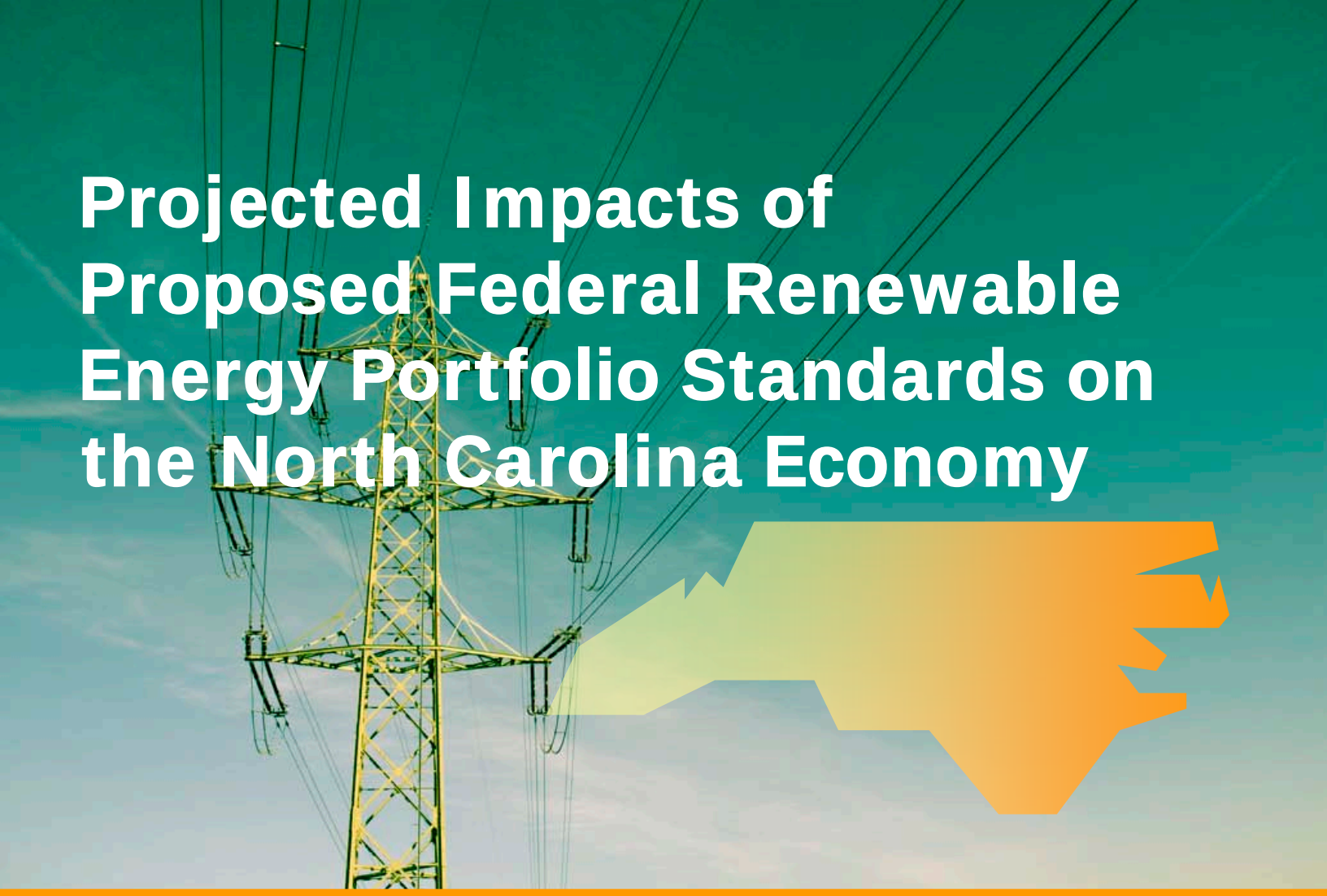

# Projected Impacts of Proposed Federal Renewable Energy Portfolio Standards on the North Carolina Economy

**Final Report to**

**Bipartisan Policy Center**

***by***

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## Executive Summary

The purpose of this study is to project how meeting proposed Federal Renewable Energy Portfolio Standards might impact the North Carolina economy. The impacts from two Federal proposals, the 25% RES and the 20% RES, are compared with the impacts from the current North Carolina Renewable Energy and Energy Efficiency Portfolio Standard (NC REPS).

Projections of future electricity demands and renewable energy requirements under each of the three policy scenarios were used to project the amounts of renewable energy that would need to be generated. Once projections of renewable energy requirements for the state were made, the type and number of facilities required to meet these energy needs was projected. Renewable energy technologies were assessed to determine their ability to contribute to meeting the additional renewable energy requirements given the resource base of North Carolina. The expenditures on construction of additional renewable energy facilities and recurring operating expenditures on inputs to renewable energy generation were then used to project the economic impacts of meeting the additional renewable energy requirements. A regional input/output model, IMPLAN was used to project the economic impacts from expenditures by the renewable electricity industry both statewide and by BEA regions. Economic impacts from the renewable electricity generation, renewable electricity feedstock production, such as dedicated energy crop production or collecting wood or poultry wastes, and from electricity rate per kWh changes were projected. Renewable energy sources projected included solar, hog waste digesters, poultry litter direct fire, co-fire of wood wastes, landfill gas, direct fire of wood wastes, and direct fire of dedicated energy crops.

An estimated 6.2 to 7.8 billion kWh will be generated from renewable resources by 2015 under the various NC REPS and RES scenarios. By 2025 this increases to 10.8 to 23.7 billion kWh depending on the scenario (Table ES.1).

Statewide, the projected 2015 Total Industry Output (TIO) from operating additional renewable facilities is $1.7 billion under the NC REPS, $1.6 billion under the 25% RES, and just under $2.0 billion under the 20% RES (Table ES.2). For 2025, the annual TIO from operating is $2.7 billion under the NCREPS, $5.4 billion under the 25% RES, and $4.9 billion under the 20% RES. Under each policy scenario, the Raleigh-Durham-Cary Region is projected to experience the greatest addition to economic activity, with the Greenville Region second, and the Greensboro-Winston-Salem-High Point Region third. The largest annual operating economic impacts are projected to be derived from direct fire of dedicated energy crops and wood wastes. This is followed by co-fire of wood and poultry wastes.

A significant portion, 25% to 30%, of the economic impacts from the additional renewable electricity would be associated with feedstock production. In 2015, the TIO from feedstock production under the NC RES is estimated at $361.7 million. By 2025, the total impact under NC RES that year increases to $691.9 million. Under the 25% RES and 20% RESs, the total economic impact in 2025 from feedstock production is projected at $1.6 billion and $1.4 billion, respectively.

The North Carolina agricultural sector averaged nearly $8.0 billion in receipts during 2003 to 2007. With an average of $5.1 billion in expenses, the agricultural sectors realized net farm income has averaged nearly $3.0 billion over the same period. In 2007, the direct economic activity from the agricultural and logging sectors is estimated at $9.9 billion. In 2025, the economic activity generated from the NC RES is estimated at $2.2 billion with 0.7 billion derived from agricultural and forest (logging) activities. In the 25% and 20% RES, this estimate of annual impacts increases to $1.6 and $1.4 billion, respectively, of which $0.85

billion and $0.76 billion are direct impacts to the agricultural sector. Economic activity generated at the farm level could increase by $7,227 per farm for the NC RES and to $16,028 per farm if the potential renewable energy projects are undertaken

Although there are negative household income impacts from increased electricity prices, the overall economic impacts from the additional renewable electricity industry are still positive. The total impact of the three scenarios is positive for the state and within each BEA region of the state. Under the NC REPS, the net projected economic impact is $2.2 billion, with $692 million coming from biomass feedstock production from agriculture and forestry. There is a net estimated impact of close to $4.5 billion under the 25% RES, with $1.6 billion of that impact occurring from agricultural and forest activities. Under the 20% RES, in 2025, there is a net impact of $4.1 billion, with $1.4 billion of that impact resulting from agricultural and forest production.

Table ES.1. Summary Electricity Production by Projected Energy Source for North Carolina, 2015 and 2025

| | 2015 | | | 2025 | | |
|---|---|---|---|---|---|---|
| Variable | NC Res | 20% RES Federal | 25% RES Federal | NC Res | 20% RES Federal | 25% RES Federal |
| | | | Billion kWh | | | |
| Total Generation[a] | 125.9 | 124.8 | 124.5 | 134.6 | 133.6 | 134.9 |
| Total Renewable Generation | 6.16 | 7.76 | 6.26 | 10.79 | 20.89 | 23.69 |
| Municipal Waste: | | | | | | |
| Landfill | 0.9 | 0.9 | 0.9 | 0.2 | 0.2 | 0.2 |
| Co-fire: | | | | | | |
| Wood | 0.7 | 0.7 | 0.7 | 2.3 | 2.3 | 2.3 |
| Digester: | | | | | | |
| Swine | 0.18 | 0.18 | 0.18 | 0.28 | 0.28 | 0.28 |
| Poultry | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 | 1.05 |
| Direct Fire: | | | | | | |
| Wood | 3.3 | 2.8 | 2.6 | 2.9 | 2.9 | 2.9 |
| Dedicated Energy Crops | 0.4 | 2.5 | 1.2 | 3.8 | 13.9 | 16.7 |
| Solar: | | | | | | |
| Non Industrial | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Industrial | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 | 0.43 |

In 2007, North Carolina consumed 130 billion kWh of electricity. This is projected to be 127.4 in 2015 and 140.6 billion kWh in 2025.

[a]Total generation assumes energy savings strategies will be maximized to the fullest extent of the law possible.

Table ES.2. Summary of the Projected Economic Impacts for North Carolina, 2015 and 2025[a]

| | 2015 | | | 2020 | | |
|---|---|---|---|---|---|---|
| Variable | NC Res | 20% RES Federal | 25% RES Federal | NC Res | 20% RES Federal | 25% RES Federal |
| Economic Impacts | | | Million dollars | | | |
| Total Industry Output: | | | | | | |
| Operating | 1,658.1 | 1,986.2 | 1,635.4 | 2,663.8 | 4,913.8 | 5,425.0 |
| Household | (250.5) | (335.9) | (276.6) | (421.1) | (831.9) | (957.8) |
| Agriculture and Forestry: | | | | | | |
| Direct | 210.8 | 252.9 | 205.3 | 382.4 | 451.2 | 848.1 |
| Total | 361.7 | 451.2 | 357.6 | 691.9 | 1,441.3 | 1,622.8 |
| Investment Impacts[b] | 6,825.8 | 8,123.7 | 6,825.8 | 10,052.8 | 18,130.9 | 20,139.0 |
| Employment Impacts | | | Number of jobs | | | |
| Operating | 6,992.0 | 8,132.0 | 6,835.0 | 11,102.0 | 19,311.0 | 21,091.0 |
| Investment | 44,101.0 | 52,216.0 | 44,101.0 | 64,810.0 | 115,410.0 | 127,965.0 |
| | | | $/kWh | | | |
| Projected change in energy price | 0.0029 | 0.0037 | 0.0031 | 0.0042 | 0.0083 | 0.0096 |

[a] Does not include cost impact on price of energy saving technologies

[b] Investment impacts are one time impacts estimated to occur during the 2010-2015 period for 2015, and 2021 to 2025 for the 2025 column.

## Table of Contents

## Table of Contents

## List of Tables

## List of Figures

## Projected Impacts of Proposed Federal Renewable Energy Portfolio Standards on the North Carolina Economy

### Study Purpose

The purpose of this study is to project how meeting proposed Federal Renewable Energy Portfolio Standards might impact the North Carolina economy. The two proposals analyzed, which will be discussed later in this document, are the 25% RES and the 20% RES. To conduct the analysis, these two proposed Federal Renewable Energy Portfolio Standards are compared with North Carolina's existing Renewable Energy and Energy Efficiency Portfolio Standard (NC REPS) and existing and planned renewable energy generation. Changes from projected energy generation under the North Carolina REPS to renewable energy generation required meet the proposed Federal standards are estimated. Renewable energy technologies are assessed to determine their ability to contribute to meeting the additional renewable energy requirements given the resource base of North Carolina. The expenditures on construction of additional renewable energy facilities and recurring operating expenditures on inputs to renewable energy generation are then used to project the economic impacts of meeting the additional renewable energy requirements. These impacts are projected for the state and for Bureau of Economic Analysis (BEA) regions within the state (Figure 1) (Appendix E).

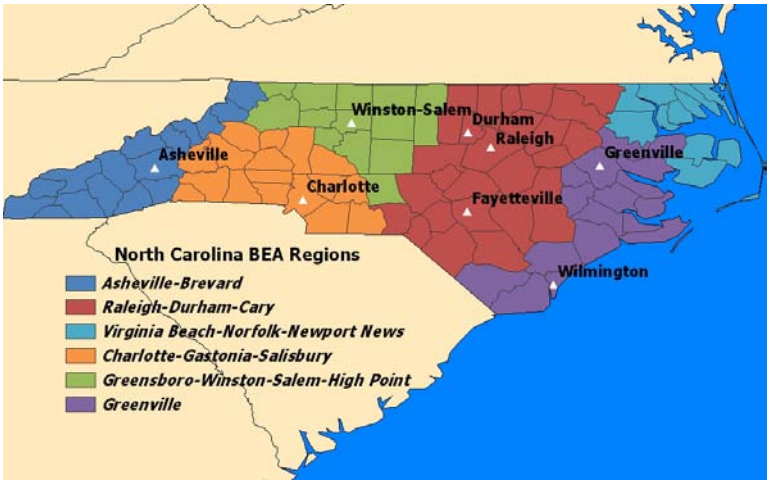



**Figure 1. North Carolina Bureau of Economic Analysis Regions**

### Methods of Analysis

In this analysis, projections of renewable energy requirements for the state of North Carolina must be made for three policy scenarios: 1) the NC REPS, 2) the 20% RES, and 3) the 25% RES. Once projections of renewable energy requirements for the state are made, the type and number of facilities required to meet these energy needs must be determined. The number and type of facilities are determined not only at the state level, but also at the Bureau of Economic Analysis (BEA) region level.

The number and type of facilities in each BEA region are determined based upon plans for facility construction or the potential for facilities based on resources in the region. For example, swine waste energy conversion facilities are placed in BEA regions according to location of swine production. Because in many cases, the sizes and technologies of facilities that might be placed in a region are unknown, representative technologies and sizes for facilities that might go into a region are assumed. These sizes and technologies are selected based upon previous literature and availability of engineering cost data.

Costs, facility sizes, and input requirements for representative renewable energy technologies are then used to project required facility expenditures. Descriptions of the representative technologies are in the Appendix B of this document. The costs and prices presented in the tables in Appendix B are all in $2006. A regional input/output model, IMPLAN (Olson and Lindall, 1999) is used to project the economic impacts from expenditures by the energy conversion facilities both statewide and by BEA regions. Impacts from the various technologies differ depending on the pre-specified demand for that technology, the capital costs involved, and the operating costs. The dollar value projections presented in the document from the IMPLAN model are all in $2009.

The IMPLAN model results presented include estimates of Total Industry Output (TIO), Employment, and Value-Added. Total industry output, a measure of economic activity, is defined as the value of production by industry per year. Employment represents total wage and salary employees, as well as self-employed jobs in a region, for both full-time and part-time workers. Total value added is defined as all income to worker paid by employers; self-employed income; interests, rents, royalties, dividends, and profit payments; and excise and sales taxes paid by individuals to businesses. The IMPLAN results presented include both direct and total impacts. Direct effects measure the response for a given industry given a change in final demand for that same industry. Indirect effects represent the response by all local industries from a change in final demand for a specific industry. Induced effects represent the response by all local industries caused by increased (decreased) expenditures of new household income and inter-institutional transfers generated (lost) from the direct and indirect effects of the change in final demand for a specific industry. Total effects are the sum of direct, indirect, and induced effects. For purposes of brevity, only direct and total effects are presented.

The operating costs for the various technologies shown in Appendix B were used to generate “breakeven” prices for each technology. The breakeven price for each technology was then weighted by projected electricity sales from that technology to arrive at an overall weighted renewable electricity price. The difference between the electricity prices with the additional renewable energy under the two federal proposals and the NC REPS and without the additional renewable energy are assumed to be passed on to consumers either directly through changes in electricity rates or indirectly through rate increases to commercial users that then pass on these costs to consumers through increases in prices of goods and services. The household incomes of consumers in the IMPLAN model were then impacted by this overall amount.

The analysis in this document will be as follows. First, the requirements under the proposed federal renewable portfolio and energy efficiency savings (20% RES and 25% RESs) and the NC REPS will be presented. Second, an energy profile of North Carolina will be presented. Third, the state’s energy situation by potential source of renewable energy will be analyzed, including assessment of potential for feedstocks to supply sufficient energy. Fourth, projections of North Carolina’s renewable energy demand under the NC REPS will be provided, followed by projections under the 20% RES, and the 25% RES. Fifth, the economic impacts of meeting the renewable energy requirements under the various policy scenarios will be projected and compared.

## The Proposed Federal Renewable Portfolio Standards and Federal Energy Savings Requirements

Two proposals have been put forward regarding federal energy standards. The first is for a federal renewable energy portfolio standard. The second proposes energy savings requirements for utilities and a renewable energy portfolio standard.

*The 20% RES*

The proposed new PURPA Section 610-Federal Renewable Portfolio Standard made by 20% RES, or The 20% RES, would require that electric utilities obtain certain percentages of their sales of electricity to consumers from new renewable energy, existing renewable energy, or energy efficiency (Summary of Bingaman Discussion Draft, 2009). These percentages are as shown in Table 1.

Eligible sources include solar, wind, ocean or geothermal energy, biomass, landfill gas, or incremental hydropower. The proposed means of compliance are that the electric utility will submit renewable energy credits, federal energy efficiency credits, or alternative compliance payments. Federal energy efficiency credits cannot be used to meet more than 25% of the requirement. The required percentages shown in Table 1 are adjusted by 25% energy efficiency credits, with these adjusted values shown in the far right column. The alternative compliance payments are at a rate of 3 cents per kWh.

**Table 1. Proposed Federal RPS Annual Renewable Energy Percentage Requirement Under the New PURPA Section 610 by Bingaman (The 20% RES)**

| Year | Required Annual Percentage of Sales | Required Annual Percentage Adjusted for Energy Efficiency Credits |
|---|---|---|
| 2011-2012 | 4.0 | 3.0 |
| 2013-2015 | 8.0 | 6.0 |
| 2016-2018 | 12.0 | 9.0 |
| 2019-2020 | 16.0 | 12.0 |
| 2021-2039 | 20.0 | 15.0 |

*The 25% RES*

The second proposal is an energy savings act coupled with a renewable energy portfolio standard, termed the “Save American Energy Act” (Save American Energy Act, 2009) and the “American Renewable Energy Act” (American Renewable Energy Act, 2009) respectively. This set of proposals was made by Markey (The 25% RES) to amend PURPA. The “Save American Energy Act” would require nationwide minimal levels of electricity and natural gas savings to be obtained through utility efficiency programs, building energy codes, appliance standards, and related efficiency measures (Save American Energy Act, 2009). The performance standards as they relate to retail electricity distributors are shown in Table 2.

**Table 2. Proposed Electricity Savings Requirements for Retail Electricity Distributors Under the "Save American Energy Act" (The 25% RES)**

| Year | Cumulative Electricity Savings Percentage |
|---|---|
| 2012 | 1.00 |
| 2013 | 2.00 |
| 2014 | 3.25 |
| 2015 | 4.50 |
| 2016 | 6.00 |
| 2017 | 7.50 |
| 2018 | 10.00 |
| 2019 | 12.50 |
| 2020 | 15.00 |

The "American Renewable Energy Act" requires the following annual percentages of renewable energy displayed in Table 3. The percentage may be met by submitting the Federal renewable energy credit or an alternative compliance payment. The payment is equal to the lesser of 200% of the Federal renewable electricity credit for the previous compliance year or 5 cents adjusted by the Gross Domestic Product Implicit Price Deflator. The proposed Act treats wind, solar, geothermal, biomass or landfill gas, qualified hydropower, and marine or hydrokinetic renewable energy as qualified renewables.

**Table 3. Proposed Annual Renewable Energy Percentage Requirement Under the "American Renewable Energy Act" (The 25% RES)**

| Year | Required Annual Percentage |
|---|---|
| 2012 | 6.00 |
| 2013 | 6.00 |
| 2014 | 8.50 |
| 2015 | 8.50 |
| 2016 | 11.00 |
| 2017 | 11.00 |
| 2018 | 14.00 |
| 2019 | 14.00 |
| 2020 | 17.50 |
| 2021 | 17.50 |
| 2022 | 21.00 |
| 2023 | 21.00 |
| 2024 | 23.00 |
| 2025 | 25.00 |

The Department of Energy, Energy Information Administration (EIA) conducted an analysis of the 25% RES for a federal renewable energy portfolio (EIA, 2009). The percentages projected by EIA, given exclusion of small power retailers, hydro sales, municipal solid waste (MSW) sales, and energy efficiency credits, are shown in Table 4.

**Table 4. The 25% RES for Federal Renewable Energy Portfolio Standard: Analysis by the Energy Information Administration**

| Calendar Year | Required in Proposed Law | Annual Percentage Excluding: Small Power Retailers | Small Power Retailers, Hydro Sales, and MSW Sales | Sm. Power Retailers, Hydro and MSW Sales, and States Taking Allowable Energy Effic. Credits |
|---|---|---|---|---|
| | | | Percent | |
| 2012 | 6.0 | 5.3 | 5.0 | 3.4 |
| 2013 | 6.0 | 5.3 | 5.0 | 3.4 |
| 2014 | 8.5 | 7.5 | 7.1 | 4.9 |
| 2015 | 8.5 | 7.5 | 7.1 | 4.9 |
| 2016 | 11.0 | 9.7 | 9.2 | 6.3 |
| 2017 | 11.0 | 9.7 | 9.2 | 6.3 |
| 2018 | 14.0 | 12.3 | 11.8 | 8.0 |
| 2019 | 14.0 | 12.3 | 11.8 | 8.0 |
| 2020 | 17.5 | 15.4 | 14.7 | 10.0 |
| 2021 | 17.5 | 15.4 | 14.7 | 10.0 |
| 2022 | 21.0 | 18.5 | 17.6 | 12.0 |
| 2023 | 21.0 | 18.5 | 17.6 | 12.0 |
| 2024 | 23.0 | 20.2 | 19.3 | 13.1 |
| 2025 | 25.0 | 22.0 | 21.0 | 17.0 |

(Source: EIA, 2009).

## North Carolina Renewable Energy and Energy Efficiency Portfolio Standard

North Carolina's Renewable Energy and Energy Efficiency Portfolio Standard (NC REPS), was enacted by *Senate Bill 3* in August 2007. The NC REPS specifies that 12.5% of 2020 retail sales by 2021 will come from renewable sources for investor-owned utilities (DSIRE, 2008; North Carolina General Assembly, 2007). The requirement for electric cooperatives and municipal utilities is 10% of 2017 retail sales by 2018. The full law is presented in Appendix A, Table A.1 of this document. Energy efficiency technologies, including combined heat-and-power (CHP) systems powered by non-renewable fuels, can be used to meet up to 25% of the renewable energy requirements through 2021 and up to 40% of the standard may be met through energy efficiency after 2021.

*Eligible energy resources* include solar-electric, solar thermal, wind, hydropower up to 10MW, ocean current or wave energy, biomass that uses Best Available Control Technology (BACT) for air emissions, landfill gas, waste heat from renewables, and hydrogen derived from renewables. Biomass is defined as including agricultural waste, animal waste, wood waste, spent pulping liquors, combustible residues, combustible liquids, combustible gases, energy crops, or landfill methane; or waste heat derived from a renewable energy resource.

The overall target for renewable energy does include some technology specifications. These specifications are 0.2% solar by 2018 (which includes solar electric, solar water heating, solar absorption cooling, solar dehumidification, solar thermally driven refrigeration, and solar industrial process heat), 0.2% energy recovery from swine waste by 2018, and 900,000

megawatt-hours (MWh) of electricity derived from poultry waste by 2014. The compliance schedule for investor-owned utilities is displayed in Table 5.

**Table 5. Compliance Schedule for Investor-Owned Utilities Under the NC REPS**

| Year | Compliance Percentage |
|---|---|
| 2010 | 0.02% of retail sales from solar |
| 2012 | 3% of 2011 retail sales (including 0.07% from solar + 0.07% from swine waste + 170,000 MWh from poultry waste) |
| 2013 | 3% of 2011 retail sales (including 0.07% from solar + 0.07% from swine waste + 700,000 MWh from poultry waste |
| 2014 | 3% of 2011 retail sales (including 0.07% from solar + 0.07% from swine waste + 900,000 MWh from poultry waste) |
| 2015 | 6% of 2017 retail sales (including 0.14% from solar + 0.14% from swine waste + 900,000 MWh from poultry waste) |
| 2018 | 10% of 2017 retail sales (including 0.20% from solar + 0.20% from swine waste + 900,000 MWh from poultry waste) |
| 2021 | 12.5% of 2020 retail sales (including 0.20% from solar + 0.20% from swine waste + 900,000 MWh from poultry waste) |

While electric cooperatives and municipal utilities must meet the solar, swine waste and poultry waste goals, only the overall target of 10% must be met by 2018. Cooperatives and municipal utilities are permitted to use demand side management or energy efficiency to satisfy the standard without limitation. They may also use large hydropower to meet up to 30%.

Under North Carolina Utility Commission rules, a renewable energy credit (REC) is equivalent to 1 MWh of renewable energy generation, but the law states that RECs do not include credit for emissions reductions from oxides of sulfur and nitrogen, mercury or carbon dioxide. Excess RECs may be applied to the next year's compliance target. Utilities may use unbundled RECs from out-of-state renewable energy facilities to meet up to 25% of the portfolio standard. Qualifying out-of-state facilities are (1) hydroelectric power facilities with a generation capacity up to 10 MW, or (2) renewable energy facilities placed into service on or after January 1, 2007. Suppliers with fewer than 150,000 customers are not limited in the amount of out-of-state renewable energy RECs they may use to meet the standard.

Utilities may recover the incremental cost of renewable resources and up to $1 million in alternative energy research expenditures annually from customers. The cost per customer account is capped according to the following schedule: for 2008, residential $10, commercial $50, and industrial $500; for 2012 residential $12, commercial $150, and industrial $1,000; for 2015, residential $34, commercial $150, and industrial $1,000.

## North Carolina's Current Energy Profile

North Carolina's net electricity generation for 2008 was 126.2 million MWh (Table 6). In 2008, the retail sales were 130.0 million MWh. North Carolina's energy portfolio is currently heavily reliant upon coal-fired electricity and nuclear energy. Based upon 2008 data, about 60.7% of net electricity generation comes from coal-fired and about 31.5% comes from nuclear (Figure 2). Non-hydroelectric renewables account for less than 2%.

**Table 6. North Carolina Net Electricity Generation, 2008**

| | Million MWh |
|---|---|
| Total Net Electricity Generation | 126.2 |
| *By Source:* | |
| Petroleum-Fired | .3 |
| Natural Gas-Fired | 4.1 |
| Coal-Fired | 76.6 |
| Nuclear | 39.8 |
| Hydroelectric | 3.4 |
| Other Renewables | 1.9 |
| Other | .1 |

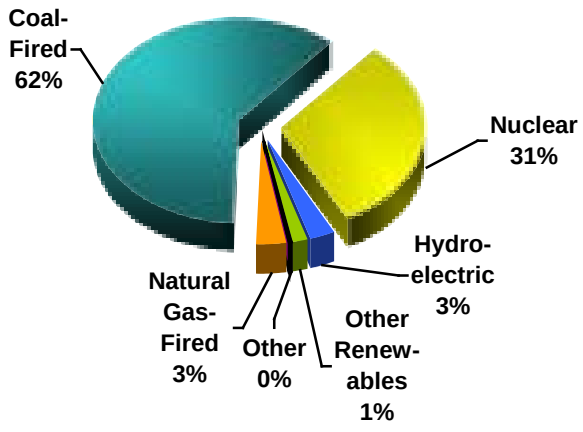



**Figure 2. Sources of Net Electricity Generation, 2008**

(Source: Department of Energy, Energy Information Administration, Electric Power Monthly, March 2009)

Facilities that use at least some renewable sources to produce energy had a total of 565.4 MW of nameplate capacity. This can be compared with 29,619 MW of nameplate capacity for all facilities in the state. Renewable sources used include black liquor, wood solids, landfill gas, metropolitan solid waste, and other biomass solids. Some of the combinations of feedstocks are wood solids and bituminous coal, landfill gas and distillate fuel oils, and metropolitan solid waste and natural gas. The names, locations, energy sources, and nameplate capacities of facilities using renewable energy sources are displayed in Table 7. The locations by type of energy source are mapped in Figure 3.

**Table 7. North Carolina Electricity Generation Facilities Using Renewable Energy Sources, 2007**

| Utility Name | Plant Name | Street | City | Zip | Total Name-plate | Energy Sources* | Plan-ned Modif |
|---|---|---|---|---|---|---|---|
| Blue Ridge Paper Products Inc | Canton North Carolina | 175 Main Street | Canton | 28716 | 40 | BIT, BLQ RFO, WDS | N |
| Carlyle/Riverstone Renewable Energy | Coastal Carolina Clean Power | 1838 NC 11 & 903 | Kenansville | 28349 | 44.1 | WDS, BIT, TDF | N |
| Catawba County | Blackburn Landfill Co-Generation | 4017 Rockyford Road | Newton | 28658 | 2.9 | LFG | N |
| CMS Generation Operating Co II | Craven County Wood Energy LP | 201 Executive Parkway | New Bern | 28562 | 50 | WDS, PG, OBS,WO | N |
| Corn Products Intl Inc | Corn Products Winston Salem | 4501 Overdale Road | Winston-Salem | 27107 | 0.9 | WDS,BIT, NG | N |
| Corn Products Intl Inc | Corn Products Winston Salem | 4501 Overdale Road | Winston-Salem | 27107 | 7.5 | WDS,BIT, NG | N |
| Domtar Paper Company LLC | Domtar Paper Co LLC Plymouth NC | NC Hwy 149 N | Plymouth | 27962 | 146.5 | WDS,BIT, RFO,DFO, SLW, BLQ | N |
| Gas Recovery Systems Inc | Charlotte Motor Speedway | 5101 Morehead Road | Concord | 28027 | 5.3 | LFG, DFO | N |
| Industrial Power Generating Company LLC | New Bern | 7420 Old US 70 West | New Bern | 28562 | 3.6 | LFG, DFO | N |
| International Paper Co-Riegel | International Paper Riegelwood Mill | 865 John L Riegel Road | Riegelwood | 28456 | 61.5 | BLQ, WDS, RFO NG | N |
| KAPSTONE Kraft Paper Corp | KapStone Kraft Paper Corp | 100 Gaston Road | Roanoke Rapids | 27870 | 22.5 | BIT, RFO, WDS | N |
| Michigan Cogeneration Sys Inc | Salem Energy Systems LLC | 335 West Hanes Mill Road | Winston-Salem | 27105 | 4.5 | LFG | N |
| New Hanover County | New Hanover County WASTEC | 3002 Hwy 421 North | Wilmington | 28401 | 10.5 | MSW, NG | N |
| Primary Energy of North Carolina LLC | Primary Energy Roxboro | 331 Allie Clay Rd. | Roxboro | 27573 | 67.5 | BIT, TDF, WDS | N |
| Primary Energy of North Carolina LLC | Primary Energy Southport | 1281 Powerhouse Dr. S.E. | Southport | 28461 | 67.5 | BIT, TDF, WDS | N |
| Weyerhaeuser Co-New Bern | Weyerhaeuser New Bern NC | Highway 43 North | New Bern | 28563 | 29.7 | BLQ, RFO | N |

(Source: Department of Energy, Energy Information Administration, Form EIA-860 Database)
*See Appendix A, Table A.2 for an abbreviation listing of energy sources.

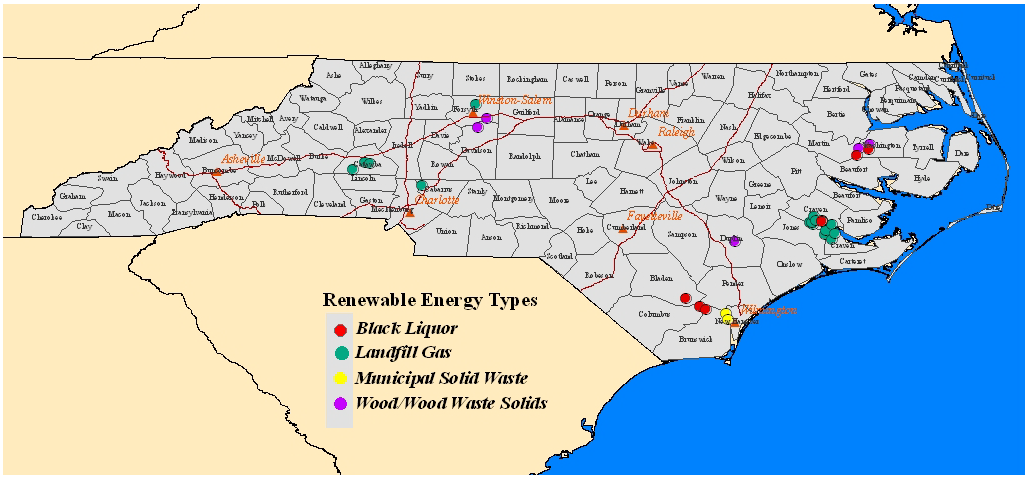



**Figure 3. Electricity Generators Using Renewable Energy Sources, 2007**

Several other electricity generation sites have been proposed that would use renewable energy sources. These locations are shown in Table 8. The largest facilities would be owned by FibroWatt and would incinerate poultry litter.

**Table 8. Proposed North Carolina Electricity Generation Facilities Using Renewable Energy Sources, 2007**

| Utility Name | Plant Name | City | State | Zip | Nameplate Capacity | Energy Source | Target Year |
|---|---|---|---|---|---|---|---|
| Fibrowatt LLC | Fibrowatt-Sampson County | Faison | NC | 28341 | 55 | OBS, PG | 2011 |
| Fibrowatt LCC | Fibrowatt-Montgomery County | Biscoe | NC | 27209 | 55 | OBS, PG | 2012 |
| Fibrowatt LLC | Fibrowatt-Surry County | Elkin | NC | 28621 | 40 | OBS, PG | 2011 |
| SAS Institute Inc | SAS 1MW Capacity Solar Array | Cary | NC | 27513 | 0.5 | SUN | 2008 |
| SAS Institute Inc | SAS 1MW Capacity Solar Array | Cary | NC | 27513 | 0.5 | SUN | 2008 |

(Sources: Department of Energy, Energy Information Administration, Form EIA-860 Database, Fibrowatt)

Other facilities, not in the EIA-860 database listed in Table 8, include the solar projects planned by Duke Energy with SunEdison and distributed solar projects planned by Duke (Duke Energy Solar Webpage, 2009). Duke Energy proposes to purchase electricity from a 16MW solar farm being constructed by SunEdison. Duke also proposes to work with homeowners and businesses to install another 8 MW of distributed solar power across the state. In addition, a landfill gas facility of 2 MW capacity is proposed for 2009 construction (EPA, 2008).

## Potential for Energy Generation to Meet Renewable Energy Requirements

Several sources are candidates for renewable energy in North Carolina. In some cases, these sources are already being used to generate renewable electricity. The potential for sources to supply electricity are discussed in the following section. The potential sources include poultry litter, swine manure, landfill gas, solar, co-fire of biomass, and direct fire of biomass from a dedicated energy crop.

*Poultry Litter*

North Carolina's poultry industry includes broilers, turkeys, layers, pullets, and other types of poultry. According to the 2007 Census, the 2007 inventory was 149.9 million broilers, 17.9 million turkeys, and 12.7 million layers (Table 9). Using estimates of poultry litter producer per bird per day, the potential tons of litter is calculated at just over 2.1 million tons of litter per year. With the capacity to litter feedstock ratio of a 55 MW facility using 700,000 tons per year, the potential MW of capacity is 170 MW for the state. These estimates suggest there is enough litter produced in-state to support about 2 or 3 large scale poultry litter incineration facilities. The locations of broilers, turkeys, and layers by county are shown in Figure 4. The requirements under the NC REPS are for 900,000 MWh of electricity from poultry litter by 2014. As shown in the Appendix B, Table B.9, the representative large-scale facility could produce about 385,440 MWh/year. Hence, only two or three large scale facilities would meet the NC REPS. The facilities planned by Fibrowatt, which will incinerate poultry waste, are listed in Table 8.

**Table 9. North Carolina Poultry Numbers, Projected Litter Production, and Potential Energy Capacity**

| | Number | Pounds Litter/Day/Bird | Tons of Litter per Year | Potential MW Capacity |
|---|---|---|---|---|
| Layers | 12,748,275 | 0.135 | 314,086 | 25 |
| Pullets | 7,129,798 | 0.04 | 52,048 | 4 |
| Broilers | 149,921,809 | 0.04 | 1,094,429 | 86 |
| Turkeys | 17,865,896 | 0.21 | 684,710 | 54 |
| Quail | 1,513,994 | 0.04 | 11,052 | 1 |
| All Other | 150,788 | 0.04 | 1,101 | 0 |
| Total | | | 2,157,426 | 170 |

(Sources: Poultry Numbers-USDA/NASS 2007 Census of Agriculture, Pounds of Litter/Bird/Day-Frazier, Barnes & Associates, LLC, 2004. Broiler pounds per bird were assumed for pullets, quail, and other. Electricity capacity to tons of litter-Based upon 55 MW Fibrowatt facility using 700,000 tons of litter in LaCapra Associates, 2006)

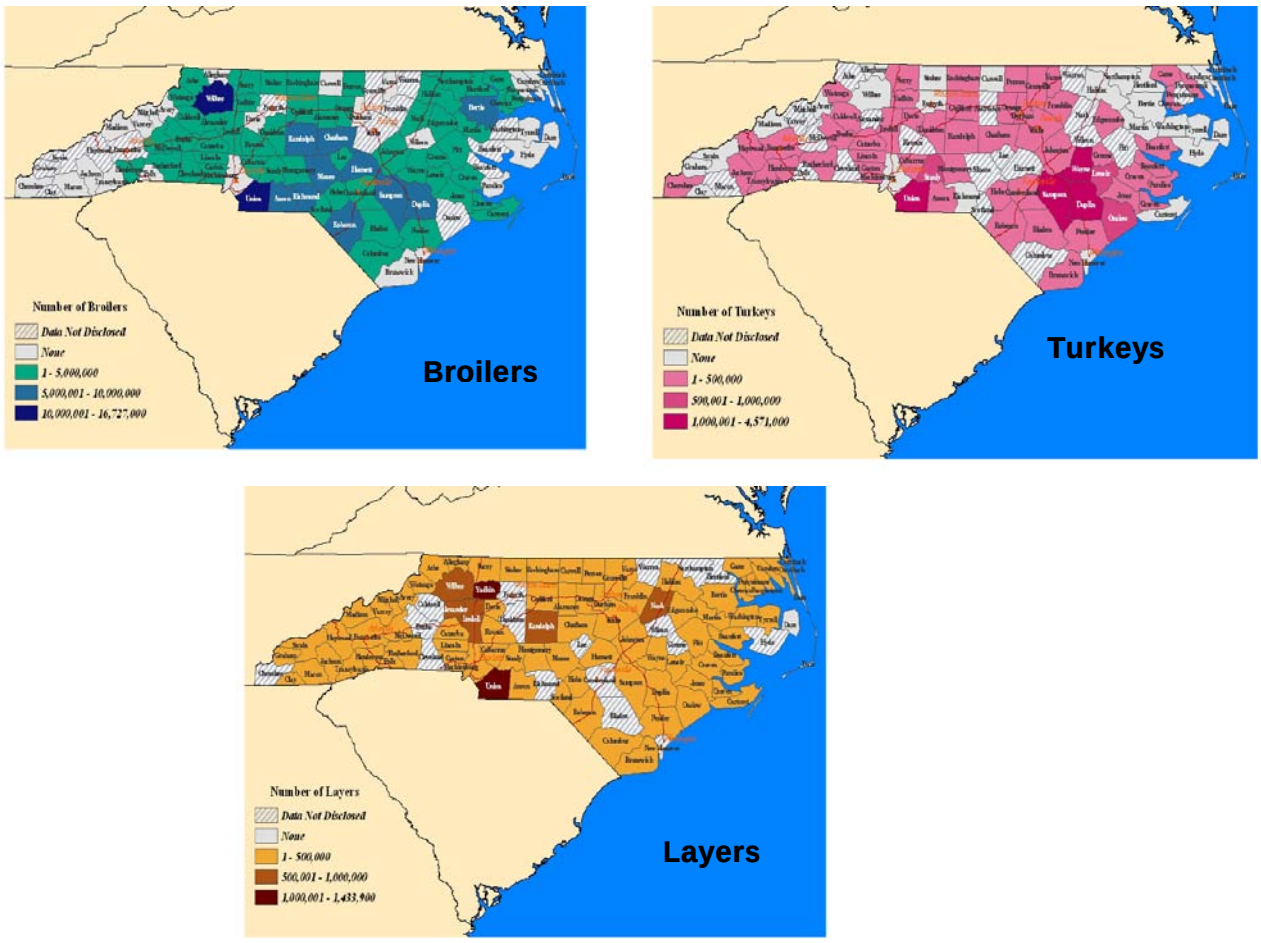



**Figure 4. Locations of Broiler, Turkey, and Layer Production, North Carolina, 2007**

*Swine Manure*

The overall swine numbers and projected manure production for North Carolina are provided in Table 10. The projected statewide total manure production is over 143 million tons per year.

**Table 10. North Carolina Swine Numbers and Projected Manure Production**

| | Farrow to wean | Farrow to finish | Finish only | Farrow to feeder | Nursery | Other |
|---|---|---|---|---|---|---|
| Inventory | 1,415,329 | 892,014 | 4,481,822 | 1,367,999 | 1,496,685 | 480,155 |
| Manure Lbs/Day | 60 | 77 | 84 | 64 | 84 | 84 |
| Tons Manure/ Year | 15,497,853 | 12,535,027 | 68,706,331 | 15,978,228 | 22,944,181 | 7,360,776 |
| State Total Tons | 143,022,396 | | | | | |

(Sources: Hog Numbers-USDA/NASS 2007 Census of Agriculture, Manure per Head- Chastain, Camberato, Albrecht, and Adams, 2003)

If only larger farms, 2,000 head herd size or greater, are used in the analysis, the total inventory of hogs and pigs available for contributing manure to energy production would be 9,370,967 head (Table 11). This is a total of 1,146 operations. Assuming 80,000 head required per MW of capacity, the potential capacity is then 117.14 MW statewide (LaCapra Associates, 2006; EPA Anaerobic Digesters Database). If electricity production is limited to operations with 5,000 head or more (608 farms total), the potential MW would be 94.85 MW. The locations of hogs by county are displayed in Figure 5. The largest concentrations of hogs are in Sampson, Duplin, Bladen, and Wayne counties in the southeastern section of North Carolina.

**Table 11. North Carolina Hogs and Pigs Inventory by Herd Size, 2007**

| Herd Size | Number of Farms | Number of Hogs |
|---|---|---|
| Total inventory | 2,836 | 10,134,004 |
| Farms with- | | |
| 1 to 24 | 927 | 5,129 |
| 25 to 49 | 104 | (D) |
| 50 to 99 | 64 | (D) |
| 100 to 199 | 42 | 5,396 |
| 200 to 499 | 47 | 14,192 |
| 500 to 999 | 48 | 34,900 |
| 1,000 to 1,999 | 454 | 695,700 |
| 2,000 to 4,999 | 542 | 1,783,259 |
| 5,000 or more | 608 | 7,587,708 |

(Source: Hog Numbers-USDA/NASS 2007 Census of Agriculture)

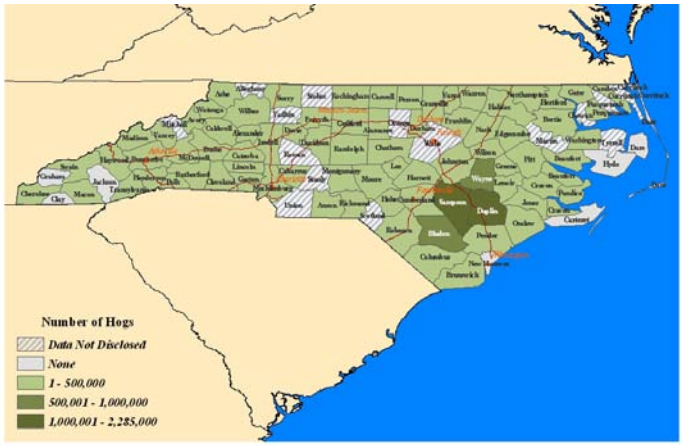



**Figure 5. Locations of Hog Production, North Carolina, 2007**

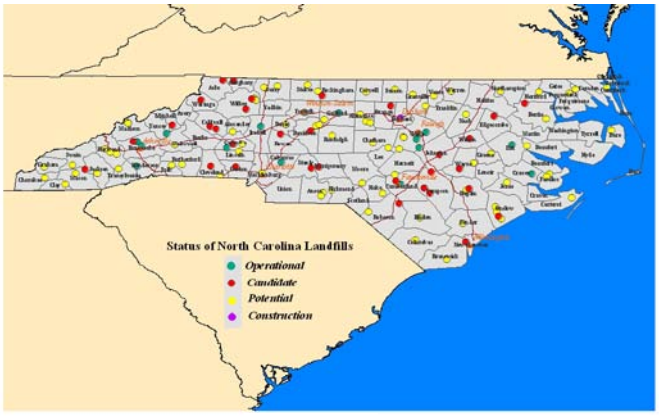
As can be seen in Appendix B, Table B.8, the representative size hog digester system selected is for a 4,000 sow operation that has .05 MW capacity producing 275,940 kWh/year. From Table 12, a total of 7,587,708 hogs are on farms with 5,000 head or more. This suggests potential generation from 1,897 digesters for a total of 523.4 million kWh.

Projections for electricity requirements from swine manure are 281.1 million kWh by 2025 (Table 13). Therefore, sufficient capacity is projected to be available to meet and exceed

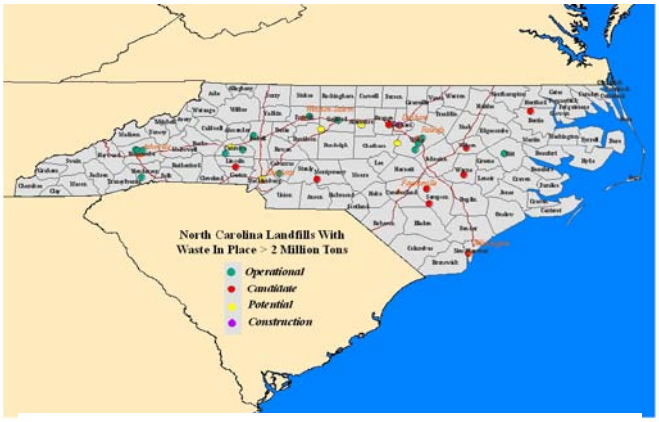
the requirement. To meet the requirement of 281.1 million kWh would necessitate a total of 1,019 of the representative digester systems.

*Landfill Gas*

From Table 6, it could be seen that as of 2007, four electricity generators used landfill gas. Since that time some facilities have been under construction or are in planning. The maps in Figure 6 use data from the EPA Landfill Gas Projects Database. This data reflects the facilities listed in Table 6, but also includes newer or planned projects. The second map in Figure 6 shows locations of landfills with greater than 2 million tons of waste in place. Currently, an additional facility that is about 2 MW is under construction (Environmental Protection Agency, Landfill Methane Outreach Program, Energy Projects and Candidate Landfills Database).




Landfills




Landfills With > 2 Million tons of Waste in Place

**Figure 6. North Carolina Landfills and Landfills with Great than 2 Million Tons of Waste in Place**

*Solar*

Based on National Renewable Energy Laboratory estimates, nearly the entire state of North Carolina falls into the 4.5 to 5.5 kWh/m$^2$/day based on annual average daily solar radiation data[1](Figure 7)(NREL, 2009). Two technologies for solar are assumed in this analysis – utility sized and rooftop sized for residential and small businesses. The planned locations of the utility sized facilities are already known and therefore placed in the appropriate BEA region. With regard to the rooftop technology, projected population is used to weight the number of panels to BEA region (Figure 8) (Table 12).

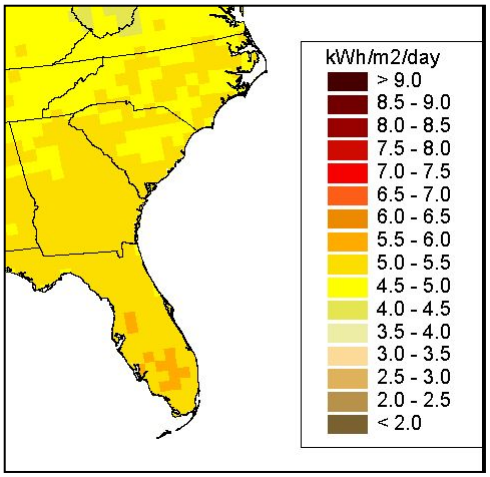



**Figure 7. PV Solar Radiation (Flat Plate, Facing South, Latitude Tilt, North Carolina and Surrounding States**
(Source: NREL, 2009)

[1] The US range is from 7.5 to 8 kWh/m$^2$/day in Arizona to 3.5 to 4 kWh/m$^2$/day in Western Washington.

**Table 12. Projected Population by BEA Region, North Carolina**

| BEA Region/State | 2015 | 2020 | 2025 |
|---|---|---|---|
| Asheville-Brevard | 753,236 | 790,363 | 825,611 |
| Raleigh Durham Cary | 3,476,996 | 3,763,612 | 4,055,703 |
| Virginia Beach-Norfolk-Newport News | 223,288 | 236,826 | 249,462 |
| Charlotte-Gastonia-Salisbury | 2,839,901 | 3,092,860 | 3,352,163 |
| Greensboro-Winston-Salem-High Point | 1,794,853 | 1,880,657 | 1,967,570 |
| Greenville | 1,175,412 | 1,239,985 | 1,300,875 |
| North Carolina | 10,263,686 | 11,004,303 | 11,751,384 |

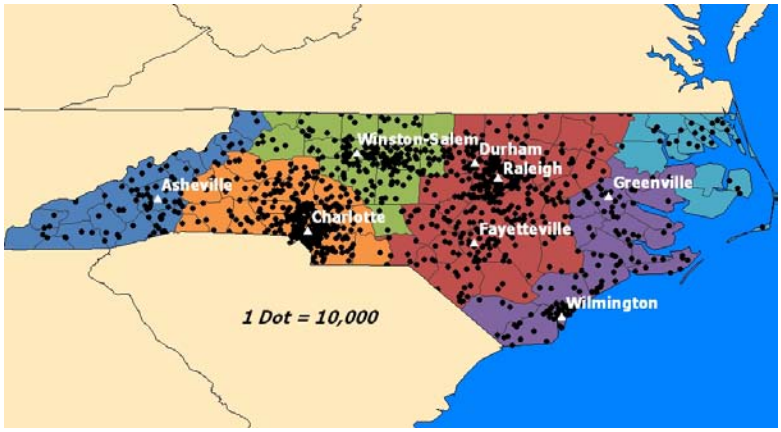



**Figure 8. 2025 Population Projections, North Carolina**

(Source: Office of State Budget and Management, North Carolina, 2009)

*Co-Fire*

As shown in Table 7, North Carolina already has electricity produced through co-firing biomass with bituminous coal, with the primary feedstock being wood solids. The potential for additional co-firing of biomass is reliant on additional facilities using wood solids along with coal. If electric power plants with less than 200 MW of capacity using bituminous coal, but not currently co-firing, are considered as candidates plants for co-firing biomass with coal at a rate of 15%, then the total nameplate of additional co-firing capacity is 2,083 MW. These candidate plants are listed in Table 13.

**Table 13. Candidate Electricity Generators Using Bituminous Coal with Less than 200 MW Nameplate Capacity**

| Utility Name | Plant Name | City | State | Zip | Nameplate Capacity |
|---|---|---|---|---|---|
| Duke Energy Carolinas, LLC | G G Allen | Belmont | NC | 28012 | 165 |
| Duke Energy Carolinas, LLC | Dan River | Eden | NC | 27288 | 150 |
| Duke Energy Carolinas, LLC | Riverbend | Mount Holly | NC | 28120 | 133 |
| Duke Energy Carolinas, LLC | Buck | Salisbury | NC | 28145 | 125 |
| Duke Energy Carolinas, LLC | Riverbend | Mount Holly | NC | 28120 | 100 |
| Duke Energy Carolinas, LLC | Buck | Salisbury | NC | 28145 | 80 |
| Duke Energy Carolinas, LLC | Dan River | Eden | NC | 27288 | 70 |
| Duke Energy Carolinas, LLC | Cliffside | Cliffside | NC | 28024 | 65 |
| Duke Energy Carolinas, LLC | Buck | Salisbury | NC | 28145 | 40 |
| Duke Energy Carolinas, LLC | Cliffside | Cliffside | NC | 28024 | 40 |
| Edgecombe Operating Services LLC | Edgecombe Genco LLC | Battleboro | NC | 27809 | 57.4 |
| North Carolina Power Holdings, LLC | Lumberton | Lumberton | NC | 28359 | 34.7 |
| North Carolina Power Holdings, LLC | Elizabethtown Power LLC | Elizabethtown | NC | 28337 | 34.7 |
| Primary Energy of North Carolina LLC | Primary Energy Southport | Southport | NC | 28461 | 67.5 |
| Progress Energy Carolinas Inc | Cape Fear | Moncure | NC | 27559 | 187.9 |
| Progress Energy Carolinas Inc | Cape Fear | Moncure | NC | 27559 | 140.6 |
| Progress Energy Carolinas Inc | L V Sutton | Wilmington | NC | 28401 | 112.5 |
| Progress Energy Carolinas Inc | Lee | Goldsboro | NC | 27530 | 75 |
| Progress Energy Carolinas Inc | W H Weatherspoon | Lumberton | NC | 28358 | 73.5 |
| Progress Energy Carolinas Inc | W H Weatherspoon | Lumberton | NC | 28358 | 46 |
| Unifi Kinston, LLC | Unifi Kinston LLC | Kinston | NC | 28501 | 7.5 |
| University of North Carolina | Univ of NC Chapel Hill Cogen Facility | Chapel Hill | NC | 27599 | 28 |
| Westmoreland Partners | Roanoke Valley Energy Facility I | Weldon | NC | 27890 | 182.3 |
| Westmoreland Partners | Roanoke Valley Energy Facility II | Weldon | NC | 27890 | 57.8 |
| | | | | | Total=2073.4 |

(Source: Department of Energy, Energy Information Administration, Form EIA-860 Database)

*Direct Fire*

In this analysis, feedstocks for direct fire in are assumed to come from dedicated energy crops or from wood wastes. The potential for dedicated energy crop production will likely be based on the quantities available of forest residues and the amount of cropland/pastureland that can be converted. In addition, the price of that feedstock will likely be related to quantities demanded. As estimates for these data, a solution from POLYSYS generated for '25 X '25 in 2006 is used (English et al., 2006). Analysis from these data indicates that forest residues in North Carolina were available between $20 and $55/ton (Figure 9). From this same analysis, there are 1.5 million tons of dedicated energy crop estimated to be available in 2015, 9.9 million in 2020, and 18.9 million in 2025. Acreage yields used in the analysis is 4.6, 7.6, 9.4 tons per acre, respectively, over the same period. The price per ton for dedicated energy crops in North Carolina ranged from $49 to $58 per ton. The price $55 per ton was used for all three periods in this analysis.

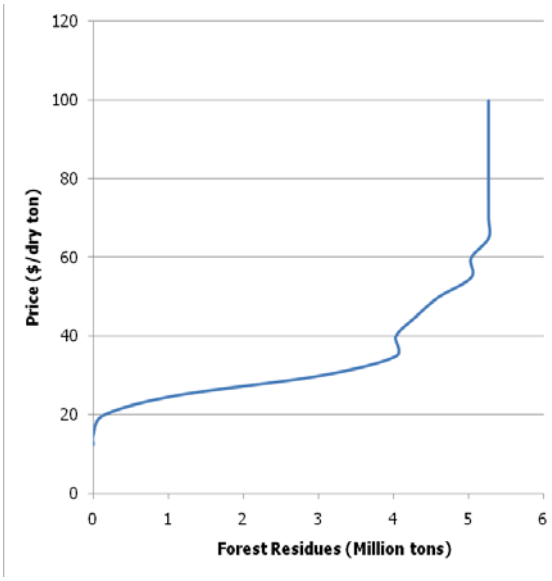



**Figure 9. Projected Statewide Supply of Forest Residues, North Carolina, 2025**

## Projections of North Carolina Electricity Demand and Net Generation Under the NC REPS

Because the NC REPS and the percentages from renewables that would be required in the federal proposals are based upon percentages of sales, it is necessary to obtain projections of electricity demand for the state through 2025. In order to calculate electricity demand and net generation projections for North Carolina, several pieces of information were used -- actual electricity demand and net generation statistics for 2008 from EIA's Electric Power Monthly and annual growth rate projections for the Southeast regions (excluding Florida) from EIA's Annual Energy Outlook, along with North Carolina's net generation for 2008 to project future net generation values. Future demand was projected based upon the 2008 ratio of electricity demand to net generation. The actual values of net generation and electricity sales for 2008 are shown, along with the projected values, in Figure 10. By the year 2025, the projections are about 140.6 million MWh of sales and 136.4 million MWh of net generation.

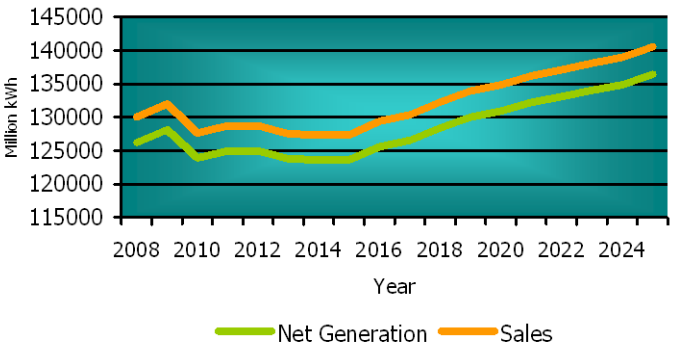



**Figure 10. Projected Net Generation and Sales of Electricity for North Carolina**

The NC REPS specifies an overall percentage of renewable energy that must be met by given dates. For investor-owned utilities, this percentage is 3% of 2011 retail sales by 2012, 6% of 2014 retail sales by 2015, 10% of 2017 retail sales by 2018, and 12.5% of 2020 retail sales by 2021 (See Table 4). Cooperatives and municipalities only must meet the requirements up to and including 10% of 2017 retail sales by 2018. Hence, in 2021 and beyond, the compliance percent was weighted according to nameplate capacity by the types of sellers versus investor-owned utilities (12.4% overall rather than 12.5% based upon current nameplate capacity). The percentages required were multiplied by the projected retail sales for the appropriate year to obtain the amount of renewable electricity required each year. These projections are shown in Table 13.

A portion of the North Carolina REPS may be met be energy efficiency savings (up to 25% through 2020 and up to 40% in 2021 and beyond). To account for these savings, the overall energy demand was multiplied by the percent that could be derived from energy savings to obtain the energy savings amount. These amounts are displayed in Table 13.

The North Carolina REPS specifies certain percentages or amounts from solar, poultry waste, and swine waste as shown in Table 5. Requirements for solar are 0.02% of retail sales by 2010, .07% by 2012, .14% by 2015, and .20% by 2018. Requirements for swine waste are 0.07% by 2012, .14% by 2015, and .20% by 2018. Poultry waste requirements are 170,000 MWh by 2012, 700,000 MWh by 2013, and 900,000 MWh by 2014. For solar and swine waste, the projected electricity demand is multiplied by the percentage to obtain the electricity generation required. The projected million kWh required from solar, poultry waste, and swine waste is shown in Table 13.

The energy efficiency savings amount was subtracted from the total amount of million kWh required under the NC REPS. Several solar and poultry waste facilities were already planned or in construction and these were accounted for in the analysis. A total of 150 MW of capacity are planned for poultry waste (about 1,048.4 million kWh of generation). For solar, a 16 MW capacity utility scale facility (427.5 million kWh) is planned with another 8 MW capacity of distributed solar being planned (10.6 million kWh). A landfill gas project is also planned (2 MW capacity or 14.98 million kWh). The projected million kWh from these planned facilities were subtracted from the required amount after energy efficiency savings. Also, the million kWh that would have to be derived from swine waste were subtracted (Table 13).

For co-fire, facilities located in the state using bituminous coal with under 200 MW of capacity not currently co-firing wood were considered candidate plants (2,073 MW or 2,180 million kWh). If the plants are limited to these specifications and 15% co-fire (311 MW), the total capacity for co-fire at a 15% co-fire rate is about 3,947 million kWh (2,180 additional + existing generation using wood of 1,767). The projected values for additional generation from existing renewable sources are shown in Table 14.

The bottom row of Table 14 shows the amount of renewable electricity required after energy efficiency savings, planned renewable facilities generation, generation to meet swine waste requirements, and growth in generation from existing renewable sources. For example, by 2012, an additional 1,314 million kWh of electricity would need to be met beyond energy savings, what is already planned, generation to meet the swine waste requirements, and growth in existing renewables. These amounts might be derived from other sources, such as landfill gas, biomass co-fire, or biomass direct fire. In this analysis, it is assumed that the additional demand in North Carolina will be met using biomass fr3om dedicated renewable energy crops and also additional growth in landfill gas. For landfill gas, the actual values for generation were adjusted each year by the projected rate of growth (1.5% per year) made by the Energy Information Administration. By 2025, this would be an additional 24.4 million kWh

## Table 14. Electricity kWh Requirements Under the NC REPS

| | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Million kWh | | | | | | | | | |
| | | | | | | | Projected Electricity Demand | | | | | | | | | |
| | 127,647 | 128,751 | 128,750 | 127,508 | 127,356 | 127,371 | 129,413 | 130,380 | 132,297 | 133,985 | 134,892 | 136,215 | 137,126 | 138,114 | 138,959 | 140,566 |
| | | | | | | | NC REPS Specifications | | | | | | | | | |
| Required Overall | 26 | 26 | 3,863 | 3,863 | 3,863 | 7,641 | 7,641 | 7,641 | 13,038 | 13,038 | 13,038 | 16,781 | 16,781 | 16,781 | 16,781 | 16,781 |
| Effic. Savings | 0 | 0 | 571 | 549 | 549 | 1,494 | 1,474 | 1,474 | 2,822 | 2,821 | 2,820 | 6,009 | 6,008 | 6,007 | 6,007 | 6,005 |
| Required Solar | 26 | 26 | 90 | 89 | 89 | 178 | 181 | 183 | 265 | 268 | 270 | 272 | 274 | 276 | 278 | 281 |
| Required Swine Waste | 0 | 0 | 90 | 179 | 178 | 178 | 259 | 261 | 265 | 268 | 270 | 272 | 274 | 276 | 278 | 281 |
| Required Poultry Waste | 0 | 0 | 0 | 700 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 | 900 |
| | | | | | | | Energy Requirements Less Energy Efficiency Savings (EES) | | | | | | | | | |
| | 26 | 26 | 3,291 | 3,313 | 3,313 | 6,147 | 6,167 | 6,168 | 10,216 | 10,217 | 10,218 | 10,772 | 10,773 | 10,774 | 10,774 | 10,776 |
| | | | | | | | Generation from Planned Facilities | | | | | | | | | |
| Smaller Scale Solar | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| Utility Scale Solar | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 | 427 |
| Poultry Waste | 0 | 663 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 | 1,048 |
| Landfill Gas | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| | | | | | | | Energy Requirements Less EES and Planned Facilities Generation | | | | | | | | | |
| | -428 | -1,090 | 1,790 | 1,812 | 1,812 | 4,646 | 4,666 | 4,666 | 8,715 | 8,716 | 8,716 | 9,271 | 9,271 | 9,272 | 9,273 | 9,274 |
| | | | | | | | Energy Requirements Less EES, Planned Facilities Generation, and Swine Waste Requirements | | | | | | | | | |
| | -428 | -1,090 | 1,699 | 1,633 | 1,633 | 4,467 | 4,407 | 4,406 | 8,450 | 8,448 | 8,446 | 8,998 | 8,997 | 8,996 | 8,995 | 8,993 |
| | | | | | | | Projected Additional Generation from Co-Fire | | | | | | | | | |
| Co-Fire | 96 | 196 | 302 | 413 | 530 | 654 | 783 | 919 | 1,062 | 1,212 | 1,371 | 1,537 | 1,712 | 1,896 | 2,089 | 2,089 |
| | | | | | | | Energy Requirements less EES, Planned Facilities Generation, Swine Waste Requirements, and Projected Additional Generation from Existing Renewables | | | | | | | | |
| | -523 | -1,287 | 1,397 | 1,220 | 1,103 | 3,814 | 3,624 | 3,487 | 7,388 | 7,235 | 7,076 | 7,461 | 7,285 | 7,100 | 6,906 | 6,904 |

of electricity. A 2 MW capacity (14.98 million kWh) facility is already planned. The difference by between 24.4 million kWh by 2025 and the 14.98 million kWh planned can be taken. This leaves about 9.37 million kWh to be provided by an additional similarly sized facility to the one planned.

## Projections to Meet the Federal Proposals

*The 25% RES*

The percentages of renewable energy required under the 25% RES as projected by the Energy Information Administration are displayed in Table 15 (Adjusted Markey Percentage). Based upon the projected electricity demand shown and these percentages, the projected million kWh requirements under the 25% RES are calculated. The North Carolina REPS requirements with allowances for energy efficiency savings are shown as a point of reference. The million kWh hours under the NC REPS with energy efficiency savings are subtracted from the million kWh hours required under the 25% RES to ascertain additional electricity generation that would be required. Notably, by 2025, an additional 13,221 million kWh would need to be from renewable sources.

**Table 15. Comparison of the 25% RES with the NC REPS**

| 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Projected Electricity Demand (Million kWh) | | | | | | | | | | | | | | | |
| 127,647 | 128,751 | 128,750 | 127,508 | 127,356 | 127,371 | 129,413 | 130,380 | 132,297 | 133,985 | 134,892 | 136,215 | 137,126 | 138,114 | 138,959 | 140,566 |
| Adjusted 25% RES Percentage | | | | | | | | | | | | | | | |
| 0 | 0 | 3 | 3 | 5 | 5 | 6 | 6 | 8 | 8 | 10 | 10 | 12 | 12 | 13 | 17 |
| Adjusted 25% RES Requirement (Million kWh) | | | | | | | | | | | | | | | |
| 0 | 0 | 4,378 | 4,335 | 6,240 | 6,241 | 8,153 | 8,214 | 10,584 | 10,719 | 13,489 | 13,622 | 16,455 | 16,574 | 18,204 | 23,896 |
| NC REPS Less EES (Million kWh) | | | | | | | | | | | | | | | |
| 26 | 26 | 3,291 | 3,313 | 3,313 | 6,147 | 6,167 | 6,168 | 10,216 | 10,217 | 10,218 | 10,772 | 10,773 | 10,774 | 10,774 | 10,776 |
| Difference Between 25% RES and NC REPS (Million kWh) | | | | | | | | | | | | | | | |
| -26 | -26 | 1,086 | 1,022 | 2,927 | 94 | 1,986 | 2,046 | 367 | 502 | 3,272 | 2,849 | 5,682 | 5,800 | 7,429 | 13,121 |

*The 20% RES*

Requirements under the 20% RES for a federal renewable energy portfolio standard are shown in Table 16. The 20% RES percentages are listed in the table. The percentages are taken of the prior year's electricity sales. Under the 20% RES, 25% or less can be met with energy efficiency credits. Therefore, in the table, the percentages adjusted for the 25% energy efficiency credits are calculated. These adjusted percentages are used to calculate the million kWh required under the 20% RES. The requirement under the North Carolina REPS given energy efficiency credits is then subtracted from requirement under the 20% RES. These values are also presented in Table 16. Shown in Table 16, by 2025, the 20% RES would require an additional 10,068 million kWh above the North Carolina REPS.

**Table 16. Comparison of the 20% RES with the NC REPS**

| 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 | 2025 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Projected Electricity Demand (Million kWh) | | | | | | | | | | | | | | | |
| 127,647 | 128,751 | 128,750 | 127,508 | 127,356 | 127,371 | 129,413 | 130,380 | 132,297 | 133,985 | 134,892 | 136,215 | 137,126 | 138,114 | 138,959 | 140,566 |
| 20% RES Percentage | | | | | | | | | | | | | | | |
| 4 | 4 | 4 | 8 | 8 | 8 | 12 | 12 | 12 | 16 | 16 | 20 | 20 | 20 | 20 | 20 |
| 20% RES Percentage With 25% Energy Efficiency Credit | | | | | | | | | | | | | | | |
| 3 | 3 | 3 | 6 | 6 | 6 | 9 | 9 | 9 | 12 | 12 | 15 | 15 | 15 | 15 | 15 |
| 20% RES Requirement (Million kWh) | | | | | | | | | | | | | | | |
| 3,959 | 3,829 | 3,863 | 7,725 | 7,650 | 7,641 | 11,463 | 11,647 | 11,734 | 15,876 | 16,078 | 20,234 | 20,432 | 20,569 | 20,717 | 20,844 |
| NC REPS Less EES (Million kWh) | | | | | | | | | | | | | | | |
| 26 | 26 | 3,291 | 3,313 | 3,313 | 6,147 | 6,167 | 6,168 | 10,216 | 10,217 | 10,218 | 10,772 | 10,773 | 10,774 | 10,774 | 10,776 |
| Difference Between 20% RES and NC REPS (Million kWh) | | | | | | | | | | | | | | | |
| 3,934 | 3,804 | 571 | 4,412 | 4,337 | 1,494 | 5,296 | 5,479 | 1,518 | 5,658 | 5,861 | 9,462 | 9,659 | 9,795 | 9,943 | 10,068 |

## Placement of Additional Renewable Energy Facilities Across the State

Once the number of plants at the state level was determined, the location (BEA region) of the plants and value of the feedstock was decided. This was achieved through the use of various types of weights along with information from POLYSYS generated output[2]. Since the locations of the poultry waste conversion, landfill, and the industrial solar facilities were already established, these were allocated to the BEA's in which they have been proposed. Forest residues used in the generation of electricity through co-fire and direct combustion methods were allocated based on information supplied initially from Marie Walsh and documented in (English, et. al., 2006) (Figure 11). The non-industrial solar technologies were allocated to each BEA based on projected population levels for the years 2015, 2020, and 2025 (Office of State Budget and Management, 2009) (Figure 12). Cropland in corn, soybeans, and hay was used to weight the plants requiring a dedicated energy crop (Figure 13).

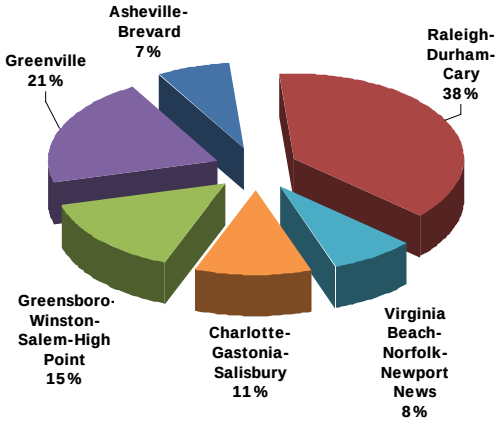



**Figure 11. Proportion of Forest Residues in Each BEA Region Assuming $55/Dry Ton, North Carolina**

[2] The output used in this analysis from POLYSYS, an agricultural simulation model, was initially generated for an analysis used by the 25 X 25 group (English, et al., 2006).

Using these data, the BEA locations and timing of investment in the electric producing facilities were projected (Table 17). The results in Table 17 reflect either announced plants or investment in additional renewable energy plants that would be required to meet the NC REPS. As previously indicated, several solar, landfill, and poultry facilities are already under construction or planned. Based on announcements about plans for construction, these are assumed in place during the 2010 through 2015 period. Since the sizes of these plants have been announced, and our assumed representative facility sizes, as shown in Appendix B, are fixed, partial plants (for example, 2.7 poultry plants) represent the fraction of representative plant size that the announced plant sizes are. The facilities investment create one-time impacts in each BEA region's and the state's economy. Therefore, the numbers of facilities invested in, as shown in Table 17, are used with the economic input-output models for the state and each BEA region to project the economic impacts from investment in the renewable energy facilities. The facilities invested in, by BEA region and facility type, under the 25% RES and the 20% RES are contained in Appendix B, Tables B.9-B.10.

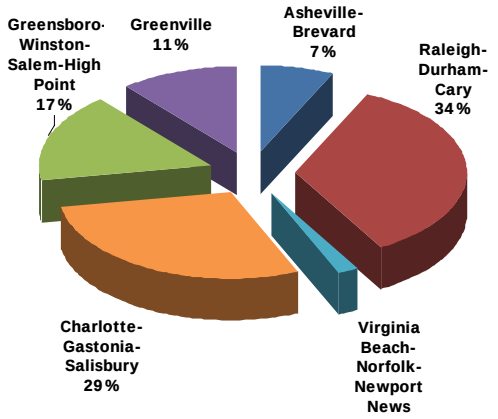



**Figure 12. Proportion of 2025 Population in Each BEA, North Carolina**

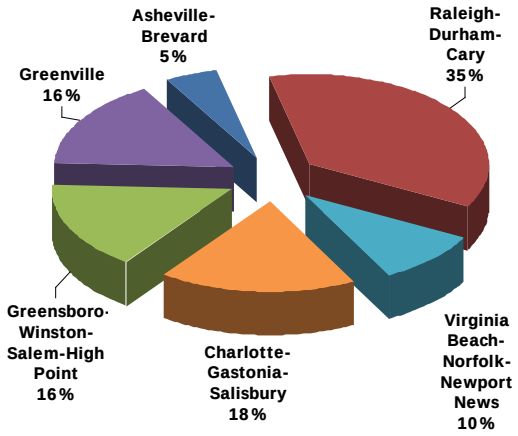



**Figure 13. Proportion of Cropland in Each BEA, North Carolina**

Table 18 displays the additional renewable facilities that would be operating by type and BEA region as of 2015, 2020, and 2025 under the NC REPS. These operating facilities reflect the cumulative investment in facilities from Table 17 (The operating facilities numbers under the 25% RES and the 20% RES are shown in Appendix B, Tables B.11-B.12). The number of facilities operating is used along with the economic input-output models for the state and each BEA region to project the economic impacts from year-to-year operations of the renewable energy facilities.

## Economic Impacts for 2015 and 2025: Investment and Operating

Multiple annual impacts accrue as a result of investing in renewable energy. The impacts reported in this section include the impacts of investing in and operating a renewable electricity industry. The impacts from the renewable electricity industry will come not only from electricity generation, but also from production of feedstocks for renewable electricity. Therefore, impacts are also reported for harvesting dedicated energy crops or forest residues, collecting poultry waste, and of land shifts out of traditional crops to dedicated energy crops, and the impacts of a change in electricity prices (assuming the increased cost of producing the renewable electricity is passed on to consumers). This section provides impacts for the years

2015, 2020, and 2025. Impacts presented include total industry output, employment, and value-added to the state's and BEA Regions' economies.

**Table 17. Assumed Additional Renewable Electricity Generating Facilities Investment to Meet the NC REPS, 2015, 2020, and 2025, North Carolina**

| BEA Region/State | 2010-2015 | 2016-2020 | 2021-2025 | 2010-2015 | 2016-2020 | 2021-2025 |
|---|---|---|---|---|---|---|
| | | Solar | | | Solar Industrial | |
| Asheville-Brevard | 58.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 271.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 17.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 221.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 139.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greenville | 91.6 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| North Carolina | 800.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| | | Swine | | | Poultry | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 491.8 | 251.4 | 31.3 | 1.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 155.2 | 79.3 | 9.9 | 1.7 | 0.0 | 0.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| North Carolina | 647.0 | 330.7 | 41.1 | 2.7 | 0.0 | 0.0 |
| | | Landfill | | | Co Fire - Wood | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 |
| Raleigh-Durham-Cary | 0.5 | 0.5 | 0.0 | 3.0 | 2.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 1.0 |
| North Carolina | 0.5 | 0.5 | 0 | 6 | 7 | 2 |
| | | Direct Fire-Wood | | | Direct Fire- Dedicated Energy | |
| Asheville-Brevard | 0 | 0 | 0 | 0 | 1 | 0 |
| Raleigh-Durham-Cary | 9 | 0 | 0 | 1 | 7 | 0 |
| Virginia Beach-Norfolk-Newport News | 2 | 0 | 0 | 0 | 2 | 0 |
| Charlotte-Gastonia-Salisbury | 1 | 0 | 0 | 1 | 4 | 0 |
| Greensboro-Winston-Salem-High Point | 2 | 0 | 0 | 1 | 3 | 0 |
| Greenville | 4 | 0 | 0 | 1 | 3 | 0 |
| North Carolina | 18 | 0 | 0 | 4 | 20 | 0 |

**Table 18. Additional Renewable Electricity Generating Facilities Operating to Meet the NC REPS, 2015, 2020, and 2025, North Carolina**

| BEA Region/State | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| | | Solar | | | Solar Industrial | |
| Asheville-Brevard | 58.7 | 58.7 | 58.7 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 271.0 | 271.0 | 271.0 | 0.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 17.4 | 17.4 | 17.4 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 221.4 | 221.4 | 221.4 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 139.9 | 139.9 | 139.9 | 0.0 | 0.0 | 0.0 |
| Greenville | 91.6 | 91.6 | 91.6 | 3.0 | 3.0 | 3.0 |
| North Carolina | 800.0 | 800.0 | 800.0 | 3.0 | 3.0 | 3.0 |
| | | Swine | | | Poultry | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 491.8 | 743.2 | 774.4 | 1.0 | 1.0 | 1.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 155.2 | 234.5 | 244.4 | 1.7 | 1.7 | 1.7 |
| Greenville | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| North Carolina | 647.0 | 977.7 | 1,018.8 | 2.7 | 2.7 | 2.7 |
| | | Landfill | | | Co Fire - Wood | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 |
| Raleigh-Durham-Cary | 0.5 | 1.0 | 1.0 | 3.0 | 5.0 | 5.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 2.0 |
| Greensboro-Winston-Salem-High Point | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 2.0 | 4.0 | 5.0 |
| North Carolina | 0.5 | 1.0 | 1.0 | 6.0 | 13.0 | 15.0 |
| | | Direct Fire-Wood | | | Direct Fire-Dedicated Energy | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Raleigh-Durham-Cary | 9.0 | 9.0 | 9.0 | 1.0 | 8.0 | 8.0 |
| Virginia Beach-Norfolk-Newport News | 2.0 | 2.0 | 2.0 | 0.0 | 2.0 | 2.0 |
| Charlotte-Gastonia-Salisbury | 1.0 | 1.0 | 1.0 | 1.0 | 5.0 | 5.0 |
| Greensboro-Winston-Salem-High Point | 2.0 | 2.0 | 2.0 | 1.0 | 4.0 | 4.0 |
| Greenville | 4.0 | 4.0 | 4.0 | 1.0 | 4.0 | 4.0 |
| North Carolina | 18.0 | 18.0 | 18.0 | 4.0 | 24.0 | 24.0 |

More detailed tables are presented in Appendix C, which display two types of impacts, direct and total. The direct impacts are the expenditures directly from the additions to demand for a particular industry. The total impacts include the direct impacts along with impacts from multiplier effects. These additional impacts include indirect and induced. The indirect impacts are those that result from the industry's expenditures on input supplies and services. The

induced impacts are those that result from those who are employed in the industry spending their income in the study region.

*Economic Impacts: Investment in Renewable Electricity Industry*

Based upon the facilities numbers, facilities locations by BEA Region, and expenditures by representative facilities shown in Appendix B, economic impacts were projected using IMPLAN. Economic impacts by BEA Region from the investment in additional renewable energy facilities under each of the three policy scenarios are shown in Appendix C Tables C.1-C.3. Table C.1 displays the TIO from the investment in the additional renewable energy facilities, while Table C.2 displays the employment, and Table C.3 displays the value-added. It should be noted that investment impacts are one-time impacts that occur in the year when the facilities are constructed.

Economic Activity (Total Industry Output) from Investment

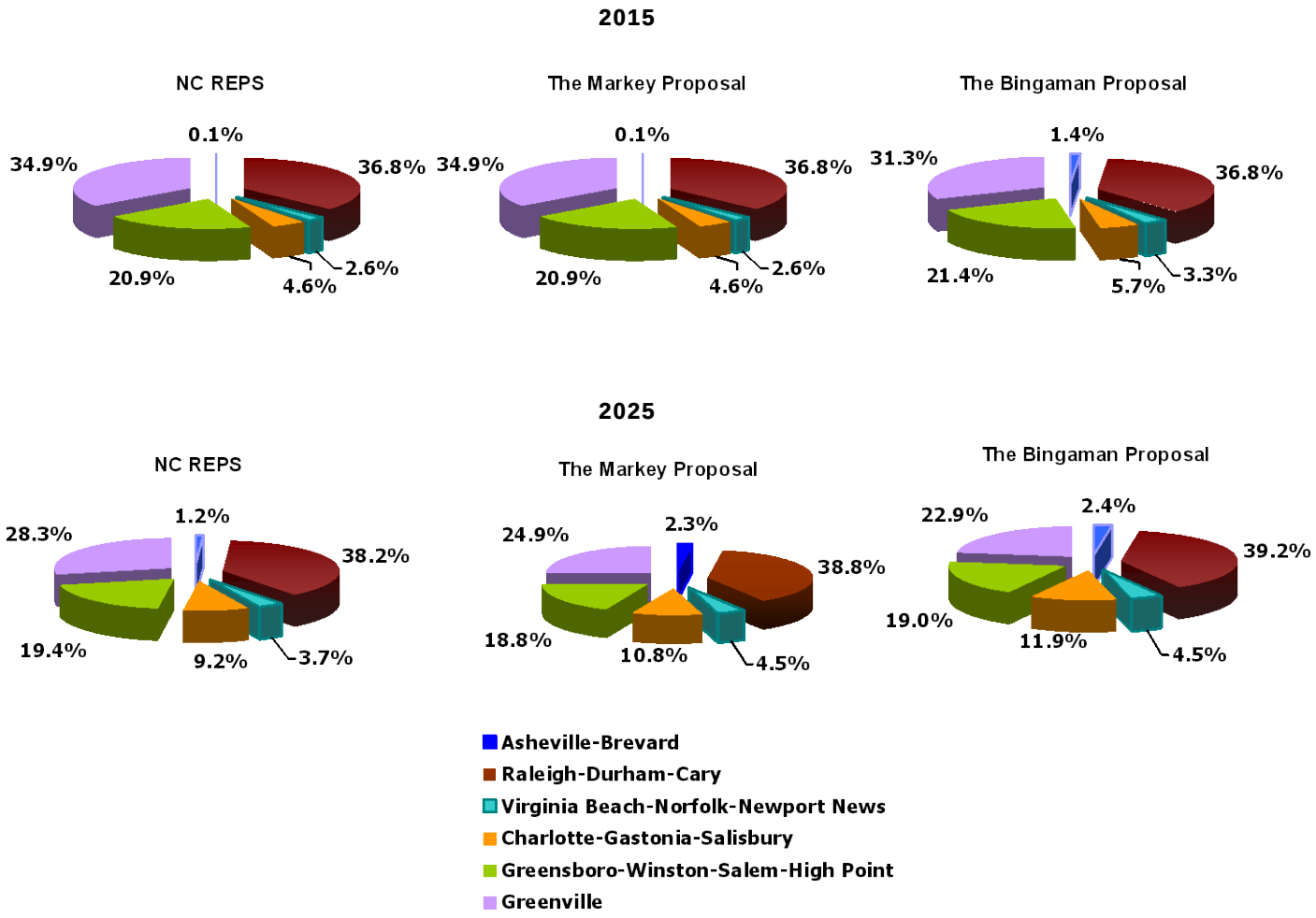
Figure 14 displays the TIO that would occur from investment in additional renewable electricity facilities under the three policy scenarios (NC REPS, The 25% RES, and the 20% RES) for 2015 and 2025. The figure provides the overall TIO and what shares the BEA Regions would accrue. These TIO values represent total impacts (direct + indirect + induced impacts). Under each policy scenario, the Raleigh-Durham-Cary Region is projected to experience the greatest TIO, with the Greenville Region second, and the Greensboro-Winston-Salem-High Point Region third. Statewide, the 2015 TIO from investment in additional renewable facilities is $6.8 billion under the NC REPS, $6.8 billion under the 25% RES, and $8.1 billion under the 20% RES. By 2025, the TIO from investment is $10 billion under the NCREPS, $20.1 billion under the 25% RES, and $18.1 under the 20% RES.

Employment from Investment

The total number of jobs involved in the renewable energy industry directly created annually increases from nearly 18,000 to 44,101 jobs between 2015 and 2025 under the NC REPS alternative (Table 19). Annual jobs in the renewable energy industry would increase to 127,965 under the 25% RES and 115,410 under the 20% RES. These jobs are distributed similarly to the economic activity that is projected.

**Table 19. Employment Projections Under the Three Policy Scenarios for 2015 and 2025, North Carolina**

| | NC REPS | | The 25% RES | | The 20% RES | |
|---|---|---|---|---|---|---|
| Year | Direct | Total | Direct | Total | Direct | Total |
| 2015 | 17,999 | 44,101 | 17,999 | 44,101 | 21,323 | 52,216 |
| 2025 | 26,750 | 64,810 | 52,640 | 127,965 | 47,501 | 115,410 |




| | Statewide Total Industry Output | | |
|---|---|---|---|
| Year | NC REPS | The 25% RES | The 20% RES |
| 2015 | $6,825,823,289 | $6,825,823,289 | $8,123,704,709 |
| 2025 | $10,052,834,918 | $20,139,008,438 | $18,130,898,264 |

**Figure 14. Total Industry Output from Investment in Additional Renewable Energy Under the NC REPS, the 25% RES, and the 20% RES, 2015 and 2025**

*Economic Impacts: Year-to-Year Operations of Renewable Electricity Facilities*

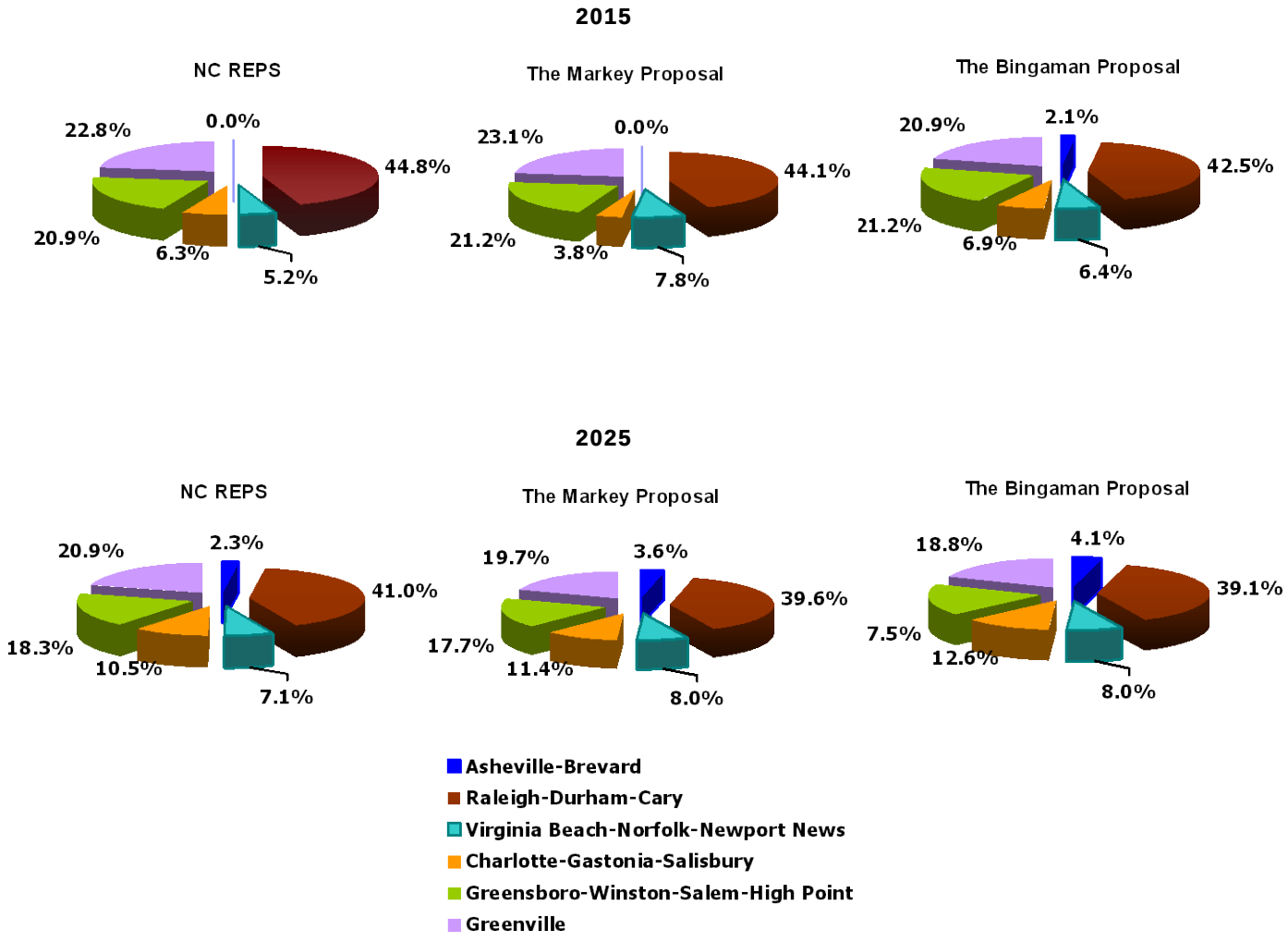
Some economic impacts occur each year as a result of the year-to-year business activities of the renewable energy industry. This section presents a summary of those projections. Detailed economic impacts by BEA Region from the year-to-year operations of the additional renewable energy facilities for the three policy scenarios are shown in Tables C.4-C.6. Table C.4 shows the total industry output from the annual operations of the additional renewable energy facilities, while Table C.5 displays the employment, and Table C.6 shows the value-added.

Economic Activity (Total Industry Output) from Operating

In addition to economic activity resulting from investment in renewable facilities, operation of the renewable energy facilities is projected to add ongoing economic activity to North Carolina's economy annually. In 2015, the annual impact is measured at $1.6 billion under the North Carolina legislation, $1.6 billion under the 25% RES, and $1.9 billion if the 20% RES is adopted not including the impacts of energy saving technologies which are unidentified but contained at various levels in each of the scenarios. Statewide, by 2025, the annual TIO from operating is $2.6 billion under the NCREPS, $5.4 billion under the 25% RES, and $4.9 under the 20% RES.

Figure 15 displays the Total Industry Output that would occur from operations in the additional renewable energy facilities under the three policy scenarios (NC REPS, The 25% RES, and the 20% RES) for 2015 and 2025. The figure provides the overall TIO and what shares the BEA Regions would accrue. These TIO values represent total impacts (direct + indirect + induced impacts). Under each policy scenario, the Raleigh-Durham-Cary Region is projected to experience the greatest TIO, with the Greenville Region second, and the Greensboro-Winston-Salem-High Point Region third.

In Table C.7, the total industry output (including direct, indirect, and induced impacts) from year-to-year operations by BEA Region and by renewable technology are shown for each of the three policy scenarios. Figures 16 and 17 contain the economic impacts as measured by increased total industry output for 2015 and 2025 as a result of the individual projected technologies. As can be seen these figures, the largest annual operating economic impacts are projected to be derived from direct fire of dedicated energy crops and wood wastes. This is followed by co-fire of wood and poultry wastes.




| | Statewide Total Industry Output | | |
|---|---|---|---|
| Year | NC REPS | The 25% RES | The 20% RES |
| 2015 | $1,658,111,509 | $1,635,403,342 | $1,986,198,387 |
| 2025 | $2,663,777,815 | $5,424,961,238 | $4,913,762,829 |

**Figure 15. Total Industry Output from Year-to-Year Operations of Additional Renewable Energy Under the NC REPS, the 25% RES, and the 20% RES, 2015 and 2025**

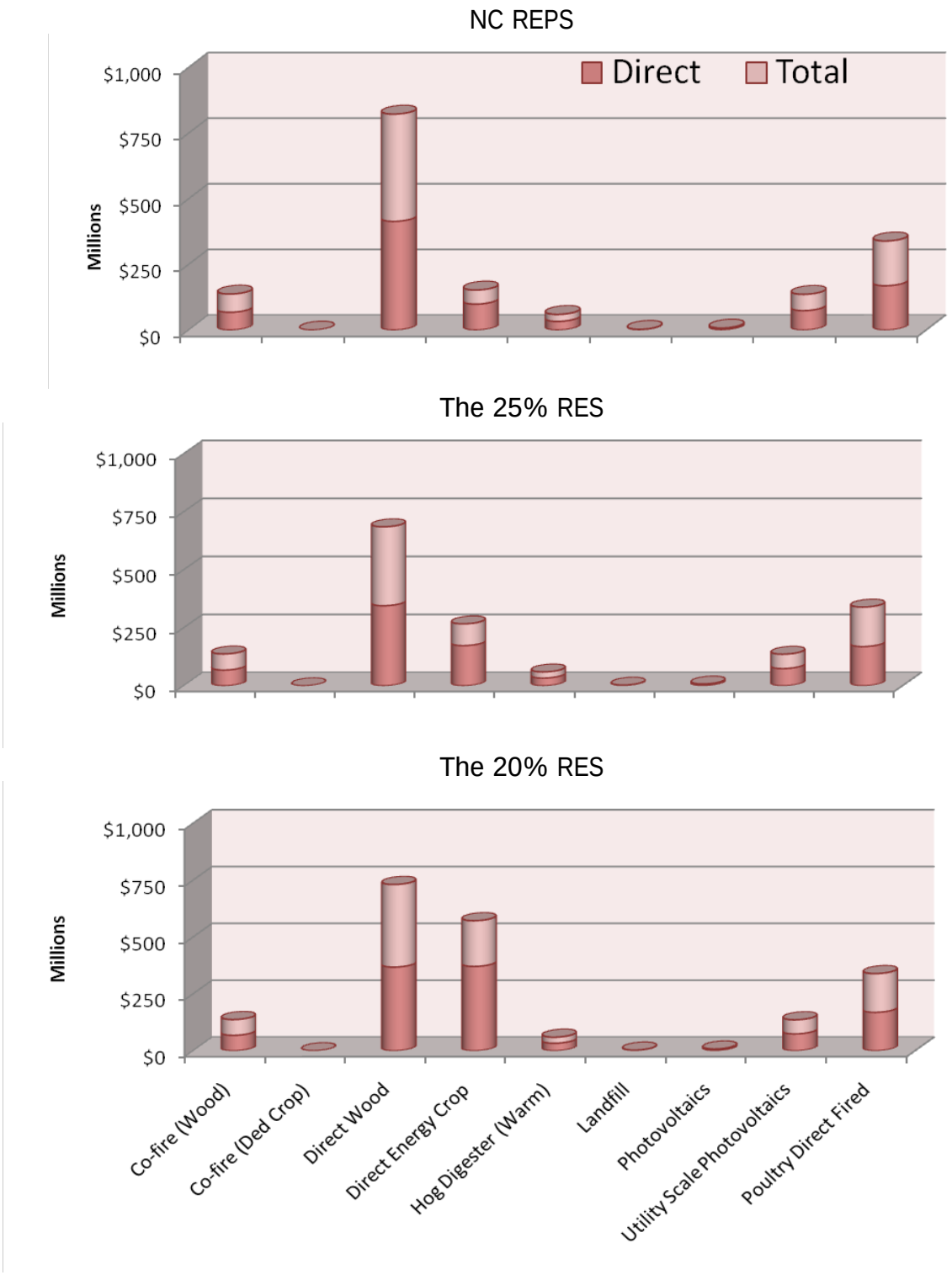



**Figure 16. Total Industry Output From Year-to-Year Operations under the Three Policy Scenarios, By Renewable Energy Technology, North Carolina, 2015**

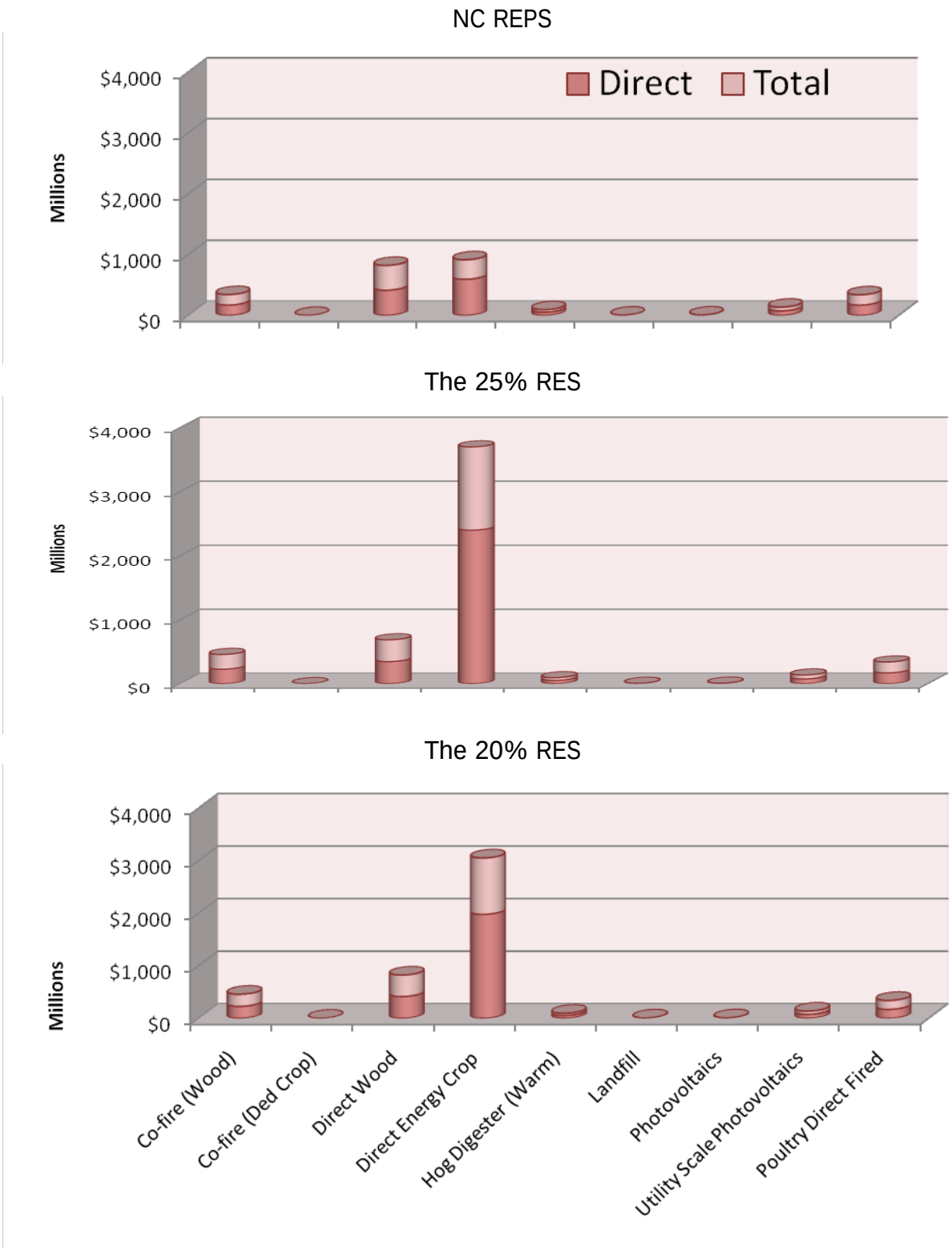



**Figure 17. Total Industry Output From Year-to-Year Operations under the Three Policy Scenarios, By Renewable Energy Technology, North Carolina, 2025**

Employment from Operating

The total number of jobs involved in the renewable energy industry directly created annually increases from nearly 7,000 to 11,102 jobs between 2015 and 2025 under the NC REPS alternative (Table 20). Annual jobs in the renewable energy industry would increase to 21,091 under the 25% RES and 19,311 under the 20% RES. Figures 18 and 19 represent the jobs across the three policy scenarios and renewable energy technology. These jobs are distributed similarly to the economic activity that is projected.

**Table 20. Employment Projections for the Three Policy Scenarios for 2015 and 2025, North Carolina**

| | NC REPS | | The 25% RES | | The 20% RES | |
|---|---|---|---|---|---|---|
| Year | Direct | Total | Direct | Total | Direct | Total |
| 2015 | 1,362 | 6,992 | 1,362 | 6,835 | 1,596 | 8,132 |
| 2025 | 2,332 | 11,102 | 4,187 | 21,091 | 3,823 | 19,311 |

*Economic Impacts: Agricultural and Forestry Feedstock Production*

Three types of impacts associated with agricultural and forestry feedstock production are measured in this analysis – the impact of growing a dedicated energy crop, of harvesting/collecting either forest residues or poultry waste, and the impact of land use changes toward dedicated energy crops. Projected land use changes that occur in North Carolina as a result of producing dedicated energy crops on agricultural lands were derived from previous POLYSYS analysis done for 25x25. For every acre of dedicated energy crop grown, 0.39 acres of traditional cropland (corn, cotton, soybeans, and wheat) were converted. Other lands required for a dedicated energy crop came from pastureland with the remaining pastureland under increased management so that the same animal units could be maintained.

In 2015, the direct economic activity under NC REPS is estimated to exceed $210.8 million each year in economic activity. When multiplied through the economy, this increases to $361.7 million (Table 21). By 2025, the total impact under NC RES increases to $691.9 million. Under the 25% RES and 20% RESs, in 2025, the direct total industry output increases to $848.1 and $760.7 million with a total annual economic impact of $1,662.8 and $1,441.3 million, respectively. Under the NC REPS, slightly over 40% of this economic activity will take place in the Raleigh-Durham-Cary BEA region (Figure 20). See Appendix C, Tables C8 through C10 for detailed estimates of changes in economic activity, jobs, and value-added, respectively.

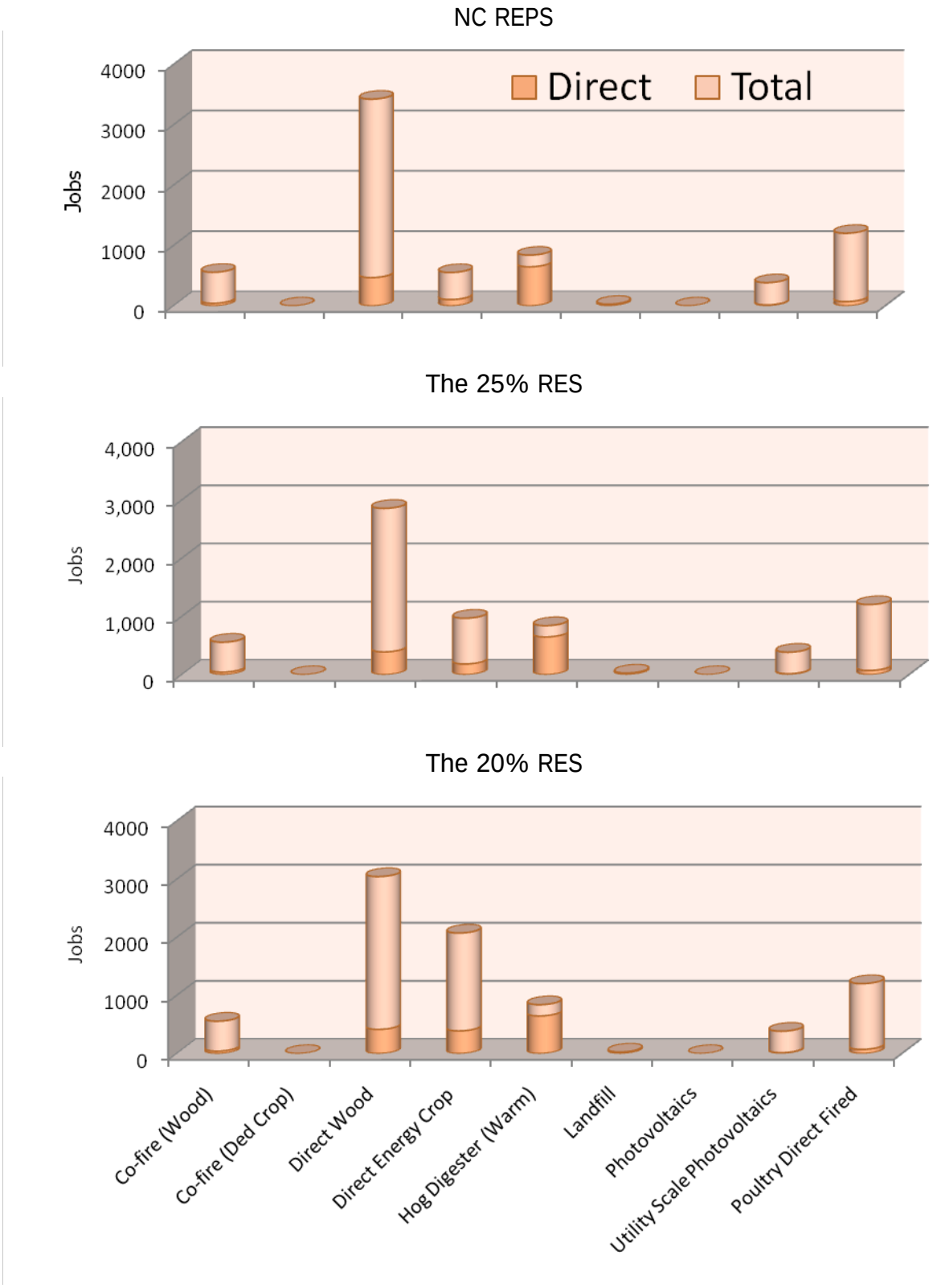



**Figure 18. Jobs Resulting from the Additional Renewable Energy under the Three Policy Scenarios, North Carolina, 2015**

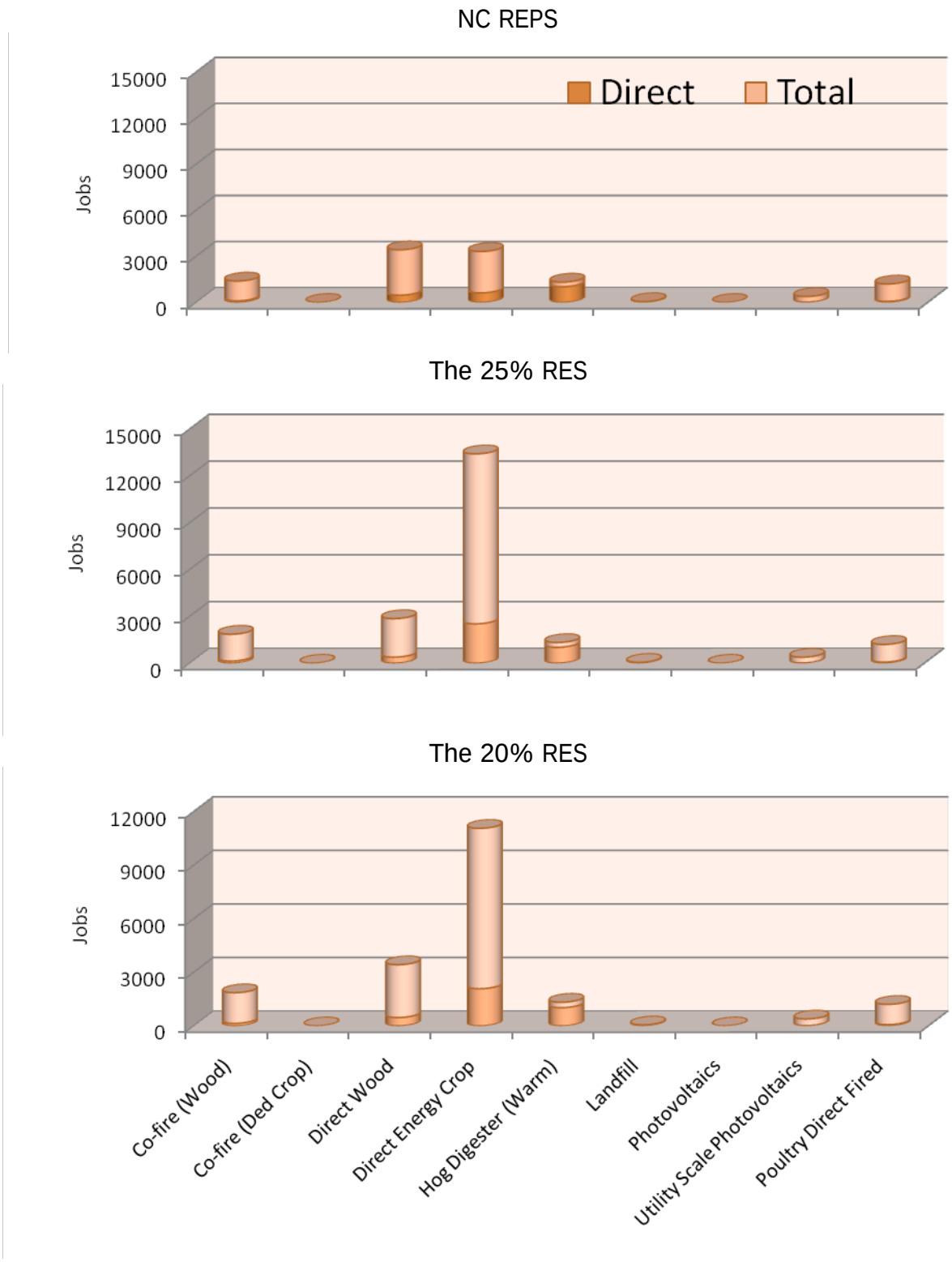



**Figure 19. Jobs Resulting from the Additional Renewable Energy under the Three Policy Scenarios, North Carolina, 2025**

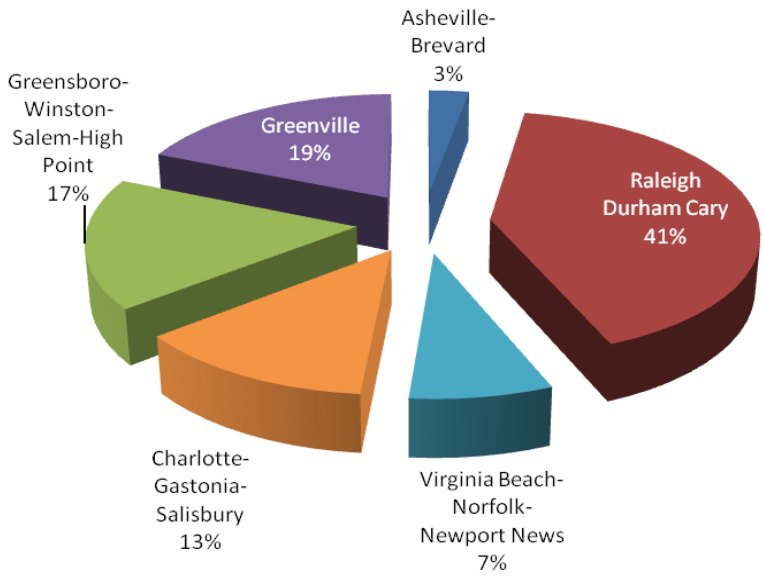



**Figure 20. Total Industry Output from Additions to Agricultural and Forestry Feedstock Production Under the NC REPS, by BEA, 2025**

**Table 21. Total Industry Output from Additions to Agricultural and Forestry Feedstock Production Under the Three Policy Scenarios, 2015 and 2025, North Carolina**

| | NC REPS | | The 25% RES | | The 20% RES | |
|---|---|---|---|---|---|---|
| Year | Direct | Total | Direct | Total | Direct | Total |
| | | | Million | | | |
| 2015 | $210.8 | $361.7 | $205.3 | $357.6 | $252.9 | $451.2 |
| 2025 | $382.4 | $691.9 | $848.1 | $1,622.8 | $760.7 | $1,441.3 |

Employment also increases as a result of increased agricultural activity. Under the current NC RES, in 2015 there is a projected direct increase in jobs of 659 which increases to 1,266 jobs by 2025. When indirect and induced effects are accounted for, this impact increases to nearly 4,000 by 2025. Under both the 25% RES and 20% RESs, the total jobs impacts in 2025 are 9,686 and 8,549 jobs, respectively.

*Economic Impacts of Potential Rate Increases*

With the additional renewable electricity, electric rates per kWh are projected to increase. As outlined in the methods, the rate increase projections are based upon "breakeven" prices for the various technologies and projections of electricity sales by type of technology. The projected electricity rate changes per kWh for 2015, 2020, and 2020 under the three policy scenarios are presented in Table 22. As can be seen, the price increments would be the greatest under the 20% RES in 2020 and 2025. These rate increases represent about 4% to

13% of current electricity prices. The projections of the 2025 statewide Total Industry Output impacts from the rate increases are -$421.1million under the NC REPS, -$957.8 million under the 25% RES, and -$831.9 under the 20% RES (Table 23). The job impacts from rate increases in 2025 are -2,896 under the NC REPS, -6,586 under the 25% RES, and -5,720 under the 20% RES.

**Table 22. Projected Electricity Rate Changes Under the Three Policy Scenarios, 2015 and 2025, North Carolina**

| Year | NC REPS | The 25% RES | The 20% RES |
|---|---|---|---|
| | | ($/kWh, $2006) | |
| 2015 | 0.00288 | 0.00305 | 0.00371 |
| 2020 | 0.00432 | 0.00583 | 0.00697 |
| 2025 | 0.00421 | 0.00958 | 0.00832 |

**Table 23. Projected Economic Impacts from Electricity Rate Changes Under the Three Policy Scenarios, 2015 and 2025, North Carolina**

| | NC REPS | | The 25% RES | | The 20% RES | |
|---|---|---|---|---|---|---|
| | Direct | Total | Direct | Total | Direct | Total |
| | | | *2015* | | | |
| Total Industry Output (Million) | -$162.2 | -$250.5 | -$172.2 | -$276.6 | -$209.1 | -$335.9 |
| Jobs | -946 | -1,791 | -1,004 | -1,902 | -1,220 | -2,310 |
| Total Value-Added (Million) | -$64.5 | -$119.5 | -$68.5 | -$126.9 | -$83.1 | -154.1 |
| | | | *2020* | | | |
| Total Industry Output (Million $) | -$258.5 | -$415.1 | -$348.4 | -$559.5 | -$416.6 | -$669.1 |
| Jobs | -1,507 | -2,854 | -2,032 | -3,847 | -2,429 | -4,601 |
| Total Value-Added (Million $) | -$102.7 | -$190.4 | -$138.5 | -$256.6 | -$165.6 | -$306.9 |
| | | | *2025* | | | |
| Total Industry Output (Million $) | -$262.2 | -$421.1 | -$596.4 | -$957.8 | -$518.0 | -$831.9 |
| Jobs | -1,529 | -2,896 | -3,478 | -6,586 | -3,021 | -5,720 |
| Total Value-Added (Million $) | -$104.2 | -$193.2 | -$237.1 | -$439.3 | -$205.9 | -$381.6 |

## Conclusions

This study projected potential economic impacts for North Carolina under three energy policy scenarios. The first policy evaluated is the current North Carolina law. The other two are potential federal legislative actions: The 25% RES (Save American Energy and American Renewable Energy Acts) and the 20% RES. To conduct the analysis, renewable electricity requirements under the federal proposals are compared with North Carolina's existing law, taking into account already planned new renewable energy generation in the state. The

changes in economic activity resulting from the changes in renewable electricity requirements were then projected using IMPLAN, an economic input-output model. Projected economic impacts were reported for the years 2015, 2020, and 2025.

Assuming that the state does take advantage of the Energy Savings strategies in each of the proposals, all three proposals, by 2025, will require 281 million kWh from solar and digester technologies, 900 million kWh from direct combustion of poultry wastes, and 15 million kWh from additional landfill technology. The remaining kWh for each of the proposals is assumed to be generated from agricultural and forest feedstocks. The 25% RES is projected to require the most renewable electricity by 2025, an increase of 13,121 million kWh above that required by NC REPS. The 20% RES requires 10,068 million kWh more than NC REPS. This projected increase in kWh is assumed to be met by two technologies: co-fire and direct fire power plants using either forest residues or dedicated energy crops.

To meet the demand for renewable electricity under the NC REPS scenario, 42,175 MW direct combustion power plants would be required by 2025. This number increases to 80 under the 20% RES and 112 under the 25% RES. These plants will require 116,170 dry tons per year of dedicated energy crops or 110,500 dry tons per year of forest residues.

By 2015, 800 rooftop solar sites along with three solar industrial facilities are projected for North Carolina generating 10.65 million kWh of electricity. Constructing these facilities requires nearly $900 million in investment and create 4,500 jobs directly with an additional 3,000 created over the construction period of the projects.

Only three poultry waste direct fired facilities are projected for the state and these three are already planned. These facilities, assuming $20/ton for the poultry waste, will provide 1,048 million kWh of electricity, and including multiplier effects, $340 million in economic activity and 1,200 jobs in 2025.

Wood and dedicated energy crops are used in either co-fire or direct combustion facilities to provide the bulk of renewable electricity. By 2025, nearly 9,000 million kWh of electricity are projected annually for these types of facilities under the NC REPS scenario. This increases to over 21 million kWh under the 25% RES scenario, creating a total industry output of over $900 million and nearly 7,000 jobs in the year 2025.

The demands for agricultural feedstock are significant under all three proposals. By 2025, 2.4 million and 2.7 million dry tons of forest residues and dedicate energy crop, respectively, are required in the NC REPS scenario. This feedstock demand increases to 2.6 million and 8.8 million dry tons of forest residues and dedicated energy crop in the 20% RES scenario. The greatest amount of agricultural and forest feedstock is required in the 25% RES scenario with 2.5 million dry tons in wood and 10.7 million dry tons of dedicated energy crops. The harvesting and collection of the wood and the growing of the dedicated energy crops have a significant impact on the state's economy. By 2025, the total economic impact from agriculture is close to $692 million, $1.4 billion, and $1.6 billion for the NC REPS, 20% RES, and 25% RES scenarios, respectively. As can be seen in the Table 24, the economic activity from feedstock production constitutes about 25% to 30% of the overall additional economic activity. Under the 25% RES and 20% RESs, with the requirement of additional renewable electricity above the NC REPS, the percent contribution by agriculture and forestry increases. This is because much of the additional demand is met through co-fire and direct fire of biomass.

Electricity from renewable energy technologies is more expensive than from conventional sources, such as coal. Therefore, the overall electricity price is projected to increase. These projected increases are $0.0042, $0.0096, and $0.0083/kWh under the NC REPS, The 25% RES, and The 20% RES scenarios, respectively in 2025. These increases in costs per kWh will have a negative impact on household incomes available for spending on

other goods and services. The direct impacts to consumers in 2025 are estimated at -$262, -$596, and -$518 million for the NC REPS, the 25% RES, and the 20% RES, respectively.

**Table 24. Summary of Annual Economic Impacts by Scenario, North Carolina, 2025**

| Impact | NC REPS | The 25% RES | The 20% RES |
|---|---|---|---|
| | | Million $ | |
| **Operating** | 2,664 | 5,425 | 4,914 |
| Household | -421 | -958 | -832 |
| Net | 2,243 | 4,467 | 4,082 |
| Contribution from agriculture and forestry | 692 | 1,623 | 1,441 |
| **Investment** | 10,053 | 20,139 | 18,131 |

Under the NC REPS, the net projected economic impact is $2.2 billion, with $692 million coming from biomass feedstock production from agriculture and forestry. There is a net estimated impact of close to $4.5 billion under the 25% RES, with $1.6 billion of that impact occurring from agricultural and forest activities. Under the 20% RES in 2025, there is a net impact of close to $4.1 billion, with $1.4 billion of that impact resulting from agricultural and forest production. In addition to the impacts from the annual operations, as new facilities are constructed, investment impacts are created. These investment impacts for 2025 are $10 to $20 billion depending on the scenario.

The North Carolina agricultural sector averaged nearly $8.0 billion in receipts during 2003 to 2007. With an average of $5.1 billion in expenses, the agricultural sectors realized net farm income has averaged nearly $3.0 billion over the same period (Figure 21). In 2007, the direct economic activity from the agricultural and logging sectors is estimated at $9.9 billion. In 2025, the economic activity generated from the NC RES is estimated at $2.2 billion with 0.7 billion derived from agricultural and forest (logging) activities. In the 24% and 20% RES, this estimate of annual impacts increases to $1.6 and $1.4 billion, respectively, of which $0.85 billion and $0.76 billion are direct impacts to the agricultural sector. Economic activity generated at the farm level could increase by $7,227/farm for the NC RES and to $16,028 per farm if the potential renewable energy projects are undertaken (Figure 22) and Appendix D).

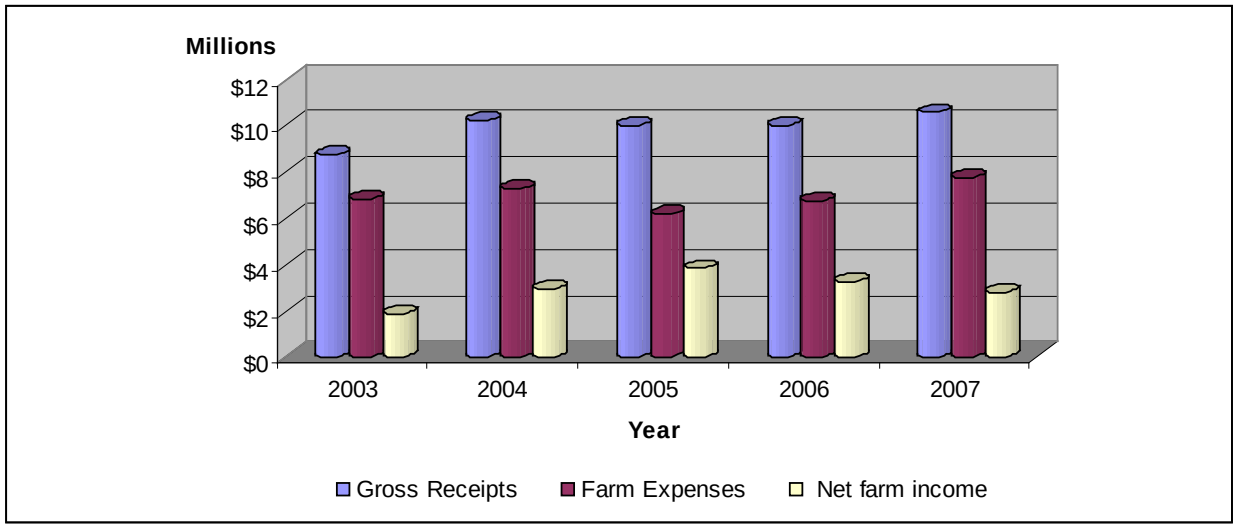



**Figure 21. North Carolina's agricultural receipts, expenses, and realized net farm income, 2003 - 2007.**

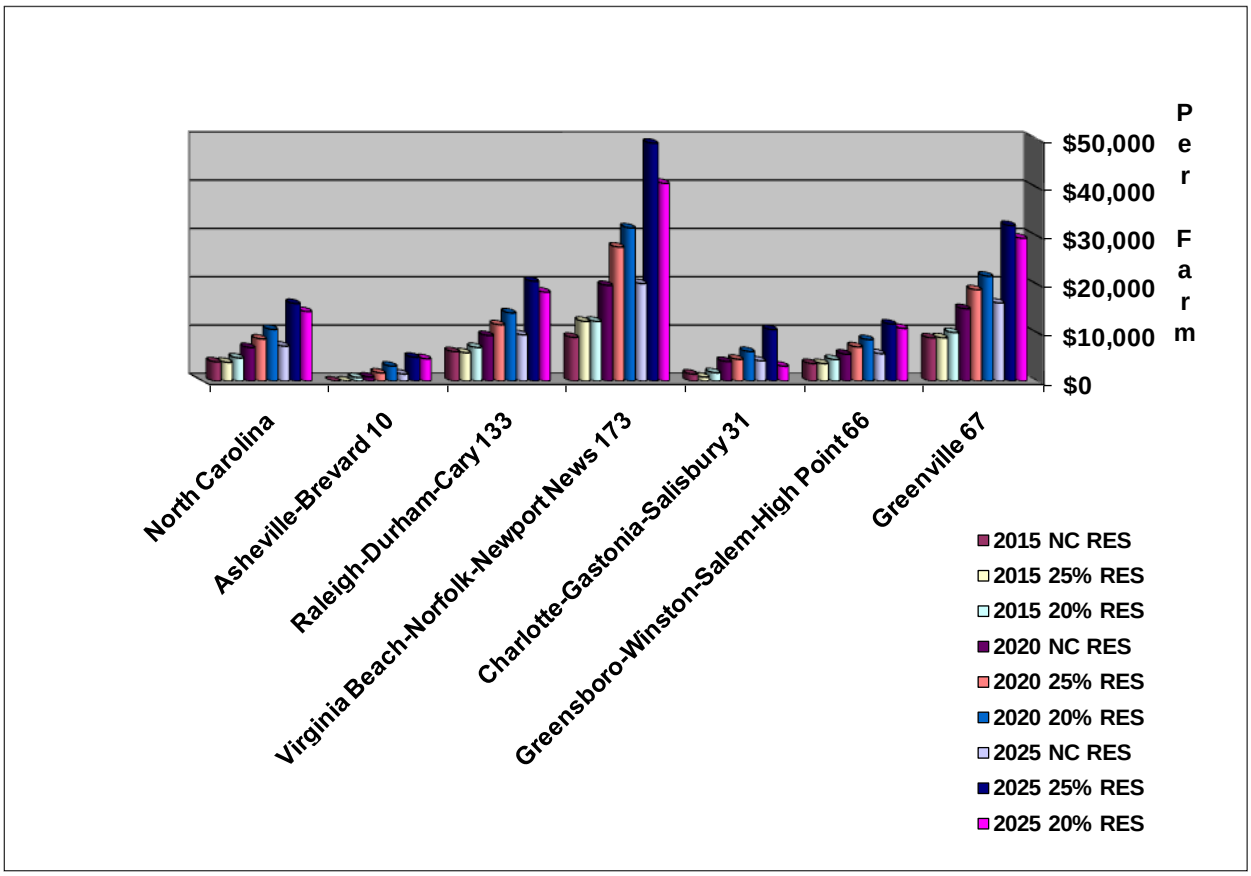



**Figure 22. Potential Gains in Per Farm Economic Activity by BEA, 2015, 2020, and 2025.**

## References Used


American Renewable Energy Act. Proposal to 111th Congress First Session by Markey. 2/4/2009.

Borenstein, Severin. 2008. "The Market Value and Cost of Solar Photovoltaic Electricity Production". Center for the Study of Energy Markets, University of California Energy Institute; Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

Chastain, J., J. Camberato, J. Albrecht, and J. Adams. 2003. South Carolina Confined Animal Manure Managers Certification Program – Swine**.** Swine Manure Production and Nutrient Content, Chapter 3. Available at http://www.clemson.edu/camm/Camm_s/Ch3/sch3a_03.pdf.

Database of State Incentives for Renewable Energy. North Carolina Renewable Energy and Energy Efficiency Portfolio Standard. Available at http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code=NC09R&state=NC&CurrentPageID=1&RE=1&EE=1. Last accessed 4/13/2009.

Department of Energy, Energy Information Administration. Annual Energy Outlook 2009 Reference Case Service Report, April 2009. Available at http://www.eia.doe.gov/oiaf/aeo/l. Last accessed 4/27/09.

Department of Energy, Energy Information Administration. Electric Power Monthly. March 2009 Edition. Available at http://www.eia.doe.gov/cneaf/electricity/epm/epm_sum.html. Last accessed 4/13/09.

Department of Energy, Energy Information Administration, Form EIA-860 Database. Available at http://www.eia.doe.gov/cneaf/electricity/page/eia860.html. Last accessed 4/13/09.

Department of Energy, Energy Information Administration, Impacts of a 25-Percent Renewable Electricity Standard as Proposed in the American Clean Energy and Security Act Discussion Draft. Report #: SR-OIAF/2009-04. April 2009. Available at http://www.eia.doe.gov/oiaf/servicerpt/acesa/index.html**.** Last accessed 5/9/09.

Duke Energy. Solar Webpage. Available at http://www.duke-energy.com/environment/solar.asp. Last accessed 5/9/09.

Electric Power Resources Institute. Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

English, B., R. Menard, Marie Walsh, and K. Jensen**.** Economic Impacts of Using Alternative Feedstocks in Coal-Fired Plants in the Southeastern United States. Department of Agricultural Economics, Agri-Industry Modeling and Analysis Group, Project Report, December 2004.

English, B., D. De La Torre Ugarte, K. Jensen, C. Hellwinckel, J. Menard, B. Wilson, R. Roberts, and M. Walsh. 25% Renewable Energy for the United States By 2025: Agricultural and Economic Impacts. Report to the '25X'25 Energy Work Group. November 2006.

Environmental Protection Agency. Anaerobic Digesters Database. Available at http://www.epa.gov/agstar/operational.html. Last accessed 5/9/09.

Environmental Protection Agency, Landfill Methane Outreach Program. 2005. Documents, Tools, and Resources. Energy Project Landfill Gas Utilization Software (E-Plus).

Environmental Protection Agency, Landfill Methane Outreach Program. Energy Projects and Candidate Landfills. December 2008. Available at http://www.epa.gov/lmop/proj/index.htm. Last accessed 5/9/09.

Fibrowatt Webpage. Available at http://www.fibrowattusa.com/us-projects.cfm?id=29. Last accessed 5/9/09.

Frazier, Barnes & Associates, LLC, 2004. "Feasibility Study for Use of Poultry Litter to Create Biomass Energy". Available at http://www.michigan.gov/documents/cis/CIS_EO_Poultry_CoGen_Report_180812_7.pdf Last accessed 4/13/09.

LaCapra Associates, 2006. "Analysis of a Renewable Portfolio Standard for the State of North Carolina". Available at http://www.lacapra.com/downloads/NC_RPS_Report.pdf. Last accessed 4/13/09.

Minnesota Implan Group. IMPLAN Users Manual. YEAR

Moser, M., R. Mattocks, S. Gettier, and K. Roos. 1998. "Benefits, Costs and Operating Experience at Seven New Agricultural Anaerobic Digesters". Presented at Bioenergy '98, Expanding Bioenergy Partnerships, Madison, Wisconsin, October 4-8.

National Renewable Energy Laboratory (NREL). Department of Energy. Annual PV Solar Radiation. Available at http://www.nrel.gov/gis/images/map_pv_us_annual_may2004.jpg. Last accessed 5/11/09.

North Carolina General Assembly. Enacted Legislation. Available at http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_62/GS_62-133.8.html. Last accessed 4/8/2009.

Office of State Budget and Management, North Carolina, North Carolina County/State Population Projections. Available at http://www.osbm.state.nc.us/ncosbm/facts_and_figures/socioeconomic_data/population_estimates/county_projections.shtm . Last accessed 4/20/09.

Olson, D. and S. Lindall. 1999. "IMPLAN Professional Software, Analysis, and Data Guide." Minnesota IMPLAN Group, Inc., 1725 Tower Drive West, Suite 140, Stillwater, MN 55082. Available at http://www.implan.com/. Last accessed 4/20/09.

Save American Energy Act. Proposal to 111th Congress First Session by Markey. 2/4/2009.

Summary of Bingaman Discussion Draft Renewable Portfolio Standard (RPS), January 2009. Draft as of 2/11/2009.

USDA, National Agricultural Statistics Service. 2007 Census of Agriculture. North Carolina State Level Data. Available at http://www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_1_State_Level/North_Carolina/index.asp. Last accessed 4/13/09.

# APPENDIX A
# NORTH CAROLINA RENEWABLE 62-133.8. RENEWABLE ENERGY AND ENERGY EFFICIENCY PORTFOLIO STANDARD (REPS)

## Table A.1. North Carolina Renewable 62-133.8. Renewable Energy and Energy Efficiency Portfolio Standard (REPS).

(a) Definitions. – As used in this section:

(1) "Combined heat and power system" means a system that uses waste heat to produce electricity or useful, measurable thermal or mechanical energy at a retail electric customer's facility.

(2) "Demand-side management" means activities, programs, or initiatives undertaken by an electric power supplier or its customers to shift the timing of electricity use from peak to nonpeak demand periods. "Demand-side management" includes, but is not limited to, load management, electric system equipment and operating controls, direct load control, and interruptible load.

(3) "Electric power supplier" means a public utility, an electric membership corporation, or a municipality that sells electric power to retail electric power customers in the State.

(4) "Energy efficiency measure" means an equipment, physical, or program change implemented after January 1, 2007, that results in less energy used to perform the same function. "Energy efficiency measure" includes, but is not limited to, energy produced from a combined heat and power system that uses nonrenewable energy resources. "Energy efficiency measure" does not include demand-side management.

(5) "New renewable energy facility" means a renewable energy facility that either:

a. Was placed into service on or after January 1, 2007.

b. Delivers or has delivered electric power to an electric power supplier pursuant to a contract with NC GreenPower Corporation that was entered into prior to January 1, 2007.

c. Is a hydroelectric power facility with a generation capacity of 10 megawatts or less that delivers electric power to an electric power supplier.

(6) "Renewable energy certificate" means a tradable instrument that is equal to one megawatt hour of electricity or equivalent energy supplied by a renewable energy facility, new renewable energy facility, or reduced by implementation of an energy efficiency measure that is used to track and verify compliance with the requirements of this section as determined by the Commission. A "renewable energy certificate" does not include the related emission reductions, including, but not limited to, reductions of sulfur dioxide, oxides of nitrogen, mercury, or carbon dioxide.

(7) "Renewable energy facility" means a facility, other than a hydroelectric power facility with a generation capacity of more than 10 megawatts, that either:

a. Generates electric power by the use of a renewable energy resource.

b. Generates useful, measurable combined heat and power derived from a renewable energy resource.

c. Is a solar thermal energy facility.

(8) "Renewable energy resource" means a solar electric, solar thermal, wind, hydropower, geothermal, or ocean current or wave energy resource; a

biomass resource, including agricultural waste, animal waste, wood waste, spent pulping liquors, combustible residues, combustible liquids, combustible gases, energy crops, or landfill methane; waste heat derived from a renewable energy resource and used to produce electricity or useful, measurable thermal energy at a retail electric customer's facility; or hydrogen derived from a renewable energy resource. "Renewable energy resource" does not include peat, a fossil fuel, or nuclear energy resource.

(b) Renewable Energy and Energy Efficiency Standards (REPS) for Electric Public Utilities. –

(1) Each electric public utility in the State shall be subject to a Renewable Energy and Energy Efficiency Portfolio Standard (REPS) according to the following schedule:

| Calendar Year | REPS Requirement |
|---|---|
| 2012 | 3% of 2011 North Carolina retail sales |
| 2015 | 6% of 2014 North Carolina retail sales |
| 2018 | 10% of 2017 North Carolina retail sales |
| 2021 and thereafter | 12.5% of 2020 North Carolina retail sales |

(2) An electric public utility may meet the requirements of this section by any one or more of the following:

a. Generate electric power at a new renewable energy facility.

b. Use a renewable energy resource to generate electric power at a generating facility other than the generation of electric power from waste heat derived from the combustion of fossil fuel.

c. Reduce energy consumption through the implementation of an energy efficiency measure; provided, however, an electric public utility subject to the provisions of this subsection may meet up to twenty-five percent (25%) of the requirements of this section through savings due to implementation of energy efficiency measures. Beginning in calendar year 2021 and each year thereafter, an electric public utility may meet up to forty percent (40%) of the requirements of this section through savings due to implementation of energy efficiency measures.

d. Purchase electric power from a new renewable energy facility. Electric power purchased from a new renewable energy facility located outside the geographic boundaries of the State shall meet the requirements of this section if the electric power is delivered to a public utility that provides electric power to retail electric customers in the State; provided, however, the electric public utility shall not sell the renewable energy certificates created pursuant to this paragraph to another electric public utility.

e. Purchase renewable energy certificates derived from in-State or out-of-state new renewable energy facilities. Certificates derived from out-of-state new renewable energy facilities shall not be used to meet more than twenty-five percent (25%) of the requirements of this section, provided that this limitation shall not apply to an electric public utility with less than 150,000 North Carolina retail jurisdictional customers as of December 31, 2006.

f. Use electric power that is supplied by a new renewable energy

facility or saved due to the implementation of an energy efficiency measure that exceeds the requirements of this section for any calendar year as a credit towards the requirements of this section in the following calendar year or sell the associated renewable energy certificates.

(c) Renewable Energy and Energy Efficiency Standards (REPS) for Electric Membership Corporations and Municipalities. –

(1) Each electric membership corporation or municipality that sells electric power to retail electric power customers in the State shall be subject to a Renewable Energy and Energy Efficiency Portfolio Standard (REPS) according to the following schedule:

| Calendar Year | REPS Requirement |
|---|---|
| 2012 | 3% of 2011 North Carolina retail sales |
| 2015 | 6% of 2014 North Carolina retail sales |
| 2018 and thereafter | 10% of 2017 North Carolina retail sales |

(2) An electric membership corporation or municipality may meet the requirements of this section by any one or more of the following:

a. Generate electric power at a new renewable energy facility.

b. Reduce energy consumption through the implementation of demand-side management or energy efficiency measures.

c. Purchase electric power from a renewable energy facility or a hydroelectric power facility, provided that no more than thirty percent (30%) of the requirements of this section may be met with hydroelectric power, including allocations made by the Southeastern Power Administration.

d. Purchase renewable energy certificates derived from in-State or out-of-state renewable energy facilities. An electric power supplier subject to the requirements of this subsection may use certificates derived from out-of-state renewable energy facilities to meet no more than twenty-five percent (25%) of the requirements of this section.

e. Acquire all or part of its electric power through a wholesale purchase power agreement with a wholesale supplier of electric power whose portfolio of supply and demand options meets the requirements of this section.

f. Use electric power that is supplied by a new renewable energy facility or saved due to the implementation of demand-side management or energy efficiency measures that exceeds the requirements of this section for any calendar year as a credit towards the requirements of this section in the following calendar year or sell the associated renewable energy certificates.

(d) Compliance With REPS Requirement Through Use of Solar Energy Resources. – For calendar year 2018 and for each calendar year thereafter, at least two-tenths of one percent (0.2%) of the total electric power in kilowatt hours sold to retail electric customers in the State, or an equivalent amount of energy, shall be supplied by a combination of new solar electric facilities and new metered solar thermal energy facilities that use one or more of the following applications: solar hot water, solar absorption cooling, solar dehumidification, solar thermally driven refrigeration, and solar industrial process heat. The terms of any contract entered into between an electric power supplier and a new solar electric facility or new metered solar

thermal energy facility shall be of sufficient length to stimulate development of solar energy; provided, the Commission shall develop a procedure to determine if an electric power supplier is in compliance with the provisions of this subsection if a new solar electric facility or a new metered solar thermal energy facility fails to meet the terms of its contract with the electric power supplier. As used in this subsection, "new" means a facility that was first placed into service on or after January 1, 2007. The electric power suppliers shall comply with the requirements of this subsection according to the following schedule:

| Calendar Year | Requirement for Solar Energy Resources |
|---|---|
| 2010 | 0.02% |
| 2012 | 0.07% |
| 2015 | 0.14% |
| 2018 | 0.20% |

(e) Compliance With REPS Requirement Through Use of Swine Waste Resources. – For calendar year 2018 and for each calendar year thereafter, at least two-tenths of one percent (0.2%) of the total electric power in kilowatt hours sold to retail electric customers in the State shall be supplied, or contracted for supply in each year, by swine waste. The electric power suppliers, in the aggregate, shall comply with the requirements of this subsection according to the following schedule:

| Calendar Year | Requirement for Swine Waste Resources |
|---|---|
| 2012 | 0.07% |
| 2015 | 0.14% |
| 2018 | 0.20% |

(f) Compliance With REPS Requirement Through Use of Poultry Waste Resources. – For calendar year 2014 and for each calendar year thereafter, at least 900,000 megawatt hours of the total electric power sold to retail electric customers in the State shall be supplied, or contracted for supply in each year, by poultry waste combined with wood shavings, straw, rice hulls, or other bedding material. The electric power suppliers, in the aggregate, shall comply with the requirements of this subsection according to the following schedule:

| Calendar Year | Requirement for Poultry Waste Resources |
|---|---|
| 2012 | 170,000 megawatt hours |
| 2013 | 700,000 megawatt hours |
| 2014 | 900,000 megawatt hours |

(g) Control of Emissions. – As used in this subsection, Best Available Control Technology (BACT) means an emissions limitation based on the maximum degree a reduction in the emission of air pollutants that is achievable for a facility, taking into account energy, environmental, and economic impacts and other costs. A biomass combustion process at any new renewable energy facility that delivers electric power to an electric power supplier shall meet BACT. The Environmental Management Commission shall determine on a case-by-case basis the BACT for a facility that would not otherwise be required to comply with BACT pursuant to the Prevention of Significant Deterioration (PSD) emissions program. The Environmental Management Commission may adopt rules to implement this subsection. In adopting rules, the Environmental Management Commission shall take into account cumulative and secondary impacts associated with the concentration of biomass facilities in close proximity to one another. In adopting rules the Environmental Management Commission shall provide for the manner in which a facility that would not otherwise be required to comply with BACT pursuant to the PSD emissions programs shall meet the BACT requirement.

(h) Cost Recovery and Customer Charges. –

(1) For the purposes of this subsection, the term "incremental costs" means all reasonable and prudent costs incurred by an electric power supplier to:

a. Comply with the requirements of subsections (b), (c), (d), (e), and (f) of this section that are in excess of the electric power supplier's avoided costs other than those costs recovered pursuant to G.S. 62-133.9.

b. Fund research that encourages the development of renewable energy, energy efficiency, or improved air quality, provided those costs do not exceed one million dollars ($1,000,000) per year.

c. Comply with any federal mandate that is similar to the requirements of subsections (b), (c), (d), (e), and (f) of this section that exceed the costs that the electric power supplier would have incurred under those subsections in the absence of the federal mandate.

(2) All reasonable and prudent costs incurred by an electric power supplier to comply with any federal mandate that is similar to the requirements of subsections (b), (c), (d), (e), and (f) of this section, including, but not limited to, the avoided costs associated with a federal mandate that exceeds the avoided costs that the electric power supplier would have incurred pursuant to subsections (b), (c), (d), (e), and (f) of this section in the absence of the federal mandate, shall be recovered by the electric power supplier in an annual rider charge assessed in accordance with the schedule set out in subdivision (4) of this subsection increased by the Commission on a pro rata basis to allow for full and complete recovery of all reasonable and prudent costs incurred to comply with the federal mandate.

(3) Except as provided in subdivision (2) of this subsection, the total annual incremental cost to be incurred by an electric power supplier and recovered from the electric power supplier's retail customers shall not exceed an amount equal to the per-account annual charges set out in subdivision (4) of this subsection applied to the electric power supplier's total number of customer accounts determined as of December 31 of the previous calendar year. An electric power supplier shall be conclusively deemed to be in compliance with the requirements of subsections (b), (c), (d), (e), and (f) of this section if the electric power supplier's total annual incremental costs incurred equals an amount equal to the per-account annual charges set out in subdivision (4) of this subsection applied to the electric power supplier's total number of customer accounts determined as of December 31 of the previous calendar year. The total annual incremental cost recoverable by an electric power supplier from an individual customer shall not exceed the per-account charges set out in subdivision (4) of this subsection except as these charges may be adjusted in subdivision (2) of this subsection.

(4) An electric power supplier shall be allowed to recover the incremental costs incurred to comply with the requirements of subsections (b), (c), (d), (e), and (f) of this section and fund research as provided in subdivision (1) of this subsection through an annual rider not to exceed the following per-account annual charges:

| Customer Class | 2008-2011 | 2012-2014 | 2015 and thereafter |
|---|---|---|---|
| Residential per account | $10.00 | $12.00 | $34.00 |
| Commercial per account | $50.00 | $150.00 | $150.00 |

| | | | |
|---|---|---|---|
| Industrial per account | $500.00 | $1,000.00 | $1,000.00 |

(5) The Commission shall adopt rules to establish a procedure for the annual assessment of the per-account charges set out in this subsection to an electric public utility's customers to allow for timely recovery of all reasonable and prudent costs of compliance with the requirements of subsections (b), (c), (d), (e), and (f) of this section and to fund research as provided in subdivision (1) of this subsection. The Commission shall ensure that the costs to be recovered from individual customers on a per-account basis pursuant to subdivisions (2) and (3) of this subsection are in the same proportion as the per-account annual charges for each customer class set out in subdivision (4) of this subsection.

(i) Adoption of Rules. – The Commission shall adopt rules to implement the provisions of this section. In developing rules, the Commission shall:

(1) Provide for the monitoring of compliance with and enforcement of the requirements of this section.

(2) Include a procedure to modify or delay the provisions of subsections (b), (c), (d), (e), and (f) of this section in whole or in part if the Commission determines that it is in the public interest to do so. The procedure adopted pursuant to this subdivision shall include a requirement that the electric power supplier demonstrate that it made a reasonable effort to meet the requirements set out in this section.

(3) Ensure that energy credited toward compliance with the provisions of this section not be credited toward any other purpose, including another renewable energy portfolio standard or voluntary renewable energy purchase program in this State or any other state.

(4) Establish standards for interconnection of renewable energy facilities and other nonutility-owned generation with a generation capacity of 10 megawatts or less to an electric public utility's distribution system; provided, however, that the Commission shall adopt, if appropriate, federal interconnection standards.

(5) Ensure that the owner and operator of each renewable energy facility that delivers electric power to an electric power supplier is in substantial compliance with all federal and state laws, regulations, and rules for the protection of the environment and conservation of natural resources.

(6) Consider whether it is in the public interest to adopt rules for electric public utilities for net metering of renewable energy facilities with a generation capacity of one megawatt or less.

(7) Develop procedures to track and account for renewable energy certificates, including ownership of renewable energy certificates that are derived from a customer owned renewable energy facility as a result of any action by a customer of an electric power supplier that is independent of a program sponsored by the electric power supplier.

(j) Report. – No later than October 1 of each year, the Commission shall submit a report on the activities taken by the Commission to implement, and by electric power suppliers to comply with, the requirements of this section to the Governor, the Environmental Review Commission, and the Joint Legislative Utility Review Committee. The report shall include any public comments received regarding direct, secondary, and cumulative environmental impacts of the implementation of the requirements of this section. In developing the report, the

Commission shall consult with the Department of Environment and Natural Resources. (2007-397, s. 2(a).)

(Source: North Carolina General Assembly. Enacted Legislation. Available at http://www.ncga.state.nc.us/EnactedLegislation/Statutes/HTML/BySection/Chapter_62/GS_62-133.8.html. Last accessed 4/8/2009)

Table A.2. Energy Source Abbreviations

| Abbrev-iation | Description | Abbrev-iation | Description |
|---|---|---|---|
| BIT | (Anthracite Coal, Bituminous Coal) | BLQ* | Black Liquor |
| LIG | Lignite Coal | GEO* | Geothermal |
| SUB | Subbituminous Coal | LFG* | Landfill Gas |
| WC | Waste/Other Coal (Anthracite Culm, Bituminous Gob, Fine Coal, Lignite Waste, Waste Coal) | MSW* | Municipal Solid Waste |
| SC | Coal Synfuel. Coal-based solid fuel that has been processed by a coal synfuel plant, and coal-based fuels such as briquettes, pellets, or extrusions, which are formed from fresh or recycled coal and binding materials. | OBS* | Other Biomass Solid (Animal Manure and Waste, Solid Byproducts, and other solid biomass not specified) |
| DFO | Distillate Fuel Oil (includes all Diesel and No. 1, No. 2, and No. 4 Fuel Oils) | OBL* | Other Biomass Liquid (Ethanol, Fish Oil, Liquid Acetonitrile Waste, Medical Waste, Tall Oil, Waste Alcohol, and other Biomass not specified) |
| JF | Jet Fuel | OBG * | Other Biomass Gases (Digester Gas, Methane, and other biomass gases) |
| KER | Kerosene | OTH | Other (Batteries, Chemicals, Coke Breeze, Hydrogen, Pitch, Sulfur, Tar Coal, and miscellaneous technologies) |
| RFO | Residual Fuel Oil (includes No. 5 and No. 6 Fuel Oils and Bunker C Fuel Oil) | PUR | Purchased Steam |
| WO | Oil-Other and Waste Oil (Butane (Liquid), Crude Oil, Liquid Byproducts, Oil Waste, Propane (Liquid), Re-refined | SLW | Sludge Waste |
| PC | Petroleum Coke | SUN* | Solar (Photovoltaic, Thermal) |
| NG | Natural Gas | TDF | Tires |
| BFG | Blast Furnace Gas | WAT | Water (Conventional, Pumped Storage) |
| OG | Other Gas (Butane, Coal Processes, Coke-Oven, Refinery, and other processes) | WDS* | Wood/Wood Waste Solids (Paper Pellets, Railroad Ties, Utility Poles, Wood Chips, and other wood solids) |
| PG | Propane | WDL* | Wood Waste Liquids (Red Liquor, Sludge Wood, Spent Sulfite Liquor, and other wood related liquids not |
| SG | Synthetic Gas, other than coal-derived | WND* | Wind |
| SGC | Synthetic gas, derived from coal | | |
| NUC | Nuclear (Uranium, Plutonium, Thorium) | | |
| AB* | Agriculture Crop Byproducts/Straw/Energy Crops | | |

*Classified as “renewable” energy sources in this study.

# APPENDIX B
# EXPENDITURES BY REPRESENTATIVE RENEWABLE ENERGY FACILITIES

**Conversion Technology**: Large Residential or Small Commercial Solar Photovoltaic
**Facility Size (Nameplate)**: 0.01 MW (dc)
**Capacity Factor:** 0.152
**Generation/Year:** 13,315 kWh (dc)/year
**Total Industry Output**: $1,003 ($0.0753/kWh)
**Breakeven Total Industry Output:** $4,987 ($0.3677/kWh)
**Employees**: 0
**Source**: Borenstein, Severin. 2008. "The Market Value and Cost of Solar Photovoltaic Electricity Production". Center for the Study of Energy Markets, University of California Energy Institute; Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.1. IMPLAN Expenditures for Solar Photovoltaic Technology**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 311 | Semiconductors & Related Device Manufacturing (Solar Panels) | $82,863 |
| Operating | 485 | Commercial Machinery Repair & Maintenance | $275 |
| Depreciation | 311 | Semiconductors & Related Device Manufacturing | $3,836 |

*2006 dollars

**Expenditure Summary for Solar Photovoltaic Technology**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $82,863 | $6.22 |
| Operating | $275 | $0.02 |
| Depreciation | $3,836 | $0.29 |

*2006 dollars

**Conversion Technology**: Utility Scale Solar Photovoltaic Power Plant (One-Axis Tracking)
**Facility Size (Nameplate)**: 50 MW
**Capacity Factor:** 0.305
**Generation/Year:** 133,590,000 kWh/year
**Total Industry Output**: $10,059,327 ($0.0753/kWh)
**Breakeven Total Industry Output:** $23,816,479 ($0.1783/kWh)
**Employees**: 5
**Source**: Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.2. IMPLAN Expenditures for Utility Scale Solar Photovoltaic Power Plant (One-Axis Tracking)**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 311 | Semiconductors & Related Device Manufacturing (Heliostats, Collectors, & Concentrators) | $154,950,457 |
| Investment | 425 | Banking (Project & Process Contingency) | $29,105,109 |
| Investment | 439 | Architectural & Engineering Services (General Facilities & Engineering Fees) | $25,751,548 |
| Investment | 442 | Computer System Design Services (Balance of Plant) | $61,123,024 |
| Investment | 451 | Management of Companies & Enterprises (Owner costs) | $11,268,875 |
| Operating | 485 | Commercial Machinery Repair & Maintenance | $441,955 |
| Depreciation | 311 | Semiconductors & Related Device Manufacturing | $15,495,046 |

*2006 dollars

**Expenditure Summary for Solar Photovoltaic Technology**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $282,199,014 | $2.11 |
| Operating | $441,955 | $0.003 |
| Depreciation | $15,495,046 | $0.12 |

*2006 dollars

**Conversion Technology**: Wood Fired Power Plant
**Facility Size (Nameplate)**: 25 MW
**Capacity Factor:** 0.800
**Generation/Year:** 175,200,000 kWh/year
**Total Industry Output**: $13,192,560 ($0.0753/kWh)
**Breakeven Total Industry Output:** $22,186,475 ($0.1266/kWh)
**Employees**: 26
**Source**: Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.3. IMPLAN Expenditures for Wood Fired Power Plant**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 37 | Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack) | $11,863,878 |
| Investment | 161 | Paint & Coating Manufacturing (Paint) | $148,500 |
| Investment | 203 | Iron & Steel Mills (Structural Steel) | $4,198,787 |
| Investment | 240 | Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin) | $22,892 |
| Investment | 259 | Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2) | $1,164,724 |
| Investment | 273 | Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant) | $163,847 |
| Investment | 277 | Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X)) | $617,701 |
| Investment | 278 | AC, Refrigeration, & Forced Air Heating (Cooling Tower) | $2,649,048 |
| Investment | 285 | Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set) | $17,510,303 |
| Investment | 292 | Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor) | $246,019 |
| Investment | 315 | Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS) | $1,472,982 |
| Investment | 316 | Industrial Process Variable Instruments (Instrumentation) | $2,121,239 |
| Investment | 346 | Motor Vehicle Body Manufacturing (Truck Scale/Unloader) | $115,288 |
| Investment | 425 | Banking (Contingency Fee) | $12,347,492 |
| Investment | 451 | Management of Companies & Enterprises (Home Office Expense (w/Overhead), Field Expenses (w/Overhead), Contractor Fees) | $18,719,831 |
| Operating | 14 | Logging (Feedstock) | $6,077,500 |
| Operating | 485 | Commercial Machinery Repair & Maintenance (Maintenance) | $2,348,845 |
| Depreciation | 37 | Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack) | $593,194 |
| Depreciation | 161 | Paint & Coating Manufacturing (Paint) | $14,850 |

**Table B.3. IMPLAN Expenditures for Wood Fired Power Plant**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Depreciation | 203 | Iron & Steel Mills (Structural Steel) | $209,939 |
| Depreciation | 240 | Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin) | $2,289 |
| Depreciation | 259 | Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2) | $116,472 |
| Depreciation | 273 | Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant) | $16,385 |
| Depreciation | 277 | Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X)) | $61,770 |
| Depreciation | 278 | AC, Refrigeration, & Forced Air Heating (Cooling Tower) | $264,905 |
| Depreciation | 285 | Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set) | $1,751,030 |
| Depreciation | 292 | Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor) | $24,602 |
| Depreciation | 315 | Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS) | $147,298 |
| Depreciation | 316 | Industrial Process Variable Instruments (Instrumentation) | $212,124 |
| Depreciation | 346 | Motor Vehicle Body Manufacturing (Truck Scale/Unloader) | $11,529 |

*2006 dollars

**Expenditure Summary for Wood Fired Power Plant**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $73,362,531 | $0.42 |
| Operating | $8,426,345 | $0.05 |
| Operating w/out Feedstock Expenditure | $2,348,845 | $0.01 |
| Depreciation | $3,426,388 | $0.02 |

*2006 dollars

**Conversion Technology**: Dedicated Energy Crop Fired Power Plant
**Facility Size (Nameplate)**: 25 MW
**Capacity Factor:** 0.800
**Generation/Year:** 175,200,000 kWh/year
**Total Industry Output**: $13,192,560 ($0.0753/kWh)
**Breakeven Total Industry Output:** $23,427,874 ($0.1337/kWh)
**Employees**: 26
**Source**: Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722

**Table B.4. IMPLAN Expenditures for Dedicated Energy Crop Fired Power Plant**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 37 | Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack) | $11,863,878 |
| Investment | 161 | Paint & Coating Manufacturing (Paint) | $148,500 |
| Investment | 203 | Iron & Steel Mills (Structural Steel) | $4,198,787 |
| Investment | 240 | Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin) | $22,892 |
| Investment | 259 | Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2) | $1,164,724 |
| Investment | 273 | Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant) | $163,847 |
| Investment | 277 | Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X)) | $617,701 |
| Investment | 278 | AC, Refrigeration, & Forced Air Heating (Cooling Tower) | $2,649,048 |
| Investment | 285 | Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set) | $17,510,303 |
| Investment | 292 | Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor) | $246,019 |
| Investment | 315 | Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS) | $1,472,982 |
| Investment | 316 | Industrial Process Variable Instruments (Instrumentation) | $2,121,239 |
| Investment | 346 | Motor Vehicle Body Manufacturing (Truck Scale/Unloader) | $115,288 |
| Investment | 425 | Banking (Contingency Fee) | $12,347,492 |
| Investment | 451 | Management of Companies & Enterprises (Home Office Expense (w/Overhead), Field Expenses (w/Overhead), Contractor Fees) | $18,719,831 |
| Operating | 9 | Dedicated Energy Crop (Feedstock) | $7,318,899 |
| Operating | 485 | Commercial Machinery Repair & Maintenance (Maintenance) | $2,348,845 |
| Depreciation | 37 | Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack) | $593,194 |

**Table B.4. IMPLAN Expenditures for Dedicated Energy Crop Fired Power Plant**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Depreciation | 161 | Paint & Coating Manufacturing (Paint) | $14,850 |
| Depreciation | 203 | Iron & Steel Mills (Structural Steel) | $209,939 |
| Depreciation | 240 | Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin) | $2,289 |
| Depreciation | 259 | Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2) | $116,472 |
| Depreciation | 273 | Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant) | $16,385 |
| Depreciation | 277 | Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X)) | $61,770 |
| Depreciation | 278 | AC, Refrigeration, & Forced Air Heating (Cooling Tower) | $264,905 |
| Depreciation | 285 | Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set) | $1,751,030 |
| Depreciation | 292 | Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor) | $24,602 |
| Depreciation | 315 | Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS) | $147,298 |
| Depreciation | 316 | Industrial Process Variable Instruments (Instrumentation) | $212,124 |
| Depreciation | 346 | Motor Vehicle Body Manufacturing (Truck Scale/Unloader) | $11,529 |

*2006 dollars

**Expenditure Summary for Dedicated Energy Crop Fired Power Plant**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $73,362,531 | $0.42 |
| Operating | $9,667,744 | $0.06 |
| Operating w/out Feedstock Expenditure | $2,348,845 | $0.01 |
| Depreciation | $3,426,388 | $0.02 |

*2006 dollars

**Conversion Technology**: Co-fire (15%) of Cellulosic Residues (Dedicated Energy Crop) with Coal
**Facility Size (Co-fire Nameplate)**: 15.6 MW
**Capacity Factor:** 0.800
**Generation/Year:** 109,850,400 kWh/year
**Total Industry Output**: $8,271,735 ($0.0753/kWh)
**Breakeven Total Industry Output:** $11,673,379 ($0.1063/kWh)
**Employees**: 7
**Source**: English, B., J. Menard, M. Walsh, and K. Jensen. 2004. "Economic Impacts of Using Alternative Feedstocks in Coal-Fired Plants in the Southeastern United States".

**Table B.5. IMPLAN Expenditures for: Co-fire (15%) of Cellulosic Residues (Dedicated Energy Crop) with Coal**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 41 | Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical) | $2,346,421 |
| Investment | 232 | Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom) | $75,243 |
| Investment | 292 | Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.) | $522,830 |
| Investment | 298 | Industrial Process Furnace & Oven Manufacturing (Modification at Burners) | $34,209 |
| Investment | 316 | Industrial Process Variable Instruments (Controls) | $165,213 |
| Investment | 346 | Motor Vehicle Body Manufacturing (Truck Tipper with Hopper and Feeder) | $123,326 |
| Investment | 425 | Banking (Contingency (30%)) | $907,930 |
| Investment | 439 | Architectural & Engineering Services (Engineering @ 10%) | $389,953 |
| Operating | 9 | Dedicated Energy Crop (Feedstock) | $4,588,983 |
| Operating | 485 | Commercial Machinery Repair & Maintenance | $282,178 |
| Depreciation | 41 | Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical) | $234,642 |
| Depreciation | 232 | Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom) | $3,762 |
| Depreciation | 292 | Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.) | $52,283 |
| Depreciation | 298 | Industrial Process Furnace & Oven Manufacturing (Modification at Burners) | $3,421 |
| Depreciation | 316 | Industrial Process Variable Instruments (Controls) | $16,521 |
| Depreciation | 346 | Motor Vehicle Body Manufacturing (Truck Tipper with Hopper and Feeder) | $12,333 |

*2006 dollars

**Expenditure Summary for Co-fire (15%) of Cellulosic Residues (Dedicated Energy Crop) with Coal**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $4,565,125 | $0.04 |
| Operating | $4,871,161 | $0.04 |
| Operating w/out Feedstock Expenditure | $282,178 | $0.003 |
| Depreciation | $322,962 | $0.003 |

*2006 dollars

**Conversion Technology**: Co-fire (15%) of Cellulosic Residues (Wood Residues) with Coal
**Facility Size (Co-fire Nameplate)**: 15.6 MW
**Capacity Factor:** 0.800
**Generation/Year:** 109,850,400 kWh/year
**Total Industry Output**: $8,271,735 ($0.0753/kWh)
**Breakeven Total Industry Output:** $10,896,281 ($0.0992/kWh)
**Employees**: 7
**Source**: English, B., J. Menard, M. Walsh, and K. Jensen. 2004. "Economic Impacts of Using Alternative Feedstocks in Coal-Fired Plants in the Southeastern United States".

**Table B.6. IMPLAN Expenditures for: Co-fire (15%) of Cellulosic Residues (Wood Residues) with Coal**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 41 | Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical) | $2,346,421 |
| Investment | 232 | Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom) | $75,243 |
| Investment | 292 | Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.) | $522,830 |
| Investment | 298 | Industrial Process Furnace & Oven Manufacturing (Modification at Burners) | $34,209 |
| Investment | 316 | Industrial Process Variable Instruments (Controls) | $165,213 |
| Investment | 346 | Motor Vehicle Body Manufacturing (Truck Tipper with Hopper and Feeder) | $123,326 |
| Investment | 425 | Banking (Contingency (30%)) | $907,930 |
| Investment | 439 | Architectural & Engineering Services (Engineering @ 10%) | $389,953 |
| Operating | 14 | Logging (Feedstock) | $3,811,885 |
| Operating | 485 | Commercial Machinery Repair & Maintenance | $282,178 |
| Depreciation | 41 | Other New Construction (Biomass Handling System Installation, Civil Structural, Electrical) | $234,642 |
| Depreciation | 232 | Prefabricated Metal Buildings and Components (Wood Silo with Live Bottom) | $3,762 |
| Depreciation | 292 | Conveyor & Conveying Equipment Manufacturing (Conveyor #1, Radial Stacker, Radial Screw, Conveyor #2, etc.) | $52,283 |
| Depreciation | 298 | Industrial Process Furnace & Oven Manufacturing (Modification at Burners) | $3,421 |
| Depreciation | 316 | Industrial Process Variable Instruments (Controls) | $16,521 |
| Depreciation | 346 | Motor Vehicle Body Manufacturing (Truck Tipper with Hopper and Feeder) | $12,333 |

*2006 dollars

**Expenditure Summary for Co-fire (15%) of Cellulosic Residues (Wood Residues) with Coal**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $4,565,125 | $0.04 |
| Operating | $4,094,063 | $0.04 |
| Operating w/out Feedstock Expenditure | $282,178 | $0.003 |
| Depreciation | $322,962 | $0.003 |

*2006 dollars

**Conversion Technology**: Landfill Gas
**Facility Size (Nameplate)**: 4.6 MW
**Capacity Factor:** 0.856
**Generation/Year:** 34,457,555 kWh/year
**Total Industry Output**: $2,594,654 ($0.0753/kWh)
**Breakeven Total Industry Output:** $2,929,556 ($0.0850/kWh)
**Employees**: 30
**Source**: Environmental Protection Agency, Landfill Methane Outreach Program. 2005. Documents, Tools, and Resources. Energy Project Landfill Gas Utilization Software (E-Plus).

**Table B.7. IMPLAN Expenditures for Landfill Gas**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 41 | Other New Construction (Electricity Generation Installation & Other Costs, Gas Treatment Installation & Other Costs, Inter Connect Installation & Other Costs) | $2,041,998 |
| Investment | 205 | Iron, Steel Pipe & Tube from Purchased Steel (Pipe) | $1,687,370 |
| Investment | 239 | Metal Tank, Heavy Gauge, Manufacturing (Condensate Knockout) | $112,638 |
| Investment | 261 | Oil & Gas Field Machinery & Equipment (Well & Well Heads) | $775,457 |
| Investment | 275 | Air Purification Equipment Manufacturing (Filters) | $16,577 |
| Investment | 276 | Industrial & Commercial Fan and Blower Manufacturing (Blowers) | $51,696 |
| Investment | 277 | Heating Equipment, except Warm Air Furnaces (Radiator Costs) | $238,008 |
| Investment | 289 | Air & Gas Compressor Manufacturing (Compressor) | $92,700 |
| Investment | 298 | Industrial Process Furnace & Oven Manufacturing (Flares) | $76,340 |
| Investment | 316 | Industrial Process Variable Instruments (Monitor) | $1,021 |
| Investment | 333 | Electric Power & Specialty Transformer Manufacturing (Substation Costs & Intertie Wiring Costs) | $320,985 |
| Investment | 336 | Relay & Industrial Control Manufacturing (Protective Relays Costs) | $47,099 |
| Investment | 341 | Wiring Device Manufacturing (System Disconnect Costs) | $99,182 |
| Investment | 350 | Motor Vehicle Parts Manufacturing (IC Low Engine & Engineer Wiring Costs) | $2,087,201 |
| Investment | 442 | Computer Systems Design Services (Substation Telemetry Costs) | $10,025 |
| Operating | 485 | Commercial Machinery Repair & Maintenance (Collection System Variable O&M, Compression System Variable O&M,) | $989,521 |
| Depreciation | 41 | Other New Construction (Electricity Generation Installation & Other Costs, Gas Treatment Installation & Other Costs, Inter Connect Installation & Other Costs) | $204,200 |
| Depreciation | 205 | Iron, Steel Pipe & Tube from Purchased Steel | $168,737 |

**Table B.7. IMPLAN Expenditures for Landfill Gas**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| | | (Pipe) | |
| Depreciation | 239 | Metal Tank, Heavy Gauge, Manufacturing (Condensate Knockout) | $11,264 |
| Depreciation | 261 | Oil & Gas Field Machinery & Equipment (Well & Well Heads) | $77,546 |
| Depreciation | 275 | Air Purification Equipment Manufacturing (Filters) | $1,658 |
| Depreciation | 276 | Industrial & Commercial Fan and Blower Manufacturing (Blowers) | $5,170 |
| Depreciation | 277 | Heating Equipment, except Warm Air Furnaces (Radiator Costs) | $23,801 |
| Depreciation | 289 | Air & Gas Compressor Manufacturing (Compressor) | $9,270 |
| Depreciation | 298 | Industrial Process Furnace & Oven Manufacturing (Flares) | $7,634 |
| Depreciation | 316 | Industrial Process Variable Instruments (Monitor) | $102 |
| Depreciation | 333 | Electric Power & Specialty Transformer Manufacturing (Substation Costs & Intertie Wiring Costs) | $32,098 |
| Depreciation | 336 | Relay & Industrial Control Manufacturing (Protective Relays Costs) | $4,710 |
| Depreciation | 341 | Wiring Device Manufacturing (System Disconnect Costs) | $9,918 |
| Depreciation | 350 | Motor Vehicle Parts Manufacturing (IC Low Engine & Engineer Wiring Costs) | $208,720 |

*2006 dollars

**Expenditure Summary for Landfill Gas**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $7,658,297 | $0.22 |
| Operating | $989,521 | $0.03 |
| Depreciation | $764,827 | $0.02 |

*2006 dollars

**Conversion Technology**: Warm Climate Methane Digester for Swine (4,000 Sow Farrow to Wean Pig with Pit Recharge)
**Facility Size (Nameplate)**: 0.05 MW
**Capacity Factor:** 0.630
**Generation/Year:** 275,940 kWh/year
**Total Industry Output**: $20,778 ($0.0753/kWh)
**Breakeven Total Industry Output:** $49,441 ($0.1792/kWh)
**Employees**: 1
**Source**: Moser, M., R. Mattocks, S. Gettier, and K. Roos. 1998. "Benefits, Costs and Operating Experience at Seven New Agricultural Anaerobic Digesters". Presented at Bioenergy '98, Expanding Bioenergy Partnerships, Madison, Wisconsin, October 4-8.

**Table B.8. IMPLAN Expenditures for Warm Climate Methane Digester for Swine (4,000 Sow Farrow to Wean Pig with Pit Recharge)**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 41 | Other New Construction (Excavation, Engine-generator building, heat loop, electrical) | $120,971 |
| Investment | 101 | Textile Bag & Canvas Mills (Digester Cover) | $65,615 |
| Investment | 173 | Plastic Pipe, Fittings, and Profile Shapes (Manure Transfer Pipe) | $4,826 |
| Investment | 277 | Heating Equipment, except Warm Air Furnaces (Gas/hot water piping, boiler & hot water storage, hot water use equipment) | $31,471 |
| Investment | 288 | Pump & Pumping Equipment Manufacturing (Gas pump, meter) | $4,019 |
| Investment | 333 | Electric Power & Specialty Transformer Manufacturing (Engine-generator) | $106,683 |
| Investment | 439 | Architectural & Engineering Services (Engineering) | $30,470 |
| Operating | 485 | Commercial Machinery Repair & Maintenance (Engine Maintenance) | $19,389 |
| Depreciation | 41 | Other New Construction (Excavation, Engine-generator building, heat loop, electrical) | $6,049 |
| Depreciation | 101 | Textile Bag & Canvas Mills (Digester Cover) | $6,562 |
| Depreciation | 173 | Plastic Pipe, Fittings, and Profile Shapes (Manure Transfer Pipe) | $483 |
| Depreciation | 277 | Heating Equipment, except Warm Air Furnaces (Gas/hot water piping, boiler & hot water storage, hot water use equipment) | $3,147 |
| Depreciation | 288 | Pump & Pumping Equipment Manufacturing (Gas pump, meter) | $402 |
| Depreciation | 333 | Electric Power & Specialty Transformer Manufacturing (Engine-generator) | $10,668 |
| Byproduct | 30 | Power Generation & Supply (Electricity) | $48,839 |
| Byproduct | 142 | Petroleum Refineries (Value of reduced propane use) | $31,149 |

*2006 dollars

**Expenditure Summary for Warm Climate Methane Digester for Swine (4,000 Sow Farrow to Wean Pig with Pit Recharge)**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $364,056 | $1.32 |
| Operating | $19,389 | $0.07 |
| Depreciation | $27,310 | $0.10 |
| Byproduct | $79,988 | $0.29 |

*2006 dollars

**Conversion Technology**: Poultry Litter Combustion (700,000 tons/year)
**Facility Size (Nameplate)**: 55 MW
**Capacity Factor:** 0.800
**Generation/Year:** 385,440,000 kWh/year
**Total Industry Output**: $29,023,632 ($0.0753/kWh)
**Breakeven Total Industry Output:** $59,897,512 ($0.1554/kWh)
**Employees**: 26
**Source**: Renewable Energy Technical Assessment Guide—TAG-RE: 2006. EPRI, Palo Alto, CA: 2007. 1012722; Frazier, Barnes & Associates, LLC. 2004. "Feasibility Study for Use of Poultry Litter to Create Biomass Energy Final Report." Prepared for Michigan Biomass Energy Program, Grant No.: PLA-03-32 and West Michigan Co-Gen LLC; La Capra Associates, Inc., GDS Associates, Inc., and Sustainable Energy Advantage, LLC. 2006. "Analysis of a Renewable Portfolio Standard for the State of North Carolina, Technical Report." Prepared for the North Carolina Utilities Commission.

**Table B.9. IMPLAN Expenditures for Poultry Litter Combustion Plant**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Investment | 37 | Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack) | $40,130,990 |
| Investment | 161 | Paint & Coating Manufacturing (Paint) | $502,320 |
| Investment | 203 | Iron & Steel Mills (Structural Steel) | $14,202,901 |
| Investment | 240 | Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin) | $77,433 |
| Investment | 259 | Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2) | $3,939,817 |
| Investment | 273 | Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant) | $554,231 |
| Investment | 277 | Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X)) | $2,089,449 |
| Investment | 278 | AC, Refrigeration, & Forced Air Heating (Cooling Tower) | $8,960,721 |
| Investment | 285 | Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set) | $59,230,697 |
| Investment | 292 | Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor) | $832,190 |
| Investment | 315 | Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS) | $4,982,538 |
| Investment | 316 | Industrial Process Variable Instruments (Instrumentation) | $7,175,346 |
| Investment | 346 | Motor Vehicle Body Manufacturing (Truck Scale/Unloader) | $389,975 |
| Investment | 425 | Banking (Contingency Fee) | $37,973,192 |
| Investment | 451 | Management of Companies & Enterprises (Home Office Expense (w/Overhead), Field Expenses (w/Overhead), Contractor Fees) | $63,322,070 |
| Operating | 12 | Poultry Litter (Feedstock) | $14,000,000 |

**Table B.9. IMPLAN Expenditures for Poultry Litter Combustion Plant**

| Type | IMPLAN Sector | IMPLAN Sector Description | Expenditures* |
|---|---|---|---|
| Operating | 485 | Commercial Machinery Repair & Maintenance (Maintenance) | $11,573,114 |
| Depreciation | 37 | Manufacturing & Industrial Buildings (Concrete Substructures, Piping, Electrical, Insulation, Process Structural, Stack) | $2,006,550 |
| Depreciation | 161 | Paint & Coating Manufacturing (Paint) | $50,232 |
| Depreciation | 203 | Iron & Steel Mills (Structural Steel) | $710,145 |
| Depreciation | 240 | Metal can, box, & Other Container Manufacturing (Receiving Hopper/Magnet, Reclaim Hopper, Feed Bin) | $7,743 |
| Depreciation | 259 | Construction Machinery Manufacturing (Hammer Mill/Hopper, Dozer 1, & Dozer 2) | $393,982 |
| Depreciation | 273 | Other Commercial & Service Industry Machinery Manufacturing (Demineralizer Plant) | $55,423 |
| Depreciation | 277 | Heating Equipment, except Warm Air Furnaces (No. 2 Oil Burners (4X)) | $208,945 |
| Depreciation | 278 | AC, Refrigeration, & Forced Air Heating (Cooling Tower) | $896,072 |
| Depreciation | 285 | Turbine & Turbine Generator Set Units Manufacturing (Stoker Steam Generator, Steam Turbine/Generator Set) | $5,923,070 |
| Depreciation | 292 | Conveyor & Conveying Equipment Manufacturing (Rotary Disc Screen/Hopper, RDS Conveyor, HM Conveyor, Reclaim Conveyor, Feed Conveyor) | $83,219 |
| Depreciation | 315 | Automatic Environmental Control Manufacturing (NOx Control _SNCR, CEMS) | $498,254 |
| Depreciation | 316 | Industrial Process Variable Instruments (Instrumentation) | $717,535 |
| Depreciation | 346 | Motor Vehicle Body Manufacturing (Truck Scale/Unloader) | $38,998 |
| Byproduct | 30 | Power Generation & Supply (Electricity Revenue) | $26,362,773 |
| Byproduct | 32 | Water, Sewage, & Other Systems (Steam Revenue) | $10,096,163 |
| Byproduct | 157 | Phosphatic Fertilizer Manufacturing (Ash Revenues) | $7,294,451 |

*2006 dollars

**Expenditure Summary for Poultry Litter Combustion Plant (700,000 tons per year)**

| Expenditure Type | Total $* | $/kWh |
|---|---|---|
| Investment | $244,363,869 | $0.63 |
| Operating | $25,573,114 | $0.07 |
| Operating w/out Feedstock Expenditure | $11,573,114 | $0.03 |
| Depreciation | $11,590,166 | $0.03 |
| Byproducts | $43,753,387 | $0.11 |

*2006 dollars

**Table B.10. Assumed Additional Renewable Electricity Generating Facilities Investment to Meet the Markey Proposal, 2015, 2020, and 2025, North Carolina**

| BEA Region/State | 2010-2015 | 2016-2020 | 2021-2025 | 2010-2015 | 2016-2020 | 2021-2025 |
|---|---|---|---|---|---|---|
| | | Solar | | | Solar Industrial | |
| Asheville-Brevard | 58.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 271.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 17.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 221.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 139.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greenville | 91.6 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| North Carolina | 800.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| | | Swine | | | Poultry | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 491.8 | 251.4 | 31.3 | 1.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 155.2 | 79.3 | 9.9 | 1.7 | 0.0 | 0.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| North Carolina | 647.0 | 330.7 | 41.1 | 2.7 | 0.0 | 0.0 |
| | | Landfill | | | Co Fire - Wood | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 |
| Raleigh-Durham-Cary | 0.5 | 0.5 | 0.0 | 3.0 | 2.0 | 2.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 1.0 |
| Greensboro-Winston-Salem-High Point | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 2.0 |
| North Carolina | 0.5 | 0.5 | 0.0 | 6.0 | 7.0 | 7.0 |
| | | Direct Fire-Wood | | | Direct Fire- Dedicated Energy | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 3.0 |
| Raleigh-Durham-Cary | 7.0 | 0.0 | 0.0 | 3.0 | 13.0 | 20.0 |
| Virginia Beach-Norfolk-Newport News | 2.0 | 0.0 | 0.0 | 1.0 | 3.0 | 5.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 6.0 | 10.0 |
| Greensboro-Winston-Salem-High Point | 2.0 | 0.0 | 0.0 | 1.0 | 6.0 | 8.0 |
| Greenville | 4.0 | 0.0 | 0.0 | 1.0 | 6.0 | 8.0 |
| North Carolina | 15.0 | 0.0 | 0.0 | 7.0 | 36.0 | 54.0 |

**Table B.11. Assumed Additional Renewable Electricity Generating Facilities Investment to Meet the Bingaman Proposal, 2015, 2020, and 2025, North Carolina**

| BEA Region/State | 2010-2015 | 2016-2020 | 2021-2025 | 2010-2015 | 2016-2020 | 2021-2025 |
|---|---|---|---|---|---|---|
| | | Solar | | | Solar Industrial | |
| Asheville-Brevard | 58.7 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 271.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 17.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 221.4 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 139.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greenville | 91.6 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| North Carolina | 800.0 | 0.0 | 0.0 | 3.0 | 0.0 | 0.0 |
| | | Swine | | | Poultry | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 491.8 | 251.4 | 31.3 | 1.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 155.2 | 79.3 | 9.9 | 1.7 | 0.0 | 0.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| North Carolina | 647.0 | 330.7 | 41.1 | 2.7 | 0.0 | 0.0 |
| | | Landfill | | | Co Fire - Wood | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Raleigh-Durham-Cary | 0.5 | 0.5 | 0.0 | 3.0 | 2.0 | 1.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 | 2.0 |
| Greensboro-Winston-Salem-High Point | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 2.0 | 2.0 | 2.0 |
| North Carolina | 0.5 | 0.5 | 0.0 | 6.0 | 8.0 | 6.0 |
| | | Direct Fire-Wood | | | Direct Fire- Dedicated Energy | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 1.0 |
| Raleigh-Durham-Cary | 8.0 | 1.0 | 0.0 | 5.0 | 15.0 | 9.0 |
| Virginia Beach-Norfolk-Newport News | 2.0 | 0.0 | 0.0 | 1.0 | 4.0 | 2.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 3.0 | 7.0 | 4.0 |
| Greensboro-Winston-Salem-High Point | 2.0 | 0.0 | 0.0 | 3.0 | 7.0 | 4.0 |
| Greenville | 4.0 | 1.0 | 0.0 | 2.0 | 6.0 | 4.0 |
| North Carolina | 16.0 | 2.0 | 0.0 | 15.0 | 41.0 | 24.0 |

## Table B.12. Additional Renewable Electricity Generating Facilities Operating to Meet the Markey Proposal, 2015, 2020, and 2025, North Carolina

| BEA Region/State | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| | | Solar | | | Solar Industrial | |
| Asheville-Brevard | 58.7 | 58.7 | 58.7 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 271.0 | 271.0 | 271.0 | 0.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 17.4 | 17.4 | 17.4 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 221.4 | 221.4 | 221.4 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 139.9 | 139.9 | 139.9 | 0.0 | 0.0 | 0.0 |
| Greenville | 91.6 | 91.6 | 91.6 | 3.0 | 3.0 | 3.0 |
| North Carolina | 800.0 | 800.0 | 800.0 | 3.0 | 3.0 | 3.0 |
| | | Swine | | | Poultry | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 491.8 | 743.2 | 774.4 | 1.0 | 1.0 | 1.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 155.2 | 234.5 | 244.4 | 1.7 | 1.7 | 1.7 |
| Greenville | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| North Carolina | 647.0 | 977.7 | 1,018.8 | 2.7 | 2.7 | 2.7 |
| | | Landfill | | | Co Fire - Wood | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 |
| Raleigh-Durham-Cary | 0.5 | 1.0 | 1.0 | 3.0 | 5.0 | 7.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 3.0 |
| Greensboro-Winston-Salem-High Point | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 2.0 | 4.0 | 6.0 |
| North Carolina | 0.5 | 1.0 | 1.0 | 6.0 | 13.0 | 20.0 |
| | | Direct Fire-Wood | | | Direct Fire-Dedicated Energy | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 2.0 | 5.0 |
| Raleigh-Durham-Cary | 7.0 | 7.0 | 7.0 | 3.0 | 16.0 | 36.0 |
| Virginia Beach-Norfolk-Newport News | 2.0 | 2.0 | 2.0 | 1.0 | 4.0 | 9.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 7.0 | 17.0 |
| Greensboro-Winston-Salem-High Point | 2.0 | 2.0 | 2.0 | 1.0 | 7.0 | 15.0 |
| Greenville | 4.0 | 4.0 | 4.0 | 1.0 | 7.0 | 15.0 |
| North Carolina | 15.0 | 15.0 | 15.0 | 7.0 | 43.0 | 97.0 |

## Table B.13. Additional Renewable Electricity Generating Facilities Operating to Meet the Bingaman Proposal, 2015, 2020, and 2025, North Carolina

| BEA Region/State | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 |
|---|---|---|---|---|---|---|
| | | Solar | | | Solar Industrial | |
| Asheville-Brevard | 58.7 | 58.7 | 58.7 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 271.0 | 271.0 | 271.0 | 0.0 | 0.0 | 0.0 |
| Virginia Beach-Norfolk-Newport News | 17.4 | 17.4 | 17.4 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 221.4 | 221.4 | 221.4 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 139.9 | 139.9 | 139.9 | 0.0 | 0.0 | 0.0 |
| Greenville | 91.6 | 91.6 | 91.6 | 3.0 | 3.0 | 3.0 |
| North Carolina | 800.0 | 800.0 | 800.0 | 3.0 | 3.0 | 3.0 |
| | | Swine | | | Poultry | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Raleigh-Durham-Cary | 491.8 | 743.2 | 774.4 | 1.0 | 1.0 | 1.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Greensboro-Winston-Salem-High Point | 155.2 | 234.5 | 244.4 | 1.7 | 1.7 | 1.7 |
| Greenville | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| North Carolina | 647.0 | 977.7 | 1,018.8 | 2.7 | 2.7 | 2.7 |
| | | Landfill | | | Co Fire - Wood | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 |
| Raleigh-Durham-Cary | 0.5 | 1.0 | 1.0 | 3.0 | 5.0 | 6.0 |
| Virginia Beach-Norfolk-Newport News | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 1.0 | 2.0 | 4.0 |
| Greensboro-Winston-Salem-High Point | 0.0 | 0.0 | 0.0 | 0.0 | 1.0 | 1.0 |
| Greenville | 0.0 | 0.0 | 0.0 | 2.0 | 4.0 | 6.0 |
| North Carolina | 0.5 | 1.0 | 1.0 | 6.0 | 14.0 | 20.0 |
| | | Direct Fire-Wood | | | Direct Fire-Dedicated Energy | |
| Asheville-Brevard | 0.0 | 0.0 | 0.0 | 1.0 | 3.0 | 4.0 |
| Raleigh-Durham-Cary | 8.0 | 9.0 | 9.0 | 5.0 | 20.0 | 29.0 |
| Virginia Beach-Norfolk-Newport News | 2.0 | 2.0 | 2.0 | 1.0 | 5.0 | 7.0 |
| Charlotte-Gastonia-Salisbury | 0.0 | 0.0 | 0.0 | 3.0 | 10.0 | 14.0 |
| Greensboro-Winston-Salem-High Point | 2.0 | 2.0 | 2.0 | 3.0 | 10.0 | 14.0 |
| Greenville | 4.0 | 5.0 | 5.0 | 2.0 | 8.0 | 12.0 |
| North Carolina | 16.0 | 18.0 | 18.0 | 15.0 | 56.0 | 80.0 |

# APPENDIX C
# ECONOMIC IMPACTS FROM ADDITIONAL RENEWABLE ENERGY FACILITIES

**Table C.1. Total Industry Output From Investment in Additional Renewable Energy Under the NC REPS, 25% RES, and 20% RES***

| BEA Region/State | NC REPS | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | *2015* | | | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $4,399,453 | $7,438,661 | $4,399,453 | $7,438,661 | $59,768,794 | $100,880,723 |
| Raleigh-Durham-Cary | $1,289,298,178 | $2,262,235,939 | $1,289,298,178 | $2,262,235,939 | $1,528,214,215 | $2,679,232,417 |
| Virginia Beach-Norfolk-Newport News | $105,888,192 | $162,131,782 | $158,832,288 | $243,197,673 | $158,832,288 | $243,197,673 |
| Charlotte-Gastonia-Salisbury | $164,100,192 | $280,907,420 | $84,461,513 | $144,781,873 | $243,738,871 | $417,032,967 |
| Greensboro-Winston-Salem-High Point | $762,716,618 | $1,287,096,939 | $762,716,618 | $1,287,096,939 | $921,467,262 | $1,553,991,625 |
| Greenville | $1,241,020,618 | $2,148,554,169 | $1,241,020,618 | $2,148,554,169 | $1,320,634,739 | $2,276,996,982 |
| North Carolina | $3,643,068,934 | $6,825,823,289 | $3,643,068,934 | $6,825,823,289 | $4,363,919,461 | $8,123,704,709 |
| | *2020* | | | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $59,768,794 | $100,880,723 | $115,138,135 | $194,322,785 | $174,602,619 | $294,798,702 |
| Raleigh-Durham-Cary | $1,956,157,566 | $3,429,757,103 | $2,433,989,640 | $4,263,750,059 | $2,911,821,714 | $5,097,743,015 |
| Virginia Beach-Norfolk-Newport News | $215,825,159 | $330,468,035 | $321,713,351 | $492,599,817 | $374,657,447 | $573,665,708 |
| Charlotte-Gastonia-Salisbury | $487,477,742 | $834,065,934 | $567,116,421 | $970,191,481 | $806,032,458 | $1,378,568,122 |
| Greensboro-Winston-Salem-High Point | $1,035,666,621 | $1,747,631,656 | $1,273,792,587 | $2,147,973,685 | $1,511,918,553 | $2,548,315,714 |
| Greenville | $1,489,435,409 | $2,549,875,584 | $1,728,277,772 | $2,935,204,023 | $1,887,506,014 | $3,192,089,649 |
| North Carolina | $5,401,574,702 | $10,004,915,019 | $6,675,793,566 | $12,299,898,075 | $7,954,835,264 | $14,604,005,661 |
| | *2025* | | | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $63,863,937 | $107,914,578 | $285,341,301 | $481,682,826 | $234,067,103 | $395,274,619 |
| Raleigh-Durham-Cary | $1,968,133,300 | $3,451,017,833 | $4,048,384,622 | $7,082,650,661 | $3,645,368,393 | $6,378,824,855 |
| Virginia Beach-Norfolk-Newport News | $215,825,159 | $330,468,035 | $586,433,831 | $897,929,272 | $480,545,639 | $735,797,490 |
| Charlotte-Gastonia-Salisbury | $487,477,742 | $834,065,934 | $1,368,326,045 | $2,340,103,277 | $1,134,232,842 | $1,940,382,962 |
| Greensboro-Winston-Salem-High Point | $1,039,104,720 | $1,753,546,618 | $1,916,496,419 | $3,229,082,639 | $1,832,857,940 | $3,088,020,048 |
| Greenville | $1,494,221,623 | $2,557,872,072 | $2,374,763,168 | $3,978,739,503 | $2,215,534,926 | $3,721,853,877 |
| North Carolina | $5,427,059,244 | $10,052,834,918 | $11,025,880,944 | $20,139,008,438 | $9,910,939,438 | $18,130,898,264 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in $2009.

**Table C.2. Employment From Investment in Additional Renewable Energy Under the NC REPS, 25% RES, and 20% RES***

| BEA Region/State | NC REPS | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | | | *2015* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | 12 | 41 | 12 | 41 | 426 | 829 |
| Raleigh-Durham-Cary | 7,231 | 15,373 | 7,231 | 15,373 | 8,524 | 18,159 |
| Virginia Beach-Norfolk-Newport News | 838 | 1,417 | 1,257 | 2,125 | 1,257 | 2,125 |
| Charlotte-Gastonia-Salisbury | 701 | 1,629 | 369 | 848 | 1,034 | 2,409 |
| Greensboro-Winston-Salem-High Point | 3,958 | 8,523 | 3,958 | 8,523 | 4,764 | 10,273 |
| Greenville | 7,849 | 16,535 | 7,849 | 16,535 | 8,288 | 17,440 |
| North Carolina | 17,999 | 44,101 | 17,999 | 44,101 | 21,323 | 52,216 |
| | | | *2020* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | 426 | 829 | 840 | 1,617 | 1,296 | 2,477 |
| Raleigh-Durham-Cary | 11,023 | 23,363 | 13,608 | 28,935 | 16,192 | 34,507 |
| Virginia Beach-Norfolk-Newport News | 1,717 | 2,898 | 2,555 | 4,315 | 2,974 | 5,023 |
| Charlotte-Gastonia-Salisbury | 2,068 | 4,818 | 2,400 | 5,598 | 3,398 | 7,938 |
| Greensboro-Winston-Salem-High Point | 5,429 | 11,633 | 6,638 | 14,258 | 7,847 | 16,883 |
| Greenville | 9,250 | 19,399 | 10,567 | 22,113 | 11,445 | 23,922 |
| North Carolina | 26,558 | 64,432 | 32,432 | 78,781 | 38,344 | 93,206 |
| | | | *2025* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | 468 | 901 | 2,125 | 4,053 | 1,752 | 3,337 |
| Raleigh-Durham-Cary | 11,107 | 23,525 | 22,388 | 47,820 | 20,194 | 43,101 |
| Virginia Beach-Norfolk-Newport News | 1,717 | 2,898 | 4,649 | 7,856 | 3,812 | 6,440 |
| Charlotte-Gastonia-Salisbury | 2,068 | 4,818 | 5,763 | 13,468 | 4,801 | 11,196 |
| Greensboro-Winston-Salem-High Point | 5,454 | 11,680 | 9,925 | 21,374 | 9,483 | 20,429 |
| Greenville | 9,293 | 19,474 | 14,163 | 29,499 | 13,285 | 27,690 |
| North Carolina | 26,750 | 64,810 | 52,640 | 127,965 | 47,501 | 115,410 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade.

**Table C.3. Value-Added From Investment in Additional Renewable Energy Under the NC REPS, 25% RES, and 20% RES***

| BEA Region/State | NC REPS | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | | | *2015* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $160,539 | $1,852,187 | $160,539 | $1,852,187 | $26,770,988 | $50,255,452 |
| Raleigh-Durham-Cary | $537,357,630 | $1,084,275,350 | $537,357,630 | $1,084,275,350 | $638,616,657 | $1,285,841,627 |
| Virginia Beach-Norfolk-Newport News | $48,360,908 | $80,830,116 | $72,541,362 | $121,245,174 | $72,541,362 | $121,245,174 |
| Charlotte-Gastonia-Salisbury | $80,555,455 | $147,286,052 | $41,543,327 | $76,007,390 | $119,567,583 | $218,564,714 |
| Greensboro-Winston-Salem-High Point | $332,570,987 | $623,990,624 | $332,570,987 | $623,990,624 | $403,284,307 | $754,952,614 |
| Greenville | $513,048,863 | $1,028,102,078 | $513,048,863 | $1,028,102,078 | $546,501,323 | $1,089,366,712 |
| North Carolina | $1,635,810,264 | $3,403,341,426 | $1,635,810,264 | $3,403,341,426 | $1,974,880,219 | $4,064,501,801 |
| | | | *2020* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $26,770,988 | $50,255,452 | $53,381,437 | $98,658,717 | $82,072,129 | $150,828,440 |
| Raleigh-Durham-Cary | $818,871,915 | $1,647,576,036 | $1,021,389,969 | $2,050,708,590 | $1,223,908,023 | $2,453,841,144 |
| Virginia Beach-Norfolk-Newport News | $98,734,775 | $164,932,143 | $147,095,683 | $245,762,259 | $171,276,137 | $286,177,317 |
| Charlotte-Gastonia-Salisbury | $239,135,166 | $437,129,428 | $278,147,294 | $508,408,090 | $395,183,678 | $722,244,076 |
| Greensboro-Winston-Salem-High Point | $453,105,206 | $848,973,302 | $559,175,186 | $1,045,416,287 | $665,245,166 | $1,241,859,272 |
| Greenville | $617,978,699 | $1,220,143,728 | $718,336,079 | $1,403,937,630 | $785,240,999 | $1,526,466,898 |
| North Carolina | $2,456,414,976 | $5,015,765,414 | $3,056,734,048 | $6,185,919,094 | $3,659,490,060 | $7,360,921,075 |
| | | | *2025* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $28,851,231 | $54,021,910 | $135,293,027 | $247,634,970 | $110,762,821 | $202,998,163 |
| Raleigh-Durham-Cary | $823,749,083 | $1,657,654,632 | $1,706,066,211 | $3,413,844,738 | $923,623,295 | $1,779,773,182 |
| Virginia Beach-Norfolk-Newport News | $98,734,775 | $164,932,143 | $267,997,953 | $447,837,549 | $219,637,045 | $367,007,433 |
| Charlotte-Gastonia-Salisbury | $239,135,166 | $437,129,428 | $670,799,773 | $1,225,923,438 | $556,294,588 | $1,016,816,180 |
| Greensboro-Winston-Salem-High Point | $454,482,098 | $851,721,236 | $845,630,557 | $1,576,125,794 | $808,048,698 | $1,506,531,186 |
| Greenville | $620,264,927 | $1,224,267,602 | $990,528,215 | $1,902,302,450 | $923,623,295 | $1,779,773,182 |
| North Carolina | $2,467,699,821 | $5,039,439,777 | $5,106,280,461 | $10,183,103,632 | $4,581,001,273 | $9,159,219,162 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in $2009.

**Table C.4. Total Industry Output From Year-to-Year Operations of Additional Renewable Energy Under the NC REPS, 25% RES, and 20% RES***

| BEA Region/State | NC REPS | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | *2015* | | | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $299,543 | $342,377 | $299,543 | $342,377 | $25,022,493 | $39,612,161 |
| Raleigh-Durham-Cary | $355,873,303 | $707,155,166 | $359,311,147 | $688,297,318 | $431,761,075 | $811,528,047 |
| Virginia Beach-Norfolk-Newport News | $46,094,365 | $81,852,398 | $70,817,315 | $121,725,018 | $70,817,315 | $121,725,018 |
| Charlotte-Gastonia-Salisbury | $60,146,795 | $99,625,406 | $37,142,767 | $58,531,443 | $86,588,667 | $132,452,607 |
| Greensboro-Winston-Salem-High Point | $186,207,607 | $330,723,562 | $186,207,607 | $330,723,562 | $235,653,507 | $404,342,642 |
| Greenville | $213,884,034 | $360,403,600 | $213,884,034 | $360,403,600 | $238,606,984 | $398,005,609 |
| North Carolina | $862,505,623 | $1,658,111,509 | $867,662,371 | $1,635,403,342 | $1,088,449,951 | $1,986,198,387 |
| | *2020* | | | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $25,022,493 | $39,612,161 | $49,745,443 | $78,881,945 | $85,766,193 | $136,296,914 |
| Raleigh-Durham-Cary | $565,915,320 | $1,045,707,329 | $717,690,864 | $1,254,453,091 | $862,590,720 | $1,500,914,549 |
| Virginia Beach-Norfolk-Newport News | $106,838,065 | $182,792,303 | $156,283,965 | $262,537,543 | $181,006,915 | $302,410,163 |
| Charlotte-Gastonia-Salisbury | $170,336,395 | $267,748,397 | $196,778,267 | $300,575,598 | $270,947,117 | $411,457,344 |
| Greensboro-Winston-Salem-High Point | $275,775,297 | $466,255,961 | $349,944,147 | $576,684,581 | $424,112,997 | $687,113,201 |
| Greenville | $310,648,484 | $513,859,691 | $384,817,334 | $626,665,718 | $432,544,312 | $705,696,276 |
| North Carolina | $1,454,535,910 | $2,614,250,359 | $1,855,259,762 | $3,201,721,136 | $2,256,967,918 | $3,857,479,989 |
| | *2025* | | | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $36,320,293 | $57,757,346 | $135,212,093 | $214,836,482 | $121,786,943 | $193,711,883 |
| Raleigh-Durham-Cary | $567,504,473 | $1,048,503,808 | $1,236,334,617 | $2,063,630,098 | $1,097,984,223 | $1,868,967,357 |
| Virginia Beach-Norfolk-Newport News | $106,838,065 | $182,792,303 | $279,898,715 | $461,900,643 | $230,452,815 | $382,155,403 |
| Charlotte-Gastonia-Salisbury | $170,336,395 | $267,748,397 | $455,305,567 | $690,462,081 | $392,434,517 | $599,860,998 |
| Greensboro-Winston-Salem-High Point | $276,236,664 | $467,010,251 | $559,486,914 | $890,314,170 | $523,466,164 | $835,105,651 |
| Greenville | $321,946,284 | $534,184,723 | $605,196,534 | $968,131,854 | $554,031,712 | $896,754,376 |
| North Carolina | $1,479,233,293 | $2,663,777,815 | $3,271,485,121 | $5,424,961,238 | $2,920,207,157 | $4,913,762,829 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in $2009.

**Table C.5. Employment From Year-to-Year Operations of Additional Renewable Energy Under the NC REPS, 25% RES, and 20% RES***

| BEA Region/State | NC REPS | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | | | *2015* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | 0 | 0 | 0 | 0 | 26 | 155 |
| Raleigh-Durham-Cary | 814 | 3,365 | 814 | 3,232 | 892 | 3,713 |
| Virginia Beach-Norfolk-Newport News | 52 | 336 | 78 | 495 | 78 | 495 |
| Charlotte-Gastonia-Salisbury | 59 | 342 | 33 | 192 | 85 | 438 |
| Greensboro-Winston-Salem-High Point | 278 | 1,303 | 278 | 1,303 | 330 | 1,558 |
| Greenville | 159 | 1,292 | 159 | 1,292 | 185 | 1,434 |
| North Carolina | 1,362 | 6,992 | 1,362 | 6,835 | 1,596 | 8,132 |
| | | | *2020* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | 26 | 155 | 52 | 310 | 85 | 534 |
| Raleigh-Durham-Cary | 1,276 | 4,884 | 1,432 | 5,580 | 1,588 | 6,541 |
| Virginia Beach-Norfolk-Newport News | 111 | 736 | 163 | 1,053 | 189 | 1,212 |
| Charlotte-Gastonia-Salisbury | 170 | 902 | 196 | 998 | 274 | 1,366 |
| Greensboro-Winston-Salem-High Point | 443 | 1,853 | 521 | 2,236 | 599 | 2,618 |
| Greenville | 251 | 1,882 | 329 | 2,310 | 381 | 2,624 |
| North Carolina | 2,277 | 10,863 | 2,693 | 12,920 | 3,116 | 15,382 |
| | | | *2025* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | 33 | 224 | 137 | 844 | 118 | 758 |
| Raleigh-Durham-Cary | 1,307 | 4,924 | 1,997 | 8,584 | 1,860 | 7,925 |
| Virginia Beach-Norfolk-Newport News | 111 | 736 | 293 | 1,846 | 241 | 1,529 |
| Charlotte-Gastonia-Salisbury | 170 | 902 | 463 | 2,295 | 392 | 1,996 |
| Greensboro-Winston-Salem-High Point | 452 | 1,865 | 745 | 3,330 | 712 | 3,140 |
| Greenville | 258 | 1,964 | 551 | 3,612 | 499 | 3,358 |
| North Carolina | 2,332 | 11,102 | 4,187 | 21,091 | 3,823 | 19,311 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade.

**Table C.6. Value-Added From Year-to-Year Operations of Additional Renewable Energy Under the NC REPS, 25% RES, and 20% RES***

| BEA Region/State | NC REPS | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | | | *2015* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $48,026 | $71,154 | $48,026 | $71,154 | $10,953,011 | $19,315,601 |
| Raleigh-Durham-Cary | $153,290,882 | $313,885,342 | $153,671,786 | $307,073,808 | $186,196,289 | $364,946,153 |
| Virginia Beach-Norfolk-Newport News | $21,442,904 | $36,146,558 | $32,347,889 | $57,059,231 | $32,347,889 | $57,059,231 |
| Charlotte-Gastonia-Salisbury | $28,517,423 | $47,500,169 | $17,802,890 | $28,577,539 | $39,612,860 | $63,701,009 |
| Greensboro-Winston-Salem-High Point | $73,432,616 | $141,490,426 | $73,432,616 | $141,490,426 | $95,242,586 | $176,464,264 |
| Greenville | $91,783,517 | $158,813,799 | $91,783,517 | $158,813,799 | $102,688,502 | $177,188,582 |
| North Carolina | $368,515,356 | $734,188,890 | $369,086,703 | $725,535,168 | $467,041,092 | $891,131,921 |
| | | | *2020* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $10,953,011 | $19,315,601 | $21,857,996 | $38,560,048 | $39,480,992 | $67,865,339 |
| Raleigh-Durham-Cary | $244,384,899 | $472,411,718 | $310,195,713 | $574,533,340 | $375,244,719 | $690,278,030 |
| Virginia Beach-Norfolk-Newport News | $49,970,885 | $88,716,842 | $71,780,855 | $130,542,188 | $82,685,840 | $151,454,861 |
| Charlotte-Gastonia-Salisbury | $78,855,374 | $128,490,199 | $89,950,811 | $144,691,039 | $122,665,766 | $197,376,244 |
| Greensboro-Winston-Salem-High Point | $113,093,102 | $205,561,926 | $145,808,057 | $258,022,683 | $178,523,012 | $310,483,440 |
| Greenville | $137,934,494 | $235,678,700 | $170,649,449 | $290,803,049 | $192,268,967 | $328,369,802 |
| North Carolina | $635,191,694 | $1,188,245,990 | $810,242,753 | $1,468,858,364 | $990,869,129 | $1,778,689,420 |
| | | | *2025* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $17,671,022 | $29,376,445 | $61,290,962 | $106,354,233 | $57,103,988 | $97,170,630 |
| Raleigh-Durham-Cary | $244,473,063 | $473,106,242 | $541,819,599 | $962,919,090 | $480,195,759 | $866,662,641 |
| Virginia Beach-Norfolk-Newport News | $49,970,885 | $88,716,842 | $126,305,780 | $235,105,553 | $104,495,810 | $193,280,207 |
| Charlotte-Gastonia-Salisbury | $78,855,374 | $128,490,199 | $205,718,672 | $331,051,479 | $179,721,728 | $289,109,364 |
| Greensboro-Winston-Salem-High Point | $113,118,698 | $205,740,225 | $239,791,544 | $408,122,197 | $222,168,548 | $380,609,415 |
| Greenville | $144,652,505 | $246,548,976 | $271,325,351 | $459,541,865 | $249,324,929 | $423,609,486 |
| North Carolina | $648,744,320 | $1,213,036,886 | $1,446,254,462 | $2,529,478,524 | $1,293,013,367 | $2,285,024,412 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in $2009.

**Table C.7. Total Industry Output From Year-to-Year Operations Under the Three Policy Scenarios, 2015, 2020, and 2025***

| | NC REPS | | | 25% RES | | | 20% RES | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 |
| Region Name | | | | | *Solar* | | | | |
| Asheville-Brevard | $342,377 | $342,377 | $342,377 | $342,377 | $342,377 | $342,377 | $342,377 | $342,377 | $342,377 |
| Raleigh Durham Cary | $2,520,571 | $2,520,571 | $2,520,571 | $2,520,571 | $2,520,571 | $2,520,571 | $2,520,571 | $2,520,571 | $2,520,571 |
| Virginia Beach-Norfolk-Newport News | $95,540 | $95,540 | $95,540 | $95,540 | $95,540 | $95,540 | $95,540 | $95,540 | $95,540 |
| Charlotte-Gastonia-Salisbury | $1,290,198 | $1,290,198 | $1,290,198 | $1,290,198 | $1,290,198 | $1,290,198 | $1,290,198 | $1,290,198 | $1,290,198 |
| Greensboro-Winston-Salem-High Point | $1,607,760 | $1,607,760 | $1,607,760 | $1,607,760 | $1,607,760 | $1,607,760 | $1,607,760 | $1,607,760 | $1,607,760 |
| Greenville | $755,504 | $755,504 | $755,504 | $755,504 | $755,504 | $755,504 | $755,504 | $755,504 | $755,504 |
| North Carolina | $7,608,000 | $7,608,000 | $7,608,000 | $7,608,000 | $7,608,000 | $7,608,000 | $7,608,000 | $7,608,000 | $7,608,000 |
| Region Name | | | | | *Solar Industrial* | | | | |
| Asheville-Brevard | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Raleigh-Durham-Cary | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Virginia Beach-Norfolk-Newport News | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Charlotte-Gastonia-Salisbury | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Greensboro-Winston-Salem-High Point | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Greenville | $115,681,827 | $115,681,827 | $115,681,827 | $115,681,827 | $115,681,827 | $115,681,827 | $115,681,827 | $115,681,827 | $115,681,827 |
| North Carolina | $136,173,669 | $136,173,669 | $136,173,669 | $136,173,669 | $136,173,669 | $136,173,669 | $136,173,669 | $136,173,669 | $136,173,669 |
| Region Name | | | | | *Swine Manure* | | | | |
| Asheville-Brevard | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Raleigh-Durham-Cary | $44,382,828 | $67,025,287 | $69,821,766 | $44,382,828 | $67,025,287 | $69,821,766 | $44,382,828 | $67,025,287 | $69,821,766 |
| Virginia Beach-Norfolk-Newport News | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Charlotte-Gastonia-Salisbury | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Greensboro-Winston-Salem-High Point | $12,990,550 | $19,695,350 | $20,449,640 | $12,990,550 | $19,695,350 | $20,449,640 | $12,990,550 | $19,695,350 | $20,449,640 |
| Greenville | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| North Carolina | $59,712,924 | $90,261,576 | $94,045,548 | $59,712,924 | $90,261,576 | $94,045,548 | $59,712,924 | $90,261,576 | $94,045,548 |

**Table C.7. Total Industry Output From Year-to-Year Operations Under the Three Policy Scenarios, 2015, 2020, 2025, Continued**

| | NC REPS | | | 25% RES | | | 20% RES | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 |
| Region Name | | | | | *Poultry Waste* | | | | |
| Asheville-Brevard | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | |
| Raleigh Durham Cary | $121,829,027 | $121,829,027 | $121,829,027 | $121,829,027 | $121,829,027 | $121,829,027 | $121,829,027 | $121,829,027 | $121,829,027 |
| Virginia Beach-Norfolk-Newport News | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Charlotte-Gastonia-Salisbury | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Greensboro-Winston-Salem-High Point | $203,001,524 | $203,001,524 | $203,001,524 | $203,001,524 | $203,001,524 | $203,001,524 | $203,001,524 | $203,001,524 | $203,001,524 |
| Greenville | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| North Carolina | $339,377,090 | $339,377,090 | $339,377,090 | $339,377,090 | $339,377,090 | $339,377,090 | $339,377,090 | $339,377,090 | $339,377,090 |
| Region Name | | | | | *Landfill Gas* | | | | |
| Asheville-Brevard | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Raleigh-Durham-Cary | $2,670,332 | $5,340,663 | $5,340,663 | $2,670,332 | $5,340,663 | $5,340,663 | $2,670,332 | $5,340,663 | $5,340,663 |
| Virginia Beach-Norfolk-Newport News | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Charlotte-Gastonia-Salisbury | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Greensboro-Winston-Salem-High Point | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Greenville | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| North Carolina | $2,764,324 | $5,528,648 | $5,528,648 | $2,764,324 | $5,528,648 | $5,528,648 | $2,764,324 | $5,528,648 | $5,528,648 |
| Region Name | | | | | *Co-Fire Wood* | | | | |
| Asheville-Brevard | $0 | $0 | $18,145,185 | $0 | $0 | $18,145,185 | $0 | $18,145,185 | $36,290,370 |
| Raleigh-Durham-Cary | $71,552,742 | $119,254,570 | $119,254,570 | $71,552,742 | $119,254,570 | $166,956,398 | $71,552,742 | $119,254,570 | $143,105,484 |
| Virginia Beach-Norfolk-Newport News | $0 | $21,194,665 | $21,194,665 | $0 | $21,194,665 | $21,194,665 | $0 | $21,194,665 | $21,194,665 |
| Charlotte-Gastonia-Salisbury | $20,280,663 | $40,561,326 | $40,561,326 | $20,280,663 | $40,561,326 | $60,841,989 | $20,280,663 | $40,561,326 | $81,122,652 |
| Greensboro-Winston-Salem-High Point | $0 | $18,398,979 | $18,398,979 | $0 | $18,398,979 | $36,797,958 | $0 | $18,398,979 | $18,398,979 |
| Greenville | $40,650,064 | $81,300,128 | $101,625,160 | $40,650,064 | $81,300,128 | $121,950,192 | $40,650,064 | $81,300,128 | $121,950,192 |
| North Carolina | $137,230,452 | $297,332,646 | $343,076,130 | $137,230,452 | $297,332,646 | $457,434,840 | $137,230,452 | $320,204,388 | $457,434,840 |

**Table C.7. Total Industry Output From Year-to-Year Operations Under the Three Policy Scenarios, 2015, 2020, 2025, Continued**

| | NC REPS | | | 25% RES | | | 20% RES | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 | 2015 | 2020 | 2025 |
| Region Name | | | | | *Direct Fire Wood* | | | | |
| Asheville-Brevard | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 | $0 |
| Raleigh Durham Cary | $426,265,731 | $426,265,731 | $426,265,731 | $331,540,013 | $331,540,013 | $331,540,013 | $378,902,872 | $426,265,731 | $426,265,731 |
| Virginia Beach-Norfolk-Newport News | $81,756,858 | $81,756,858 | $81,756,858 | $81,756,858 | $81,756,858 | $81,756,858 | $81,756,858 | $81,756,858 | $81,756,858 |
| Charlotte-Gastonia-Salisbury | $41,093,963 | $41,093,963 | $41,093,963 | $0 | $0 | $0 | $0 | $0 | $0 |
| Greensboro-Winston-Salem-High Point | $76,314,188 | $76,314,188 | $76,314,188 | $76,314,188 | $76,314,188 | $76,314,188 | $76,314,188 | $76,314,188 | $76,314,188 |
| Greenville | $165,714,196 | $165,714,196 | $165,714,196 | $165,714,196 | $165,714,196 | $165,714,196 | $165,714,196 | $207,142,745 | $207,142,745 |
| North Carolina | $822,700,314 | $822,700,314 | $822,700,314 | $685,583,595 | $685,583,595 | $685,583,595 | $731,289,168 | $822,700,314 | $822,700,314 |
| Region Name | | | | | *Direct Fire Dedicated Energy* | | | | |
| Asheville-Brevard | $0 | $39,269,784 | $39,269,784 | $0 | $78,539,568 | $196,348,920 | $39,269,784 | $117,809,352 | $157,079,136 |
| Raleigh-Durham-Cary | $37,933,935 | $303,471,480 | $303,471,480 | $113,801,805 | $606,942,960 | $1,365,621,660 | $189,669,675 | $758,678,700 | $1,100,084,115 |
| Virginia Beach-Norfolk-Newport News | $0 | $79,745,240 | $79,745,240 | $39,872,620 | $159,490,480 | $358,853,580 | $39,872,620 | $199,363,100 | $279,108,340 |
| Charlotte-Gastonia-Salisbury | $36,960,582 | $184,802,910 | $184,802,910 | $36,960,582 | $258,724,074 | $628,329,894 | $110,881,746 | $369,605,820 | $517,448,148 |
| Greensboro-Winston-Salem-High Point | $36,809,540 | $147,238,160 | $147,238,160 | $36,809,540 | $257,666,780 | $552,143,100 | $110,428,620 | $368,095,400 | $515,333,560 |
| Greenville | $37,602,009 | $150,408,036 | $150,408,036 | $37,602,009 | $263,214,063 | $564,030,135 | $75,204,018 | $300,816,072 | $451,224,108 |
| North Carolina | $152,544,736 | $915,268,416 | $915,268,416 | $266,953,288 | $1,639,855,912 | $3,699,209,848 | $572,042,760 | $2,135,626,304 | $3,050,894,720 |
| Region Name | | | | | *Total* | | | | |
| Asheville-Brevard | $342,377 | $39,612,161 | $57,757,346 | $342,377 | $78,881,945 | $214,836,482 | $39,612,161 | $136,296,914 | $193,711,883 |
| Raleigh-Durham-Cary | $707,155,166 | $1,045,707,329 | $1,048,503,808 | $688,297,318 | $1,254,453,091 | $2,063,630,098 | $811,528,047 | $1,500,914,549 | $1,868,967,357 |
| Virginia Beach-Norfolk-Newport News | $81,852,398 | $182,792,303 | $182,792,303 | $121,725,018 | $262,537,543 | $461,900,643 | $121,725,018 | $302,410,163 | $382,155,403 |
| Charlotte-Gastonia-Salisbury | $99,625,406 | $267,748,397 | $267,748,397 | $58,531,443 | $300,575,598 | $690,462,081 | $132,452,607 | $411,457,344 | $599,860,998 |
| Greensboro-Winston-Salem-High Point | $330,723,562 | $466,255,961 | $467,010,251 | $330,723,562 | $576,684,581 | $890,314,170 | $404,342,642 | $687,113,201 | $835,105,651 |
| Greenville | $360,403,600 | $513,859,691 | $534,184,723 | $360,403,600 | $626,665,718 | $968,131,854 | $398,005,609 | $705,696,276 | $896,754,376 |
| North Carolina | $1,658,111,509 | $2,614,250,359 | $2,663,777,815 | $1,635,403,342 | $3,201,721,136 | $5,424,961,238 | $1,986,198,387 | $3,857,479,989 | $4,913,762,829 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in $2009.

**Table C.8. Total Industry Output from Agriculture and Forestry Feedstock Production Under the Three Policy Scenarios, 2015, 2020, and 2025***

| BEA Region/State | NC RES | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | | | *2015* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $0 | $0 | $0 | $0 | $5,524,952 | $10,046,713 |
| Raleigh-Durham-Cary | $95,105,879 | $165,446,665 | $91,391,609 | $161,118,825 | $108,494,450 | $193,031,954 |
| Virginia Beach-Norfolk-Newport News | $13,878,074 | $21,683,098 | $18,959,976 | $30,039,168 | $18,959,976 | $30,039,168 |
| Charlotte-Gastonia-Salisbury | $16,373,191 | $26,717,079 | $9,434,154 | $16,474,269 | $19,597,958 | $36,552,285 |
| Greensboro-Winston-Salem-High Point | $43,927,303 | $68,715,310 | $43,927,303 | $68,715,310 | $54,091,107 | $87,972,268 |
| Greenville | $41,542,554 | $65,622,107 | $41,542,554 | $65,622,107 | $46,624,456 | $74,623,254 |
| North Carolina | $210,827,001 | $361,742,115 | $205,255,596 | $357,642,207 | $252,849,849 | $451,246,216 |
| | | | *2020* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $6,344,395 | $11,405,568 | $12,688,790 | $22,811,136 | $23,385,437 | $40,438,997 |
| Raleigh-Durham-Cary | $147,346,665 | $264,847,948 | $182,086,775 | $334,851,134 | $220,273,941 | $406,093,696 |
| Virginia Beach-Norfolk-Newport News | $30,384,872 | $48,257,836 | $42,539,418 | $68,036,154 | $48,616,691 | $77,925,313 |
| Charlotte-Gastonia-Salisbury | $46,029,906 | $81,650,167 | $51,245,415 | $94,822,091 | $69,477,234 | $129,944,192 |
| Greensboro-Winston-Salem-High Point | $67,506,745 | $110,688,214 | $85,738,564 | $144,827,938 | $103,970,383 | $178,967,662 |
| Greenville | $69,474,248 | $112,940,384 | $87,706,067 | $145,034,873 | $100,722,377 | $166,506,583 |
| North Carolina | $366,819,709 | $663,916,131 | $461,470,785 | $860,360,301 | $565,644,697 | $1,060,744,503 |
| | | | *2025* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $10,934,163 | $18,021,727 | $37,261,807 | $65,219,463 | $35,032,148 | $59,642,322 |
| Raleigh-Durham-Cary | $149,654,745 | $269,147,204 | $322,723,099 | $604,761,220 | $287,688,440 | $535,189,737 |
| Virginia Beach-Norfolk-Newport News | $30,961,892 | $49,146,572 | $75,522,373 | $121,481,261 | $62,790,807 | $100,814,207 |
| Charlotte-Gastonia-Salisbury | $47,472,456 | $84,068,042 | $121,275,067 | $226,551,797 | $35,032,148 | $59,642,322 |
| Greensboro-Winston-Salem-High Point | $68,660,785 | $112,718,826 | $143,036,650 | $249,563,748 | $132,318,615 | $231,594,436 |
| Greenville | $74,980,540 | $121,671,302 | $149,356,405 | $251,525,194 | $137,198,093 | $228,728,603 |
| North Carolina | $382,448,453 | $691,879,251 | $848,094,761 | $1,622,833,230 | $760,693,561 | $1,441,252,167 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in $2009.

**Table C.9. Employment from Agriculture and Forestry Feedstock Production Under the Three Policy Scenarios, 2015, 2020, and 2025**

| BEA Region/State | NC RES | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | | | *2015* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | 0 | 0 | 0 | 0 | -111 | -64 |
| Raleigh-Durham-Cary | 307 | 931 | 279 | 899 | 328 | 1,083 |
| Virginia Beach-Norfolk-Newport News | 51 | 130 | 63 | 177 | 63 | 177 |
| Charlotte-Gastonia-Salisbury | 34 | 114 | 8 | 65 | -9 | 135 |
| Greensboro-Winston-Salem-High Point | 90 | 300 | 90 | 300 | 54 | 355 |
| Greenville | 149 | 386 | 149 | 386 | 163 | 442 |
| North Carolina | 659 | 1,929 | 609 | 1,901 | 706 | 2,417 |
| | | | *2020* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | -54 | -1 | -109 | -2 | -147 | 34 |
| Raleigh-Durham-Cary | 485 | 1,543 | 593 | 1,976 | 723 | 2,409 |
| Virginia Beach-Norfolk-Newport News | 107 | 293 | 147 | 417 | 723 | 2,409 |
| Charlotte-Gastonia-Salisbury | 97 | 392 | 86 | 456 | 109 | 625 |
| Greensboro-Winston-Salem-High Point | 132 | 517 | 137 | 677 | 143 | 838 |
| Greenville | 252 | 690 | 316 | 901 | 363 | 1,034 |
| North Carolina | 1,171 | 3,752 | 1,438 | 4,950 | 1,767 | 6,142 |
| | | | *2025* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | -22 | 54 | -173 | 123 | -119 | 143 |
| Raleigh-Durham-Cary | 504 | 1,579 | 1,104 | 3,676 | 984 | 3,237 |
| Virginia Beach-Norfolk-Newport News | 112 | 302 | 267 | 762 | 223 | 631 |
| Charlotte-Gastonia-Salisbury | 120 | 423 | 257 | 1,156 | 237 | 998 |
| Greensboro-Winston-Salem-High Point | 155 | 547 | 256 | 1,249 | 232 | 1,158 |
| Greenville | 276 | 746 | 551 | 1,604 | 506 | 1,444 |
| North Carolina | 1,266 | 3,954 | 2,781 | 9,686 | 2,506 | 8,549 |

**Table C.10. Value-Added from Agriculture and Forestry Feedstock Production Under the Three Policy Scenarios, 2015, 2020, and 2025***

| BEA Region/State | NC RES | | 25% RES | | 20% RES | |
|---|---|---|---|---|---|---|
| | | | *2015* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $0 | $0 | $0 | $0 | $5,432,497 | $8,173,024 |
| Raleigh-Durham-Cary | $28,102,440 | $62,489,753 | $35,248,244 | $70,570,691 | $47,506,237 | $91,046,654 |
| Virginia Beach-Norfolk-Newport News | $3,404,938 | $6,945,922 | $8,681,941 | $14,251,892 | $8,681,941 | $14,251,892 |
| Charlotte-Gastonia-Salisbury | $7,878,988 | $13,377,658 | $6,279,904 | $10,216,931 | $16,833,780 | $26,679,027 |
| Greensboro-Winston-Salem-High Point | $15,760,977 | $28,987,489 | $15,760,977 | $28,987,489 | $26,314,891 | $45,000,453 |
| Greenville | $14,273,787 | $26,508,262 | $14,273,787 | $26,508,262 | $19,550,764 | $34,241,366 |
| North Carolina | $121,833,313 | $262,749,061 | $132,617,710 | $276,055,426 | $176,515,686 | $346,733,647 |
| | | | *2020* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $5,848,169 | $8,912,162 | $11,696,338 | $17,824,324 | $18,605,187 | $28,774,911 |
| Raleigh-Durham-Cary | $70,998,271 | $132,620,497 | $113,625,321 | $197,476,915 | $140,051,035 | $242,300,149 |
| Virginia Beach-Norfolk-Newport News | $15,981,586 | $25,349,090 | $27,490,424 | $41,575,254 | $33,244,843 | $49,688,336 |
| Charlotte-Gastonia-Salisbury | $32,376,916 | $52,659,138 | $42,286,592 | $67,709,069 | $59,549,732 | $95,025,056 |
| Greensboro-Winston-Salem-High Point | $34,479,535 | $58,431,254 | $51,742,711 | $85,152,638 | $69,005,887 | $111,874,022 |
| Greenville | $34,479,535 | $58,431,254 | $51,425,501 | $83,563,695 | $58,892,139 | $95,750,679 |
| North Carolina | $193,748,760 | $352,840,091 | $298,035,870 | $518,604,873 | $378,944,706 | $654,234,793 |
| | | | *2025* | | | |
| | Direct | Total | Direct | Total | Direct | Total |
| Asheville-Brevard | $7,029,332 | $11,164,827 | $30,903,940 | $47,670,435 | $25,995,968 | $40,582,458 |
| Raleigh-Durham-Cary | $72,105,335 | $134,864,705 | $235,832,669 | $395,558,391 | $196,922,525 | $335,286,702 |
| Virginia Beach-Norfolk-Newport News | $16,258,346 | $25,816,976 | $57,507,939 | $84,246,151 | $45,722,341 | $67,552,101 |
| Charlotte-Gastonia-Salisbury | $33,068,851 | $53,926,193 | $103,185,937 | $165,056,229 | $86,510,602 | $138,965,892 |
| Greensboro-Winston-Salem-High Point | $35,033,075 | $59,475,466 | $100,831,569 | $162,147,192 | $93,960,845 | $151,157,276 |
| Greenville | $35,789,759 | $60,984,725 | $101,684,340 | $160,799,712 | $85,718,217 | $137,761,473 |
| North Carolina | $199,180,116 | $364,675,439 | $629,582,303 | $1,068,244,586 | $534,451,486 | $916,256,117 |

* The North Carolina numbers are greater than the sum of the BEA regions. This is due to interregional trade. All dollar value impacts are in $2009.

# APPENDIX D
# NORTH CAROLINA AGRICULTURAL ECONOMIC ACTIVITY FOR SELECTED RES SCENARIOS BY BEA

## Table D.1. Economic Activity for North Carolina's Agricultural and State Economy, 2006

| *State/BEA Region* | Direct Economic Activity [a] | | | | | | *Proportion of Agriculture to Total Economy* | *Number of Farms[b]* |
|---|---|---|---|---|---|---|---|---|
| | Total State | Agricultural | Logging | Fishing | Hunting/ Trapping | Total Ag/For | | |
| | Million 2006 $ | | | | | | Proportion | Number |
| North Carolina | $677,477.5 | $8,230.7 | $1,326.5 | $43.9 | $276.7 | $9,877.8 | 0.015 | 52,913 |
| Asheville-Brevard 10 | $36,678.1 | $370.8 | $63.9 | $0.0 | $11.1 | $445.8 | 0.012 | 7,582 |
| Raleigh-Durham-Cary 133 | $214,100.7 | $3,762.4 | $528.2 | $0.0 | $75.8 | $4,366.4 | 0.020 | 15,634 |
| Virginia Beach-Norfolk-Newport News 173 | $10,277.2 | $486.4 | $126.5 | $9.2 | $16.1 | $638.2 | 0.062 | 1,535 |
| Charlotte-Gastonia-Salisbury 31 | $219,407.8 | $1,344.5 | $148.0 | $0.0 | $142.8 | $1,635.2 | 0.007 | 11,381 |
| Greensboro-Winston-Salem-High Point 66 | $136,892.5 | $1,118.1 | $123.9 | $0.0 | $17.1 | $1,259.2 | 0.009 | 12,137 |
| Greenville 67 | $60,634.0 | $1,052.3 | $337.1 | $34.0 | $13.9 | $1,437.4 | 0.024 | 4,644 |

Sources: [a] Data developed from IMPLAN data bases; [b] 2007 Census of Agriculture

## Table D.2. Projected Agricultural Economic impacts as a Result of Selected Renewable Electricity Standards, North Carolina, by BEA region, 2015, 2020, and 2025

| | 2015 | | | 2020 | | | 2025 | | |
|---|---|---|---|---|---|---|---|---|---|
| | ***NC RES*** | ***25% RES*** | ***20% RES*** | ***NC RES*** | ***25% RES*** | ***20% RES*** | ***NC RES*** | ***25% RES*** | ***20% RES*** |
| North Carolina | $210,827,001 | $205,255,596 | $252,849,849 | $366,819,709 | $461,470,785 | $565,644,697 | $382,448,453 | $848,094,761 | $760,693,561 |
| Asheville-Brevard 10 | $0 | $0 | $5,524,952 | $6,344,395 | $12,688,790 | $23,385,437 | $10,934,163 | $37,261,807 | $35,032,148 |
| Raleigh-Durham-Cary 133 | $95,105,879 | $91,391,609 | $108,494,450 | $147,346,665 | $182,086,775 | $220,273,941 | $149,654,745 | $322,723,099 | $287,688,440 |
| Virginia Beach-Norfolk-Newport News 173 | $13,878,074 | $18,959,976 | $18,959,976 | $30,384,872 | $42,539,418 | $48,616,691 | $30,961,892 | $75,522,373 | $62,790,807 |
| Charlotte-Gastonia-Salisbury 31 | $16,373,191 | $9,434,154 | $19,597,958 | $46,029,906 | $51,245,415 | $69,477,234 | $47,472,456 | $121,275,067 | $35,032,148 |
| Greensboro-Winston-Salem-High Point 66 | $43,927,303 | $43,927,303 | $54,091,107 | $67,506,745 | $85,738,564 | $103,970,383 | $68,660,785 | $143,036,650 | $132,318,615 |
| Greenville 67 | $41,542,554 | $41,542,554 | $46,624,456 | $69,474,248 | $87,706,067 | $100,722,377 | $74,980,540 | $149,356,405 | $137,198,093 |

**Table D.3. Estimated 2007 Gross Receipts Per Farm and Estimated Potential Per Farm Economic Impacts of Selected RES Scenarios for North Carolina by BEA, 2015, 2020, and 2025**

| State/BEA Region | 2007 Agricultural Gross Receipts | 2015 | | | 2020 | | | 2025 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | *NC RES* | *25% RES* | *20% RES* | *NC RES* | *25% RES* | *20% RES* | *NC RES* | *25% RES* | *20% RES* |
| | | Dollars/farm | | | | | | | | |
| North Carolina | $186,680 | $3,984 | $3,879 | $4,779 | $6,933 | $8,721 | $10,690 | $7,228 | $16,028 | $14,376 |
| Asheville-Brevard 10 | $58,799 | $0 | $0 | $104 | $120 | $240 | $442 | $207 | $704 | $662 |
| Raleigh-Durham-Cary 133 | $279,288 | $1,797 | $1,727 | $2,050 | $2,785 | $3,441 | $4,163 | $2,828 | $6,099 | $5,437 |
| Virginia Beach-Norfolk-Newport News 173 | $415,798 | $262 | $358 | $358 | $574 | $804 | $919 | $585 | $1,427 | $1,187 |
| Charlotte-Gastonia-Salisbury 31 | $143,679 | $309 | $178 | $370 | $870 | $968 | $1,313 | $897 | $2,292 | $662 |
| Greensboro-Winston-Salem-High Point 66 | $103,745 | $830 | $830 | $1,022 | $1,276 | $1,620 | $1,965 | $1,298 | $2,703 | $2,501 |
| Greenville 67 | $309,511 | $785 | $785 | $881 | $1,313 | $1,658 | $1,904 | $1,417 | $2,823 | $2,593 |

# APPENDIX E – Adjusted Bureau of Economic Analysis Regions Defined by County

**Table E.1. Adjusted Bureau of Economic Analysis Region Assignment by County**

| County | Bureau of Economic Analysis Region |
|---|---|
| Alamance | Greensboro-Winston-Salem-High Point |
| Alexander | Charlotte-Gastonia-Salisbury |
| Alleghaney | Greensboro-Winston-Salem-High Point |
| Anson | Charlotte-Gastonia-Salisbury |
| Ashe | Asheville-Brevard |
| Avery | Asheville-Brevard |
| Beaufort | Greenville |
| Bertie | Virginia Beach-Norfolk-Newport News |
| Bladen | Raleigh-Durham-Cary |
| Brunswick | Greenville |
| Buncombe | Asheville-Brevard |
| Burke | Charlotte-Gastonia-Salisbury |
| Cabarrus | Charlotte-Gastonia-Salisbury |
| Caldwell | Charlotte-Gastonia-Salisbury |
| Camden | Virginia Beach-Norfolk-Newport News |
| Carteret | Greenville |
| Caswell | Greensboro-Winston-Salem-High Point |
| Catawba | Charlotte-Gastonia-Salisbury |
| Chatham | Raleigh-Durham-Cary |
| Cherokee | Asheville-Brevard |
| Chowan | Virginia Beach-Norfolk-Newport News |
| Clay | Asheville-Brevard |
| Cleveland | Charlotte-Gastonia-Salisbury |
| Columbus | Greenville |
| Craven | Greenville |
| Cumberland | Raleigh-Durham-Cary |
| Currituck | Virginia Beach-Norfolk-Newport News |
| Dare | Virginia Beach-Norfolk-Newport News |
| Davidson | Greensboro-Winston-Salem-High Point |
| Davie | Greensboro-Winston-Salem-High Point |
| Duplin | Raleigh-Durham-Cary |
| Durham | Raleigh-Durham-Cary |
| Edgecombe | Raleigh-Durham-Cary |
| Forsyth | Greensboro-Winston-Salem-High Point |
| Franklin | Raleigh-Durham-Cary |
| Gaston | Charlotte-Gastonia-Salisbury |
| Gates | Virginia Beach-Norfolk-Newport News |
| Graham | Asheville-Brevard |
| Granville | Raleigh-Durham-Cary |
| Greene | Greenville |
| Guilford | Greensboro-Winston-Salem-High Point |

**Table E.1. Adjusted Bureau of Economic Analysis Region Assignment by County**

| County | Bureau of Economic Analysis Region |
|---|---|
| Halifax | Raleigh-Durham-Cary |
| Harnett | Raleigh-Durham-Cary |
| Haywood | Asheville-Brevard |
| Henderson | Asheville-Brevard |
| Hertford | Virginia Beach-Norfolk-Newport News |
| Hoke | Raleigh-Durham-Cary |
| Hyde | Virginia Beach-Norfolk-Newport News |
| Iredell | Charlotte-Gastonia-Salisbury |
| Jackson | Asheville-Brevard |
| Johnston | Raleigh-Durham-Cary |
| Jones | Greenville |
| Lee | Raleigh-Durham-Cary |
| Lenoir | Greenville |
| Lincoln | Charlotte-Gastonia-Salisbury |
| Macon | Asheville-Brevard |
| Madison | Asheville-Brevard |
| Martin | Greenville |
| Mcdowell | Charlotte-Gastonia-Salisbury |
| Mecklenburg | Charlotte-Gastonia-Salisbury |
| Mitchell | Asheville-Brevard |
| Montgomery | Greensboro-Winston-Salem-High Point |
| Moore | Raleigh-Durham-Cary |
| Nash | Raleigh-Durham-Cary |
| New Hanover | Greenville |
| Northhampton | Raleigh-Durham-Cary |
| Onslow | Greenville |
| Orange | Raleigh-Durham-Cary |
| Pamlico | Greenville |
| Pasquotank | Virginia Beach-Norfolk-Newport News |
| Pender | Greenville |
| Perquimans | Virginia Beach-Norfolk-Newport News |
| Person | Raleigh-Durham-Cary |
| Pitt | Greenville |
| Polk | Charlotte-Gastonia-Salisbury |
| Randolph | Greensboro-Winston-Salem-High Point |
| Richmond | Raleigh-Durham-Cary |
| Robeson | Raleigh-Durham-Cary |
| Rockingham | Greensboro-Winston-Salem-High Point |
| Rowan | Charlotte-Gastonia-Salisbury |
| Rutherford | Charlotte-Gastonia-Salisbury |
| Sampson | Raleigh-Durham-Cary |
| Scotland | Raleigh-Durham-Cary |

**Table E.1. Adjusted Bureau of Economic Analysis Region Assignment by County**

| County | Bureau of Economic Analysis Region |
|---|---|
| Stanly | Charlotte-Gastonia-Salisbury |
| Stokes | Greensboro-Winston-Salem-High Point |
| Surry | Greensboro-Winston-Salem-High Point |
| Swain | Asheville-Brevard |
| Transylvania | Asheville-Brevard |
| Tyrrell | Virginia Beach-Norfolk-Newport News |
| Union | Charlotte-Gastonia-Salisbury |
| Vance | Raleigh-Durham-Cary |
| Wake | Raleigh-Durham-Cary |
| Warren | Raleigh-Durham-Cary |
| Washington | Greenville |
| Watauga | Asheville-Brevard |
| Wayne | Raleigh-Durham-Cary |
| Wilkes | Greensboro-Winston-Salem-High Point |
| Wilson | Raleigh-Durham-Cary |
| Yadkin | Greensboro-Winston-Salem-High Point |
| Yancey | Asheville-Brevard |