

## CHAPTER 12

### SUMMARY AND RECOMMENDATIONS

#### Summary

*North Carolina's Sensible Greenhouse Gas Reduction Strategies* is a proposed plan to help reduce North Carolina's greenhouse gas (GHG) emissions. Although no specific guidelines are in place for the United States, it behooves North Carolina to have a sensible plan developed through a consensus of citizens, should the United States and the State choose to reduce GHG emissions.

Designed to be a bottom-up plan, *North Carolina's Sensible Greenhouse Gas Reduction Strategies* was developed initially by comparing all existing plans for other states, including Vermont's, Wisconsin's, and Oregon's, to determine the methods best suited to the State. One problem seemed evident from the start, and verified by EPA personnel, the methods used to evaluate reduction measures and strategies in the other states were mostly econometric models that did not directly or effectively measure reductions of GHGs in CO<sub>2</sub> equivalents (eCO<sub>2</sub>).

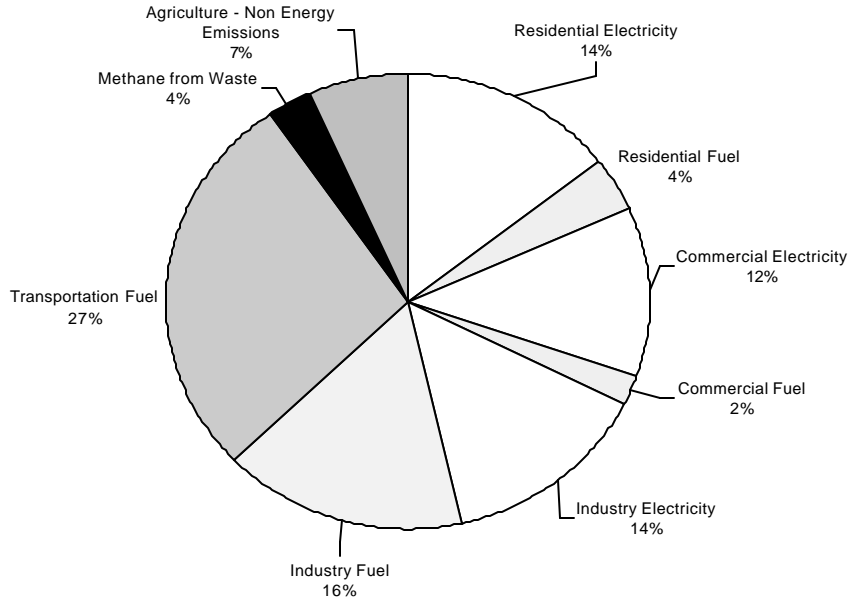
Through consultation with others, we learned of a *Greenhouse Gas Emissions Software* produced for the International Council for Local Environmental Initiatives (ICLEI), a worldwide effort to reduce GHGs in towns and cities. Developed by Torrie Smith Associates, this software offered considerable potential for the North Carolina study. With the blessings of EPA, we chose to use this innovative software. Using North Carolina as a beta site, Torrie Smith Associates modified this user-friendly software to operate at a statewide level rather than a local level.

The research team built a forecast of eCO<sub>2</sub> emissions for 1990 and 2010 using the *The North Carolina Greenhouse Gas Inventory for 1990* (Appalachian State University 1996) and the *North Carolina Energy Outlook, 1998* (Standard & Poor's DRI 1999), as well as *State Profile: North Carolina* (Woods & Poole 1997) and other sources.

Total 1990 emissions from all sources in the State were 145 million tons (megatons) of eCO<sub>2</sub>. When electricity usage was allocated to the correct economic sectors, Industry accounted for 30% of the total, Transportation for 27%, Residential 18%, Commercial 14%, Non-Energy Agriculture 7%, and Waste 4% (Figure 12-1).

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**Figure 12-1: North Carolina Greenhouse Gas Emissions in 1990, by Sector and by Fuel vs. Electricity  
(Total Emissions in 1990: 145 Megatons)**



Based on a business as usual forecast for 2010, North Carolina's eCO<sub>2</sub> emissions are projected to be 216.1 megatons. If the United States chooses in the future to reduce its eCO<sub>2</sub> emissions by 7% below its 1990 levels by 2010, North Carolina's share, a 7% reduction of eCO<sub>2</sub> emissions from the 2010 forecast would require emissions to be a maximum of 135 megatons, a reduction of 81.1 megatons. This would amount to a 38% reduction from the 2010 projection (Table 12-1).

The basic strategy of this study was to test proposed eCO<sub>2</sub> reduction measures in the Torrie Smith Associates model to determine their utility, cost effectiveness, and impacts. From a list of more than 250 measures and strategies, we modeled those that could have significant impacts. These strategies could reduce 106 megatons of eCO<sub>2</sub> by 2010 from the business as usual forecast. This reduction is considerably more than the 81.1 megatons necessary to meet the 7% reduction for 1990 for North Carolina and could lower emissions in 2010 from 216.1 to 110.1 megatons. The 106-megaton reduction represents an annual savings in the year 2010 of 504 trillion Btu in energy and \$6.7 billion in energy costs.

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**Table 12-1: Emissions by Source, 1990, 2010 and After Measures (in megatons)**

	1990 Emissions	2010 Business as Usual Emissions	Total Reductions	Net Emissions in 2010
Electricity	58.05	91.58	52.35	39.24
Natural Gas	9.40	17.28	3.19	14.09
Heating Oil	7.90	11.01	4.64	6.36
Building Diesel	5.03	6.80	2.14	4.66
Gasoline	31.14	40.58	12.39	28.19
Diesel	7.70	14.00	-0.01	14.01
Propane	2.63	4.48	1.15	3.33
CNG	0.34	0.50	0.00	0.50
Coal	7.67	5.02	2.86	2.16
Waste Related*	5.73	13.85	22.26	-8.41
Agricultural and Other	9.54	10.99	0.20	10.79
Forest Sequestration	--	--	4.95	-4.95
<i>Total</i>	145.12	216.09	106.12	109.97

\*Note that waste-related emissions include only the methane at landfills, whereas waste related emission reductions include upstream GHG reductions as well as impacts at the landfills.

Based upon the proposed reduction of 106 megatons of eCO<sub>2</sub>, each sector's 1990 emissions and 2010 reduction is summarized below in Table 12-2.

**Table 12-2: Emission Reductions of Measures by Fuel Source**

Source	eCO <sub>2</sub> (megatons)
Electricity - Demand Side	30.96
Electricity - Supply Side	21.39
Gasoline	12.39
Diesel Fuel	-0.01
Natural Gas	3.19
Heating Oil	4.64
Coal	2.86
Other Petroleum	2.14
Propane	1.15
Recycling	9.11
Reduction	6.15
Methane Recovery	7.00
Agricultural Methane	0.20
Forest Sequestration	4.95
<i>Total eCO<sub>2</sub></i>	106.12

**Utilities Sector.** The Utilities Sector produces electricity used by the other sectors of the economy. Data for 1990 allocated utility emissions to the end use sectors, specifically Industry, Commercial, Residential, and Agriculture. To keep from double-counting emissions attributable to the Utilities Sector and to seek savings from strategies attributable to this sector, we summed the supply-side utilities emissions from the projected 2010 emissions totals, after subtracting the impact of all the electricity demand measures implemented in the end use sectors. This allowed us to analyze the impacts of strategies specific to the Utilities Sector. Thus, the Utilities Sector's emissions could be

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reduced by 21.4 megatons, representing 20.2% of North Carolina's reduction total. Table 12-3 summarizes the utility sector's reduction.

**Table 12-3: "Other" Sector Summary of Reductions\***

	eCO <sub>2</sub> megatons	% of Total
Utility Supply Side	21.4	20.2
Forest Sequestration	5.0	4.7
Agricultural Methane	**	**

\*"Other" sectors include Agriculture, Forestry and the Utility industries

\*\*Less than 0.05

**Industrial Sector.** With 30% of the State's 1990 emissions, the Industrial Sector's projected 2010 emissions could be reduced by 16.7 megatons of eCO<sub>2</sub>, representing 15.7% of North Carolina's reduction total. We chose fuel switching (1 strategy) and energy efficient equipment and lighting improvements (15 strategies) to achieve this goal. Because much of Industry's energy use is electrical, electricity demand strategies account for much of the Industrial Sector's remaining share of emission reductions. Table 12-4 summarizes the Industrial Sector's reduction by energy source.

**Table 12-4: Industrial Sector Summary of Reductions by Fuel Source**

	Btu (mil)	Coefficients (Tons of CO <sub>2</sub> per million Btu)	eCO <sub>2</sub> (megatons)
Electricity	41	0.185	8
Natural Gas	26	0.059	2
Heating Oil	26	0.081	2
Propane	6	0.07	*
Coal	28	0.103	3
Other Petroleum Fuels	26	0.081	2

\* Less than 0.05

**Commercial Sector.** With 14% of the State's 1990 emissions, the Commercial Sector's projected 2010 emissions could be reduced by 5.4 megatons of eCO<sub>2</sub>, representing 5.1% of North Carolina's reduction total. We chose improved energy efficiency of existing and new commercial buildings (3 strategies) and improved equipment and lighting (10 strategies) to achieve the goal. Electricity demand strategies account for much of the Commercial Sector's remaining share of emissions. Table 12-5 summarizes the Commercial Sector's reduction by energy source.

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**Table 12-5: Commercial Sector Summary of Reductions by Fuel Source**

	Btu (mil)	Coefficients (Tons of CO <sub>2</sub> per million Btu)	eCO <sub>2</sub> (megatons)
Electricity	26	0.185	5
Natural Gas	5	0.059	*
Heating Oil	4	0.081	*
Propane	1	0.07	*

\* Less than 0.05

**Residential Sector.** With 18% of the State's 1990 emissions, the Residential Sector's projected 2010 emissions could be reduced by 22.7 megatons of eCO<sub>2</sub>, representing 21.4% of North Carolina's reduction total. We chose improved energy efficiency of appliances and equipment (13 strategies) and improving the energy efficiencies of both existing and new buildings (7 strategies) to meet the goal. Again, electricity demand strategies account for the largest share of emission reductions. Table 12-6 summarizes the Residential Sector's reduction by energy source.

**Table 12-6: Residential Sector Summary of Reductions by Fuel Source**

	Btu (mil)	Coefficients (Tons of CO <sub>2</sub> per million Btu)	eCO <sub>2</sub> (megatons)
Electricity	100	0.185	18
Natural Gas	23	0.059	1
Heating Oil	28	0.081	2
Propane	10	0.07	1

**Transportation Sector.** With 27% of the State's 1990 emissions, the Transportation Sector's projected 2010 emissions could be reduced by 12.4 megatons of eCO<sub>2</sub>, representing 11.7% of North Carolina's reduction total. We selected car/van pooling (1 strategy), increasing vehicle fuel efficiency (2 strategies), other VMT reduction strategies (5), and switching to public transportation (1 strategy) to achieve this sector's goal. Table 12-7 summarizes the Transportation Sector's reduction by energy source.

**Table 12-7: Transportation Sector Summary of Reductions by Fuel Source**

	Gallons (mil)	Btu (mil)	Coefficients (Tons of CO <sub>2</sub> per million Btu)	eCO <sub>2</sub> (megatons)
Gasoline	1255	157	0.079	12
Diesel	*	*	0.081	*

\* Less than 0.05

**Agriculture Sector.** With only 7% of the State's 1990 emissions, the Agriculture Sector's projected 2010 emissions could be reduced by 199,610 tons of eCO<sub>2</sub>, representing 0.2%

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of North Carolina's reduction total. We chose to work primarily with the non-energy portion of this sector because there were very poor data documenting its energy use, and because the methods used in the Utility Sector implicitly cover agricultural energy use. Because of the large number of feedlot operations in North Carolina, manure management is a key strategy for reducing methane emissions in this sector. Using this biogas to make electricity results in additional greenhouse gas reductions. Table 12-3 summarizes the Agriculture Sector's reduction.

**Waste Sector.** With only 4% of the State 1990 emissions, the Waste Sector's projected 2010 emissions could be reduced by 22.3 megatons of eCO<sub>2</sub>, representing 21.0% of North Carolina's reduction total. We chose improved methane recovery from existing landfill recovery projects (1 strategy), new methane recovery projects (1 strategy), improvement in existing waste recycling (3 strategies), new waste recycling (3 strategies), and waste reduction (3 strategies) to meet these goals. Because this sector generates CH<sub>4</sub> (methane), a highly reactive GHG and because recycling saves energy in the production of paper, metals, glass and other recyclables, the savings possible from this sector can be quite large. Table 12-8 summarizes the Waste Sector's reduction by energy source.

**Table 12-8: Waste Sector Summary of Reductions**

	Unit (mil)	eCO <sub>2</sub> (megatons)
Recycling	5	9
Reduction	3	6
Methane Recovery	7	7

**Forest Sector.** The Forest Sector was a net sink for C, which means that this sector can uptake a considerable amount of CO<sub>2</sub> and sequester (store) the C until the organic plant matter either decays or is burned. Consequently, we chose to test a strategy of increasing North Carolina's forestland by 10 percent, from 19.3 million acres in 1990 to 21.5 million acres in 2010. This strategy yielded a net uptake of 4.95 megatons of CO<sub>2</sub>, representing 4.7% of North Carolina's reduction total. Table 12-3 summarizes the Forestry Sector's reduction by energy source.

**Emissions Comparison.** Table 12-9 compares GHG emissions in the base year of 1990 with projected emissions (under a business-as-usual scenario) for the target year of 2010. To provide a scenario for meeting the proposed target of 7% below 1990 emissions, we modeled numerous emission reduction strategies. Reductions from these strategies totaled 106 megatons of eCO<sub>2</sub>, surpassing the minimum emissions reductions of 81.1 megatons of eCO<sub>2</sub>. It should be noted that the forestry sector is not an emissions source, but is included in this summary table under the modeled reductions as forests could serve as a possible sink for carbon. Emissions from electrical utilities were allocated to their end use sectors (residential, commercial, industrial, transportation, and agriculture) and thus do not appear separately in the emissions columns of the summary table. However, substantial GHG savings can be achieved in this area, with nearly 30% of total reductions

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due to electricity demand side measures in the end use sectors. In addition, changes in the power plant fuel supply mix relative to the business-as-usual mix, as well as other measures taken by the utilities sector itself, contribute another 20% to the total emission reductions achieved by 2010. On a sector basis, the shares of total emission reductions were residential (21.4% of the total reductions), waste (21% of the total reductions), electrical utility (supply side measures) (20.2% of the total), industrial (15.7% of the total), and about 5% each from the commercial buildings sector and forestry carbon sink.

**Table 12-9. Emissions by Sector, 1990 and 2010**

Sector	Base Year		Target Year		Modeled Reductions	
	1990	1990	2010	2010	2010	2010
	eCO <sub>2</sub> (megatons)	Percent of Total	eCO <sub>2</sub> (megatons)	Percent of Total	eCO <sub>2</sub> (megatons)	Percent of Total
<b>Residential</b>	26.3	18	46.3	21	22.7	21.4
<b>Commercial</b>	20.7	14	32.1	15	5.4	5.1
<b>Industrial</b>	43.3	30	57.2	27	16.7	15.7
<b>Transportation</b>	39.6	27	55.7	26	12.4	11.7
<b>Waste</b>	5.8	4	13.8	6	22.3	21
<b>Agriculture</b>	9.5	7	11	5	0.2	0.2
<b>Utility</b>					21.4	20.2
<b>Forests</b>					5	4.7
<b>Total</b>	145.1	100	216.1	100	106	100

*North Carolina's Sensible Greenhouse Gas Reduction Strategies* represents the first step in an evolving plan, as are those of other states. Changes in the economic structure of the State, stakeholder influences, and new technologies will certainly bring new eCO<sub>2</sub> emissions reduction strategies to the forefront as the State moves into the 21<sup>st</sup> Century. As the ninth fastest growing state, North Carolina's increasing population makes it more difficult reduce its GHG. For this reason, we have tried to offer a group of strong GHG emissions reduction strategies, but we acknowledge that there are many more possible alternatives.

We anticipate constructive criticisms of this plan. This was a target-driven, "backcast" study to see what types of measures would be needed to achieve the levels of emission reductions that may be required to meet the 7% goal, not to mention the much higher levels that may be required if climate change turns out to be a more serious and more urgent problem than we hope.

Ultimately, it will be the decisions of the United States and North Carolina whether to implement plans to reduce GHGs. Although the implementation of this plan will bring reduced emissions of GHGs, another very important outcome will be the conservation of resources for North Carolina's future generations. In the meantime, understanding the problem and being prepared are what this plan is all about. It just makes good \$ense.

**Recommendations**

No document dealing with a subject as complex as reducing GHGs is complete without suggestions for implementation. Care must be taken to ensure that future generations of North Carolinians benefit from our wisdom. We offer this document as a State plan for reducing North Carolina's GHGs, and we offer the following specific recommendations for implementing the strategies outlined in this report.

North Carolina is a progressive southern state with a rapidly growing economy. Therefore, it is wise to anticipate the future, protect our resources, and recommend policy. Global warming is a very real issue that, we believe, warrants careful thought and planning by all State agencies to assure the careful and sensible development of our resources. While it would be easy to disregard the issue of global warming, it behooves us all to become knowledgeable about its causes and impacts. And it behooves our State officials to have a plan to reduce GHGs and implementation procedures for that plan in place.

We strongly recommend the need to get on with the design and testing of implementation strategies. Whether one agrees or disagrees with the numbers in this report, no one can dispute that putting North Carolina on a track for reduced greenhouse gas emissions of any percentage represents a significant change in the direction of the State's energy economy. While there are indications that this change may actually be economically beneficial in the long run, the transition can be made much smoother if we plan for it and try to facilitate it.

***To: Governor Jim Hunt***

We recommend that Governor Hunt establish by Executive Order a greenhouse gas emission reduction goal for North Carolina. Setting a reduction goal is a forward-looking, progressive step that will call attention to global warming as a North Carolina issue, encouraging citizens to become concerned and knowledgeable about the issues. Furthermore, establishing this goal will influence the legislature to begin to anticipate impacts that may affect North Carolina's future. Finally, as the Head of State, by establishing an emission reduction goal, Governor Hunt will focus the attention of all State agencies on global warming issues and the importance of having strategies for implementing a State plan.

***To: The Energy Policy Council***

As a direct participant in the energy policy process for the State of North Carolina, the Energy Policy Council should develop a set of strategies that the state should undertake to better understand the impacts that growth in North Carolina has on our climate, and how the state can address these impacts. As a body that represents the Legislature, Governor's Office, various departments of the executive branch and representatives of

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public interest, the Energy Policy Council can be seen as affecting the direction of energy policy across all branches of government.

### ***To: The Division of Energy***

As the organization responsible for administering numerous projects dealing with energy issues across sectors, the Division of Energy can create educational fact sheets and other public relations efforts in all media venues for businesses, consumers and children that explain the connection between activities, consumption of energy and their impacts. Additionally, these fact sheets can educate the public and businesses about the importance of greenhouse gas reduction strategies.

### ***To: North Carolina Utilities Commission***

The North Carolina Utilities Commission is directed, in part, to "...provide just and reasonable rates and charges for public utility services and promote conservation of energy..." This agency is vital to planning and long-term management of North Carolina's future electricity and natural gas production, transportation, and consumption. Planning for the implication of global warming and the reduction of GHGs is essential in the Utilities Sector.

### ***To: Department of Environment and Natural Resources***

Through its rulemaking responsibilities, the Department of Environment and Natural Resources can assure proper implementation of state policies, as through the recently enacted air quality bill. It can utilize some of the strategies outlined in this document to ensure greater energy efficiency and to reduce mobile and stationary sources of pollution and GHG emissions.

### ***To: Department of Transportation***

The Department of Transportation is currently in the process of revising the *Statewide Transportation Plan* and implementing policies stated in the *Transit 2001* plan. This provides the opportunity for the Department of Transportation to incorporate appropriate and relevant strategies suggested by this document into these specific transportation planning processes. These general guidelines include encouraging alternative fuel vehicles, pricing mechanisms, and modes of transportation other than single-occupant vehicles.

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### ***To: The Governor's Smart Growth Commission***

The Smart Growth Commission can incorporate GHG reduction strategies into recommendations for Smart Growth strategies in urban and rural areas of North Carolina. The recommendations can be either a separate policy statement concerning GHG emissions reductions, or recommendations for GHG emissions reductions can be incorporated into specific policy areas that the Smart Growth Commission is tasked to address. Greater energy efficiencies and savings and environmental implications of atmospheric pollution and GHGs are concerns in all of North Carolina's economic sectors as the growing population and economy look toward the future.

### ***To: The League of Municipalities***

All global initiatives are best acted upon at the local level. Members of The League of Municipalities understand and can support the measures that municipalities need to take to offset the risks of GHG emissions. One policy statement that the League can incorporate is membership in the Clean Cities and ICLEI initiatives, which involve hundreds of cities internationally that are assessing air quality and GHG emissions. These cities are recognized worldwide for their progressive efforts to improve their environments and save energy.

### ***To: The Citizens of North Carolina***

Understanding and acting upon concerns of GHG emissions is an important initiative for our children's futures. The nature of a representative democracy is in most cases reactive rather than proactive. That is, most issues are not acted upon until they become visible to policy-makers and politicians at all levels of government.

GHG emissions and their suspected role in global warming are major worldwide concerns, whose implications may not become apparent to policy-makers until it is too late to implement solutions. A grassroots effort to encourage policy-makers to seek solutions now not only can increase the chances of successfully reducing GHG emissions and lowering their environmental effects, but can save energy resources for the future.

Global warming and greenhouse gases are important issues for the 21<sup>st</sup> century, as North Carolina seeks a quality environment for its citizens. The strategies in this plan obviously address environmental concerns. However, it is also economically prudent to provide appropriate environmental stewardship to ensure the resources necessary for North Carolina's continued economic growth.