CHAPTER 8

UTILITY SECTOR STRATEGIES

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Overview

In 1990, electricity in North Carolina accounted for 59 megatons of CO_2 emissions, fully 40% of all greenhouse gas emissions in the state. At 0.188 tons of CO_2 per million Btu, it is by far the most GHG intensive form of energy in the state. Electricity emits over twice as much CO_2 per unit of end use energy as gasoline and other petroleum products, and three times as much as the direct use of natural gas. The utility sector is, therefore, a critical sector for any comprehensive GHG emissions reduction strategy. This chapter considers the history and near future for the state's utility industry and addresses technical measures to reduce emissions and policies to implement these technical measures.*

Changes in the electric utility industry are rapidly occurring throughout the United States. To date, eleven states have legislated electricity restructuring and six others have issued utility commission orders to begin restructuring on either a comprehensive or partial basis. Activity on some level, ranging from draft legislative proposals to intensive studies such as the one in North Carolina, is underway in 49 states, with 23 states passing comprehensive electric utility restructuring legislation as of the start of 2000. Most of these changes have taken place in just the last two years. For an industry that has been one of the United States' largest and most regulated, this change will be seen as threatening and destabilizing to many people.

Electric utilities have strung millions of miles of wire into millions of homes so that almost every American is tied to the utility grid and its abundant benefits. This is a technological marvel, accomplished in just one short century. For the rest of the world, electricity has not yet reached even 40 percent, or 2.3 billion, of the world's inhabitants. The lives of North Carolinians have clearly been improved by these benefits. Electricity runs the motors in our factories, powers the lights in our offices, cools our homes, and allows us to communicate by television, radio and computers. Our state owes much of its good fortune to the infrastructure and service received from its 108 rural electric cooperative, municipal and investor-owned utility companies.

North Carolina is currently studying electric utility restructuring. With the passage of House Bill 12 in February 1997, the legislature created the *Study Commission on the Future of Electric Service in North Carolina*, which is currently hearing recommendations from the various stakeholders on when and how the state should restructure. Over fifty percent of the U.S.

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* The North Carolina Solar Center would like to thank the North Carolina Solar Energy Association (NCSEA) for their assistance and guidance in preparing this chapter. NCSEA has been involved in utility policy issues as part of the Study Commission on the Future of Electricity in North Carolina.

population lives in states that have passed comprehensive electric utility restructuring laws or orders, so there is precedent to suggest that restructuring may be in North Carolina's future too.

Assumptions

Current Electricity Use In North Carolina

Since 1984, electrical energy consumption has grown at a rate of 3.4% per year (Standard & Poor's DRI 1999). Future estimates show this growth slowing, but without enhanced energy efficiency numbers, estimates still show a growth rate of about 3.0% per year through the year 2010. (Standard & Poor's DRI 1999) This amounts to an overall growth in electricity demand of 40% over that of 1996. Transportation and other uses of energy are estimated to increase only 18% and 21%, respectively, over the same time periods. These trends are illustrated in Figure 8-1, which projects growth in fuel consumption through 2010. With these growth projections on the horizon, the restructuring issue becomes even more important for North Carolina.

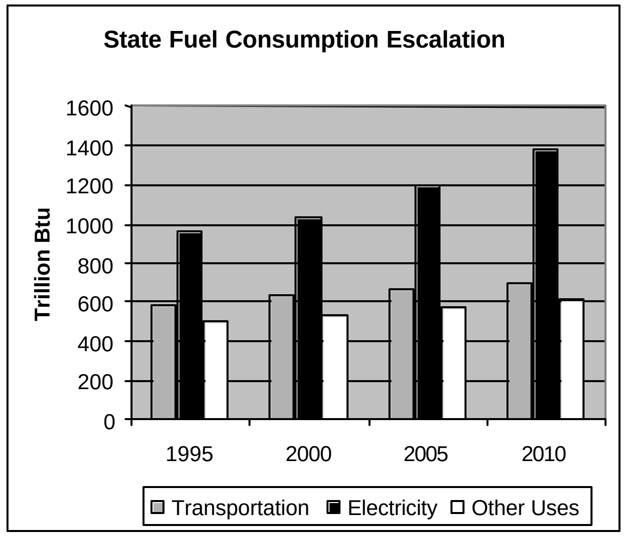


Figure 8-1: Energy Use by Major Sectors.

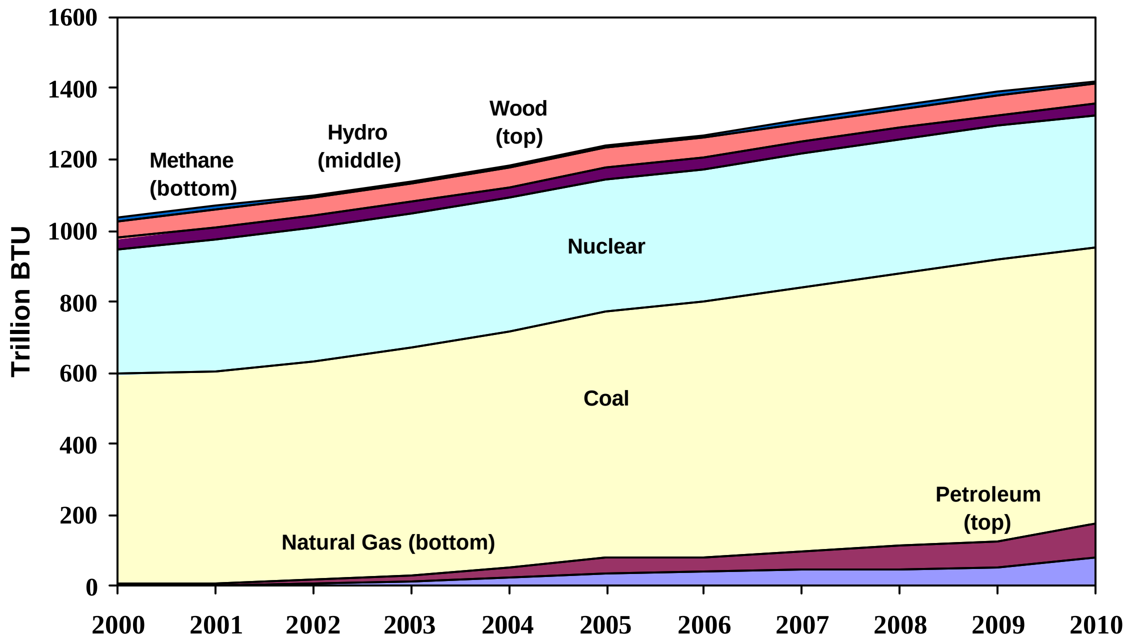
Much of North Carolina's renewable electricity is generated by hydroelectric facilities. When these facilities shut down for any reason, the corresponding fuel usage impact is significantly greater than the kilowatt-hours lost by the generating plant. For instance, when a hydro facility shuts down, the load is typically replaced by a dispatchable coal-fired generating facility. The fuel necessary to produce an equal amount of electrical energy is approximately three times the number of kilowatt-hours generated. This is due to the fact that the average coal generating facilities produce electricity at an efficiency of about 35%, with 65% of the energy in a unit of coal fuel (or any central thermal plant operation) lost in the form of waste heat and auxiliary loads to run the facility.

Other parts in the utility system that cause losses are transmission and distribution. When looking at all the energy sold in North Carolina in all sectors and dividing this by the overall energy generated at all the utility generating facilities, the overall system is approximately 95% efficient (Federal Energy Regulatory Commission 1997). This is calculated on an annual basis and is averaged over that entire time period. Depending on the time of day and the time of year, the system may be more or less efficient.

North Carolina Energy Outlook, 1998

The Standard & Poor's DRI (1999) report projects a steady, sustained growth in energy consumption for electricity production, based on final electricity demand. Figure 8-2 shows the overall growth rate in utility fuel input with the relative contributions of the major fuels broken out.

Figure 8-2: Projected Utility Fuel Consumption Growth



Source: Standard & Poor's DRI 1999.

The North Carolina Utility System

The primary characteristic of North Carolina's energy demand profile is its rapid growth in all sectors of the economy. According to Standard & Poor's DRI *North Carolina Energy Outlook 1998* (1999*)*, electric growth is projected to continue to be strong: 2.6% in total energy demand growth and between 2% and 2.2% in peak demand (capacity) growth. This is in line with regional load growth projections by the Southern Electric Reliability Council (SERC). The Virginia and Carolina Region (VACAR) of the SERC has projected peak load growths of 2.3% for both summer and winter peaks for 1995 – 2004 (North Carolina Utilities Commission 1997). In fact, the Southeast has the fastest rate of energy demand growth in the entire United States.

North Carolina's final electricity consumption in terms of kWh sales is evenly divided between the residential (38.5%), commercial (28.3%), and industrial (32%) sectors (Energy Information Administration 1997), and the state's electric demand growth is taking place in all three sectors. Industrial production in North Carolina is projected to have a growth rate that climbs to 8% in the year 2010. While the ratio of energy intensive industry jobs to non-energy intensive industry jobs is projected to decline in North Carolina, the largest growth in energy demand in the state will be in the industrial sector. The NC economy still relies heavily on manufacturing with 25% of all jobs – the highest rate in the nation – in this sector. And, in the residential sector, the state has had a 1.8% population growth rate over the past three years, which ranks it 8th in the country (North Carolina Utilities Commission 1997).

In terms of seasonal electric use, North Carolina is a summer peaking state except for Nantahala Power and Light (a subsidiary of Duke Power), Blue Ridge Electric Membership cooperative, and Carolina Power and Light's network in the western part of the state. This is a significant characteristic as it allows planners to focus on ways to reduce only summer peak demand, and this matches well with solar generation which can be used as a summer peak shaving strategy.

Note on Methodology: Carbon Dioxide Emissions from Electricity in North Carolina

As described in Chapter 2, this study employed a method in which the greenhouse gas emissions from electricity production are pro-rated over the end use of kilowatt-hours and assigned to their respective sectors (residential, commercial, industrial). For the base year 1990, an emissions coefficient of 0.188 tons of CO_2 per million Btu was computed and applied evenly to all final demands for electricity. Table 8-1 summarizes the derivation of that coefficient. Note that simply dividing the CO_2 emissions from power plants in North Carolina in 1990 by the total use of electricity in North Carolina in 1990 would underestimate the emissions associated with North Carolina electricity use because it would fail to account for the significant net inflow of electricity from other states that occurred in 1990. As shown in the table, we adjusted for this inflow of power by assuming it had the national average emission coefficient for electricity in 1990, or about 0.26 tons of CO_2 per million Btu of end-use electricity.

Table 8-1: North Carolina Electricity Supply, Demand and Emissions, 1990: Derivation of CO_2 Emissions Coefficient for Electricity.**

Primary Source	Input	Assumed Efficiency	Power to the Busbar	T&D Losses	Electricity to End Users	CO_2 Emissions of Primary Source*	CO_2 Emissions from Electricity
	Trillion Btu	(Percent)	Trillion Btu	(Percent)	Trillion Btu	tons per million Btu*	Megatons
Petroleum Products	2.174	35%	0.761	6.0%	0.715	0.081	0.18
Natural Gas	2.543	35%	0.890	6.0%	0.837	0.059	0.15
Coal	451.703	35%	158.096	6.0%	148.610	0.103	46.53
Nuclear	276.700	35%	96.845	6.0%	91.034	0.000	0.00
Hydro	72.300	35%	25.305	6.0%	23.787	0.000	0.00
Other	6.100	35%	2.135	6.0%	2.007	0.000	0.00
Out of state supply			49.600	6.0%	46.624	0.260	12.12
Totals	**811.5**		**333.6**		**313.6**		**58.97**
End Use Coefficient for CO_2 Emissions from Electricity (tons per MM Btu):							**0.188**

* Except for out-of-state supply, where the emissions coefficient is applied directly to the busbar power.
** The data in the table may not agree exactly with electricity supply and demand figures elsewhere in the report because of slight data and method difference, but the differences are small and do not have a significant effect on the CO_2 emissions coefficient of 0.188 tons per MMBtu.

Emissions from Electricity in 2010 Under Business-As-Usual Conditions

As described in Chapter 2, the method employed this analysis included a “business-as-usual” forecast of emissions in the year 2010. By “business-as-usual” we refer to a projection of future emissions in which the state’s population and economy grow according to conventional economic forecasts, and in which no special efforts beyond those already underway are made to reduce greenhouse gas emissions. The *North Carolina Energy Outlook, 1998* (Standard & Poor’s DRI 1999) was used as the basis for this business-as-usual projection, and the resulting electricity sector is shown in Table 8-2. This table takes the same form as the Table 8-1 for 1990, except no out-of-state supply of electricity is assumed.

Table 8-2: North Carolina Electricity Supply, Demand and Emissions, 2010, State Outlook*

Primary Source	**Primary Input**	**Assumed Efficiency**	**Electricity to the Busbar**	**T&D Losses**	**Electricity to End Users**	**CO2 Emissions of Primary Source**	**CO2 Emissions from Electricity**
	Trillion Btu	(Percent)	Trillion Btu	(Percent)	Trillion Btu	tons per million Btu	Megatons
Petroleum Products	79.200	35%	27.720	5.0%	26.334	0.081	6.42
Natural Gas	180.800	40%	72.320	5.0%	68.704	0.059	10.67
Coal	753.200	38%	286.216	5.0%	271.905	0.103	77.58
Nuclear	376.200	35%	131.670	5.0%	125.087	0.000	0.00
Hydro	53.000	35%	18.550	5.0%	17.623	0.000	0.00
Other	6.100	35%	2.135	5.0%	2.028	0.000	0.00
Out of state supply			0.000	n/a	n/a	n/a	n/a
Totals	**1,448.5**		**538.6**		**511.7**		**94.66**
End Use Coefficient for CO_2 Emissions from Electricity (tons per MMBtu):							**0.185**

* The data in the table may not agree exactly with electricity supply and demand figures elsewhere in the report because of slight data and method difference, but the differences are small and do not have a significant effect on the CO_2 emissions coefficient of 0.185 tons per MMBtu.

In the business-as-usual forecast (*North Carolina Energy Outlook*), electricity demand grows to 512 trillion Btu by 2010, fully 31% higher than its 1990 level. Nuclear and hydro are projected to hold at present (1999) output levels, but coal consumption by power plants grows to 167% of its 1990 levels. The use of natural gas for power production was just beginning in 1990 but by 2010 is forecast to grow to 180 trillion Btu and be supplying over 13% of the state’s power. Petroleum fueled power plants also grow from a very small contribution in 1990 to about 5% of the state’s power by 2010.

Overall, the CO_2 emissions per end-use kilowatt-hour do not change much in the business-as-usual scenario, but absolute emissions grow to 95 million tons, and electricity’s percentage contribution to North Carolina’s total greenhouse gas emissions grows from its already high level of 40% to about 45% by 2010. These results clearly underline the critical importance of electricity in any strategy for reducing North Carolina’s greenhouse gas emissions.

Impact on the Utility Sector of the End Use Sector Analyses

The analyses for the residential, commercial and industrial sectors contained in the previous chapters contain very aggressive scenarios for the more efficient use of electricity. In contrast to the Business-As-Usual Forecast, which is tuned to the *North Carolina Energy Outlook* for the year 2010, the demand for electricity in 2010 would be dramatically lower if the electricity demand side measures described in the sector analyses were implemented.

To avoid double counting of emission reduction impacts from electricity demand side measures and changes in the utility sector itself, the following convention was adopted. First, the electricity demand side measures described in the residential, commercial and industrial sector chapters were quantified using the business-as-usual emission coefficient for electricity in 2010 of 0.185 tons per million Btu's. The total impact of electricity saving measures is summarized in Table 8-3.

Table 8-3: Emission Reductions in 2010 from Electricity Demand Measures

Sector	**Energy Savings in 2010**	**Emission Reductions in 2010**
	(Trillion Btu)	(Megatons of eCO_2)
Residential	99.64	18.44
Commercial	38.39	7.10
Industrial	41.28	7.64
TOTAL	**179.31**	**33.17**

These measures reduce the demand for (and the needed supply of) electricity by such a large amount that the remaining electricity demand could be met with a mix of sources that would result in less greenhouse gas emissions per kilowatt-hour than the business-as-usual outlook. In the business-as-usual outlook, the electricity supply system must produce 540 Trillion Btu's of electricity by the year 2010; after the impact the demand side measures it would need only produce 344 Trillion Btu's, slightly more than in 1990.

There are many different ways that electricity supply system could adjust to this lower level of output, and given the rapid change in this industry, the way it actually would respond is probably still being invented. Greenhouse gas emissions per kilowatt-hour would decline from their forecast level in most scenarios for meeting the lower demand. Table 8-4 presents one possible profile of a North Carolina electricity industry in 2010 after a vigorous program of demand side savings.

A comparison of Table 8-4 and Table 8-2 reveals the extent of the changes in electricity supply that are possible if demand growth can be curbed. In Table 8-4, nuclear is held at current levels, natural gas power grows at the rate projected in the *North Carolina Energy Outlook*, and oil fired power production is phased out altogether. There is a modest program of increased hydro and other renewables, but most importantly coal-fired power production drops to 104 TBtu from 286 TBtu in the business-as-usual forecast. In this scenario, emissions per kilowatt-hour decline from their forecast level of 0.185 tons per million Btu to 0.119 tons per million Btu. When this lower coefficient is applied to the "post savings" demand for electricity in 2010, it reduces emissions by a further 21.4 megatons from the level computed using the business-as-usual forecast of emissions intensity. This reveals the magnitude of the double benefit that can come from vigorous demand side savings in electricity. In addition to the 33 megatons of savings from the demand side measures themselves, the lower residual demand for electricity would allow the system to be operated at a much lower carbon intensity, yielding another 21 megatons of emission reductions relative to the business-as-usual forecast.

It should be noted that the reductions described in Table 8-4 do not necessarily reflect the recommended strategies in the following section. Table 8-4 is intended to be illustrative of one possible scenario for supply-side CO_2 emissions reductions. In the technical strategies section, a more aggressive use of renewable energy and hydroelectric resources is evaluated.

Table 8-4: North Carolina Electricity Supply, Demand and Emissions, 2010, After Demand Side Measures, Mix Adjustment and Supply Side Measures

Primary Source	**Input**	**Assumed Efficiency**	**Power to the Busbar**	**T&D Losses**	**Electricity to End Users**	**CO_2 Emissions of Primary Source**	**CO_2 Emissions from Electricity**
	Trillion Btu	(Percent)	Trillion Btu	(Percent)	Trillion Btu	tons per million Btu	Megatons
Petroleum Products	0.000	35%	0.000	5.0%	0.000	0.081	0.00
Natural Gas	180.000	40%	72.000	5.0%	68.400	0.059	10.62
Coal	275.000	38%	104.500	5.0%	99.275	0.103	28.33
Nuclear	375.000	35%	131.250	5.0%	124.688	0.000	0.00
Hydro	53.000	35%	18.550	5.0%	17.623	0.000	0.00
New hydro, other, renewables	50.000	35%	17.500	5.0%	16.625	0.000	0.00
Out of state supply			0.000	n/a	n/a	n/a	n/a
Totals	**933.0**		**343.8**		**326.6**		**38.95**

End Use Coefficient for CO_2 Emissions from Electricity (tons per MMBtu): 0.119

Additional CO_2 Reductions Beyond Impact of Demand Side Measures in Megatons eCO_2: 21.43

Emissions Reduction Strategies

This section considers six technical strategies for reducing greenhouse gas emissions from the utility sector:

- Increased Renewable Energy Use
- Increased Hydroelectric Use
- Fuel Switching to Natural Gas
- Fuel Switching to Light Oil
- Distributed Generation
- Improved Power Plant Generation Efficiency

Table 8-5 lists the CO_2 emissions reductions from each of these strategies. This table assumes that in the case of renewables, hydroelectric, and fuel switching, that these new fuels and technologies are replacing 100% coal. In the narrative below, hydroelectric has been grouped under renewables, and fuel switching to natural gas and light oil is discussed jointly.

Table 8-5: Emissions Impacts from Utility Mitigation Strategies.

Strategy		**Emissions Reductions from Projected 2010 Levels (Megatons CO_2)**
Increase Renewable Energy Use by 10%		14
Restore Hydroelectric Output to 1990 Levels		2
Fuel Switching to Natural Gas		9
Fuel Switching to Light Oil		1.6
Distributed Generation		15
Improved Power Plant Generation Efficiency		7.6
	TOTAL:	**49.2**

Strategies: Renewable Energy

> Ultimately our energy needs will have to be fulfilled from renewable energy sources, either because the depletable energy sources have been exhausted or, as is more likely, the environmental costs of using the depletable sources have become so high that renewable sources will be cheaper.
>
> - Tom Tietenberg, Environmental Economist

There is an abundance of renewable energy resources in North Carolina that are only partially being used and others that have yet to be utilized. Technology developments are making these renewable resources more and more cost effective. In order to help these important technologies take a more prominent role in our state's future, we must begin now to develop and implement them in a more systematic fashion. Critical factors to be considered are how renewable energy can produce electricity for the grid, as well as meet energy needs on-site through distributed generation, and how energy efficiency can lower the demand. Examples of successful renewable energy installations in North Carolina are cited below.

One of the most promising measures for reducing our state's greenhouse gas emissions is the increased use of renewable energy resources. Renewable energy has always played a significant role in providing our state with the electricity it needs: hydroelectric power was the energy source that fueled the beginning of our state's industrialization. Over the past 40 years we have experienced a gradual shift away from renewable approaches and we now find North Carolina dominated by coal and nuclear power, with only about 3.5% of our electricity generated with renewable power.

In 1990, the U.S. Department of Energy conducted an evaluation of commercialized and emerging renewable energy technologies that could have an impact on energy choices between 1990 and 2030. The conclusions of this analysis were that through increased research, development, and demonstration initiatives, the contributions from renewables could increase from the 1988 level of 8.0% to approximately 17.8% by 2010, 26.7% in 2020 and 39.6% in 2030. But, with enhanced energy efficiency, the growth rate could be cut to one-half percent per year and the contribution that renewables could provide of total demand would increase to over 20% in 2010 (Congressional Research Service 1990).

A 1991 study conducted by the Alliance to Save Energy, the American Council for an Energy-Efficient Economy, the Natural Resources Defense Council, and the Union of Concerned Scientists looked at a policy driven scenario that encourages efficiency and renewables. These groups predicted that the combined efforts of efficiency and renewables could contribute 17.8% of our energy demand by 2010 and 35.3% by 2030 (Alliance to Save Energy et al 1991).

While the future for additional coal or nuclear plants will be clouded by increased environmental regulation and cost, the state is forecasting a 41% increase in electricity demand by 2010 (Standard & Poor's DRI 1999). This staggering amount of growth is forecast at an average annual rate of 2.7%. However, our electric growth since 1984 has actually occurred at an even faster pace (3.4% annually) and, in recent years, has skyrocketed to about 4% annually. If we project ahead using these most recent *actual* growth rates, then electricity demand would rise by more than 60% by 2010. We can, and should, meet and reduce future demand by using energy conservation and efficiency measures, replacing some electrical end uses with on-site renewable generation, and producing clean efficient centrally-generated renewable energy.

Vignette 8-1: PV Applications in N.C.

Duke Power, US Department of Energy, Innovative Design, and the N.C. Solar Center made up the PV Bonus Team which designed and installed a new application of PV on two commercial buildings which captures the excess heat off the back of the panels to preheat either water or air. At Applebee's Restaurant in Salisbury, NC the heat preheats water for kitchen and other uses, so the system serves a dual purpose of providing electricity and hot water. Applebee's is saving 1kW of peak electricity with their system and about 12 kW of peak savings on their hot water needs. At CCB Bank in Bessemer City, the excess heat is used for space heating in their customer and office areas, and the electricity reduces peak demand.

The PV panels which were used for extensive testing by Carolina Power & Light at the Shearron Harris test facility were donated to the NC Solar Center, and now provides reliable electricity for operation of the Solar House at NC State University. These panels are grid-connected, so they provide electricity to the CP&L system when the energy is not needed at the demonstration house (such as weekends and holidays).

Solar energy: photovoltaics (PV). PV technology converts sunlight directly into electricity. It works any time the sun is shining, but more electricity will be produced when the light is more intense (a sunny day) and is striking the PV modules directly (when the rays of sunlight are perpendicular to the PV modules). Unlike solar systems for heating water, PV technology does not use the sun's heat to make electricity. Instead, PV produces electricity directly from the electrons freed by the interaction of sunlight with semiconductor materials in the PV cells.

PV systems are typically divided between on-grid (or “utility tied”) and off-grid (or “independent”). Off-grid PV systems for homes or other buildings must have battery storage for times when PV power is not available. For on-grid or utility tied systems, batteries are optional. One of the advantages of a grid-tied system is that you can use the utility as your back up and forego the purchase of batteries. If you have a grid-tied system with batteries, you will be able to run your system and supply loads even when the utility power goes down.

PV-generated electricity is more expensive than conventional utility-supplied electricity. Improved manufacturing has reduced the cost to less than one percent of what it was in the 1970s, but the cost (amortized over the life of the system) is still about 25 cents per kilowatt-hour. This is roughly three times the retail price that most North Carolina residents now pay for electricity from their utilities. The solar tax credits help make PV more affordable, but it cannot match today’s price for electricity from your utility.

Solar thermal electric. Solar thermal electric systems come in a variety of shapes and sizes. The most common system is the parabolic trough. Parabolic trough systems use mirrored troughs, which focus energy on a fluid-carrying receiver tube at the parabola's focal line. The troughs track the sun to heat the fluid, which is then pumped through heat exchangers to generate super-heated steam to run a turbine generator. Luz International has been very successful with its parabolic trough generating systems. It now has over 350 MW of installed generating capacity on the Southern California Edison electrical grid. To ensure its reliability as a power supplier, Luz has an auxiliary gas-fired boiler to provide uninterrupted power during peak demand periods.

A new joint venture between Duke Engineering & Services, a subsidiary of Duke Energy, and Solar Roof International, a North Carolina company, is entering the commercialization stage of a high temperature solar thermal system for industrial process heat, absorption cooling, and electricity production. One of the prototypes is currently being tested at the NC Solar Center. It is expected to be installed on commercial rooftops this year. Outputs will equal approximately one megawatt per 100,000 square foot of industrial building. Larger, utility scale systems with similar design now are providing 350 MW of peaking power to California’s grid currently through Southern California Edison.

Vignette 8-2: Wind Applications in N.C.

In Carteret County there are three residential wind power sites operating generating a total of 3.7 kW. Two sites have 0.85 kW and 0.75 kW units, respectively, and the third site has three units operating, producing 2.1 kW of electricity. All the homes have the option to be grid connected, but are not currently connected. The site with the largest unit also has hourly data recording instruments, which have collected five years of data for future assessment. Additionally, there is a museum at Cape Lookout that is wind-powered and has been able to replace most of its fossil fuel use.

Water pumping windmills are sprinkled from the coast to the mountains and have been in existence for over 100 years. Some new units have been installed recently. Open Grounds Farm has 30+ units for pumping water to cattle reliably where it is cost prohibitive for the utility to run lines.

Wind power. The cost of wind power has dramatically reduced over the past 20 years. The last study done in the state of North Carolina on this subject is nearly 15 years old and was limited in its scope. The mountains and the coastal regions both have significant potential for the use of wind power. Estimates of generation potential show that between 1,000 to 2,000 megawatts of power are available throughout the state. Using a conservative capacity factor of 20% for wind power, this is a potential resource of 1.75 to 3.5 million MWh of electricity annually (Federal Energy Regulatory Commission 1997).

Reports from Europe are showing the direct impact that wind installations are having on CO_2 emissions. New numbers from the Danish Energy Board has shown that the nation's carbon dioxide emissions have been reduced by 2.8% due to newly installed wind power. Last year 9% of Denmark's electricity was supplied by wind. The new wind installations displaced some electricity formerly generated by coal (Energy Efficiency and Renewable Energy Network 1999).

Biomass. Biomass includes the use of wood waste in any form, agricultural waste products such as poultry and swine manure, municipal solid waste, and methane gas production from landfills for the purpose of producing electricity. North Carolina is one of the leading states in the nation in producing electricity from biomass. The Weyerhauser pulp and paper manufacturing facility in Plymouth, North Carolina has a 113 MW facility which is one of the single largest wood-waste-to-electricity generating facilities in the nation. Other large facilities include a recently built 45 MW wood-waste facility in New Bern and an 18 MW landfill gas facility in the Triad. North Carolina has a total of approximately 300 MW of biomass capacity which produces approximately 1.8 million MWh of electricity annually (based on an estimated average capacity factor of 68%) (North Carolina Solar Center 1998).

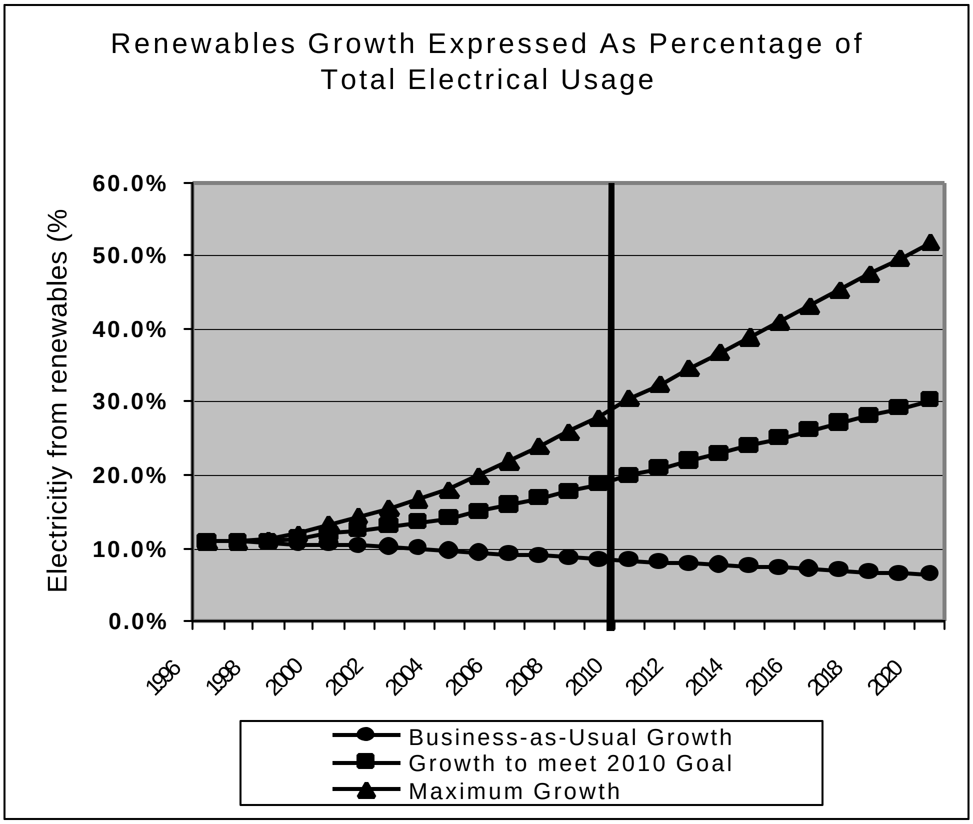
Of all the wood processing that is done here, estimates are that less than 10% of the wood-waste products from these facilities is actually wasted. The production of energy is one of the ways the efficient use of this prolific natural resource can be increased. And, the environmental benefits of biomass have been recognized by the electric industry group, Electric Power Research Institute (EPRI). As noted in the EPRI Journal, "Biomass-fueled generating systems promise an effective and economically feasible approach to reducing the contribution of fossil-fuel based generation to emissions of the greenhouse gas carbon dioxide."

Hydroelectric. Historically, this resource has provided almost all of the renewable energy used in this state for electricity production. Although current electricity production figures exceed 5 million megawatt-hours (MWh) of annual energy production, (Standard & Poor's DRI 1999) there is a potential for at least another 4 million MWh of production from existing sites that were used for water power in the past (Research Triangle Institute 1978). The costs associated with renovating these facilities are substantially below the cost of establishing new small-hydro facilities. The cost of permitting these facilities, however, has become exorbitant. If we are to be able to take advantage of this important resource, the process must be streamlined and facilitated to encourage development.

The price that utilities are willing to pay independent hydroelectric power producers has been steadily decreasing over the past several years. The value of this important resource needs to be recognized by the state and prices kept at predictable levels so that existing producers will be able to keep their facilities operating and reducing the state's consumption of fossil fuels. Over 1,000 MW of hydroelectric plants are currently operating in North Carolina with over 80 MW provided through small independent power facilities. Estimates show that another 1,000 to 1,500

MW could be developed using existing dam facilities. The real need is for low interest capital to be made available for developers to rebuild these facilities. There also must be a market set aside for renewables like hydro to ensure that these local resources are perpetuated. One goal for North Carolina should be the restoration of hydroelectric generating capacity to 1990 levels.

Figure 8-3: Renewables Growth Scenarios for North Carolina.



Source: North Carolina Solar Energy Association 1998

Figure 8-3 illustrates different growth scenarios for renewable energy use in North Carolina over the next twenty years. The vertical line represents the year 2010. The business-as-usual downward trend reflects the declining percentage of renewable generation in North Carolina as the state's capacity grows. The maximum growth line reflects the maximum physically feasible increase in renewables based on research by the North Carolina Solar Energy Association (1998). As discussed below in the policies section, a realistic goal for renewables in North Carolina will fall somewhere in between these two lines.

Figure 8-3 shows three potential scenarios of renewable energy growth in the electrical sector over the next 22 years. The maximum growth rate scenario represents an upper bound to the potential growth rate of renewables in the state based on current technology levels. New and lower cost renewable resources will certainly be developed over this time period causing the maximum goal to increase. This will make higher goals for renewables more achievable in the future. From a percentage point of view, this figure shows that if renewables grow only gradually over the next 22 years, the overall percentage of renewables will continue to decline steadily to a level of 6.4% by the year 2020, thereby continuing our dependence on fossil and nuclear generation, sending fuel dollars out of state and furthering the problems of nuclear waste disposal and poor air quality.

Strategy: Fuel Switching: Replace Coal With Use Of Natural Gas and Light Oil

Fuel switching from coal to natural gas and light oil for power generation can lead to estimated CO_2 reductions of up to 10.6 megatons annually by 2010. To a certain extent, natural gas and light oil can be incorporated into existing power generation units in the state, but most of the increased use of natural gas and light oil in North Carolina in the future will be from capacity additions. From this perspective, emissions reductions from this goal are far more plausible: the vast majority of new capacity in the state is already planned to be gas-fired generation.

While this report is focussed exclusively on greenhouse gases, it is important to note the numerous other environmental benefits that will accrue to our state when coal is replaced by cleaner fuels. Not only will CO_2 emissions be reduced, but both SO_x and NO_x will be appreciably reduced by fuel switching strategies. In fact, it could be fairly argued that these air quality improvements from fuel switching would be more significant than the associated greenhouse gas reductions.

Strategy: Distributed Generation

Distributed generation refers to the use of (usually) smaller-scale generation units located closer to the point of energy demand. As electric utility restructuring legislation opens the energy marketplace to allow for more competition among generators, one likely consequence is that instead of building a small number of large central power stations, we will see more and more generation units that are of small to medium capacity. From Edison's first generation unit in 1882 until late into this century economies of scale have led to larger and larger generating units. However, technology changes have led to the recent realization that smaller generating units can be as or more thermally and economically efficient than the large central generating units that currently supply the vast majority of the electricity in this country.

Distributed resources are small-scale (kWs to MWs) generation, cogeneration, and/or storage systems located at or near a load center which provide energy to loads and/or to the grid. Advantages of distributed resources include:

- tailored to meet customer needs (reserve margin, etc.)
- low emissions
- deferment of T&D capital costs (congestion, growth, etc.)
- lower investment cost than large central power station and network
- short installation times
- easily relocated

Distributed resources (i.e. microturbines, solar, fuel cells, etc.) are now being investigated to address issues such as peak shaving, power quality, reliability, dynamic stability, and the need for increased base load generation. The insertion of distributed resources, however, increases the complexity of optimizing, controlling, and protecting the current power system. In the future power system, distributed resources will have a great impact on real-time system operation and planning. Therefore, distributed resources must be taken into consideration in system performance so that operation and security is not compromised. Such studies are being conducted, and power system controls equipment manufacturers are developing the tools to manage distributed generation sources.

Fortunately for North Carolina, much of the move toward distributed generation sources will take place naturally. This trend will be accelerated when and if the state restructures the utility industry to allow for competition among generators.

Strategy: Improve Existing Power Plant Efficiencies

Improving the thermal efficiencies of existing power plants in North Carolina will save an estimated 7.6 megatons of CO_2 annually by 2010. Considering the current economic pressures to increase power plant efficiency, further thermal efficiency increases may be difficult to achieve. In a very positive note, in November 1999, Duke Power was ranked first nationally in coal power plant thermal efficiency with an average heat rate of 9,382 Btu/kWh among its eight plants. Table 8-6 lists Duke and CP&L's coal-fired plants in North Carolina and their CO_2 emissions levels.

Table 8-6: 1995 Emissions Data for North Carolina's Fossil Power Plants

Company/Plant Name	CO_2 Emissions (Tons)	CO_2 Emissions Rates (lbs/MWh)
Duke Power		
Belews Creek	12,350,708	2,048
Buck	486,480	2,537
Cliffside	2,784,386	2,317
Dan River	477,244	2,796
GG Allen	3,661,778	2,186
Marshall	13,757,769	2,182
Riverbend	395,414	**
Carolina Power and Light		
Asheville	2,939,767	2,253
Cape Fear	1,599,350	2,052
HB Robinson	891,487	2,367
LV Sutton	1,971,796	2,329
Lee	994,751	2,306
Mayo	5,035,618	2,479
Roxboro	14,220,431	2,214
WH Weatherspoon	313,653	2,498

**Not reported.
Source: Public Citizen 1997.

Policies

As noted above all policies to reduce CO_2 emissions in the utility sector will focus on reducing power production from coal. This can be accomplished in a variety of ways: using renewables to fill all new capacity needs, co-firing coal plants with biomass, replacing coal facilities with new gas and renewables plants, and increasing the thermal efficiency of existing coal plants. The policies below outline ways to accomplish the goal of reduced coal power production. These policies are:

- Renewable Portfolio Standard
- Public Benefit Fund
- Emissions Limits and Trading Credits Program

In the past, demand side management (DSM) has been one of the key strategies for reducing the load growth and hence environmental impact. Extensive energy efficiency programs developed under the DSM banner have taught citizens how to save energy through efficiency and conservation. These programs have long lasting effects and have been proven to lower demand and consumption. In this chapter demand side management is not dealt with directly because these types of strategies are discussed in the various end use sector chapters such as residential, commercial and industrial.

Renewable Portfolio Standard (RPS). A goal for renewables could be 10% by 2010. The RPS would require each utility selling power in North Carolina to use renewable energy generation to generate a certain percent of its electricity. The RPS is a flexible, easily verifiable way to guarantee that renewables grow in the new deregulated market. With a RPS included in restructuring legislation we will have a cleaner, sustainable energy future and an improved local economy.

A RPS will help lower the cost and increase the competitiveness of renewable technologies by increasing sales and commercialization and improving the technology. It will help level the playing field. Non-renewable fuels and generation technologies currently have a large market advantage over renewables due to large government subsidies and research and development assistance, already capitalized existing generating plants, and possible recapitalization of some plants through stranded cost payments. Additionally, even though wind and micro hydro generation costs are now comparable to other generation technologies, North Carolina utilities have shown little interest in generating electricity with renewables since the middle third of this century when the major hydro dams where built. Most recent renewable investments have been made by independent power producers, such as micro hydro investors, industries building cogeneration plants, or consumers installing small solar, hydro and wind systems. For the renewables to grow in an unregulated, lowest cost generation market, a RPS is necessary at least until the 20% goal is reached.

Generating utilities can meet the RPS by building renewable generation, long term purchase contracts for block purchases of renewable power, purchase of credits from other generators with renewable generating capacity in excess of the RPS, or from purchasing credits created by the installation of small renewable energy systems by others.

While the RPS requires oversight and enforcement, it has the distinct advantage of being a clearly measurable goal (e.g. 2% solar by 2010), is simple to administer, and allows utility service providers flexibility to meet that goal in the manner they deem most economical and appropriate. Utilities that fail to meet the RPS ordinarily would face penalties.

The RPS requires the balancing presence of an open market and a public benefit fund because it favors a market that is heavily weighted toward the lowest cost renewable technologies available today: wind, biomass and hydro. It will probably not promote new and emerging technologies, existing renewable installations, research and development needs, nor protect low-income consumers. In addition, under a RPS, utilities could choose to do all or most of the work themselves, or purchase renewables out-of-state, bypassing in-state jobs and businesses.

With the establishment of a gradually increasing RPS schedule, spanning a 10-year period, North Carolina would ensure the sustained orderly development of renewable energy technologies. A practical and realistic approach, the RPS would bolster the development of the state's renewable energy industry to a level of competitiveness with conventional fuels and promote self-sufficiency.

Public Benefits Fund. A Public Benefits Fund (PBF)[*] is a wire charge applied to the sale of all non-renewable generated electricity and is similar to the system benefit charge used in other states. The fund collects and distributes money for investment in actions that are in the public interest, but which would not happen in a regulated or unregulated market. It is collected from each ratepayer as a small fraction for each kilowatt-hour sold. It can support smaller scale renewable energy projects, energy efficiency projects not done by the market place, training, consumer education, low interest loans and other financing mechanisms as well as funds for low income assistance.

During the transition period to a competitive market a significantly large PBF is necessary because deregulated energy marketers will not provide the necessary funds to continue renewable and energy efficiency investments or low income assistance that NC has supported in the past. However, as a policy tool, it is important to note that the public benefits fund can be applied with or without the restructuring of the utility industry. In the absence of restructuring legislation such a fund can be established by the Utilities Commission.

A PBF is also necessary when a RPS is implemented because the RPS typically favors economical and established renewable technologies. While supporting the goal of the RPS, the PBF will also commercialize newer technologies, provide affordable loans for in-state, smaller scale, renewable and efficiency projects, and create new local jobs and businesses. Lastly, a PBF is necessary for the same reasons stranded costs must be addressed. Both actions are necessary to correct market imperfections caused by not taking into account pollution and greenhouse gas emissions from electrical generation.

[*] A Public Benefits Fund is also known as a System Benefits Charge in many states.

Over the last five years as competition has entered the industry, most utilities have responded by dramatically cutting or eliminating research and development, renewable energy and Demand Side Management programs and funding (North Carolina Solar Energy Association 1998). In North Carolina, investor-owned utilities' DSM and R&D programs have been reduced in recent years from 1993 levels when these funds amounted to over $125 million, or 1.25 mills/kWh (North Carolina Solar Energy Association 1998).

Of the states that have adopted a public benefits fund, only California and Rhode Island have begun the process of collecting and expending the funds, establishing guidelines and programs, or deciding which technologies and energy sources will receive funding. The California restructuring legislation creates a public benefits fund of approximately 2 mils for each kilowatt-hour sold, providing over a four-year period $540 million for renewable energy applications, and $864 million for energy efficiency programs and incentives. Massachusetts, New Jersey, and Ohio are pursuing a dual strategy of providing both a Public Benefits Fund and a Renewable Portfolio Standard, attempting to capture the different strengths inherent in both approaches.

In North Carolina, a per kWh charge is now used to fund, by legislative statute, the N.C. Utilities Commission and the Public Staff, and to fund Advanced Energy Corporation (formerly, N.C. Alternative Energy Corporation) by voluntary participation of the investor-owned utilities and rural electric cooperatives. In the case of Advanced Energy, which currently collects $0.00003567/kWh (approximately $3.5 million annually), 70% of the funds are placed in restricted accounts for each contributing utility and expenditure is directed and approved by each utility (North Carolina Solar Energy Association 1998).

A public benefits fund has the advantage of being inherently flexible and adaptable to the needs and resources of North Carolina. Funds can be provided to a wide array of technologies, ranging from those now in commercialization to others still undergoing research and development. Funds can also be supplied to end users, rather than concentrating commercial control and development in the hands of the utilities, to foster a renewable energy industry and infrastructure that is diverse and independent.

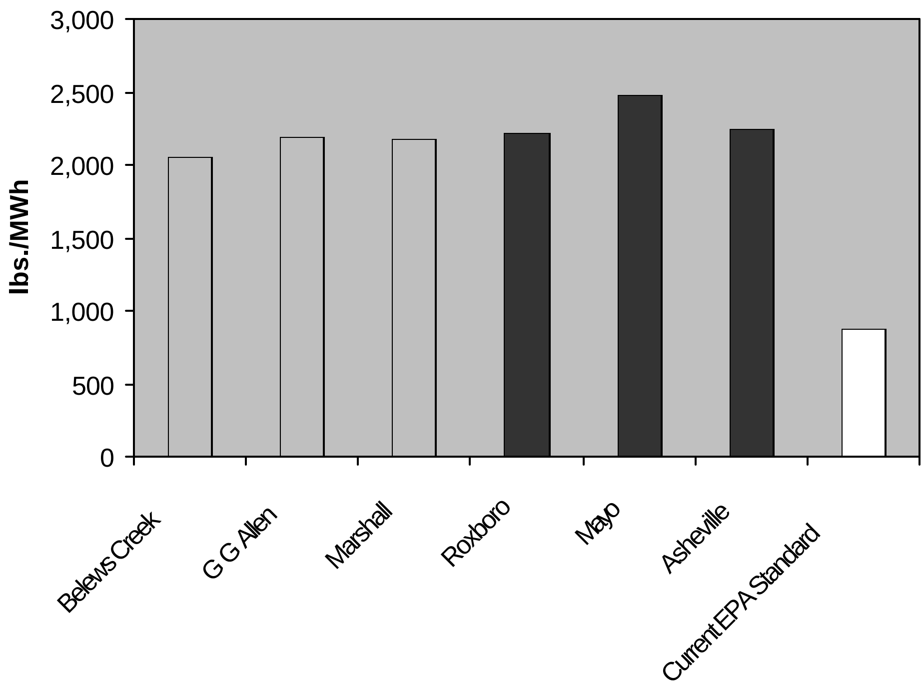
The following are recommendations for the distribution of money collected under the Public Benefits Fund (North Carolina Solar Energy Association 1998). These recommendations would send money to both the demand and supply side of the electricity equation, therefore transcending numerous chapters of this report.

- A majority of the available funds be provided directly to end users—residential, institutional, commercial, and industrial consumers—in the form of rebates, low-interest loans, and grants;
- A portion of the funds be used for research, development and demonstration of new and emerging technologies done in North Carolina that are targeted for major contributions to North Carolina for renewable generation in the period of 2005-2020;
- A portion of the funds be used for technical assistance and training including in-state university and school programs, public and professional education and awareness of renewable energy technologies to prepare the market for introduction of the technologies and establish the infrastructure to serve it; and

- A portion of the funds be available as economic development incentives to encourage manufacturing plants and distributors of renewable energy technologies to locate in N.C.
- A portion of the funds be available to the utilities to assist them in reaching the renewable portfolio standard goals.

Emissions Limits and Trading Credits Program. Ultimately, while a the increased use of renewables through a portfolio standard will decrease CO_2 emissions in North Carolina, there will need to be strict emissions limits placed on our state's fossil fuel plants in order for us to meet our greenhouse gas emissions reduction goals. Emissions standards on new and existing coal plants have been the focus of a great deal of attention both in North Carolina and nationally. In response to the 1990 Clean Air Act amendments, the U.S. Environmental Protection agency has issued emissions standards for new coal-fired power plants. However, older plants are grandfathered and are not required to meet the new, stricter standards. Figure 8-4 illustrates the large difference in some of North Carolina's grandfathered plant emissions to the new EPA standards. The six plants chosen for comparison are the three largest plants owned by Duke Power and CP&L, respectively.

Figure 8-4: CO_2 Emissions Rates from Duke and CP&L's Largest Coal-Fired Plants Compared to the Current EPA Standards



Source: North Carolina Solar Energy Association

Implementing tighter CO_2 emissions standards for North Carolina's grandfathered coal-fired plants is an important undertaking for state energy policy makers and regulators if North Carolina is to seriously reduce our CO_2 emissions. What is recommended is a new emissions limit coupled with an emissions credit trading program. The limit would assure the state that reductions are made, while a tradable credit program creates a flexible, market-based environment in which the most efficient steps to reduce emissions are taken (Tietenberg 1992).

An emissions trading program would start with a cap on emissions assigned to each utility or to each plant. An appropriate cap would need to be set by state regulators. The utilities would then have two options for reaching the proscribed standard: either reduce plant emissions to or below the set limits, or reduce emissions to a point above the set limits and then purchase on the open market emissions reduction credits from other utilities or plant owners whose plants are emitting below the set levels. Under this scenario, utilities or plant owners who would have an easier time reaching the limits (through new technology, innovation, etc.) would have an economic incentive to do better than the standards, because any emissions reductions beyond the standards could be sold in the form of credits. Such programs have been established for sulfur dioxide and other pollutants.

Conclusions

In summary, the supply side of the electricity equation will be a critically important part of any statewide strategy to address greenhouse gas emissions. This chapter has discussed various technical strategies and policies that could be used to reduce CO_2 emissions from our state's power plants, which could lower GHG emissions by 21.4 megatons, representing 20.2% of North Carolina's total 2010 emissions (Table 8-7). And, as noted earlier in this chapter, reductions in CO_2 emissions per kWh will have an impact on emissions reduction strategies for the end use categories addressed in other chapters. Cleaning up our state's power production process will not be easy for North Carolina policy makers, but certain trends are favorable to such changes: potential restructuring suggests competition and innovation in the power producing sector, and the rapid development of clean power sources such as renewables offers viable alternatives to fossil fuels.

Table 8-7: Emissions Impacts from Mitigation Strategies – Utilities Sector

	Reductions eCO_2 (Megatons)	Percent of Total
Electrical Utility Supply	21.39	20.2

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