Chapter 1
Background and Overview

The Climate Action Planning Initiative

North Carolina leaders, including the General Assembly, have acted upon concerns that North Carolina would be prudent to examine steps that could and should be taken to address climate change and any man made components of the problem. The concerns include potential that the state's vast coastal areas and other resources may suffer damage from climate changes. In 2002 the North Carolina General Assembly passed, and the Governor signed, a major bill, commonly known as the Clean Smokestack Act (CSA), that is resulting in major reductions in sulfur dioxide (SO_2) and oxides of nitrogen (NO_x) emissions from coal-fired power plants.

The CSA also charged the North Carolina Division of Air Quality (DAQ) with studying and reporting on potential controls for carbon dioxide (CO_2) emissions from coal-fired electric power plants. This resulted in a series of reports with recommendations for reducing North Carolina's carbon emissions. One of those recommendations was to develop a climate action plan. Under the CSA's Section 13 requirements, the Division released a draft inventory and forecast of the state's GHG emissions as well as the third report (September 2005) with a list of recommendations assembled by the Division.

The Center for Climate Strategies (CCS), a non-profit organization with expertise and a history of similar efforts regarding greenhouse gas (GHG) emissions, prepared the draft inventory and forecast under contract and through donated funds. The Center also made recommendations on a process which would result in a prioritized list of GHG mitigation options. Following the publication of the September 2005 report, the North Carolina Department of Environment and Natural Resources (DENR) with management supplied by the DAQ, initiated a follow up to that report and began the first steps toward a comprehensive climate action plan by commencing a facilitated stakeholder process to consider potential mitigation options.

During this period, the state General Assembly also established the Legislative Commission on Global Climate Change (LCGCC, or "the Commission") to assess GHG concerns and, among other things, provide a recommendation to the General Assembly regarding whether the state should establish a cap on emissions, and if so, what that cap should be. The Commission held its first meeting in February 2006 and initiated a climate-related fact-finding effort regarding the science and potential recommendations. The DAQ (assisted with support from CCS) was asked to provide technical background and implementation support to the work of the LCGCC. This cooperative effort was initiated and is expected to continue through the Commission's life, currently proposed to be extended until October 2009.

DAQ recognized that it was possible, and even likely, that many potential GHG mitigation options would stimulate economic growth and new jobs in the state, in addition to reducing the effects of climate change. Thus, a stakeholder process was initiated which called on over 40 volunteer stakeholders representing a broad range of interests and expertise to be formed into a body to be called the Climate Action Plan Advisory Group (CAPAG). This diverse group of North Carolina citizens, representing business, industry, environmental and educational organizations and government, took on the responsibility of analyzing and making recommendations for priority options to reduce GHG emissions in the state. Many of the CAPAG members were also members of the LCGCC. Their work included:

- Development, prioritization, analysis and approval of a final collection of existing and proposed actions that could contribute to GHG emissions reductions.
- Review and approval of an inventory of historical and forecasted GHG emissions in North Carolina as a basis against which to gauge priorities and progress.
- Consideration of costs and emission reductions of recommended options.

This report is the outcome of that effort, one that involved a distinguished and broad group of stakeholders including other state agencies, with technical support and facilitation from the CCS.

Recent Developments

North Carolina has undertaken several efforts to conserve energy while addressing GHG emissions. The North Carolina State Energy Office has developed and is currently updating the State Energy Plan.[1] Examples of efforts undertaken by other entities include the following:

- *Major utilities in North Carolina have expanded existing demand-side management programs (DSM) for the RCI sectors.*
- *Under the authority of the North Carolina Utilities Commission, a Public Benefits Charge is collected on electricity sales, a portion of which is managed by the Advanced Energy Corporation and used to fund energy efficiency and economic development programs.*
- *NC GreenPower coordinates a voluntary program of green power purchasing for consumers in the governmental, residential, commercial and industrial sectors.*
- *The state fleet of vehicles has been required (and this requirement continues to expand) to meet several standards goals related to make the fleet Flex-fueled and to increase the purchase of hybrid and other high mileage/low emitting vehicles.*

In addition, during 2007 the North Carolina General Assembly considered several bills related to mitigation options that were also considered by the CAPAG. The following includes legislation passed by the General Assembly and signed by the Governor. Note that the CAPAG had completed analysis of its mitigation options before the final requirements of these bills were determined. As a result, the GHG reductions and costs (or cost savings) reflected in this report have not been aligned specifically with these new statutes.

- Senate Bill (SB) 3 (Promote Renewable Energy/Energy Efficiency) includes the following:
    - Requires a percentage of energy sales in North Carolina to come from new renewable sources and efficiency measures on the following schedule: 3% by 2012 (up to 0.75%

[1] See Annex A to Appendix E (Residential, Commercial and Industrial Sectors) for summaries of the North Carolina State Energy Office (SEO) and State Energy Plan (SEP) policies and programs related to RCI mitigation options. Also note that that plan is now being updated.

from efficiency); 6% by 2015 (up to 1.5% from efficiency); 10% by 2018 (up to 2.5% from efficiency); and 12.5% by 2021 (up to 5% from efficiency).
    - Requires specific amounts of electricity sales from: (1) solar (0.02% in 2010 up to 0.2% in 2018); (2) swine waste (0.07% in 2012 up to 0.2% in 2018); and (3) poultry waste (170,000 megawatt hours in 2012 up to 900,000 megawatt hrs in 2014.
    - Requires any new biomass energy facility to meet Best Available Control Technology (BACT). Other language was included to ensure that renewable energy technologies do not have secondary, undesirable consequences. Impacts on residential consumers must not exceed $10 per year 2008-2011; $12 per year 2012-2014; and $34 per year 2015 and beyond.
    - Allows for ongoing review of construction costs for new power plants and recovery of costs in a general rate case.
- SB 567 (Allow Distribution of E-Blend Fuels) - Allows E85 to be dispensed from dispensers approved for E10 provided the manufacturer has initiated the process for approval by an independent testing lab.
- SB 1272 (Definition of Biodiesel) - An individual that produces biodiesel for use in a private (non-commercial) vehicle is exempt from the motor fuels tax.
- SB 1277 (State Diesel Vehicles' Warranties/B20 Fuel) - Every new diesel vehicle purchased by the State shall be covered by an express manufacturer's warranty that allows the use of B20 fuel.
- SB 1452 (Diesel School Buses to Use Minimum B20 Fuel) - Requires that 2% of the annual diesel used by North Carolina school buses be B20 by June 2008 (2% = ~ 500,000 gallons).
- SB 668 (Energy Conservation in State Buildings) - Energy Conservation in State Buildings – Specific performance criteria and goals for sustainable, energy efficient public buildings must be established.
- SB 670 (Energy Devices That Use Renewable Resources) - Use of Solar Collectors on detached single-family residences – As long as they aren't facing public access or common areas, an ordinance, deed restriction, covenant and other similar agreements cannot prohibit or have the effect of prohibiting their installation.

The CAPAG Process

The CAPAG first met in February of 2006 and was charged with making recommendations to DAQ that would then be a resource list and as input to further state consideration and proposals for action. The CAPAG met seven times with the final decisional meeting held in July 2007. In addition a meeting to review this report's capture of the intent of the members of CAPAG was held in October 2007. This report addresses comments provided at that meeting and shortly thereafter. In all, about 75 meetings and significant conference calls of the CAPAG and their supporting technical work groups (TWGs) were held between February 2006 and July, 2007 to identify and analyze various potential mitigation actions.

The CAPAG was assisted and supported by, five TWGs representing local and outside expertise in key sectors selected for analysis: Energy Supply (ES); Residential, Commercial, Industrial

(RCI); Transportation and Land Use (TLU); Agriculture, Forestry, and Waste Management (AFW); and Cross-Cutting Issues (CC). The TWGs consisted of CAPAG members as well as individuals not on the CAPAG with interest and expertise in the issues being addressed by each TWG. CAPAG members as well as individuals not on the CAPAG with interest and expertise in the issues being addressed formed each TWG. Where members of the TWG did not fully agree upon recommendations to the CAPAG, the summary of their efforts was reported to the CAPAG for their further consideration and actions. (See Appendix B for a listing of the members of each group.)

The CAPAG process involved a model of informed self-determination through a facilitated stepwise consensus building approach. Under the oversight of DENR, the process was conducted by the CCS, an independent, expert facilitation and technical analysis team. It was based on procedures that CCS consultants have used in a number of other state climate change planning initiatives since 2000, but adapted specifically for North Carolina. The CAPAG process sought, but did not mandate consensus, and it explicitly documented the level of CAPAG support for individual mitigation options and key findings established through a voting process, outlined and agreed to in advance.

The 56 top priority (out of over 300 total) recommendations adopted by the CAPAG and presented in this report underwent two levels of screening by the CAPAG. First, a potential mitigation option being considered by a TWG was not accepted as a "priority for analysis" and developed for full analysis unless it had a supermajority of support from CAPAG members present at the decisional meetings (with a "supermajority" defined as 80% or more of the CAPAG members attending a meeting agree). Second, after the analyses were conducted, only options that received at least majority support from CAPAG members present at the decisional meetings were adopted by the CAPAG and included in this report. In total, of the 56 recommended mitigation options adopted by the CAPAG, more than 85% (48) received unanimous consent, and just over 14% (8) received a majority of support, of those present at the CAPAG decisional meetings. The TWGs recommendations to the CAPAG were documented and presented to the CAPAG at each CAPAG meeting. All meetings were open to the public, were widely advertised, and all materials for and summaries of the CAPAG and TWG meetings were posted on the project website.

Analysis of Options

With CCS providing facilitation and technical analysis, the TWGs prepared mitigation options for CAPAG consideration using a "mitigation option template" conveying key information:

- Mitigation option description
- Mitigation option design (goals, timing, parties involved)
- Implementation mechanisms
- Related policies / programs in place
- Type(s) of GHG reductions
- Estimated GHG reductions and costs (or cost savings)

- Key uncertainties
- Additional benefits and costs
- Feasibility issues
- Status of group approval
- Level of group support
- Barriers to consensus

In its deliberations, the CAPAG modified and embraced various mitigation options. The final versions for each sector, conforming to the mitigation option templates, appear in Appendices E through I and constitute the most detailed record of decision of the CAPAG. Appendix D presents a description of the methods used for quantification of mitigation options. CCS and the TWGs produced estimates of the GHG emission reductions and costs (or cost savings) of various mitigation options, both in terms of a net present value from 2007-2020 and a dollars-per-ton cost (i.e., cost-effectiveness).[2] The key methods are summarized here:

- *Estimates of GHG reductions.* Using the projection of future GHG emissions (see below) as a starting point, analysis of the impact of mitigation options produced estimates of the GHG reductions attributable to each option in the years 2010 and 2020, and cumulative over the time period 2007-2020. Many options were estimated to affect the quantity or type of fossil fuel combusted; others affected methane (CH_4) or CO_2 sequestered, etc. Among the many assumptions involved in this task was selection of the appropriate GHG accounting framework, namely, the choice between taking a "production-based" approach versus a "consumption-based" approach to various sectors of the economy.[3] The CAPAG took a "production-based" approach in all sectors except the electricity sector, in both forecasting emissions and in estimating the GHG impacts of mitigation options. This issue, along with other GHG estimation issues (e.g., analysis of overlapping or interacting mitigation option impacts), are discussed in detail in Chapter 2 (GHG Inventory and Reference Case Projections), Appendix D (Methods for Quantification), and Chapters 3 through 6 and Appendices E through H for each sector.
- *Estimates of costs or cost savings.*
    - *Discounted and Annualized Costs.* Standard approaches were taken here. The "present value" of costs was calculated by applying a real discount rate of 5%. Dollars-per-ton estimates were derived as an annualized cost per ton, dividing the "present value cost" by the cumulative GHG reduction measured in tons. As was the case with GHG reductions, the period 2007-2020 was analyzed.

[2] The analysis addressed emission reductions and associated cost or cost savings and did not attempt to estimate specific price changes or utility rate changes that might result from implementation of a mitigation option.

[3] In brief, a production-based approach estimates GHG emissions associated with goods and services produced within the state, and a consumption-based approach estimates GHG emissions associated with goods and services consumed within the state. In some sectors of the economy, these two approaches may not result in significantly different numbers, however, the power sector is notable in that it is responsible for large quantities of GHG emissions, and states often produce far more or far less electricity than they consume (with the remainder attributable to power exports or imports). North Carolina imports electric power and must account for the emissions this consumption creates, even though they are not produced in-state.

- *Cost savings.* Many options created easily monetized cost savings (e.g., fuel savings and electricity savings). In these cases, monetized cost savings were subtracted from monetized costs, resulting in net costs. These net costs could be positive or negative; negative costs indicated that the option saved money or produced "cost savings."
- *Direct vs. Indirect Effects.* Estimates costs and cost savings were based on "direct effects" (i.e., those borne by the entities implementing the option).[4] Implementing entities could be: individuals, companies, and/or government agencies, etc. In contrast, conventional cost-benefit analysis takes the "societal perspective" and tallies every conceivable impact on every entity in society (and quantifies these wherever possible).
- *North Carolina vs. National/Global perspective.* Estimates costs and cost savings were based on implementing entities in North Carolina, not on a broader societal perspective (national or global). One implication of this is that national taxes or subsidies that affect actions in North Carolina were not part of the analysis.

- *Contributing issues.* The CAPAG recommendations were guided in part by the GHG reductions and monetized costs and cost savings of various options, but members also felt that other considerations should also have weight. The CAPAG developed a checklist for TWGs to use to keep in mind important human, social, economic, environmental, and other factors that may warrant consideration when evaluating GHG emission reduction strategies. The TWGs were asked to examine these qualitative terms where deemed important, and quantify them on a case-by-case as needed depending on need and where data were readily available.

North Carolina GHG Emissions Inventory and Reference Case Projections

In support of requirements to the CSA and in cooperation with DENR, CCS prepared a draft document, entitled *Revised Draft North Carolina Greenhouse Gas Inventory and Reference Case Projections 1990–2020* (hereafter *Inventory and Projections*).[5] The projection of future emissions aimed to capture as accurately as possible the trajectory of emissions given policies and programs in place as of 2004. The draft was presented to the CAPAG at its first meeting, and then approved by unanimous consent at the CAPAG's fifth meeting following technical review and revision.[6] The *Inventory and Projections* included detailed coverage of all economic sectors and GHGs in North Carolina, including future emissions trends and assessment issues related to energy, economic, and population growth. The assessment included estimates of total statewide

[4] "Additional benefits and costs" were defined as those borne by entities other than those implementing the option. These indirect effects were quantified on a case-by-case basis depending on magnitude, importance, need and availability of data.

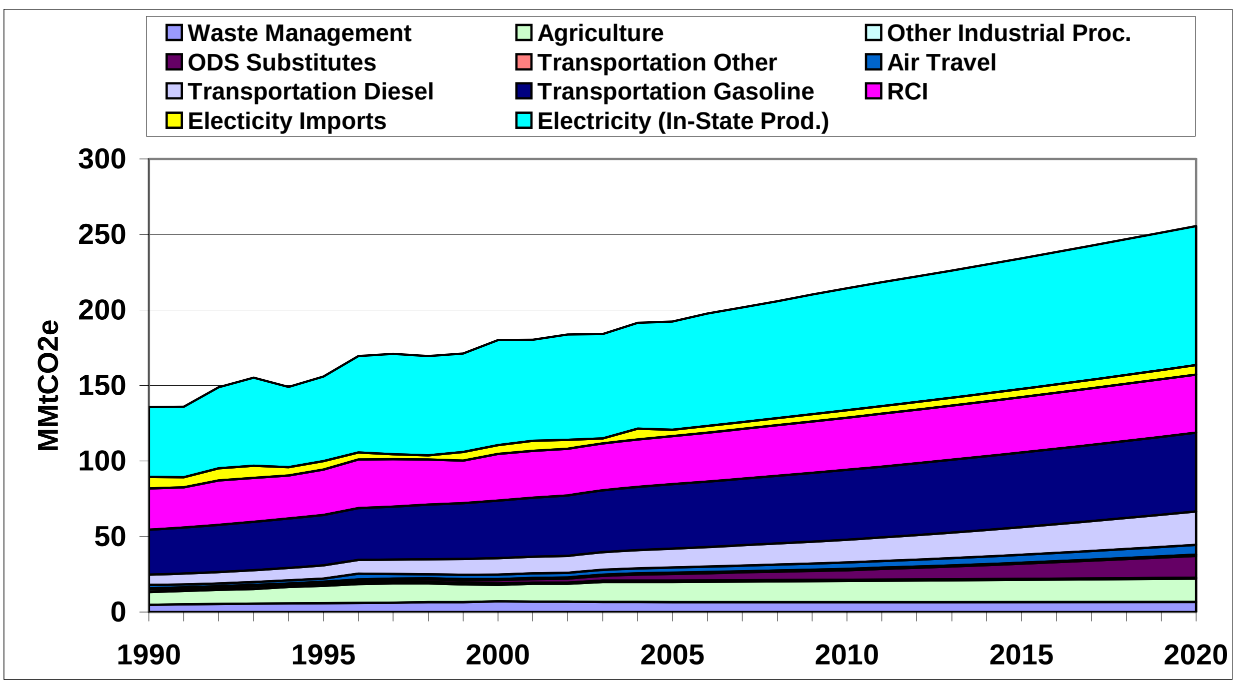
[5] *Revised Draft North Carolina Greenhouse Gas Inventory and Reference Case Projections 1990-2020*, prepared by the Center for Climate Strategies for the North Carolina DENR/DAQ, February 2006, http://www.ncclimatechange.us or http://daq.state.nc.us/monitor/eminv/gcc.

[6] *Final North Carolina Greenhouse Gas Inventory and Reference Case Projections 1990-2020*, prepared by the Center for Climate Strategies for the North Carolina DENR/DAQ, September 2007, http://www.ncclimatechange.us or http://daq.state.nc.us/monitor/eminv/gcc.

"gross emissions" (leaving aside carbon sequestration[7]) and "net emissions" (in which reductions due to sequestration are subtracted from gross emissions) on a production basis for all sources and a consumption basis for the electricity sector (see prior discussion under "Analysis of Options" in this chapter for an explanation of the production versus consumption approach). Further discussion of the issues involved in developing the inventory and reference case projections is summarized in Chapter 2 (Inventory and Projections of GHG Emissions) and discussed in detailed in the final report for the *Inventory and Projections*.

The *Inventory and Projections* revealed substantial emissions growth rates and related mitigation challenges. Figure 1-1 shows the reference projections for North Carolina's gross GHG emissions (not counting sequestration) as rising fairly steeply to 256 $MMtCO_2e$ by 2020, growing by 88% over 1990 levels. Figure 1-1 also provides the sectoral breakdown of forecasted GHG emissions. Accounting for sequestration in North Carolina's forests and soil would decrease the gross estimates from 23 to 24 $MMtCO_2e$ per year. On a net emissions basis (using the consumption-based approach), North Carolina's GHG emissions grow by about 106% over 1990 levels (about 232 $MMtCO_2e$ in 2020).

Figure 1-1. Gross GHG Emissions by Sector, 1990-2020: Historical and Projected (Consumption-based Approach) Business as Usual/Base Case



[7] Sequestration refers to the storing of carbon in mines, brine strata, oceans, plants and soil. As trees and other plants grow they remove CO_2, the principal GHG, from the atmosphere transforming the carbon (C) through photosynthesis into cellulose, starch and sugars, thus sequestering it in their structures and roots. The oxygen (O_2) is released back into the atmosphere. North Carolina's forests and agricultural lands are capable of sequestering much CO_2, as described in Chapter 6 (Agriculture, Forestry and Waste Management).

The inventory and projection of North Carolina's GHG emissions provided several critical findings, including:

- As is common in many states, the electricity and transportation sectors are the two sectors with the largest emissions, and are expected to continue to grow faster than other sectors.
- Consumption of electricity is growing faster in North Carolina than population. In addition, there appears to be a trend toward an increasing reliance on natural gas and imported electricity. Vehicle-miles traveled (VMT) are also projected to grow faster than the state's population. Freight traffic (resulting in increased diesel consumption) and increasing use of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) as substitutes for ozone-depleting substances (ODS) in refrigeration, air conditioning, and other applications is also increasing more rapidly than population.

While North Carolina's emissions estimated growth rate (88% from 1990 to 2020 on a gross emissions, consumption basis) presents challenges, it also provides major opportunities. Key choices on technologies and infrastructure can have a significant impact on the emissions of a fast-growing state. The CAPAG's recommendations document the opportunities for the state to reduce its GHG emissions while continuing its strong economic growth by being more energy efficient, using more renewable energy sources, and increasing the use of cleaner transportation modes, technologies, and fuels. The inventory and reference case projections are discussed in more detail in Chapter 2 of this report and the entire study appears in the final report for the *Inventory and Projections*.[8]

Overview of CAPAG Mitigation Option Recommendations

The CAPAG offers 56[9] recommended options to DENR for mitigating North Carolina's GHG emissions. Among the CAPAG members that attended each decisional meeting, the level of support for these options is very high; 86% (48 options) received unanimous consent, and 14% (8 options) received a super majority. Figure 1-2 below presents:

- Projected growth in North Carolina's gross GHG emissions on a consumption basis (blue line). The consumption based approach accounts for emissions associated with the generation of electricity in-state and imported from out-of-state to meet North Carolina's demand for electricity.
- Projected emissions <u>if each and every one</u> of the CAPAG's recommendations is completely, strictly and properly implemented and the estimated reductions are fully achieved (green line).

[8] Detailed documentation of the inventory and reference case projections is provided in Final North Carolina Greenhouse Gas Inventory and Reference Case Projections, 1990-2020, prepared by the Center for Climate Strategies for the North Carolina DENR/DAQ, September 2007, http://www.ncclimatechange.us or http://daq.state.nc.us/monitor/eminv/gcc.

[9] This number is based on the total number of options approved by the CAPAG (see Table 1-3). Some options were renumbered (i.e., AFW-7 to AFW-4b; TLU 2 to TLU-1b) or combined (e.g., AFW 9&10), and others were divided into sections a, b, c to yield a total of 56 options supported by CAPAG.

As the figure illustrates, full adoption by the state and complete, strict and proper implementation of each and every one of the CAPAG's recommendations are projected to reduce gross GHG emissions (consumption basis) by approximately 47%, from 256 million metric tons of carbon dioxide equivalent (MMtCO_2e) in the reference case forecast to 137 MMtCO_2e by 2020. Implementation of CAPAG's recommendations would thus be estimated to reduce North Carolina's gross GHG emissions to within 1% of 1990 levels by 2020. Table 1-1 provides the numeric estimates underlying Figure 1-2. Table 1-3 shows the estimated GHG reductions; costs or savings from each option; and, its cost effectiveness (cost or savings per ton of reduction). Detailed descriptions and analysis of these options are presented in Chapters 3 through 7 of this report, and in the Appendixes.

Figure 1-2. Annual GHG Emissions: Reference Case Projections and CAPAG Recommendations (Consumption-Basis, Gross Emissions)

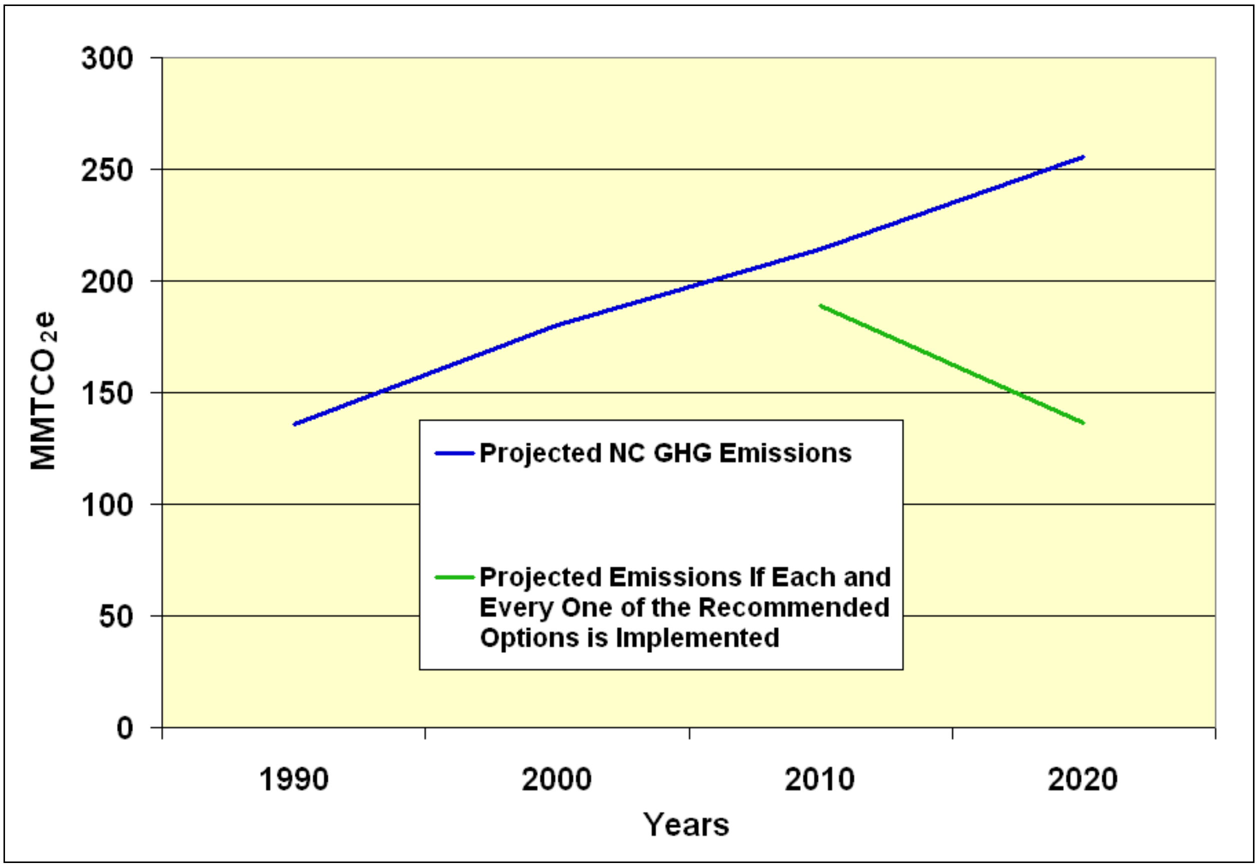


Table 1-1. Annual Emissions: Reference Case Projections, and Impact of CAPAG Recommendations (Consumption-Basis, Gross Emissions)

Annual Emissions (MMTCO_2e)	1990	2000	2010	2020
Reference Case Projections	135.6	180.1	214.5	255.6
GHG Reductions From CAPAG Recommendations			25.5	119.0
Annual Emissions With CAPAG Recommendations			189.0	136.6

The CAPAG's recommendations tabulated in the Executive Summary, along with a listing of the estimated reductions for each. Chapters 3 through 7 and the Appendices provide detailed descriptions and analysis of GHG reductions, costs, additional impacts, feasibility, etc. for individual options developed by the five TWGs/sectors:

- Residential, Commercial, Industrial (RCI)
- Energy Supply (ES)
- Transportation and Land Use (TLU)
- Agriculture and Forestry (AF)
- Cross-Cutting Issues (CC)

Table 1-2. Summary by Sector of Estimated Impacts of Implementing All of the CAPAG Recommendations

Sector	GHG Reductions ($MMtCO_2e$)			Net Direct Cost (Million $)	Cost-Effectiveness ($/tCO_2e$)
	2010	2020	Total 2007-2020	2007–2020 (NPV)	
Residential, Commercial and Industrial (RCI, non-electricity options only)	0.1	1.5	7.9	–987	N/A
Energy Supply (ES, including RCI options with impacts on electricity consumption, and adjusted for RCI and ES electricity options that overlap)	6.5	62.7	375	–5.9	–0.016
Transportation and Land Use	11.1	25.5	232	–4,350	–19
Agriculture, Forestry and Waste Management	7.8	29.3	213	270	1.27
Cross-Cutting Issues	*Non-quantified, enabling options*				
TOTAL (includes all adjustments for overlaps and recent actions)*	**25.5**	**119**	**828**	**–5,073**	**N/A**

*Notes: NPV=Net Present Value. Negative values in the Net Direct Cost and the Cost-Effectiveness columns represent, as discussed above, net *cost savings* associated with the options. Within each sector, values have been adjusted to eliminate double counting for options or elements of options that overlap. In addition, values associated with options or elements of options within a sector that overlap with options or elements of options in another sector have been adjusted to eliminate double counting.

N/A = Not available; for RCI non-electricity options, an overall cost-effectiveness value is not provided because dividing the net non-electric cost savings (mostly due to natural gas energy efficiency) by the net non-electric emission reductions (which factors in both additional fuel for combined heat and power (CHP) and gas savings from energy efficiency) yields results that can be misleading.

For the ES sector, emission reductions and costs associated with ES-2b, ES-4a, and ES 6a (see Table 1-3) were used to estimate the cumulative impacts shown in Table 1-2. Note that the row in Table 1-2 for the RCI sectors includes only that portion of RCI emissions reductions and net costs (in this case, cost savings) that are from RCI options (or elements of options) that affect fuels that are combusted for purposes other than to generate electricity. RCI emissions reductions and net costs that affect electricity use or generation are included in the ES row in Table 1-2, because the emissions reductions and costs of electricity-sector options are dependent on the electrical load served, which is affected by RCI electricity savings. As a result, the net cost savings reported in the ES row in Table 1-2, -$5.9 million, is actually the sum of a large estimated net savings from RCI options and a large estimated net cost from ES options.

Table 1-3. Summary of CAPAG's 56 Mitigation Option Recommendations by Sector

	Mitigation Option Name	GHG Reductions ($MMtCO_2e$)			Net Direct Cost (Million $)	Cost-Effective-ness ($\$/tCO_2e$)	Level of Support
		2010	2020	Total 2007–2020	2007–2020 (NPV)		
	Residential, Commercial, and Industrial (RCI)						
RCI–1	Demand Side Management Programs for the RCI Sectors - Recommended Case: "Top-Ten States" EE Investment	1.9	11.6	77.1	–1,895	–25	UC
RCI–2	Expand Energy Efficiency Funds	1.5	8.0	54.8	–1,346	–25	UC
RCI–3	Energy Efficiency Requirements for Government Buildings	0.0	1.1	6.4	–88	–14	UC
RCI–4	Market Transformation and Technology Development Programs	0.0	2.0	10.5	–339	–32	UC
RCI–5	Improved Appliance and Equipment Efficiency Standards	0.0	1.0	5.3	–336	–63	UC
RCI–6	Building Energy Codes	0.5	3.5	23.1	–400	–17	UC
RCI–7	"Beyond Code" Building Design Incentives and Targets, Incorporating Local Building Materials and Advanced Construction	0.7	5.2	34.2	–494	–14	UC
RCI–8	Education (Consumer, Primary/Secondary, Post-Secondary/ Specialist, College and University Programs)	Not quantified					UC
RCI–9	Green Power Purchasing (required for state facilities) and Bulk Purchasing Programs for Energy Efficiency or Other Equipment	0.1	0.5	3.5	11	3	UC
RCI–10	Distributed Renewable and Clean Fossil Fuel Power Generation	1.2	4.6	33.5	392	12	UC
RCI–11	Residential, Commercial, and Industrial Energy and Emissions Technical Assistance and Recommended Measure Implementation	0.5	2.1	14.9	–494	–33	UC
	Sector Total After Adjusting for Overlaps	**5.3**	**33.0**	**218.7**	**–3,994**	**–18**	
	Reductions From Recent Actions**	**0.5**	**1.2**	**10.1**			
RCI–1	Demand Side Management Programs for the Residential, Commercial and Industrial Sectors	0.3	0.7	6.2			
RCI–2	Expand Energy Efficiency Funds	0.2	0.4	3.6			
RCI–6	Building Energy Codes	0.0	0.0	0.0			
RCI–9	Green Power Purchasing (required for state facilities) and Bulk Purchasing Programs for Energy Efficiency or Other Equipment	0.0	0.0	0.3			
	Sector Total Plus Recent Actions	**5.8**	**34.2**	**228.8**			

	Mitigation Option Name	GHG Reductions ($MMtCO_2e$)			Net Direct Cost (Million $)	Cost-Effective-ness ($/t$CO_2e$)	Level of Support
		2010	2020	Total 2007–2020	2007–2020 (NPV)		
	Energy Supply (ES)						
ES-1	Renewable Energy Incentives	0.01	0.04	0.33	15	45.1	UC
ES-2	Environmental Portfolio Standard						
ES-2a	Original Analysis	6.94	44.3	288.7	1,634	5.7	UC
ES-2b	20% Combined Target	5.90	23.4	166.2	409.80	2.5	UC
ES-2c	Load Growth Offset Target	5.53	22.3	160.3	393.95	2.5	UC
ES-3	Removing Barriers to CHP and Clean DG	0.69	2.8	20.1	127.98	6.4	UC
ES-4	CO_2 Tax and/or Cap-and-Trade						
ES-4a	Electric Sector Only	0.84	3.3	20.4	119	5.8	SMJ
ES-4b	Economy-wide	1.84	7.1	47.7	284	6.0	SMJ
ES-5	Legislative Changes to Address Environmental and Other factors	Not quantified					UC
ES-6	Incentives for Advanced Coal						
ES-6a	Replacement of New 800 MW Pulverized Coal Plant	0.00	3.9	31.0	949	30.6	UC
ES-6b	Replacement of Existing 800 MW Pulverized Coal Plant	0.00	5.4	42.9	2,061	48.1	UC
ES-7	Public Benefit Charge	0.8	3.4	24.4	329	13.5	SMJ
ES-8	Waste to Energy	0.0	0.0	0.02	–0.7	–36.8	UC
ES-9	Incentives for CHP and Clean DG	Combined with ES-3					UC
ES-10	NC GreenPower Renewable Resources Program	0.01	0.2	0.95	35	37.0	UC
	Sector Total After Adjusting for Overlaps*	**6.5**	**62.7**	**375**	**–5.9**	**–0.016**	
	Reductions From Recent Actions (None)	**0**	**0**	**0**	**0**	**0**	
	Sector Total Plus Recent Actions*	**6.5**	**62.7**	**375**	**–5.9**	**–0.016**	

	Mitigation Option Name	GHG Reductions ($MMtCO_2e$)			Net Direct Cost (Million $)	Cost-Effective-ness ($\$/tCO_2e$)	Level of Support
		2010	2020	Total 2007–2020	2007–2020 (NPV)		
	Transportation and Land Use (TLU)						
TLU-1a	Land Development Planning	2.6	8.0	58.2	Net savings		SMJ
TLU-1b	Multi-Modal Transportation and Promotion (formerly TLU-2)	3.7	5.8	52.4	–1,300	–25	UC
TLU-3a	Surcharges to Raise Revenue	1.2	2.2	15.7	–1,800	–117	SMJ
TLU-3b	Rebates/ Feebates to Change Fleet Mix	0	< 0.5	2.8	Not quantified	–40 to +10	SMJ
TLU-4	Truckstop Electrification	Included in TLU–8			Net savings		UC
TLU-5	Tailpipe GHG Standards	0	8.1	44.5	–1,150	–38	SMJ
TLU-6	Biofuels Bundle	1.9	4.5	35.4	Not quantified		UC
TLU-7	Procure Efficient Fleets	Included in TLU–6					UC
TLU-8	Idle Reduction/Elimination Policies	0.1	0.2	2.2	–6	–4	UC
TLU-9	Diesel Retrofits	0.3	2.2	13.5	Not quantified		UC
TLU-11	Pay-As-You Drive Insurance	2.3	5.3	42.0	Expected net savings		SMJ
TLU-12	Advanced Technology Incentives	Not quantified					UC
TLU-13	Buses – Clean Fuels	Included in TLU–6					UC
	Sector Total After Adjusting For Overlaps	**11.1**	**25.5**	**232.3**	**–4,350**	**–19**	
	Reductions From Recent Actions (None)	**0**	**0**	**0**	**0**	**0**	
	Sector Total Plus Recent Actions	**11.1**	**25.5**	**232.3**	**–4,350**	**–19**	

	Mitigation Option Name	GHG Reductions ($MMtCO_2e$)			Net Direct Cost (Million $)	Cost-Effective-ness ($/t$CO_2e$)	Level of Support
		2010	2020	Total 2007–2020	2007–2020 (NPV)		
	Agriculture, Forestry, and Waste (AFW)						
AFW-1	Manure Digesters & Energy Utilization	0.2	0.9	6.4	199	32	UC
AFW-2	Biodiesel Production (incentives for feedstocks and production plants)	0.2	0.8	5.1	286	56	UC
AFW-3	Soil Carbon Management (including organic prod. methods incentives)	0.2	0.2	3.0	–16	–5	UC
AFW-4a	Preservation of Working Land–Agricultural Land	0.2	0.3	2.6	290	114	UC
AFW-4b	Preservation of Working Land–Forest Land (formerly AFW-7)	1.7	4.3	36	112	3	UC
AFW-5	Agricultural Biomass Feedstocks for Electricity or Steam Production	0.009	0.02	0.2	10	54	UC
AFW-6	Policies to Promote Ethanol Production	0.9	6.9	38	200	5	UC
AFW-8	Afforestation and/or Restoration of Nonforested Lands	0.2	2.4	15	128	9	UC
AFW-9&10	Expanded Use of Forest Biomass and Better Forest Management	1.5	5.9	48	–639	–13	UC
AFW-11	Landfill Methane and Biogas Energy Programs	1.1	2.9	20	23	1	UC
AFW-12	Increased Recycling Infrastructure and Collection	0.2	0.5	4.1	52	13	UC
AFW-13	Urban Forestry Measures	1.4	4.3	34	–376	–11	UC
	Sector Total After Adjusting For Overlaps	**7.9**	**29**	**213**	**270**	**1**	
	REDUCTIONS FROM RECENT ACTIONS (None)	**0**	**0**	**0**	**0**	**0**	
	Sector Total Plus Recent Actions	**7.9**	**29**	**213**	**270**	**1**	

	Mitigation Option Name	GHG Reductions ($MMtCO_2e$)			Net Direct Cost (Million $)	Cost-Effective-ness ($/t$CO_2e$)	Level of Support
		2010	2020	Total 2007–2020	2007–2020 (NPV)		
	Cross-Cutting Issues (CC)						
CC-1	GHG Inventories and Forecasts	*Not quantified*					UC
CC-2	GHG Reporting	*Not quantified*					UC
CC-3	GHG Registry	*Not quantified*					UC
CC-4	Public Education and Outreach	*Not quantified*					UC
CC-5	Adaptation	*Not quantified*					UC
CC-6	Options for Goals or Targets (for CAPAG in support of LCGCC)	*Not quantified*					UC

For “Level of Support” column: UC = unanimous consent (all CAPAG members attending meeting agree), SMJ = supermajority (80% or more of the CAPAG members attending meeting agree).

NPV=Net Present Value. Negative values in the Net Direct Cost and the Cost-Effectiveness columns represent, as discussed above, net *cost savings* associated with the options.

Some options were renumbered (i.e., AFW-7 to AFW-4b; TLU-2 to TLU-1b) or combined (e.g., AFW-9&-10), and others were divided into sections a, b, c to yield a total of 56 options supported by CAPAG.

* For ES-2, ES-4, and ES-6, emission reductions and costs associated with ES-2b, ES-4a, and ES-6a were used to estimate the cumulative impacts shown in Tables 1-2 and 1-3.

** “Recent actions” represent initiatives undertaken in North Carolina that reduce GHG emissions that were implemented shortly before or during the CAPAG process. The emission reductions associated with recent actions are not accounted for in the GHG emissions inventory and reference case projections. Emissions reductions associated with these recent actions were therefore estimated separately, and are counted toward overall statewide reductions along with reductions from the mitigation options recommended by the CAPAG.

Perspectives on Mitigation Option Recommendations

There can be a large imprecision in the GHG reductions associated with various options. Figure 1-3 presents the estimated tons of reductions for each mitigation option recommendation for which estimates were available, expressed as a cumulative figure for the period 2007–2020.

In addition to the imprecision in GHG reductions achieved by each option, there are also uncertainties in the exact cost (or cost savings) per ton of reduction achieved. Figure 1-4 presents the estimated dollars per ton cost (or cost savings, depicted as a negative number) for each recommended mitigation option, for which cost estimates were available. This measure is calculated by dividing the net present value of the cost of the option by the cumulative GHG reductions, all for the period 2007–2020.

In some cases, there is a wide variation in the cost effectiveness of mitigation options depending on the assumptions used in the analysis. As an example, option TLU-5 (Tailpipe GHG Standards) recommends that North Carolina adopt California GHG emissions standards for light-duty vehicles to reduce GHG emissions (also known as the Pavley standards). California standards require GHG emissions reductions of about 30% from new vehicles, phased in from 2009 to 2016, through a variety of means. The California Air Resources Board (CARB) estimated that the cost of compliance in a new vehicle in model year 2016 would be approximately $1,000. To determine the net impact on consumers, CARB calculated the increase in monthly loan payments versus the savings from reduced fuel consumption. Their net resulting estimate is that consumers would achieve a net savings, starting at the time of purchase, of approximately $3.50 to $7.00 / month.

In contrast, automobile manufacturers estimate that the California standards would cost around $3,000 per vehicle, and calculated that savings on fuel would offset less than half of that cost for consumers. A review of the literature and assumptions used to derive the different estimates gives a range of cost-effectiveness values of –$38 to –$117 per ton of CO_2e reduced. That is, for each ton reduced, between $38 and $117 would be saved. More than ten other states have adopted the California standards and, among other factors that support the use of a savings estimate toward the higher end of the range, manufacturers should realize economies-of-scale that would lower manufacturing costs as additional states adopt and implement the standards. Although we believe that savings are likely to be higher than the –$38 per ton end of the range, we use a cost-effectiveness of –\$38 per ton of CO_2e reduced in our calculations in an effort to be conservative.

Note that this option cannot be implemented until any pending law suits are settled and the US Environmental Protection Agency issues a waiver under the Clean Air Act authorizing California to implement the standards. This may take some months.

Figure 1-3. CAPAG Mitigation Option Recommendations Ranked by Cumulative GHG Reductions, 2007–2020

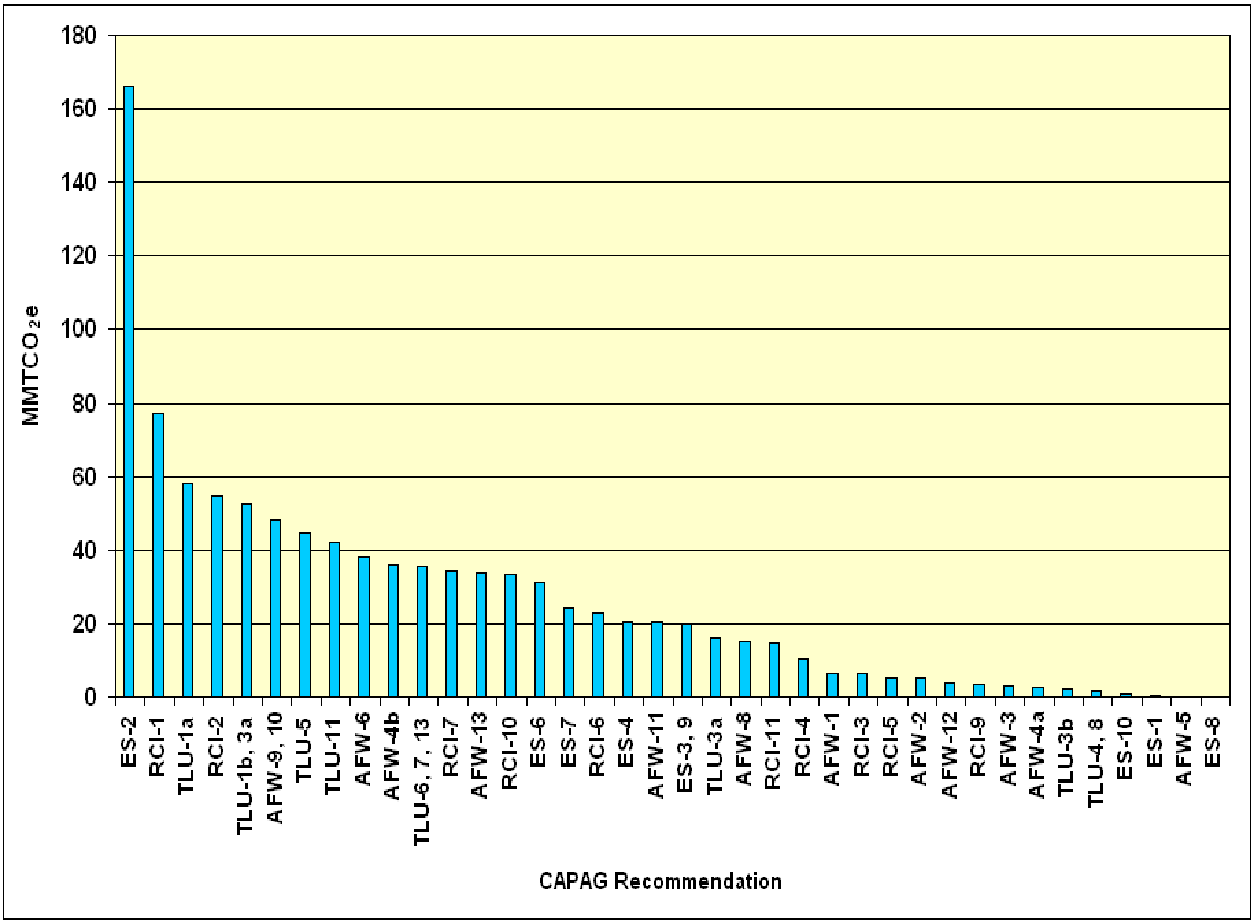
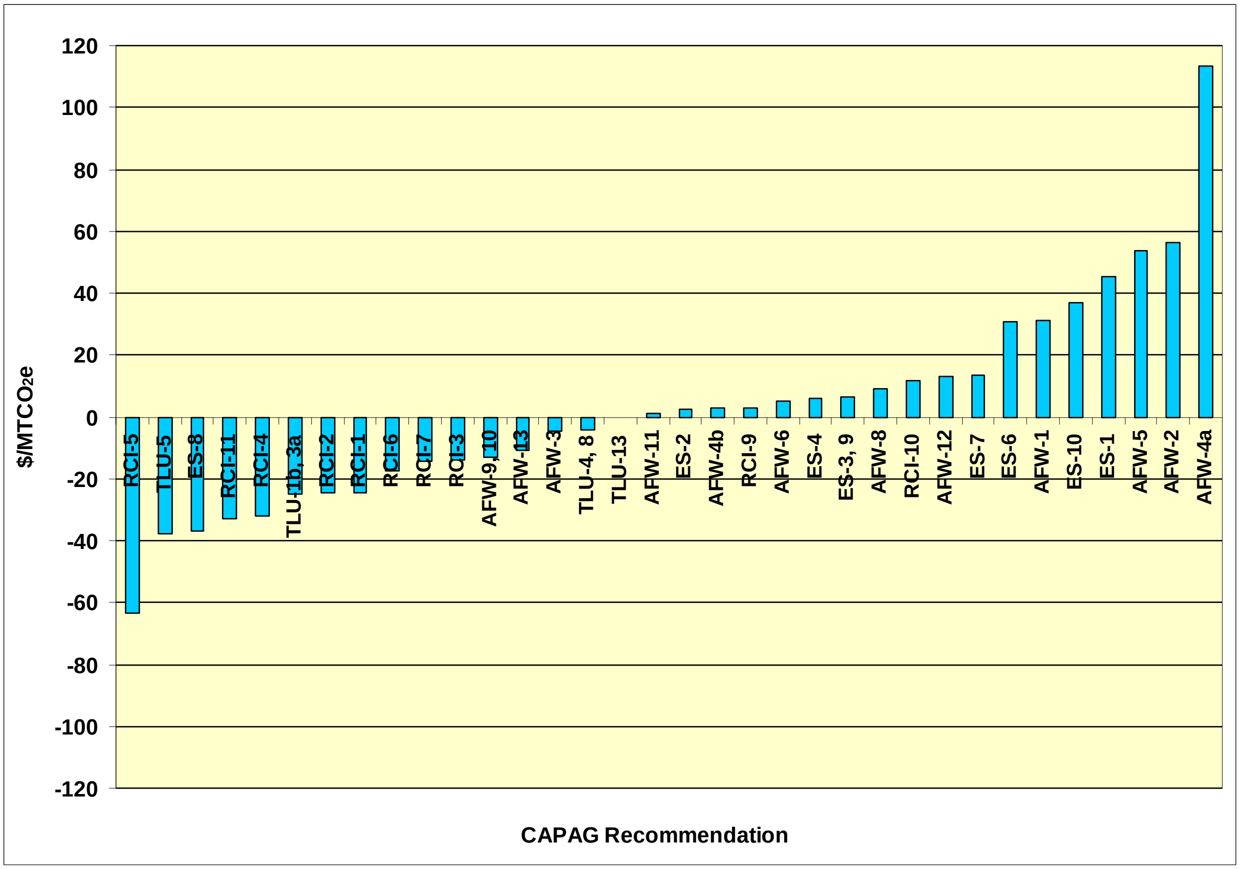


Figure 1-4. CAPAG Mitigation Option Recommendations Ranked by Dollars per Ton



Note: Negative values represent net cost savings and positive values represent net costs associated with the mitigation options.

Secondary Economic Impact Analysis of Mitigation Options

In July 2007, CCS engaged the Appalachian State University (ASU) Energy Center to conduct further analysis of the potential economic and jobs impact of the CAPAG's recommended mitigation options. Resource limitations prevented analysis of all options so, in consultation with DAQ/ DENR, the ASU Energy Center prioritized thirty options for analysis. Together these options account for more than 90% of the GHG emissions reductions associated with the recommended mitigation options. The thirty options were bundled into twenty-three scenarios with similar options grouped together for analysis. This analysis was not part of the materials that were available and discussed or reviewed by the CAPAG directly but is believed consistent with their work and recommendations. The details of this study are included separately as a stand-alone report.[10]

For the study, the ASU Energy Center utilized the NC Energy Scenario Economic Impact Model (NC ESEIM). Originally developed in 2005 for the North Carolina Energy Policy Council, the

[10] A complete copy of the ASU Energy Center report entitled "Secondary Economic Impact Analysis of GHG Mitigation Options for North Carolina" is available at http://www.ncclimatechange.us or http://daq.state.nc.us/monitor/eminv/gcc.

peer-reviewed model assesses the impacts of various energy policies on the North Carolina economy, measured in terms of employment, employee and proprietor compensation (income), and the incomes earned by labor and capital (gross state product).

At the core of the NC ESEIM is an input-output economic impact model that estimates how a given change in public policy might result in positive or negative impacts to the economy. Input-output analysis conceives of the economy as a set of interrelated sectors where the consumption of finished goods and services, or final demand, catalyzes a chain reaction of production. As final demand for goods and services change, the upstream sectors in the economy respond accordingly, creating a ripple or multiplier effect. The economic multipliers in the NC ESEIM are derived from data published by the Minnesota IMPLAN Group.[11]

This approach is distinguishable from the approach undertaken by the CAPAG. The CAPAG sought to quantify the direct costs and cost savings borne by those entities implementing an option to mitigate GHG emissions. The quantified costs were subtracted from the quantified cost savings to produce a "net direct cost." Building on the work of the CAPAG, the ASU Energy Center sought to measure the full multiplier effect of both positive and negative changes in final demand resulting from a given option. Moreover, the secondary analysis considers the relative effect of an option on all of the affected sectors of the state's economy.[12] Therefore, the ASU Energy Center report should be considered a complement to the CAPAG report that seeks to identify the likely ancillary effects of implementing a given option.

While more sophisticated econometric models exist, input-output analysis is typically a reasonable approximation of the economic impacts associated with the type of modest policy changes considered by the CAPAG. Moreover, numerous national, regional, and state-level studies, including reports for Florida, Maryland, and Texas, utilize a similar approach in estimating the potential economic impacts of changes in energy policy.[13]

The NC ESEIM, as well as its application in the Secondary Economic Impact Analysis, has undergone extensive peer-review. An initial review of the model was performed by Adam Rose, Ph.D., Economist and Research Professor at the University of Southern California (Rose and Wei 2005). Dr. Rose also coordinated an anonymous peer review of the Secondary Economic Impact Analysis during the summer of 2008. Based on these comments the Energy Center has made a number of refinements to the underlying methodology so as to fully and properly account for the potential implications of the options analyzed.[14]

[11] Minnesota IMPLAN Group, Inc. (2005). North Carolina State Data Package, 2004.Stillwater, MN, Minnesota IMPLAN Group, Inc. The Minnesota IMPLAN Group (www.implan.com) is the developer of IMPLAN Professional, a computer software application for conducting input-output economic analysis in use by more than 1,000 public and private institutions.

[12] For a more detailed overview of the analytical approach used by the NC ESEIM please refer to Chapter 1 of the ASU Energy Center Report.

[13] See Laitner, J.A. 2008. "Positive Returns: State Energy Efficiency Analyses Can Inform U.S. Energy Policy Assessments." American Council for and Energy Efficient Economy, at http://www.aceee.org/.

[14] For a complete discussion of the methodological refinements made as a result the peer review process please refer to Appendix C of the ASU Energy Center Report.

On the whole, implementation of the modeled mitigation option bundles would result in a mildly positive economic impact on North Carolina's economy. By 2020, the mitigation options analyzed would result in the creation of more than 15,000 jobs, $565 million in employee and proprietor income, and $302 million in gross state product. For the study period, 2007–2020, the mitigation options analyzed would generate more than $2.2 billion net present value (NPV) in net additional employee and proprietor income and more than $1.2 million (NPV) in net gross state product (see Table 1-4).[15] The base year for the NC ESEIM is 2004; therefore all results are reported in 2004 dollars.

Table 1-4. Economic Impact Analysis Summary Results for All Options Analyzed in Key Years

	Net Annual Employment (FTE)			Net Income ($2004, million)				Total Value Added ($2004, million)			
	2010	**2015**	**2020**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**
Energy Supply Options	–409	–384	1,744	–41	–53	26	–297	–99	–152	–118	–1,046
Residential, Commercial, and Industrial Options	3,518	6,961	9,110	136	271	364	1,942	114	125	42	937
Agriculture, Forestry, and Waste Management Options	1,202	1,960	3,318	39	75	183	649	78	145	331	1,267
Transportation and Land Use Options	783	432	871	–1	–19	–8	–91	24	7	48	128
All Options Analyzed	**5,094**	**8,970**	**15,042**	**134**	**274**	**565**	**2,203**	**116**	**126**	**302**	**1,287**

Note: Negative values identify loss of jobs, income, or value added. FTE = full-time equivalent; NPV = net present value.

Table 1-5 presents summary results for the ES mitigation options analyzed. By 2020, these options would result in the creation of more than 1,700 jobs, $26 million in employee and proprietor income, but a decrease in $118 million in gross state product. Over the study period, 2007–2020, the options would decrease employee and proprietor income by $297 million (NPV) and net gross state product by $1.046 billion (NPV).The base year for the NCESEIM is 2004; therefore all results are reported in 2004 dollars.

The negative effects of the option are driven primarily by the technology and fuel price assumptions of the CAPAG, which result in a "negative payback" where commercial and industrial end-users spend more to install and operate CHP systems than a business as usual case. As a result, firms in these sectors reduce their final demand for endogenous goods and services, the effect of which is amplified throughout the economy, causing the negative effects. Moreover,

[15] Net present value (NPV) is calculated assuming a discount rate of 5%.

in order to remain consistent with the final integration of all option preformed by the CAPAG, the efficiency components of ES-2 are assumed to obtained by the demand side options of the RCI sectors.

Table 1-5. Summary Results for Energy Supply (ES) Options Analyzed

	Net Annual Employment (FTE)			Net Income ($2004, million)				Total Value Added ($2004, million)			
Energy Supply Options	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**
ES-1 & -2 and AFW-5 (PTC, REPS, Biomass)	–11	330	2,148	–0	10	90	116	–0	5	77	54
ES-3 & -9 (CHP)	–541	–271	34	–48	–48	–48	–361	–112	–146	–183	–1,094
ES-6a (IGCC)	98	–100	–96	4	–4	–4	–6	6	–5	–6	–6
ES-6b (IGCC)	45	–341	–333	3	–11	–12	–78	6	–5	–7	–3
ES-8 (Municipal Biogas)	0	–2	–10	0	–0.1	–0.5	–0.9	–0	–0.2	–0.7	–1.5
All ES Options	–409	–384	1,744	–41	–53	26	–297	–99	–152	–118	–1,046

Note: Negative values identify loss of jobs, income, or value added. FTE = full-time equivalent; NPV = net present value.

Table 1-6 presents summary results for the RCI mitigation options analyzed. By 2020, these options would result in the net creation of more than 9,100 jobs, $364 million in additional employee and proprietor income, and $42 million in net gross state product. Over the study period, 2007–2020, the options would generate $1.9 billion (NPV) in additional employee and proprietor income and $937 million (NPV) in gross state product. The economic impacts associated with these options are driven primarily by energy bill savings resulting from energy efficiency measures.

Table 1-6. Summary Results for Residential, Commercial & Industrial (RCI) Options Analyzed

	Net Annual Employment (FTE)			Net Income ($2004, million)				Total Value Added ($2004, million)			
Residential, Commercial & Industrial Options	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**	**2007 –2020 (NPV)**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**
RCI-1, -2 & -11 (Efficiency Funding & Energy Audits)	1,309	3,121	4,575	45	105	160	789	18	–4	–55	36
RCI-4 & -5 (Market Transformation & Appliance Standards)	-	430	771	-	15	26	87	-	1	–11	–9
RCI-6 (Energy Codes)	1,964	2,076	2,163	83	86	90	623	96	77	57	571
RCI-7 & -3 (High Performance Building)	126	1,239	1,372	3	61	76	388	–5	46	32	273
RCI-9 (Bulk Purchasing)	105	99	12	4	4	–1	33	5	3	–5	28
RCI-10 (Residential Solar Hot Water Only)	13	–4	218	1	0	13	21	0	1	24	37
All RCI Options	3,518	6,961	9,110	136	271	364	1,942	114	125	42	937

Note: Negative values identify loss of jobs, income, or value added. FTE = full-time equivalent; NPV = net present value.

Table 1-7 presents summary results for the AFW options analyzed. By 2020, these options would result in the net creation of more than 3,300 jobs, $183 million in additional employee and proprietor income, and $331 million in gross state product. Over the study period, 2007–2020, the options would generate nearly $649 million (NPV) in additional employee and proprietor income and $1.2 billion (NPV) in gross state product. The positive economic impacts associated with these options are driven primarily by capital investments to build manufacturing capacity to meet the biofuels production goals articulated in the mitigation options.

Table 1-7. Summary Results for Agriculture, Forestry, and Waste Management (AFW) Options

	Net Annual Employment (FTE)			Net Income ($2004, million)				Total Value Added ($2004, million)			
Agriculture, Forestry, and Waste Management Options	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**
AFW-1 (Manure Digesters)	51	48	53	2	2	2	19	3	2	2	24
AFW-2 (Biodiesel)	51	48	53	–6	–12	10	–72	–7	–15	17	–85
AFW-4a & -4b (Easements)	2	–4	3	–.2	–1	–1	–4	1	2	4	18
AFW-6 (Cellulosic Ethanol)	547	1,399	2,781	23	74	163	547	43	135	298	1,016
AFW-8 (Afforestation)	–13	–45	66	–1	–2	4	–9	–1	–3	8	–8
AFW-9 & -10 (Forest Management)	–9	–33	–48	–2	–6	–9	–41	–.1	–.3	–.4	–2
AFW-11 (Landfill Gas)	–6	–24	–5	–.1	–1	0.4	–2	1	–.3	2	4
AFW-12 (Recycling)	1	2	6	.1	.1	.3	2	.3	.3	1	3
AFW-13 (Urban Forestry)	566	524	475	22	19	17	106	37	22	8	115
All AFW Options	1,202	1,960	3,318	39	75	183	649	78	145	331	1,267

Note: Negative values identify loss of jobs, income, or value added. FTE = full-time equivalent; NPV = net present value.

Table 1-8 presents summary results for the TLU mitigation options analyzed. By 2020, these options would result in the creation of more than 870 net jobs and $48 million in net gross state product but the loss of $8 million in employee and proprietor income. Over the study period, 2007–2020, the options would generate $128 million (NPV) in gross state product but the loss of $91 million (NPV) in employee and proprietor income. The bulk of the positive economic impacts associated with these options are driven by consumer re-spending of reduced vehicle operating costs.

The negative impacts associated with TLU-5 are largely the result of the relative effect of reduced vehicle operating costs versus the displacement of retail gasoline sales. While TLU-5 results in a net savings to vehicle owners, the positive multiplier effect of these savings do not outweigh the constrictive multiplier effect of displaced retail gasoline sales. However, it should be noted that the modeling assumptions of this option are intentionally conservative. For example, it assumes as the U.S. Energy Information Administration's 2007 regional retail fuel price forecast for gasoline, which averages $2.21 per gallon over the study period and is considerably lower than the current market prices. Variability in the baseline fuel price assumption is considered and discussed in a set of sensitivity analyses in Chapter 6 of the ASU Report. These sensitivities suggest that if energy prices remain at, or near, their recent highs then vehicle greenhouse emissions standards would result in substantial positive economic impacts.

Table 1-8. Summary Results for Transportation and Land Use (TLU) Options Analyzed

	Net Annual Employment (FTE)			Net Income ($2004, million)				Total Value Added ($2004, million)			
Transportation and Land Use Options	**2010**	**2015**	**2020**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**	**2010**	**2015**	**2020**	**2007–2020 (NPV)**
TLU-1b (Shift to Transit Spending)	98	127	252	–29	–31	–27	–213	–23	–26	–19	–173
TLU-3a (Registration Surcharge for Transit Spending)	718	646	632	30	28	28	205	49	45	46	332
TLU-5 (CO_2 Tailpipe Standard)	–32	–341	–14	–1	–17	–9	–83	–2	–12	21	–31
All TLU Options	783	432	871	–1	–19	–8	–91	24	7	48	128

Note: Negative values identify loss of jobs, income, or value added. FTE = full-time equivalent; NPV = net present value.

Potential Investment Costs Associated with Mitigation Options

At its October 16, 2007 meeting, the CAPAG requested a summary of the potential annual upfront public and private investments associated with the mitigation options. These results are summarized in Table 1-9. The potential annual investment costs associated with the options are based on the methods used to estimate the costs or cost savings of each option analyzed during the CAPAG process, and supplemental research conducted by the Appalachian State University (ASU) Energy Center.[16]

While implementation of some of the mitigation options may require significant upfront investments of public and/or private resources, these investments, in many cases, also result in significant savings over time. Moreover, many of the mitigation options result in ongoing savings beyond the period included in the CAPAG and ASU Energy Center analyses. Finally, almost all of these initial investment costs will be financed over time reducing the actual annual costs borne by the public and private sectors.

Consider for example TLU-5 (Tailpipe GHG Standards). As noted above, this mitigation option would require automakers to install additional pollution control technologies increasing the purchase price of a new vehicle and monthly car payments. However, these same pollution control technologies will increase fuel economy and reduce the vehicle operating expenses, which tend to offset the increased purchase price.

[16] Documentation of the methods used to develop estimates of the upfront investment costs is provided in the ASU Energy Center's report "Secondary Economic Impact Analysis of GHG Mitigation Options for North Carolina," at http://www.ncclimatechange.us or http://daq.state.nc.us/monitor/eminv/gcc.

Table 1-9. Projected Potential Upfront Investment Costs of Mitigation Options (Million in 2005 Dollars)

	2010	2015	2020	2007–2020 (NPV)
Energy Supply Options				
ES-1 (Renewable Energy Incentives)				
Private investment	10	61	124	414
Public investment	1	2	2	13
Total investment	10	63	127	426
ES-2 (Environmental Portfolio Standard, SB3 Analysis)				
Private investment	-	676	911	4,310
Total investment	-	676	911	4,310
ES-3 & -9 (CHP)				
Private investment	238	396	570	3,082
Total investment	238	396	570	3,082
ES-6a (IGCC versus new pulverized coal)				
Private investment	47	9	9	195
Total investment	47	9	9	195
ES-6b (IGCC displacing existing pulverized coal)				
Private investment	318	69	69	1,353
Total investment	318	69	69	1,353
ES-8 (Municipal Biogas)				
Public investment	0.2	1	3	9
Total investment	-	1	3	9
All ES Policies				
Private investment	**613**	**1,211**	**1,686**	**9,037**
Public investment	**1**	**3**	**5**	**21**
Total investment	**614**	**1,214**	**1,692**	**9,058**
Residential, Commercial, and Industrial Options				
RCI-1 (Efficiency Funding)				
Private investment	208	329	368	2,527
Total investment	208	329	368	2,527
RCI-2 (1% PBF)				
Private investment	146	154	173	1,242
Total investment	146	154	173	1,242
RCI-11 (Energy Audits)				
Private investment	9	10	10	84
Total investment	9	10	10	84
RCI-4 (Market Transformation)				
Private investment	-	8	19	53
Total investment	-	8	19	53
RCI-5 (Appliance Standards)				
Private investment	-	25	25	141
Total investment	-	25	25	141

	2010	2015	2020	2007–2020 (NPV)
RCI-6 (Energy Codes)				
Private investment	225	227	231	1,640
Total investment	225	227	231	1,640
RCI-3 (Energy Efficient Government Buildings)				
Public investment	-	63	71	397
Total investment	-	63	71	397
RCI-7 (High-Performance Buildings)				
Private investment	56	93	93	671
Total investment	56	93	93	671
RCI-9 (Bulk Purchasing)				
Private investment	59	59	-	470
Public investment	2	4	5	26
Total investment	61	63	5	496
RCI-10 (Residential Solar Hot Water Heating Only)				
Private investment	37	41	44	351
Total investment	37	41	44	351
All RCI Policies				
Private investment	**740**	**947**	**964**	**7,188**
Public investment	**1.686**	**66**	**76**	**423**
Total investment	**742**	**1,014**	**1,040**	**7,611**
Agriculture, Forestry, and Waste Management Options				
AFW-1 (Manure Digesters)				
Private investment	19	28	39	238
Total investment	19	28	39	238
AFW-2 (Biodiesel)				
Private investment	45	88	93	414
Public investment	24	49	15	273
Total investment	69	138	107	686
AFW-4a (Farmland Easements)				
Public investment	21	31	51	263
Total investment	21	31	51	263
AFW-4b (Forestland Easements)				
Public investment	8	14	20	107
Total investment	8	14	20	107
AFW-5 (Biomass Subsidy)				
Public investment	3	-	-	10
Total investment	3	-	-	10
AFW-6 (Cellulosic Ethanol)				
Private investment	188	339	742	3,008
Public investment	25	-	-	190
Total investment	213	339	742	3,198
AFW-8 (Afforestation)				
Public investment	3	15	15	98
Total investment	3	15	15	98

	2010	2015	2020	2007–2020 (NPV)
AFW-9 & -10 (Forest Management)				
Public investment	16	54	78	358
Total investment	16	54	78	358
AFW-11 (Landfill Gas)				
Private investment	12	12	15	112
Total investment	12	12	15	112
AFW-12 (Recycling)				
Private investment	6	10	15	79
Total investment	6	10	15	79
AFW-13 (Urban Forestry)				
Private investment	96	84	76	896
Total investment	96	84	76	896
All AFW Policies				
Private investment	**382**	**616**	**1,057**	**5,105**
Public investment	**81**	**167**	**255**	**1,353**
Total investment	**463**	**784**	**1,312**	**6,459**
Transportation and Land Use Options				
TLU-1b (Shift to Transit Spending)				
Public investment	347	347	347	2,487
Total investment	347	347	347	2,487
TLU-3a (Registration Surcharge for Transit $)				
Public investment	33	33	33	239
Total investment	33	33	33	239
TLU-5 (CO_2 Tailpipe Standard)				
Private investment	26	401	553	2,341
Total investment	26	401	553	2,341
All TLU Options				
Private investment	**26**	**401**	**553**	**2,702**
Public investment	**380**	**380**	**380**	**3,156**
Total investment	**406**	**781**	**933**	**5,858**

NPV = net present value (calculated assuming a discount rate of 5%); SB = Senate Bill; CHP = combined heat and power; IGCC = integrated gasification combined cycle; PBF = Public Benefits Fund; CO_2 = carbon dioxide.