# Chapter 4
# Energy Supply

## Overview of GHG Emissions

Greenhouse gas (GHG) emissions from the energy supply (ES) sector in North Carolina include emissions from electricity generation and represent a substantial portion of the State's overall GHG emissions (approximately 46% of gross emissions in 2000). A significant portion of North Carolina's gross GHG emissions are associated with electricity imports - roughly 8% of the State's electricity-related fossil fuel emissions were associated with imports in 2000, though this is expected to decline to about 6% by 2020 based on the reference case forecast.

As shown on Figure 4-1, ES emissions are expected to increase from 1990 levels of 54 million metric tons (MMt) of carbon dioxide equivalent ($CO_2e$) to about 98 $MMtCO_2e$ by 2020, or by approximately 83% on a consumption basis. This projection assume that the gross electric generation trends shown in Figure 4-2 are not perturbed by GHG-reducing actions, such as implementation of some or all of the recommendations identified in this chapter.

**Figure 4-1. Historical and projected GHG emissions from the Electric Sector, North Carolina, 1990 to 2020 (consumption basis)**

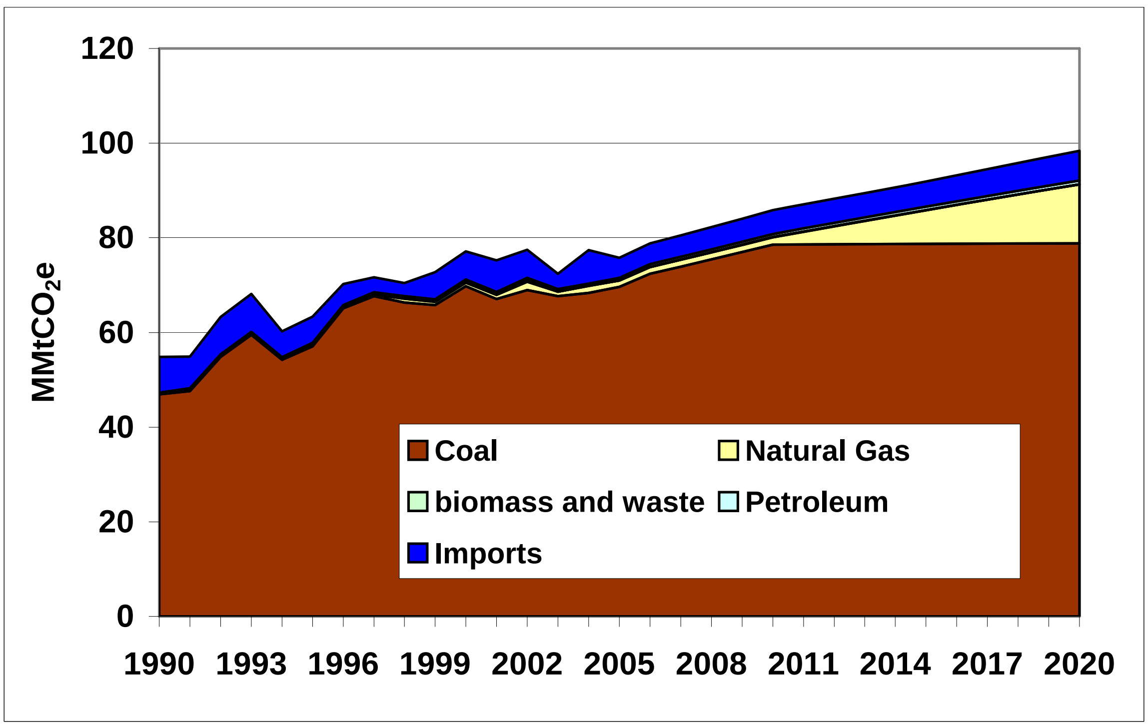
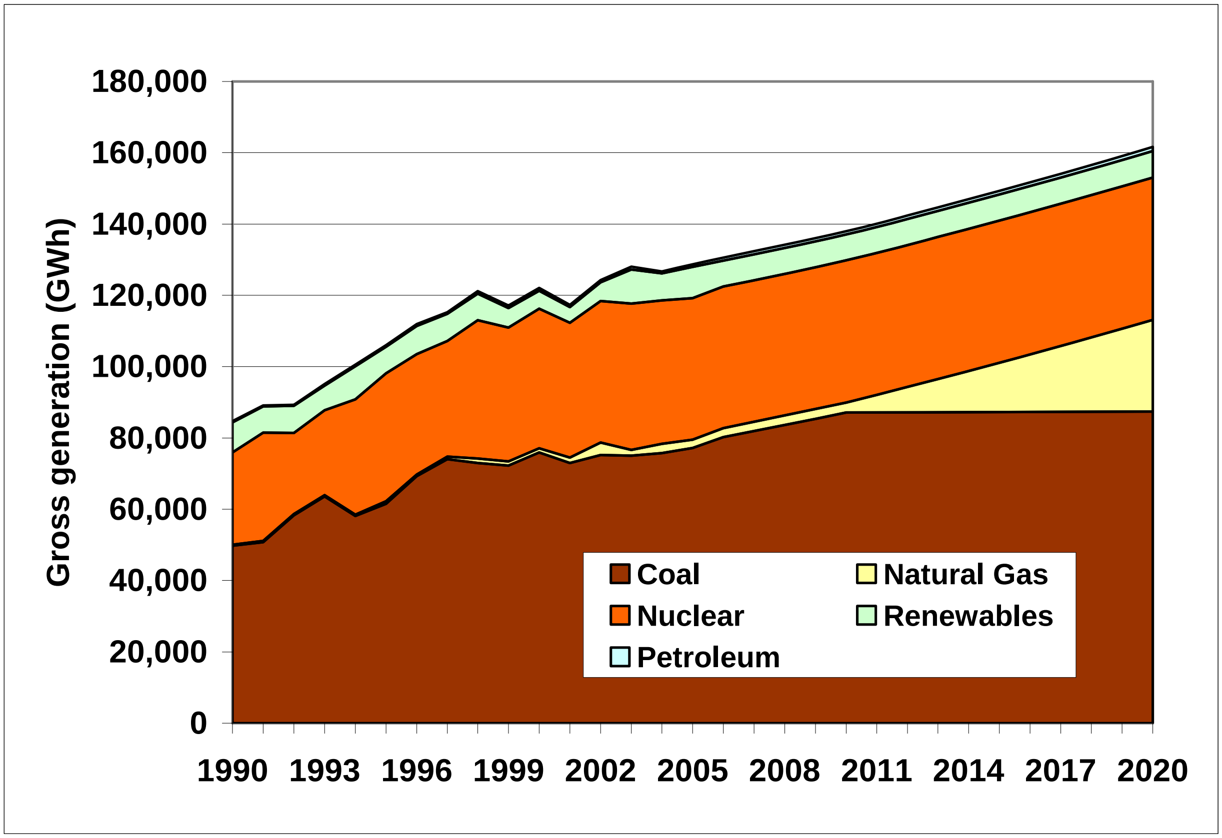


**Figure 4-2. Historical and projected In-State Electric Gross Generation By Source,, 1990–2020**




*Note: only capacity additions assumed at the time of the analysis are included in the above generation projections..*

## Key Challenges and Opportunities

The key challenge in addressing GHG emissions from North Carolina's ES sector is the continued growth of electricity demand within the State. Electricity sales are projected to grow annually at the rate of about 1.6% between 2003 and 2020. This challenge is compounded by the fact that there is expected to be continued significant reliance on electricity produced by coal-fired power stations. These units produced 59% of all electrical energy generated in the state in 1990. While the share of coal-fired electricity is projected to decrease slowly, it is still projected to be a relatively high 54% by 2020.

Fortunately, there are significant opportunities in North Carolina to reduce the GHG emissions growth attributable to energy production and supply, including diminishing the carbon intensity of electrical generation through greater use of renewable energy options, and recapture of waste energy through combined heat and power and other technologies. Significant opportunities to reduce GHG emissions through mitigation options addressing electricity consumption also exist, and can often provide net cost savings to consumers and to the State. The CAPAG has identified several demand-side management, energy efficiency, and conservation measures in the Residential, Commercial, and Industrial Sector; these are detailed in Chapter 3.

North Carolina has significant renewable resources in the form of biomass, wind and hydro energy. North Carolina also has untapped onshore and offshore wind resources, albeit not necessarily well located to meet domestic demand. The intermittent nature of winds inhibits its value for providing baseload capacity, but its value to the electricity grid can be enhanced by carefully planning of wind facilities at multiple sites so they can support power demand in parts of the grid where it is most needed.

## Overview of Mitigation Option Recommendations and Estimated Impacts

The CAPAG recommends a set of 9 mitigation options for the ES sector that offer the potential for significant GHG emission reductions. These recommendations include efforts to increase the supply of electricity from renewable energy sources (ES-1, ES-2, ES-8, and ES-10), encourage lower-emitting fossil fuel generation (ES-6), increase distributed generation and distributed combined heat and power (ES-3 and ES-9), implement cap in-state carbon emissions (ES-4), align environmental objectives within the planning process (ES-5), and reduce electricity demand (ES-7). It is important to note that all the options identified above were approved by unanimous consent of the CAPAG with the exception of the cap-and-trade option (ES-4) and the public benefits option (ES-7), both of which were nonetheless approved by a supermajority of the CAPAG.

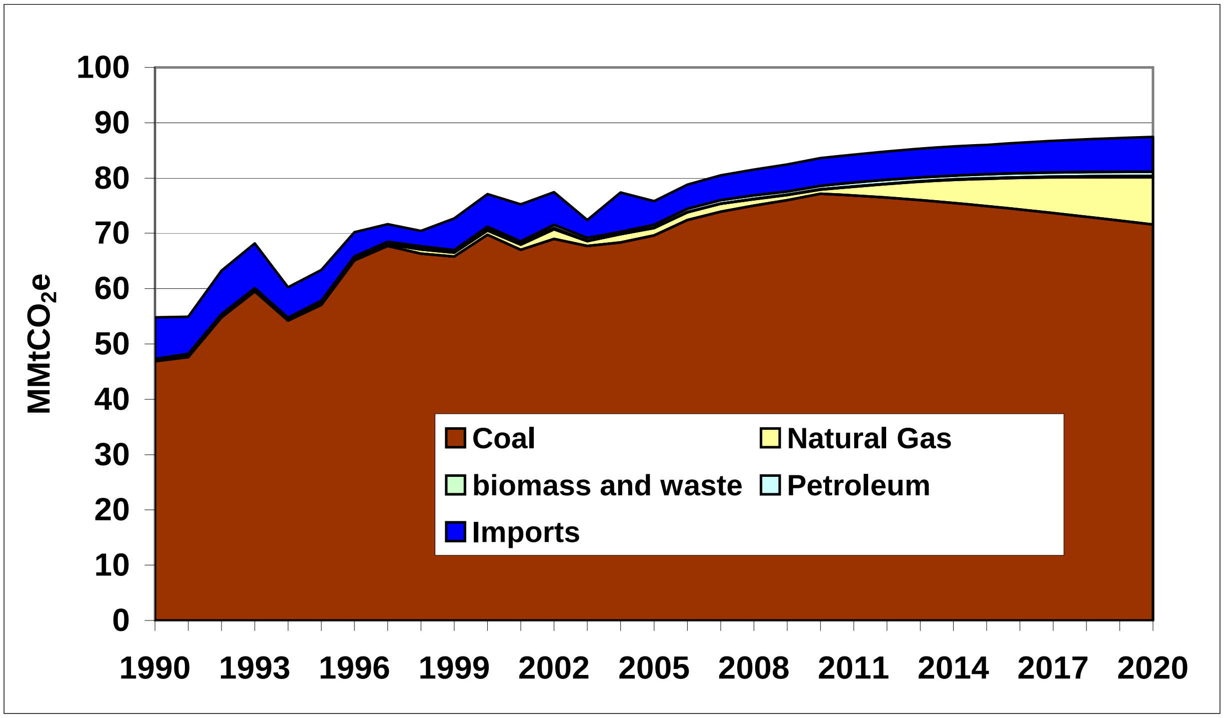
A glance at the numbers in Table 4-1 would seem to suggest that if simply added together, the cumulative emission reductions of these mitigation options could exceed 800 $MMtCO_2e$ in 2020, and NPV costs could approach $4 billion, assuming all options are implemented in isolation from each other. These options are *not*, however, independently additive. In fact, they tend to overlap heavily, so simply summing them would introduce significant double-counting. These options essentially target – through different means – the avoidance of the same or similar emissions sources (e.g., the emissions from existing fossil-fuel power plants and those yet to be built). When taken together in a combined scenario that assumes all of the CAPAG's recommendations are fully implemented, these electricity supply recommendations are estimated to lead to cumulative GHG emissions reductions of about 78 $MMtCO_2e$ through 2020, at a NPV (net present value) cost of about $1.4 billion. (See Appendix F for discussion of the methodology used for the integrated analysis.)

In fact, the CAPAG's recommendations concerning GHG emissions from electricity generation are also highly interactive with its RCI mitigation option recommendations concerning electricity use, because reducing electricity demand can offset the need for new generation, often at a lower cost or even with a savings. The scenario above (full implementation of all CAPAG recommendations) takes into account the many overlaps among ES and RCI mitigation options that reduce the demand for power.

The approach used for estimating emission reductions and costs associated with the combined set of ES and RCI mitigation options involved four major steps. First, electricity saving overlaps among RCI options was accounted for to eliminate the possibility of double-counting. Second, aggregate costs associated with the achieving total demand-side electricity savings were estimated. Third, revised electric generation requirements were estimated that accounted for savings associated with energy efficiency options. Finally, a revised electric generation mix was determined that accounted for renewable energy and other ES options.

Overall, the combined ES and RCI recommendations yield potential reductions in electricity sector emissions from reference case projections of about 63 $MMtCO_2e$ per year by 2020 and cumulative reductions of 375 $MMtCO_2e$ from 2007 through 2020, at a net savings of approximately $6 million through the year 2020 on an NPV basis. These combined ES and RCI results are shown in Figures 4-3 and 4-4.[1]

**Figure 4-3. Impact of electric supply options on electricity sector emissions (energy supply options only) mitigation case, 1990-2020**

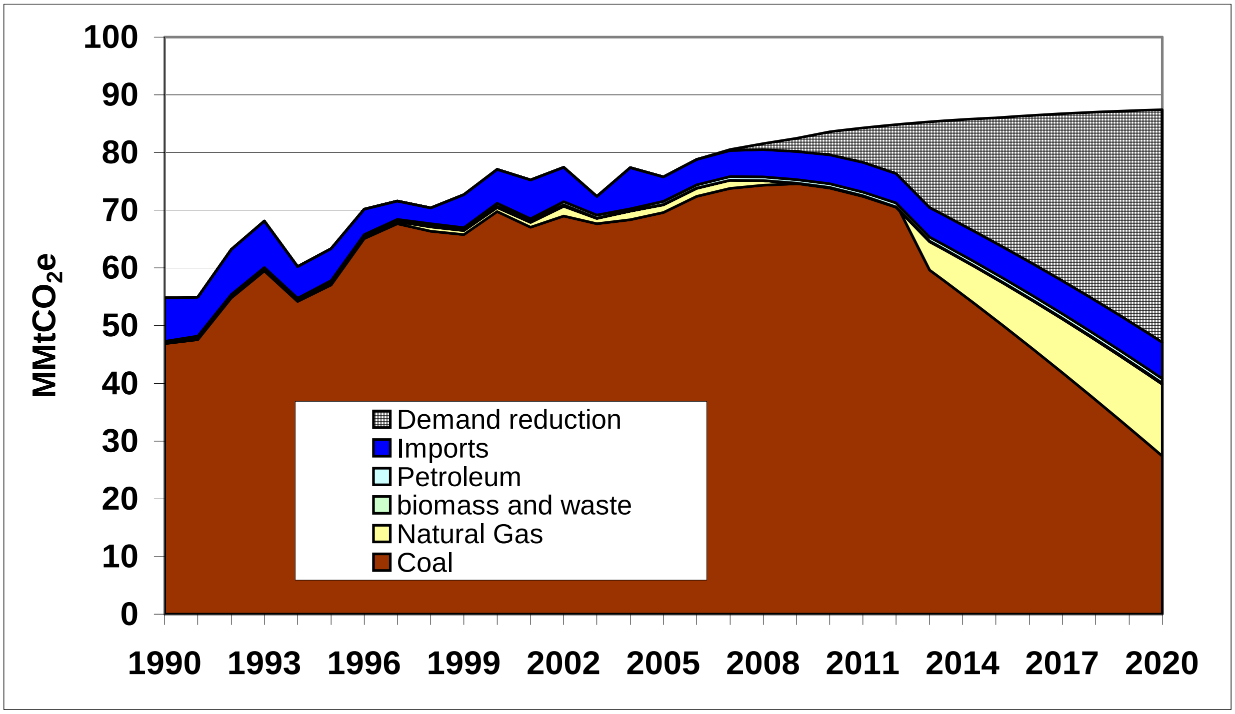



The estimated impacts of the recommended ES mitigation options are shown in Table 4-1. The CAPAG mitigation option recommendations described briefly here (and in more detail in Appendix F to this report) result not only in significant emissions savings, but offer significant additional benefits as well. A substantial expansion of renewable energy in North Carolina, for instance, may be accompanied by a corresponding increase in related jobs in North Carolina as energy investment shifts from fossil fuel production to the manufacture of renewable technologies. Portfolio diversification and hence energy security could be enhanced by the greater penetration of renewable energy resources into the energy marketplace. Moreover,

[1] The net cost savings are based on fuel expenditures, operations, maintenance, and administrative costs, and amortized, incremental equipment costs. All NPV analyses here use a 5% real discount rate.

energy reliability could be enhanced through the penetration of distributed generation.[2] Finally, air pollution-related public health and visibility impacts would decline with reduced fossil fuel-fired emissions from electricity generation. Nevertheless, some renewable sources (i.e., biomass) do emit small levels of GHGs.

**Figure 4-4. Impact of supply- and demand-side mitigation option recommendations on electricity generation sector emissions (including demand reductions) mitigation case, 1990-2020**

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[2] See, for example, the study entitled, "The Role of Distributed Generation in Power Quality and Reliability" by Energy and Environmental Analysis, Inc prepared for NYSERDA in 2004 (available from http://www.eea-inc.com/natgas_reports/DGPowerQualityReport-NYSERDA.pdf).

## Table 4-1. CAPAG-recommended mitigation options and results for the Energy Supply sector

| | Mitigation Option Name | GHG Reductions ($MMtCO_2e$) | | | Net Present Value (Million $) | Cost-Effective-ness ($\$/tCO_2e$) | Level of Support* |
|---|---|---|---|---|---|---|---|
| | | 2010 | 2020 | Total 2007–2020 | | | |
| 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 | |

* UC = unanimous consent (all agree), SMJ = super majority (at least 80 percent or more agree).

** For ES-2, ES-4, and ES-6, emission reductions and costs associated with ES-2b, ES-4a, and ES 6a were used in the cumulative analysis.

*** On August 20, 2007, toward the end of the CAPAG process, Governor Mike Easley signed into law S.L. 2007-397, which establishes a Renewable Energy and Energy Efficiency Portfolio Standard for the state.

## Energy Supply Sector
## Mitigation Option Descriptions

The ES sector includes emissions mitigation opportunities related to electricity generation. These options include mitigation activities associated with the generation, transmission, and distribution of electricity, whether generated through the combustion of fossil fuels or by renewable energy sources; in a centralized power station supplying the grid or by distributed generation facilities; or imported into the state.

### ES-1. Renewable Energy Incentives (Biomass, Wind, Solar, Geothermal, Hydro)

This option focuses on financial incentives that promote the greater use of renewable energy. The incentives are focused primarily for residences, businesses, and other electricity end-users rather than for research and development, outreach, or inter-governmental programs. The effect of these incentives is to encourage investment in renewable power sources by providing direct financial support for adoption of these technologies.

### ES-2. Environmental Portfolio Standard (Renewables and Energy Efficiency) with Renewable Energy Credit Trading

A renewable portfolio standard (RPS) is a mitigation option requiring investor-owned electric utilities to supply a certain percentage of retail electricity from renewable energy sources by a stipulated date. A type of RPS that includes measurable, verifiable and lasting efficiency options is an Environmental Portfolio Standard (EPS). Utilities can satisfy the renewable energy component of the EPS requirement by generating renewable energy themselves or by purchasing renewable energy credits (REC) from a renewable energy generator. A REC is equal to 1 kWh of eligible and verified renewable electricity produced

Three different targets were analyzed for the EPS, as briefly outlined in the bullets below:

- Aggressive target: this corresponds to a 31% combined energy efficiency and renewable energy target by 2020.
- 20% target: this corresponds to a 20% combined energy efficiency and renewable energy target by 2020.
- Load growth offset target: this corresponds to a combined energy efficiency and renewable energy target by 2020 that offsets load growth over that period.

### ES-3 and ES-9. Removing Barriers and Providing Incentives to Combined Heat and Power (CHP) and Clean DG

Combined Heating Cooling and Power (CHP), also know as cogeneration, is a method of utilizing the thermal energy (heat) produced when generating electricity (power) in a single, coordinated process. CHP is more energy-efficient than separate generation of electricity at a central electric plant and production of localized thermal energy for the end user. This distributed generation resource allows for recycling the heat, which is normally wasted to cooling towers or lakes at centralized electric generating stations, to meet onsite thermally-driven demand such as process and space heating, cooling, and dehumidification.

## ES-4. $CO_2$ Tax and/or Cap-and-Trade (Covering Sources Including Fossil, Renewable, and Nuclear on Life Cycle Basis)

A cap and trade system is a market mechanism in which $CO_2$ and other GHG emissions are limited or capped at a specified level, and those participating in the system can trade permits (a permit is an allowance to emit one ton of $CO_2$ or its equivalent in other GHGs) in order to lower costs of compliance. For every ton of $CO_2$ (or other GHGs) released, an emitter must hold a permit. Therefore, the number of permits issued or allocated is, in effect, the cap on emissions. The government can give permits away for free (with permits distributed based on any one of many different criteria, to those participating in the cap and trade system or even to those who are not), auction them, or a combination of the two methods. Participants can range from a small group within a single sector to the entire economy, and can be implemented upstream (at the level of fuel extraction or import) or downstream at the points where fuel is consumed. The CAPAG considered two options for a cap-and-trade system in North Carolina: economywide and only on the power sector. Also, substantial discussion at the TWG and CAPAG levels focused on the geographic coverage of the system, with a number of members indicating that a national system is preferable to state or regional systems.

## ES-5. Aligning Environmental and Profit Incentives Through Electric Sector Regulatory/Rate Reform

Several regulatory and rate reforms in North Carolina would encourage electric utilities to invest in clean, non-carbon-producing energy resources such as renewables and energy efficiency. Under the current rate structure, utilities have an incentive to invest in new large capital projects, which also may inhibit investments in energy efficiency. North Carolina could align the regulated electric utilities' profit motive with increased energy efficiency by removing perverse disincentives to energy efficiency. For example, a carbon adder on new supply sources would have the effect of favoring low carbon-emitting sources such as renewables and/or demand side energy efficiency over higher carbon-emitting sources such as IGCC, natural gas, and coal stations, in ascending order of the impact of a carbon adder.

## ES-6. Incentives for Advanced Coal

Integrated gasification combined cycle (IGCC) is an emerging technology for coal-fired electricity generation, offering the potential for higher efficiency and reduced cost of pollutant emissions control. IGCC involves partially combusting coal under high pressure to produce a synthetic gas, which is then used in a combined-cycle combustion plant to generate electricity. IGCC can be combined with carbon capture and sequestration or reuse (CCSR) in North Carolina to lead to significant $CO_2$ emission reductions relative to those of conventional coal technology. Options for carbon storage are available though limited in the NC region. Based on initial studies, potential sites are located offshore and just west of the state.[3] Support for RD&D for a range of other new technologies to further reduce GHG emissions from coal generation is also envisaged in this option.

## ES-7. Public Benefits Charge on Electric Bills to Support Energy Efficiency Programs

A public benefits charge (sometimes called a systems benefits charge) is a non-bypassable fee attributed to electric customers based on their electricity use in a given time period. The funds collected are then provided to a third party to provide energy efficiency programming. The purpose behind public benefits charges is most often to reduce energy consumption. While efficiency improvements carry significant air quality and GHG benefits, this impact is rarely a consideration for creation of a program. In a GHG-constrained mitigation option context, these benefits boost the attractiveness of a public benefits charge option.

## ES-8. Waste to Energy

The combustion of waste materials, or their conversion by biological or thermo-chemical means to an easily-used fuel, can be used to produce heating, cooling or electric generation with lower GHG emissions than many conventionally-fueled alternatives. This waste-to-energy mitigation option focuses exclusively on the use of methane derived from Municipal Sewage Treatment (MST) to produce electricity. This is due to the fact that the use of other waste resources to substitute for fossil fuels—including landfill gas (LFG), animal waste, agriculture waste, and forestry waste—are all covered under the Agriculture, Forestry, and Waste Management (AFW) TWG, and direct combustion of MSW is opposed by environmental interests.

## ES-10. NC GreenPower Renewable Resources Program

NC GreenPower is an independent, nonprofit organization established to improve North Carolina's environment through voluntary consumer contributions toward the production of renewable energy. The goal of NC GreenPower is to supplement the state's existing power supply with more green energy—electricity generated from renewable resources like the sun, wind and organic matter. The program accepts financial contributions from North Carolina citizens and businesses to help offset the cost to produce green energy. NC GreenPower differs from a Renewable Portfolio Standard (RPS) in that the RPS requires that electric utilities provide a certain level of renewable energy capacity in their generation mix. NC GreenPower is entirely voluntary, with the revenue going toward paying incremental costs of renewable energy generation. Also, because all power purchased through NC GreenPower is produced inside the state, the program provides local and statewide economic development benefits.

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[3] See "Potential Sinks for Geologic Storage of Carbon Dioxide Generated in the Carolinas", by Smith R., et al, prepared for the Southern States Energy Board, March 2007; available at http://www.beg.utexas.edu/environqlty/co2seq/pubs_presentations/CarolinasSummary_16April07.pdf.