like methane. Credits can be earned by reducing greenhouse gas emissions directly. Under some scenarios, opportunities to earn credits may also occur through activities that indirectly reduce greenhouse gas pollution, such as renewable energy development or carbon sequestration in forests.

Supply and demand drives the marketplace. To function efficiently, a carbon market needs buyers and sellers. Currently, in North Carolina, many sectors have the potential to supply carbon credits. Possible suppliers include:

- Swine industry: for converting waste and reducing methane for fuel.
- Forestry industry: for sequestering carbon by reducing deforestation and by increasing reforestation projects for both sequestration and for renewable energy.
- Reforestation of agricultural land:
    - Planting agricultural land to trees where tobacco farmers previously grew tobacco and tobacco production is expected to be discontinued, and
    - Tree planting on agricultural lands that were former wetlands converted to agriculture prior to 1976, to create "new" wetlands for Wetland Mitigation Banking or mitigation credit.
- Agriculture industry for sequestering carbon and reducing energy use through no-till farming.
- Renewable energy industry for providing lower GHG impact energy.
- Manufacturers and utilities: for voluntarily decreasing direct emissions of CO_2 before implementation of mandated caps.
- Other Corporations (e.g., universities and business establishments, etc.): for voluntarily decreasing emissions through new energy-efficient building designs and transportation innovations.

Because North Carolina does not have a CO_2 cap, there is no current demand within the state for carbon credits. North Carolina could potentially create an economic engine for the State by implementing GHG emission reductions and establishing a carbon marketplace. Several organizations already exist that could help our State track its carbon credits and trading activity. Preparing North Carolina for the emerging carbon markets could be made possible through one of several policy options to avoid losing any such revenues to other states. Many agree that a national cap on CO_2 emissions is necessary and forthcoming.

As national carbon caps are established, North Carolina will likely need to anticipate and be prepared for the related economic opportunities. Carbon caps will undoubtedly bring a national carbon marketplace, characterized by buying and selling of carbon equivalence

credits. North Carolina should further evaluate the steps required to take advantage of such carbon market and implement evolved policies that prepare our utility, swine, forestry, agriculture and other industries, to sell carbon credits for their emissions reductions or for sequestering carbon in trees and soil. The emergence of new technologies to reduce greenhouse gas emissions from power plants, confined animal feeding operations, and other emission sources presents potential opportunities for North Carolina. By developing and evaluating ways for providing incentives for the use of such innovative technologies, we can potentially reduce our state's greenhouse gas emissions while addressing other environmental problems and even creating jobs.

In addition to capitalizing on economic opportunities, many feel that our state's top decision-makers need to be evaluating mitigation scenarios and planning how to minimize potential climate change threats (such as coastal inundation, lost agricultural revenue and human health issues). In light of the global and national pressures for action, and because of the threats climate change poses to our state, many feel that North Carolina needs to prepare its economy and its people for a carbon-constrained world.

Potential Cost Scenarios

The DAQ workshop in April 2004 (See Appendix A) provided a beginning level of cost analysis of efforts to reduce CO_2, from different viewpoints. Dr. Anne Smith's presentation[55] represented such analyses for both mercury and CO_2 measures from an industry perspective. Related discussions reflected broad reactions and variant perspectives one would expect from this type of analysis, from both environmental and industry sectors. The industry perspective is primarily that economic impacts of North Carolina attempting to address CO_2 unilaterally would be significant and negative arguing that the State needs to await federal action on CO_2, and the environmental advocates perspective is that action needs to begin now and will provide significant economic return and "reimbursements."

Some of Dr. Smith's main points were:

- CO_2 comes from coal, oil and natural gas generation, but coal emits roughly 2x more CO_2 per kwh than natural gas.
- Retrofit controls are the most costly control option with a switch from coal to gas costing about $30-50/ton C for first few %; switching from coal to renewables costing about $100/ton C for first few %; and removal of CO_2 from stack costing about $300/ton C (large reductions).
- On-system controls are expensive even for new generation. For example, she believes that building IGCC with C-sequestration would cost about $100/ton C, with large reductions possible, but likely with decades of lead-time.
- Fuel Switches, according to the analysis, would have various effects and considerations:

[55] Dr. Anne Smith, Charles Rivers Associates, Washington, D.C., ***Insights on Economic Impacts of Utility Mercury and CO_2 Controls,*** Presentation at NC Division of Air Quality Mercury and CO_2 Workshop, April 20, 2004, Raleigh, NC. (See Appendix A).

- **Coal-to-Gas**: A 20% reduction in current coal MWh would require: 1) a 50% increase in current gas generation, 2) more new gas plants to be built, 3) drive natural gas prices up (affecting other industry), and would reduce national CO_2 emissions <3%,
- **Coal-to-Renewables**: A 10% reduction in current coal MWh would require >5-fold increase in renewable capacity, to reduce national CO_2 emissions <3%, and
- **Both** would drive $/ton higher than the estimates above for "first few %" of reductions, and would require a multi-decade approach with on-system reductions costing less than $100/tonne C.

Other "off-line" changes may be more achievable she surmised: such as changes in land use practices, changes in forestry practices, energy demand-reduction projects, and projects in other countries that reduce their CO_2 baseline (a trading option). The presentation concluded that the costs would be much cheaper (<$10/ton C). Some important questions would remain: 1) Are these real reductions from baseline?, 2) Are these permanent reductions?, and 3) Will they remain cheap once there is a real demand for them? She concluded that on-system reductions would cause much higher price increases.

Dr. Smith contends that a unilateral North Carolina policy would result in the potential for power to be brought in from outside states without a carbon cap, that the cost of power and gas would rise to industry in the State, National and global emissions would not be reduced, jobs may be lost and consumers in the State will face losses in living standards. On the other hand, she indicated that as a part of a unified national carbon policy, inter-regional competitive issues would be diminished, competition would be increased with international sources, there would still be 'leaks' in emissions on an international basis, but that this State would then face impacts more similar to the U.S. wide average impacts. These concepts and information need to be debated and resolved before final recommendations are made.

Making analysis of cost impacts even more difficult will be the impact of changes in supplies, or perceived changes in supplies of energy from various sources in the world and how much it will cost. All energy prices, whether for gas, oil or coal (or other) are distinctly interrelated and fluctuate together, with some delays. Recent excursions in prices for crude oil may be temporary, but there are many who project that production of crude will peak in the next few years and begin to fall. Such changes would have a significant impact upon energy costs, but also serve to make it more difficult to determine the true effects and costs of making reductions in consumption. The graphs below in Figures III-1 and III-2 do not reflect more recent dramatic changes in cost and supply resulting to middle eastern and Russian influences on the market, but these recent events only seem to accelerate and exacerbate the issue and provide a backdrop for future discussions and conclusions.

These positions likely will undergo additional analyses prior to release of the final report, but reaching a consensus and a common resolution of the different perspectives will likely be a major effort.

Figure III-1, World Oil Production [56]

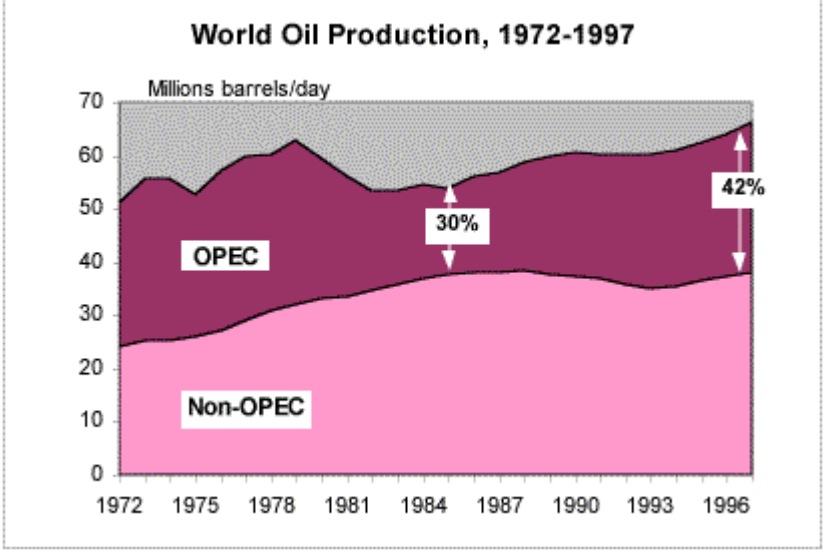
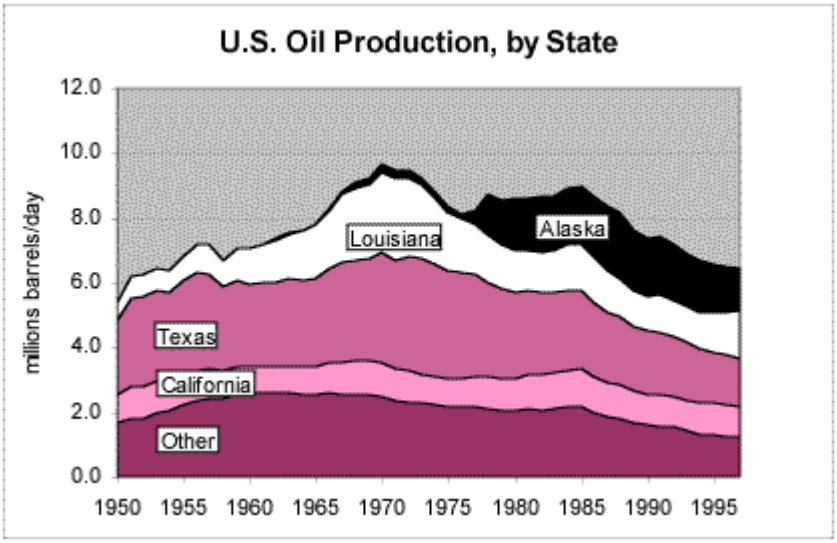


Figure III-2, U.S. Oil Production, 1950-97



[56] National Association of State Energy Officials, *Understanding the Petroleum Industry*, 2004, http://www.naseo.org/Default.htm

CHAPTER IV REDUCTION AND SEQUESTRATION TECHNOLOGIES AND OPTIONS

Over 100 coal-fired power plants have been announced (some since cancelled) for planning and construction in the U.S. in recent years, according to Cinergy CEO Jim Rogers in a recent speech. He interjected that the current energy policy in the U.S. seems to be "find more/use more."[57] "This policy and practice has to change before these alternatives will begin to be viable to replace and reduce emissions," he summarized. Targets are needed that will provide for these advances to be put into practice and result in real and continuing reductions in the carbon limited future.

Since the release of the First Interim Report in 2003, DAQ has continued to review available literature and emerging information. In addition, DAQ hosted a workshop in April of 2004 that involved stakeholders, experts on various related topics and other interested participants. This chapter is primarily a summary and update of pertinent technical and related information on reductions in use of fossil fuels and sequestration of emissions collected from that workshop and other sources since the release of the first report.

Various methods and scenarios have been suggested to prevent emissions by reductions in carbon-fuel consumption and to capture and sequester them post-emission. These proposals cover a wide range of cost and practicality. Some are obviously too expensive or sufficiently impractical, or so energy inefficient, that they may be readily dismissed (for the time being, at least). Others may have promise and be options that may be worth further consideration, maybe in a shorter range of five to ten years. Others may require further technical development and piloting on large scale, such that they may be more likely worthy of further consideration within10 to 30 years. The purpose of this discussion is to identify the most obvious, potentially important and promising of those options and place them in the proper category for future re-evaluation. At this point, none of these options should be viewed as recommendations, but potential options for future consideration for selection of recommendations. Such final recommendations and changes may also require further coordination outside the State with other regional and national groups.[58]

Most action-initiating activity to date seems to be in the government circles. However, in 2003, the federal government and industry organizations representing companies from 12 energy-intensive economic sectors joined in a new voluntary partnership called "Climate VISION." The economic sectors include automobile manufacturers, chemical manufacturers, railroads, the oil and gas industry, the electric power industry, the mining industry, and the cement, iron and steel, aluminum, magnesium, semiconductors, and forest products industries. Joining this initiative were the U.S. Departments of Energy (DOE), Transportation (DOT), Agriculture (DOA) and the U.S. Environmental Protection Agency (EPA). Climate VISION

[57] James Rogers, CEO of Cinergy Corporation, *Keynote Speaker* at Air & Waste Management Association meeting in Indianapolis, IN, (Personal notes of James Southerland), June 23, 2004.

[58] Gerald R. Hill, Ph.D., Senior Technical Advisor, Southern States Energy Board, Southeast Regional Carbon Sequestration Partnership, Presentation to North Carolina Division of Air Quality Workshop on Mercury and CO_2, Raleigh, NC, April 21, 2004. (See Appendix A).

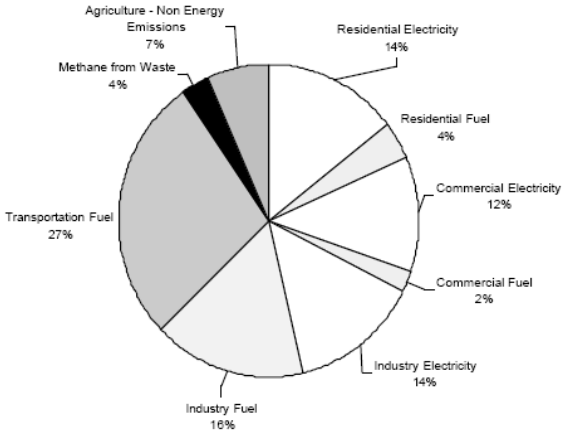
works with industry to identify and pursue cost-effective solutions to reduce emissions using existing technologies; develop tools to calculate and report emission intensity reductions; speed the commercial adoption of advanced technologies; and develop strategies to reduce emissions intensity in other economic sectors.

The electric power sector participates in the Climate VISION program through the Electric Power Industry Climate Initiative (EPICI) and its Power Partners program, with the DOE. The memberships of the seven organizations that comprise EPICI represent 100% of the power generators in the United States. The power sector, through EPICI, plans to finalize its work plan in the form of a Memorandum of Understanding (MOU) with DOE. The MOU will outline proposed implementation actions to reduce greenhouse gas emissions intensity by 2012. The power sector, in conjunction with DOE and other federal agencies, will implement the actions. In North Carolina, Duke Energy and Progress Energy are both participating in this program through their membership in, and participation with, the Electric Power Research Institute (EPRI).[59] Projects proposed or included to date include planting of additional forest for sequestration and other similar programs.

As discussed in the First Interim Report, the Appalachian State University Energy Center produced a report in January 2000[60] that provides an in-depth analysis by sector of their recommendations for a sensible GHG reduction strategy. This document has some parallels to that report and draws upon it to some extent without reproducing the estimates and calculations included in that report. That same Center assisted in a major portion of the tasks associated with development of the State Energy Plan (SEP) as discussed further on the following pages and in Appendix D to this document. The Figure IV-1 below, extracted from that report, gives a good refresher or reference point from which to review the importance of the various sectors toward realizing a potential solution.

Figure IV-1

Figure 1: North Carolina Greenhouse Gas Emissions in 1990, by Sector and by Fuel vs. Electricity
(Total Emissions in 1990: 145 Megatons)



[59] Personal Communications (emails) from George Everett of Duke Energy and Cheryl Vetter of Progress Energy, to James Southerland, NC DAQ, August 2004.

[60] Department of Geography and Planning, Appalachian State University, *North Carolina's $ensible Greenhouse Gas Reduction $trategies*, Boone, NC, January 2000. http://www.geo.appstate.edu.

Energy Efficiency : Use Less - The State Energy Plan

The most obvious way to reduce CO_2 emissions is to burn less carbon-based fuels. This is essentially one of the major goals of the State Energy Plan. For most practical purposes, the reduction of CO_2 and reductions of energy usage are synonymous. Thus, the State Energy Plan (SEP) is closely related to the development and implementation of action plans for the reductions of GHG in North Carolina. Efforts and actions to reduce energy consumption will translate into reductions in GHG emissions, particularly CO_2.

The First Interim Report discussed the SEP in limited detail. The SEP was approved in June of 2003. The State Energy Office (SEO) and other departments are now working on strategies for implementing that plan. For example, the SEP envisions a North Carolina Climate Action registry as one of its products.[61] This is in relative harmony with the implications of programs to reduce greenhouse gases. Some additional tracking mechanisms for the results and progress of reducing emissions through the implementation of the SEP, for example, may be necessary to allow tracking of progress for the overall effort. Thus, the two programs are closely linked and must track closely together. A copy of the NC's SEP may be obtained from the SEO, or may be downloaded from their web site.[62] The SEP provides most of the information discussed in this section of the report.

The SEP indicates that CO_2 emissions will likely continue to increase into the near future and the only viable options currently available for reducing these emissions are increasing efficiency and switching to alternative sources of energy generation, such as nuclear, hydropower, solar, wind and biomass. Although combustion of biomass produces one molecule of CO_2 per molecule of carbon in the material, just as fossil fuels do, the biomass is "re-used" carbon that was not derived from ancient deposits or previously sequestered emissions, and thus does not have the same net impact upon the environment as do the "new" fossil fuels. Large conversion may be unrealistic without wholesale switching to more expensive natural gas combustion with less certainty in supply.

The Secretary (or designated representative) of the Department of Environment and Natural Resources (DENR), represents DENR on the Energy Policy Council (EPC). This facilitates coordination and implementation of the SEP and its integration with parallel actions and plans to reduce GHG. In 2003, the EPC approved 93 measures that meet the plan's objectives. These measures, in the form of policy and program recommendations, primarily address the following sectors and issues in the state:

- Energy, Economics and the Environment
- Fossil and Nuclear Fuels
- Electric Utilities and Energy Use
- Alternative Fuels from Biomass
- Alternative Energy Sources
- Energy Use in the Public Sector
- Energy Use in the Residential Sector

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[61] Larry Shirley, Director, State Energy Office, *Development, Components and Status of the NC State Energy Plan*, Presentation at NC DAQ Mercury and CO_2 workshop, Raleigh, NC, April 19, 2004. (See Appendix A).

[62] *State Energy Plan*, http://www.energync.net/State%20Energy%20Plan%2003.pdf .

- Energy Use in the Commercial Sector
- Energy Use in the Residential Sector
- Energy Use in the Transportation Sector
- Funding for Energy Policies and Programs

Appendix D contains a more extensive listing of SEP recommendations and lists the 15 key legislative, regulatory, and administrative policies the EPC determined would require action in 2003 and 2004. Some of the items discussed in more detail below also relate to elements in that plan. Basic elements of the plan are addressed below.

Programs to Directly Increase Energy Efficiency at Generation Units

Most of the existing coal-fired boilers in North Carolina, and elsewhere, were built many years ago, in the general era between 1950 and 1980, with an expected lifetime of 30 to 50 years. Thus, the population of boilers is aging, many already beyond their originally expected useful life. In the meanwhile, a number of design and technology advances have been made that could potentially make improvements in efficiency if applied to existing facilities. These improvements may only be on the order of a percent or a few percent, but are significant in the economics of running a large power generation unit constantly for several years. The increases in design efficiency generally allow more production of electricity with less fuel and with less emissions of nitrogen oxides, which leaves less to be removed by other means. Due to the costs and the complexity of the regulations (e.g., State/federal new source review and prevention of significant deterioration regulations) many improvements and refinements that might have made have been discouraged or confused in complications. Some efficiency improvements on generation units can be made, but may require consideration of such projects under EPA's new source review (NSR) rules.

In the December 31, 2002 proposed rule on Routine Maintenance, Repair, and Replacement (67 FR 80290), EPA indicated that, "NSR should not impede industry in making energy and process efficiency improvements which, on balance, will be beneficial both economically and environmentally" (57 FR 80301). The State is currently reviewing related rules and policies to determine if any changes need to be made to North Carolina rules and whether there may be any additional latitude resulting to encourage (or not discourage) such projects.

State Agencies, Local Governments, Schools & NPOs

The State's cost of energy and fuel (excluding gasoline) in 2002 was $179 million.[63] The largest share of the State's energy expenditures was for electricity, which was 65 percent of the State's total energy costs. The university system is the largest consumer of energy in North Carolina's state government. Over half (53 percent) of the State government's energy expenditures occur at the universities. New education construction bonds passed in 2000 may further increase energy consumption by the university system if offsetting

[63] *State Energy Plan*, *State Energy Plan*, North Carolina State Energy Policy Council/State Energy Office, http://www.energync.net/State%20Energy%20Plan%2003.pdf ., June 2003.

energy efficiency measures are not incorporated into these projects and retrofitted to existing structures.

The North Carolina League of Municipalities, North Carolina Association of County Commissioners, and North Carolina Association of School Boards have formed a collaborative association named LoGESO (Local Government Energy Savings Organization). In 1999 and 2000, LoGESO conducted an assessment focused on what they might do to reduce energy expenditures. They evaluated steps that constituents might take to conserve energy and improve efficiency. The study found fewer than 25 percent of potential energy efficiency expectations had been realized in the sites focused on during the study. This was due, in part, because of the small size of many energy efficiency projects. They did not attract competitive bids from established firms, they concluded, due to the high costs of assembling bids. In addition, few local jurisdictions tracked and reported energy use and expenditures. Based upon the consultant's experience elsewhere, North Carolina local governments could experience a 5-10 percent reduction in purchased energy through an aggressive energy reduction program. This would result in an estimated $50 million in savings over a five-year period.

The cost of energy represents a significant drain on State and local resources. Educational facilities also stimulate fuel use for transport of children to and from schools via both personal vehicles and school buses. The total cost of student transportation is a substantial portion of the total cost of energy for education. Increased adoption of walking and biking, as well as increased bus use by those commuting by private vehicles could save substantially on total energy consumption, and thus related emissions. [64]

Commercial/Industrial

The commercial sector has a high potential for improving efficiency in both existing and new buildings. Insuring energy reliability, promoting wise land use and improving environmental quality are directly related to energy efficient construction codes and techniques. Efficiency strategies for commercial buildings include building energy efficiency, lighting efficiency and increased use of natural daylight, heating and cooling system efficiency, alternative energy options and hot water efficiency.

North Carolina's industrial sector uses about 28 percent of the total energy used in the state (the highest in the state). Energy saving improvements for industry are typically grouped into four primary categories:

- General energy-saving technologies applicable to all manufacturing sectors, such as high-efficiency lighting and computer control of air conditioning.
- Industry-specific energy-saving technologies, such as recovery of "waste" heat.
- Energy management activities, such as energy audits, load control and full-time energy managers.
- Other innovative approaches, such as changing processes or developing new approaches for industrial development.

[64] *State Energy Plan*, *State Energy Plan*, North Carolina State Energy Policy Council/State Energy Office, http://www.energync.net/State%20Energy%20Plan%2003.pdf ., June 2003.

A study conducted by the national energy laboratories, including Oak Ridge, Lawrence-Berkeley and the National Renewable Energy Lab, concluded that nationwide energy savings of 7.4 percent in the industrial sector could be achieved by the year 2020 by implementing moderate energy saving programs. With a more aggressive approach, savings of 16.5 percent by year 2020 was determined to be possible. These savings excluded the effects of increased combined heat and power (CHP), or co-generation. With moderate implementation of CHP, the national labs' report estimated that national energy savings of 1.1 percent could be achieved by 2020. Under such an aggressive program, an estimated 5.8 percent would be saved. The potential decreases in energy consumption from the policies recommended for the industrial sector of North Carolina total about 8.5 percent in existing industrial facilities and 12 percent in new facilities.

Residential

In 2000, residences in North Carolina accounted for 23 percent of the total energy consumption in the state. Because this sector concerns virtually every citizen of the state directly, energy use in residences remains key for energy efficiency. The residential sector provides tremendous opportunity for reducing energy use. Fortunately, many energy efficiency measures are cost-effective and provide additional advantages to the owner, such as improved comfort and increased home durability and benefits to the state, 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 usually cost just marginally more than comparable less efficient homes. Efficient homes help reduce the costs of home ownership, because the annual energy savings generally exceed the additional annual mortgage costs.[65]

[65] *State Energy Plan*, North Carolina State Energy Policy Council/State Energy Office, http://www.energync.net/State%20Energy%20Plan%2003.pdf ., June 2003.

Renewable Energy (Substitution for Fossil Fuels – Also Addressed in SEP)

Although substitution of renewable energy for fossil fuel energy is somewhat inherent in the SEP, it is identified here separately because of its importance in many discussions on the CO_2 topic. There are several promising ways to utilize renewable energy to potentially replace or substitute for the combustion of fossil fuels. One must also keep in mind that some sectors of renewable energy, such as combustion of biomass will also release CO_2 emissions and though they substitute for fossil fuels, this release of GHG must be taken into account in evaluations. Several of the renewable energy sources generate electric current without any combustion or generation of CO_2 or other GHG.

NC GreenPower, included in the SEP, and now in an active process of recruiting members or participants, is an existing (but new) program in North Carolina that provides customers with the option to purchase units of "green" power generated with renewable or other means of substitution for electricity that would be otherwise be generated from coal-fired units. The more participation there is from the customers, the greater the environmental benefits, including reductions in "new" CO_2 from fossil fuels. This program is unique to North Carolina, with all three utilities included, as several co-ops. The program allows most citizens of the state the opportunity to participate (A "reasonable" premium is charged for the option to actually purchase the green power units with these funds being used directly to offset extra costs of procuring that power).

In the United States, we have grown accustomed to very dependable power. When the switch is flipped, it is rare for the lights not to come on. However, one of the potential downsides of renewable energy may be the loss of some of this reliability, according to the "naysayers." A substantial quantity of new infrastructure dispersed among many locations would be required to provide the levels of "replacement" energy needed, and designs of those systems will need to keep reliability as a strong consideration. Some of this proposed capacity would not always be available when needed, which would likely require other generation capacity to be available for back-up when there are periods of rain (solar), low wind, disruptions in the supply of biofuel, etc.. Thus, such plans and changes would need to consider these options and situations holistically so that the system is adequate to cover all situations, at all times, whether by providing excess capacity of other renewable generation or by more conventional means. If the latter, some economic subsidy might be necessary to guarantee that this capacity, otherwise idle, would be available when called upon.

Solar:

The sun's energy can be used in four primary ways:

- solar thermal,
- passive solar heating and cooling,
- day-lighting and
- Photovoltaic.

Solar thermal collectors function relatively well in North Carolina's diffused sunlight. Solar thermal includes using solar energy for heating or cooling of interior spaces and water heating. In addition, solar energy is used for cooling and refrigeration. When concentrated with lenses or mirrors, sunlight can generate boiling water which is used directly or to drive various types of engines. This steam can be used to run steam turbines to produce electricity, much like in coal-fired power plant.

Passive solar includes orienting windows toward the south, and using concrete and other heavy building materials for thermal storage and shading strategies that avoid summer overheating. The SEP reports that "Passive solar buildings can have comparable costs as similar, non-solar structures and yet save significantly on heating and cooling costs while providing improved comport and quality of light. The main constraints are lack of awareness and consumer demand along with inadequate training and interest among residential and commercial designs, builders an developers."

Day-lighting is the practice of paying special attention to the use of natural lighting in the design stages of buildings and can provide an energy and cost savings in buildings if properly conceived and implemented.

Photovoltaic devices provide a newer frontier in capturing and using solar energy. They do not capture sunlight's heat energy directly, but rather use solar radiation directly to stimulate a flow of electrons, thus generating electricity. Photovoltaic energy is cost effective in some remote locations, but further research and technical advances are needed before the cost per peak watt of electricity is economic in typical situations. Some new technologies are dual functioning to make them more cost effective. For example, a roof system could be made of photovoltaic material thus providing electricity and roof protection for a residence.

One of the big advantages of solar energy systems is that they are most effective in producing energy in the summer months, the season with the peak electric utility demand in North Carolina. The very nature of solar energy systems thus cut electrical demand on the electrical grid during peak demand periods.

Wind/Substitution

Wind power generation is the fastest growing electricity generation technology used in the world.[66] Of the 10 wind classes that exist, determined by average annual wind velocities, the continental United States only has sites with the less intensive six classes. Class 5 and 6 sites are abundant in North Carolina's western mountains; with class three and class four sites being located in the mountains and along the eastern coast. Many of the mountain sites could likely generate electricity in the range of $0.03 to $0.04 per kWh - competitive with new coal and natural gas generation. According to the Energy Efficiency and Renewable Energy Network, North Carolina has the capacity to produce 8

[66] Dr. Dennis Scanlin, Appalachian State University,, *Wind Energy in North Carolina*, DAQ Mercury/CO_2 Workshop, Raleigh, NC, April 21, 2004 (See Appendix A)

million MWh, or about 7 percent of current electricity consumption in the State. This would come from using wind technology in Class 3 and higher sites only.

Two tax programs encourage wind energy generation. The federal Production Tax Credit (PTC) provides $0.018 per kWh of wind energy generated, and North Carolina's Renewable Energy tax credit (35 percent, with a maximum of $250,000). In order to compensate for existing development, environmentally sensitive areas, and other land-use conflicts, this estimate excludes 50 percent of total forests, 30 percent of total farmland, and 10 percent of total rangelands. The federal tax credit is in jeopardy of expiration which would be a significant blow to this program and the future of investments in wind energy.

Cost to site wind machines in areas with the greatest wind resources; namely the high ridges in Western North Carolina, is the single largest barrier to wind technology in North Carolina. The Mountain Ridge Protection Act of 1983, also know as the Ridge Law, was designed to prohibit the construction of unsightly structures taller than 35 feet on North Carolina ridges above 3,000 feet in elevation. Although exclusions exist for telecommunications towers, electrical *transmission* facilities, structures of a "relatively slender" nature, "minor" vertical protrusions, and even "windmills," the North Carolina Attorney General stated that electrical *generation* equipment is in violation of the Ridge Law. If upheld, this interpretation effectively prohibits development of many sites with the best wind resources in North Carolina.

Hydroelectric/Substitution

Hydropower currently represents the primary renewable energy supply for utilities in North Carolina. In 1999, hydroelectric plants supplied over 3.5 million MWh of electricity or about 3.5 percent of total state electricity sales. Hydroelectric generation typically requires less initial capital than coal and nuclear facilities, but more than natural gas, while typically providing the most economical source of electricity in terms of actual costs of generation. With a price under $0.025 per kWh, the total cost of hydroelectric generation is the cheapest source of electricity currently available for North Carolina.

The Idaho National Engineering and Environmental Laboratory, under contract with the DOE, assessed North Carolina's undeveloped hydroelectric generation potential. The study found 93 sites in North Carolina with approximately 508 MW of undeveloped generation capacity that might be used to generate electricity. The greatest capacity of any one site was 76 MW but over three quarters of the sites were estimated to be capable of providing less than five MW. According to the Energy Efficiency and Renewable Energy Network, North Carolina possesses roughly 8 million MWh of total new hydroelectric generation potential, which would meet approximately 7 percent of all generation in North Carolina.

A significant barrier to additional hydroelectric power for North Carolina is the drought experienced in recent years and the expiration of avoided cost contracts between electric utilities and owners of hydropower facilities. Hydropower's environmental impact on the ecology of the operation site has also been a significant deterrent to new development. A

shift away from large-scale projects to less intrusive low-head, small and micro-hydro projects has some responsibility. Rapidly growing demand for water for irrigation, industrial processes, cooling water, fish and wildlife considerations, and other human needs pose further limits to expanding hydroelectric development. All these factors will likely be considered when and if licensing or re-licensing events arise.

Biomass Burning/Substitution

Biomass is a carbon-based fuel, often derived from fast growing trees, or bushes, that can be used to fuel utility and other boilers. Though burning of biomass generates CO_2, it substitutes carbon already in atmospheric and biome circulation, for fossil fuels, thus lessening the net impact of "new carbon" on the overall environmental system. Agricultural and waste management sectors provide potential sources of energy for both electrical generation and other direct uses as fuels. Additionally, recent proposals and programs for fire hazard reduction have increased the interest and economics of using small diameter (low economic value) trees, bushes and shrubs for replacement of fossil fuels in electric generation. Efforts to further evaluate and extend such efforts in North Carolina are underway at NCSU and in the DENR Department of Forest Resources.

DOE estimates that 15.8 billion kWh of electricity could be generated from renewable biomass fuels each year in North Carolina. This is enough electricity to potentially supply about 39 percent of the residential electricity demand in the state. Of these sources, 80 percent of the potential biomass fuels would be from wood waste from logging, industrial, yard waste, furniture manufacture and construction. While more biomass as fuel offers a partial replacement for fossil fuels such as petroleum or coal, combustion of the biomass still creates climate change emissions and may provide additional control issues for other pollutants, such as NOx and particulate matter.

The largest potential supply of woody biomass for energy is standing timber or "stumpage." Much of North Carolina's 18.3 million acres of forestland is occupied by low-value trees not well suited for traditional wood markets. Twelve million of these acres are considered as having high potential for wildfire, a danger not only to the forests, but also to the surrounding communities, especially North Carolina's rapidly expanding urban-rural interface. On December 3, 2003, President Bush signed into law the Healthy Forests Restoration Act. This act targets forests presenting wildfire danger and calls for reductions in low-value standing fuels, restoration of healthy forests, and development of woody biomass energy. Development of a woody biomass energy market in North Carolina can help reduce fire danger while improving forest health.

Wood chips have not worked well as a fuel for co-firing with coal in utility boilers except in gasification applications. However, woody biomass has been used successfully for distributed generation across the U.S.,[67] and to the extent this occurs, current and future load requirements of fossil-fired power plants are reduced.

[67] Dennis Hazel, NC State University, Forestry Department, *Written Comments on Draft 2nd Interim Report*, August 9, 2004.

Use of biomass has secondary advantages of using damaged and depleted soils and aiding in their restoration. There is a benefit of sequestering more CO_2 (albeit somewhat temporarily) in soils in the process of adding organic matter to these soils. Since the Southeast has a long warm season and substantial water, it is well suited to growing biomass "crops.

Biofuels, including ethanol, biodiesel and mixtures, are made from various agricultural crops and residues. However, the resulting fuels are usually interchangeable with conventional fossil fuels in regular vehicles without modifications, especially in diesels. Ten tons of biomass can yield ~1000 gallons of biofuel, resulting in emission reduction from their use in vehicles due to the clean burning nature. Particularly, there is little or no sulfur emitted from these fuels, in contrast to petroleum-based fuels.

North Carolina has abundant biomass, such as landfill gas, mill residues, animal waste, forest residues, energy crops and urban wood. These fuels have a potential to supply up to ~20 percent of North Carolina's electric needs. Thus, high growth is predicted in this economic sector over the next decade. These fuel sources have the economic potential to create more local jobs, particularly in rural areas than many other types of projects. In addition, existing infrastructure (yards, trucks, rail sidings, etc.) uniquely positions the North Carolina wood industry to procure and deliver bulky biomass crops in a timely and efficient manner.

Biofuel conversion facilities are currently planned for construction in North Carolina.[68] However, EPA has specifically listed fuel switches from coal to natural gas, and from coal to wood, as pollution control projects that would be presumptively environmentally beneficial in the Final Rules on Prevention of Significant Deterioration (PSD) and Nonattainment New Source Review (NSR) issued on December 31, 2002 (67 FR 80186). DAQ is currently evaluating rule options and these will be implemented whenever they are final rules.

NC GreenPower, discussed earlier, provides an example of the use of renewable fuels to replace fossil. A recent summary of the NC GreenPower program appeared in the DENR's newsletter.[69] Survey and practice have indicated that the public is willing to invest additional premiums on their electric bills to insure the use of additional renewable energy, but the program is still in its early stages and will provide further indication of this factor as time passes and experiences accumulate.

There are additional issues that arise from considering biomass sequestration as a potential partial solution to the atmospheric carbon burden. There is a potential for biomass and carbon sequestration to work at cross purposes. Forestland planted for the specific purpose of carbon sequestration cannot be used as a source of biomass and then counted as sequestration. To do so would negate the benefit of the sequestration, and incidentally, any carbon credits earned.

[68] Karen Rindge, *Renewable Energy: Good for NC's Economy*, **Carolina Sun**, Summer 2004
[69] DENR News, http://www.enr.state.nc.us/upclose/pages/greenpower.html, July 2004.

Capture and Use of Underutilized Energy Sources/Substitution

Energy capture includes such activities as recovery of methane from landfills and from animal manure. Confined Animal Feeding Operations (CAFO's) are of particular importance in North Carolina. The State is nationally number two in ranking for hog production and has a swine population of about ten million (Iowa is number one with approximately fourteen million) out of a national total of approximately sixty million. Poultry operations, particularly chickens and turkeys are also important in the State, with dairy and beef cattle being important, but contributing to the waste "resources" with a much lesser quantity. If one does look at these wastes as a resource awaiting development, the potential impact becomes significant.

Research has been underway in this area for several years in North Carolina at the North Carolina Animal and Poultry Waste Management Research Center on the North Carolina State University (NCSU) campus and at several other agricultural campuses throughout the country. They have been attempting to develop better means of disposal of animal waste, many targeting recovery of resource value. In 2000, Smithfield Foods and the North Carolina Attorney General's Office entered into agreements to fund and study "promising new technologies" with expectation that these would provide solutions to the ammonia and odor problems in particular, and to waste disposal problems in general.

Results of this program have been recently unveiled. The reports are just recently available, but some of the promising technologies studied included methods and processes to turn the carbon in the waste into fuels for distribution as an energy source. This program will continue to pursue many of the technologies and make them more economically viable, but the conversion options, in particular, may hold promise for supplementing the fuel supply at no large expense on the CO_2 budget, providing another source of carbon fuel that does not depend on fossil fuels. At the DAQ Mercury and CO_2 workshop, Kurt Creamer, P.E., one of the researchers from NCSU, who has been working on this project with Dr. Mike Williams, Director of the Smithfield Agreement Project, discussed these efforts.[70] Reports from the research currently being released will be available soon and the studies will likely result in several papers and other technical documents over the next several months and few years.

Recovery of methane from other decomposing "bio-materials" such as found in landfills and wastewater treatment facilities, has been increasing and provides additional potential for added use. Several operations in North Carolina utilize these operations to "mine" methane mixtures from the natural anaerobic decomposition and utilize them in boilers and other combustion equipment with the eventual production of steam and electricity. In fact, EPA first research on this potential was first conducted on landfills in North Carolina and the technology proven as economically viable. Electricity may be used by the generating entity or sold to a neighbor (if legally allowed in the circumstance). Steam may be used directly or sold for process heat, agricultural production (e.g. greenhouse crops) and other uses.

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[70] Kurt Creamer, *NC Animal Waste as a Potential Resource for Reducing CO2 and Methane Emissions,* Presentation at DAQ Workshop, Raleigh, NC , April 21, 2004 (See Appendix A), www.cals.ncsu.edu/waste_mgt/ .

One factor that may need additional discussion and actions within the Legislature related to these type operations is the legal constraints and implications regarding the sale of electricity to the grid (net metering) or to a neighboring industrial, commercial or residential area. Laws pertaining to their being a regulated monopoly protect the electric utilities and these laws may require evaluation for change. Some energy developments such as the production of electricity from animal waste, land fills and other operations that may need to sell electricity to their potential customers may raise issues regarding the legalities and limits of such operations with regard to these same laws and regulations. They may not constitute impenetrable barriers, but further evaluation and possible legislative actions will likely be needed before it is possible to fully adapt some of these energy sources.

Post-Emission Capture and Sequestration

This section is primarily to address the capture and sequestration of CO_2 after already emitted by the combustion of carbon fuels by biological or technology and hardware.

Agricultural and Forest Sequestration

Growth of plants and other organisms that utilize CO_2 in their natural metabolic processes, remove CO_2 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,[71] forests increase their growth when exposed, or immersed, in elevated levels of CO_2. Thus, the growth of any forest or crop is likely to increase uptake, just "because it is there." However, it is evident that this increase in uptake is not sufficient to offset the rate of increase of release of CO_2 that is encountered globally today. Increases in biomass and organic matter in all U.S. forests in the past 40 years have only offset ¼ of the national emissions during that period.[72] However, these emissions can be offset to a significant degree[73]. Therefore, many efforts and proposals have been advanced to increase the sequestering efficiency and quantity 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 carbon sequestered that will again be burned or otherwise oxidized and those that will likely remain in the unburned state for decades or even centuries and effectively remove that carbon from circulation on a permanent basis.

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 CO_2 emissions must be evaluated with consideration for biodiversity protection consistent with other environmental programs and policies. Storage and sequestration of carbon in forests can

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[71] William H. Schlesinger, Dean, Nicholas School of the Environment and Earth Sciences, ***The Global Carbon Cycle and the Duke Forest Free-Air CO_2 Enrichment (FACE) Project***, Presentation at the DAQ C Mercury and CO_2 Workshop, April 21, 2004, Raleigh, NC. (See Appendix A).

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

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

potentially provide North Carolina an additional productive mechanism to sequester CO_2. Existing North Carolina forests currently store roughly 416 million tons of aboveground carbon. Planting new forests could sequester substantial additional carbon.[74,75] Programs for added permanent carbon sequestration through forestry thus provide a serious option to mitigate CO_2 emissions from power plants and other sources.

Carbon Storage Trends for North Carolina's Forests:

As North Carolina's forests diminish, so does their use as long-term storage of carbon. North Carolina lost more than 1 million acres of forests over the last 12 years, largely due to urban sprawl. North Carolina's forests now occupy 18.3 million acres, even less than in the 1930s, following an era of agricultural conversion.[76] Many forest communities have been especially hard hit, most notably the state's natural pine. Longleaf pine declined 30% since 1990, [77] and shortleaf pine declined by 38% in the same time period.[78] This trend of forestland loss is projected to continue for at least the next four decades[79]. Steady decline in the state's forests means a decrease in the amount of CO_2 stored. In fact, the loss of forestland over the past decade resulted in the loss of roughly 17 million tons of aboveground carbon.

Older forests store more carbon than younger forests but North Carolina's forests are getting younger. Since 1990, forests younger than ten years old increased by 15% and forests between 11 and 20 years old increased by 35%.[80, 81] Younger forests provide less suitable habitat for wildlife and have much less capacity for carbon storage than older age classes. Forests harvest rates have overtaken growth rates. Timber harvests have increased 30% since 1990, following another large jump in harvest rates during the late 1980s. Of harvested acres, 76% were clear-cut, which increases runoff, sedimentation and water quality concerns if not properly managed and impact the ability of forests to retain sequestered carbon.

Complexity of Carbon Sequestration

When considering carbon sequestration, the total amount of carbon sequestered should be the greatest priority and measure of effectiveness. Fast-growing trees accumulate carbon more quickly than slower growing trees, but this only accounts for a portion of the carbon that may be stored in a forest. When considering carbon sequestration comprehensively, it is important to also account for forest types, soils, management activities and stand age. Many generation and sequestration activities are occurring simultaneously in this complex situation, as illustrated in Figure IV-1. All the variables in this figure can have impact on the effective sequestration process.

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[74] Mark Brown, *Forest Statistics for North Carolina, 2002*, Table 9.

[75] USDA Forest Service, *Southern Forest Resource Assessment*, p. 45, Table 18.4.

[76] Environmental Defense,. *North Carolina Forests at a Crossroads: Selected Results of the 2002 Forest Statistics of North Carolina,* 2004.

[77] Mark Brown. *Forest Statistics for North Carolina*, 2002. January 2004. Table 9.

[78] Tony Johnson. *Forest Statistics of North Carolina, 1990*. July 1991. Table 10.

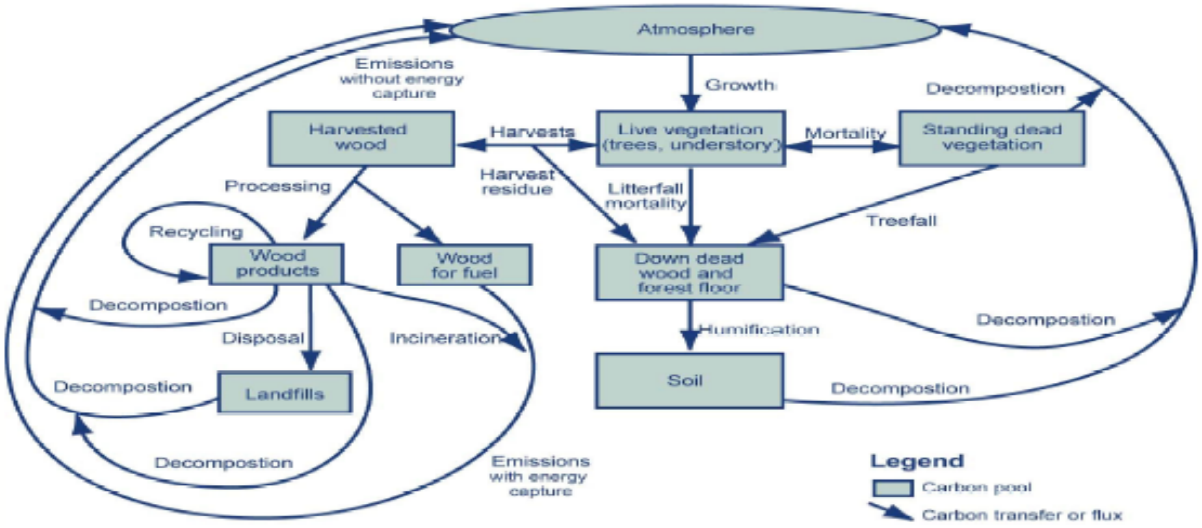
[79] USDA Forest Service, *Southern Forest Resource Assessment* (SFRA), GTR-SRS-53.

[80] Mark Brown. *Forest Statistics for North Carolina*, 2002. January 2004. Table 12.

[81] Tony Johnson. *Forest Statistics of North Carolina* (SFRA), 1990. July 1991. Table 13.

Figure IV-1

Summary diagram of forest carbon stocks and carbon transfer among stocks



Source: Adapted from USEPA (2003a), and Heath and others (2003)

In general, southern hardwood forests store more carbon than pine forests. Southern forests average 25 tons per acre of above ground carbon, but this figure varies widely by forest type. Southern pines (loblolly, longleaf, slash, etc) average 14-19 tons per acre of aboveground carbon. By comparison, bottomland hardwood forests and Appalachian hardwoods average 32 tons per acre of stored carbon.[82, 83] Loblolly pine can sequester 3.2 tons CO_2 annually compared to rates of 2.3 – 3.4 tons CO_2 annually for hardwood forests on old agricultural lands.

Forest soils account for some 50 – 60% of the total carbon in temperate forests.[84] Converting intensively managed agricultural fields to forests would be expected to begin the process of rebuilding soil carbon pools. Several studies have documented the CO_2 sequestration potential of forests in the Southeastern US. One study[85] reported that a 35 year-old loblolly pine stand had removed 345 tons per acre of CO_2 as plant carbon and 176 tons per acre as soil carbon. Another study[86] reported average annual sequestration rates of between 1.7 and 2.2 tons per acre of carbon over the first 15 years and as many as 110 metric tons total in 90 years in many parts of the Southeast.

Forest management affects both the growth rate of woody biomass and the soil carbon (as described above). When forests are managed for "maximum financial yield, they will

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[82] SFRA, p. 445.

[83] **Journal of Forestry**, 9/00, Vol. 98, No. 9, p. 23

[84] SFRA, p. 443.

[85] U.S. Department of Energy. *Carbon Sequestration, State of Science, Draft Report. Ch. 4: Carbon Sequestration in Terrestrial Ecosystems* . 1999.

[86] Birdsey, R.A. 1996. "Regional Estimates Of Timber Volume And Forest Carbon For Fully Stocked Timberland., Average Management After Cropland Or Pasture Reversion to Forest," Appendix 3 in *Forests and Global Change*, *Vol. 2, Forest Management Opportunities for Mitigation Carbon Emissions* (R.N. Sampson and D. Hair, ed.) **American Forests**, Washington, D.C.

rarely contain more than approximately one-third of the carbon stored in a forest grown to maximum biomass."[87] Similarly, forests that are publicly owned have the highest rates of above ground storage per acre, while more intensively managed forest industry lands have the lowest carbon storage rates. Family-owned forests fall between these two groups.[88] 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.[89] In addition, some 53% of the carbon in harvested wood is lost through emissions and energy use.[90] 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.

Recent Developments in Georgia and California

In **Georgia,** a new law[91] has established a registry for offsetting reductions in greenhouse gases obtained by carbon sequestration relating to forest resources and other plant life. This law provides for development of purposes, function, procedures, protocols, etc. for a voluntary reporting on standardized forms and software, and other requirements, to stimulate and track sequestered carbon emissions from forests and agricultural activities in the state. This new law is rather unique, but reflective of the role sequestration may be able to play in lowering net emissions of GHG to the atmosphere.

The Georgia law is specifically directed at direct human-induced land use change or forestry activities, additional human-induced activities related to removal by sinks in land use change and forestry categories, additional human-induced activities related to removal by sinks in agricultural soils, additional human-induced activities related to removal by sinks in products in use from harvested timber or agricultural crops and other human-induced activities related to removals by sinks. This legislation may be of interest for future directions in other states, but being voluntary, it is not ideally formulated to provide a significant role in a comprehensive program for reductions of GHG in the atmosphere.

California's Climate Action Registry (SB812),[92] passed Fall 2002, allows landowners to register increases in their forests' carbon stocks derived from stewardship forestry and conservation. SB 812 is the third in a series of significant state legislative initiatives to combat global warming, and follows on the heels of AB 1493, which calls for the regulation of automobile CO_2 emissions. SB 812 ensures that including the forestry sector in registries, and crediting forest activities to reduce emissions, will make a significant difference in carbon dioxide levels. For carbon stocks to qualify for the California Registry, the bill requires that:

- Forest practices must exceed legal and regulatory requirements, thus preventing carbon dioxide emissions and achieving reductions of carbon dioxide in the atmosphere beyond those that would take place otherwise.

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[87] SFRA, p. 444.
[88] SFRA, p. 445.
[89] SFRA, p. 443.
[90] SFRA, p. 446.
[91] Georgia SB 356 (*Carbon Sequestration Registry Act; provide Information system of registry*), Georgia General Assembly, passed and sent to the Governor on April 24, 2004.
[92] California SB812, *California Governor Signs Nation's First Law To Fight Global Warming With Forest Conservation*, Sept. 9, 2002, http://pacificforest.org/ , http://www.climateregistry.org/docs/PROTOCOLS/Forestry/04.06.14_Final_Forest_Protocols_Board_Overview.pdf .

- Forest carbon benefits must be permanent, making a permanent difference for global warming and conservation.
- Forest practices must promote and maintain native forests, while avoiding the environmental harm that could result from the planting of non-native species.

Creating an Effective Carbon Storage and Sequestration Program

Carbon sequestration has gained favor as a viable option for reducing CO_2 levels in the atmosphere. Currently these sinks handle about 15 percent of the manmade emissions.[93] The USDA currently has a global change research budget of about $71 million per year which is among other things, evaluating effectiveness of various agricultural and forest potentials.

A carbon sequestration program must have an accurate system of measuring and recording carbon stocks if it is to ensure long-term atmospheric benefits.[94].. Carbon can be stored over very long time horizons, but land use changes can rapidly reverse gains. An effective carbon sequestration and storage program must include mechanisms to ensure that users of stored carbon are fully responsible and liable for replacing carbon that is lost in the future. Creating such mechanisms will likely foster innovative solutions to manage risks, such as carbon insurance.

This discussion of carbon sequestration and storage raises additional issues for the use of biomass as a potential (partial) solution to reduce the atmospheric carbon burden. Policy considerations for the use of biomass as a fuel are similar to those for permanent sequestration. The potential for biomass fuels and carbon sequestration to work at cross-purposes must be recognized and incorporated into such an effort. Forestland planted for the specific purpose of permanent carbon sequestration should not be turned into biomass for fuels. To do so negates the benefits and any carbon credits earned.

A forest carbon sequestration program must create additional reductions in greenhouse gases to be effective. These reductions must go beyond those reductions that would have occurred without the carbon sequestration program. This concerns both on-the-ground practices and utilization of harvested wood products. Only carbon that would otherwise not be sequestered should be credited. An agricultural field planted to trees represents the simplest accounting situation. How to credit existing forests or forest products that would have been created anyway presents a greater challenge. Current planning should consider sequestration as an integral factor in the overall plan for GHG reductions.

Carbon sequestration provides an excellent yet challenging opportunity for North Carolina to address sequestration of some of the atmospheric CO_2. The most ideal scenario might be the development of policies that provide the greatest opportunities for reducing emissions and protecting other conservation goals such as biodiversity. Developing policies consistent with existing policies and programs to protect the State's

[93] William Hohenstein, USDA Global Change Program Office, *USDA Global Change Activities*, August 2, 2002,. http://www.climatescience.gov/Library/agency-briefings-jul2002/USDA/USDA_Introduction%20and%20Overview.ppt .

[94] Adapted from Environmental Defense. "A Bridge to Climate Protection: Slowing Global Warming by Marketing Carbon Stored in Farms and Forests," 2003.

diverse natural resources will ensure the greatest benefits, and will be an option to consider in addressing this issue further.

End-of-Pipe Hardware/Technologies

Several methods to reduce emissions directly from the stacks of fossil fueled power plants (primarily coal) have been proposed and are being researched by the DOE. Though some of these may be useful in the future, they are still in the development and proving stages and not ready for practical and "off the shelf" application. Some of these are discussed below for completeness and planning purposes and complete recommendation options. The DOE Global Climate Change Initiatives[95] stated goal is to achieve a 90 percent CO_2 capture with less than a 10 percent increase in cost of energy services (net of any value-added benefits, e.g., CO_2 credit trading, etc.). This can be adopted as "rule of thumb" criteria for assessing the practicality of various technologies available, or under development. Further discussion on individual technologies is presented below. The rather extended discussion of approaches and research is not intended to imply that many, or any, of these technologies are likely to be available for "off shelf" use in any near term period.

CO_2 Capture Options

A second approach to reduction of emissions of CO_2 into the atmosphere from coal fired boilers and other large facilities is by capturing them by some means and converting the CO_2 chemically or physically into a form or substance that can be stored indefinitely. This may be through "end of pipe" hardware approaches or by other means. At the DAQ workshop in April of 2004, Kevin Johnson provided an excellent overview[96] of means that might be feasible to capture the CO_2 that has already been formed (i.e. exhaust from a smokestack) and permanently sequester it. The capture technologies being most enthusiastically evaluated or developed fall into basic categories described below.

Conventional Amine Absorption

Conventional amine absorption is the only technique used commercially, to date, to capture CO_2 from flue gas. Essentially, a chemical compound (amine) is injected into a flue, by way of a variation of a scrubber-like device that maximizes chemical contact and reaction. This device captures the compounds in a form that is sufficiently stable to be handled without special precautions, such as specific limits on temperature, pressure, etc. The amine degrades via oxidation and reaction with SO_2 and other flue gas constituents to lessen its performance over time. Lower amine concentration results in larger equipment, higher solvent circulation rates, and increased energy requirements for CO_2 regeneration from the rich amine stream. Only a few small plants (<1000 tpd CO_2 removal, or about 50 - 100 MW) are in commercial operation. Currently, this approach of 'conventional' amine absorption/stripping is estimated to increase electricity costs by over 50 percent, and consume 30 percent, or more, of plant's

[95] Bob Kane, USDOE, Climate Challenge Program, ***The Administration's Global Climate Change Initiative And Enhanced Opportunities for Carbon Sequestration On Minded Lands***, USDOE, , http://www.mcrcc.osmre.gov/PDF/Forums/MarketBasedReforest/1-1.pdf .

[96] Kevin Johnson, URS Corp, ***Some Projected Add-On Control Options for CO_2 Reductions at a Coal-Fired Generating Unit,*** DAQ Mercury and CO_2 Workshop, Raleigh, NC, April 21, 2004 (See Appendix A).

output.[97] Though technically feasible, this sort of penalty does not appear to offer a practical solution at this time.*Advanced Amine Absorption*

Advanced amine absorption uses proprietary oxidation inhibitors and other additives with specially designed membranes, custom solvent and amine formulations with a similar basic approach. Various commercial vendors have been pursuing process improvements, including Fluor, Praxair, Kvaerner, MHI, ABB, Lummus and Crest. Currently, costs are reported to be in the range of about $30 to $40 per ton of CO_2, with R&D development goals set at about $20/ton CO_2. Advanced amine absorption processes may hold promise for intermediate-term CO_2 capture, with incremental (i.e., not breakthrough) reductions in costs. There is a critical need for large-scale pilot plant demonstration(s) on SO_2/NO_X-laden, coal-fired flue gas before more definitive projections can be made. Research breakthroughs and innovation in applications can certainly be significant, but are do not yet appear to be within the range of practicality.

Gas Separation Membranes

Gas separation membrane technology uses gas-liquid or catalyzed liquid membrane separators or reactors to "pull" the CO_2 gas from the exhaust stream. They may potentially use unique physical solvents, often still of a proprietary nature. Several potential vendors are currently actively involved in development of this concept or technology. These include Kvaerner, Carbozyme (catalyzed enzyme) and Electrocore (natural enzyme).

Temperature Swing Adsorption

Temperature swing adsorption concepts are similar in the use of custom-designed sorbents that adsorb CO_2 at lower temperatures, and then desorb CO_2 at higher temperatures. They include zeolites, synthetic zeolites, activated carbon (Adsorption Research, Inc./DOE). Though this technology holds promise for some time in the future, it is not ready for practical application today.

Regenerable CO_2 Sorbents

Regenerable CO_2 sorbent technology involves an absorption step for CO_2 removal, followed by a sorbent regeneration step where CO_2 is off-gassed. The process generally uses alkali and alkaline-earth metals (e.g., K_2CO_3 and CaO) deposited on a substrate. This technology is the focus of several ongoing research experiments. Advantages over amine-based liquid systems include: a) no large quantities of water involved in capture step and b) there are additional energy savings due to lower gas/solid pressure drop. RTI International (of RTP, NC) currently has efforts underway to develop this technology with support from DOE. Costs remain high with large energy use penalties.

The DOE has funded several such research projects that address the collection of CO_2 from stack gases of a coal-fired power plant. Except for amine absorption technologies, all CO_2 capture technologies still at the laboratory, bench-scale development level. Based on lab results, several vendors (Carbozyme, ARI) "claiming" projected full scale cost performances on the order of $5-15/ton CO_2 at some time in the future. These, and

[97] National Coal Council, "R&D Needs and Deployment Issues for Coal-Related GHG Management", May 2003.

other, potential "breakthrough" CO_2 capture technologies warrant further investigation and research investments but do not provide immediate promise or answers.

Geological Sequestration

The discussions immediately preceding relate to the capture of the gas in some form. This does not include transforming it to a stable and neutral element of the environment. One of the most promising means of disposal being researched is that of injection into geological strata such as subsurface coal mines, oil seams or deep underground brine "pools." Injection into oil or coal seams may also have some added benefit from production (release from strata) of methane that can be tapped and used in the utility boiler or for other purposes.

Obviously, these technologies require access to the proper strata for disposal of the waste stream before they might likely be considered viable. Eastern North Carolina may have some limited deep brine strata near the coast, but the state has no mines that would likely provide an opportunity for using this technology. Also, if such practical formations exist and prove feasible, there are currently no coal-fired (or other) boilers in that area, meaning that there would be additional transport costs to consider. The DOE recently announced the intent to develop an Environmental Impact Assessment of several brine strata. One of the potential formations to be assessed could be in Northeastern North Carolina. The proposal and Environmental Impact Assessment processes are time consuming, but prospects of information to be gained from evaluation of these formations is viewed as positive for the State. If the capture technology proves viable at some time in the future, it would be imperative to have a place to sequester the waste stream to render it harmless. The proposed DOE action would likely help answer these questions and a portion of the disposition puzzle for North Carolina. Such technologies might also influence location of future power generation units. Even with such an alternative available, the costs of collection and disposal would remain high and would very likely result in large reductions in the efficiency and generation of useful power at any such plant.[98]

[98]Kevin Johnson, *Some Projected Add-On Control Options for CO_2 Reductions at a Coal-Fired Generating Unit*, URS Corporation, DAQ Mercury and CO_2 Workshop, Raleigh, NC, April 21, 2004 (see Appendix A).

Other Technologies and Emerging Options

Many technologies have been developed, or are in an advanced state of development, such that they fall into a gray area of categorization. Some may be feasible to apply almost immediately, yet others are still on the shelf for one reason or other. Some of these technologies could easily move to a more advanced stage with little time and notice.

Conversion of Coal Units to Gas Units

A few years ago, many industry experts believed that coal-fired electric generating plants were "dinosaurs."[99] Coal was under attack; natural gas was cleaner burning, plentiful and "inexpensive." Improvements in combined cycle gas burning units had increased their efficiency. Natural gas units were generally less expensive in terms of capital investment. However, as natural gas units began to come on line, the price of natural gas went up in response to the decline in supply. The price of gas rose almost 175 percent over five years. With current natural gas prices even the more efficient new gas plants can operate economically only during the very infrequent periods of peak demand. Use of natural gas should not be dismissed out of hand for future expansion, but it probably is not a top candidate just because of reduced air quality impacts. Demand, alternate uses of the fuel, price and questionable net impacts make it necessary to look very closely at options and alternatives before implementing any significant expansion of conversion from coal as a fuel to natural gas.

Coal Gasification

Though direct use of natural gas may not be the answer for coal replacement, use of coal gasification may provide a partial answer. Integrated Gasification Combined Cycle (IGCC) is a process[100] for converting coal partially or completely to combustible gases. It is not a new technology (from the early 1800's through the 1940's most fuel gas used for residential and commercial applications was fuel gas from gasification of coal or coke), but is undergoing renewed interest, research and development, especially following recent successful demonstrations of practical applications. Eastman Chemical has used the technology routinely and has now licensed many of their developments, as a "chemical engineering process." IGCC is billed as the next generation of the technology of choice.

Coal can be gasified in a number of ways. After conversion, the resulting gases - carbon monoxide, carbon dioxide, hydrogen, methane and nitrogen - can be used as fuels or as raw materials for chemical or fertilizer manufacture. Gasification is inherently a cleaner process because coal is not combusted and the relatively small volumes of "syngas" are easier to clean up than the much larger volumes of flue gases at a coal combustion plant.[101]

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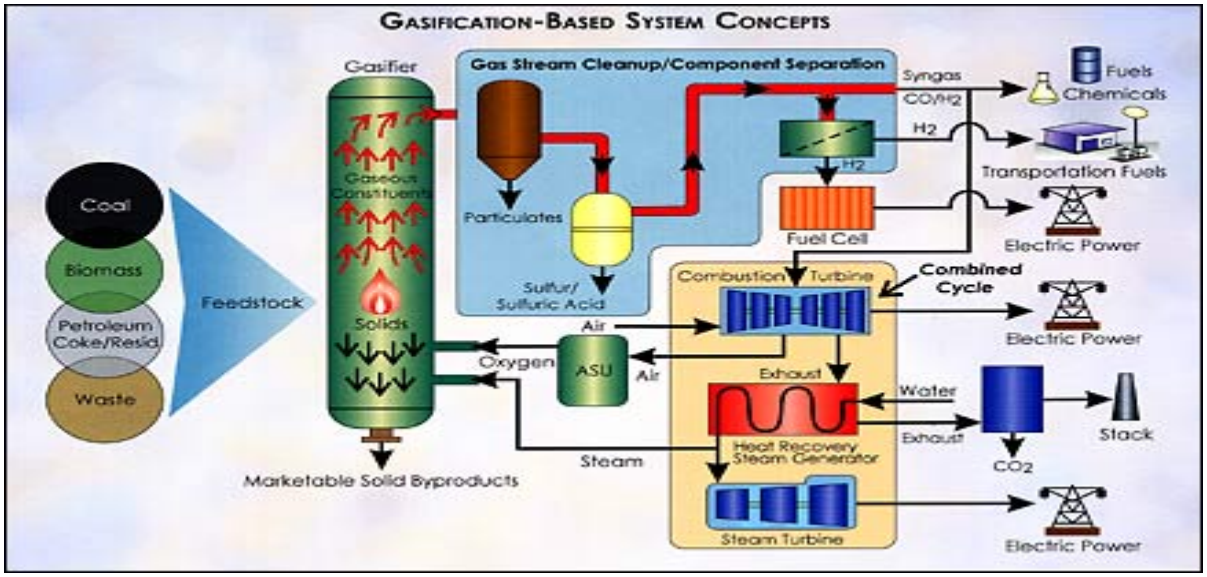
[99] Cinergy Corporation, *2003 Annual Report*.

[100] E. L. Clark., ***Coal Gasification***, http://www.zetatalk.com/energy/tengy11a.htm.

[101] Joe Chaisson, Clean Air Task Force, ***Integrated Coal Gasification Combined Cycle (IGCC) Power Plants and Geologic Carbon Sequestration***, DAQ Mercury and CO_2 Workshop, Raleigh, NC, April 21, 2004 (See Appendix A).

The first pioneering coal gasification electric power plants are now operating commercially in the United States and in 49 other nations. [102] Many experts predict that coal gasification will be at the heart of the future generations of clean coal technology plants for several decades into the future. Rather than burning coal directly, gasification breaks down coal, or virtually any carbon-based feedstock, into its basic chemical constituents. In a modern gasifier, coal is typically exposed to hot steam and carefully controlled amounts of air or oxygen under high temperatures and pressures. Under these conditions, carbon molecules in coal break apart, and set chemical reactions into motion that typically produce a mixture of carbon monoxide, hydrogen and other gaseous compounds. Gasification may be one of the best ways to produce hydrogen for future automobiles and power-generating fuel cells. Hydrogen and other coal gases may also be used to fuel power-generating turbines or as the chemical "building blocks" for a wide range of commercial products. DOE's Office of Fossil Energy is working on coal gasifier advances that enhance efficiency, environmental performance, and reliability as well as expand the gasifier's flexibility to process a variety of feedstock (including biomass and municipal and industrial waste).

Figure IV-2: Schematic of Gasification Process



Credit: DOE

Environmental Benefits of Gasification

The environmental benefits of gasification of coal and other carbon-based fuels result from the process's capability to cleanse as much as 99 percent of the pollutant-forming impurities from coal-derived gases.[103] Sulfur for example, emerges as hydrogen sulfide and can be captured by processes routinely used today in the chemical industry. In some alternatives, the sulfur is extracted in an elemental form that can be sold commercially. IGCC plants can achieve low NOx emissions as the substantial amount of nitrogen

[102] DOE, Office of Fossil Energy, *Coal Gasification*, http://www.fe.doe.gov/programs/powersystems/gasification/ .
[103] Ibid, *Coal Gasification*.

contained in coal is readily removed in the syngas clean-up process. Thus, NOx formation at an IGCC plant is primarily the result of thermal NOx produced at high temperatures in a combustion turbine.

The DOE Office of Fossil Energy is also exploring advanced syngas cleaning and conditioning processes that are even more effective in eliminating emissions from coal gasifiers. Multi-contaminant control processes are being developed that reduce pollutants to parts-per-billion levels and are effective in cleaning **mercury** and other trace metals, in addition to other impurities. Coal gasification may offer a further environmental advantage in addressing concerns over carbon dioxide. If oxygen is used in a coal gasifier instead of air, carbon dioxide is emitted as a concentrated gas stream, making it more viable and inexpensive to capture for ultimate disposition in various sequestration approaches. (By contrast, when coal burns or reacts in air, 80 percent of which is nitrogen, the resulting carbon dioxide is much more diluted and more costly to separate from the larger mass of gases flowing from the combustor or gasifier.)

Efficiency Benefits

Coal gasification also results in significant efficiency gains. In a typical coal combustion plant, heat from burning coal boils water, to make steam that drives a steam turbine-generator. Only about *a third* of the energy value of coal converts to electricity by most combustion plants. The rest is lost as waste heat. A coal gasification power plant typically gets dual duty from the gases that it produces. First, the coal gases, cleaned of their impurities, are fired in a gas turbine, much like natural gas, to generate one source of electricity. The hot exhaust of the gas turbine is then used to generate steam for a more conventional steam turbine-generator. This dual source of electric power, called a "combined cycle," converts much more of coal's inherent energy value into useable electricity. The fuel efficiency of a combined cycle power plant using gasified coal can thus be boosted to about 50 percent or more. Future concepts that incorporate a fuel cell or fuel cell-gas turbine hybrid will likely achieve even higher efficiencies, perhaps in the 60 percent range, or nearly twice today's typical coal combustion plants. With remaining waste heat being channeled into process steam or heat, perhaps for nearby factories or district heating plants, greenhouses, etc. the overall net fuel use efficiency of future gasification plants could possibly reach 70 to 80 percent.

Higher efficiencies translate into more economical electric power and potential savings for ratepayers. A more efficient plant also uses less fuel to generate power, meaning that proportionally less CO_2 is produced. Coal gasification power processes under development by DOE could cut the formation of CO_2 by 40 percent or more compared to today's conventional coal-burning plant. The capability to produce electricity, hydrogen, chemicals, or various combinations while virtually eliminating air pollutants and greatly reducing generation of GHG emissions makes coal gasification one of the most promising technologies for the energy plants of tomorrow. Many contend that its day has come and can be used as off-the-shelf technology, with continuing improvements.[104]

[104] Joseph Chaisson, Integrated ***Coal Gasification Combined Cycle (IGCC) Power Plants and Geologic Carbon Sequestration***, DAQ Mercury and CO_2 Workshop, Raleigh, NC, April 21, 2004 (See Appendix A).

Carbon Capture

From a climate perspective, a significant advantage of IGCC is that technology exists to remove carbon from syngas at a reasonable cost. Once captured, carbon can be compressed and transported to an appropriate site for injection into a suitable geologic formation for indefinite sequestration from the atmosphere as discussed earlier. All parts of this "carbon capture and sequestration" technology are in commercial practice today, but would need to be "up-scaled" to meet the requirements for a commercial IGCC utility plant.

Combined Cycle Turbines

Combined cycle turbines[105, 106] are relatively large stationary turbine units that are most frequently fueled by natural gas and used as intermittent peaking capacity for high load times. Some of the same, or similar, efficiency enhancements that were described above for IGCC can apply to these units. Combined cycle systems are capable of breaking the 60 percent efficiency barrier. They integrate the gas turbine, steam turbine and heat recovery steam generator into a seamless system, optimizing each component's performance. These units use higher efficiency and output to reduce the cost of electricity of this gas-fired power generation system.

Most existing units are open loop air-cooled gas turbines that have a significant temperature drop across the first stage nozzles, which reduces firing temperature. The combined cycle or closed-loop steam cooling systems allow the turbine to fire at a higher temperature for increased performance, without increased combustion temperatures with their usual increased emission levels of NOx. This closed-loop steam cooling enables them to achieve 60percent fuel efficiency capability while maintaining strict low NOx standards and reducing CO_2 emissions. Additionally, closed-loop cooling minimizes parasitic extraction of compressor discharge air, thereby allowing more air to flow to the head-end of the combustor for fuel premixing. They also offer a greater than 40 percent reduction in land area per installed megawatt, compared to other combined cycle systems, which helps reduce the overall cost of producing electricity. This technology is already in use at several plants in the State. Progress Energy's Cape Fear plant, for example, has two combined cycle units that power turbines from the original boilers at the site.[107] Several other new combined cycle units have also been built in the State and should be considered strongly in reviews and evaluations of new or modified units in the future.

Distributed Generation

Distributed generation applies to various schemes and methods whereby fuel, such as pipeline natural gas (locally generated methane from animal waste, etc), is distributed to small electrical generating units which then do not necessarily have to be connected to the electrical grid to satisfy the need of the individual customer. These generating units may be in the form of fuel cells, turbines or reciprocating engines (spark or diesel) and

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[105] General Electric, *GE Power Systems Gas Turbine and Combined Cycle Products*, http://www.gepower.com/prod_serv/products/gas_turbines_cc/en/downloads/gasturbine_cc_products.pdf .

[106] Siemens- Westinghouse, *Combined Cycle Plant Ratings,* , http://www.siemenswestinghouse.com/en/plantrating/index.cfm .

[107] Cheryl Vetter, Progress Energy- *Comments on the Draft CO_2 Emissions Reduction Options for Coal-fired Electrical Utility Boilers and Other Stationary Sources, Second Interim Report,* August 6, 2004.

generally eliminate much of the line losses associated with the current distribution system (on the order of 10 percent of electricity generated is lost in line losses). However, these "small" units are generally not as efficient as a central unit with larger output, may be noisy, may be prone to abandonment or low maintenance practices, have the limitations of releasing their emissions (most likely NOx as the major pollutant of concern) at ground level, are not amenable to reliable emission controls and may have other environmental shortfalls. In addition, to function most efficiently there may need to be connections to the grid anyways for dependability of service and sale of excess production to the grid, when/if net metering legalities are resolved.

The potential for distributed generation is quite large. Some distributed generation sites, such as an animal waste fuel facility, could potentially become economic development zones where a single generator could serve the electrical needs of multiple facilities within that zone, or perhaps a nearby residential neighborhood.

For distributed generation to reach its potential in North Carolina, a change in the current utility territorial law may be required. At the current time, an entity wishing to sell the output from a distributed generation system to an end-use customer may, possibly, not be able to do so without becoming a regulated utility in NC, unless the entity is either an electric cooperative or a municipal electric system. It is unlikely that an entrepreneur will want to become a regulated utility subject to the various reporting requirements.

Hydrogen Fuels & Fuel Cells

A fuel cell uses the chemical energy of hydrogen to produce electricity and water, cleanly and efficiently. Fuel cells are unique in terms of the variety of their potential applications; they can provide energy for systems as large as a utility power station and as small as a smoke detector.

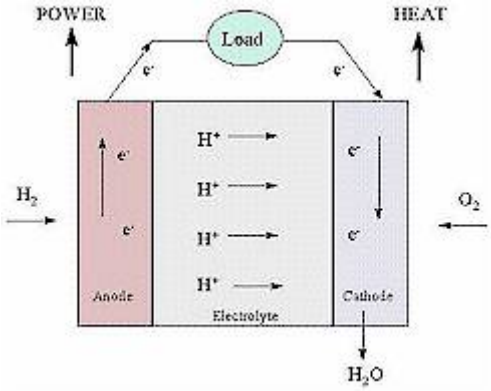
Hydrogen production and its combustion either in fuel cells or in "open flame" technologies have the potential to solve several major challenges facing America today: dependence on petroleum imports, poor air quality, and GHG emissions. DOE's Hydrogen, Fuel Cells & Infrastructure Technologies Program[108] is working to accelerate the development and successful market introduction of these technologies. The IGCC process referenced above is a potential building block for production of hydrogen from coal. In addition, work is progressing for direct use of coal in fuel cells. Some of this work was pioneered in the National Aeronautics and Space Administration (NASA) work preliminary to space travel. Research and developments of both hydrogen production technologies and those that provide for its effective uses as a clean burning fuel are "almost accessible" and the expectations for their application are high in the next few years. As noted above, IGCC technologies can easily provide a hydrogen stream for use to fuel these devices or other purposes needing hydrogen.

Fuel cells have several benefits over conventional combustion-based technologies currently used in many power plants and passenger vehicles. They produce much smaller

[108] U.S. DOE, Hydrogen, Fuel Cells & Infrastructure Technologies Program, http://www.eere.energy.gov/hydrogenandfuelcells/ .

quantities of GHG that contribute to global warming and none of the air pollutants that create smog and cause health problems. If pure hydrogen is used as a fuel, fuel cells emit only heat and water as a byproduct, though higher temperature applications have the potential to generate some NOx. Obviously, this technology is not yet available off the shelf for replacement of coal fired electrical generation but seems to have promise. Also, the cost factors are somewhat elusive at this point. As the technologies develop further, one can reasonably expect that these factors will be better defined and a sensible and reliable analysis of their potential (cost) impact on the market place can be developed. A simple rendering of how a fuel cell works is shown in Figure IV-3.

Figure IV-3
How a Fuel Cell Works[109]



Recovery of Fuel Value from Animal Waste at CAFOs

Confined animal feeding operations (CAFO's) generate huge quantities of waste high in carbon, and usually ammonia. Research underway for several years in North Carolina at the North Carolina Animal and Poultry Waste Management Research Center on the North Carolina State University (NCSU) campus and at several other agricultural campuses throughout the country is attempting to develop better means of disposal of animal waste, with recovery of resource value. North Carolina is the second largest hog producer in the US, with approximately 10 million pigs, thus at NCSU, the focus of these activities has been primarily on swine operations. In 2000, Smithfield Foods and the North Carolina Attorney General's Office entered into agreements to fund and study "promising new technologies" with expectation that these would provide solutions to the ammonia and odor problems in particular, and to waste disposal problems in general.

Results of this program have been recently unveiled. The reports will soon be available, but some of the promising technologies studied included methods and processes to turn the carbon in the waste into fuels for distribution as an energy source. This program will continue to pursue many of the technologies and make them more economically viable, but the conversion options, in particular, may hold promise for supplementing the fuel supply at no large expense on the CO_2 budget, providing another source of carbon fuel that does not depend on fossil fuels. At the DAQ Mercury and CO_2 workshop, Kurt

[109] NASA, *How a Fuel Cell Works*, http://www.grc.nasa.gov/WWW/Electrochemistry/doc/fuelcell.html .

Creamer, P.E., one of the researchers from NCSU, who has been working on this project with Dr. Mike Williams, Director of the Smithfield Agreement Project, discussed these efforts.[110] Reports from the research are currently being released and the studies will likely result in several papers and other technical documents soon. As for other potential electric sources, the net metering and other related legalities may need to be addressed before all the roadblocks are removed.

Nuclear Power

Despite other environmental and social impacts, nuclear does have substantial air quality and CO_2 benefits. Nuclear power is basically a clean (air pollution-wise), non-CO_2-emitting source of electric power. A new nuclear power plant has not been built in the U.S. in the last couple of decades, but DOE is currently in the process of "dry-run" permitting new nuclear capacity. Finland, Japan and Taiwan have also recently announced new nuclear plants. Reluctance to build such capacity has been largely due to fear of or potential for releases of nuclear radiation and because of the lack of long-term, safe storage and disposal facilities for "spent" nuclear fuels. The more recent fear of, or actual potential, for some of these fuels falling into the hands of terrorists and others has not helped enhance the chances of new plants being constructed. Many design improvements for safety have been made in reactors since the last units were built here, and reactors continue to operate and be built in other countries. Whether, or when, these units may enjoy serious further consideration in North Carolina is uncertain, but that uncertainty does not dismiss this option from being on this list.

Industrial Initiatives

The private sector often has motivation and commitment to make reductions on their own. Though the point here is not to show a complete cross-section of such efforts, several companies have developed a strong environmental reputation by "going the extra mile" and demonstrating their good citizenship. Two examples that operate in North Carolina are mentioned below:

- DuPont has become a leader in safety issues as well as several environmental areas. For CO_2 reduction results, it has undergone massive programs to revamp the way it does business and manufactures products. For example, the company as a whole, used nine percent less total energy in 2002 than it did in 1990, despite an almost 30 percent increase in production. The resulting energy savings were nearly $2 billion. Mr. William Bailey of DuPont made a presentation at the DAQ Mercury and CO_2 Workshop in April 2004 and his presentation slides are available that summarize their efforts and results.[111]

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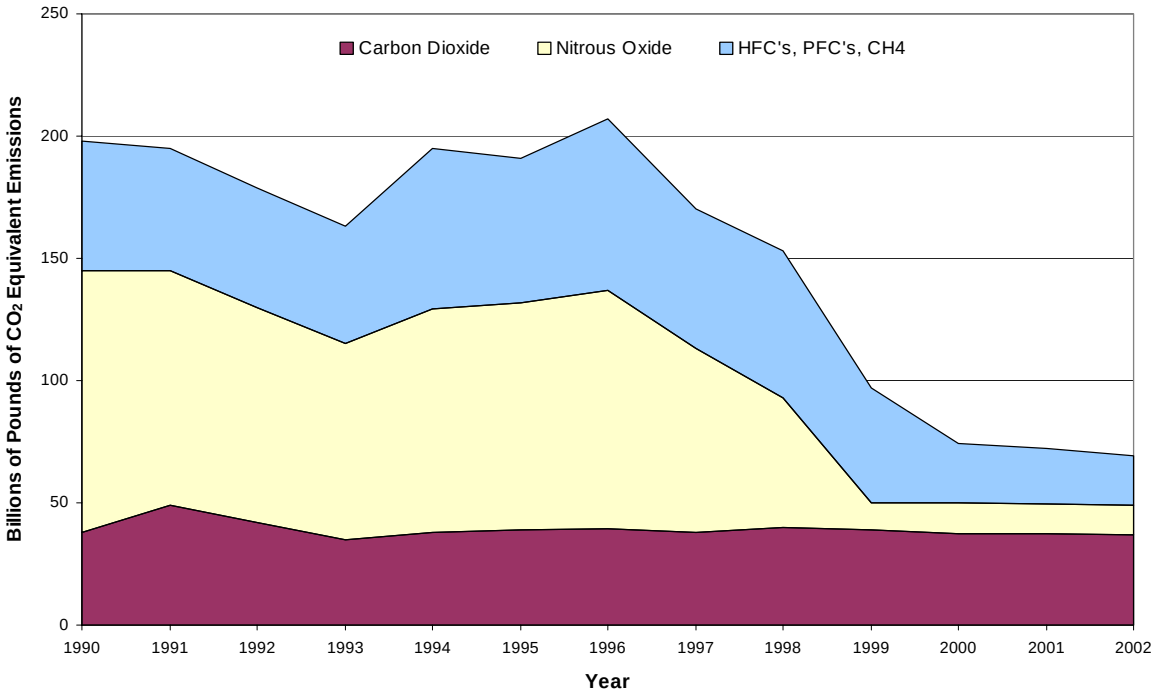
[110] Kurt Creamer, *NC Animal Waste as a Potential Resource for Reducing CO2 and Methane Emissions,* Presentation at DAQ Workshop, Raleigh, NC , April 21, 2004 (See Appendix A), www.cals.ncsu.edu/waste_mgt/ .

[111] William Bailey P.E., Principal Consultant E. I. DuPont de Nemours and Co., Inc. Charlotte, NC, *Reducing Greenhouse Gas Emissions in DuPont*, Presentation at DAQ Mercury and CO_2 Workshop, Raleigh, NC, April 21, 2004. http://daq.state.nc.us/news/leg/2004-04-hg-co2-agenda.pdf . (See Appendix A)

Figure IV-4: Emission Reductions at DuPont 1990-2002



- IBM provides another example of such an environmentally forward-looking company. Between 1990 and 2002, IBM's energy conservation measures resulted in savings of 12.8 billion kilowatt hours of electricity, avoiding nearly 8 million tons of CO_2 emissions and saving the company $729 million in reduced energy costs.

Other Potential Policy Options for North Carolina

Although already covered to some degree by the SEO's energy plan discussed above, several particular energy related policies seem appropriate for further discussion and added emphasis. These policy options do not necessarily relate to hardware or technologies so much as to a means to an end different from what is now in place.

Renewables Portfolio Standards:

One way to encourage increased use of renewable sources of energy as already discussed in this report, is to establish a Renewables Portfolio Standard (RPS). The RPS is a flexible, market-driven policy that can help ensure that the public benefits of wind, solar, biomass and geothermal continue to be considered for their maximum contributions toward using less energy and the accompanying reductions in CO_2 emissions as electricity markets become more competitive. RPS can help ensure that some minimum amount of renewable energy is included in the portfolio of electricity resources serving the State, and, by increasing the required amount over time, the RPS can put the electricity industry on a path toward increasing their sustainability. Because RPS is a market standard, it relies almost entirely on the private market for implementation.

Market implementation will normally result in competition, efficiency and innovation that will deliver renewable energy at the lowest possible cost.

Renewable Energy Credits, or "Credits," are central to RPS. A "credit" is a tradable certificate of proof that a specific number of kilowatt-hours (kWh) of electricity have been generated by a renewable-fueled source. Credits are denominated in "kWh," and are a separate commodity from the power itself. The RPS requires all electricity generators (or electricity retailers, depending on policy design) to demonstrate, through ownership of credits, that they have supported an amount of renewable energy generation equivalent to an established percentage of their total annual kWh sales. For example, if the RPS is set at 5 percent and a generator sells 100,000 kWh in a given year, the generator would need to possess 5,000 credits at the end of that year.

With RPS, investors and generators make all decisions about how to comply, including: the type of renewable energy to acquire, the technologies to use, the renewable developers to do business with, the price to pay and the agreeable contract terms. Generators decide whether to invest in renewable energy projects and generate their own credits, enter into long-term contracts to purchase credits, or renewable power along with credits, or simply to purchase credits on the 'spot' market. Only the bottom line is enforced, i.e. possession of a sufficient number of credits at the end of each year. The credit system provides compliance flexibility and avoids the need to "track electrons." Because the RPS applies equally to all generators, it is competitively neutral.

Government involvement in RPS is usually limited to certifying credits, monitoring compliance and imposing penalties if necessary. The credit certification process applies to renewable producers who wish to certify their renewables output. Monitoring compliance requires each generator to demonstrate ownership of a sufficient number of credits relative to electricity sales.
Fourteen states have adopted RPS requiring that a certain percentage of their electricity be generated by renewable energy. These are Arizona, California, Connecticut, Iowa, Maine, Massachusetts, Minnesota, Nevada, New Jersey, New Mexico, New York, Pennsylvania, Texas and Wisconsin.[112] Although North Carolina has not adopted a full RPS, the NC GreenPower program is essentially an adaptation of the concept which may serve to demonstrate how other similar actions on a broader scale might work in the State.

Net-Metering

"Net Metering" is a special metering and billing agreement between utilities and their customers that facilitates the connection of small energy generating systems (conceivably both renewable and conventional) to the power grid. These programs encourage small scale renewable energy systems, ensure that customers always have a reliable source of energy from the grid during times when their generators are not producing energy, and provide substantial benefits to the electric system, the economy and the environment.

[112] Amy Royden-Bloom, ***Reducing CO_2 from Coal-Fired Utilities: State and Local Initiatives***, DAW Mercury and CO_2 Workshop, April 21, 2004, Raleigh, NC. (See Appendix A).

When a customer's renewable generator is producing, more power than is being consumed, the customer's meter runs backward, generating credits. When a customer uses more power than is being produced, the meter runs forward in a normal manner. The customer is charged only for the "net" power used from the electricity service provider over a designated period.

Distributed generation is also discussed later in this report and is closely associated. For distributed generation to reach its maximum potential in North Carolina, changes in the utility territorial law may be required. Now, an entity wishing to sell the output from a distributed generation system to an end-use customer may not be able to do so without becoming a regulated utility in NC, unless the entity is already an electric cooperative or a municipal electric system. By revising these laws and adopting net metering laws, states encourage the installation and use of renewable energy generators such as those produced from animal waste. Such systems may help lessen our dependence on domestic and foreign fossil fuels, add to the diversification of our current energy portfolio and help lessen the environmental footprint associated with electricity generation and consumption. Customers with net metering systems are likely to be more aware of their energy consumption and consume less energy than the average customer. Net metering is also a way to increase the energy in the power grid to keep up with increases in demand during peak power-use times, which is particularly of interest to states facing power shortages.

Currently, 37 states require at least some utilities to offer net metering for small wind systems, although the requirements vary considerably. In recent years many states have enacted net metering laws, including California, Connecticut, Delaware, Massachusetts, Montana, Nevada, New Hampshire, New Jersey, Ohio, Oregon, Vermont, Virginia, and Washington. North Carolina is one of only 11 states without some form of net metering.[113] In most states with net metering statutes, utilities are required to offer net metering for renewable systems, although many states limit eligibility to small systems.

State Energy Plan Priority # (6) is a recommendation that the General Assembly should consider adopting net metering for all utilities. **Status**: Discussions are underway on net metering and interconnection issues between utilities, renewable energy advocates and generators. A NCUC docket, related to NC GreenPower program, is being developed.[114]

NC Climate Action Registry

Much discussion has occurred in North Carolina on a climate change or climate action registry that would establish and supplement existing voluntary reporting programs. Such a registry would provide a mechanism to track all GWG emissions. However, a registry alone will not necessarily accomplish any major reductions. Without inclusion of all emitting sources in the inventory and registry to determine and track the true rate of increase (or decrease) of emissions from activities within the state, a complete and

[113] Rusty Haynes, North Carolina Solar Center, *Database Empowers Economic Development*, Carolina Sun, Summer 2004.

[114] Larry Shirley, Director, State Energy Office, *Development, Components and Status of the NC State Energy Plan*, Presentation at NC DAQ Mercury and CO_2 workshop, Raleigh, NC, April 19, 2004 (See Appendix A).

accurate assessment of the total is impossible. The two major contributing sectors (coal fired power generation and transportation) are otherwise already reporting or can be tracked independently of a traditional registry. The EPA National Acid Precipitation Program already mandates continuous measurement and annual reporting of their emissions, and these are available from the national database. In addition, North Carolina utilities are reporting to DOE's 1605 (b) voluntary registry. Emissions from transportation sectors can be reasonably estimated by tracking fuel usage and translation of these data into CO_2 by simple chemical reaction calculations.

There are already several competing registries (World Resources Institute, 1605b, the Greenhouse Gas Protocol, a developing ISO standard, Climate Leaders) all with different thresholds, methods and requirements. Sources are likely to participate in a voluntary registry only if it provides them with an indication of success while other facilities that are not able to paint such a picture of their situation are less likely to voluntarily report. Thus, a national registry should be revised so that it will provide an overall program of complete assessment and tracking of all sources.

A draft discussion plan for a North Carolina registry and intermediate steps toward reaching the goals of such a program are outlined in **Appendix C**. This plan is <u>not a recommended plan</u> but is provided to point out some of the needs, and requirements to be defined, and choices to be made, before implementing such a program. The reader should review the plan and arguments, and provide comments upon a better design and means for implementation of such a proposed registry, should it become determined as a requirement or need. The draft plan in **Appendix C** will no doubt be further revised to reflect comments from reviewers of this document. Such comments will hopefully include response to the basic concept of further development of a more "Comprehensive North Carolina Plan for GHG Mitigation**,"** or other some other multi-state integrated programs suggested in this draft. Many of the components of this draft are speculative and dependent upon future developments outside of the control of DAQ.

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CHAPTER V WHAT ARE OTHERS DOING

In a democratic society, the people, through their elected officials, may set policies based upon what they feel is most important. These policies will be reflected at all levels, from international, national, down through state and local. The 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 section reviews some of the existing situations and policies.

Update on International Developments

There are few recent international milestones. The Kyoto treaty[115] was being considered in 1997 and at that time, the Senate passed the Byrd/Hagel Resolution stating that the United States should not sign on to any international agreement on limiting greenhouse gases if developing nations would not be required to adhere to limitations, or the agreement would cause harm to the U.S. economy. In 1999, the Clinton Administration agreed to legally binding, numerical limits on GHG as prescribed by the Kyoto Treaty. The Bush. Administration continues to agree with general principles of the climate change efforts and needs for action, but opposes the Kyoto Protocol. In 2002, President Bush directed the Department of Energy[116] to improve its guidelines for voluntary reporting of GHG emissions, reductions and avoidance in an effort to appease some of the criticisms of its policies. A history and more details on the international situation are included in Appendix B.

Another major world leader in a similar situation to the U.S. is Russia. It initially signed the protocol,[117] but later decided not to ratify it and recently again reversed its stance. Though a large number (122 as of April 15, 2004) of countries have accepted, ratified, or otherwise approved, the Protocol, and it remains open for additional signatures in the UN in New York City, it appears a major event and redirection will be needed to keep this Protocol from a slow continuing march toward death. In addition, in the past several months, the international bodies met in Italy for their periodic general conference and continued discussions.

Federal Actions and Status

The Bush Administration continues to agree that global warming is a major problem and that we must take action, but continues to oppose the Kyoto Protocol. Just as this report was being finalized, new announcements were made about how the Administration was recognizing that emissions of CO_2 and other GWG are "the only likely explanation for global warming over the last three decades."[118] However, the directions to date and proposals extended for the future, are aimed at slowing the pace of growth, instead of reversing the phenomenon. The U.S. Congress plays a key role in how the U.S. responds

[115] United Nations Framework; Convention on Climate Change, http://unfccc.int/resource/docs/convkp/conveng.pdf.
[116] World Watch Institute, http://www.worldwatch.org/features/climate/activities/#1.
[117] Russia: Kyoto pact harms economy, CNN.com, December 2, 2003, http://www.cnn.com/2003/WORLD/europe/12/02/russia.kyodo.reut/.
[118] Andrew C. Revkin, *U.S. Report Turns Focus to Greenhouse Gases*, Greenwire, August 26, 2004.

to the challenges of global climate change. Legislation will be necessary to reduce GHG in any significant way. In addition, the Senate must ratify any treaty made by the U.S. This gives the Senate a major role in any international agreements and action plans. The budgets of all federal agencies, which include funding for programs to curb U.S. emissions, are established in the agencies' annual spending (or appropriations) bills. Congress then conducts hearings on these proposals.[119]

International climate change agreements must be ratified by the U.S. Senate for the United States to be a party, giving the Senate major influence over the U.S. negotiating position. The budgets of all federal agencies, which include funding for programs to curb U.S. emissions, are established in the agencies' annual spending (or "appropriations") bills, enacted by Congress. Congress conducts hearings that focus attention on global climate change and shape the national debate over how best to address it. With climate change, as with other issues, congressional action can differ significantly from that recommended by the U.S. President.

Members of both the Democratic and Republican Parties have offered climate change measures. As the scientific evidence of climate change has mounted, so has congressional activity. The number of climate change related legislative proposals increased from seven introduced in the 105th Congress (1997 - 1998) to twenty-five in the 106th Congress. Legislative proposals to require reporting and disclosure of GHG emissions and to protect companies from future penalties for reductions taken early seem to dominate. Many proposals are also aimed at carbon sequestration. An eventual program that is more comprehensive and possibly including a mandatory reduction of emissions, while allowing trading emission credits and rewards for increases in efficiency, may be slowly evolving. The forty-five bills, resolutions and amendments specifically addressing global change and GHG emissions introduced to date in the 108th Congress are listed in Appendix B.

Interest appears to be growing in certain legislative proposals, including measures to require the reporting and disclosure of GHG emissions, protect companies reducing GHG emissions from being penalized under a future GHG reduction program, and to promote carbon sequestration. Two bills have had bipartisan support. In the Senate, the *McCain-Lieberman Climate Stewardship Act of 2003* proposed capping GHG emissions of the electricity, manufacturing, commercial and transportation sectors of the economy (representing 85 percent of U.S. emissions) at their 2000 level, by 2010, and their 1990 level by 2016. Emitters would be able to trade GHG emissions credits and get credit for pre-enactment GHG reductions, carbon sequestration and international GHG reductions, up to a limit. The bill lost by a vote of 55 to 43, but Senator McCain has vowed to continue pushing this legislation until the Senate passes it. In March 2004, 20 members of the House (10 Republicans and 10 Democrats) introduced *Gilchrest-Olver Climate Stewardship Act of 2004* that echoes language of the McCain-Lieberman bill. It would require U.S. industries to reduce emissions of six primary GHGs from four sectors to 2000 levels, by 2010.

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[119] Worldwatch Institute, *Climate Change: Reducing the Threat of Climate Change in the U.S.: A Survey of Activities*, 2004. http://www.worldwatch.org/features/climate/activities/#1

In addition, two bills and several amendments were introduced to set up GHG registries. *The National Greenhouse Gas Emissions Inventory and Registry Act of 2003* was introduced in both the House and Senate, and would require large GHG emitters to report and disclose their emissions. Entities could also register their GHG reductions. *The Energy Policy Act of 2003*, which won approval by a vote of 84-14 in the Senate**,** includes three climate change titles. Title XI would establish a voluntary National GHG Registry. It also conditions that if, five years after enactment, less than 60 percent of U.S. anthropogenic GHG emissions had been reported voluntarily, reporting would be mandatory for large GHG emitters. The title also would encourage any future Congress to consider registered reductions as applicable towards future GHG reduction requirements. The bill establishes a *National Climate Change Strategy* with the goal of stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. It would also establish an Office of National Climate Change Policy within the White House, and a research and development program toward the goal of stabilization of GHG concentrations. A similar bill awaits passage in the House.

Addressing the challenge of climate change may ultimately include a more comprehensive set of approaches, possibly including a mandatory program to reduce GHG emissions and allow the trading of GHG emissions credits, and efficiency standards to promote the use of efficient products and technologies. Enacting such policy may be a longer-term proposition.

Pursuant to existing federal legislation and programs, several named efforts and programs are underway. These include Climate VISION, Climate Leaders, Climate Wise, the DOE 1605 (b) Registry and several others that cross Cabinet and Agency lines among EPA, DOE, USDA, NOAA, NASA, etc. Some are research oriented, some are mitigation oriented. Many of these programs are discussed in more detail in a separate context elsewhere in this document.

State and Regional Activities

The Pew Center for Global Climate change lists 28 different states with 44 state and local programs that reduce greenhouse gas emissions. Some programs were designed specifically to address climate change, but many were designed for other purposes: for example, to improve energy efficiency or to promote water conservation. All, however, directly or indirectly result in greenhouse gas reductions. During 2003 alone, at least 24 states introduced 90 bills to build frameworks to regulate GHG emissions. One-quarter of all U.S. states have enacted Renewables Portfolio Standards (RPS), which mandate an increase in the states' share of electricity generated with renewable energy. About half of all U.S. states have established renewable energy funds to provide subsidies for installation of renewable energy projects, or for the production of renewable electricity, for energy efficiency projects, and for energy education and awareness programs.

A few multi-state efforts exist. In 2003, the governors of California, Oregon, and Washington began efforts to draft recommendations on ways to collaborate regionally in reducing emissions in several sectors of their economies, including using more efficient

vehicles, increasing the share of renewables in electricity generation, and creating emissions accounting systems and inventories. Also in 2003, New York invited the governors of 10 other states to participate in the development of a regional program to cap and trade CO_2 emissions. Design for this Regional Greenhouse Gas Initiative is planned for completion in 2005.

In some relation to this effort is that by the North East States for Coordinated Air Use Management (NESCAUM) with many of the same states. The NESCAUM has initiated significant efforts toward their objectives through their Regional GHG Initiative (RGGI). The goal of their efforts is to develop the framework for a power sector GHG cap and trade system. They also plan to have a model rule in place by April 2005. Nine states are officially participating as members in this effort; with two states officially 'observing' and others invited. North Carolina is evaluating whether to become an official observer, but in the meantime is an unofficial observer.[120]

Option for Joint Actions Harmonizing With Other States

North Carolina provides only a small part of the global emissions of GHG, making it rather obvious that this State cannot solve the global problem alone. The State must work in consonance with other states in the region and United States, and even with other countries over the entire globe. We must take into account some perspective of what other states and groups of states are doing to address the problem. It is imperative that we be in harmony with them and with the international community in order to develop and utilize a "currency" for exchange and record keeping that is universal and does not impose unneeded hardships on reporting and controlling facilities.

The development of ways to reduce GHG and establish North Carolina as a truly important "part of the global solution" is not simple or something that can be done in isolation. Perhaps, the development of an integrated regional, multi-state, multi-departmental approach encompassing climate change, air quality and energy could assist in arriving at a solution that would do the job and be accepted as credible. A means for doing such planning and implementation would likely require some strong initiatives from the top levels of state governments, appropriation of resources, development of a motivated group of stakeholders, plus time, leadership and patience. Three recent reports provide some insights, guidance and information on experiences and how such large-scale options might be exercised.[121,122,123] The further development of this concept may harmonize well with a "Comprehensive North Carolina Plan for GHG Mitigation" mentioned later in this report under the GHG Registry discussions. It is definitely a concept that warrants further study and evaluation.

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[120] Amy Royden-Bloom, *Reducing CO_2 from Coal-Fired Utilities: State and Local Initiatives*, NC DAQ Mercury and CO_2 Workshop, April 21, 2004, Raleigh, NC. (See Appendix A)

[121] 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.

[122] *State Policy Solutions to Climate Change; Midwest Workshop Proceedings*, Pew Center on Global Climate Change, November 4-5, 2003.

[123] 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 .

APPENDIX A *APRIL 19-21, 2004 DAQ WORKSHOP PRESENTATIONS (CO_2 ONLY) TITLES, SPEAKER NAMES AND AFFILIATION*

DUE TO SIZE OF ELECTRONIC FILES, THESE PRESENTATIONS ARE NOT INCLUDED IN THIS VERSION OF THIS REPORT, BUT MAY BE SEEN AT DAQ'S WEBSITE:
http://daq.state.nc.us/news/leg/2004-04-hg-co2-agenda.pdf

Monday, April 19 Opening Session

Introduction and Welcome: Keith Overcash, Director, NC Division of Air Quality, DENR

Background and Significance of Clean Smokestacks Act: Brock Nicholson, Deputy Director, NC Division of Air Quality, DENR

Basis for Issues to be Discussed: CO 2 and Mercury:

Moderator, Sheila Holman, Chief, Planning Section NC Division of Air Quality

Review of the Science and Concerns for Climate Change in North Carolina: Ryan Boyles, Associate State Climatologist, State Climate Office of NC at NCSU

History and Transitions of the Global Warming Program and Policies in the US: Wiley Barbour, Environmental Resources Trust

Development, Components and Status of the NC State Energy Plan: Larry Shirley, Director, NC State Energy Office, NC Department of Administration

Lunch Speaker - Importance and Impacts of CSA Sections 12 and 13 and Your Input for the Future of North Carolina: Secretary William (Bill) Ross, NC Department of Environmental and Natural Resources

Tuesday, April 20

Environmental Leadership: The Pursuit of Clean Air: *Ben White, Progress Energy*

Renewable Energy as a Mechanism for Reducing Pollution: *Alden Hathaway, Environmental Resources Trust, Inc., Washington, DC*

Lunch Speakers

Mercury and CO_2 Emissions from the Power Generation Sector : *Dr. C.V. Mathai, Manager for Environmental Policy, Arizona Public Service Company, Phoenix, AZ*

Insights from Economic Analyses of the Impacts to the Utility Industry from Mercury and CO_2 Controls*: Dr. Anne E. Smith, Vice President, Charles River Associates, Washington, DC*

General CO_2 Topics and Issues:

Moderator, Phil Bisesi, Project Manager, North Carolina State Energy Office

Potential Impacts for the NC State Energy Plan on Emissions of CO_2 with Technical Procedures and Assumptions Upon Which These Plans Were Developed: *Jeff Tiller, Appalachian State University*

Technology, Energy Efficiency, and Renewable Energy for Emission Reduction: *Ward Lenz, Director, Energy Programs and John Morrison, Vice President, Advanced Energy*

The People, the Planet, and the Pocketbook: How a Green Builder Program Can Avoid Emissions Using Solar Energy: *Dona Stankus, AIA, NC Solar Center*

Potential in NC for Extraction of Wind Energy : *Dr. Dennis Scanlin, Professor, Technology Department, Appalachian State University*

Past, Present and Projected Participation in Climate Wise by North Carolina Companies: *James Haven, Global Warming Initiatives, Inc.*

Wednesday, April 21 : NC Specific CO 2 Topics and Issues–

Moderator: Phyllis D. Jones, NC Division of Air Quality

Review of Real/Practical and Projected Options fro CO_2 at a Coal-Fired Generating Unit: *Kevin Johnson, URS*

Integrated Gasification Combined Cycle (IGCC) Technology; Carbon Sequestration and Cost Implications : *Joe Chaisson, (Harpswell, ME), Clean Air Task Force (Boston, MA)*

The Global Carbon Cycle and the Duke Forest Free-Air CO_2 Enrichment (FACE) Project: *Dr. William H. Schlesinger, Dean, Nicholas School of the Environment & Earth Sciences, Duke University*.

NC Animal Waste as a Potential Resource for Reducing CO_2 and Methane Emissions: *Kurt Creamer P.E., Animal and Poultry Waste Management Center, NC State University*

Industry Experience in Reducing CO2 and GHG Emissions – A Case Study of International Proportions: *Bill Bailey, DuPont, Charlotte, NC*

Reducing CO_2 from Coal-Fired Utilities: State and Local Initiatives: *Amy Royden, STAPPA/ALAPCO*

Lunch speaker – Herding Sheep: The Commons and the Marketplace; Michael Shore, Environmental Defense

Overview of the Southeast Regional Carbon Sequestration Partnership: Gerald R. Hill, Ph.D, Senior Technical Advisor, Southeastern Regional Carbon Sequestration Partnership

Summaries:

Integrated Gasification Combined Cycle (IGCC) Technology; Carbon Sequestration and Cost Implications : *Joe Chaisson, (Harpswell, ME), Clean Air Task Force (Boston, MA)*

IGCC: WHAT IS IT?

• Chemical conversion of coal to synthetic gas for combustion in a modified gas turbine.

• Inherently cleaner process because coal is not combusted and the relatively small volumes of syngas are easier to clean up than the much larger volumes of flue gases at a coal combustion plant.

IGCC Environmental Impacts –

General

• IGCC plants are more efficient in converting coal to electricity than conventional coal plants and thus produce less CO2 per unit of electricity generated.

• Near-term IGCC plants would produce about 20% less CO2 - per unit of electricity produced - than would the average existing coal plant.

• The longer term potential could be for IGCC plants to produce about one-third less CO2 - per unit of electricity produced - as would the average existing coal plant.

• IGCC plants can potentially capture and geologically sequester up to 90% (or more) of coal fuel carbon content.

Air Pollution

• Commercially available IGCC power plant technologies can have much lower air pollution emissions than new conventional coal plants.

• Actual air emissions performance will likely depend, at least in part, on what control technology and performance levels are required by regulators.

Waste

• Commercially available IGCC power plant technologies produce substantially smaller volumes (about one half) of solid wastes than do new conventional coal plants using the same coal.

• IGCC solid wastes are less likely to cause environmental damage than fly ash from conventional coal plants because IGCC ash melts in the gasification process, resulting in an ash much less subject to leaching pollutants than is conventional coal combustion fly ash.

Mercury Management

• Mercury capture at IGCC plants is quite feasible and much less costly than at conventional coal plants and the potential exists to indefinitely sequester mercury captured at IGCC facilities.

• Proven, low cost mercury controls can remove most of the mercury from coal syngas produced (14 years experience at Eastman Chemical).

• Mercury is captured in a small volume activated carbon bed. Bed contents are currently managed as hazardous wastes (due to other toxics captured), but could be sequestered in a long-term mercury storage facility or the mercury contained could be economically recycled.

• Thus coal IGCC with a carbon bed plant mercury control is the only technology today that can convert coal to power and capture most of the coal mercury in a form and volume suitable for permanent sequestration.

APPENDIX B *SUMMARY OF RECENT INTERNATIONAL, FEDERAL, REGIONAL, STATE AND LOCAL ACTIONS RELATED TO CLIMATE CHANGE*

International Actions, Treaties and Negotiations:

Framework Convention on Climate Change (Rio Climate Treaty)

Signed at Rio de Janeiro, Brazil in June 1992 by over 150 nations including the United States of America, the Rio Climate Treaty came into force in March 1994 and has been ratified or acceded to by virtually every nation including all populous countries except Turkey. The Rio Climate Treaty came out of the Rio Earth Summit and was signed by over a hundred heads of state and government including US President George Herbert Walker Bush. The Rio Climate Treaty sets an overall framework for climate protection and identifies as an objective for "stabilization of greenhouse gas concentrations in the atmosphere at a level that would produce dangerous anthropogenic interference with the climate system."

The Rio Climate Treaty does not set any binding emission limitations. It does, however, call for developed countries to adopt national policies and take measures "with the aim of returning individually or jointly" their net greenhouse emissions to 1990 levels. By the mid-1990s it was apparent that the voluntary measures of the Rio Treaty were not stopping the upward emissions trend in most industrialized countries so the parties to the Rio Climate Treaty began looking toward an emissions protocol with binding limitations on developed country parties. After two-and-a-half years of negotiations such a protocol was agreed to in December 1997 in Kyoto, Japan.

Kyoto Protocol

Even before the protocol was negotiated in final text in Kyoto, opponents in the US Senate sealed its doom with a 97-0 resolution expressing the sense of the Senate that the US should not sign an agreement which would either threaten the economic health of the US or which would impose binding requirements on the US without also imposing binding requirements on developing countries. While the first requirement might be met, there was no way that the Kyoto Protocol could meet the second requirement since developing countries had been guaranteed that they would be exempt from binding limitations.

The Kyoto Protocol ultimately set requirements for developed countries which, if agreed to and successfully implemented, would produce an overall reduction of just over 5% below developed country 1900 emissions by the 2008-2012 time frame that was set in the protocol as the first commitment period. In the absence of any international controls it is estimated that global emissions might rise about 40% by 2012. With Kyoto implemented by all developed countries it is anticipated that global emissions might rise by 30% over the same period.

G-8 Renewable Energy Initiative

In July 2000 at their Okinawa Summit the G-8, at the urging of British Prime Minister Tony Blair, agreed to create a Renewable Energy Task Force to address the challenge of two billion people lacking access to electricity. The Task Force drafted a Report that calls for G-8 member countries to support renewable energy actions in developing countries and to complement this with efforts in their domestic markets to scale up use of renewable energy. Prime Minister Tony Blair vowed that his country would seek to reduce its emissions of carbon dioxide by 60 percent by 2050.

Small Island States Clean Energy Initiative

In October 1998 the Climate Institute and Counterpart International organized a Symposium on Sustainable Energy Options for Small Island States. Present were the Foreign Minister of Jamaica, the UNDP administrator and senior staff, several USAID representatives and Permanent representatives from UN missions. An immediate outgrowth of this was the decision of the Caribbean nation of St. Lucia to become the world's first Sustainable Energy Demonstration Country. This was announced by the Government of St. Lucia at a press conference held jointly with the Climate Institute in November 1999 at the Bonn climate conference. Before making this announcement St. Lucia began steps to remove tariffs on renewable energy technologies and support equipment. In November 2000 St. Lucia's Prime Minister Dr. Kenny Anthony called on other countries at the Hague climate conference to follow St. Lucia's lead. In July 2001 the St. Lucia government approved a 10-year Sustainable Energy Plan.
Global Sustainable Energy Islands Initiative

Seeking to expand the Sustainable Energy Demonstration Country concept to other island nations, the Climate Institute and four partners — Counterpart International, Winrock International, Forum for Energy and Development and the Organization of American States — formed a consortium to support the interest of all small island states and potential donors by bringing renewable energy and energy efficiency projects, models, and concepts together in a sustainable plan for small island nations. At this time the two island states closest to joining St. Lucia in an effort to de-carbonize their energy systems are Grenada and Dominica, both in the Caribbean.

Iceland's Effort to Become First Hydrogen Based National Economy

Iceland whose per capita greenhouse emissions are among the highest in the world is now moving aggressively to become the world's first hydrogen-based economy. The country of about 270,000 has embraced a vision first put forth in the 1970s by Bragi Arnason, a professor at the University of Iceland. To reach its goal of becoming the world's first hydrogen-based national economy Iceland seeks to leverage its access to plentiful inexpensive hydro and geothermal power to speed commercialization of fuel cells for transport and power generation.

Federal Actions from the 108TH Congress Relative to Climate Change

The U.S. Congress plays a key role in determining how the United States responds to the challenge of global climate change. Legislation, enacted by Congress, will be necessary to reduce U.S. emissions of greenhouse gases substantially. International climate change agreements must be ratified by the U.S. Senate for the United States to be a party, giving the Senate major influence over the U.S. negotiating position. The budgets of all federal agencies, which include funding for programs to curb U.S. emissions, are established in the agencies' annual spending (or "appropriations") bills, enacted by Congress. Congress conducts hearings that focus attention on global climate change and shape the national debate over how best to address it. With climate change, as with other issues, congressional action can differ significantly from that proposed by the U.S. President.
As the scientific evidence of climate change has mounted, so has congressional activity. The number of climate change-related legislative proposals increased from seven introduced in the 105th Congress (1997-1998) to 25 in the 106th Congress (1999-2000), to over 80 in the 107th Congress (2001-2002). Forty-five such legislative proposals have been introduced to date in the 108th Congress (2003-2004), as are delineated below. [124]

There appears to be growing interest in certain legislative proposals, including measures to require the reporting and disclosure of greenhouse gas (GHG) emissions, protect companies reducing GHG emissions from being penalized under a future GHG reduction program, and promote carbon sequestration. In the Senate, the **McCain-Lieberman Climate Stewardship Act of 2003** proposed capping GHG emissions of the electricity, manufacturing, commercial and transportation sectors of the economy (representing 85% of U.S. emissions) at their 2000 level by 2010 and their 1990 level by 2016. Emitters would be able to trade GHG emissions credits and get credit for pre-enactment GHG reductions, carbon sequestration, and international GHG reductions, up to a limit. The bill lost by a vote of 55 to 43, but Senator McCain has vowed to continue pushing this legislation. In March 2004, 20 members of the House (10 Republicans and 10 Democrats) introduced **Gilchrest-Olver Climate Stewardship Act of 2004** that echoes language of the McCain-Lieberman bill. It would require U.S. industries to reduce emissions of six primary GHGs from four sectors to 2000 levels by 2010.

In addition two bills and several amendments were introduced to set up green house gas registries. **The National Greenhouse Gas Emissions Inventory and Registry Act of 2003** was introduced in both the House and Senate, which would require large GHG emitters to report and disclose their emissions. Entities could also register their GHG reductions. **The Energy Policy Act of 2003**, which won approval by a vote of 84-14 in the Senate**,** includes three climate change titles. Title XI would establish a National Greenhouse Gas Registry and allow entities to report voluntarily their GHG emissions and emission reductions to the registry. If, five years after enactment, less than 60% of U.S. anthropogenic GHG emissions had been reported voluntarily, reporting would be required of large GHG emitters. The title also would encourage future Congresses to consider registered reductions as applicable towards future GHG reduction requirements. The bill would establish a National Climate Change Strategy with goals of 1) stabilizing

[124] World watch, http://www.worldwatch.org/features/climate/activities/#1

GHG concentrations in the atmosphere; 2) establishing an Office of National Climate Change Policy within the White House; and 3) a research and development program with a goal to stabilize GHG concentrations. A similar bill must is awaiting passage in the House.

The 45 bills, resolutions, and amendments specifically addressing global climate change and GHG emissions introduced to date in the 108th Congress are listed here:

Greenhouse Gas Reduction

S.17: The Global Climate Security Act of 2003, includes several climate change measures, including a provision establishing a commission to review measures necessary to prevent a doubling of GHG concentrations in the atmosphere, a provision to require large emitters to report and disclose their GHG emissions (see S.194), and a resolution urging U.S. participation in international climate change negotiations (see S.925 under "International Negotiations"). Sponsor: **Sen. Thomas A. Daschle** (D-SD) (17 cosponsors)

S.139: **McCain-Lieberman Climate Stewardship Act of 2003**, would cap the GHG emissions of the electricity, manufacturing, commercial and transportation sectors of the economy (representing 85% of U.S. emissions) at their 2000 level by 2010 and their 1990 level by 2016. Emitters would be able to trade GHG emissions credits and get credit for pre-enactment GHG reductions, carbon sequestration, and international GHG reductions, up to a limit. The 2003 bill lost by a vote of 55 to 43, but Senator McCain has vowed to continue pushing this legislation until the Senate passes it.
Sponsor: **Sen. Joseph Lieberman** (D-CT) (6 cosponsors)

H.R. 4067 Gilchrest-Oliver Climate Stewardship Act of 2004 – In March 2004, 20 members of the House (10 Republicans and 10 Democrats) introduced a bill that echoes language of the McCain-Lieberman bill. It would require U.S. industries to reduce emissions of six primary GHGs from four sectors to 2000 levels by 2010.

Global Warming Amendment to the Energy Policy Act (H.R.6) offered during markup in the House Energy and Commerce Committee, which would require the President, using existing authority, to establish a voluntary program to reduce the carbon intensity of the United States by 18% by 2012 (as announced by President Bush). (See H.R.6 E.H. under "Energy Policy."). Sponsor: **Rep. Henry A. Waxman** (D-CA) – **Action**: 4/2/03: Not accepted by the House Energy and Commerce Committee by voice vote.

Greenhouse Gas Reporting

S.194: **The National Greenhouse Gas Emissions Inventory and Registry Act of 2003**, which would require large GHG emitters to report and disclose their emissions. Entities could also register their GHG reductions. (See S.17 under "Greenhouse Gas Reduction.")
Sponsor: **Sen. Jon Corzine** (D-NJ) (2 cosponsors)

Energy and Climate Change Amendment to the Energy Policy Act (S.14) filed during markup in the Senate Energy Committee, which would require large GHG emitters to report and disclose their emissions and register their GHG reductions. The amendment would establish a National Climate Change Strategy, a White House Director of Climate Change Policy, an Office of Climate Change Policy at the Department of Energy, and a Forest Carbon Program at the Department of Agriculture. (See S.14 and H.R.6 E.A.S. under "Energy Policy.")
Sponsor: **Sen. Jeff Bingaman** (D-NM) – **Action**: 4/29/03 The amendment was filed but not offered during markup.

H.R.1245: **The National Greenhouse Gas Emissions Inventory Act of 2003**, which would require large GHG emitters to report and disclose their emissions. Entities could also register their GHG reductions.
Sponsor: **Rep. John W. Olver** (D-MA) (49 cosponsors)

National Greenhouse Gas Emissions Inventory Amendment to the Energy Policy Act (H.R.6) filed during markup in the House Energy and Commerce Committee, would require large emitters of GHGs to report and disclose their emissions and allow entities to register their GHG reductions (language identical to H.R.1245). (See H.R.6 E.H. under "Energy Policy.")
Sponsor: **Rep. Diana L. DeGette** (D-CO) – **Action**: 4/2/03 The amendment was filed but not offered during markup.

(See also H.R.6 E.A.S. under "Energy Policy," and S.17 under "Greenhouse Gas Reduction.")

Internati*onal Negotiations*

Sense of Congress on Climate Change Amendment to the Energy Policy Act (H.R.6) offered during markup in the House Energy and Commerce Committee, urges the U.S. to participate in international negotiations with the objective of securing U.S. participation in a future binding climate change treaty. (See H.R.6 E.H. under "Energy Policy.")
Sponsor: **Rep. Henry A. Waxman** (D-CA) – **Action**: 4/2/03: Not accepted by the House Energy and Commerce Committee by a vote of 18 – 34. 4/9/03: Rep. Waxman filed the amendment with the intent of offering it during debate on H.R.6 on the House floor, but was not allowed to bring it to a vote.

S.925: **The Foreign Relations Authorization Act, Fiscal Year 2004**, among other things, includes a Sense of the Congress Resolution urging the U.S. to participate in international negotiations, with the objective of securing U.S. participation in a future binding climate change treaty.
Sponsor: **Sen. Richard G. Lugar** (R-IN) – **Action**: 4/9/03: During markup in the Senate Foreign Relations Committee, **Sen. Joe Biden** (D-DE) and **Sen. John F. Kerry** (D-MA) offered the climate change resolution as an amendment, and it was accepted by voice vote. The bill was then reported out of committee by a vote of 19 – 0. The bill has been debated but not passed by the full Senate.

H.R.1950: **The Foreign Relations Authorization Act, Fiscal Year 2004**, as reported by the House International Relations Committee, included a Sense of the Congress Resolution urging the U.S. to participate in international negotiations, with the objective of securing U.S. participation in a future binding climate change treaty.
Sponsor: **Rep. Henry J. Hyde** (R-IL) (2 cosponsors) – **Action**: 5/2/03: During markup in the House International Relations Committee, the climate change resolution was offered as an amendment by **Rep. Robert Menendez** (D-NJ) and accepted by a vote of 21 – 18. 7/9/03: During markup in the House Energy and Commerce Committee, the climate change resolution was struck by a vote of 28 – 17.

(See also S.17 under "Greenhouse Gas Reduction" and H.R.6 E.A.S. under "Energy Policy.")

Energy Policy

H.R.6 E.A.S.: **The Energy Policy Act of 2003 as passed by the Senate**, is identical to H.R.4 E.A.S. in 2002, the Senate-passed Energy Policy Act of 2002. The bill includes three climate change titles. Title XI would establish a National Greenhouse Gas Registry and allow entities to report voluntarily their GHG emissions and emission reductions to the registry. If, five years after enactment, less than 60% of U.S. anthropogenic GHG emissions had been reported voluntarily, reporting would be required of large GHG emitters. The title also would encourage future Congresses to consider registered reductions as applicable towards future GHG reduction requirements. Title X would establish a National Climate Change Strategy with the goal of stabilization of GHG concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system; an Office of National Climate Change Policy within the White House; and a research and development program with a goal of stabilization of GHG concentrations. Title X also includes a Sense of the Congress Resolution urging the U.S. to participate in international negotiations, to secure U.S. participation in a future binding climate change treaty. Title XIII would authorize various climate change research activities. (See Energy and Climate Change Amendment under "Greenhouse Gas Reporting.")
Sponsor: **W.J. "Billy" Tauzin** (R-LA) – **Action**: 7/31/03: Passed by the Senate by a vote of 84 – 14, in lieu of S.14 (see below).

H.R.6 E.H.: **The Energy Policy Act of 2003 as passed by the House**, among other things, would direct the Department of Energy to research technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production, including for the reduction of GHG emissions and sequestration of carbon. The bill would also establish a research program in genetics, protein science, and computational biology of microbes and plants, one goal of which would be to develop technologies and methods based on the biological functions of microbes and plants to convert carbon dioxide to organic carbon. The bill would authorize carbon capture and sequestration research and development. (See H.R.1213 under "Clean Coal," H.R.238 and H.R.1645 under "Carbon Sequestration, Genomes," the Global Warming Amendment under "Greenhouse Gas Reduction," the Sense of Congress on Climate

Change Amendment under "International Negotiations," and the National Greenhouse Gas Emissions Inventory Amendment under "Greenhouse Gas Reporting.")
Sponsor: **W.J. "Billy" Tauzin** (R-LA) (4 cosponsors) – **Action**: 4/11/2003: Passed by the House by a vote of 247 – 175.

H.R.318: **The Biofuels Air Quality Act**, among other things, would require consideration under the congestion mitigation and air quality improvement program of the extent to which a proposed project or program reduces atmospheric carbon emissions.
Sponsor: **Rep. John M. Shimkus** (R-IL) (15 cosponsors)

H.R.1644: **The Energy Policy Act of 2003**, would authorize clean coal research relating to the separation and capture of carbon dioxide. (See H.R.6 E.H.)
Sponsor: Rep. Joe Barton (R-TX) – Action: 4/10/03: Incorporated into H.R.6 E.H.

S.14: The Energy Policy Act of 2003, would establish a Hydrogen Fuel Initiative directing research into the production of hydrogen from fossil fuels, in conjunction with carbon capture and sequestration. The bill would authorize Clean Coal Power Initiative funding for projects that include the separation and capture of carbon dioxide. The bill would also establish a Genomes to Life Program, one long-term goal of which would be the advancement of science and technology regarding the conversion of carbon dioxide to organic carbon. (See S.582 and S.727 under "Clean Coal," and S.682 under "Carbon Sequestration, Genomes.")
Sponsor: **Sen. Pete V. Domenici** (R-NM) – **Action**: 4/30/03: Reported out of the Senate Energy Committee. The bill was debated on the Senate floor, but not passed by the Senate. H.R.6 E.A.S. (see above) was passed instead.

Appropriations

H.J.RES.2: **The Consolidated Appropriations Resolution 2003** provides $175 million to support policies and programs in developing countries and countries in transition that directly: (1) promote energy conservation, energy efficiency and clean energy; (2) measure, monitor, and reduce GHG emissions; (3) increase carbon sequestration activities; and (4) enhance climate change mitigation and adaptation programs. Also, the President must submit a report to the Appropriations Committees on federal agency obligations and expenditures, domestic and international, for climate change and technology transfer programs in fiscal year 2003. Also provides that funds may be used to support tropical forestry and biodiversity conservation activities and energy programs aimed at reducing GHG emissions.
Sponsor: **Rep. C.W. "Bill" Young** (R-FL) – **Action**: 2/20/2003: Became Public Law No: 108-7.

H.R.2800: **The Foreign Operations, Export Financing, and Related Programs Appropriations Act, 2004** would allow appropriated funds to support tropical forestry and biodiversity conservation activities and energy programs aimed at reducing GHG emissions. (See S.1426.)
Sponsor: **Rep. Jim Kolbe** (R-AZ) – **Action**: 7/24/03 Passed by the House by a vote of 370 - 50

S.1426: **The Foreign Operations, Export Financing, and Related Programs Appropriations Act of 2004** would appropriate $5.6 million for the Intergovernmental Panel on Climate Change/United Nations Framework Convention on Climate Change, and $185 million to support policies and programs in developing countries and countries in transition that, among other things, would measure, monitor, and reduce GHG emissions, increase carbon sequestration activities and enhance climate change mitigation and adaptation programs. Also, the bill would allow appropriated funds to support tropical forestry and biodiversity conservation activities and energy programs aimed at reducing GHG emissions. In addition, the bill would require the President to report on all Federal agency obligations and expenditures for climate change programs and activities in fiscal year 2004; as well as fiscal years 2003 and 2004 obligations and estimated expenditures, and fiscal year 2005 requested funds by the United States Agency for International Development for a variety of climate change activities. (See H.R.2800.)
Sponsor: **Sen. Mitch McConnell**, (R-KY) – **Action**: 7/17/03: Reported out of the Senate Appropriations Committee.

Power Plants

S.366: **The Clean Power Act of 2003**, would require reductions of CO_2, as well as SO_2, NO_X, and mercury emissions, from electric power plants. CO_2 emissions would be reduced to 1990 levels by 2009. (See H.R.2042.)
Sponsor: **Sen. James M. Jeffords** (I-VT) (19 cosponsors)

S.485: **The Clear Skies Act of 2003**, would require reductions of power plant emissions of SO_2, NO_X, and mercury, but not CO_2, and would exempt new power plants from the current requirement that they disclose their CO_2 emissions. (See H.R.999.)
Sponsor: **Sen. James M. Inhofe** (R-OK) (1 cosponsor) Introduced at the request of the Administration.

S.843: **The Clean Air Planning Act of 2003**, would require reductions of CO_2, as well as SO_2, NO_X, and mercury emissions, from electric power plants. CO_2 emissions would be reduced to 2006 levels by 2009 and to 2001 levels by 2013.
Sponsor: **Sen. Thomas R. Carper** (D-DE) (3 cosponsors)

H.R.999: **The Clear Skies Act of 2003** would require reductions of power plant emissions of SO_2, NO_X, and mercury, but not CO_2, and would exempt new power plants from the current requirement that they disclose their CO_2 emissions. (See S.485.)
Sponsor: **Rep. Joe Barton** (R-TX) (1 cosponsor) Introduced at the request of the Administration.

H.R.2042: **The Clean Smokestacks Act of 2003** would require reductions of CO_2, as well as SO_2, NO_X, and mercury emissions, from electric power plants. CO_2 emissions would be reduced to 1990 levels by 2009. (See S.366.)
Sponsor: **Rep. Henry A. Waxman** (D-CA) (86 cosponsors)

Transportation

S.788: The Second Century of Flight Act would direct the Federal Aviation Administration to research emerging aircraft technologies to minimize the effects on climate change, and would direct NASA to research technologies enabling commercial aircraft to reduce carbon dioxide emissions. (See H.R.2271.)
Sponsor: **Sen. Ernest F. Hollings** (D-SC) (7 cosponsors)

S.824: **The Aviation Administration FY2004-2006 Authorizations Act** would develop a research and implementation plan for the application of emerging aircraft technologies that would minimize the effects on climate change per unit of production of thrust and flight speed. (See H.R.2115.)
Sponsor: **Sen. John McCain** (R-AZ) (3 cosponsors) – **Action**: 6/12/03: The Senate incorporated this measure in H.R.2115 as an amendment, which passed the Senate by a vote of 94 – 0. 7/25/03: Conference report on H.R.2115 filed.

S.1072: Safe, Accountable, Flexible, and Efficient Transportation Equity Act of 2003 would establish a multimodal energy and climate change program to study the relationship of energy, transportation, and climate change, and call for the development of strategies to reduce GHG emissions from transportation. (See H.R. 2088)
Sponsor: **Sen. James Inhofe** (R-OK) (3 cosponsors) Introduced at the request of the Administration.

H.R.2088: **The Safe, Accountable, Flexible, and Efficient Transportation Equity Act of 2003**, which, among other things, would establish a multimodal energy and climate change program to study the relationship of energy, transportation, and climate change, and call for the development of strategies to reduce GHG emissions from transportation. (See S.1072)
Sponsor: **Rep. Don Young** (R-AK) (3 cosponsors) Introduced at the request of the Administration.
H.R.2115: **The Aviation Administration FY2004-2006 Authorizations Act as in the conference report**, which, among other things, would develop a research and implementation plan for the application of emerging aircraft technologies that would minimize the effects on climate change per unit of production of thrust and flight speed. (See S.824. The House-passed version of H.R.2115 did not include the climate change-related provision.)
Sponsor: **Rep. Don Young** (R-AK) (3 cosponsors) – **Action**: 7/24/03 Conference held. 7/25/03 Conference report filed.

H.R.2271: The Second Century of Flight Act would require the Federal Aviation Administration to develop a research plan for emerging technologies that minimize the effects on climate change per unit of production of thrust and flight speed; and require NASA to develop a research plan to enable commercial aircraft to significantly reduce CO_2 emissions. (See S.788.)
Sponsor: **Rep. Todd Tiarht** (R-KS) (1 cosponsor)

Hydrogen

S.821: **The Hydrogen and Fuel Cell Energy Act of 2003** would seek to reduce the life cycle pollution and GHG emissions from energy use by promoting, e.g., hydrogen R&D, federal purchasing of stationary fuel cells, and tax incentives for hydrogen and fuel cell vehicles and related infrastructure.
Sponsor: **Sen. Tom Harkin** (D-IA)

H.R.1299: **The Hydrogen Fuel Act of 2003**, includes a finding that it is in the national interest to support the development of a light duty vehicle fleet that is free or near free of GHG emissions.
Sponsor: **Rep. Sherwood Boehlert** (R-NY)

H.R.1395: To provide for the establishment of research, development, demonstration, and commercial application programs for fuel cell and hydrogen production, delivery, and storage technologies for transportation and stationary applications. The bill would require the Department of Energy, to award projects for hydrogen production and capture of associated carbon dioxide.
Sponsor: **Rep. John B. Larson** (D-CT)

H.R. 1777: A bill to provide for the establishment at the Department of Energy of a program for hydrogen fuel cell vehicles and infrastructure. The bill would require DOE to address the production of hydrogen from fossil fuels, which may include carbon capture and sequestration.
Sponsor: **Rep. Sherwood Boehlert** (R-NY)

Clean Coal

S.582: The Coal Energy Research Development and Demonstration Act of 2003, would authorize carbon capture and sequestration research and development, and provide tax credits for advanced clean coal technology units that meet certain carbon emission rate standards. (See S.14 under "Energy Policy.")
Sponsor: **Sen. Jim Bunning** (R-KY) (8 cosponsors)

S.727: **The National Coal Research, Development, and Demonstration Act of 2003** would authorize carbon capture and sequestration research and development, and provide tax credits for advanced clean coal technology units that meet certain carbon emission rate standards. (See S.14 under "Energy Policy.")
Sponsor: **Sen. Robert C. Byrd** (D-WV) (13 cosponsors)

S.1149: **The Energy Tax Incentives Act of 2003** would provide tax credits for advanced clean coal technology units that meet certain carbon emission rate standards.
Sponsor: **Sen. Charles E. Grassley** (R-IA) – **Action**: 5/23/03: Reported by the Senate Finance Committee.

H.R.1213: **The Clean Coal Power Act of 2003** would authorize carbon capture and sequestration research and development, and provide tax credits for advanced clean coal

technology units that meet certain carbon emission rate standards. (See H.R.6 E.H. under "Energy Policy.")
Sponsor: **Rep. Ed Whitfield** (R-KY) (18 cosponsors)
H.R.1269: **The Coal Energy Research, Development, and Demonstration Act of 2003** would authorize carbon capture and sequestration research and development.
Sponsor: **Rep. Jerry F. Costello** (D-IL) (5 cosponsors)

Carbon Sequestration, Genomes

S.682: **The Genomes to Life Research and Development Act** would establish a research and development program in systems biology and proteomics (a proteome is a protein complement to a genome), one long-term goal of which would be to stabilize atmospheric levels of carbon dioxide to counter global warming, and one specific goal of which would be to understand the Earth's natural carbon cycle and to create strategies to stabilize atmospheric carbon dioxide. (See S.14 under "Energy Policy.")
Sponsor: **Sen. Pete V. Domenici** (R-NM) (3 cosponsors)

H.R.238: **The Energy Research, Development, Demonstration, and Commercial Application Act of 2003** would direct the Department of Energy to research technologies for ultra-deepwater and unconventional natural gas and other petroleum resource exploration and production, including for the reduction of GHG emissions and sequestration of carbon. (See H.R.6 E.H. under "Energy Policy.")
Sponsor: **Rep. Sherwood L. Boehlert** (R-NY) (1 cosponsor) – **Action**: 5/22/03 Reported out of the House Science Committee

H.R.1645: To establish a research, development, and demonstration program in genetics, protein science, and computational biology of microbes and plants to support the energy and environmental mission of the Department of Energy. One goal of the program would be to develop technologies and methods based on the biological functions of microbes and plants to convert carbon dioxide to organic carbon. (See H.R.6 E.H. under "Energy Policy.")
Sponsor: **Rep. Sherwood Boehlert** (R-NY)

H.R.1904: **The Healthy Forests Restoration Act of 2003** would direct the Department of Agriculture to establish a healthy forests reserve program, one goal of which would be to enhance carbon sequestration.
Sponsor: **Rep. Scott McInnis** (R-CO) (137 cosponsors) – **Action**: 5/20/03 Passed by the House by a vote of 256 – 170.

Climate Science

S.1164: The Abrupt Climate Change Research Act of 2003 would establish within the National Oceanic and Atmospheric Administration (NOAA), a program of scientific research on abrupt climate change.
Sponsor: **Sen. Susan M. Collins**, (R-ME) (4 cosponsors)

HR 984: **National Oceanic and Atmospheric Administration Act of 2003** would authorize the Commerce Department to establish joint or cooperative institutes with qualified colleges and nonprofit research organizations to collaborate on long-term climate change research.
Sponsor: **Rep. Wayne T. Gilchrest** (R-MD)

H.R.1578: **The Global Change Research and Data Management Act of 2003** would promote and coordinate global change research.
Sponsor: **Rep. Mark Udall** (D-CO) - Action: 5/1/2003: The House Science Committee voted against reporting the bill by a vote of 17 - 19.

State, Regional, Local and Private

In the United States, laws to address climate change—such as mandated emissions reductions or policies to promote renewable energy—are easier to pass at the state and local levels than at the federal level, where coal, oil, and auto industry can concentrate lobbying efforts to affect such laws. In the absence of Federal laws or regulations, states, communities, and businesses are leading the way to address climate change. Several noteworthy efforts are listed below:

Regional Activities

California, Oregon, and Washington – In 2003, the governors of these states directed their staffs to draft recommendations on ways to collaborate regionally in reducing emissions in several sectors of their economies—including by using more efficient vehicles, increasing the share of renewables in electricity generation, and creating emissions accounting systems and inventories.

New England and Canada's Eastern Provinces – In 2001, governors of New England states and premiers of Canada's Eastern provinces approved a comprehensive regional Climate Action Plan that aims to reduce GHG emissions to 1990 levels by 2010.

11 Northeastern States – In spring 2003, Governor Pataki of New York invited the governors of 10 other states to participate in the development of a regional program to cap and trade CO_2 emissions. Program design for this Regional Greenhouse Gas Initiative is expected to be complete by April 2005.

Pressing for Federal Regulations – In July 2002, the attorneys general of 11 states (Alaska, California, Connecticut, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) sent a letter to the Bush Administration pressing for strong federal measures to limit U.S. national GHG emissions.

State Legislation and Programs

The Pew Center for Global Climate change lists 28 different states with 44 state and local programs that reduce greenhouse gas emissions. Some programs were designed

specifically to address climate change, but many were designed for other purposes: for example, to improve energy efficiency or to promote water conservation. All, however, directly or indirectly result in greenhouse gas reductions. During 2003 alone, at least 24 states introduced 90 bills to build frameworks to regulate GHG emissions. One-quarter of all U.S. states have enacted Renewables Portfolio Standards (RPS), which mandate an increase in the states' share of electricity generated with renewable energy. About half of all U.S. states have established renewable energy funds to provide subsidies for installation of renewable energy projects, or for the production of renewable electricity, for energy efficiency projects, and for energy education and awareness programs.

Maine and New Jersey have set greenhouse gas reduction targets. Maine has set a statewide target for reducing greenhouse gas emissions to 1990 levels by 2010, to 10% below 1990 levels by 2020, and by as much as 75-80% over the long term. New Jersey has established a goal to reduce its greenhouse gas emissions by 3.5 percent from 1990 levels by 2005. The state draws upon voluntary agreements with public- and private-sector organizations as well as regulatory initiatives in order to reduce emissions.

Massachusetts has established a multi-pollutant cap that requires six older power plants to reduce their CO_2 emissions by ten percent relative to 1997-1999 levels by 2006 or 2008, depending on the method of compliance chosen. This represents 40 percent of the state's electricity.

Some northwest states have established programs requiring offsets in emissions for new power plant construction. In **Oregon**, the Climate Trust is a nonprofit organization that funds development of projects that counter 17 percent of new power plant CO_2 emissions. This can be done through improvements in energy efficiency of buildings, investments in renewable energy, reforestation, and other types of projects that result in emissions reductions or carbon sequestration. **Washington** as recently as June 2004 began requiring new power plants planned in the state to offset or mitigate 20 percent of their expected carbon dioxide emissions. Companies can comply with the new law by undertaking mitigation efforts such as planting trees (which sequester carbon dioxide), retrofitting diesel buses with cleaner-burning fuel, or investing in energy conservation. Alternatively, companies can pay third parties approved by the state at a rate of $1.60 for each metric ton of carbon per 30 years to undertake mitigation activities. Third parties must submit reports to the state and allow their mitigation efforts to be inspected and audited by the state.

City and Community Efforts and Commitments:

In October 2003, 155 mayors, representing more than 46 million people, issued a statement calling on the Federal government to join them in efforts to reduce the threat of climate change. (See www.iclei.org/us/mayors_statement/) The statement notes that "Global warming poses significant threats to communities across the country. We are already feeling impacts in the form of heat waves, shrinking water supplies and snow pack, increased rates of asthma, floods and storms, and coastal erosion. This issue requires an effective response from the U.S. Federal Government." The statement also

notes the economic, health and security benefits of reducing emissions through conservation, efficiency, and the use of cleaner, more sustainable technologies. Signatories include mayors of **Atlanta, Boston, Boulder, Dallas, Honolulu, Houston, Louisville, Las Vegas, Minneapolis, Newark, New Haven, Sacramento, and San Diego**. Throughout North America, 249 cities (most in the U.S.) have joined Cities for Climate Protection, a program of the International Council for Local Environmental Initiatives that commits them to inventory and create detailed action plans for reducing their GHG emissions. As of April 2004, 579 cities worldwide had joined this effort.

Private and Corporate Targets and Achievements:

Many companies have taken initiative to voluntarily set targets for greenhouse gas emissions. See the details below:

Dupont – Has already achieved its target of reducing GHG emissions 65 percent below 1990 levels; the original target date was 2010. Dupont plans to derive 10 percent of the energy it uses worldwide from renewable sources by 2010.

Silicon Valley – **Hewlett-Packard, Oracle, Calpine, Lockheed, ALZA, Life Scan, and PG&E** announced in March 2004 a plan to reduce CO_2 emissions in Santa Clara County, California, to 20 percent below 1990 levels by 2010. This is triple the goal that the Kyoto Protocol set for the United States as a whole (a 7 percent reduction below total U.S. 1990 emissions levels by 2012). Companies plan to curb their emissions by retrofitting buildings with more efficient heating and cooling systems and insulation; shifting auto fleets to hybrid vehicles; replacing light bulbs with compact fluorescent bulbs; and installing motion detectors. They expect all of these changes to be cost-effective. The city of San Jose will also take part, improving public transportation, enacting more energy efficient building codes, and converting its vehicle fleet to hybrids.

Alcoa – Has committed to reducing its GHG emissions to 20 percent below 1990 levels by 2010.

Bank of America – In May 2004, the corporation announced unprecedented targets and timetables for reducing its greenhouse gas emissions, with an initial goal to reduce emissions 7 percent by 2008, and pledged to stop funding projects that involve oil and gas exploration, among other things.

Power Companies
Five U.S. power companies committed in early 2004 to reducing their GHG emissions and to supporting a mandatory federal cap on CO_2 emissions. As part of the **PowerSwitch Challenge** initiated by the World Wildlife Fund, **Austin Energy (Texas), Burlington Electric Department (Vermont), FPL Group (Florida), Sacramento Municipal Utility District (California), and Waverly Light and Power (Iowa)** have committed to undertaking at least one of the following by 2020: increasing the share of electricity they sell that is generated by renewables to 20 percent; increasing energy

efficiency by 15 percent; and/or retiring the least-efficient half of their coal generating capacity.

Shaw's Supermarket – Now sells renewable electricity in several New England cities, and at least 3 of its stores are purchasing renewable energy to meet 25 percent of their electricity needs. Shaw's was the first supermarket chain in New England to offer green power to its customers. The renewable energy is generated on the rooftops of BJ's Wholesale Club stores.

Green Power – An estimated 10,000 U.S. businesses (and 110,000 households) are now using certified "green" electricity that is generated with renewable resources.

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APPENDIX C *DRAFT PLAN FOR A NORTH CAROLINA CLIMATE ACTION REGISTRY*

This plan has been developed by the North Carolina Department of Environment and Natural Resources (DENR), Division of Air Quality (DAQ) with input and views from the DENR Division of Pollution Prevention and Environmental Assistance (DPPEA), the State Energy Office (NCSEO) and many others such as stakeholders, national forums, federal agency information and various internal and external information sources. This draft is provided as a "straw man" to stimulate discussion. It is not provided as a recommended plan at this time. However, since there has been substantial discussion of such a registry in the State for the past few years, this draft proposal is included here for further information and generation of ideas and reactions as to what the best options to proceed might be at such a time as it is deemed necessary.

Background

Summary of NC and Federal Historical Activities

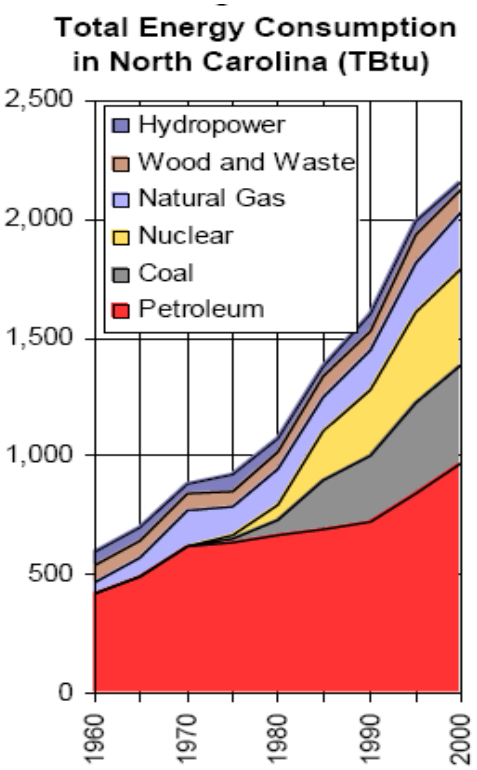
North Carolina does not have, and has never had, a stand-alone registry for GHG emissions. However, the state, through various venues has participated in many related or complementary activities over the past decade. This summary is intended to provide the essence of some of the historical and ongoing efforts that have occurred, and how they relate to today's situation and underlying thoughts on approaches to take and why. This discussion is not intended to be inclusive of all background and actions, but primarily those that relate to the development of North Carolina's plans for the future.

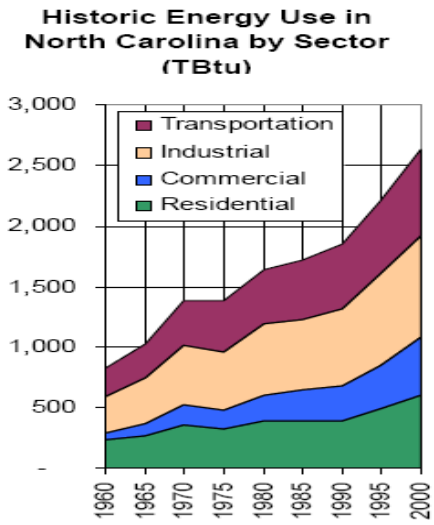
Registry of GHG's alone is not a productive end product, but could readily provide an integral tool, and be part of a larger process, to actually help generate reductions in GHG emissions. For a program to be viable to support trading, sale, etc., it must provide mechanisms for universal participation, consistent accountability among the emitters and the registration process. It must maintain a method for verification of emissions and be credible on national and international exchanges so that the "currency" is validated and interchangeable with that in other jurisdictions. In addition, the process must assure that companies or other entities are required to show all their releases, not just for those situations and jurisdictions where the results will appear more favorable to their position. It should be clearly understood at the outset that coal-fired utilities are already, in fact, reporting to the National Acid Rain Program, annually, and using continuous emission monitors (CEMs) for their CO_2 emissions, which are much more accurate and provide more complete and verified data than for other fuel combustion facilities, or other generators of GHG. In addition, generally these facilities voluntarily participate in the DOE 1605 (b) voluntary registry and any registry developed should reflect the availability of these verified and accurate data and not "re-invent this wheel." Any North Carolina Climate Change Registry should focus on other (to include "all") sources in the State, as discussed in the next section. The reader is reminded here also, of the

distinction between the GHG and CO_2, the latter of which is the literal subject of the CSA requirement.

Sources and Emissions in North Carolina

The figures below from the North Carolina SEP present a graphic view of the distribution of fuel consumption in the state. The combustion of fuel is not the only source of GHG's but is a substantial portion and for many purposes may be considered the same. Note that the predominant source of CO_2 in the State is from Petroleum fuels, which includes automobiles, trucks, trains, planes, construction equipment and various other forms of power generation. Note also that growth has been fairly consistently in all areas, but the predominant largest sector has been residential, followed by industrial. These factors need to be considered in the development of a system of registry such that the entire source population is included and that the "efforts" for the registry are productive and fruitful in comparison with the efforts and expenses involved.





The largest single sector in terms of total energy use (including the energy consumed to generate electricity for the sector) is industrial at 31% of the total. Transportation is second largest with 28% of total energy use. The residential (23%) and commercial (18%) sectors, if combined, would demonstrate that the largest energy use in the state is in buildings at 41%.

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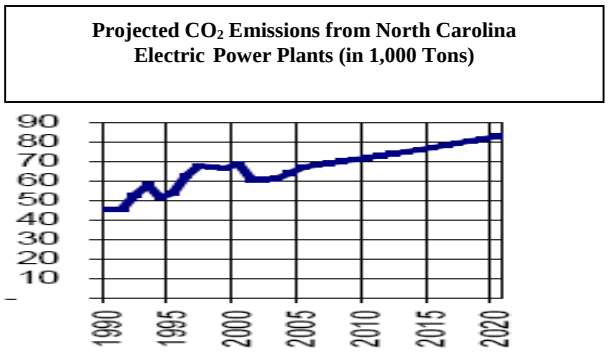
125 North Carolina State Energy Plan, June, 2003, http://www.energync.net/State%20Energy%20Plan%2003.pdf



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The discussion above is not intended to suggest that the coal fired power plants in the State are of trivial impact on the State's CO_2 or GHG emissions "burden." Approximately one third of the annual CO_2 in the state comes from the generation of electric power, and as the figure above indicates, that contribution is not expected to decrease, without some decisive actions to reduce (efficiency or reduction programs) or to substitute other sources of electricity for that generation capacity.

U.S. DOE and U.S. EPA Registries and Related Programs

GHG efforts at the federal level have been primarily under the auspices of the DOE and the EPA. A brief reflection of what prior efforts have been, and what is currently being done nationally/globally, are provided here as a backdrop for information on North Carolina's past and likely or proposed future roles.

US DOE 1605 (b)

The DOE, acting under the requirements of the Energy Policy Act of 1992[127], established the *National Inventory and Voluntary Reporting of Greenhouse Gases*, also known as the 1605 (b) Registry. This mechanism provides a means for facilities to voluntarily report their emissions and/or reductions in emissions of GHGs to a centralized national repository. NC facilities have a relatively good record of reporting and listing in this registry. NC has consistently been a national leader with participation of up to 39 facilities (generally assisted in NC by the DOE-funded pilot 'Climate Wise' program, which has since lost this federal funding support). The 1605 (b) Registry has been operating since about 1994 and continues as the primary repository of reported GHG emissions and reductions data for the US, even though it does not meet many of the desired criterion for its ultimate success.

On November 26, 2003, DOE released proposed revised General Guidelines for the voluntary reporting of greenhouse gas emissions and emission reductions under this program.[128] DOE accepted comments through February 17, 2004. DAQ and State Energy Office (SEO) staff attended the DOE's public workshop on these proposals of the policy guideline revisions and submitted formal comments. DOE has also expressed

[126] North Carolina State Energy Plan, June, 2003, http://www.energync.net/State%20Energy%20Plan%2003.pdf

[127] Section 1605(b) of the Energy Policy Act of 1992 (EPACT), 42 U.S.C.13385(b)

[128] Department of Energy, 10 CFR Part 300, General Guidelines for Voluntary Greenhouse Gas Reporting, http://www.pi.energy.gov/pdf/library/Formatted1605%28b%29GeneralGuidelinesfinal.pdf

intention to make further revisions to the proposed *General Guidelines* available for public comment, simultaneously with the issuance of proposed *Technical Guidelines* during "the late spring or early summer of 2004." To date, these proposals have not been released. NC DAQ expects to comment on these technical proposals whenever they are released. The 1605 (b) program remains a most viable repository for North Carolina GHG data. However, for this information to be useful and credible on a National/International accounting and/or trading basis, parallel technical procedures that are uniform and accepted must be developed and adopted and the reporting by all major emitters must become mandatory.

US EPA Climate Leaders

Climate Leaders[129] is a voluntary industry- government (EPA) partnership initiated in February 2002[130] at EPA, that encourages companies to develop specific long-term comprehensive climate change strategies and set (GHG) emissions reduction goals. One part of this program is GHG registration. However, there is no direct link to the DOE 1605 (b) Registry and data submittal from one agency/registry to the other is not required or automatic. This does not encourage companies to participate in multiple programs and will not likely result in their efforts being interchangeable. Several companies with operations or facilities in NC have opted to participate in this program.

The partners listed below (Spring 2004), were compiled from the EPA web page:
3M, Advanced Micro Devices, Inc., American Electric Power, Baxter International, Cinergy Corp, Eastman Kodak Company, FPL Group, Inc., General Motors Corporation, Holcim (US) Inc., IBM Corporation, Interface, Inc., International Paper, Johnson & Johnson, Miller Brewing Company, National Renewable Energy Laboratory, Norm Thompson Outfitters, Inc., Pfizer, Inc., PSEG, S.C. Johnson & Son, Inc., St. Lawrence Cement, and United Technologies Corporation.

Only a limited number (21) of the possible thousands of companies in the US had committed to this voluntary program at that time. However, the companies participating represent many large individual and collective operations. Without mandatory reporting and clearly established reduction goals, the benefit of this effort as a national or international registry is limited. As a minimum, it should feed data automatically to the DOE1605 (b) registry.

EPA's Acid Rain Reporting

The overall goal of the Acid Rain Program, as established by the Clean Air Act Amendments of 1990, is to "achieve significant environmental and public health benefits through reductions in emissions of sulfur dioxide (SO_2) and nitrogen oxides (NOx), the primary causes of acid rain." To achieve this goal at the lowest cost to society, the program employs both traditional and innovative, market-based approaches for controlling air pollution. In addition, the program has elements to encourages energy efficiency and pollution prevention.

[129] USEPA, Climate Leaders, http://www.epa.gov/climateleaders/
[130] EPA Administrator Launches Climate Leaders Program Charter Members Commit to Greenhouse Gas Inventories and Emissions Reduction Targets (2/20/2002)

Under the Acid Rain Program, each utility unit must continuously measure and record its emissions of SO_2, NOx, and CO_2, as well as volumetric flow and opacity. In most cases, a continuous emission monitoring (CEM) system is required. There are provisions for initial equipment certification procedures, periodic quality assurance and quality control procedures, recordkeeping and reporting, and procedures for filling in missing data periods. Units report hourly emissions data to EPA on a quarterly basis.

Phase I of the NOx program began on January 1, 1996 and has continued to expand and improve since. Data reported are recorded in the Emissions Tracking System, which serves as a repository of emissions data for the entire utility industry, for major boilers and boiler types, but not some peaking (e.g. internal combustion turbine) operations. There is no automatic link or data transfer mechanism currently established (or plans for such known) that results in the CO_2 (utilities/combustion emissions are limited primarily to CO_2 and not some of the other GHGs) data reported via this program to be automatically translated to the DOE 1605 (b) or other central registry. Many utilities (including NC utilities) however, do participate in the 1605 (b) Registry by "re-reporting" their emissions and/or emission reduction efforts to that registry, even though it is not required. Even then, this reporting may not be carried out consistently and with the same purpose or data presented for facility-wide and company-wide emissions.

Climate Wise in NC

As mentioned above, the Climate Wise program operated in NC for several years (with DOE funding) as a pilot program to initiate and support reporting to the DOE 1605 (b) Registry. After funding support from DOE expired, the state budget did not support the program. Thus, it ceased to be effective. However, a non-profit (501 c-3) company, *Global Warming Initiatives, INC*, was formed to search for private funding and to carry on the efforts to assist former registrants and potential new participants. That company continues to assist former participants in Climate Wise and others who are interested. However, dependable funding is lacking and it is dependant upon grants and donations from the participating companies. The future of this effort may well depend upon the infusion of additional public and private grant or other funds to continue the assistance and consultation.

Climate Leaders in NC

As identified above, several companies in North Carolina participate in EPA's Climate Leaders program. However, those that have participated have done so directly with EPA without significant input or support from NC agencies. This is the manner in which the program is likely to continue unless a specific agency in NC is identified and funded with the purpose of supporting and assisting this program. This program may identify specific interested facilities within the state, but does not necessarily result in emissions or reductions being reported to any centralized national and internationally accepted database as is necessary for a viable program with real reductions to global totals of GHG emissions.

Climate Vision in NC

In 2003, the federal government and industry organizations representing thousands of companies from 12 energy-intensive economic sectors joined in a voluntary partnership called Climate VISION. Those economic sectors include automobile manufacturers, chemical manufacturers, railroads, the oil and gas industry, the electric power industry, the mining industry, and the cement, iron and steel, aluminum, magnesium, semiconductors, and forest products industries. Joining in this presidential initiative were DOE, DOT, DOA and EPA. Climate VISION works with industry to identify and pursue cost-effective solutions to reduce emissions using existing technologies; develop tools to calculate and report emission intensity reductions; speed the commercial adoption of advanced technologies; and develop strategies to reduce emissions intensity in other economic sectors.

The electric power sector participates in the Climate VISION program through the Electric Power Industry Climate Initiative (EPICI) and its Power Partners program, which is being developed in cooperation with the Department of Energy. The memberships of the seven organizations that comprise EPICI represent 100% of the power generators in the United States. The power sector, through EPICI, plans to finalize its work plan in the form of a Memorandum of Understanding (MOU) with DOE. The MOU will outline proposed implementation actions to reduce greenhouse gas emissions intensity by 2012. The power sector, in conjunction with DOE and other federal agencies, will implement the actions. In North Carolina, Duke Energy and Progress Energy are both participating in this program through the Electric Power Research Institute (EPRI).[131]

Environmental Performance Track

EPA's *Environmental Performance Track* program is a voluntary program beyond their current requirements. A new component of the program, Challenge Commitments,[132] encourages facilities within the program to commit to regional environmental priorities as one of their performance goals. Each EPA region establishes regional environmental priorities with input from the states within the region. DENR's Division of Pollution Prevention and Environmental Assistance (DPPEA) program staff has established activities with this program which is expected to likely become more directly associated with climate change initiatives.

NC Environmental Stewardship Initiative

North Carolina's Environmental Stewardship Initiative (ESI) is a voluntary program that establishes incentives and recognizes facilities using pollution prevention and innovative approaches to meet and exceed regulatory requirements. DENR's DPPEA[133,134] manages the ESI. This program seeks to reduce the impact on the environment beyond measures required by any permit or rule, producing a better environment, conserving natural resources and resulting in long-term economic benefits. The program will educate and encourage the use of voluntary reporting of GHG.

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[131] Personal Communications (emails) from George Everett of Duke Energy and Cheryl Vetter of Progress Energy, to James Southerland, NC DAQ, August 2004.

[132] http://www.epa.gov/performancetrack/events/challenge_commitment_policy_details.pdf

[6] http://www.p2pays.org/

[134] http://www.p2pays.org/esi/

State Energy Plan Interfaces

The State Energy Office (in the Department of Administration) is North Carolina's lead agency for energy programs and serves as the official source for energy information and assistance for consumers, businesses, government agencies, and policy makers. In addition, North Carolina's General Assembly established the Energy Policy Council in 1975 as a means of addressing state-specific energy issues and concerns. The Energy Policy Council's role is periodic examination of energy use, energy production, and environmental concerns in our state.

As State and national energy issues change, and it is deemed productive, the Council is charged with revising or producing a new State Energy Plan. For the most recent plan, the Energy Policy Council started with the formation of a working group composed of members representing key energy and environmental interests, with a charge to develop an updated energy policy and program recommendations. North Carolinians from various sectors provided input to the Energy Policy Working Group[135] and the Group then produced a new State Energy Plan in 2003.

The **State Energy Plan**[136] provides a major review and an analysis of what the energy consumption patterns are in NC and a series of recommended actions that form a 'blueprint' to assist the state to achieve its energy goals. This plan shares consistent goals of reductions of use of energy, which will assist in the reduction of CO_2 emissions, as identified for potential reductions in the CSA. These complimentary legislations provide a tandem approach to different aspects of the same problems and must be carried out in parallel. One of the stated goals of the Energy Plan is to develop a GHG or Climate Change Gases Registry. Though no specifics are given, the development of these plans are envisioned to be completed cooperatively with other departments, including the DENR and its component divisions, and is substantially consistent with the CSA's intent.

Previous NC Legislative Involvement and Analysis of Proposals

In the 2002 Session of the NC General Assembly, Bills were introduced into both Houses[137]to initiate a "voluntary" Climate Action Registry (House Bill 1045 -Short Title**:** NC Climate Action Registry). The Bill's introductory language directed: "The State's tradition of environmental leadership should be recognized through the establishment of a registry to provide documentation of those greenhouse gas emissions reductions that are voluntarily achieved by sources in the State."

Furthermore, the language indicated that it was to be in preparation for mandatory greenhouse gas emissions reductions that "may be imposed on North Carolina sources at some future point." In view of this, the Bill stated that, the "State has a responsibility to use its best efforts to ensure that organizations that voluntarily reduce their emissions receive appropriate consideration for emissions reductions made prior to the implementation of any mandatory programs."

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[135] http://www.ncenergy.appstate.edu/index.php

[136] http://www.energync.net/State%20Energy%20Plan%2003.pdf

[137] http://www.ncleg.net/html2003/bills/CurrentVersion/house/hbil1045.full.html

The House Bill also stated that guidelines and the rules developed should include : programs to establish emissions baselines and to monitor and track greenhouse gas emissions, systems to verify emissions and reductions of emissions, the adoption of a uniform format for reporting emissions baselines and reductions in order to facilitate their recognition in any future regulatory scheme, and maintain a record of all emissions baselines and reductions."

This session ended without passage of any version of a **Climate Action Registry Bill**, nor were any expectations or provisions defined that would quantify the resources to be provided and the expectations of how these requirements would be fulfilled.

The draft Bills and surrounding discussions seemed to recognize that before a Climate Action Registry could become effective in achieving reductions that it had to

- Cover all sources, including all states in the US, and all countries contributing significantly to the global emissions of GHG's (or CAG's in the Bill's terminology) in order to be able to define and track the total contributions and to assure that transfer of emissions out of one area to another did not occur.

- Be mandatory, because if it is not mandatory, the total emissions and of the emissions from various sectors can not be determined.

- Be associated with a reduction goal (e.g., "xx% below the levels emitted in 1990").

- Be recognized as a database of information to serve as a "valid currency" around the world, through a process of documentation, certification and verification, such that uniform procedures were always followed and in a consistent manner.

- And, ultimately be amenable to interstate and international carbon or GWG trading programs that would allow facilities to find innovative and cost saving means to reduce their emissions in view of a global target.

These features are also consistent with the assessment of the DAQ as to what would be needed to actually achieve reductions in GHG's in North Carolina, or elsewhere.

Range of DAQ Options and Concerns/Issues for Planning a NC Registry

Overview/Introduction

Various levels of effort for development and implementation of a registry are possible. The choices however, involve resources required to implement that program, level of accuracy and transparency (documentation and public display) of information, level of quality assurance and certification, size of facility, treatment of "secondary reductions" such as consumer reductions of electric power usage, treatment of non-point sources, frequency of update and other such practical and resource-related considerations. Details and resource requirements need to be determined in consideration of what the major sources are and how they may ultimately provide for emission reductions, and the impact of costs of their control.

Basis for Program to Fit Needs/Requirements

DAQ is supportive of efforts for control/reduction of GHG and has evaluated several options and discussed several issues**.** These discussions have taken into account the needs and desires expressed in various NC reports and legislative efforts, national and international considerations for long term achievement of successful reductions in GHG and other practical issues such as resources to support such efforts. Some related points and facts from those discussions, both internally at DAQ and with other Divisions and Departments, are summarized below:

- It is prudent to take action to reduce GHG emissions and DAQ supports this goal.
- DAQ currently has no mandates or resources for GHG/CO_2 beyond the required reports for the Clean Smokestacks Act, and resources were not appropriated for these studies.
- The development of a registry is on the top 15 list of priorities in the NC **State Energy Plan.**
- USEPA does not currently consider CO_2 to be a "pollutant" (by their interpretation of the Clean Air Act), falling under the same procedures and processes that DAQ has historically implemented.
- CO_2 from coal-fired utilities (the largest emitting point source sector) is already continuously measured and reported to EPA (Acid Rain program from continuous measurements) and DOE (mandatory) for coal-fired power plants.
- Other fuel-burning industries are important, but not so much as the coal-fired utilities which already report.
- Other sources such as transportation (mobile on road and off road) emit about the same magnitude (as a group) as coal-fired utilities and should be included in such periodic compilation of estimates as well.

Though DAQ is supportive of a GHG/CO_2 registry, there are concerns and reservations that need resolution:

- A greenhouse gas registry by itself would not reduce Greenhouse gases (GHG) but could be a key tracking tool in an overall integrated program.
- To meet ultimate usefulness and be productive, a Climate Action registry should be coupled with reduction goals and complete coverage of sources.
- Adequate resources should be provided such that such a registry could be expected to accomplish the level of program that is desired.
- It would be difficult to establish and maintain a "limited" voluntary effort and its usefulness would be questionable.
- North Carolina governmental facilities and fleets, and programs addressing the emissions from these sectors should be included and their emissions tracked, perhaps as a pilot effort in the beginning of any such broader program.
- For a Registry to meet likely expectations and needs, it should:
  - Be widely accepted (Interchangeable in NC, Nationally and Internationally)
  - Be mandatory of the emitting sources (Currently ~3100 facilities in NC hold an air permit, with majority of them burning fuel of some sort; ~400 of these are larger Title V sources, including coal-fired power plants)

- Be coupled with other emitting sectors, in addition to NC's air permitted population
- Be used as the yardstick for gauging future mandatory reductions coupled with an action plan for the reductions and tracking (If one does not know the whole picture, it is difficult to act appropriately with a portion of the total)
- Be based on emission estimates that are complete, compatible and interchangeable with similar estimates from other jurisdictions up to and including other countries (Requiring going beyond project-level programs with state monetary investments in protocols, software and external coordination)
- Be administered by an organization that has sufficient funding and staffing/expertise to accomplish the tasks of
    - ✓ Outreach
    - ✓ Technical assistance
    - ✓ Protocol development and harmonization with other state and national or international protocols
    - ✓ Provide for third party certification
    - ✓ Enforcement against failures to comply with requirements
    - ✓ Provide automated output to National and International databases
    - ✓ Provide authority for speaking on behalf of state interests in national and international forums

Options Assessed

DAQ's assessments of options have covered a wide range; from "doing nothing" to an extensive stand alone program. For purposes of brevity, but to demonstrate some of these options evaluated, three levels are discussed briefly below before providing more detail of a recommended option. These levels originally evaluated fell into three general groups: "minimal," "intermediate," and "major stand-alone."

Minimal Effort-Low Benefit

A **minimal first step** toward a Climate Action Registry could be a simple "registration" of emissions accomplished by adding the GHG pollutants to the existing air emission inventory done in NC. This would require notification, and education of DAQ and facility staff, possible rule changes and some data processing system changes. It would take several months and require appropriation of additional resources and would not be certifiable nor necessarily follow complete and detailed protocols as would be needed to insure that the emissions identified are 'tradable' in the future, useful for baseline certification nor be necessarily compatible with various protocols used in other states, the nation or internationally. No resources are currently available for this option, though it is relatively minimal **compared to more comprehensive registry alternatives.**

Intermediate Commitment Option – Limited Benefits

Intermediate options could cover a wide range of levels and be pursued beyond the 'minimal registration' effort outlined above to a full scale certified, mandatory, state-wide inventory with automated reporting/participation with national/global efforts and registries is possible. One such intermediate scenario is outlined below, primarily to indicate the elements and their interactions. It would

- be a NC Voluntary Program

- require commitment to reductions state-wide, without teeth or ability and commitment to track all activities contributing

- actively support solicitation of voluntary participation in national efforts and

- require addition of GHG's to routine DAQ emission inventory

This level of program and support would involve industry workshops and more active or intensive information exchanges and education for a voluntary state program and continued efforts to support and promote the mandatory national efforts. In addition, the option could develop and provide a "third party" verification program in the future. The routine DAQ inventory would require modification to add GHG's. No efforts to provide a third party review, or for DAQ to have a strong role to get the data entered into the national registries would necessarily be involved in a base case, but the third party review and certification could be an add-on if/when additional needed funding were available.

Resources estimated for this level of activity would be in the range of over $100,000. per year with an additional $150,000 or more for contract support for a Third Party Validation program, if included.

Legislation Required: – Fee requirements and authorizations and/or funding appropriations would be necessary for such a program. Authority for program of collection of information may not be technically require legislation but would be supportive, especially if coupled with a state target for reductions.

Other considerations- This option would provide elementary base program with substantial effort and product to estimate and track GHG's but would not insure reductions without a state target and some mandatory requirements, both for reporting and needed reductions.

Concerns:

- Not mandatory-not oriented to success of an identified and measurable objective

- Not funded by guaranteed short or long term funding

Major Stand-alone Program – High Costs but Higher Benefits

It would be possible, with time, funding and continued support to develop a mandatory reporting for most major sub-sets of the emitting population; including tracking of all sectors of area and mobile sources, to fully provide a picture of the GHG emissions and the success of any reduction strategies. Such a program would need to be provided with or able to establish a regulatory enforceable target and authorizations to "own" public assets in a global trading environment such that funds could be raised and utilized to achieve reductions. Such a program is not fully fleshed out in this narrative. However, DAQ estimates that such an effort would require resources on the order of at least ten or more staff, with funding of several hundred thousand dollars. California, is a much larger state than North Carolina, but with less

registered sources in DOE's 1605 (b) Registry. It has spent large sums of money developing their program but the program does not yet have all the required elements (e.g. mandatory for all with a reduction target) to insure its long term success in achieving reductions in GHG. Since this step does not seem likely in NC at the current time, this option is not fully detailed here. However, if the need arises, further analysis and related plans could be developed and provided.

A Sensible Skeleton for Building a NC Registry

If a registry were to be established in North Carolina, the discussions and options outlined below could provide a basic skeleton upon which to build positive steps toward a sensible GHG or Climate Change Registry in NC compatible with managing future mandatory reductions and targets:

Element 1: Encourage Interfaces with DOE, EPA and Other agencies

NC would continue a strong commitment to efforts to convince federal officials and offices of the need to provide positive and certain links between the DOE 1605 (b) Registry and the EPA Climate-Wise and Climate Leaders programs and that they should be cast in a background of an overall mandatory program with specific reduction targets. Through continued technical comment with DOE and EPA and by pursuing alternate options to have an enhanced registry to track companies in NC in a nationally and international recording system to record their emissions and reductions in an accredited manner, all related programs and offices in NC should continue to assert the need and help facilitate the changes needed. Political forces are likely important in the realization of the appropriate role, so education and provision of factual information to the officials throughout the State may be an important element to realize this aspect of the program.

NC would need to develop and expand programs to provide technical assistance to potential registrants and provide them with the information on how to report emissions into the existing and developing programs. A monitoring function is also proposed whereby activities in one program automatically trigger the request and assistance function to assure this cross-reporting among the existing programs is complete. Some enhanced electronic ties may even be possible as the reporting details unfold.

The efforts under this element would include continuing to try to get an independent verification process incorporated into the federal programs, if not incorporated into the pending 1605 (b) technical revisions. The reader is reminded that these important elements already exist for coal-fired utilities.

Element 2: Informal "Registration" of GHG via Existing Procedures

Each year, the Division of Air Quality inventories all (approximately 400) Title V facilities in the state for criteria and hazardous air pollutants (HAPs) as addressed by the Clean Air Act. The annual emissions reported for these point source facilities generally include all coal-fired utilities and other major burners of carbon fuels in the state. In addition, on a five year rolling cycle, the smaller facilities report their criteria and HAP emissions.

DAQ recommends that as quickly as the identified GHG's can be added to the pollutant table [presumably to begin with Calendar Year (CY) emissions for 2005 or 2006, reported in 2006 or 2007] and the inventory instructions (as a defined "air pollutant") so that the facilities begin "registering" their emissions annually. This level of effort does not envision a detailed and prescribed formal protocol, but reference to other available

calculation procedures, protocols and software available. It would not involve third party validation. There would be a preliminary and rather cursory review by DAQ engineers as part of the routine review of the annual inventory.

Amendments and revisions to the data system would result in the generation of annual reports and listings of emissions by facilities but would not be considered a formal and legally certified "register" for cap and trade or other refined monetary or legal purposes. It would be used as a resource for future prioritization and to assist buyers and sellers to independently find a potential counterpart. If a facility wished to purchase, sell or trade emissions with other facilities, this would be done as a private exchange not involving the State. This would also allow for further assessment of cut-off points to try to simplify and keep simple procedures involving the minimum of facilities with the maximum of pay-back in terms of future reductions.

In this context, the registration process would first be targeted at the Title V facilities as these are likely to cover the vast majority of the emissions (for most criteria pollutants, the Title V facilities account for 90% or more of the emissions from point sources within the state). Coal fired utilities would be required to continue to report to the Acid Rain Program, but also provide a copy of the reports to the DAQ within the existing data system, but also include any other fuel combustion sources not covered by the Acid Rain Program. The facilities would be encouraged to voluntarily report to other EPA, DOE and International programs as further identified below, following the rules and protocols that apply to those programs.

Even this level of support within DAQ will not be without resource impact. A minimum of one full time employee (by staff or contract) with identified continuing funding would be required to establish this effort and to keep it moving toward a reasonable target.

Element 3: A Program to Encourage and Facilitate Voluntary Reporting

It will be necessary for reporting to be required, eventually, before reliable targets and inventories can be established; and thus targets developed with plans for achieving the program envisioned in these recommendations. However, the first step relies on voluntary reporting to national databases, such as the 1605 (b), with the motivation that

- Company management is generally of good conscience as far as performing toward the public good.

- Future baselines cannot be established and maintained without participation in the initial registration process; therefore, it is in the economic interest of facilities to get their emission base established as quickly as possible.

- North Carolina government entities should be full participants and track emissions and make all efforts to reduce that other private sector participants undergo.

Thus, North Carolina DENR would initiate a strong effort to encourage both mandatory and voluntary efforts through all existing and new programs that are germane to the desired

results. An inter-departmental working group would be instrumental in planning and executing such efforts such that the results are productive.

Element 4: Harmony With State/Regional/Federal/International Aspects

It is obvious that NC is a small part of a global mechanism that must be considered as a whole; on the national and international scale. What is done in NC is important and will set a good direction and example. However, the part the state will play cannot accomplish significant gains on the global or total problem alone. It is not cost effective and does not guarantee future compatibility and ability to trade/sell emissions credits etc. without the registration being recorded in a national or international registry. Although the DOE 1605 (b) Registry is grossly deficient, it is a recognized national repository. With supplemental NC specifications and guidance from NC agencies, this mechanism has the capacity to serve the repository purposes of NC and its potential reporting entities. This may change as expected technical changes in procedures are issued (soon) by DOE which may require this to be reevaluated.

Environmental Stewardship Initiative

The DPPEA implements the Environmental Stewardship Initiative (ESI) already. This program provides a means for facilities to voluntarily apply for recognition at three levels of environmental stewardship within their activities in the state. There are a number of criteria that the candidates are judged against before being declared a Steward or other level. This plan/proposal includes using this ESI as a means for promotion, and education of facilities of the CA Registry efforts.

Continue Support and Participation for Existing State/Federal Programs

The several state and federal voluntary programs should continue to be supported in some fashion through encouragement and education. These include those mentioned below.

- **DOE's** (Past) climate change efforts carried out in NC in the past (previously **Climate-Wise**) should be continued in some fashion) Such efforts on the part of NC should result in facilities submitting their GWG data to the DOE Registry.

- **EPA's Climate Leaders** program should be acknowledged and supported, with emphasis on trying to convince the EPA and DOE to integrate their programs and meet additional requirements.

- **EPA's Environmental Performance Track** may provide a means for DENR to enrich contacts with this EPA Region 4 office and include green house gas reporting and reductions via EPA's Challenge Commitment initiative, adding to the ability to encourage reporting emissions to DOE's1605 (b).

- The President's Climate Vision program is somewhat redundant and focused on energy intensity as opposed to positive overall reductions, but is a means to encourage and demonstrate reductions that are possible.

Joint DAQ Efforts With DPPEA and other State Offices in NC

The above activities will require communication and coordination across multiple NC agencies. The DAQ, DPPEA and SEO appear to be the key actors in these efforts now,

but as the program and implementation are involved, many other (if not all) state programs may have some role. Even within DENR, additional discussions and developments are envisioned whereby the planting and tracking of forest and agriculture products would be done with new goals, a sensitivity and tracking of sequestration aspects of these areas could be managed within the framework of their overall program objectives. At some point in the (short term) future, it may be appropriate to develop an inter-agency task force or council to develop, review and coordinate state-wide activities for the common goals of this program within the State.

Coordination and Harmonization with State Energy Plan Objectives

The Energy Policy Council's far reaching State Energy Plan (SEP) shares focus with many of the goals and facilities encompassed by a North Carolina Climate Action (NCCA) Registry, as energy use is a common factor in most cases. This plan for NC's role in a NCCA Registry is supportive of, and endorses, the goals and conclusions of the SEP. It is important, however, to be able to define the goals relative to overall reductions in GWG and track progress. Therefore, the plan for this registry is to develop means and procedures whereby each element within the SEP has a defined baseline and a tracking function that follows it both in terms of absolute changes in emissions, but also in terms of reductions relative to what they "would have been" had there been no reductions attributable to the SEP. This documentation and tracking function would be an important part of the NCCA Registry's overall emphasis. It would likely also provide information needed for more effective management of emission reduction programs, priorities and resources in the future.

Promotion/Assistance & Education Efforts

DAQ and DPPEA already have an infrastructure of reporting entities or other facilities that would be candidates for participation in the NCCA Registry. This contact community is the target for additional information distribution and education activities on a periodic basis. Each facility would be informed and reminded of the opportunities available and updated on what assistance and advice are available to assist them to participate in the programs.

Element 5: Update the GHG emissions inventory for the State

It is difficult to keep a proper assessment of the effects of actions and growth without the existence of an inventory of current, past and continuing emission trends for the state and for various sectors within the State. An inventory of 1990 was developed in 1994 by an effort at Appalachian State University. This inventory needs to be reviewed and updated so that it becomes a better overall management tool and a means to track emission trends more authoritatively. This effort requires approximately $200,000 over a two-year period for the initial update and a periodic supplement to that for following years (3-5 year intervals are envisioned). This is an important part of this plan. Appropriations for this would be necessary before it can begin, but it may be possible to get some private support and participation in this effort from the NC utilities or others who may also have a need for the information/data. The results of this effort would be useful both to DAQ, other parts of DENR, and the State Energy Office, and would help track performance of programs and assess future priorities.

Element 6: NC DAQ Coordination with other (Outside NC) State Programs

North Carolina is certainly no "island" surrounded by other states that do not share the problem. Whatever is done in this State must be done in concert with (all) other states and within the same context as other nations in the world. This is critical if the aspirations of making a program for trading and selling credits is to work. Otherwise, the "currency" has a very questionable value and is subject to counterfeiting. Several efforts with others are planned or already underway, in parallel.

Southeastern States and Other Atlantic/Gulf Coast States

The coastal states from Virginia through Texas have a common tie to the same bodies of water, the Atlantic and Gulf of Mexico. Since these areas seem to be most at risk in terms of direct and obvious likelihood of potential impacts from climate change, there is a common tie. One of the objectives of this plan would be to initiate involvement and development of a Southeastern/Gulf States group that either works among themselves or as an adjunct to the NESCAUM efforts (below). Development of such ties takes staff time and resources and likely extensive input and discussions with other states and groups. Therefore, this will be developed over time on a schedule governed by staff time and resources and the willingness and reactions of other state offices.

NESCAUM

The Northeast States for Coordinated Air Use Management (NESCAUM) has undertaken the development of a Regional GHG Registry Collaborative effort among the eight Northeastern States. Over the last year, several Northeast states have taken firm actions toward registering and reducing GHG emissions, laying a foundation for possible GHG trading. In support of Northeast states looking to develop their own GHG action programs, their Demo Project has worked to support changes in the policy landscape that would encourage emissions reductions and lay the foundation for emissions trading at the state and regional level.

NC has been a constant observer and participant (listener) on calls and some aspects of this ongoing effort. NESCAUM invites representatives from other states to observe or participate at some level. There is the 'unofficial observer' level, the observer and the participant. NC by virtue of being on mail lists and invited to listen in to the calls, etc. is an unofficial observer and has been for several months, monitoring the discussion of founding decisions, various issues and problems, with their solutions; technical and administrative procedures, data system issues and decisions, etc. The major limitations to becoming recognized a full level observer is the matter of available personnel time and travel costs associated with attending various meetings in person. In spite of limitations, observers are provided opportunity to work on a more active level in sub-committees and work groups, which then involves more time and resources.

The effort also recognizes full partners which is much more significant. The full partners are included in final decision-making, as well as expected to provide more time and resources for meeting general obligations and responsibilities for the management and sponsorship of these activities. These states get to weigh in on ways that the process could better encourage all states to participate officially.

As this effort becomes more advanced, and as resources become available in NC, it may be productive for NC representatives to be elevated to an official observer level. At this level, one of the objectives would be to make North Carolina's program develop in a manner that it could provide outputs in harmony with those of NESCAUM. This could further its use this as a mechanism to organize Southeastern coastal states to unite both as a separate group, and also with the NESCAUM states in a more unified front of data harmony and usefulness for future trading programs.

California

California has one of the most extensive programs that has been developed, in terms of detail and sophistication. However, it is still voluntary and short of funding for future years. In some aspects, NC can make use of information and experiences from California, but in a direct interaction, little is expected to be directly transferable. However, the NESCAUM efforts are also extracting some of the usefulness from the California efforts and extending that to their work and NC can benefit from being a part of that group and its findings.

Other Legislative Interactions & Expectations Relative to This Proposal

The Legislature/General Assembly has raised the issue and need for a NC Registry in previous times. By default, the budget shortfall was partially responsible for the cut of funding for Climate Wise (the only NC Climate Action effort) from the budget. Interim bills and discussions have indicated that there should be a NC Climate Action Registry of some description. It is not clear how such efforts will be seen in the committees and on the floor of either body of the Legislature, but will likely be a subject of significant debate and compromises. Most recently, a Bill has been introduced that would provide funding for efforts similar to Climate Wise through support of Global Warming Initiatives, Inc., to the proposed sum of $400,000/year. This bill was not passed during the 2004 session of the Legislature.

Potential Comprehensive GHG Mitigation Plan for North Carolina

Several states who have been unable to advance the recognition and actions within their legislative bodies have take action through proposals, plans and actions within the executive branch to the level that can be accomplished without legislation. These efforts stand out as signs of movement in a positive direction. They also serve to bring public and legislative attention and needed debate to the topic. A "Comprehensive GHG Mitigation Plan for North Carolina" exists only in an initial concept stage, but may be further discussed and drafted over the next several months as feedback, interest and resources allow. Such a plan would likely encapsulate many of the ideas and concepts in this plan and further define a concrete set of steps for statewide actions that can, or should, be followed within North Carolina, and perhaps others, to accomplish the proper management and reductions in GHG.

Summary of Needs for a Practical Level of a Climate Action Registry in NC

This proposal contains several important and succinct points summarized below:

- Provide support for continued and expanded technical interfaces and political efforts with congress, DOE, EPA and other national and international agencies for a clear and strong national program.
- Implement an "informal" registration process with existing procedures for Title V permit holders in NC ($$-Continuing).
- Expand efforts to encourage voluntary reporting to federal and international registries.
    - Incorporate GWG "points" into Environmental Stewardship Program.
    - Encourage Continuation of Climate Wise Program and Reporting to DOE 1605 (b) Registry.
    - Encourage participation in EPA's Climate Leaders Program.
    - Incorporate GHG reduction principles into environmental education efforts.
    - Initiate/expand support of EPA's environmental Performance Track in NC with inclusion of Climate Change objectives.
- Joint DAQ Efforts With DPPEA, SEO and other State offices in North Carolina
    - Coordination and mutual assistance efforts with SEO and the SEP.
    - Mutual promotion and assistance efforts in conjunction with DPPEA, Small Business Office and Office of Environmental Education.
- Update the North Carolina GHG inventory, within resource constraints, and set an automatic update process into motion ($$-Continuing).
- Establish and maintain cooperative working relations with other states, regions and international bodies.
    - Work with others to establish a South Atlantic States GHG or Climate Change Group with mutual goals and expectations.
    - Observe and participate with NESCAUM on a continuing but informal basis, within resource limits.
    - Keep up to date on activities regarding the California Registry.
    - Stay attuned to changes and actions on the national (legislative) issues that might influence efforts in North Carolina.
    - Maintain cognizance of other state and national programs that would provide maintenance of a "State of the Art" knowledge within DENR.
    - Maintain efforts to keep informed on international developments, particularly as relate to international standardization of calculation and trading issues.
- Maintain an information base sufficient to keep the AQC, EMC, ERC, Legislature and Governor's Office well informed, and be responsive to questions and issues.
- Develop and coordinate a more "Comprehensive GHG Reduction Plan" for North Carolina that would encompass a broader focus on responding to national and international developments supporting a mandatory GHG reporting and reduction process.

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APPENDIX D *EPC-RECOMMENDED ACTION ITEMS FROM THE NORTH CAROLINA STATE ENERGY PLAN (2003)*

The Energy Policy Council (EPC) reviewed the entire list of 93 policies and programs to determine which measures would require action by the Governor, North Carolina General Assembly, North Carolina Utilities Commission, or other regulating or administrative agency. From the entire list, the Energy Policy Council recommended the following 15 key legislative, regulatory, and administrative policies for action in 2003 and 2004:

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, and fuel cells.

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

Exec-3 The North Carolina Department of Environment and Natural Resources should create a greenhouse gas registry to track emissions of carbon dioxide and other greenhouse gases, to establish baseline greenhouse gas emissions, and to demonstrate reductions in greenhouse gas emissions for potential greenhouse gas trading systems depending upon the availability of funding.

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, fueling stations for alternative-fueled vehicles, production incentives for farmers and refiners, incentives for highly efficient or alternative-fueled vehicles, and education and awareness programs. Developmental efforts should focus on raising feedstock production levels and insuring all 100 counties in the state have alternative fueling infrastructure by 2007. In particular, the Energy Policy Council supports a state program to pay for alternative fuels development via a $1 to $2 fee applied to annual vehicle registration fees.

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, wastederived fuels, and agricultural fuels.

Exec-8 The General Assembly should reexamine the Mountain Ridge Protection Act as it pertains to 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, the State Energy Office should monitor, analyze, and report on the energy savings attributed 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 Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer life-cycle cost procedure.

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.
Funding for Energy Programs

Exec-15 The General Assembly should review options, such as a Public Benefits Fund or other means, to enable funding of the basic services provided by the State Energy Office and the recommendations in the State Energy Plan.

List of all 93 action items from the North Carolina State Energy Plan 2003

The measures above, with the prefix "Exec" are action items given high priority for 2003 to 2004.
The other actions are numbered by the chapter where they appear in the Energy Plan (e.g., 2-1 is in chapter 2).

Policies and Programs for Energy and the Environment

The Council also has a number of recommendations related to economic development, which are included in Chapter 10: Energy Use in the Industrial Sector.

Exec-3 The North Carolina Department of Environment and Natural
Resources should create a greenhouse gas registry to track emissions of carbon dioxide and other greenhouse gases, to establish baseline greenhouse gas emissions, and to demonstrate reductions in greenhouse gas emissions for potential greenhouse gas trading systems depending upon the availability of funding.

2-1 North Carolina should study opportunities for carbon sequestration in the agricultural, forestry, and other sectors. The immediate encouragement of these efforts will also insure these North Carolina industries will be ready to participate in national or international carbon trading programs as they are developed.

Energy Supply Policies and Programs

The following recommended policies and programs are related to the supply of conventional energy sources – primarily fossil fuels and nuclear energy. Many of the policies regarding energy supply are national in scope and thus beyond the purview of North Carolina. The Energy Policy Council has only included policies that the state could undertake.

3-1 The State Energy Office should work with propane dealers, the natural gas industry, electric utilities, key members of the agricultural sectors, and others concerned with alternative fuels to assess each fuel's role in the future of alternative-fueled vehicles in the state and consider how to improve the support structure via fuel supply stations.

3-2 The state should insure high priority for fuel supply by NC Department of Transportation emergency crews during weather and other emergencies – especially for strategic snow removal.

3-3 North Carolina should develop reciprocal agreements between state agencies in adjoining states (departments of motor vehicles, state energy offices, and state emergency response teams) on allowable hours of service for tanker and truck drivers during emergency situations (with clear definition of an emergency situation).

Electric Utility Policies and Programs

The following policies and programs are recommended by the Energy Policy Council regarding the electric utility industry. Several other chapters also contain policies relevant to the utility industry.

4-1 The North Carolina Utilities Commission is encouraged to promote policies that create diversity in energy supply such as natural gas, solar energy, wind energy, biomass, and hydrogen from renewable sources with particular emphasis on in-state energy development.

4-2 The North Carolina Utilities Commission is encouraged to consider increasing the availability of real-time pricing.

4-3 In determining the real costs of fuels, the North Carolina Utilities Commission is encouraged to consider the cost of externalities in economic analysis of supply resources.

4-4 The State Energy Office should explore the development of combined heat and power (CHP) technologies.

4-5 Because the December 2002, ice storm raised public interest in use of distributed generation (i.e., in facilities used as public shelters, residential housing, etc.), the State Energy Office should study distributed generation and appropriate applications.

Alternative Fuels Policies and Programs

The following policies and programs are recommended by the Energy Policy Council regarding alternative fuels for North Carolina.

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, fueling stations for alternative-fueled vehicles, production incentives for

farmers and refiners, incentives for highly efficient or alternative-fueled vehicles, and education and awareness programs. Developmental efforts should focus on raising feedstock production levels and insuring all 100 counties in the state have alternative fueling infrastructure by 2007. In particular, the Energy Policy Council supports a state program to pay for alternative fuels development via a $1 to $2 fee applied to annual vehicle registration fees.

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.

5-1 The State Energy Office should establish a panel to lead a detailed assessment of the potential for an alternative fuels industry in NC. The assessment should focus on the realistic potential for each type of alternative fuel, the economic and environmental costs and benefits, and recommendations for developing the industry.

5-2 The State Energy Office and other relevant state agencies should develop and implement a pilot project converting hog waste to methane or other fuels for the production of electricity.

5-3 The State Energy Office, Attorney General's Office, and Department of Environment and Natural Resources should assess and propose incentives for farmers to convert animal and crop wastes into energy.

5-4 The State Energy Office, Department of Agriculture, and Department of Environment and Natural Resources should support landfill methane gas projects through direct grants and loans based on need, as well as technical assistance.

Alternative and Renewable Energy Policies

Alternative and renewable electricity issues are complex because of the required linkage with the existing utility network. However, many states have adopted highly successful measures to foster development of in-state renewable electricity resources.

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, wastederived fuels, and agricultural fuels.

Exec-8 The General Assembly should reexamine the Mountain Ridge Protection Act as it pertains to 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 solar heating and cooling, active solar space heating and cooling, 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 their electricity use.

6-1 A Solar Schools Program should be developed and incorporate renewable electricity generation, solar water heating, and daylighting to reduce fossil fuel use by schools, improve the quality of education, provide a real-world energy training lab, and make our citizens more aware of the potential for renewable resources.

6-2 The State Energy Office should work with the state's professional licensing boards to develop a certification program for renewable energy installers.

Public Sector Recommended Policies and Programs

The public sector is of key importance to the State Energy Plan for several reasons, including: (1) substantial potential exists for saving energy, (2) energy savings will help reduce the state budget shortfall and decrease the cost of government, (3) a firm commitment to improving the energy efficiency of state government will show that the state means to lead by example, and (4) reducing energy consumption will help improve the state's environmental quality. The Energy Policy Council recommends the following policies and programs for North Carolina's public sector.

Exec-11 State agencies and universities, with coordination by the North Carolina Department of Administration, should reduce energy use in existing state buildings to save 20% by 2008, a reduction of 4% per year or more for the next 5 years. The State Energy Office should submit an annual report to the Energy Policy Council 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, the State Energy Office should monitor, analyze, and report on the energy savings attributed 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 Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer life-cycle cost procedure.

Exec-13 North Carolina should facilitate the efforts of local governments to finance energy efficiency and renewable energy projects; 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.

7-1 North Carolina statutes should require that designers of all new public buildings provide estimates of projected energy consumption and energy costs for the building prior to construction.

7-2 The State Energy Office should work with the North Carolina Department of Public Instruction to review prototype school designs listed on the Department of Public Instruction's Web page and determine how best to integrate improved, more efficient designs.

7-3 The North Carolina Department of Administration should implement high performance building guidelines developed for North Carolina in all new public buildings and also develop and implement high performance guidelines for new public housing.

7-4 The North Carolina Department of Administration should develop performance contracting procedures and other ways to finance energy efficiency projects for state and local governments, university and public school systems, and public housing. The Department of Administration should provide technical support to implement performance contracting projects and provide quality assurance.

7-5 State agencies should lead by example by establishing a certain minimum level of electricity to be derived from renewable sources, such as the North Carolina GreenPower program, or via installation of state-owned renewable energy projects.

7-6 North Carolina Department of Administration should require that all state facilities with motors larger than 5 horsepower to develop a motor maintenance program.

7-7 Local governments should be encouraged to implement the above actions and other energy efficiency programs.

Residential Energy Policies and Programs

The following policies and programs for the residential sector are recommended by the Energy Policy Council for implementation in North Carolina. While these policies alone will not achieve the level of savings depicted in the high efficiency scenario shown above, they will provide a starting point for improving the efficiency of residences in the State.

- Low-Income *W*eatherization

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.

- *Energy Codes in New Construction*

8-1 The State Energy Office should conduct a study on current compliance levels of residential and commercial buildings with the North Carolina state energy code. The study should make recommendations for improvements in compliance procedures and for energy code changes that are in the best interests of the state.

8-2 The State Energy Office should create an Energy Code Enforcement Assistance Program to provide additional energy code enforcement and outreach officials to serve across the state. The state should consider whether adding a state surcharge on all local building permit fees to support the program is feasible.

- *Manufactured Homes*

8-3 The State Energy Office should investigate technologies, incentives, financing options, and regulatory issues regarding minimum efficiency requirements for manufactured housing. At a minimum, the State Energy Office should encourage new manufactured homes to comply with the critical components of the state energy code for site-built residential units and promote Energy Star manufactured homes. The program should include a comprehensive statewide training program on the benefits and details of higher efficiency units.

- *High Performance Homes*

8-4 The State Energy Office should organize a statewide effort to develop criteria for a 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, Southface Energy Institute's Earthcraft Home Program, the U.S. Department of Energy's Building America program, and others.

8-5 The State Energy Office should develop a comprehensive, statewide promotional campaign for high performance buildings.

8-6 The State Energy Office should continue its work to formulate and advance mortgage-based incentives for high performance new homes.

♦ *Training*

8-7 The State Energy Office should provide training on high performance buildings to builders, subcontractors, architects and engineers, landscape architects, code enforcement officials, utility representatives, building investors, developers, financial institutions, real estate professionals, appraisers, home inspectors, renovation contractors, educators, and prospective homeowners.

8-8 The State Energy Office should provide training for building professionals on specific targeted technologies including residential daylighting, solar water heating, heat pump water heaters, new insulation products, and advanced HVAC systems and controls.

Commercial Energy Policies and Programs

The following policies and programs for the commercial sector are recommended by the Energy Policy Council for implementation in North Carolina.

9-1 The State Energy Office should work with appropriate state agencies to provide a design review service that focuses on energy-efficient components and holistic, high-performance, design strategies for new commercial buildings. The design review procedure should include a systematic life-cycle cost analysis of a variety of energy technologies and strategies for each project. The service should seek to upgrade new buildings to meet high performance building guidelines developed statewide.

9-2 The State Energy Office should promote and develop guidelines for performance contracts, conduct workshops, and provide technical assistance on developing performance contracting documents.

9-3 The State Energy Office should research current and proposed incentive programs in North Carolina and other states and develop a state commercial energy incentive program for consideration.

9-4 The State Energy Office should promote the use of and provide training for commercial building energy analysis software to assist building owners with evaluating the best energy efficiency measures to implement in existing state buildings and other commercial structures.

9-5 The State Energy Office should develop an energy audit program for existing commercial buildings to assist building managers with implementing the most energy efficient and cost effective improvements for commercial renovation projects.

Industrial Energy Policies and Programs

The following policies and programs are recommended by the Energy Policy Council for the industrial sector.

♦ *Industrial Energy Assessment and Efficiency Programs*

10-1 The State Energy Office should increase funding for industrial efficiency programs to enable the Industrial Extension Service, Industrial Assessment Service, Advanced Energy Corporation's industrial efficiency programs, and other similar programs in the state to expand technical assistance and analysis efforts to reduce energy use by the industrial 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 industrial 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.

10-2 The State Energy Office should fund an Industrial Demonstration and Testing Program aimed at developing more efficient products and processes for North Carolina's industries. In addition, the Energy Office should convene industrial energy experts and industrial facility operators to create energy efficient solutions to targeted industrial processes that consume substantial energy in the state. Finally, the Energy Office should continue and expand its involvement in the federal Industries for the
Future program.

10-3 North Carolina should evaluate whether facilities that repair or rewind motors should be certified or otherwise meet a state efficiency requirement.

- Incentives and Financing

10-4 The State Energy Office should develop rules for and conduct training programs on Performance Contracting for energy-related projects in industrial facilities.

10-5 North Carolina should create investment tax credits and other incentives for new and/or retrofitted manufacturing equipment to encourage modernization and efficiency improvements.

10-6 North Carolina should create tax credits for meeting high performance standards, including NEMA premium motors.

10-7 The State Energy Office should create a statewide voluntary challenge for industrial energy efficiency improvements.

10-8 North Carolina should create policies and regulations for distributed generation in the state, including incentives for deployment of "clean" distributed generation.

- Industrial Energy Technology Training

10-9 The State Energy Office should sponsor workshops on industrial energy efficiency around the state directed at industrial facility operators, design and process engineers, and owners. The workshops will describe the state-of-the-art in efficient technologies and describe the results of ongoing research efforts. The training effort should also address water-conserving practices around the state.

- Economic and Industrial Development Practices

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, and fuel cells.

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

10-10 The Department of Commerce should develop an industrial recruitment strategy to target appropriate industries to fit in resource efficient industrial developments (sometimes called industrial ecosystems).

10-11 In its recruitment efforts, the North Carolina Department of Commerce should give preference to industries that contribute to a more beneficial load curve and have minimal impact on the environment.

Transportation Energy Policies and Programs

The overall goals of the State Energy Plan's transportation policies are to increase the use of efficient vehicles and alternative fuels. The state's fleets can have higher efficiency and increased use of alternative fuels. Incentives may move employees and their employers to favor use of mass transit, as well as more efficient fleet vehicles. Incentives and publicity programs that are practical and affordable can encourage consumers to select vehicles that provide higher miles per gallon. It should be a priority of the State Energy Office to work in concert with North Carolina Department of Transportation to insure that policies and programs pertaining to alternate fuel use, mass transit, and transportation planning are implemented as soon as possible. Additionally, the State Energy Office should take the lead as a catalyst for bringing together the variety of plans and policies already drafted by numerous agencies and entities in the state of North Carolina.

11-1 The State Energy Office, Department of Revenue, and North Carolina Department of Transportation should assess and propose financial incentives for public and private employees who regularly ride mass transit systems and/or for their employers.

11-2 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.

11-3 The North Carolina Department of Transportation should provide fueling capability for compressed natural gas, ethanol, biodiesel, and other alternative fuels at all state fueling stations by 2005.

11-4 North Carolina should implement light rail systems to serve transportation needs and direct development along higher population and employment corridors.

11-5 The State Energy Office should develop a statewide voluntary transportation efficiency program that rewards companies who qualify through a publicity and promotion program. The program would have the goals of increasing mass transit use and pedestrianism, increasing efficiency of commuter vehicles, increasing efficiency of company fleets, increasing use of alternative-fueled vehicles by company fleets, and allowing smaller parking facilities for those who demonstrate success.

11-6 The State Energy Office should provide technical assistance for local authorities to increase ridership on local transit systems.

11-7 The State Energy Office and the North Carolina Department of Transportation should become involved in ongoing statewide efforts to develop Smart Growth community design and redesign programs that increase pedestrianism, reduce personal vehicle miles traveled, and increase mass transit use. Smart Growth and Smart Roads programs also provide other benefits such as reduced urban and suburban congestion, lower commuting times, decreased air emissions, and increased productivity.

11-8 The State Energy Office should develop information resources on Smart Growth and energy efficiency that emphasizes the many advantages of the Smart Growth concept. The goal is to require developers, planners, and designers to consider energy use when evaluating future development projects. The information resources should also describe the concept of Smart Roads that seeks to relieve congestion by promoting the safe flow of traffic at increased average speeds.

11-9 The State Energy Office should conduct a statewide consumer campaign designed to encourage the purchase of more efficient vehicles or alternative-fueled vehicles, improve maintenance to increase vehicle efficiency, increase pedestrianism, and reduce vehicle miles traveled. The program should be coordinated with the state's automotive retailers' associations.

11-10 The North Carolina Department of Administration should work with the Department of Transportation to develop a coordinated set of strategies intended to reduce vehicle miles traveled (VMT) and increase the operating efficiency of vehicles within state government. The agencies should set specific target goals for VMT reductions.

Energy Education and Research Policies and Programs

The Energy Policy Council recommends the following programs and policies regarding energy education and research for implementation in North Carolina:

12-1 The State Energy Office should develop and sponsor training programs for community colleges and universities in fields related to energy efficiency and high performance buildings.

12-2 The State Energy Office should assist in the coordination of energy education programs with museums and help create an energy museum "on wheels" using existing resources, such as the Science House at NCSU or the Museum of Life Science, wherever possible.

12-3 The State Energy Office should sponsor regional "renewable demonstration centers" or, whenever possible, use existing ones (e.g. demonstration centers such as the North Carolina Solar House and the Energy Xchange, museums such as the Museum of Life and Science, and science centers such as Discovery Place).

12-4 The State Energy Office should create energy internships or apprenticeships for graduating college students and high school students to create the next generation of energy professionals.

12-5 The State Energy Office should provide a statewide award (e.g., a college scholarship) for the most outstanding energy-related science demonstration/experiment at the state science fair.

12-6 The State Energy Office and the UNC System should help the Education Departments of colleges and universities develop coursework for junior and senior undergraduates and graduate students in energy education.

12-7 The State Energy Office and the state's colleges and universities should help Community Colleges and other vocational schools develop coursework in energy efficiency and renewable energy to help spur the industry; such as training carpentry students in energy efficient, passive solar building design and construction. Include this training in voc-tech courses in high schools.

12-8 The State Energy Office should provide training to licensed professionals in the homebuilding industry focusing on energy efficiency and renewable energy sources to promote industry awareness and implementation of these technologies.

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.

12-10 North Carolina should encourage schools to reduce school operating budgets by installing energy efficiency and renewable energy systems.

12-11 The State Department of Public Instruction should consider reinstituting its energy budget program, which provided guidelines for energy use per square foot by type of school.

12-12 The State Energy Office should work in partnership with the State Department of Public Instruction to plan school energy related initiatives and include a representative for energy-use in school facilities on the Energy Policy Council.

12-13 North Carolina should require that K-12 students learn about energy. Energy issues should be incorporated into the end-of grade tests.

12-14 The State Energy Office should sponsor a program to install solar equipment or other sustainable energy technologies on school buildings in every school district in the state.

12-15 The North Carolina Community College System should require that the community colleges' curricula provide a building science course, an energy design course for drafting programs, and a solar/renewable energy technology class.

12-16 The State Energy Office should establish a central repository for energy information. This energy data and policy analysis center should develop baseline information on energy consumption by state and local governmental entities. The center should also provide policy analysis for existing and proposed state energy policies.

12-17 The State Energy Office should conduct a comprehensive analysis of the existing Renewable Energy Tax Credits and determine if these credits should be expanded to include efficiency measures.

12-18 The North Carolina Energy Policy Council should update the State Energy Plan every five years and conduct a review of implementation of the plan on an annual basis.

12-19 State government departments and public universities should report their energy consumption and expenditures by fuel type on an annual basis to the State Energy Office.

12-20 Every two years, the State Energy Office should complete an assessment of energy use in public buildings to determine whether efficiency programs are having a significant impact on energy consumption.

12-21 Working in conjunction with the State Construction Office, the State Energy Office should monitor, analyze, and report on the energy savings attributed 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 Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer life-cycle cost procedure.

12-22 The State Energy Office should take the lead in conducting a statewide inventory of each public facility owned or leased by county and municipal government including K-12 schools and community colleges.

Funding Energy Policies and Programs

The Energy Policy Council recommends the following policy regarding funding of energy programs in North Carolina.

Exec-15 The General Assembly should review options, such as a Public Benefits Fund or other means, to enable funding of the basic services provided by the State Energy Office and the recommendations in the State Energy Plan.

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