CHAPTER 3

NORTH CAROLINA'S GREENHOUSE GAS EMISSIONS BASE YEAR ANALYSIS AND BUSINESS-AS-USUAL FORECAST

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The Base Year Inventory – Greenhouse Gas Emissions in 1990

Tables 3.1 provides emissions data from the *North Carolina Greenhouse Gas Inventory* (Appalachian State University 1996). Table 3.2 compares the *North Carolina Greenhouse Gas Inventory* (1996) with the base year inventory done for this study. Given the updated information and revised methods, there is very good agreement between the two inventories. For purposes of this study, greenhouse gas emissions in North Carolina in 1990 are taken to be 145 megatons of eCO_2.

The base year emissions are broken down by source in Figure 3.1. Energy-related emissions accounted for 90% of greenhouse gas emissions in North Carolina in 1990, with emissions from electricity generation being the single largest source at 40.0% of the total inventory and gasoline from transportation the next largest source at 21.5%.

Figure 3.2 shows the base year emissions broken down by end use sector, with the electricity emissions allocated to their respective end use sectors, and this creates quite a different perspective on the base year emissions. In this view, industry and transportation emerge as the largest end use sectors in terms of greenhouse gas emissions, contributing 30.0% and 27.3%, respectively, to total emissions. The residential and commercial buildings sectors contribute 18% and 14%, respectively, bringing the energy-related emissions total to 90% of total emissions.

Non-energy emissions represent 10% of greenhouse gas emissions, with 7% from agriculture sources of methane and nitrous oxide, and 4% from landfill methane.

Table 3-1: Base Year Emissions Analysis and Business and Usual Forecast

	Actual Emissions and Global Warming Potential (tons/yr)								
	CH_4	CH_4 as CO_2	CO_2	N_20	N_20 as CO_2	ODC as CO_2	Total CO_2	% of CO_2	GWP
Emission Source Category		equiv.			equiv.	equiv.	equiv.	equiv.	
Fossil Fuel Consumption	**9,266**	**203,841**	**120,847,628**	**3,677**	**992,883**		**122,044,351**	**90.33%**	**122,044,351**
Commercial/Institutional	7	145	3,731,586	5	1,324		3,733,054	2.76%	3,733,054
Industrial/Manufacturing	33	718	23,372,681	249	67,304		23,440,702	17.35%	23,440,702
Residential	42	927	5,591,119	352	95,113		5,687,159	4.21%	5,687,159
Utilities	269	5,928	46,231,048	394	106,391		46,343,367	34.30%	46,343,367
Transportation	8,915	196,123	41,921,195	2,677	722,751		42,840,070	31.71%	42,840,070
Biomass Fuel Consumption	**26,596**	**585,110**	**0**	**735**	**198,491**		**783,600**	**0.58%**	**783,600**
Commercial/Institutional	0	0	0	0	47		47	0.00%	47
Industrial/Manufacturing	179	3,936	0	148	40,058		43,994	0.03%	43,994
Residential	26,400	580,800	0	551	148,800		729,600	0.54%	729,600
Utilities	17	374	0	36	9,585		9,959	0.01%	9,959
Production Processes	**0**	**0**	**426,097**	**1,359**	**366,849**	**3,859,270**	**4,652,216**	**3.44%**	**4,652,216**
Lime Processing	0	0	426,097	1,359	366,849		792,946	0.59%	792,946
Ozone Depleting Compounds (ODC)	0	0	0	0	0	3,859,270	3,859,270	2.86%	3,859,270
Other Processes	0	0	0	0	0		0	0.00%	
Product End Use	0	0	0	0	0		0	0.00%	
Agriculture and Livestock Production	**377,606**	**8,307,332**	**340,548**	**3,733**	**1,007,854**		**9,655,734**	**7.15%**	**9,655,734**
Domestic Animals	37,912	834,064	0	0	0		834,064	0.62%	834,064
Animal Manure Management	326,494	7,182,868	0	0	0		7,182,868	5.32%	7,182,868
Game Animals (Deer)	13,200	290,400	0	0	0		290,400	0.21%	290,400
Fertilizer Use/Agricultural Liming	0	0	340,548	3,733	1,007,854		1,348,402	1.00%	1,348,402
Waste Disposal, Treatment, & Recovery	**266,825**	**5,870,151**	**506,614**	**70**	**18,851**		**6,395,615**	**4.73%**	**6,395,615**
Landfills	260,355	5,727,817	0	0	0		5,727,817	4.24%	5,727,817
Waste Incineration	67	1,470	506,614	0	0		508,084	0.38%	508,084
Burning of Agricultural Waste	990	21,771	0	70	18,851		40,622	0.03%	40,622
Sewage Treatment	5,413	119,092	0	0	0		119,092	0.09%	119,092
Human Emissions	**49,183**	**1,082,015**	**57,965**	**0**	**0**		**1,139,980**	**0.84%**	**1,139,980**
Land Use Changes	**-108**	**-2,372**	**-9,611,812**	**200**	**53,955**		**-9,560,229**	**-7.08%**	**-9,560,229**
Total Emissions	**729,367**	**16,046,077**	**112,567,039**	**9,774**	**2,638,883**	**3,859,270**	**135,111,269**	**100%**	**135,111,269**
%Global Warming Potential		12%	83%		2%	3%	100%		100%

Source: Appalachian State University 1996

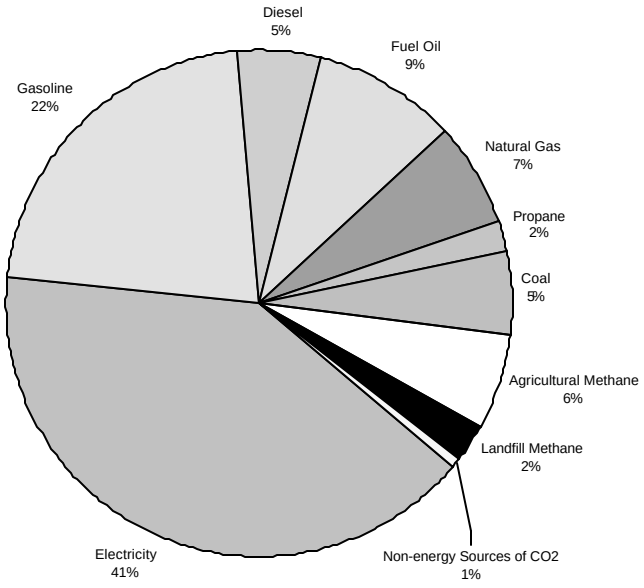
Projected Emissions in the Year 2010

The *North Carolina Energy Outlook, 1998*(Standard & Poor's DRI 1999) and the associated demographic and economic projections were used to generation the business-as-usual forecast of greenhouse gas emissions in North Carolina in the year 2010 (Table 3-2). While details varied by sector, essentially the energy end use sector models were tuned to the level of energy use by fuel represented in the *North Carolina Energy Outlook, 1998 (Standard & Poor's DRI 1999).*

Table 3-2: Greenhouse Gas Emissions in North Carolina in 1990 (Megatons of eCO_2)
Reconciliation of ASU (1996) Inventory and This Study

SOURCE	***ASU Inventory***	***This Study***	***Notes***
Fossil fuel consumption	75.70	66.78	This study uses USEIA data by fuel to estimate emissions from fuel consumption.
Electricity generation	46.34	58.05	This study higher because it attributes emissions to electricity imported to North Carolina from other states.
Biomass Fuel Consumption (non-CO2 emissions only)	0.78	0	Non-CO_2 emissions from biomass not included in this draft.
Subtotal Energy	122.82	124.83	
Lime Processing	0.79	0.43	CO_2 component only included in this study, pending confirmation of nitrous oxide component.
Ozone Depleting Chemicals	3.86	0	Not included in this study; non-Kyoto. Explanation in text.
Domestic Animals	0.83	1.31	Revised estimate.
Manure Management	7.18	7.32	Revised estimate.
Game Animals	0.29	0	Non-Kyoto. Omitted from this study.
Fertilizer Use/Liming	1.35	0.34	CO2 component only included in this study, pending confirmation of nitrous oxide component.
Landfill Methane and Sewage Treatment	5.85	5.73	Revised estimate
Waste Incineration	0.51	0	Not included in this study.
Burning of Agricultural Waste	0.04	0.02	Revised estimate.
Human Emissions	1.14	0	Not included in this study. Non-Kyoto.
Land Use Changes	-9.56	0	According to Kyoto Protocol, land use change impacts start at zero in 1990.
TOTAL 1990 EMISSIONS	**135.1**	**145.1**	

Figure 3.1: North Carolina Greenhouse Gas Emissions in 1990, by Source
Total Emissions in 1990: 145 Megatons eCO2



Demographic Profile for North Carolina's Future

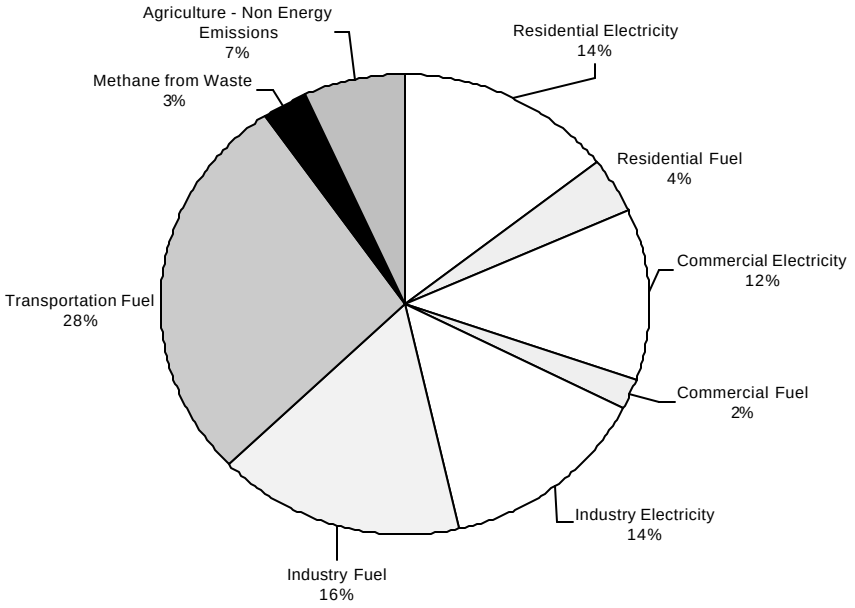
In 1990, the state's population was 6,632,448 (Table 3.3) Moderate increases in population are estimated, and as a result, by 2010 the population is projected to be 8,955,000, a 35% increase (Standard & Poor's DRI 1999). Employment is projected to be about double in 2010 as compared with 1990, and personal income and disposable income are predicted to increase moderately (Standard & Poor's DRI 1999). Personal income will increase from $138.5 billion in 1995 to $195.0 billion in year 2010, a 41 percent increase. Disposable income will increase from $117.9 billion in 1995 to $184.5 billion in year 2010, a 56 percent increase.

Table 3.3 North Carolina Population and Employment Forecast (Thousands)

	1990	1995	2000	2005	2010
Population	6,632	7,217	7,851	8,418	8,955
Employment	2,321	3,459	3,862	4,168	4,500

Sources: Standard & Poor's DRI 1999; Office of State Planning 1998

Figure 3-2: North Carolina Greenhouse Gas Emissions in 1990, by Sector and by Fuel vs. Electricity
(Total Emissions in 1990: 145 Megatons)



The gross state product (GSP), a measure of the total output of the state's economy, is predicted to increase in the future, as it has for the past seven years. In 1997, the GSP was $219 billion, and in 1998 it increased to $244 billion and is expected to top $259 billion in 1999. Despite the slower growth rate for 1999 than for 1998, the state's economy remains in good shape. This eighth consecutive year of growth will have been the longest post World War II expansion in the state's economy. For the year 2000, the GSP is forecasted to increase by a real (inflation adjusted) rate of 3.8 percent (Belk College of Business 1999).

A strong economy is predicted for the state's future, as employment diversifies away from the traditional manufacturing base. These lower-paying jobs will be replaced by jobs in banking, communications, and high-tech manufacturing, causing income levels to rise rapidly. Gaining favor as a retirement mecca, the state has had population increases averaging 1.7% the past five years. Not surprisingly, the increases in population have created a home-building boom, growth in retail and service industries, and state and local government payrolls (Standard & Poor's DRI 1999). Rapid growth in the State makes meeting the 2010 reduction goal very difficult.

These trends in population and economic growth are expected to lead to continued growth in fuel and electricity consumption, as indicated in Tables 3.4 and 3.5, which summarize the *North Carolina Energy Outlook, 1998 (Standard & Poor's DRI 1999)* by fuel and by sector, respectively. Reflecting increasing population, number of households, affluence and industrial growth, total energy demand in North Carolina is predicted to continue to increase by 40% from

years 1992 to 2010. The fuel mix is expected to change during the intervening years, with all fuels increasing except coal, which is predicted to drop by over 30% between 1992 and 2010.

Table 3.4: Forecast Energy Demand in North Carolina, by Fuel

Fuel (TBtu)	1992	1995	2000	2005	2010
Petroleum	679.5	762.5	831.4	877.9	914.2
Natural Gas	182.4	206.2	226.4	259.7	298.8
Coal	76.8	67.2	51.3	51.5	52.7
Electricity	315.2	353.5	389.2	451.8	512.2
Wood	79.2	82.7	87.5	92.2	96.9
Solar	0.5	0.6	0.6	0.7	0.7

Sources: DRI-McGraw-Hill 1996; Standard & Poor's DRI 1999

Table 3.5: Forecast Energy Demand in North Carolina, by Sector

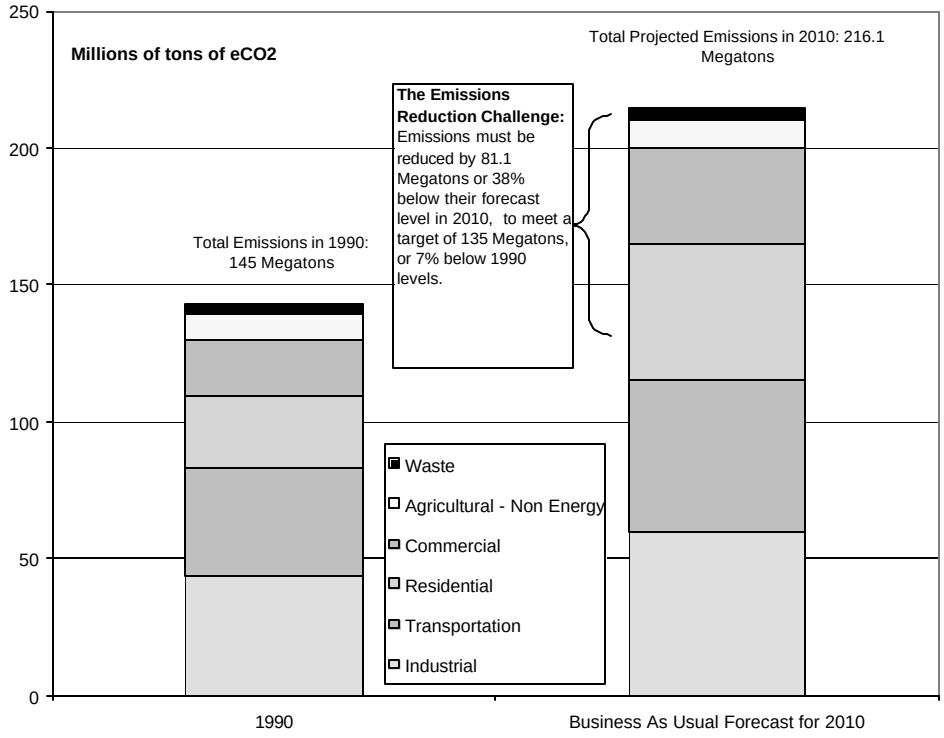
Sector (TBtu)	1992	1995	2000	2005	2010
Residential	225.2	253.2	279.5	322.1	356.8
Commercial	147.1	165.9	185.1	210.9	235.8
Industrial	424.1	447.1	455.3	493.4	540.7
Transport	537.1	606.4	666.5	707.4	742.0

Sources: DRI-McGraw-Hill 1996; Standard & Poor's DRI 1999

With an overall increase in energy demand between 1992 and 2010 of 40%, energy use is not predicted to increase equally across all sectors. The sector projected to experience the greatest energy increases between 1992 and 2010 is the commercial sector (60%), followed by residential (58%), transportation (38%) and industrial (27%).

For the non-energy sectors (Agriculture, Waste) emissions in 2010 were forecast using "business-as-usual" assumptions consistent with the demographic and economic growth that underpins the *North Carolina Energy Outlook, 1998 (Standard & Poor's DRI 1999).* The result is a 50% increase in greenhouse gas emissions by the year 2010. This means that North Carolina's target of reducing greenhouse gas emissions to 93% of their 1990 levels translates into a challenging 38% reduction in emissions below the levels they are forecast to reach under business-as-usual conditions. This is the challenge taken up by the sector analysts in their efforts to develop emission reduction scenarios for each of the major energy end use sectors, for the electric utility sector itself, for the non-energy agricultural and waste sources, and for the potential for growth in forest lands to increase North Carolina's carbon sink. For detailed analysis of individual strategies, see Appendix B.

Figure 3.3 Business-As-Usual Forecast -- North Carolina Greenhouse Gas Emissions in 2010 Vs. Base Year Emissions in 1990



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