# 2011
# NORTH CAROLINA
# CLEAN ENERGY DATA BOOK

NC SUSTAINABLE
ENERGY ASSOCIATION

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**Mission:**
Founded in 1978, the North Carolina Sustainable Energy Association is a 501(c)(3) non-profit membership organization of individuals, businesses, government and nonprofits working to ensure a sustainable future by promoting renewable energy and energy efficiency in North Carolina through education, public policy, and economic development.

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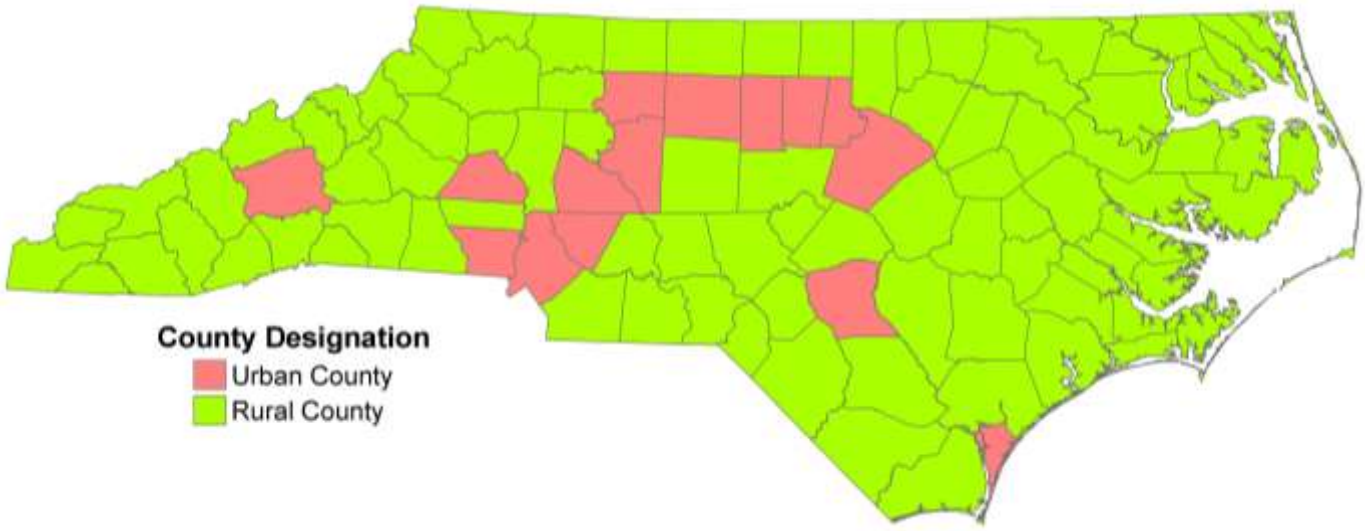
# CHAPTER 1: INTRODUCTION

Clean energy—in the form of renewable energy and energy efficiency—is an emerging and potentially significant economic driver for the State of North Carolina. Clean energy investments can be found in a diverse mix of regions from the coast to the mountains, resulting in robust renewable energy and energy efficiency infrastructure spread across the state. However, the presence of clean energy projects can go unnoticed, and future opportunities can be overlooked. To overcome this dynamic, the North Carolina Sustainable Energy Association designed this publication to:

1. Catalogue and geographically display existing clean energy infrastructure at the state, regional, and county levels.
2. Assess the additional clean energy opportunities in the seven economic development regions found in North Carolina by analyzing relative strengths, weaknesses, opportunities, and threats.
3. Determine if clean energy impacts and opportunities differ between urban and rural counties in North Carolina.

This report classifies 15 counties as urban: Alamance, Buncombe, Cabarrus, Catawba, Cumberland, Davidson, Durham, Forsyth, Gaston, Guilford, Mecklenburg, New Hanover, Orange, Rowan, and Wake. The remaining 85 counties in North Carolina are classified as rural counties (see Exhibit 1).

**Exhibit 1: Rural and urban designation of North Carolina counties.**




*Sources: North Carolina Rural Economic Development Center, NC Sustainable Energy Association.*

Chapter 2 of the report begins with an overview of North Carolina's existing energy landscape, clean energy resource base, and potential clean energy opportunities. Before reviewing later sections, it is recommended readers consult this chapter in order to understand the overall North Carolina clean energy landscape.

Chapters 3 through 9 provide a more detailed analysis of clean energy infrastructure and potential in the seven economic development regions present in North Carolina. Each regional chapter consists of the following components:

- A summary of key statistics, a regional map, and regional rankings.
- A summary of existing clean energy firms and industry evolution.
- An overview and analysis of existing commercial and government energy efficient buildings, classified by urban and rural counties.

- An evaluation of the residential energy retrofitting potential, as well as a map identifying where likely concentrations of opportunity exist. These maps should not be compared across regions because the intensity scales are different between maps.
- An overview and analysis of registered renewable energy infrastructure, classified by urban and rural counties.
- A brief discussion of the regional training, support, and community college assets. Greater detail can be found in the relevant appendix noted at the beginning of this section.
- An analysis and discussion of regional strengths, weaknesses, opportunities, and threats (SWOT).

The report concludes with appendices providing additional data and resources.

Several topics are beyond the scope of this report. This work does not cover transportation related energy topics, nor is it an exhaustive review of federal or state policies impacting clean energy development in North Carolina. Furthermore, the report does not explore the relative costs or benefits of building new generation or investing in energy efficiency measures. See Appendix 10 for national and state resources that can provide a deeper discussion of these topics.

# CHAPTER 2: NORTH CAROLINA

## *2.1 Electricity Providers in North Carolina*

Electricity customers can be classified into three categories—residential, commercial, and industrial. In North Carolina, an electric customer will be served by one of three types of electric utilities—an investor owned utility, electric membership corporation, or a municipal owned utility.[1] Since electricity is a regulated industry in North Carolina, each type of utility is granted the responsibility to serve a distinct franchise or customer base (see Exhibit 2). Natural gas is also an important energy source for residential, commercial, and industrial customers. However, residential and commercial sectors rely heavily on electricity, which accounts for over 60 percent of total energy consumption.[2] Therefore, for the purpose of this chapter, the three types of electric utilities are outlined in greater detail below.

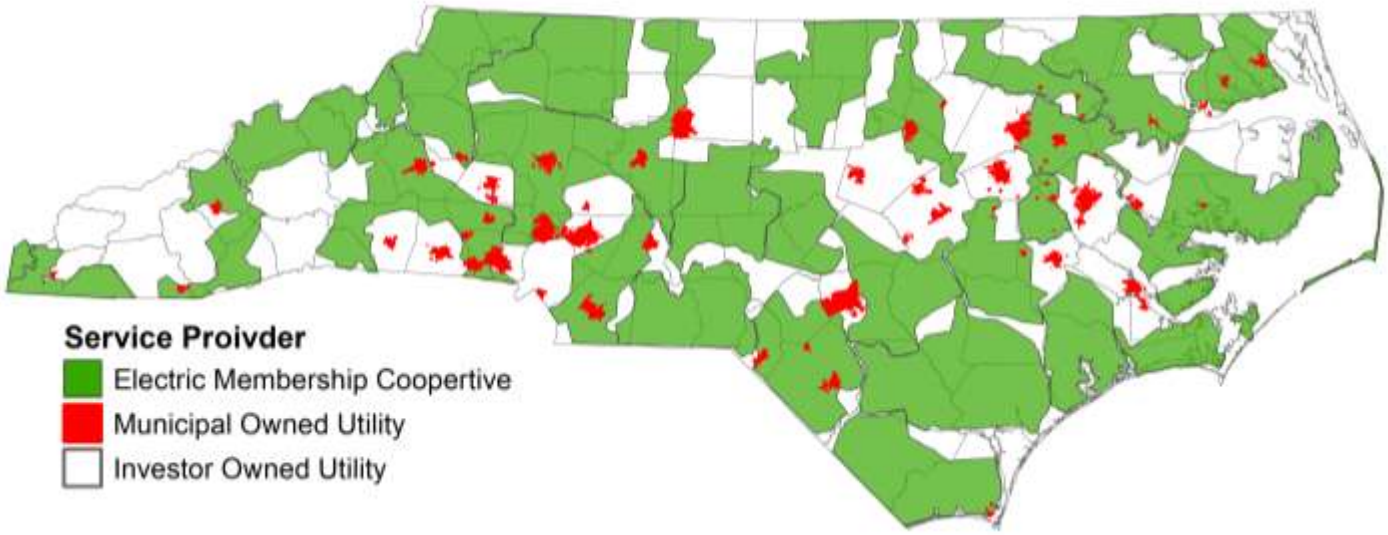



**Exhibit 2: Approximate geographic location of electric service providers in North Carolina.**
*Sources: NC OneMap, North Carolina Electric Membership Corporations, NC Sustainable Energy Association.*

The most prominent type of electric providers are investor owned utilities, or "IOUs". In 2009, North Carolina's three investor owned utilities accounted for 75 percent of electric sales in the State.[3] In addition, they served over 3.2 million customers—or 67 percent of the 4.8 million electric customers present in North Carolina. The largest investor owned utilities are Duke Energy and Progress Energy. In 2009, the two utilities accounted for 71 percent of electric sales and served 3.1 million customers in North Carolina. They also own and operate the majority of the North Carolina transmission grid—which is responsible for moving electricity over long distances. The third investor owned utility, Dominion North Carolina Power, provides service to a small territory in the Northeast portion of the State.

The second type of electric providers are electric membership corporations, also known as "EMCs" or "cooperatives". There are 31 non-profit cooperatives operating in North Carolina, 26 of which are headquartered in the state. In 2009, the 31 electric membership corporations accounted for 13 percent of retail electric sales and served over 1 million customers. The primary constituents served by electric membership corporations are residential customers, accounting for over 90 percent of all customers served.

The third type of electric providers are municipal owned utilities. These utilities are the most abundant in numbers, but serve the smallest percentage of customers. In 2009, over 70 municipal utilities accounted for 12 percent of electric sales and provided service to over 580,000 customers. While they serve fewer

customers than electric membership corporations, municipal owned utilities serve a higher proportion of traditionally more energy intensive commercial and industrial customers. This results in total electric sales that are comparable to electric membership corporations.

Comparisons between electric utilities provide an important backdrop for clean energy development and potential in North Carolina. One critical dynamic is the rural nature of electric membership corporations. This originates from a historical focus on extending access to electricity in rural communities. This continues today, with electric membership corporations maintaining an impressive geographic reach into rural communities. In aggregate, they sell electricity in 95 counties and geographically cover over 60 percent of the state. More importantly, nearly 77 percent of the residential customers served by electric membership corporations reside in rural counties. By comparison, only 33 percent of residential customers served by investor owned utilities and 45 percent of residential customers served by municipal owned utilities reside in rural counties.[4]

A second important distinction is the ownership and operation of generation facilities. Duke Energy and Progress Energy supply 96 percent of the utility-generated electricity consumed in the state—primarily through coal and nuclear facilities.[5] Over 60 percent of the coal capacity is located in rural counties while over 60 percent of the nuclear capacity is located in the urban counties of Wake and Mecklenburg.[6] Conversely, the majority of electric membership corporations and municipal owned utilities do not own or operate generation facilities. These providers typically purchase wholesale electricity through third party organizations, such as GreenCo Solutions for electric membership corporations or North Carolina Eastern Municipal Power Agency for municipal owned utilities. As a result, the power purchase or partial ownership contracts established by third party organizations can constrain individual electric utilities' ability to use renewable and efficiency resources. A more detailed discussion of generation assets and ownership can be found in the *Annual Report of the North Carolina Utilities Commission Regarding Long Range Needs for Expansion of Electric Generation Facilities for Service in North Carolina*.[7]

A third and final key comparison between electric providers is customer data related to annual consumption, electric rates, and total annual expenses. Exhibit 3 reveals residential and commercial customers served by electric membership corporations and municipal owned utilities are subject to electric rates and total annual expenses significantly higher relative to customers served by investor owned utilities. For example, residential customers served by municipal electric providers consume 10 percent less electricity, but incur total annual expenses 12 percent higher than residential customers served by investor owned utilities. Similarly, commercial customers served by municipal electric providers incur total annual expenses that are 25 percent higher than commercial customers served by investor owned utilities.

These trends—geographic coverage, generation ownership, and electric consumption—strongly influence clean energy development and opportunities in North Carolina. For example, the data indicates clean energy development in rural communities may require extensive participation from electric membership corporations; utility management and flexibility can be shaped and in some instances excessively limited by

**Exhibit 3: Annual consumption, electric rates, and total annual expenses in North Carolina, 2009.**

| | Average Residential Customer | | | Average Commercial Customer | | |
|---|---|---|---|---|---|---|
| | Annual Consumption (kWh) | Electric Rate (¢/kWh) | Total Annual Expenses | Annual Consumption (kWh) | Electric Rate (¢/kWh) | Total Annual Expenses |
| Investor Owned | 13,619 | 9.3 | $1,263 | 77,128 | 7.5 | $5,790 |
| Electric Membership | 13,741 | 11.4 | $1,570 | 35,113 | 10.1 | $3,533 |
| Municipal Owned | 12,288 | 11.5 | $1,415 | 75,707 | 9.6 | $7,237 |

*Sources: U.S. Energy Information Administration (Form EIA-861), NC Sustainable Energy Association.*

generation ownership or existing power contracts; and the attractiveness of clean energy investments can be shaped by variations in electric rates and total annual expenses. These factors are highlighted here because they are important dynamics that influence elements considered in the regional sections found later in this report.

## *2.2 Renewable Energy Potential in North Carolina*

North Carolina maintains a diversity of renewable energy resources, which varies across the state in terms of generation potential, geographic presence, and existing development. This section provides an overview of the available resources and technologies. Estimates of total resource capacity for each type of technology can differ greatly depending on the methodology used for evaluating the resource base. There are many organizations that make their estimates and methodology publically available—as such, this report does not attempt to provide specific resource base estimates. In 2006, the North Carolina Utilities Commission contracted for a statewide resource assessment which is undergoing a revision at the time of this publication. Readers interested in these numbers are encouraged to consult that report.[8]

### 2.2.1 Solar Resource and Technologies

A solar energy resource exists statewide in North Carolina. While present in rural and urban counties across the state, the resource is reduced slightly in the mountain regions of North Carolina (see Exhibit 4).
In addition, localized conditions can affect the resource at an individual site—for example, shade from trees or buildings can reduce the available solar resource.

**Exhibit 4: North Carolina solar resource.**


*Source: National Renewable Energy Laboratory.*

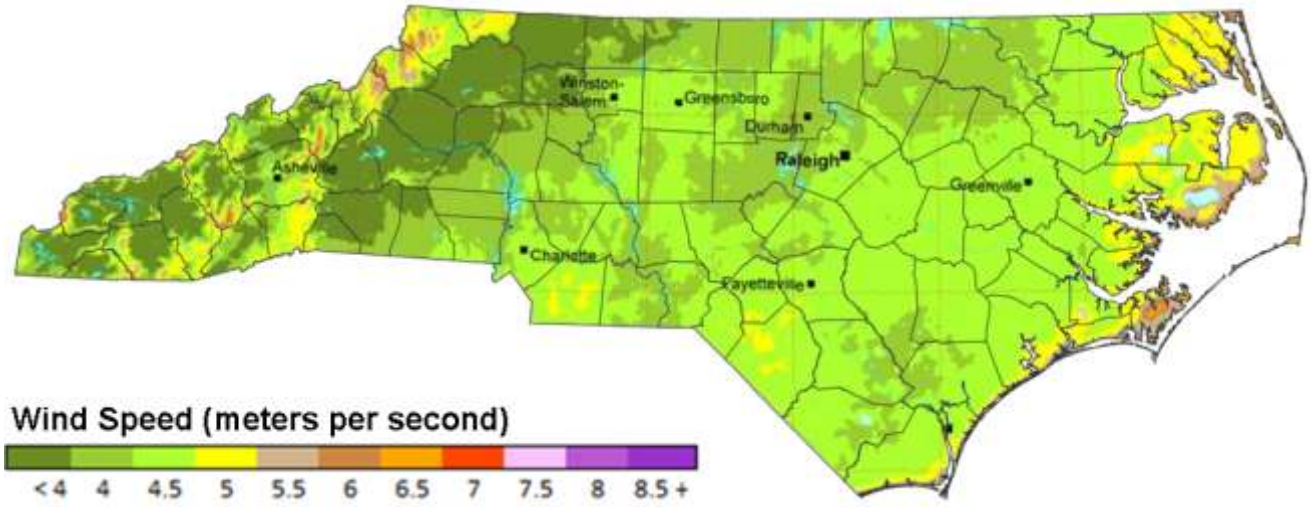
Solar energy generation can broadly be divided into “electric” and “thermal” categories. Within each of these categories there are several technologies that can be utilized. The most common electric technologies are photovoltaic or “PV” systems. These systems, which can be developed at the residential or utility scale, convert radiant energy from the sun to generate electricity. Electric systems may be fixed or achieve increased efficiency using tracking systems to follow the sun. A second type of electric solar technology is concentrating solar power or “CSP”. These technologies focus the collection of solar radiation through the use of reflective surfaces and tracking systems. In the United States, concentrating solar power is primarily being developed in the Southwest, but North Carolina has several firms participating in the research, development, and manufacturing of this technology.

Solar thermal technologies can be employed for both heating and cooling purposes. Common applications include solar water heating, solar space heating, or solar pool heating. For solar water heating, two types of systems exist: direct and indirect. In both systems, thermal energy from the sun is captured by a liquid contained within the system. In the direct heating system, this liquid is water and is transferred to a water heating unit, and ultimately the end user. In the indirect system, a separate liquid is heated and transferred through a closed circuit into a water heating unit. The heated liquid transfers the thermal energy from the contained liquid to the water—thus generating useable hot water.

### 2.2.2 Onshore Wind Resource and Technologies

Wind turbines convert the kinetic energy of wind to electric energy. North Carolina's wind resource varies dramatically, but can be found throughout the State in both rural and urban counties (see Exhibit 5). Favorable conditions for wind energy development include a steady, consistent, and unobstructed wind resource. Therefore, the placement of turbines on tall towers is an important criteria for a wind facility.

**Exhibit 5: North Carolina onshore wind resource at 80 meters.**




*Sources: AWS TruPower, National Renewable Energy Laboratory.*

Residential or small-scale turbines—which can be 100 kilowatts or less—have been developed throughout the state. The wind resource in the Piedmont is marginal for this type of renewable development and will be greatly influenced by local conditions, such as the presence of buildings or trees. Residential turbines are classified as either "vertical" or "horizontal" turbines. Many reputable small wind turbines are undergoing independent certification through the Small Wind Certification Council.

Utility scale projects exclusively use horizontal turbines. In general, wind energy developers are attracted to regions that meet or exceed an average wind speed of five meters per second at a height of 80 meters. In North Carolina, this represents the ridgelines of the western mountains and along the eastern coast. Other factors considered by commercial wind developers include access to transmission, ability to sign land lease agreements, and localized environmental impacts. While these projects can be spread across thousands of acres, the physical footprint of the project often is about two percent of the land leased by the developer. Utility scale facilities are generally erected on towers that are 80 or 100 meters in height and can have blades that extend 30 to 50 meters in length.

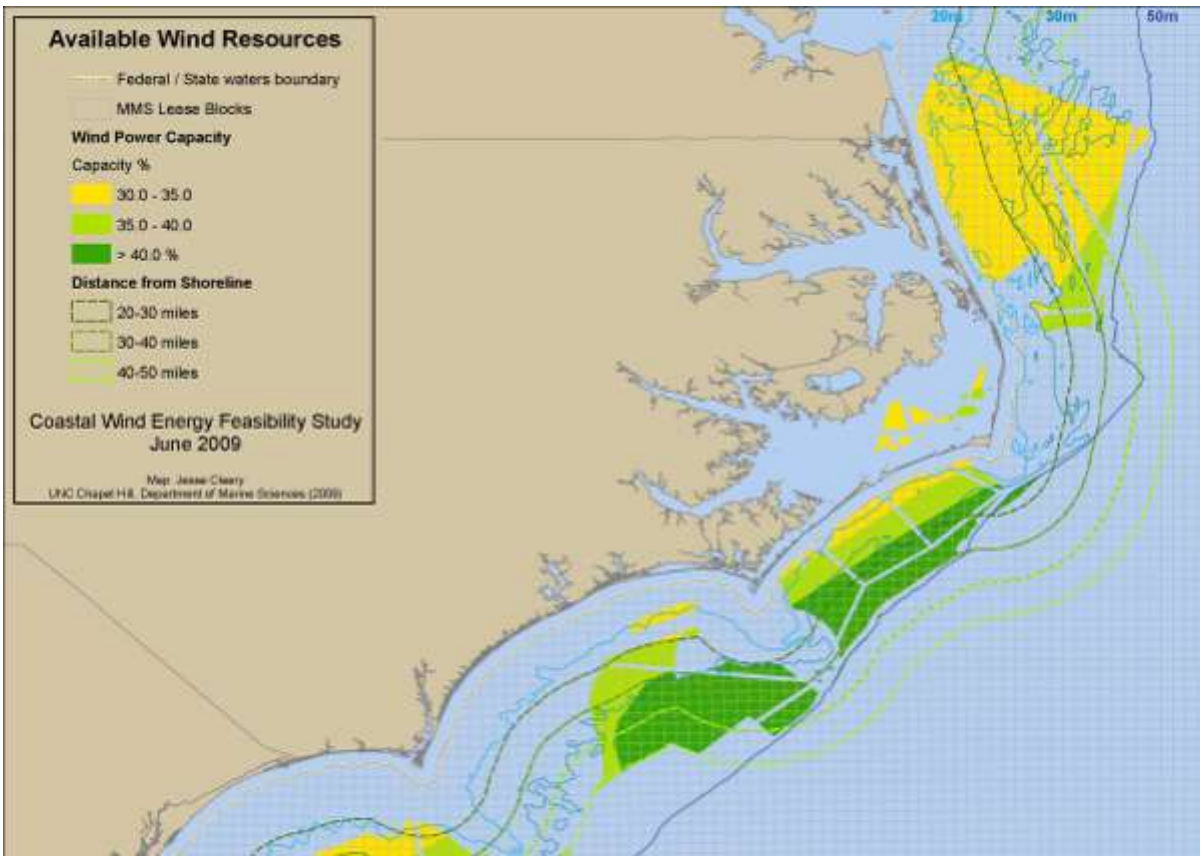
### 2.2.3 Offshore Wind Resource and Technology

Despite considerable development in Europe, there are no existing offshore wind facilities in the United States; however, several offshore wind projects are seeking regulatory approval. Many states are looking to the emergence of this new industry to be an economic driver in both coastal and inland communities. Wind turbines developed for offshore applications are larger than onshore wind turbines, and the major components will be manufactured at port facilities within the United States. The emergence of a domestic offshore wind industry is especially relevant as North Carolina boasts the largest offshore wind resource along the East Coast.[9]

An analysis conducted by the University of North Carolina at Chapel Hill examined geological, ecological and use conflicts along the North Carolina coast and found considerable wind resources remain available for development.[10] In particular, the study found there are more than 2,800 square miles in waters less than 50 meters deep and within 50 miles of the coastline. Exhibit 6 highlights areas favorable for offshore wind development based on wind power capacity—a measure of the wind potential at a given site. Areas in yellow contain the minimum wind resource required for offshore wind development. Areas in dark green contain stronger, more preferable winds for offshore wind development. The report concludes North Carolina is well positioned to develop utility scale wind energy production.

Currently, a state and federal task force organized by the Bureau of Ocean Energy Management, Regulation, and Enforcement is undertaking a more extensive analysis of potential development areas in federal waters.

**Exhibit 6: Locations favorable for offshore wind development.**



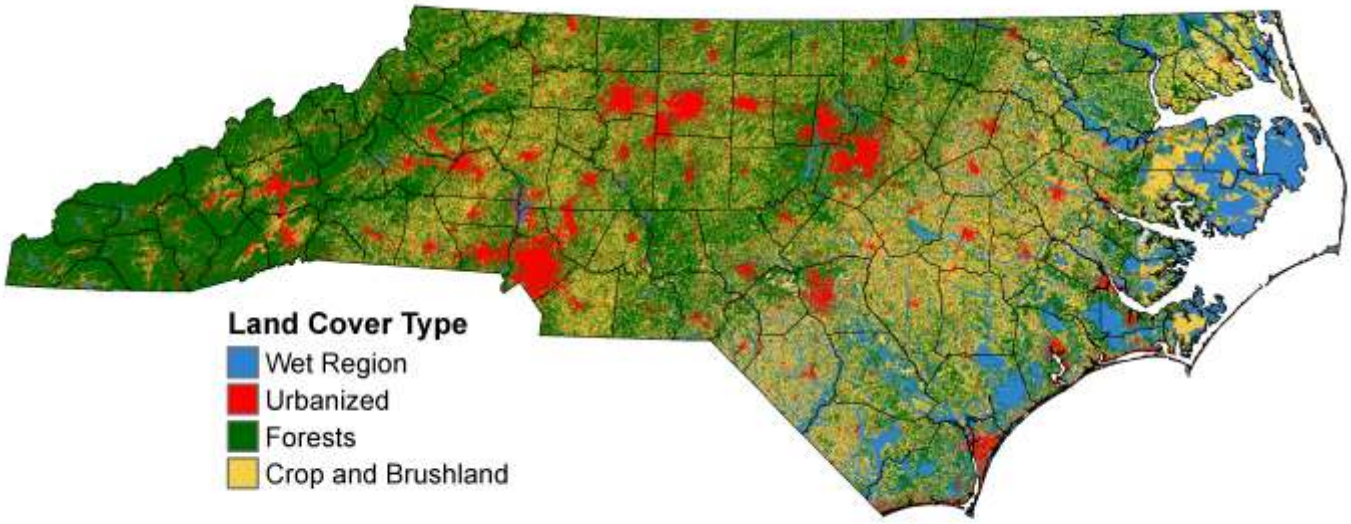

*Source: University of North Carolina at Chapel Hill.*

### 2.2.4 Biomass Resource and Technologies

Biomass energy exists in multiple forms in North Carolina. In 2007, the North Carolina General Assembly defined biomass as a resource that includes "agricultural waste, animal waste, wood waste, spent pulping liquors, combustible residues, combustible liquids, combustible gases, energy crops, or landfill methane...."[11] With such a broad resource classification, it is no surprise that biomass fuels can be found in nearly all regions of North Carolina (see Exhibits 7 and 8), although certain areas have competitive advantages in one fuel or another. Standing woody biomass dominates the western portion of the state. Urban waste streams, including wood and municipal resources, are most prevalent in the Piedmont region. Meanwhile, the eastern portion of the state dominates the crop and animal based biomass categories. Overall, North Carolina has a relatively large and diverse biomass resource base.

The technology for generating energy from each of these fuels can vary greatly, but at the broadest level three categories exist: direct combustion, gasification, and digestion. In a direct combustion system, biomass fuel is burned with the resulting heat used to create steam, which turns a turbine to generate electricity.

**Exhibit 7: North Carolina biomass land cover.**




*Sources: US Geological Survey National Land Cover Dataset 2001, NC Sustainable Energy Association.*

**Exhibit 8: Status of existing and potential landfill gas systems.**


*Sources: US EPA Landfill Methane Outreach Program, NC Onemap, NC Sustainable Energy Association.*

These are the most common systems in use today and can include co-firing technologies that mix biomass and other resources, such as coal. Gasification systems heat the biomass in a low oxygen system to produce a flammable gas, which is then burned in a gas turbine to generate electricity. Digestion is the biological breakdown of biomass fuels into a flammable gas, which is then burned and used to generate electricity. The breakdown may be highly controlled, such as in swine waste digesters, or effectively left to nature, as in landfills. Several firms in North Carolina are actively developing the state's landfill gas resource base.

### 2.2.5 Geothermal Resource and Technologies

North Carolina lacks the geological structures found in the Western United States that allow utility scale electric generation. Instead, ground source heat pumps can be deployed in North Carolina at homes or buildings to capture the relatively steady temperature of the ground as a source of heating and cooling. By using the ground as an effective thermal battery, ground source heat pump systems use far less energy than other heating and cooling sources to achieve the same performance. Ground source heat pumps can be installed in any county, rural or urban, in North Carolina.

Ground source heat pumps, which do not generate electricity, can be broadly classified into two types of systems: horizontal or vertical. Horizontal systems are deployed several feet in the ground in a series of interconnected loops. These systems require moving a substantial quantity of earth to install, and are more susceptible to seasonal temperature fluctuations. Vertical borehole systems are generally more expensive to install but have the benefits of a smaller installation footprint and lower seasonal ground temperature variations. Other types of specialized systems include pond based loops, which rely on the stable temperature of an on-site body of water.

### 2.2.6 Hydroelectric Resource and Technologies

Hydroelectricity has a long history in North Carolina, with some of the existing facilities beginning operations in the late 1800's. The resource—flowing water—can be found across much of the western and central regions of North Carolina, although there is a clear difference between the development status, size, and remaining resource potential between regions. In general, opportunities and the presence of large systems, which can exceed 100 megawatts in capacity, occur in the western mountains. Small or micro-hydroelectric opportunities, which typically involve systems less than 10 kilowatts in capacity, are more common in the central and eastern regions of North Carolina.

While turbine systems may differ depending on flow and height, the physics are largely the same regardless of the system size—flowing water turns a wheel which is tied to a generator that creates electricity. Hydroelectric resources in North Carolina are largely been developed. There are likely opportunities to improve existing facilities, but constructing new dams is unlikely.[12] A variety of turbines can be utilized and adapted for differences in the project height and flow of water. A major benefit of hydroelectric development is that electricity can be generated and dispatched within a matter of minutes from a single unit.

### 2.2.7 Smart Grid & Energy Storage Technologies

A rapidly evolving trend in the energy sector is the development and deployment of smart grid and storage technologies. The term smart grid refers to the modernization of the electric grid by incorporating technologies, tools, and techniques that allow more efficient and reliable operation of the transmission and distribution networks, and provide opportunity for more dynamic customer interface. The development of energy storage technologies would allow electricity from variable resources, such as solar or wind energy, to be managed with greater certainty. Smart grid and energy storage technologies are not renewable resources, but their development would enable a more rapid and expansive deployment of renewable energy technologies and management of electric demand. These technologies are noted here because of their

potential synergies with the clean energy industries, as well as the fact that North Carolina is home to a multitude of firms researching, developing, and manufacturing these innovative technologies.

## *2.3 Registered Renewable Energy Facilities in North Carolina*

### 2.3.1 Key Public Policy Drivers

Several public policies have been effective at encouraging the development of renewable energy technologies in North Carolina. Two important policies focus on creating value for the renewable energy certificate, or "REC", that is generated from electricity produced from a renewable energy resource. A single REC is equal to one megawatt hour of electricity generated from a renewable energy facility. The first important REC policy in North Carolina was the formation of the NC GreenPower voluntary program in 2003. NC GreenPower purchases RECs from small renewable energy generators across the state using funds collected through contributions from electric customers.[13]

The second important REC policy is the requirement that North Carolina electric utilities purchase RECs for compliance with the North Carolina Renewable Energy and Energy Efficiency Portfolio Standard, or "REPS". This state law, passed in 2007, requires investor owned utilities to provide 12.5 percent of their electric demand through renewable and efficiency resources and/or energy efficiency measures by 2021. Electric membership corporations and municipal owned utilities must meet a 10 percent requirement by 2018. Requirements phase in over time, allowing utilities time to respond to the legislative requirement. A more detailed discussion of this state policy can be found in *A Citizens Guide to the North Carolina Renewable Energy and Energy Efficiency Portfolio Standard*.[14]

In addition to NC GreenPower and the REPS, North Carolina offers a renewable energy installation tax credit. Individuals or businesses can receive up to a 35 percent state tax credit for investments related to the installation of renewable energy technologies. The state credit can be coupled with a 30 percent federal tax credit. To learn more about these tax credits, visit the *Database of State Incentives for Renewables and Efficiency*.[15]

### 2.3.2 Renewable Energy Installations in North Carolina

The policies outlined above have supported a diverse, strong, and sustained investment in renewable energy technologies in rural and urban counties in North Carolina (see Exhibit 9). Rural counties are home to a greater number of installed projects and total capacity across all renewable energy technologies except solar energy. Solar energy systems are more abundant—for both projects and capacity—in urban counties, characterized largely by rooftop systems. The majority of the projects occur in the Research Triangle region of the state (see Exhibit 10).

The available data also highlights an abundance of geothermal installations in North Carolina. There are over 800 vertical geothermal systems alone reported across the state, accounting for over 45 percent of all renewable energy projects identified in North Carolina. Horizontal geothermal installations are not reported to a state agency and therefore not captured in this report. Hydroelectric facilities contribute the greatest amount of installed capacity among renewable energy technologies, providing over 1,890 megawatts of capacity or over two thirds of the installed renewable energy capacity in North Carolina.

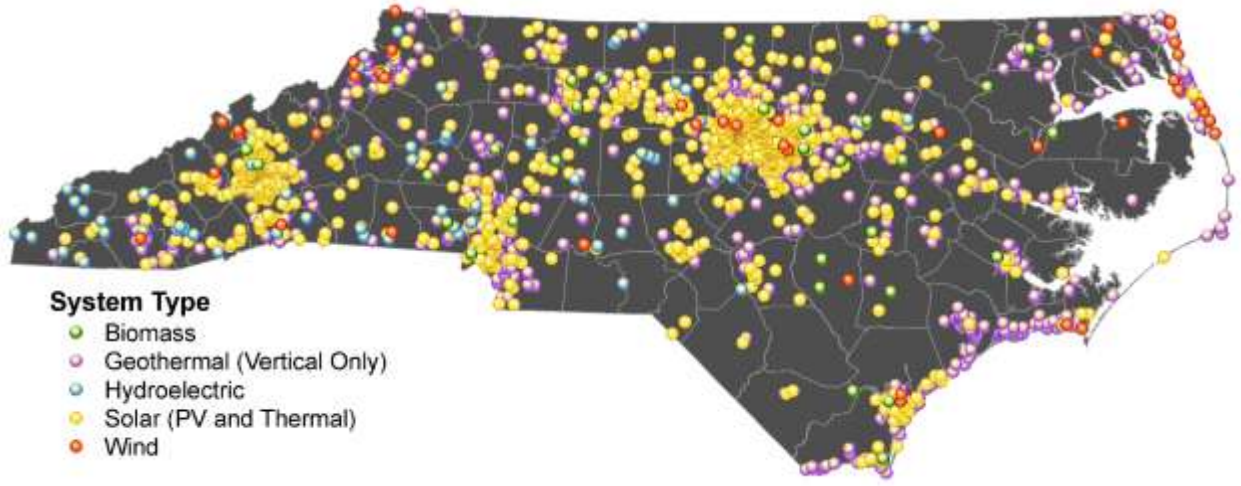
Biomass and wind energy facilities are a small proportion of the renewable energy development in North Carolina. Despite their limited number, biomass facilities are capable of contributing significant capacity to the electric infrastructure—over 550 megawatts of biomass capacity is present in North Carolina. Further, this does not take into account the thermal energy utilization often associated with these facilities. Data concerning wind energy facilities includes a 300 megawatt wind facility to be located in Perquimans and

**Exhibit 9: Registered renewable energy projects in North Carolina.**

| | Rural Counties | | Urban Counties | | North Carolina | |
|---|---|---|---|---|---|---|
| | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 17 | 483.208 | 16 | 67.514 | 33 | 550.722 |
| Geothermal | 440 | N/A | 396 | N/A | 836 | N/A |
| Hydroelectric | 55 | 1,758.532 | 12 | 140.725 | 67 | 1,899.257 |
| Solar | 331 | 19.150 | 498 | 39.992 | 829 | 59.142 |
| Wind | 51 | 300.227 | 13 | 0.03 | 64 | 300.257 |
| **State Total** | **894** | **2,561.117** | **935** | **248.261** | **1,829** | **2,809.378** |

*Notes: Geothermal data includes vertical geothermal systems and does not capture horizontal or pond loop geothermal systems. Solar data includes solar thermal in the number of projects column, but does not assign a value for these projects in the total capacity column. Wind energy data includes a 300 megawatt wind facility that has received regulatory approval from the North Carolina Utilities Commission, but is not scheduled for construction until 2012. Sources: North Carolina Utilities Commission, Federal Energy Regulatory Commission, North Carolina Department of Environment and Natural Resources, Appalachian State Wind Node.*

**Exhibit 10: Registered renewable energy systems in North Carolina.**




*Sources: North Carolina Utilities Commission, Federal Energy Regulatory Commission, North Carolina Department of Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

Pasquotank County. This project has received regulatory approval from the North Carolina Utilities Commission. If this project, which is scheduled for construction in 2012, is removed from the data, the total capacity contribution of wind energy becomes negligible.

## *2.4 Energy Efficiency Potential in North Carolina*

This report considers energy efficiency potential and investments in the residential and commercial sectors. The industrial sector, which consumes significant energy resources, is not considered because metrics to identify opportunities and datasets of established projects provide limited accessibility and insufficient granularity for our analysis.

Housing age and manufactured homes as a proportion of total housing stock can be used as two proxies to evaluate energy efficiency opportunities in the residential sector. Housing age is a valuable metric since the North Carolina Building Code did not require insulation for homes built prior to 1975. Therefore, these homes are highly unlikely to contain insulation and are strong candidates for energy retrofits. In many cases,

insulation would only be present if the original owner requested it at the time of construction, or if it was incorporated during a renovation at a later date.

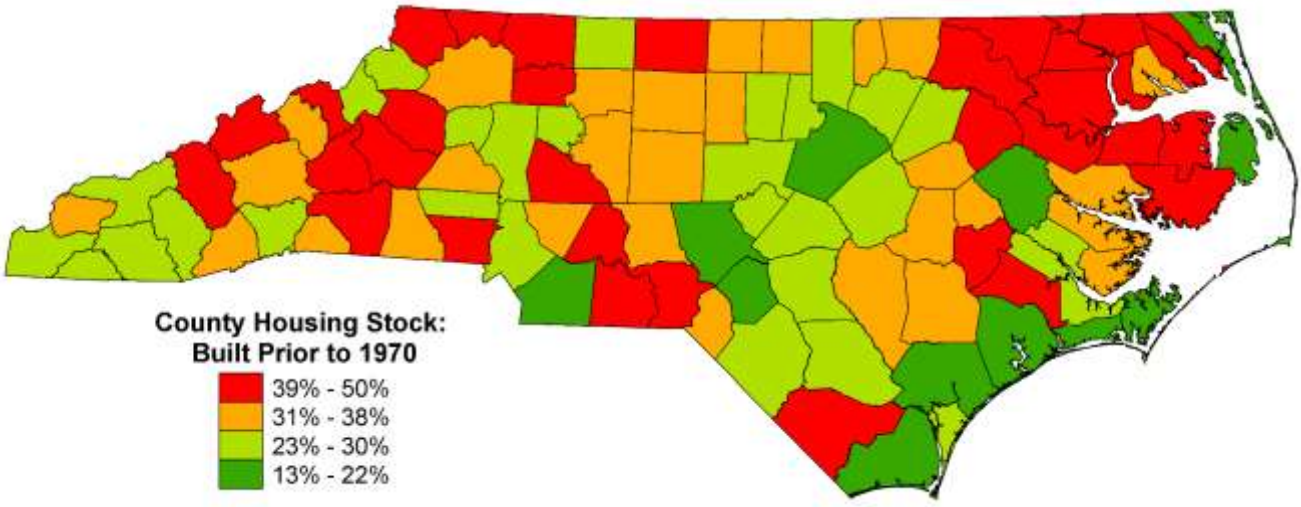
Housing data from the U.S. Census Bureau can provide insights into the geographic distribution of these homes. Since the data is available in ten year increments, identifying all homes built prior to 1970 provides a simple approximation of residential energy efficiency potential in individual counties and regions. The results demonstrate that, despite continued population growth and housing construction, a significant number of counties contain housing stock built before insulation requirements (see Exhibit 11). The counties with the largest proportions of housing stock built prior to 1970 are generally rural, and often economically disadvantaged. This can inhibit a homeowner's ability to pursue energy efficiency improvements.

A second crude measure of residential energy efficiency potential is the percentage of manufactured housing present. This is an important metric as data indicates manufactured homes consume 67 percent more energy per square foot when compared to a single-family detached home.[16] In comparison to homes built prior to 1970, there are a smaller absolute number of manufactured homes; however, select counties have high proportional densities (see Exhibit 12).

These metrics, which are not mutually exclusive, both represent energy efficiency potential and economic development opportunities. As an example, consider the impact of providing energy efficient services, such as weatherization, to low income households. Energy expenditures can be a significant strain on a low income household. In 2009, North Carolina households living below 50 percent of the national poverty level spent 60 percent of their annual income on household energy.[17] By comparison households at 150 percent of the national poverty level spent 11 percent of their annual income on household energy. Meanwhile, investments in low income energy efficiency in four Southern states were found to have a local economic multiplier effect 2.7 times greater than the multiplier effect of a comparable investment in the local manufacturing base.[18] Residential energy efficiency opportunities are explored in greater detail in the regional sections of this report.

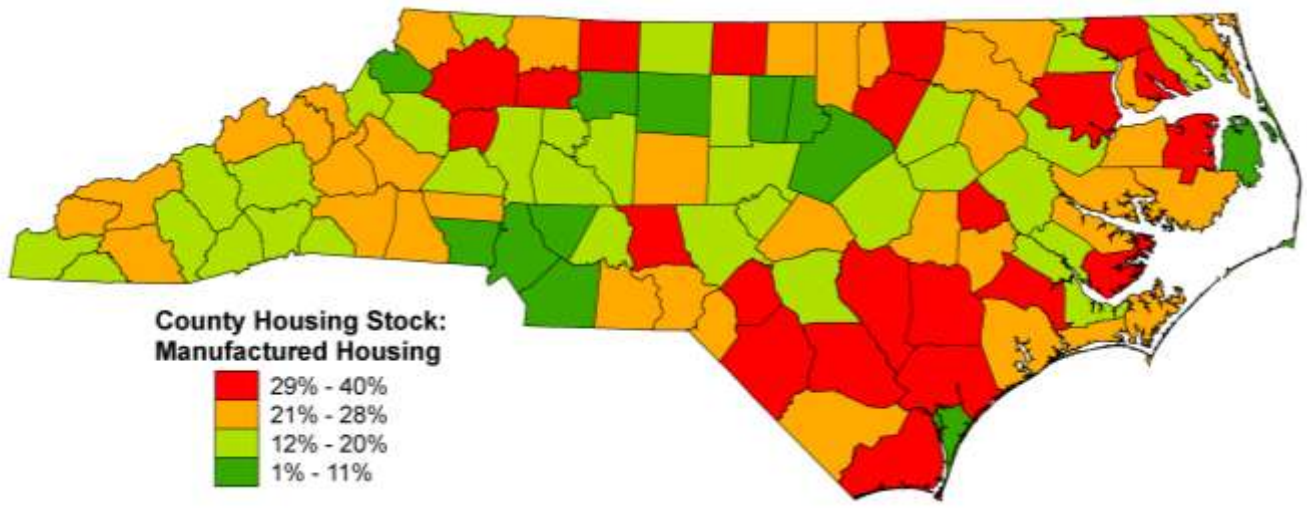
Geographically detailed metrics to estimate the energy efficiency potential in the commercial sector are not readily accessible. However, the growing presence of energy efficiency projects (see next section) suggests there are significant opportunities throughout the state.

**Exhibit 11: Homes built prior to 1970 as a proportion of county housing stock.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

**Exhibit 12: Manufactured homes as a proportion of county housing stock.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

## *2.5 Energy Efficiency Implementation in North Carolina*

Data on individual residential energy efficiency projects is not publicly available to protect homeowner privacy. Nevertheless, within the residential market, several third-party certifications focusing on new construction are available. The most familiar is the Energy Star certification maintained by the U.S. Environmental Protection Agency. Homes built to Energy Star standards are generally 20 to 30 percent more efficient than comparable new homes. Other national programs include Leadership in Energy and Environmental Design (LEED) for Homes, developed by the U.S. Green Building Council, and NAHBGreen, developed by the National Association of Home Builders.

North Carolina also has some unique certifications for new residential building that are derived in part from the Energy Star standard. The NC HealthyBuilt Homes program, which is particularly prevalent in Western North Carolina, requires in part that that homes be built to meet or exceed Energy Star standards. The SystemVision home program is geared towards the affordable housing market by providing a guaranteed limit on heating and cooling bills, and uses Energy Star as a base performance standard. Many utilities offer discounted electric rates for homes that receive energy efficiency certifications.

Existing commercial and government energy efficiency data is more accessible than residential data. This report examines LEED New Construction and the Commercial Energy Star certification programs, although buildings may opt out of these programs' public databases if they wish to remain confidential. The LEED program includes buildings registering an intent to meet the program requirements and buildings certified that they meet the requirements. For the purpose of this report, Energy Star buildings are organized into three categories: K-12 Schools, Commercial Buildings, and Supermarkets.

Across the LEED and Energy Star metrics, urban counties are home to more energy efficient projects and square footage, with the exception of Energy Star certified schools (see Exhibit 13). Rural counties also benefit from many military buildings being LEED registered. In urban counties, LEED certified buildings are largely located in the Charlotte and Raleigh metropolitan areas (see Exhibit 14).

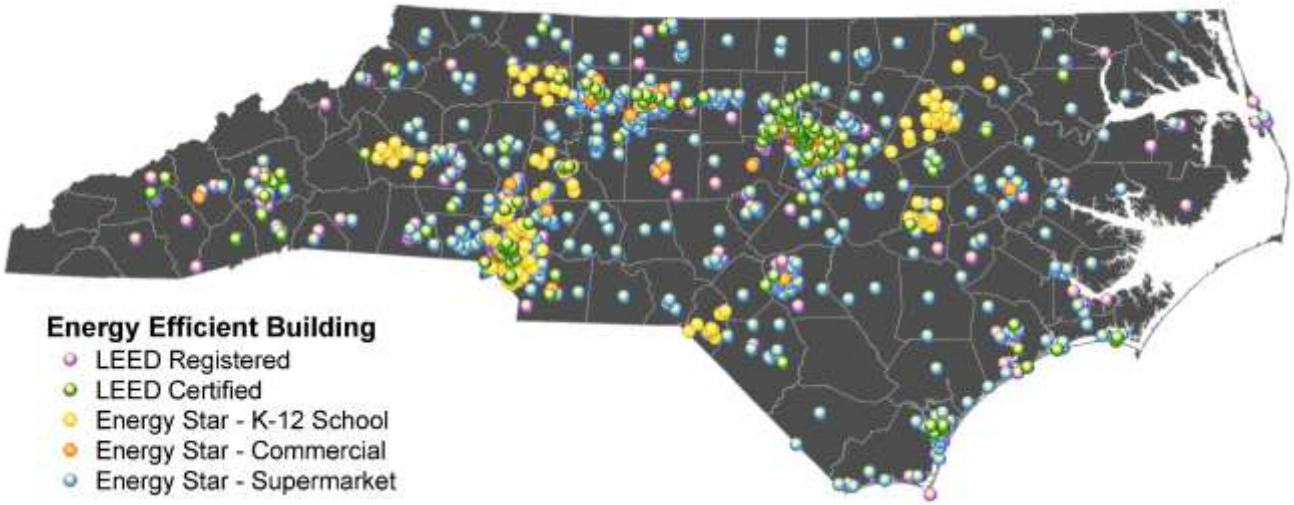
The available data also highlights differences in the diffusion of the various certification categories. For example, Energy Star supermarkets can be found across the entire state. However, these certifications are

**Exhibit 13: Energy efficient projects and square feet in urban and rural counties.**

| | Rural Counties | | Urban Counties | | North Carolina | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 166 | 9,475,495 | 429 | 48,995,716 | 595 | 58,471,211 |
| LEED Certified | 37 | 2,490,062 | 138 | 16,162,163 | 175 | 18,652,225 |
| Energy Star - K-12 School | 73 | 6,568,993 | 59 | 6,243,051 | 132 | 12,812,044 |
| Energy Star - Commercial | 10 | 292,516 | 137 | 21,618,520 | 147 | 21,911,036 |
| Energy Star - Supermarket | 233 | 8,199,792 | 258 | 9,805,146 | 491 | 18,004,938 |
| **TOTAL** | **519** | **27,026,858** | **1,021** | **102,824,596** | **1,540** | **129,851,454** |

*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 14: Commercial and government energy efficient buildings in North Carolina.**




*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

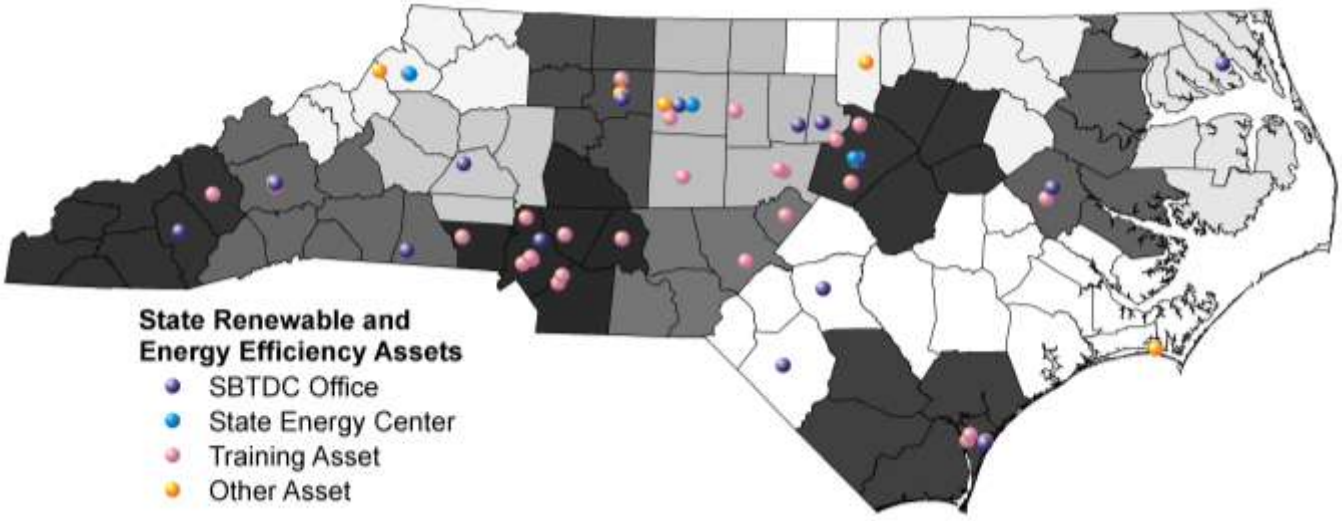
largely affiliated with one company that has chosen to aggressively pursue Energy Star certifications for their supermarkets—Food Lion. Alternatively, schools can be found across the state, but are highly concentrated within certain counties. This reflects the ambitions of individual school districts in pursuing third party certification. With the exception of Mecklenburg County, nearly all Energy Star certified schools are found in rural counties.

## *2.6 Training, Support, and Community College Assets*

North Carolina has a multitude of training, support, and community college assets focused in part or entirely on the renewable energy and energy efficiency industries (see Exhibits 15 and 16). Additional assets not identified by this report include city and county sustainability councils, local community action agencies, and other local agencies. Further, each North Carolina community college has a small business development office that can assist new entrants to the clean energy industries.

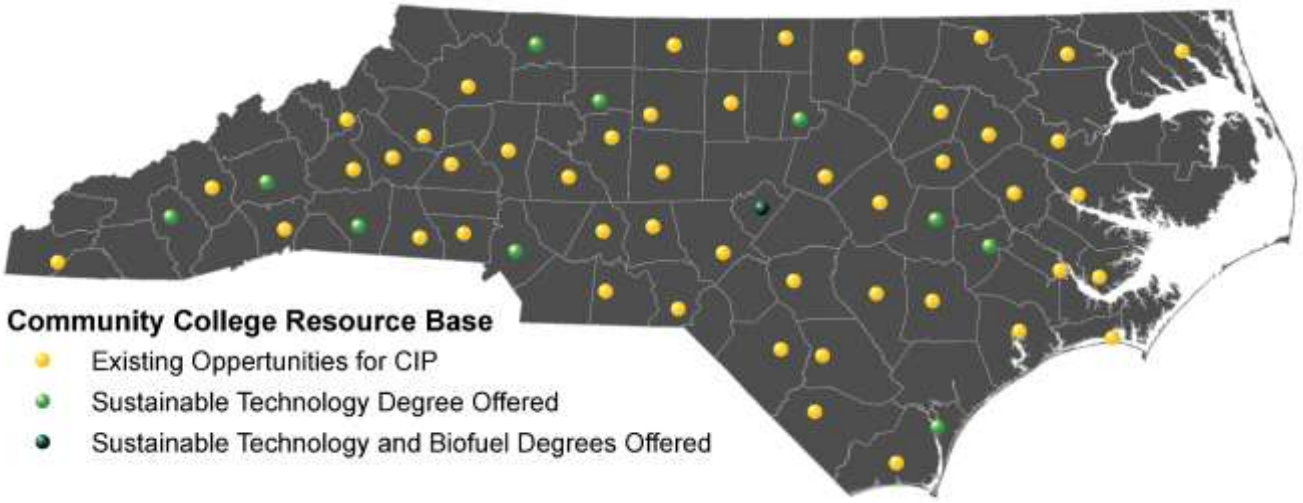
The North Carolina community college system is currently engaged in a major evaluation and restructuring of renewable energy and energy efficiency focused degrees and career training. Through the Curriculum Improvement Project (CIP), community colleges are transitioning their focus from offering college specific Sustainable Technologies or Biofuels degrees to integrating renewable energy and energy efficiency trainings as part of well established degree programs such as HVAC, Electrical Systems, or Industrial Systems.

**Exhibit 15: Select training and support assets in North Carolina.**




*Note: Shaded areas represent Resource Conservation and Development Councils. See Appendices for specific council names. Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

**Exhibit 16: North Carolina community college renewable energy and energy efficiency assets.**




*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC OneMap, NC Sustainable Energy Association.*

## 2.7 Chapter Notes and Citations

(1) This analysis omits customer and consumption data from two university owned electric utilities: New River Light and Power, located in Boone, and Western Carolina University, located in Cullowhee. Also omitted are six industrial customers served directly by the Tennessee Valley Authority, a federally owned electric corporation.

(2) U.S. Energy Information Administration. *State Energy Data System 2008.* Released June, 2010.

(3) Unless noted otherwise, data concerning utility customer and utility sales are obtained from: U.S. Energy Information Administration. Form EIA-861 "Annual Electric Power Industry Report" Database. Available at http://www.eia.doe.gov/cneaf/electricity/page/eia861.html [accessed 14 March 2011].

(4) Derived from intersecting multiple GIS layers, including U.S. Census tract centroids. Please see methodology for more details.

(5) North Carolina Utilities Commission. *Annual Report of the North Carolina Utilities Commission Regarding Long Range Needs for Expansion of Electric Generation Facilities for Service in North Carolina.* 30 November 2010. Available at http://www.ncuc.commerce.state.nc.us/reports/2010ElectricReport.pdf [accessed 14 March 2011].

(6) U.S. Environmental Protection Agency eGRID2007 version 1.1. Available at http://www.epa.goc/egrid [accessed 8/20/2010].

(7) Report is available at http://www.ncuc.commerce.state.nc.us/reports/2010ElectricReport.pdf. [accessed 14 March 2011].

(8) For a more detailed discussion of renewable energy potential see: La Capra Associates. *Analysis of a Renewable Energy Portfolio Standard for the State of North Carolina.* Prepared for the North Carolina Utilities Commission. December 2006. Available at http://www.ncuc.commerce.state.nc.us/reps/NCRPSReport12-06.pdf [accessed 22 March 2011]. For a detailed analysis of North Carolina's offshore wind resources see: University of North Carolina at Chapel Hill. *Coastal Wind: Energy for North Carolina's Future.* Prepared for the North Carolina General Assembly. June 2009. Available at http://www.climate.unc.edu/coastal-wind [accessed 22 March 2011].

(9) National Renewable Energy Laboratory. *Assessment of Offshore Wind Energy Resources for the United States*. Technical Report: NREL/TP-500-45889. June 2010. Available at: http://www.nrel.gov/docs/fy10osti/45889.pdf [accessed 22 March 2011].

(10) University of North Carolina at Chapel Hill. *Coastal Wind: Energy for North Carolina's Future.* Prepared for the North Carolina General Assembly. June 2009. Available at http://www.climate.unc.edu/coastal-wind [accessed 22 March 2011].

(11) North Carolina General Statutes § 62-133.8 Renewable Energy and Energy Efficiency Portfolio Standard (REPS).

(12) Idaho National Laboratory Hydro Power Program. Available at http://hydropower.inel.gov/ [accessed 6 June 2011].

(13) For more information on NC GreenPower visit http://www.ncgreenpower.org.

(14) Report is available on the North Carolina Sustainable Energy Association's website at http://www.energync.org.

(15) The Database for State Incentives for Renewables and Efficiency can found at http://www.dsireusa.org.

(16) Energy Information Administration. 2005 Residential Energy Consumption Survey.

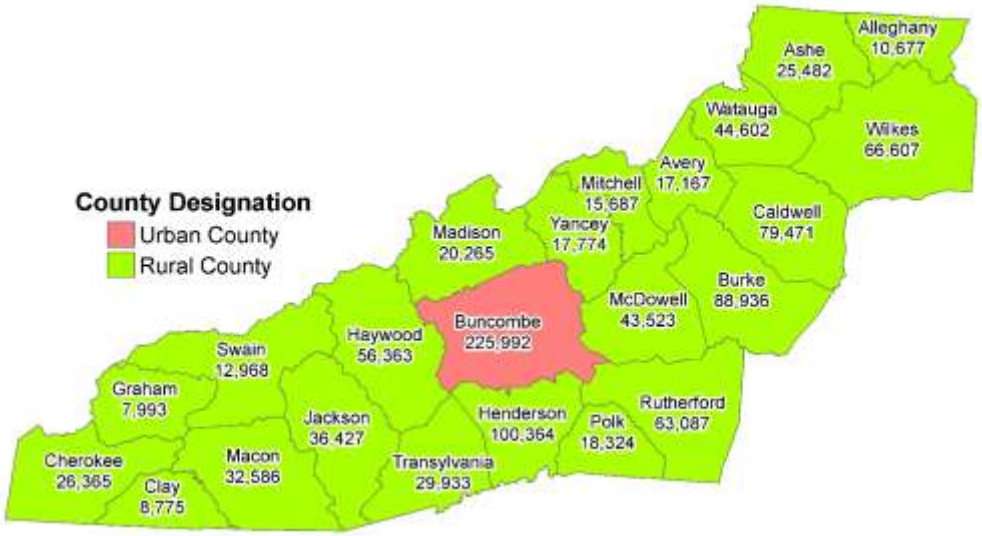
(17) Fisher, Sheehan & Colton. *Home Energy Affordability Gap.* April 2011. Available at http://www.homeenergyaffordabilitygap.com/ [accessed 6 June 2011].

(18) Oppenheim, Jerrold and Theo MacGregor. Energy Efficiency Equals Economic Development: The Economics of Public Utility System Benefit Funds. June 2008. Available at www.entergy.com/global/our_community/advocate/Poverty_book.pdf [accessed 11 May 2011].

# CHAPTER 3: ADVANTAGE WEST REGION

- ★ **Second largest clean energy industry population in North Carolina.**
- ★ **Second largest population of energy efficient home builders.**
- ★ **Third largest industry cluster in North Carolina is located in Buncombe County.**
- ★ **Leader in installed capacity for hydroelectric.**
- ★ **Received over $11 million in energy related ARRA funding, 87 percent allocated to energy efficiency.**

**Exhibit 17: County population and designation.**




*Sources: U.S. Census Bureau, NC Rural Center, NC Sustainable Energy Association.*

**Exhibit 18: Advantage West rankings compared to other North Carolina regions.**

| Overview of Existing Firms | Number of Firms | State Rank | Region Location |
|---|---|---|---|
| Renewable Energy | 43 | 3 |  |
| Energy Efficiency - Non Builder | 52 | 3 | |
| Energy Efficiency - Builder | 298 | 2 | |
| Smart Grid or Energy Storage | 4 | 3 | |
| **Region Total** | **397** | **2** | |

| Existing Commercial Energy Efficiency | Number of Buildings | State Rank | Project Square Footage | State Rank |
|---|---|---|---|---|
| LEED (Registered & Certified) | 58 | 6 | 3,148,731 | 6 |
| Energy Star (Certified) | 46 | 6 | 2,382,754 | 6 |
| **Region Total** | **104** | **6** | **5,531,485** | **6** |

| Potential for Residential Energy Efficiency | Homes Built Prior to 1970 | State Rank | Manufactured Homes | State Rank |
|---|---|---|---|---|
| Number of Units | 188,584 | 3 | 107,358 | 1 |

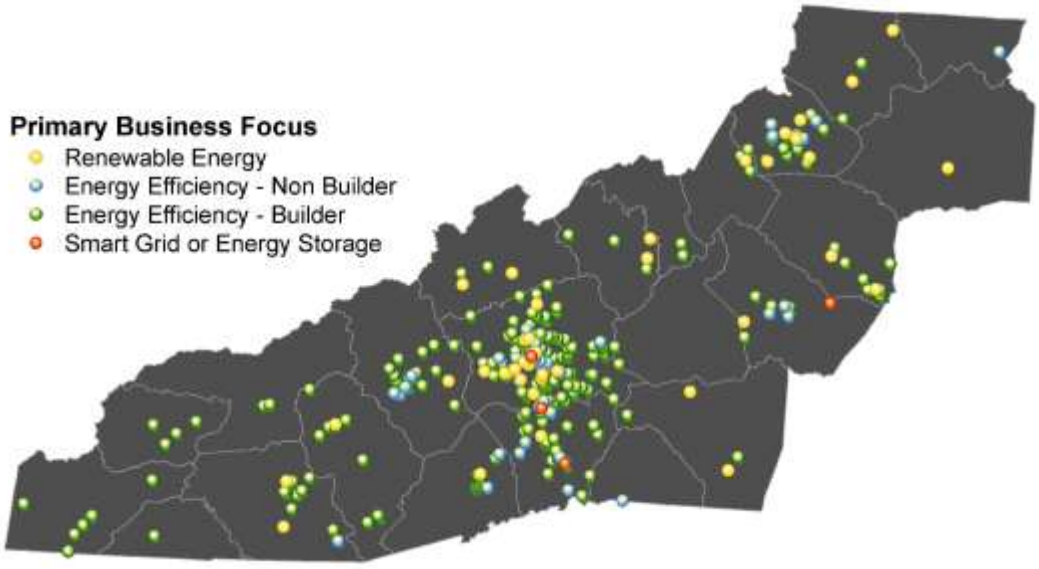
| Registered Renewable Energy Systems | Number of Systems | State Rank | System Capacity (MW) | State Rank |
|---|---|---|---|---|
| Biomass | 3 | 7 | 3.59 | 7 |
| Geothermal | 127 | 3 | N/A | N/A |
| Hydroelectric | 33 | 1 | 923.91 | 1 |
| Solar | 206 | 2 | 3.48 | 6 |
| Wind | 31 | 1 | 0.11 | 2 |
| **Region Total** | **400** | **2** | **931.09** | **1** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Source: NC Sustainable Energy Association.*

## *3.1 Overview of Existing Clean Energy Firms*

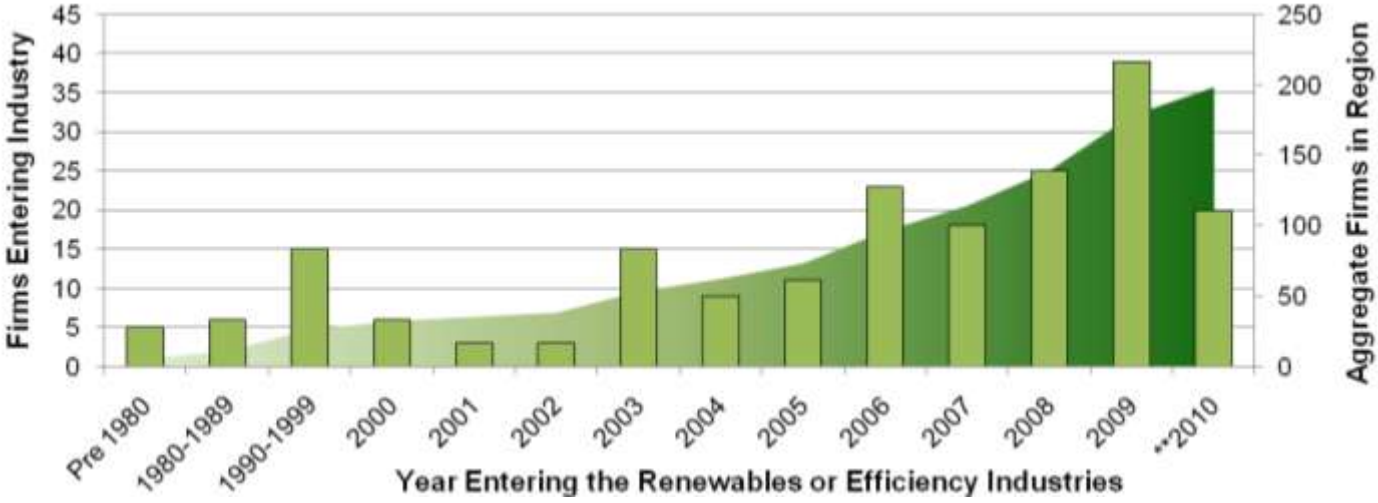
The Advantage West region is home to nearly 400 renewable energy and energy efficiency firms, giving the region the second largest population of companies in North Carolina (see Exhibit 19). Buncombe County contains over half of these firms, with 213 unique industry participants, and is the third largest county industry cluster in North Carolina. Henderson County comes in a distant second at 35 firms, while Watauga County places third with 28 firms. Over the last decade, the region experienced a sustained growth of firms pursuing clean energy activities in the region (see Exhibit 20).

**Exhibit 19: Clean energy firms with a primary location in the Advantage West region.**




*Source: NC Sustainable Energy Association.*

**Exhibit 20: Evolution of clean energy firms in the Advantage West region.**




*Notes: Exhibit only includes firms reporting a year of entry in the Energy Star program or annual North Carolina Renewable Energy and Energy Efficiency Industries Census; therefore, aggregate firms may be lower than total firms reported elsewhere. Data for 2010 is through August 31, 2010. Sources: EPA Energy Star Program, NC Sustainable Energy Association.*

The region is home to 298 energy efficient building firms, making it second only to the Research Triangle region in terms of total number of energy efficient builders. Unique to the region, many of the builders in Buncombe and surrounding counties are registered as NC HealthyBuilt Home Builders, in addition to being Energy Star or LEED Accredited Professionals. This strong local branding could potentially be used to differentiate Advantage West builders, both regionally and statewide. Although the energy efficient builders are highly concentrated in the Asheville area, the region has strong energy efficient builder coverage in nearly all areas. Only the extreme northeast appears to be lagging behind the rest of the region.

The region also supports a moderate number of firms focused on solar, biomass, and energy efficiency activities other than building. The presence of multiple firms and focus areas within the broader clean energy industry provides a degree of industry resiliency consistent with more urbanized economic development regions. There may be potential for this trait to be leveraged with some of the region's unique quality of life feature (e.g. mountains) to attract a subset of companies valuing these features.

Despite the presence of hydroelectric and small wind facilities, there are a lack of renewable energy firms with a business focus in these areas. For hydroelectric, this may be due in part to the resource having been largely developed by the middle of the 20th century. Current opportunities are primarily limited to maintaining existing facilities. Meanwhile, wind energy faces legal uncertainty surrounding the Mountain Ridge Protection Act of 1983.

## *3.2 Existing Commercial and Government Energy Efficiency*

The Advantage West region maintains over five million square feet of energy efficiency registered and certified buildings across both the LEED and Energy Star programs (see Exhibit 21). Buncombe County contains the most projects at 31, however projects can be found in all but six Advantage West counties (see Exhibit 22). Burke County maintains the second largest population of projects at 17 buildings. Energy Star certified schools account for 70 percent of this total, with the region's 12 Energy Star certified K-12 schools located in Burke County. No other county in the region had pursued Energy Star certification for any schools, despite the annual savings in operations cost that could be realized.

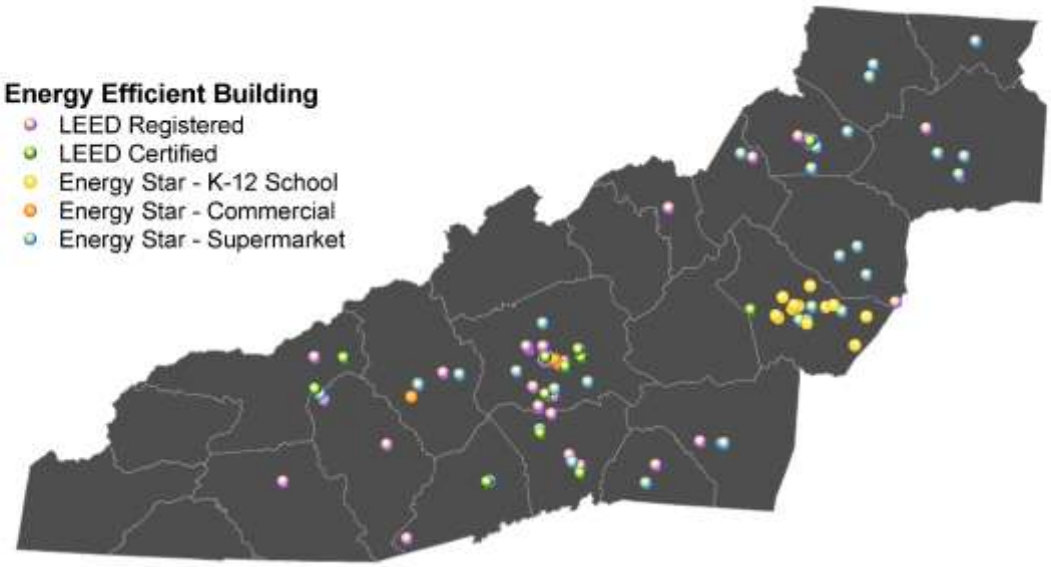
LEED registered projects can be found throughout the region, and the ratio of projects that progressed from registration to certification was 22 percent. Unlike in other regions where the LEED certified projects were largely centered in urban counties, eight of the 13 LEED certified buildings in Advantage West were found in rural counties. As with most of the other regions in North Carolina, a significant portion of existing commercial projects are Energy Star supermarkets. Food Lion was the regional leader in certifying their supermarkets with 28 of the 31 certified locations.

**Exhibit 21: Advantage West energy efficient projects and square feet in urban and rural counties.**

| | Rural Counties | | Urban Counties | | Advantage West | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 26 | 1,261,568 | 19 | 977,632 | 45 | 2,239,200 |
| LEED Certified | 7 | 744,331 | 6 | 165,200 | 13 | 909,531 |
| Energy Star - K-12 School | 12 | 1,178,192 | 0 | 0 | 12 | 1,178,192 |
| Energy Star - Commercial | 1 | 5,000 | 2 | 102,124 | 3 | 107,124 |
| Energy Star - Supermarket | 27 | 960,029 | 4 | 137,409 | 31 | 1,097,438 |
| **Region Total** | **73** | **4,149,120** | **31** | **1,382,365** | **104** | **5,531,485** |

*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 22: Advantage West commercial and government energy efficient buildings.**



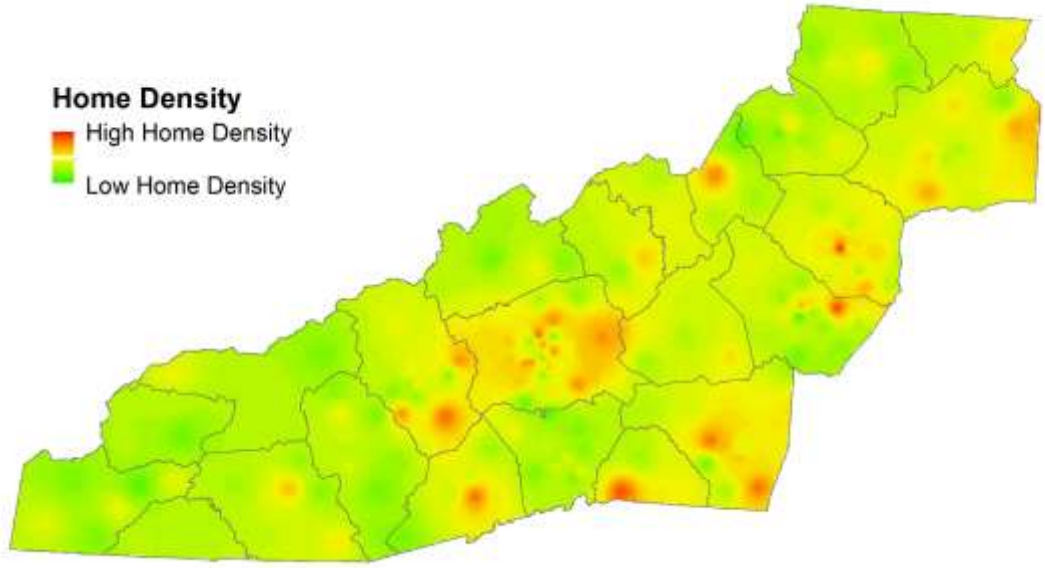

*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

## *3.3 Potential for Residential Energy Efficiency*

Residential energy efficiency presents a significant opportunity for the Advantage West region. The region has over 180,000 homes built prior to 1970, creating a tremendous opportunity for energy efficiency retrofits. Over 20 percent of these homes are located in the only urban county in the region—Buncombe County (see Exhibit 23 and Appendix 1). The residential energy efficiency opportunity is further bolstered by the fact that 35 percent of the homes in the Advantage West region were built prior to 1970—the highest percentage of any region in the state.

In addition to opportunities from homes built prior to 1970, Advantage West also supports a large population of manufactured homes (see Exhibit 24). With generally poor energy performance, retrofitting manufactured

**Exhibit 23: Probable density of homes built prior to 1970 in the Advantage West region.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

housing may have the added attraction of alleviating financial constraints for low-income households. Additionally, these projects may require smaller capital outlays and represent a viable target market for regional entities that work with traditionally underserved segments of the population.

**Exhibit 24: Housing type in Advantage West.**

| Housing Type | Number | Share |
|---|---|---|
| Single Unit | 376,243 | 69% |
| 2 to 10 Units | 41,425 | 8% |
| More than 10 Units | 16,401 | 3% |
| Manufactured Housing | 107,358 | 20% |

*Source: U.S. Census Bureau.*

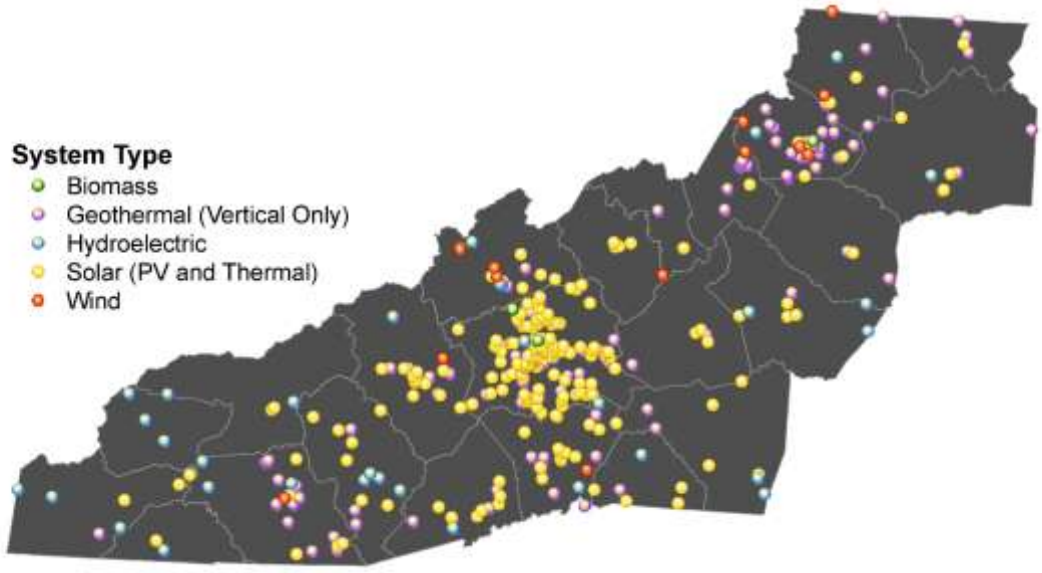
## *3.4 Registered Renewable Energy Facilities*

Multiple renewable energy systems are registered in the Advantage West region (see Exhibit 25). It is home to North Carolina's largest hydroelectric resource base, and has significant numbers of solar and vertical geothermal systems (see Exhibit 26). The largest system within each renewable technology is a 238.5 megawatt hydroelectric facility, a 1.97 megawatt biomass facility, a 1.0 megawatt solar facility, and a 100 kilowatt wind turbine.

Solar systems make up the largest share of installed units in the Advantage West region, and can be found in every county except Graham. With 111 solar projects accounting for over 55 percent of the regions solar capacity, Buncombe County is one of North Carolina's leading clusters for solar projects. The majority of the projects are rooftop solar systems designed to offset a portion of the end-user's electrical consumption. The largest system in the region is a 1.0 megawatt facility found in neighboring Haywood County. These two counties account for over 85 percent of the region's total solar capacity.

Vertical geothermal systems make up the second largest population of systems with 127 registered unique vertical systems. The overall number of geothermal units is likely to be even higher, as this number does not account for horizontal loop and other types of geothermal systems. Buncombe County is the regional leader with 44 registered vertical geothermal systems and a total of 335 boreholes. Watauga County is second with 19 systems, but only 33 boreholes. Haywood County has North Carolina's second largest vertical geothermal system with 255 boreholes.

**Exhibit 25: Location of registered renewable energy systems in the Advantage West region.**




*Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

**Exhibit 26: Registered renewable energy systems in the Advantage West region.**

| | Rural Counties | | Urban Counties | | Advantage West | |
|---|---|---|---|---|---|---|
| | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 1 | 0.200 | 2 | 3.389 | 3 | 3.589 |
| Geothermal | 83 | N/A | 44 | N/A | 127 | N/A |
| Hydroelectric | 32 | 920.906 | 1 | 3.000 | 33 | 923.906 |
| Solar | 95 | 1.537 | 111 | 1.942 | 206 | 3.479 |
| Wind | 31 | 0.113 | 0 | 0.000 | 31 | 0.113 |
| **Region Total** | **242** | **922.756** | **158** | **8.331** | **400** | **931.087** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

Despite a large biomass resource base, the Advantage West region has a relatively small number of wood-based biomass systems. Instead, companies have chosen to focus efforts on developing landfill gas to energy projects for both electrical and thermal generation (see Exhibit 8).

Finally, although there is a large hydroelectric presence in the region, most of the units are older having come online in the middle or early 19th century. There may be some potential to upgrade these facilities with new generators or turbines to increase the electrical generation. Additionally, there may be existing smaller dams that can install generation equipment without further impacting the ecosystem. Ultimately though the likelihood of developing new hydroelectric facilities, especially large units with new dams, is limited.

## ***3.5 Training, Support, and Community College Assets***

*(See Appendix 2 for detailed maps and tables of Advantage West assets)*

Three community colleges in the region offer a degree in Sustainable Technologies. Several others have the potential to develop energy efficiency or renewable energy focused units as part of the community college system's Curriculum Improvement Project (CIP)—a process that adds clean energy components to existing degrees. Blue Ridge, Haywood, Mayland, and McDowell Community Colleges already offer degrees in HVAC, Electrical Systems, and Industrial Systems. The remaining colleges listed in Appendix 2 offer at least one of these three degrees. Western Piedmont Community College may present a particularly timely opportunity for the CIP initiative as there are large number of homes built prior to 1970 nearby, and a small but growing cluster of firms that could likely benefit from additional workforce training opportunities.

The Advantage West region consists of four resource conservation and development (RC&D) regions, two of which are contained entirely in the region. The Mountain Valleys RC&D has worked with Progress Energy on implementing a K-12 renewable energy program, and facilitated the planning and development of small wind turbines at several regional schools. Partnerships of this nature could be expanded to include the community colleges and a broader focus on energy efficiency at public schools.

One of the most significant assets in the region is the Energy Center at Appalachian State University—one of North Carolina's three state energy centers. Appalachian State University also maintains a small wind facility that provides the region with the ability to test residential wind turbines.

Finally, Asheville also boasts a strong regional training and development base, with Building Performance Institute (BPI) and Residential Energy Services Network (RESNET) training opportunities located in close proximity to large populations of homes built prior to 1970, as well as one of the region's Small Business and Technology Development Centers (SBTDC) that can assist newly trained individuals and firms in developing business plans to effectively capitalize on these opportunities.

## 3.6 Strengths, Weaknesses, Opportunities, and Threats

### Strengths

- Presence of a robust community of energy efficient builders.
- Widespread adoption of a regional unique building certification in NC HealthyBuilt Homes.
- Second largest regional population of firms.
- Third largest county cluster of firms in North Carolina located in Buncombe County.
- Existing base of diversified industries with expertise in multiple types of technologies.
- High density of solar projects in Buncombe county.
- Presence of Appalachian Energy Center at Appalachian State University.
- Presence of multiple public and private training and support mechanisms.

### Weaknesses

- Only one county with significant number of Energy Star certified schools.
- Few hydroelectric maintenance firms in region.
- Limited solar adoption in the northeastern region.
- Most Energy Star grocery certifications limited to a single parent company.
- Despite high potential for residential energy efficiency, northeastern counties may be underserved.

### Opportunities

- Large number of commercial energy efficiency opportunities using largely standardized buildings.
- Homes built prior to 1970 create a clustering energy efficiency opportunities in rural counties.
- Existence of a large biomass resource.
- Strong wind resource and small wind testing center create environment for small wind expertise.

### Threats

- Hydroelectric facilities are old, and license renewal is not a forgone conclusion.
- Uncertainty if state and federal lands can be utilized for renewable energy development.
- Legal uncertainty discourages utility scale wind development.
- Securing capital for renewable and efficiency projects may be more difficult in rural areas.

The Advantage West region is well positioned to pursue new opportunities in the renewable energy and energy efficiency industries. One of the strongest opportunities exists around residential energy efficiency. One of every three homes in the region was built prior to 1970—indicating much of the housing stock represents energy retrofit potential. In addition, strong training and community college assets exist in the region**.** BPI certified trainers are well represented and compliment the significant presence of energy efficiency firms. Multiple community college colleges are well positioned to utilize existing assets to provide energy efficiency training. The region could encourage the growth and expansion of residential retrofits by exploring innovative financing mechanisms and by providing support to households unable to allocate discretionary income to energy retrofit projects.

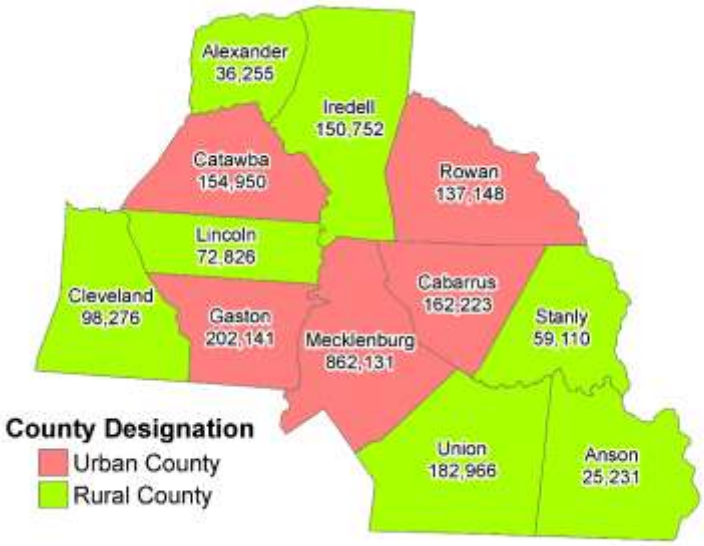
The region is also well positioned with the presence of a robust cluster of renewable energy firms. While a diverse range of business focuses are represented (e.g. solar, wind, etc), the number of firms in each category is lower than the Charlotte or Research Triangle regions. Advantage West would benefit from the continued expansion of existing firms and the recruitment of targeted new entrants in specific areas. For example, the continued expansion of solar and geothermal firms and projects could benefit the region.

The abundance of biomass in the region is complicated by the fact that large portions of the resource are situated on federal or state lands and a legal debate exists about what type of biomass resources should be considered renewable and sustainable. Similarly, utility scale wind development faces legal uncertainty in the region. The Mountain Ridge Protection Act of 1983 may limit utility scale wind energy development on protected mountain ridges. However, a robust systems presence and ongoing research surrounding residential and small wind energy creates a continued opportunity for this application of this technology.

# CHAPTER 4: CHARLOTTE REGION

- ★ **Third largest clean energy industry population in North Carolina.**
- ★ **Second largest industry cluster in North Carolina is located in Mecklenburg County.**
- ★ **Largest number of commercial energy efficiency projects and square footage in North Carolina.**
- ★ **Home to Duke Energy—a major investor owned utility serving North Carolina customers.**
- ★ **Received over $15.5 million in energy related ARRA funding, 90 percent allocated to energy efficiency.**

**Exhibit 27: County population and designation.**




*Sources: U.S. Census Bureau, NC Rural Center, NC Sustainable Energy Association.*

**Exhibit 28: Charlotte region rankings compared to other North Carolina regions.**

| Overview of Existing Firms | Number of Firms | State Rank | Region Location |
|---|---|---|---|
| Renewable Energy | 81 | 2 |  |
| Energy Efficiency - Non Builder | 110 | 2 | |
| Energy Efficiency - Builder | 154 | 3 | |
| Smart Grid or Energy Storage | 10 | 2 | |
| **Region Total** | **355** | **3** | |

| Existing Commercial Energy Efficiency | Number of Buildings | State Rank | Project Square Footage | State Rank |
|---|---|---|---|---|
| LEED (Registered & Certified) | 172 | 2 | 25,574,393 | 1 |
| Energy Star (Certified) | 243 | 1 | 23,532,917 | 1 |
| **Region Total** | **415** | **1** | **48,107,310** | **1** |

| Potential for Residential Energy Efficiency | Homes Built Prior to 1970 | State Rank | Manufactured Homes | State Rank |
|---|---|---|---|---|
| Number of Units | 264,932 | 1 | 84,714 | 6 |

| Registered Renewable Energy Systems | Number of Systems | State Rank | System Capacity (MW) | State Rank |
|---|---|---|---|---|
| Biomass | 7 | 1 | 35.30 | 5 |
| Geothermal | 92 | 4 | N/A | N/A |
| Hydroelectric | 11 | 3 | 547.13 | 2 |
| Solar | 86 | 4 | 13.15 | 2 |
| Wind | 2 | 5 (T) | <0.01 | 5 |
| **Region Total** | **198** | **4** | **595.58** | **3** |

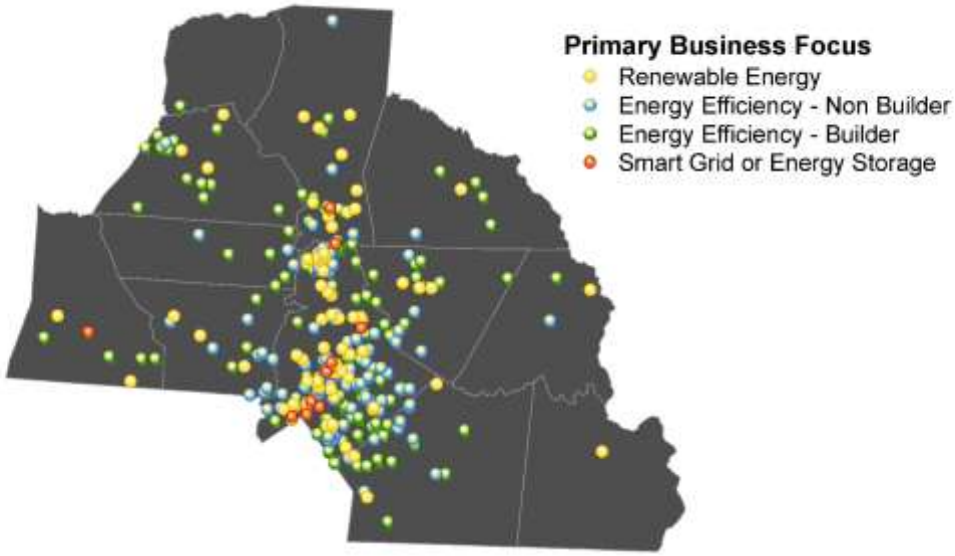
*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Source: NC Sustainable Energy Association.*

## *4.1 Overview of Existing Clean Energy Firms*

The Charlotte region is home to North Carolina's third largest clean energy industry population with over 350 firms (see Exhibit 29). The region maintains the second largest population of non-builder energy efficiency firms. Mecklenburg County is home to North Carolina's second largest industry cluster with 233 firms, for 65 percent of the region's total, while Iredell County comes in second with 28 firms. The region continues to experience steady growth of clean energy firms (see Exhibit 30). The growth can be attributed to both new firms entering and existing firms transitioning to clean energy activities.

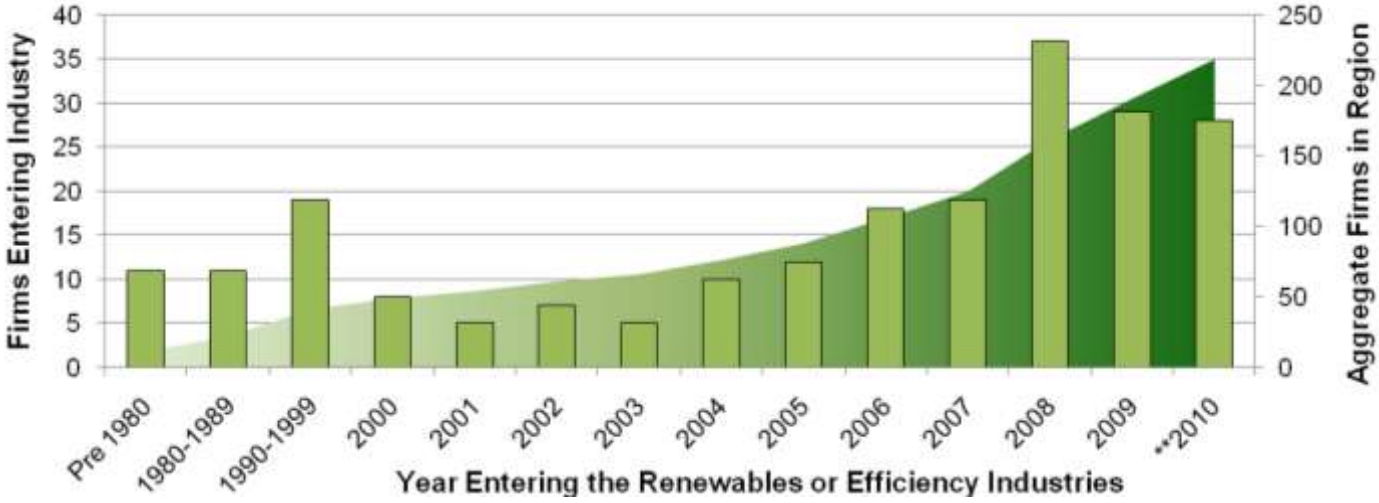
A focus where the region is a leader is wind energy component manufacturing. The Charlotte region may be able to leverage this base of existing firms to develop a wind energy component manufacturing hub within North Carolina, despite having a comparatively low wind resource base. The region is also home to several firms with substantial hydroelectric experience.

**Exhibit 29: Clean energy firms with a primary location in the Charlotte region.**




*Source: NC Sustainable Energy Association.*

**Exhibit 30: Evolution of clean energy firms in the Charlotte region.**




*Notes: Exhibit only includes firms reporting a year of entry in the Energy Star program or annual North Carolina Renewable Energy and Energy Efficiency Industries Census; therefore, aggregate firms may be lower than total firms reported elsewhere. Data for 2010 is through August 31, 2010. Sources: EPA Energy Star Program, NC Sustainable Energy Association.*

A significant advantage for the region is the corporate headquarters of Duke Energy—one of North Carolina's two major investor owned utilities—located in the City of Charlotte. Duke Energy can be an influential leader in advancing clean energy public policy and innovative programs. This advantage may be further enhanced by the pending merger of Duke Energy with the second major investor owned utility—Progress Energy based in Raleigh. The merger is expected to be complete by the end of 2011 and will result in the largest electric utility in the United States.

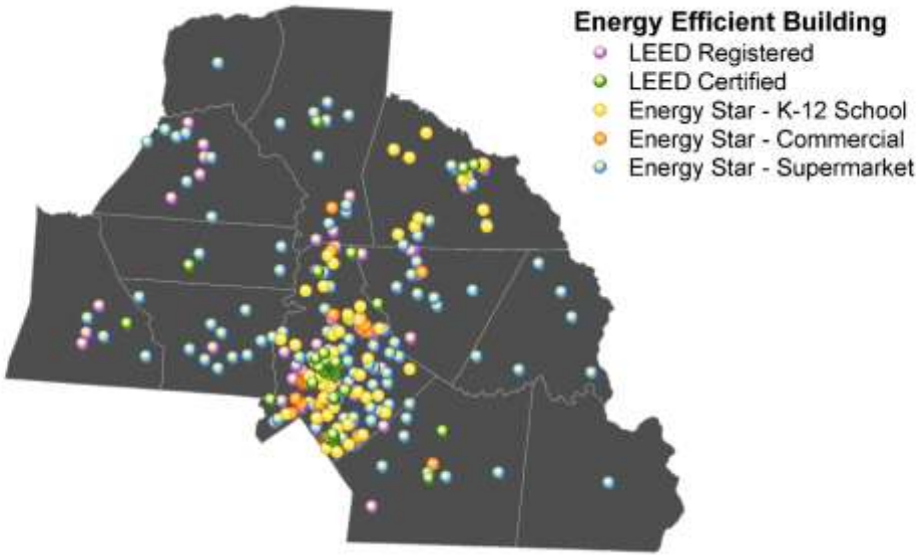
Energy efficient builders are present in large numbers and are highly dispersed across the region, which ensures local expertise and opportunity for the industry. Alexander County is relatively well served by companies located outside the Charlotte region; however, Anson County lacks any significant energy efficient builder presence from within the county or neighboring regions. As a whole, the Charlotte region displays strength in the number of firms, distribution, and diversity of focus areas within the clean energy industry. This collective provides a robust technical knowledge base and strong industry presence with clear opportunity for continued development.

## *4.2 Existing Commercial and Government Energy Efficiency*

Energy efficient commercial and government buildings are found throughout the Charlotte region, with all 12 counties having at least one registered or certified building in the LEED or Energy Star programs (see Exhibit 31). The region contains 415 buildings and over 48 million square feet in these the two programs (see Exhibit 32). According to the U.S. Environmental Protection Agency, the City of Charlotte ranked 18th in the United States for total Energy Star commercial projects in 2010.

Mecklenburg County leads the region in commercial energy efficiency with 285 buildings and over 37.6 million square feet as registered or certified. As a result, over 75 percent of the region's registered and certified square footage occurs in Mecklenburg County. Rowan County ranks second in registered and certified projects with 31 buildings. Cabarrus County ranks second in registered space with nearly 4.3 million square feet. While LEED registered projects are identified throughout the region, certified projects are largely located in and around the City of Charlotte. Food Lion was the regional leader in certifying supermarkets in the Energy Star program with 99 of the 114 certified locations. Schools certified in the Energy Star program

**Exhibit 31: Charlotte region commercial and government energy efficient buildings.**




*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 32: Charlotte Region energy efficient projects and square feet in urban and rural counties.**

| | Rural Counties | | Urban Counties | | Charlotte Region | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 17 | 1,298,793 | 97 | 14,196,615 | 114 | 15,495,408 |
| LEED Certified | 5 | 487,721 | 53 | 8,591,264 | 58 | 9,078,985 |
| Energy Star - K-12 School | 0 | 0 | 58 | 6,227,526 | 58 | 6,227,526 |
| Energy Star - Commercial | 2 | 133,941 | 69 | 12,912,993 | 71 | 13,046,934 |
| Energy Star - Supermarket | 32 | 1,107,501 | 82 | 3,150,956 | 114 | 4,258,457 |
| **Region Total** | **56** | **3,027,956** | **359** | **45,079,354** | **415** | **48,107,310** |

*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

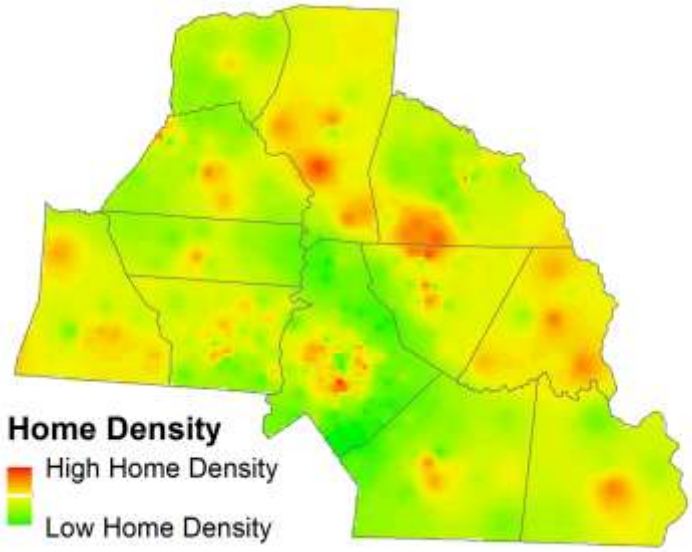
were distributed between Rowan and Mecklenburg counties, while nearly all of the Energy Star commercial locations were located in the City of Charlotte.

## *4.3 Potential for Residential Energy Efficiency*

Residential energy efficiency presents a significant opportunity for the Charlotte region as measured by the age of the housing stock. The region has nearly 265,000 homes built prior to 1970—which is the state's largest regional stock of homes that are likely to be lacking adequate insulation. In addition, five counties have more than 20,000 homes built prior to 1970 (see Appendix 1).

Mecklenburg County contains over 90,000 or 33 percent of the homes built prior to 1970 in the region. The highest concentration of retrofit opportunities in Mecklenburg County are clustered around the City of Charlotte, with lower numbers in more recently developed suburban areas (see Exhibit 33). Cabarrus, Iredell, and Rowan counties also offer relatively well defined clusters of residential retrofit opportunities. Counties predominately served by electric membership corporations or municipal electric providers—such as Gaston County, Lincoln County, and Anson County—could prove to be priority markets for residential retrofits because of higher annual electric expenses.

**Exhibit 33: Probable density of homes built prior to 1970 in the Charlotte region.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

The Charlotte region maintains the largest population of structures containing more than 10 units in North Carolina at more than 90,000 units. In the event these units are renter occupied, a challenging dynamic is created where both building owners and renters lack an incentive to invest in energy efficiency improvements. Nevertheless, these larger buildings can provide suitable opportunities for combined heat and power, geothermal, or other capital intensive projects. Further, excellent opportunities for campus or district energy systems may exist in Mecklenburg County—where over 75 percent of the region's housing consisting of more than 10 units can be found.

**Exhibit 34: Housing type in the Charlotte region.**

| Housing Type | Number | Share |
|---|---|---|
| Single Unit | 667,359 | 72% |
| 2 to 10 Units | 85,247 | 9% |
| More than 10 Units | 90,813 | 10% |
| Manufactured Housing | 84,714 | 9% |

*Source: U.S. Census Bureau.*

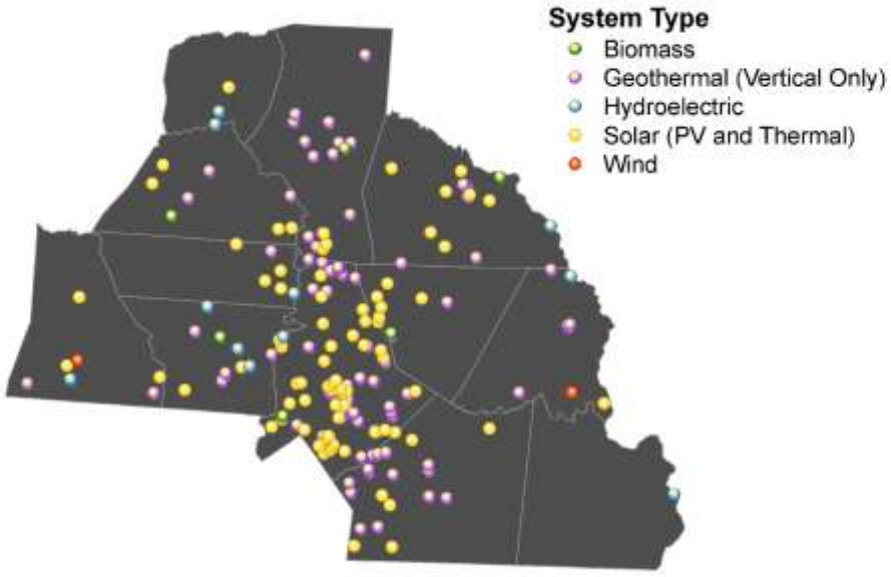
## *4.4 Registered Renewable Energy Facilities*

Multiple renewable energy systems are registered in the Charlotte region, which has a combined renewable energy capacity of 595 megawatts (see Exhibits 35 and 36). Similar to other regions of North Carolina, hydroelectric facilities contribute the largest share of generating capacity, while geothermal and solar energy systems are the most prevalent by project numbers. However, the solar project capacity profile of the region differs from other areas in North Carolina due to a substantially larger number of commercial and utility scale systems owned and operated by Duke Energy. The largest systems by technology include a 350 megawatt hydroelectric facility, a 10.4 megawatt biomass facility, and a 2.2 megawatt solar facility.

Vertical geothermal units have the largest systems presence in the Charlotte region with 92 unique systems and a total of nearly 400 boreholes. Mecklenburg County has the most systems at 36 as well as the most boreholes at 221. Iredell County contains the second largest number of systems and boreholes at 17 and 53 respectively. Union County ranks third with 15 systems and 44 boreholes.

Solar systems make up the second largest number of installed units in the Charlotte region, and can be found in every county except Anson County. Mecklenburg County leads the region in registered solar systems,

**Exhibit 35: Location of registered renewable energy systems in the Charlotte region.**




*Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

**Exhibit 36: Registered renewable energy systems in the Charlotte region.**

| | Rural Counties | | Urban Counties | | Charlotte Region | |
|---|---|---|---|---|---|---|
| | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 1 | 4.800 | 6 | 30.500 | 7 | 35.300 |
| Geothermal | 40 | N/A | 52 | N/A | 92 | N/A |
| Hydroelectric | 5 | 414.865 | 6 | 132.260 | 11 | 547.125 |
| Solar | 19 | 2.532 | 67 | 10.618 | 86 | 13.150 |
| Wind | 2 | 0.006 | 0 | 0.000 | 2 | 0.006 |
| **Region Total** | **67** | **422.203** | **131** | **173.378** | **198** | **595.581** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

accounting for a total of 6.44 megawatts of capacity or 45 percent of the region's solar capacity. The largest system in the county is a 2.171 megawatt project. Rowan County ranks second in projects with nine registered systems and solar capacity with 1.84 megawatts. The largest system in Rowan County is 1.29 megawatts. In addition, Gaston, Alexander, Cleveland, and Catawba counties all have more than 1.0 megawatts of registered solar capacity.

Several biomass landfill gas systems, as well as one cutting edge resource recovery project in the development stage, are present in the Charlotte region. As of this publication, the Charlotte region was one of only two regions in North Carolina with any activity in resource recovery for energy generation. There is also a large organic waste digester project evolving in the region. The National Renewable Energy Lab found that Mecklenburg County alone produces more than 50,000 dry tons of urban wood waste annually, as well as considerable amounts of combustible methane from landfills and waste water treatment facilities.

## *4.5 Training, Support, and Community College Assets*

*(See Appendix 3 for detailed maps and tables of Charlotte region assets)*

Central Piedmont Community College offers a degree in Sustainable Technologies. Several others have the potential to develop energy efficiency or renewable energy focused units as part of the community college system's Curriculum Improvement Project (CIP)—a process that adds clean energy components to existing degrees. Catawba, Cleveland, Gaston, and South Piedmont Community Colleges already offer degrees in HVAC, Electrical Systems, and Industrial Systems. The remaining colleges in Appendix 3 offer at least one of these degrees.

South Piedmont Community College may also present a unique bed for regional development. Multiple degree elements are in place, yet with a smaller population base there has been very limited development of the renewables and energy efficiency industries in Anson County. There may be the potential for the college to work within existing opportunities (e.g. schools and supermarkets) and the college's Small Business Center to develop an energy retrofitting base for local employment opportunities and jumpstart an efficiency sub-cluster in a largely underserved area.

The Charlotte region contains three established resource conservation and development (RC&D) regions, and one new applicant area—the South Central Piedmont RC&D. This Council will be entirely within the Charlotte region, providing a potential support organization to address some of the energy efficiency potential in the region. This organization would have the added benefit of a commercial entities already well versed in Energy Star project certification, and as such the learning curve for the new RC&D may substantially lower than in other regions.

Charlotte has a number of additional unique assets. The University of North Carolina at Charlotte is home to both the Energy Production and Infrastructure Center (EPIC) and the Infrastructure, Design, Environment and Sustainability Center (IDEAS), which focus on preparing students for careers in the energy sector. It is also home to one of the region's Small Business Technology and Development Centers (SBTDC). The City of Charlotte also has a regional office for the U.S. Green Building Council and the "Envision: Charlotte" project, an energy monitoring program designed to reduce business energy consumption in downtown by providing continuous energy use information and control.

## *4.6 Strengths, Weaknesses, Opportunities, and Threats*

### *Strengths*

- Large and highly diverse cluster of existing firms.
- National leader in Energy Star certifications.
- Existing wind manufacturing component base.
- Duke Energy corporate headquarters is located in Charlotte.
- Multiple training assets, including unique resources at the University of North Carolina at Charlotte.
- Regional experience with larger solar systems, and high solar energy potential.

### *Weaknesses*

- Solar development focused heavily on utility scale projects as opposed to a diversity of residential and utility scale projects.
- Limited number of registered geothermal systems when compared to other North Carolina regions.

### *Opportunities*

- Mecklenburg County can leverage national recognition for Energy Star leadership to promote continued investment in energy efficiency.
- The region has ample potential for residential energy efficiency retrofits from multiple unit housing and from homes built prior to 1970.
- Urban wood waste and methane resources are comparatively high, even by national standards, and traditionally under exploited.

### *Threats*

- Hydroelectric facilities are old, and license renewal is not a forgone conclusion.
- Wind resources are limited in much of the region.
- City of Charlotte is a strong regional epicenter for development and recruitment, and may inhibit development and recruitment opportunities in outlying counties.

The Charlotte region is strongly positioned to be a state leader in the renewable energy and energy efficiency industries in North Carolina. With large numbers and a diversity of firms, as well as a major utility, the region has a strong foundation for clean energy development. The City of Charlotte is home to regional and national headquarters of several consulting and engineering firms that can infuse strong expertise into the state.

The region would be well served to continue pursuing commercial energy efficiency opportunities for national branding and recognition. In addition, the region has ample residential energy efficiency retrofit opportunities. Training is locally available to outfit firms with the skills needed to capitalize on these opportunities. Although the bulk of the opportunity does exist in Mecklenburg County due to its large urban core, there are clearly regional opportunities. Formation of the South Central Piedmont Resource Council may provide a venue to focus on energy efficiency in and around counties with high levels of homes built prior to 1970. An additional noteworthy opportunity is the established base of wind component firms in the region. Promoting the region's wind expertise may assist in the ability to recruit new, complimentary component and sub-assembly firms to the region.

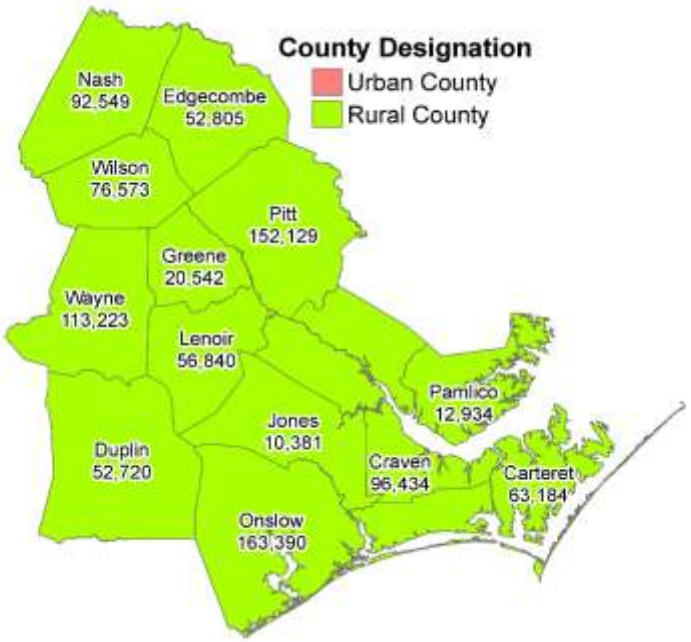
Renewable energy infrastructure development in the region has experienced a markedly different pattern than in other regions in North Carolina. In particular, Duke Energy has pursued significant commercial and utility scale solar projects in the region. Biomass opportunities are being evaluated, but are proving challenging to develop. Finally, geothermal systems are less prevalent than expected given the large population.

Training and support assets are prominent in the region, especially in the City of Charlotte. Multiple community colleges are well positioned to utilize existing degrees and provide training for a renewable energy and energy efficiency workforce. The region is also well served by university assets and private initiatives that can further enhance the workforce and support business development.

# CHAPTER 5: EASTERN REGION

- ★ **Dispersed opportunities for energy efficiency retrofits.**
- ★ **Strong coastal wind resource base.**
- ★ **Port of Morehead City identified as a prime location for offshore wind energy hub.**
- ★ **Large number of energy efficient registered buildings.**
- ★ **Strong military presence provides energy efficiency opportunities.**
- ★ **Received nearly $6.5 million in energy related ARRA funding, 100 percent allocated to energy efficiency.**

**Exhibit 37: County population and designation.**




*Sources: U.S. Census Bureau, NC Rural Center, NC Sustainable Energy Association.*

**Exhibit 38: Eastern region rankings compared to other North Carolina regions.**

| Overview of Existing Firms | Number of Firms | State Rank | Region Location |
|---|---|---|---|
| Renewable Energy | 8 | 6 |  |
| Energy Efficiency - Non Builder | 5 | 7 | |
| Energy Efficiency - Builder | 44 | 6 | |
| Smart Grid or Energy Storage | 1 | **6** | |
| **Region Total** | **58** | **6** | |

| Existing Commercial Energy Efficiency | Number of Buildings | State Rank | Project Square Footage | State Rank |
|---|---|---|---|---|
| LEED (Registered & Certified) | 99 | 4 | 5,915,055 | 5 |
| Energy Star (Certified) | 96 | 4 | 5,672,704 | 4 |
| **Region Total** | **195** | **5** | **11,587,759** | **5** |

| Potential for Residential Energy Efficiency | Homes Built Prior to 1970 | State Rank | Manufactured Homes | State Rank |
|---|---|---|---|---|
| Number of Units | 127,760 | 6 | 91,220 | 3 |

| Registered Renewable Energy Systems | Number of Systems | State Rank | System Capacity (MW) | State Rank |
|---|---|---|---|---|
| Biomass | 5 | 2 (T) | 70.33 | 3 |
| Geothermal | 146 | 2 | N/A | N/A |
| Hydroelectric | 2 | 5 (T) | 1.40 | 6 |
| Solar | 45 | 5 | 3.82 | 5 |
| Wind | 2 | 5 (T) | <0.01 | 7 |
| **Region Total** | **200** | **3** | **75.55** | **7** |

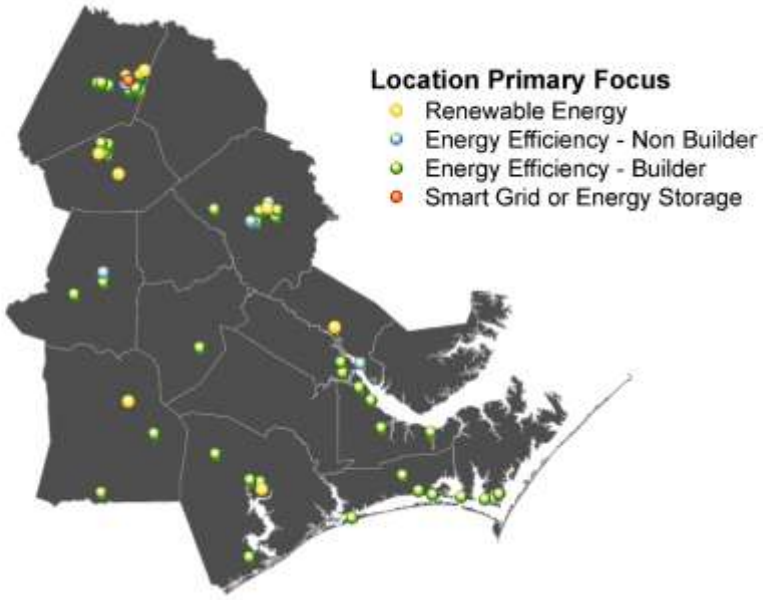
*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Source: NC Sustainable Energy Association.*

## *5.1 Overview of Existing Clean Energy Firms*

The Eastern region is comprised entirely of rural counties and is home to 58 clean energy firms. These firms are most strongly clustered around the Town of Rocky Mount (see Exhibit 39). Smaller clusters exist in Wilson, Greenville, and disbursed along the coast and inlet. Energy efficient home builders account for the majority of firms present in Eastern North Carolina. The presence of clean energy firms in the region has increased steadily over recent years (Exhibit 40)

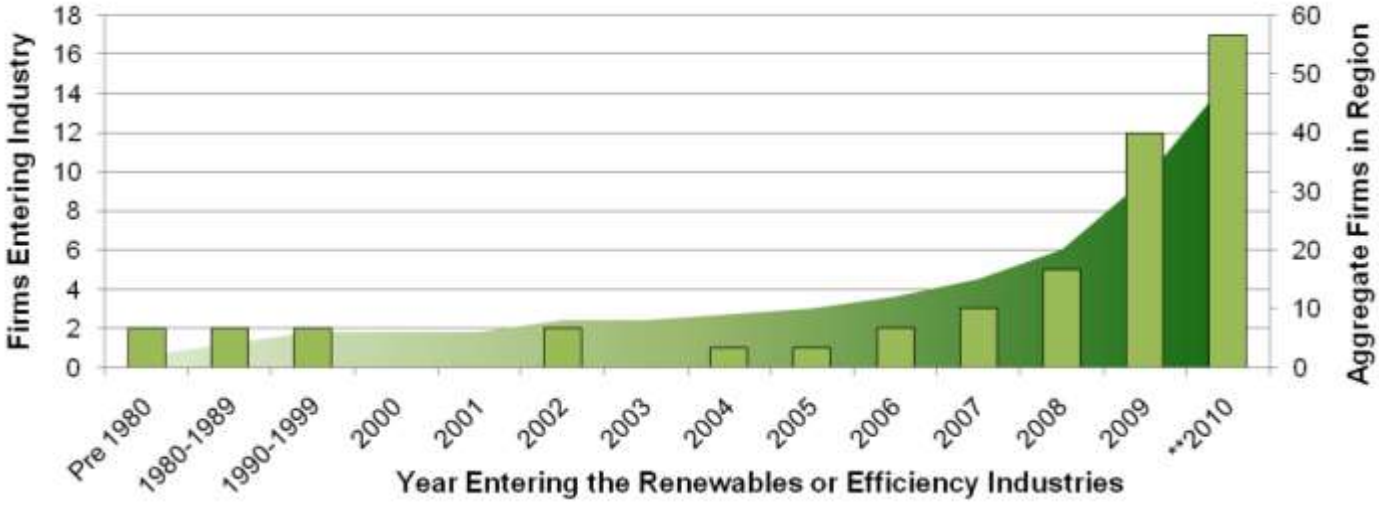
Rocky Mount is the most active area in the region with 13 firms, including at least one manufacturer with activities in the solar supply chain. Meanwhile, Wilson has two of the region's biomass firms and Greenville is home to the region's only other solar focused company. The two geothermal installers identified in the region are located in Onslow County—close to the center of region's geothermal development.

**Exhibit 39: Clean energy firms with a primary location in the Eastern region.**




*Source: NC Sustainable Energy Association.*

**Exhibit 40: Evolution of clean energy firms in the Eastern region.**




*Notes: Exhibit only includes firms reporting a year of entry in the Energy Star program or annual North Carolina Renewable Energy and Energy Efficiency Industries Census; therefore, aggregate firms may be lower than total firms reported elsewhere. Data for 2010 is through August 31, 2010. Sources: EPA Energy Star Program, NC Sustainable Energy Association.*

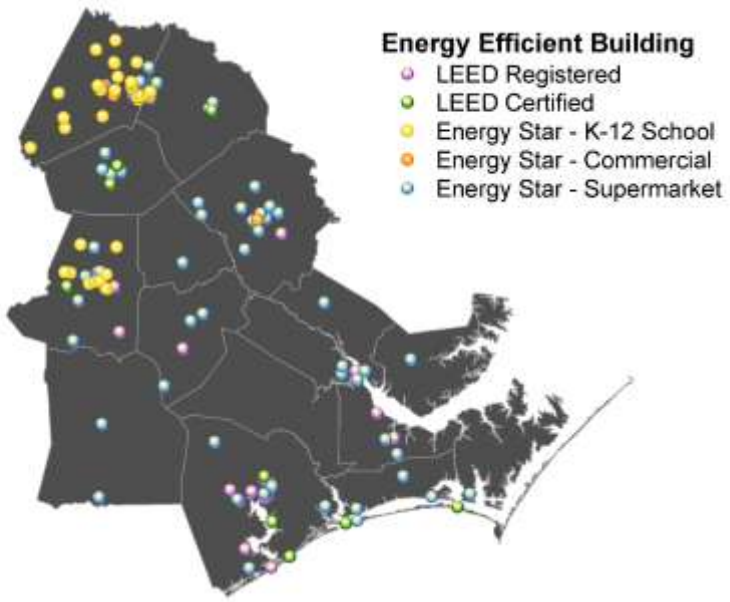
## *5.2 Existing Commercial and Government Energy Efficiency*

Commercial and government energy efficiency LEED and Energy Star projects are found in 12 of the 13 counties in the region, with Jones County being the lone exception (see Exhibit 41). The Eastern region contains 195 registered and certified buildings that encompass over 11.5 million total square feet of space (see Exhibit 42).

Onslow County leads the region with 80 registered and certified buildings and 4.8 million square feet, with the large majority occurring from LEED registered military buildings. Nash County ranks second in both the number of registered and certified projects at 30 buildings and floor space at 2.7 million square feet. Wayne County ranks third with 28 commercial energy efficient buildings totaling 1.4 million square feet.

Energy Star certified schools are found exclusively in the western portion of the region, with Nash and Wayne counties accounting for 21 and 10 projects respectively. The remaining five Energy Star certified schools are located nearby in Edgecombe County. Pitt and Craven counties rank first and second in the number of Energy Star certified supermarkets, with Food Lion being the leading supermarket seeking certification. A final trend worth noting is that the military largely pursued LEED registration over Energy Star, whereas private firms by and large pursued the Energy Star certification, especially schools and supermarkets.

**Exhibit 41: Eastern region commercial and government energy efficient buildings.**




*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 42: Eastern region energy efficient projects and square feet in urban and rural counties.**

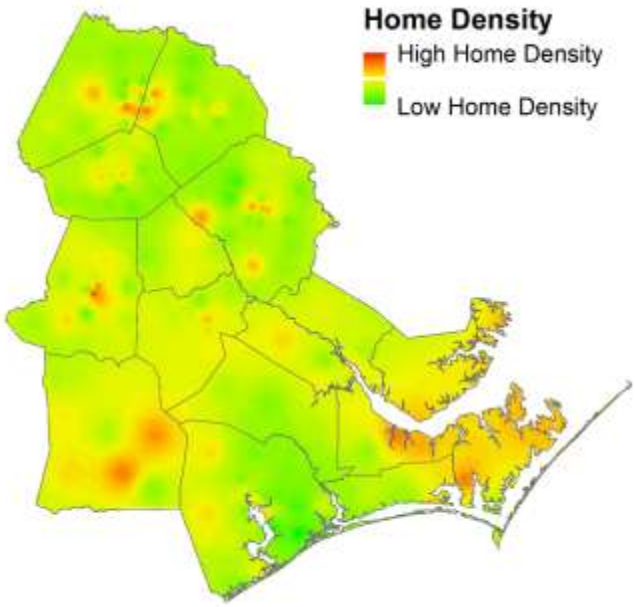
| | Rural Counties | | Urban Counties | | Eastern Region | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 83 | 5,410,178 | 0 | 0 | 83 | 5,410,178 |
| LEED Certified | 16 | 504,877 | 0 | 0 | 16 | 504,877 |
| Energy Star - K-12 School | 36 | 3,534,516 | 0 | 0 | 36 | 3,534,516 |
| Energy Star - Commercial | 3 | 70,107 | 0 | 0 | 3 | 70,107 |
| Energy Star - Supermarket | 57 | 2,068,081 | 0 | 0 | 57 | 2,068,081 |
| **Region Total** | **195** | **11,587,759** | **0** | **0** | **195** | **11,587,759** |

*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

## 5.3 Potential for Residential Energy Efficiency

The Eastern region has over 127,000 homes built prior to 1970, providing a sizeable housing stock for residential energy efficiency retrofits and economic development opportunities (see Exhibit 43). This housing stock exists across multiple counties as the majority of the counties in the region maintain over 10,000 homes built prior to 1970. This indicates a strong potential for energy efficiency retrofit opportunities.

**Exhibit 43: Probable density of homes built prior to 1970 in the Eastern region.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

A compounding factor in some instances may be the large percentage of rental homes in a county. Nearly one in three homes in the region are renter occupied. These properties can forego energy efficiency retrofits as renters have little incentive to invest capital to improve a building owned by someone else. Conversely, building owners have little incentive because they do not pay the utility bills and receive the same rent payments regardless of efficiency investments. For buildings that are owner occupied, energy efficiency retrofits may be limited by a lack of discretionary income.

Additional opportunities for residential energy efficiency may exist in the 91,000 manufactured homes present in the region (see Exhibit 44). Pitt County contains nearly 50 percent of the multiple unit housing present in the region. These larger buildings can provide opportunities for more centralized energy efficiency opportunities, such as district energy systems.

**Exhibit 44: Housing type in the Eastern region.**

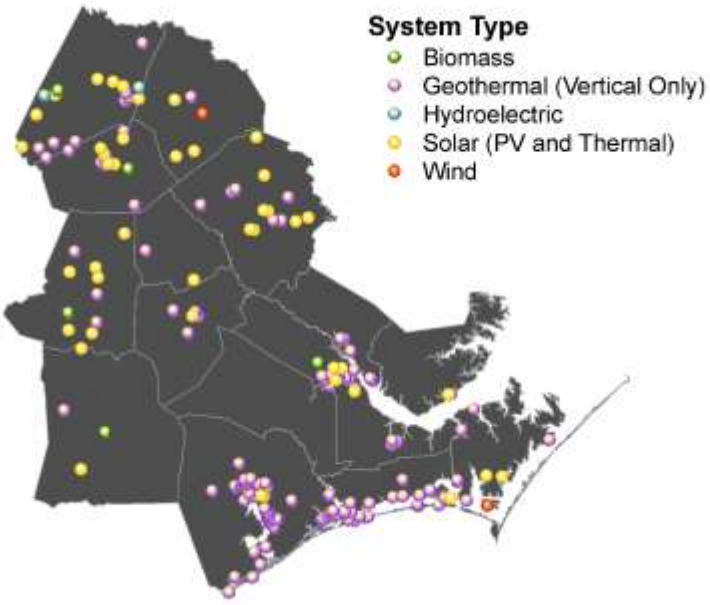
| Housing Type | Number | Share |
|---|---|---|
| Single Unit | 279,293 | 63% |
| 2 to 10 Units | 53,648 | 12% |
| More than 10 Units | 21,452 | 5% |
| Manufactured Housing | 91,220 | 20% |

*Source: U.S. Census Bureau.*

## 5.4 Registered Renewable Energy Facilities

Multiple renewable energy systems are registered in the Eastern region which has a combined renewable energy capacity of just over 75 megawatts (see Exhibits 45 and 46). Biomass systems contribute the largest share of generating capacity, while geothermal and solar projects make up the bulk of the installed systems. Despite regional onshore wind resources, there are very few registered wind systems in the region.

**Exhibit 45: Location of renewable energy systems in the Eastern region.**




*Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

**Exhibit 46: Registered renewable energy systems in the Eastern region.**

| | Rural Counties | | Urban Counties | | Eastern Region | |
|---|---|---|---|---|---|---|
| | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 5 | 70.330 | 0 | 0.000 | 5 | 70.330 |
| Geothermal | 146 | N/A | 0 | N/A | 146 | N/A |
| Hydroelectric | 2 | 1.400 | 0 | 0.000 | 2 | 1.400 |
| Solar | 45 | 3.819 | 0 | 0.000 | 45 | 3.819 |
| Wind | 2 | 0.004 | 0 | 0.000 | 2 | 0.004 |
| **Region Total** | **200** | **75.553** | **0** | **0.000** | **200** | **75.553** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

Systems in the region tend to be smaller in nameplate capacity than those found in the central and western sections of the state. The largest system is a 45 megawatt biomass facility in Craven County. The largest solar system is a 1.26 megawatt project, and the largest hydroelectric system is a 1.0 megawatt project.

Vertical geothermal systems make up the largest number of registered systems in the Eastern region. In fact, the Eastern region has the second largest registered vertical geothermal presence in North Carolina by total systems, and the largest number of boreholes at 1,611. Onslow County has the most systems and boreholes in the region, with 54 systems and 588 boreholes, led by a strong geothermal presence at military installations. Carteret County comes in second for systems with 31 projects, but fourth for boreholes at 163. Craven County is third in both categories with 22 systems and 205 boreholes. Nash County has 9 vertical geothermal systems, but ranks second boreholes at 513 on the strength of North Carolina's largest vertical geothermal system as measured by number of boreholes.

Solar systems make up the second largest number of registered units in the Eastern region, and can be found in every county except Jones County. Pitt County is the regional leader in solar systems with eight systems totaling 26.5 kilowatts of solar capacity. Craven County is the regional leader in solar capacity with over 95 percent of the county capacity resulting from a single 1.26 megawatt solar system.

One unique asset in the region is a demonstration biomass digester. With one of North Carolina's largest swine and poultry waste resources residing in Duplin County, there is potential for the Eastern region—and Duplin County in particular—to develop these resources to assist electric utilities at meeting the swine waste and poultry litter requirements in the North Carolina Renewable Energy and Energy Efficiency Portfolio Standard (REPS).

## ***5.5 Training, Support, and Community College Assets***

*(See Appendix 4 for detailed maps and tables of Eastern region assets)*

Two community colleges in the region offer a degree in Sustainable Technologies—Wayne Community College and Lenoir Community College. In addition to these two programs, several others have the potential to develop energy efficiency or renewable energy focused units as part of the community college system's Curriculum Improvement Project (CIP)—a process that adds clean energy components to existing degrees. Pitt Community College already offers degrees in HVAC, Electrical Systems, and industrial Systems. The remaining community colleges in Appendix 4 offer at least one of these degrees.

Pitt County is home to two additional important training assets. East Carolina University can support small business through the small business technology and development center (SBTDC) and Pitt Community College is certified to offer Building Performance Institute (BPI) training seminars. The presence of these assets dovetails well with existing opportunities for residential energy efficiency upgrades in the region.

A unique regional asset also worth noting is the Port of Morehead City. This port has been identified as a suitable location for the manufacturing and staging of offshore wind turbine construction. Although some upgrades would be required, a large portion of the infrastructure already exists, and it is in close proximity to North Carolina's significant offshore wind energy resource.

Finally, the Eastern region has three resource and conservation development (RC&D) councils, two of which are still in formation. However, these councils are only active in four of the 14 counties in the region. The other 10 counties have no councils, and are not pursuing development of a regional group. This may place those counties at a disadvantage in capitalizing on clean energy opportunities.

## ***5.6 Strengths, Weaknesses, Opportunities, and Threats***

The Eastern region has the fundamental elements needed for clean energy development. As with most regions, residential energy efficiency presents a major opportunity for the region, and there are several firms in position to take advantage of this. Further, the annual energy expenses associated with electrical membership corporations and municipal electric utilities may increase opportunities for energy efficiency retrofit projects. However, a key element to capitalizing on the opportunity will be ensuring access to capital, which may be problematic given the rural nature and economic challenges facing the region.

The Eastern region tied the Charlotte region for the greatest number of Energy Star certified schools at 58. The region would be well served to continue to pursue energy efficiency in local schools, thereby capturing economic savings and building a brand as an energy efficiency leader in North Carolina. Regional community colleges can provide training platforms for energy efficiency training.

### ***Strengths***

- Existing cluster of firms in Rocky Mount, Wilson, and Greenville.
- Military is developing LEED registered buildings.
- Comparatively large and well dispersed number of Energy Star certified buildings in the region.
- Strong presence of geothermal applications, especially at military installations.

### ***Weaknesses***

- Some counties have limited clean energy resources to pursue.
- Development of renewable energy resource is uneven throughout region.
- Training assets are largely concentrated in the northwest portion of region.

### ***Opportunities***

- Proximity to impressive offshore wind resources.
- Port of Morehead City identified as potential hub for offshore wind manufacturing and staging.
- Energy Star certified schools are largely confined to the Northeast, many opportunities remain.
- Dispersed residential retrofitting opportunities from houses built prior to 1970.
- Large swine and poultry fuel resource in Duplin County can be developed to meet REPS mandates.
- Abundance of open space for development of larger utility scale systems.

### ***Threats***

- Military airspace priorities may limit onshore and offshore wind development.
- Limited availability of flowing hydroelectric resources.
- Rural nature may limit recruitment of some focus areas of renewable energy, such as smart grid.
- Securing capital for renewable and efficiency projects may be more difficult in rural areas.

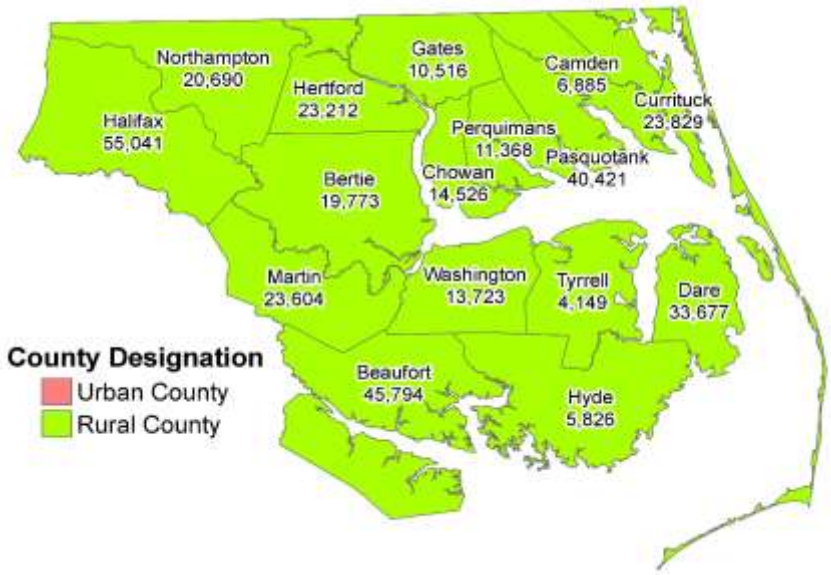
Geothermal systems display a strong foothold in the region, spearheaded by military installations. The presence of large and established facilities allowed the military to capitalize earlier than many industries. Between the presence of Camp Lejeune, New River, and Cherry Point military facilities, there is likely to be significant potential remaining for geothermal installations. These opportunities may be complimented by additional projects at municipalities, universities, schools, and hospitals.

Both onshore and offshore wind energy resources present a unique regional asset, but one that may have hurdles to exploitation. Carteret County has strong onshore wind resources, but the presence of military training in the region may limit development opportunities. For offshore wind, the Port of Morehead City is an unmatched asset in North Carolina. This port has been identified as having all the key features in place for developing an assembly and manufacturing hub for the offshore wind industry.

# CHAPTER 6: NORTHEAST REGION

- ★ **Comparatively strong wind resource base.**
- ★ **Compelling economic and social opportunities for energy efficiency.**
- ★ **Coastal region is a leader in deployment of small wind systems.**
- ★ **Coastal development opportunities for new residential energy efficient home builders.**
- ★ **Received over $2 million in energy related ARRA funding, 87 percent allocated to energy efficiency.**

**Exhibit 47: County population and designation.**




*Sources: U.S. Census Bureau, NC Rural Center, NC Sustainable Energy Association.*

**Exhibit 48: Northeast region rankings compared to other North Carolina regions.**

| Overview of Existing Firms | Number of Firms | State Rank | Region Location |
|---|---|---|---|
| Renewable Energy | 5 | 7 |  |
| Energy Efficiency - Non Builder | 6 | 6 | |
| Energy Efficiency - Builder | 14 | 7 | |
| Smart Grid or Energy Storage | 0 | 7 | |
| **Region Total** | **25** | **7** | |

| Existing Commercial Energy Efficiency | Number of Buildings | State Rank | Project Square Footage | State Rank |
|---|---|---|---|---|
| LEED (Registered & Certified) | 10 | 7 | 213,321 | 7 |
| Energy Star (Certified) | 21 | 7 | 703,256 | 7 |
| **Region Total** | **31** | **7** | **916,577** | **7** |

| Potential for Residential Energy Efficiency | Homes Built Prior to 1970 | State Rank | Manufactured Homes | State Rank |
|---|---|---|---|---|
| Number of Units | 62,682 | 7 | 35,967 | 7 |

| Registered Renewable Energy Systems | Number of Systems | State Rank | System Capacity (MW) | State Rank |
|---|---|---|---|---|
| Biomass | 4 | 5 (T) | 166.85 | 2 |
| Geothermal | 75 | 6 | N/A | N/A |
| Hydroelectric | 2 | 5 (T) | 324.00 | 3 |
| Solar | 16 | 7 | 6.55 | 4 |
| Wind | 15 | 2 | 300.10 | 1 |
| **Region Total** | **112** | **7** | **797.50** | **2** |

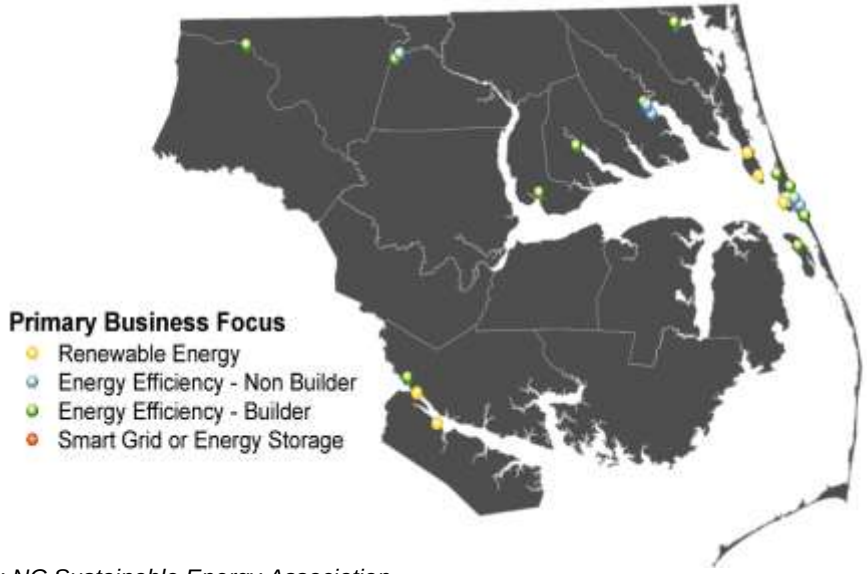
*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value; wind includes a 300 megawatt facility approved by the NC Utilities Commission—construction is expected in 2012. Source: NC Sustainable Energy Association.*

## *6.1 Overview of Existing Clean Energy Firms*

The Northeast region is comprised entirely of rural counties and is home to 25 clean energy firms. While this is the lowest number of firms in any region in North Carolina, the Northeast region maintains an operable base of firms focused in several key clean energy areas, especially along the Outer Banks (see Exhibit 49). The region has experienced slower and annually variable growth of firms entering the clean energy industry (see Exhibit 50).

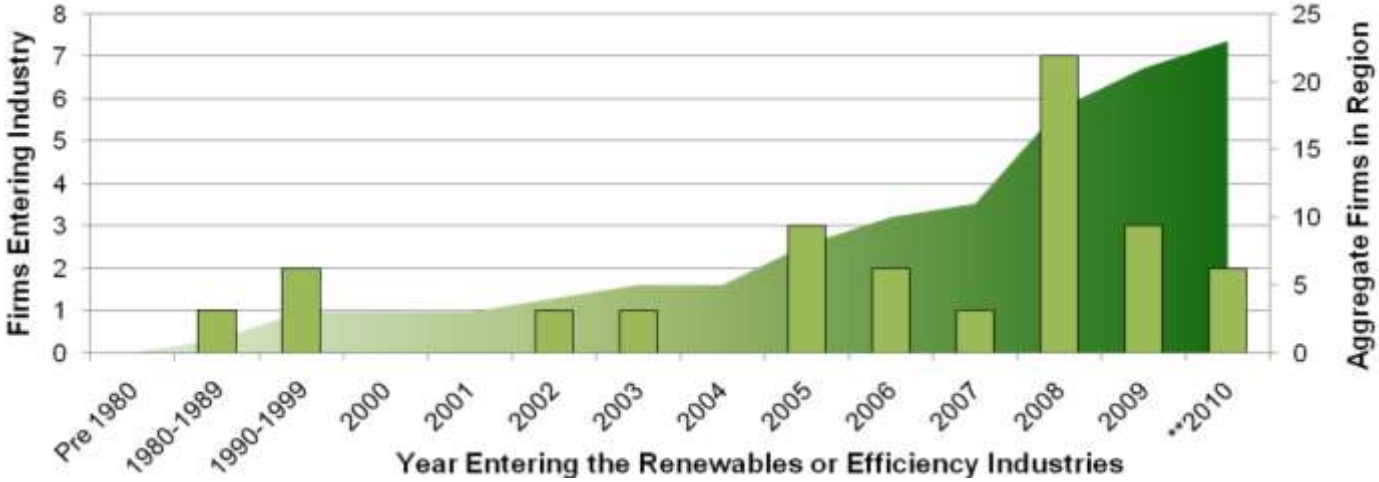
Firms are most strongly clustered in the Kill Devil Hills area. This cluster is the region's most diverse, with two solar firms and a residential wind energy firm. Additional clean energy firms exist in Washington and Elizabeth City, but in smaller numbers relative to Kill Devil Hills. One firm, located in Washington, is experienced at installing vertical axis wind turbines for residential settings.

**Exhibit 49: Clean energy firms with a primary location in the Northeast region.**




*Source: NC Sustainable Energy Association.*

**Exhibit 50: Evolution of clean energy firms in the Northeast region.**



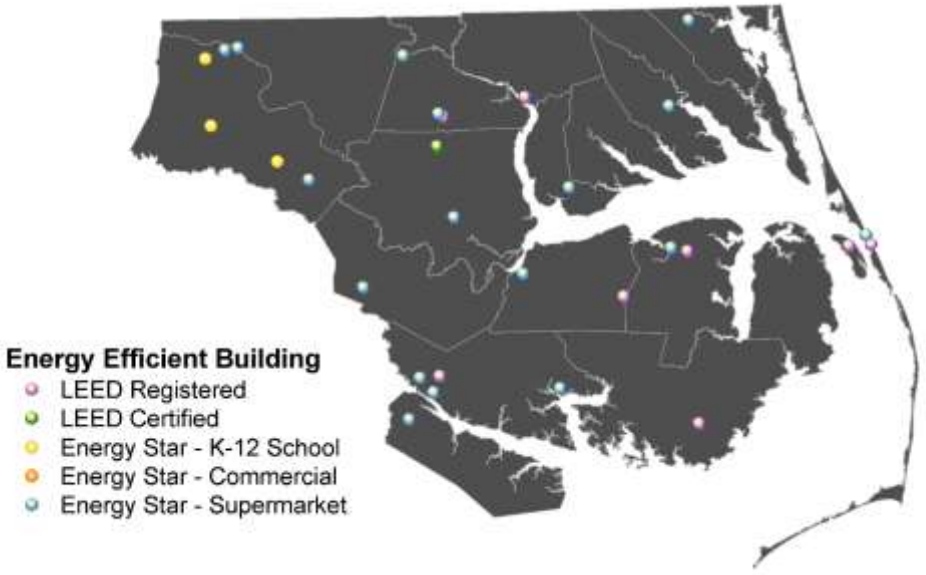

*Notes: Exhibit only includes firms reporting a year of entry in the Energy Star program or annual North Carolina Renewable Energy and Energy Efficiency Industries Census; therefore, aggregate firms may be lower than total firms reported elsewhere. Data for 2010 is through August 31, 2010. Sources: EPA Energy Star Program, NC Sustainable Energy Association.*

## *6.2 Existing Commercial and Government Energy Efficiency*

Commercial and government energy efficient projects exist in 13 of the 16 counties in the region, with Camden, Northampton, and Perquimans counties being the exceptions (see Exhibit 51). Despite the relatively low population density, the Northwest region contains 31 registered or certified energy efficiency commercial buildings for over 900,000 square feet of floor space (see Exhibit 52).

Halifax County leads the region, with seven Energy Star certified buildings occupying 24,000 square feet. The county also contains the region's three Energy Star certified schools. Beaufort County ranks second with five registered and certified buildings and 150,000 square feet. Bertie County has the single LEED certified project in the region. Food Lion is the regional leader in certifying buildings with all 18 Energy Star certified supermarkets in the region.

**Exhibit 51: Northeast region commercial and government energy efficient buildings.**




*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 52: Northeast region energy efficient projects and square feet in urban and rural counties.**

| | Rural Counties | | Urban Counties | | Northeast Region | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 9 | 211,921 | 0 | 0 | 9 | 211,921 |
| LEED Certified | 1 | 1,400 | 0 | 0 | 1 | 1,400 |
| Energy Star - K-12 School | 3 | 96,120 | 0 | 0 | 3 | 96,120 |
| Energy Star - Commercial | 0 | 0 | 0 | 0 | 0 | 0 |
| Energy Star - Supermarket | 18 | 607,136 | 0 | 0 | 18 | 607,136 |
| **Region Total** | **31** | **916,577** | **0** | **0** | **31** | **916,577** |

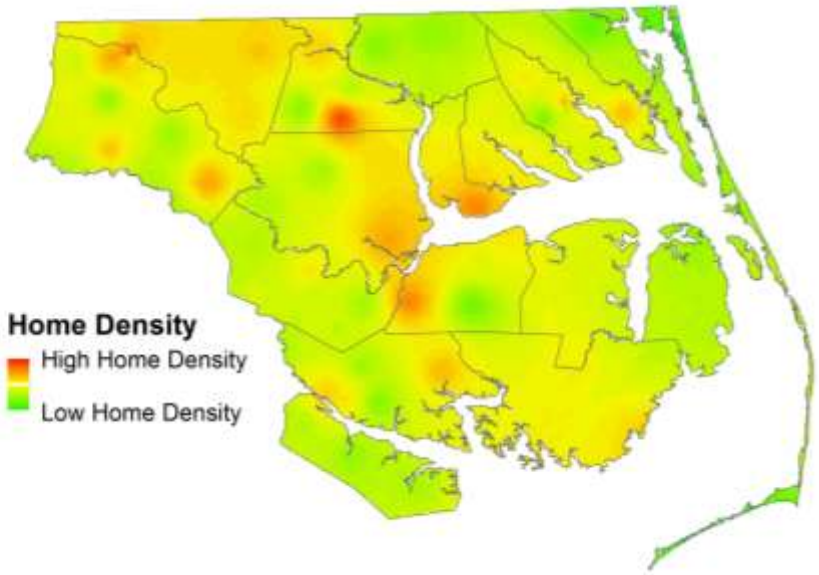
*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

## *6.3 Potential for Residential Energy Efficiency*

The Northeast region has the lowest absolute number of homes built prior to 1970 out of any of North Carolina regions with over 62,000 homes. However, with 34 percent of the region's housing stock built prior to 1970, and a large population of manufactured homes, there are ample residential retrofit opportunities.

In many counties homes built prior to 1970 can make up between 30 and 40 percent of the county level housing stock (see Exhibit 11). The western portion of the region contains the largest volume of homes built prior to 1970, with Halifax County containing nearly 18 percent of the region's total. The region as a whole displays less clustering of older homes relative to other North Carolina regions (see Exhibit 53). Several counties, especially on the Albemarle-Pamlico peninsula, have a high proportion of manufactured homes creating a compelling case for energy retrofitting activities (see Exhibits 12 and 54).

**Exhibit 53: Probable density of homes built prior to 1970 in the Northeast region.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

One interesting element to the region is the large number of "unoccupied" homes. These are likely to be seasonal homes, and while energy use is lower due to part time occupancy, the incentive to invest in energy efficiency may be minimal due to long payback periods. Dare and Currituck counties have the highest ratios of unoccupied home at 51 and 33 percent respectively.

**Exhibit 54: Housing type in the Northeast Region.**

| Housing Type | Number | Share |
|---|---|---|
| Single Unit | 129,753 | 72% |
| 2 to 10 Units | 11,567 | 6% |
| More than 10 Units | 3,300 | 2% |
| Manufactured Housing | 35,967 | 20% |

*Source: U.S. Census Bureau.*

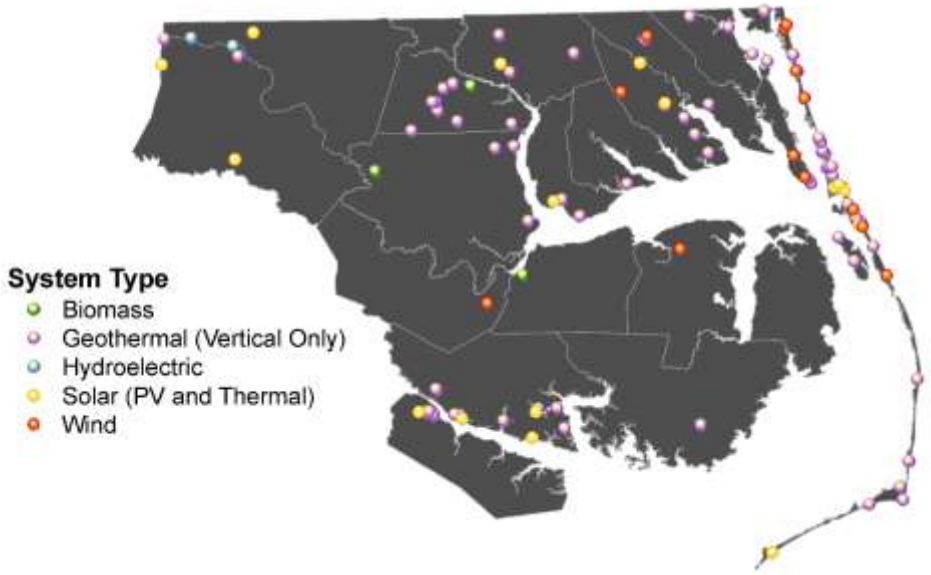
## *6.4 Registered Renewable Energy Facilities*

Every type of renewable energy system can be found in the Northeast region, which has a registered renewable energy capacity of 797 megawatts (see Exhibits 55 and 56). This includes a 300 megawatt wind facility permitted by the North Carolina Utilities Commission and expected to be under constructed in 2012. The largest system for each technology includes a 224 megawatt hydroelectric facility, a 146 megawatt biomass facility, and a 5.0 megawatt solar energy project. The region is home to a robust number of residential scale wind energy systems. One unique element in the Northeast region is a waste heat recovery unit in Beaufort County. The 54 megawatt unit, built at a chemical company facility, marks an innovative means to generate onsite power through thermal energy that would otherwise be lost to the environment.

In terms of installations, vertical geothermal systems are the most prevalent renewable technology in the region. Dare County leads the way with 25 vertical systems and 264 boreholes. Beaufort County ranks second for registered projects with 25 systems, followed by Currituck County with 11 systems. Hyde County has one registered system, but it is a larger project registering 48 boreholes.

Despite the open space and low population density, the development of renewable systems has been slower than in other regions of North Carolina. Nevertheless, the region has the potential to be a leader for utility scale renewable systems because the transmission network, managed by the PJM Interconnection, is closely linked to Mid-Atlantic electricity markets.

**Exhibit 55: Location of registered renewable energy systems in the Northeast region.**




*Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

**Exhibit 56: Registered renewable energy systems in the Northeast region.**

| | Rural Counties | | Urban Counties | | Northeast Region | |
|---|---|---|---|---|---|---|
| | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 4 | 166.850 | 0 | 0.000 | 4 | 166.850 |
| Geothermal | 75 | N/A | 0 | N/A | 75 | N/A |
| Hydroelectric | 2 | 324.000 | 0 | 0.000 | 2 | 324.000 |
| Solar | 16 | 6.549 | 0 | 0.000 | 16 | 6.549 |
| Wind | 15 | 300.102 | 0 | 0.000 | 15 | 300.102 |
| **Region Total** | **112** | **797.501** | **0** | **0.000** | **112** | **797.501** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value; wind includes a 300 megawatt facility approved by the NC Utilities Commission—construction is expected in 2012. Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

## 6.5 Training, Support, and Community College Assets

*(See Appendix 5 for detailed maps and tables of Northeast region assets)*

None of the community colleges in the region offer degrees in Sustainable Technologies; but others have the potential to develop energy efficiency or renewable energy focused units as part of the community college system's Curriculum Improvement Project (CIP)—a process that adds clean energy components to existing degrees. Martin Community College has degrees in HVAC, Electric Systems, and Industrial Systems. The remaining community colleges in Appendix 5 offer at least one of these degrees.

As a source of support to grow the local clean energy industry, regional community colleges could provide opportunities for training and retrofitting within the context of energy efficiency and management. As can be seen in the regional commercial and government energy efficiency map, the development of commercial and government energy efficiency has been largely untapped in the region. This holds true even for Energy Star certified supermarkets, which have been a prime development area in other regions. In addition, the community college system may be able to find industry mentors to mentor students in energy efficiency.

The Northeast region has three resource and conservation development (RC&D) councils present across all 16 counties of the region. However, the Four Rivers RC&D Council is still in formation and may need to establish itself more prior to becoming a viable asset. The region also features a Small Business Technology and Development Council (SBTDC) at Elizabeth City State University. This SBTDC has a track record of assisting regional firms that are operating in the clean energy industries. Elizabeth City State University is home to the Center for Green Research and Evaluation whose objective is to increase the number businesses producing or providing green-related goods or services in the region.

## 6.6 Strengths, Weaknesses, Opportunities, and Threats

### Strengths

- Small cluster established in Kill Devil Hills.
- The Small Business Technology and Development Center has engaged clean energy firms.
- Resource conservation and development councils are organized across all 16 counties.
- Western area of the region has a comparatively large population of homes built prior to 1970.
- Model local wind ordinance has been modified and adopted in several coastal counties.
- Existing strength and base for geothermal systems.
- Transmission infrastructure provides access to Mid-Atlantic electricity markets.

### Weaknesses

- Limited training and support assets in region, especially on Albemarle-Pamlico Peninsula.
- Smaller population densities result in lower overall energy retrofit opportunities.
- High proportion of unoccupied rental homes, especially in coastal region.
- Limited number of firms reporting a primary location in region.

### Opportunities

- Compelling social reasons to develop residential energy efficiency programs.
- Strong onshore and offshore wind resources.
- Abundance of open space for development of renewable systems to connect to Mid-Atlantic transmission system.
- Commercial and government energy efficiency certification is largely unexploited in region.

### Threats

- Rural nature may limit recruitment of some renewable energy industry focuses, such as smart grid.
- Limited transportation network in some areas.
- Securing capital for renewable and efficiency projects may be more difficult in rural areas.

The Northeast region has several key areas of strength that can be developed to create a more robust clean energy industry. The significant number of homes built prior to 1970 and the high proportions of manufactured homes present immediate energy retrofit opportunities. A potential barrier to residential energy efficiency is likely to be limited access to capital, as households may lack adequate discretionary income for efficiency investments. A compounding issue may be the limited number of firms present and capable of performing efficiency retrofits. Further, another significant area of weakness for the region is the limited training and support resources, especially for energy efficiency, beyond the community colleges system and Elizabeth City State University.

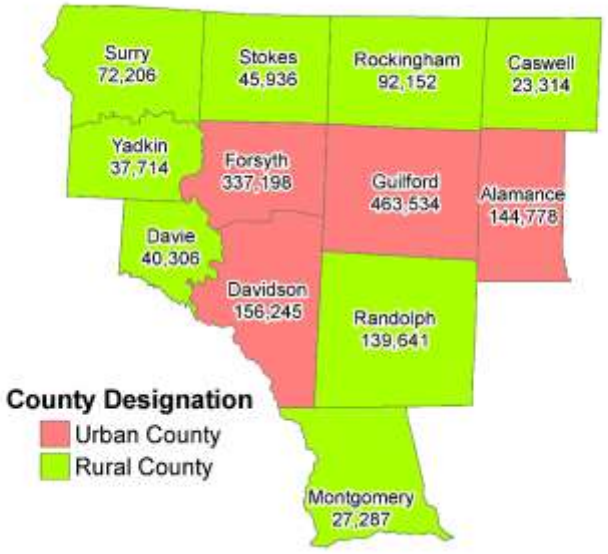
A second noteworthy opportunity for the region is the presence of an onshore and offshore wind resource. Construction of a 300 megawatt wind facility approved by North Carolina Utilities Commission would provide a significant number of local construction jobs and a small number of long term operation and maintenance jobs. Additional onshore wind projects or the development of North Carolina's offshore wind resources would provide additional construction, operation, and maintenance jobs for the region.

Onshore development or renewable resources in the Northeast region benefits from a unique element. The electric transmission infrastructure is managed by the PJM Interconnection—a regional transmission operator responsible for moving over 163.5 gigawatts of electricity around the East Coast and into the Midwest. PJM Interconnection also provides a wholesale electricity market where generators can bid to sell power. This infrastructure is important because it allows renewable energy projects of any technology to sell electricity and potentially renewable energy certificates into Mid-Atlantic markets. No other region in the state has this unique asset because the transmission infrastructure elsewhere in the state is managed by Duke Energy or Progress Energy. These utilities incur fees to purchase or sell electricity across transmission territories, such as the PJM Interconnect.

# CHAPTER 7: PIEDMONT TRIAD REGION

- ★ **Large industry clusters in Forsyth and Guilford County.**
- ★ **Home to North Carolina's largest solar energy project in Davidson County.**
- ★ **Comparatively robust population of solar energy companies throughout the supply chain.**
- ★ **Second largest population of homes built prior to 1970 presents major opportunities for energy retrofitting.**
- ★ **Received over $14 million in energy related ARRA funding, 91 percent allocated to energy efficiency.**

**Exhibit 57: County population and designation.**




*Sources: U.S. Census Bureau, NC Rural Center, NC Sustainable Energy Association.*

**Exhibit 58: Piedmont Triad rankings compared to other North Carolina regions.**

| Overview of Existing Firms | Number of Firms | State Rank | Region Location |
|---|---|---|---|
| Renewable Energy | 35 | 4 |  |
| Energy Efficiency - Non Builder | 50 | 4 | |
| Energy Efficiency - Builder | 115 | 4 | |
| Smart Grid or Energy Storage | 3 | **4** | |
| **Region Total** | **203** | **4** | |

| Existing Commercial Energy Efficiency | Number of Buildings | State Rank | Project Square Footage | State Rank |
|---|---|---|---|---|
| LEED (Registered & Certified) | 79 | 5 | 11,758,719 | 4 |
| Energy Star (Certified) | 131 | 3 | 6,998,175 | 3 |
| **Region Total** | **210** | **4** | **18,756,894** | **3** |

| Potential for Residential Energy Efficiency | Homes Built Prior to 1970 | State Rank | Manufactured Homes | State Rank |
|---|---|---|---|---|
| Number of Units | 246,017 | 2 | 86,606 | 4 |

| Registered Renewable Energy Systems | Number of Systems | State Rank | System Capacity (MW) | State Rank |
|---|---|---|---|---|
| Biomass | 4 | 5 (T) | 17.28 | 6 |
| Geothermal | 65 | 7 | N/A | N/A |
| Hydroelectric | 13 | 2 | 92.74 | 4 |
| Solar | 95 | 3 | 19.52 | 1 |
| Wind | 2 | 5 (T) | <0.01 | 5 |
| **Region Total** | **179** | **5** | **129.54** | **5** |

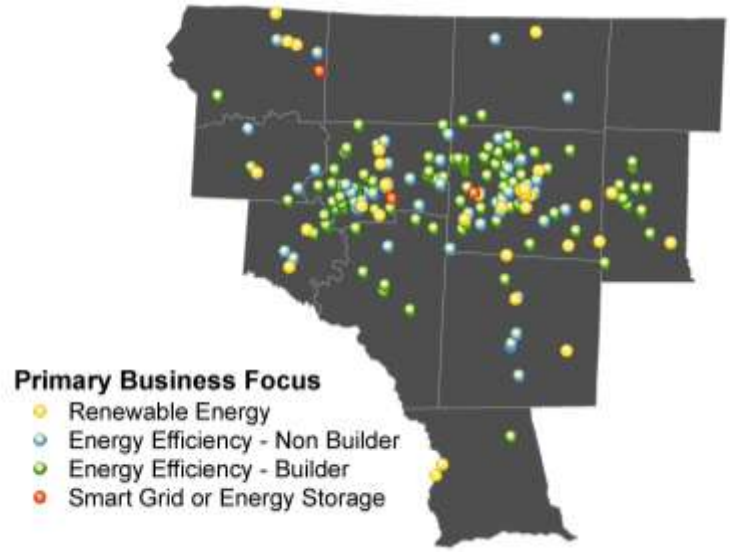
*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Source: NC Sustainable Energy Association.*

## *7.1 Overview of Existing Clean Energy Firms*

The Piedmont Triad region is home to 203 clean energy firms, which are present in 10 of the 12 counties in the region (see Exhibit 59). The firms are strongly clustered in two distinct areas— Greensboro and Winston-Salem. The remaining firms are primarily located near the interstate corridors found in the region. The region has experienced significant growth of clean energy firms (see Exhibit 60), which is impressive considering the competition from neighboring Charlotte and Research Triangle regions.

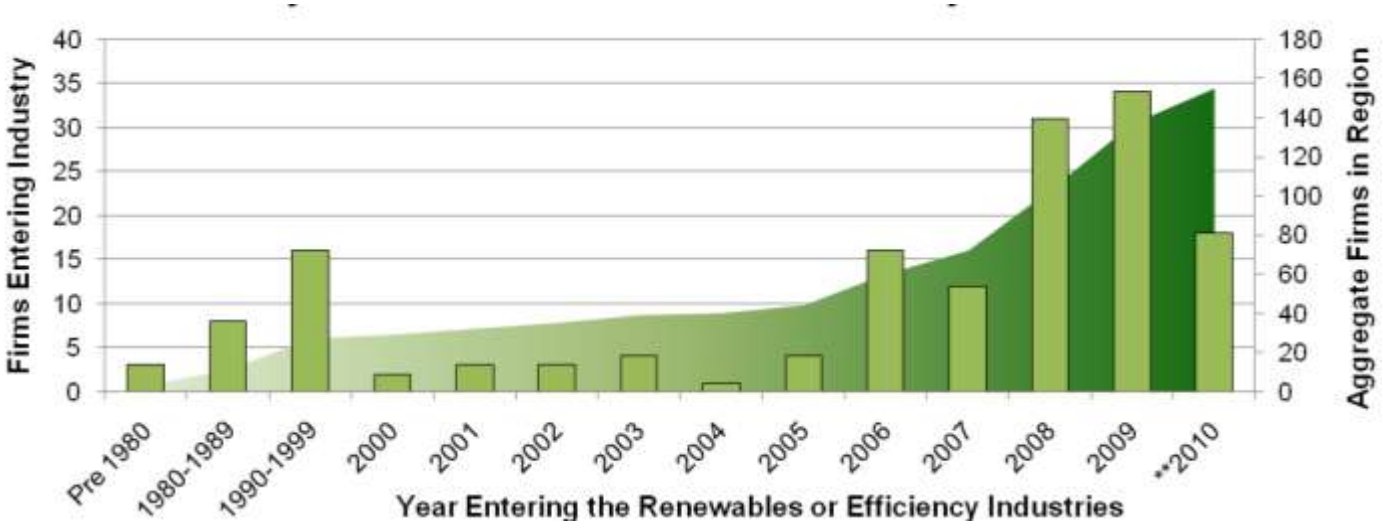
Guilford County is the regional leader with 82 firms present, followed by Forsyth County with 60 firms. While over half the firms are energy efficient builders, the region maintains a robust and diversified clean energy cluster. Solar firms are particularly well represented and there is a notable presence of biomass firms with one of these firms being a recognized leader in combined heat and power applications. Several emergent technology firms are also present in the region, concentrating primarily in the energy storage field.

**Exhibit 59: Clean energy firms with a primary location in the Piedmont Triad region.**




*Source: NC Sustainable Energy Association.*

**Exhibit 60: Evolution of clean energy firms in the Piedmont Triad region.**




*Notes: Exhibit only includes firms reporting a year of entry in the Energy Star program or annual North Carolina Renewable Energy and Energy Efficiency Industries Census; therefore, aggregate firms may be lower than total firms reported elsewhere. Data for 2010 is through August 31, 2010. Sources: EPA Energy Star Program, NC Sustainable Energy Association.*

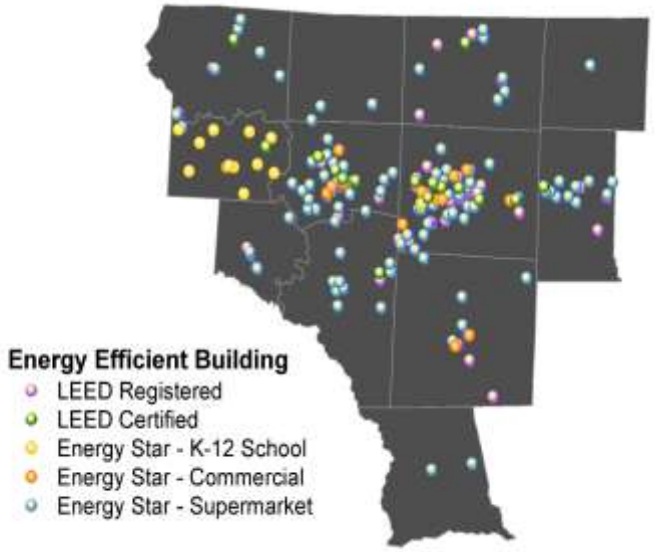
## *7.2 Existing Commercial and Government Energy Efficiency*

The Piedmont Triad region is home to 210 registered and certified energy efficient buildings that total over 18.5 million square feet (see Exhibit 61). Commercial and government energy efficiency registrations and certifications were exceptionally strong in 2009, resulting in at least one project in each county in 2010. LEED registered projects contribute the most in terms of square footage, while Energy Star supermarkets are the most numerous projects.

Guilford County leads the region with 75 certified and registered buildings totaling over 5.3 million square feet (see Exhibit 62). Forsyth County ranks second in projects with 46 buildings, but first in registered and certified floor space totaling 10 million square feet. The remaining registered and certificated buildings are more equally distributed across the Piedmont Triad relative to other regions in North Carolina. Six other counties have at least 10 registered and certified buildings.

With a project in every county, Food Lion leads the region with the most registered or certified buildings with 91 Energy Star certified supermarkets. These buildings account for over 3 million of the region's square feet of floor space. Despite Food Lion's presence in rural counties, the majority of register and certified projects and floor space occur in urban counties of the Piedmont Triad region. Yadkin County is the only county in the region to have pursued Energy Star certification for K-12 schools.

**Exhibit 61: Piedmont Triad region commercial and government energy efficient buildings.**




*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 62: Piedmont Triad energy efficient projects and square feet in urban and rural counties.**

| Certification | Rural Counties | | Urban Counties | | Piedmont Triad | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 13 | 402,582 | 50 | 10,473,067 | 63 | 10,875,649 |
| LEED Certified | 3 | 119,102 | 13 | 763,968 | 16 | 883,070 |
| Energy Star - K-12 School | 11 | 989,774 | 1 | 15,525 | 12 | 1,005,299 |
| Energy Star - Commercial | 3 | 78,368 | 16 | 2,304,394 | 19 | 2,382,762 |
| Energy Star - Supermarket | 30 | 1,032,079 | 70 | 2,578,035 | 100 | 3,610,114 |
| **Region Total** | **60** | **2,621,905** | **150** | **16,134,989** | **210** | **18,756,894** |

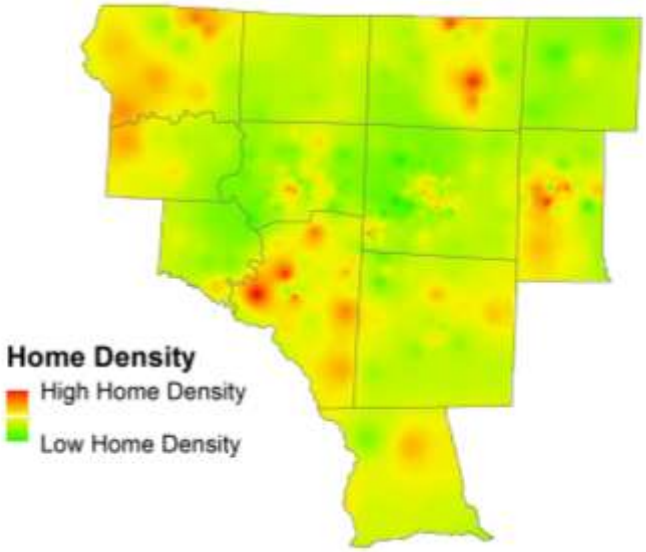
*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

## *7.3 Potential for Residential Energy Efficiency*

Residential energy efficiency is a significant opportunity for the Piedmont Triad region. Homes built prior to 1970 make up 35 percent of the regional housing stock, placing the region on par with the Advantage West region for largest proportion of housing stock built prior to 1970.

In absolute numbers, there are over 246,000 homes built prior to 1970—the largest total number in any region except the Charlotte. Over half of the homes built before 1970 are in Guilford and Forsyth counties. These homes are highly concentrated in these and other counties in the region (see Exhibit 63). In addition, 12 percent of the regional housing stock consists of manufactured homes (see Exhibit 64). This is a moderate ratio of manufactured housing units relative to other regions. Nevertheless, there are specific counties that

**Exhibit 63: Probable density of homes built prior to 1970 in the Piedmont Triad region.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

may consider prioritizing energy retrofitting of manufactured housing because of higher stock proportions. In particular, Stokes, Caswell, and Montgomery counties all have a high ratio of manufactured housing (see Exhibit 12). Energy efficiency opportunities with multiple unit housing are concentrated in Forsyth and Guilford counties, which contain over 83 percent of this type of housing in the region.

**Exhibit 64: Housing type in Piedmont Triad region.**

| Housing Type | Number | Share |
|---|---|---|
| Single Unit | 494,038 | 70% |
| 2 to 10 Units | 75,286 | 11% |
| More than 10 Units | 52,283 | 7% |
| Manufactured Housing | 86,606 | 12% |

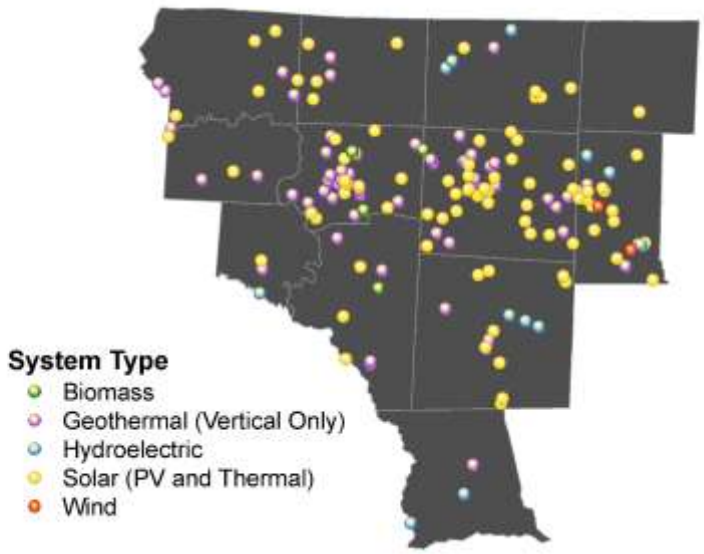
*Source: U.S. Census Bureau.*

## *7.4 Registered Renewable Energy Facilities*

Solar, wind, biomass, and hydroelectric systems are all present in the Piedmont Triad region, which has a registered renewable energy capacity of just over 129 megawatts (see Exhibits 65 and 66). Hydroelectricity accounts for the largest share of the region's capacity, followed by solar and biomass. In terms of projects, solar and vertical geothermal are the most prevalent technologies. Wind energy development is limited to two systems in the region.

The technology with the largest system is hydroelectric, with an 84 megawatt unit. The largest solar project in the region—and in the state—is a 15.5 megawatt located in Davidson County. For biomass, the largest

**Exhibit 65: Location of registered renewable energy systems in the Piedmont Triad region.**




*Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

**Exhibit 66: Registered renewable energy systems in the Piedmont Triad region.**

| | Rural Counties | | Urban Counties | | Piedmont Triad | |
|---|---|---|---|---|---|---|
| | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 0 | 0.000 | 4 | 17.275 | 4 | 17.275 |
| Geothermal | 15 | N/A | 50 | N/A | 65 | N/A |
| Hydroelectric | 10 | 90.576 | 3 | 2.165 | 13 | 92.741 |
| Solar | 29 | 1.506 | 66 | 18.013 | 95 | 19.519 |
| Wind | 0 | 0.000 | 2 | 0.006 | 2 | 0.006 |
| **Region Total** | **54** | **92.082** | **125** | **37.459** | **179** | **129.541** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

facility is 8.4 megawatt combined heat and power unit. Montgomery County contains the largest capacity with 85 megawatts from two hydroelectric systems. Meanwhile, Guilford County leads in total number of renewable projects with 36 solar systems.

Solar systems make up the largest share of renewable units in the region with a total of 95 projects. These systems are clustered in Guilford, Forsyth, and Alamance counties. Vertical geothermal systems rank second in terms of installations at 65 projects. Forsyth and Guilford counties each contain 20 registered geothermal systems. However, the borehole profiles are distinctly different with 113 boreholes in Guilford County and 54 boreholes in Forsyth County.

## ***7.5 Training, Support, and Community College Assets***

*(See Appendix 6 for detailed maps and tables of Piedmont Triad region assets)*

Forsyth and Surry Community Colleges both offer a degree in Sustainable Technologies. In addition to these two programs, several community colleges have the potential to develop energy efficiency or alternative energy focused units as part of the community college system's Curriculum Improvement Project (CIP)—a

process that adds clean energy components to existing degrees. Forsyth, Guilford, Rockingham, and Surry Community Colleges already offer degrees in HVAC, Electrical Systems, and Industrial Systems. The remaining community colleges in Appendix 6 region offer at least one of these degrees.

The Piedmont Triad region has three resource and conservation development (RC&D) councils, which are active in all 12 counties in the region. The region benefits from the fact that all three councils are well established and as such may be able to assist counties with residential energy efficiency projects. The Pilot View RC&D Council is contained entirely within the Piedmont Triad and may be able to uniquely align activities with local and regional economic development community stakeholders, thereby capitalizing on resource and effort sharing opportunities.

At least 12 unique training and development assets exist in the Piedmont Triad region that can be leveraged to grow the clean energy economy. First and foremost, the region is home to one of North Carolina's three state energy centers—the Center for Energy Research and Technology (CERT) at North Carolina A&T State University**.** CERT focuses on building energy efficiency in the industrial sector. In addition, Wake Forest University is home to the Center for Nanotechnology and Molecular Materials. This center has a clean energy research core with focuses on solar cells, batteries, and lighting. The center offers opportunities for joint research with industry and has worked with several North Carolina solar firms.

Additional assets in the region include third party training opportunities available from professionals associated with Building Performance Institute training (BPI), Residential Energy Network (RESNET), and the North American Board Certified Energy Practitioners (NABCEP). The region also contains three Small Business Technology and Development Centers and a regional office of the U.S. Green Building Council.

## ***7.6 Strengths, Weaknesses, Opportunities, and Threats***

### ***Strengths***

- Well dispersed regional renewable energy and energy efficiency industry with strong centers in Greensboro and Winston-Salem.
- Strong base of commercial and government registered and certified energy efficient buildings.
- High profile solar project in Davidson County.
- Multiple solar firms, with focus throughout industry supply chain.
- State energy center at North Carolina A&T State University specializes in building energy efficiency.

### ***Weaknesses***

- Energy efficient builders are heavily concentrated along interstate corridor.
- Limited smart grid and geothermal firms.
- Third party training opportunities exist, but are spatially restricted.
- Limited number of registered vertical geothermal systems in the region.

### ***Opportunities***

- Large proportion and number of homes built prior to 1970 provide energy retrofitting opportunities.
- Biomass resources are present, particularly in Montgomery County and northern part of region.
- High concentration multiple unit housing in Guilford and Forsyth County.
- Large urban areas may afford opportunity for municipal waste resource recovery facilities.

### ***Threats***

- Limited wind energy resources.
- Regional firms are competing with firms based in the Charlotte and Research Triangle regions.
- Uwharrie National Forest may preclude deployment of renewable development in southern portion of the region.

The Piedmont Triad region has both a strong base and clear opportunity for continued development of the region's clean energy industry. The strong presence of energy efficiency firms and a significant population of homes built prior to 1970 present a clear synergy for capitalizing on residential retrofit opportunities. The region could benefit from increased dispersion of energy efficient firms into Rockingham and Randolph counties. Randolph County in particular has a large urban area in Asheboro, as well as a small base of commercial energy efficiency firms.

In addition, public schools present an opportunity for energy savings from buildings with well defined energy profiles. Despite this opportunity, only Yadkin County has begun to aggressively pursue Energy Star certification. The more densely populated counties of Forsyth and Guilford have comparatively more schools, but only one Energy Star certification between the two counties. With an existing base of clean energy firms, these counties should consider pursuing energy efficiency certification and the associated financial savings at K-12 are schools. Further, the process could be an opportunity to engage students and offer local training opportunities.

The development of renewable energy systems has been dominated by small residential solar systems. Although these systems have been concentrated in urban areas, where rooftops are more prevalent, the region benefits from the visibility of North Carolina's largest solar photovoltaic system.

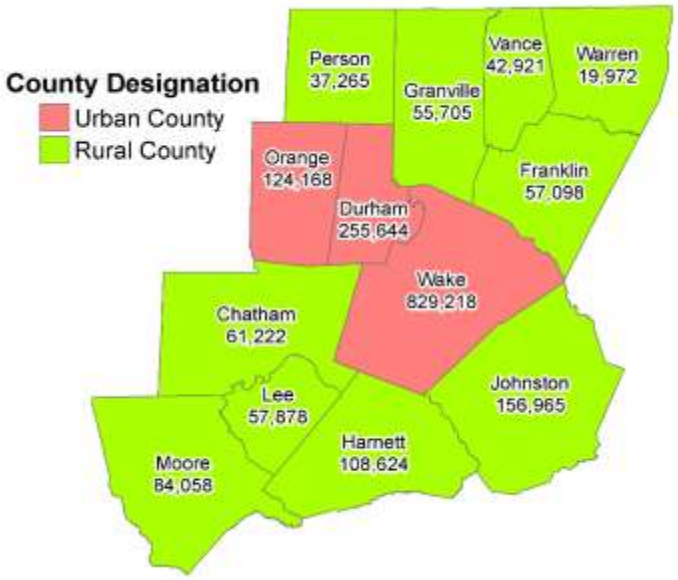
There may be potential to develop hydroelectric resources at existing dams, including Belews Lake, Lake Jeanette, and Lake Brandt. In addition to these new opportunities, many of the existing small hydroelectric stations are from the early part of the 19th century, and there may be potential to improve the generation performance at these plants with simple turbine and generator upgrades.

Training, support and community college assets are significant in the region, particularly in the Northwest corner where two community colleges offer degrees in sustainable technology. Third party assets in the region are largely concentrated between Winston-Salem and Greensboro.

# CHAPTER 8: RESEARCH TRIANGLE REGION

- ★ **Largest clean energy industry population in North Carolina.**
- ★ **Largest industry cluster in North Carolina located in Wake county.**
- ★ **Rapidly growing internationally recognized smart grid industry cluster.**
- ★ **Robust research and development base at Research Triangle Park.**
- ★ **Received over $23 million in energy related ARRA funding, 87 percent allocated to energy efficiency.**

**Exhibit 67: County population and designation.**




*Sources: U.S. Census Bureau, NC Rural Center, NC Sustainable Energy Association.*

**Exhibit 68: Research Triangle rankings compared to other North Carolina regions.**

| Overview of Existing Firms | Number of Firms | State Rank | Region Location |
|---|---|---|---|
| Renewable Energy | 111 | 1 |  |
| Energy Efficiency - Non Builder | 142 | 1 | |
| Energy Efficiency - Builder | 344 | 1 | |
| Smart Grid or Energy Storage | 26 | 1 | |
| **Region Total** | **623** | **1** | |

| Existing Commercial Energy Efficiency | Number of Buildings | State Rank | Project Square Footage | State Rank |
|---|---|---|---|---|
| LEED (Registered & Certified) | 195 | 1 | 19,096,179 | 2 |
| Energy Star (Certified) | 158 | 2 | 10,310,273 | 2 |
| **Region Total** | **353** | **2** | **29,406,452** | **2** |

| Potential for Residential Energy Efficiency | Homes Built Prior to 1970 | State Rank | Manufactured Homes | State Rank |
|---|---|---|---|---|
| Number of Units | 174,744 | 4 | 84,963 | 5 |

| Registered Renewable Energy Systems | Number of Systems | State Rank | System Capacity (MW) | State Rank |
|---|---|---|---|---|
| Biomass | 5 | 2 (T) | 60.95 | 4 |
| Geothermal | 254 | 1 | N/A | N/A |
| Hydroelectric | 5 | 4 | 9.29 | 5 |
| Solar | 341 | 1 | 9.34 | 3 |
| Wind | 9 | 3 | 0.02 | 3 |
| **Region Total** | **614** | **1** | **79.59** | **6** |

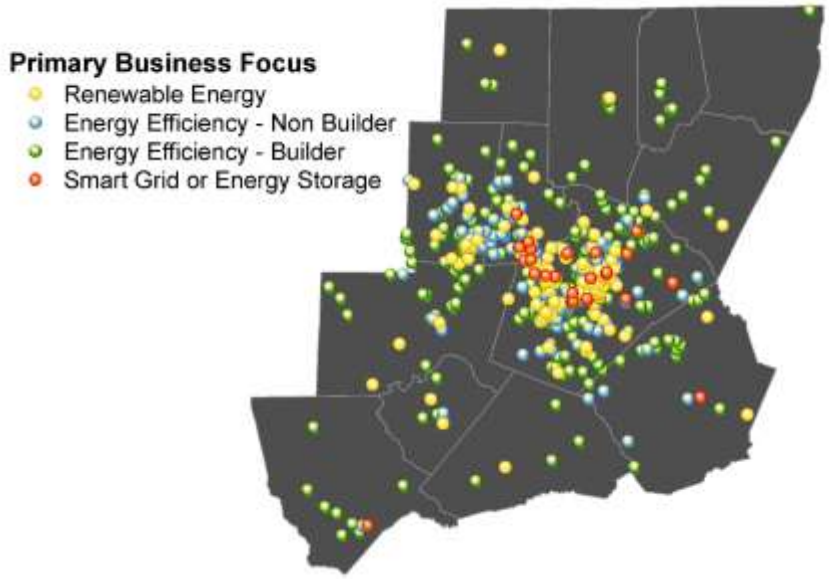
*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Source: NC Sustainable Energy Association.*

## *8.1 Overview of Existing Clean Energy Firms*

The Research Triangle region is home to North Carolina's largest clean energy cluster at 623 firms (see Exhibit 69). It is also home to the state's largest county level cluster in Wake County with 366 firms. The regional base is highly diverse, with double digit numbers for each concentration of firms, except hydroelectric and geothermal.

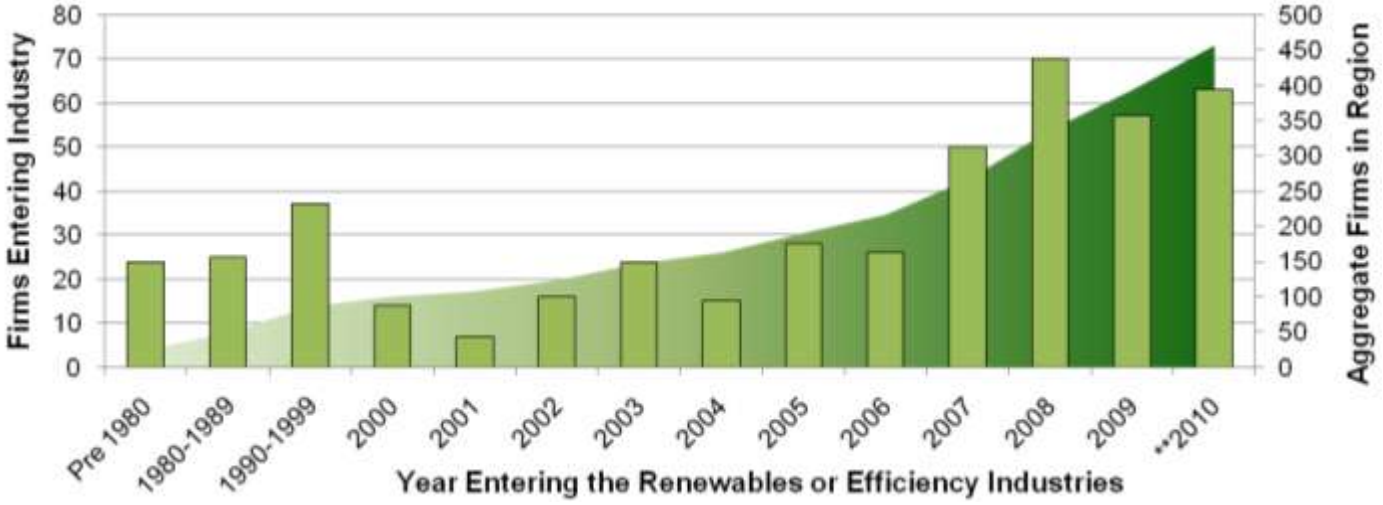
A significant asset in the Research Triangle region is a large and clustered base of smart grid firms. The Research Triangle region has received international recognition for this established and growing cluster. Energy efficient builders are highly prominent in the region with at least one firm in every county. Wake County leads the region with 186 energy efficient builders, followed by Orange County with 47 firms, and Durham County with 30 firms. Several Energy Star partners in the region produce high annual volumes of Energy Star certified homes. The presence and growth of energy efficient builders have been a contributing factor to the rapid and sustained growth of clean energy firms in the region (see Exhibit 70).

**Exhibit 69: Clean energy firms with a primary location in the Research Triangle region.**




*Source: NC Sustainable Energy Association.*

**Exhibit 70: Evolution of clean energy firms in the Research Triangle region.**



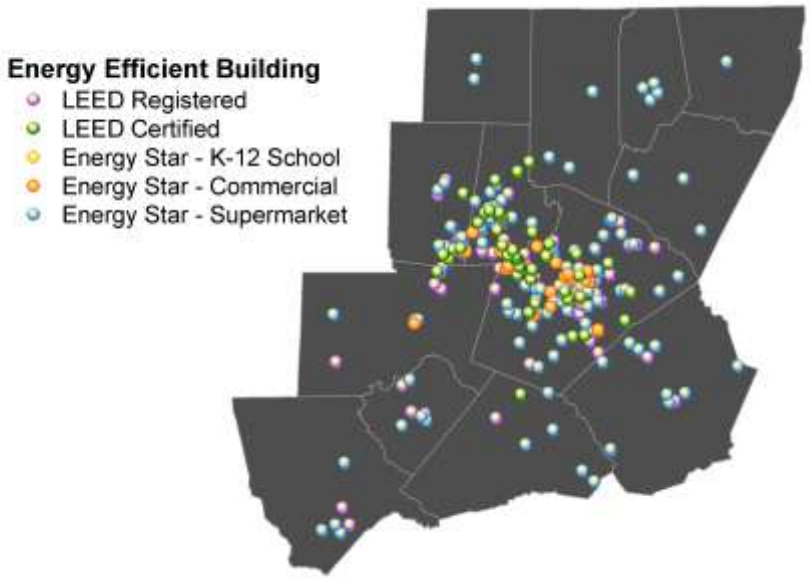

*Notes: Exhibit only includes firms reporting a year of entry in the Energy Star program or annual North Carolina Renewable Energy and Energy Efficiency Industries Census; therefore, aggregate firms may be lower than total firms reported elsewhere. Data for 2010 is through August 31, 2010. Sources: EPA Energy Star Program, NC Sustainable Energy Association.*

## *8.2 Existing Commercial and Government Energy Efficiency*

Energy efficient commercial and government buildings can be found in all 13 counties in the region (see Exhibit 71). Combined, there are 353 registered and certified buildings in the LEED and Energy Star programs, accounting for nearly 29.5 million square feet of floor space (see Exhibit 72). Wake County is the leader with 164 buildings and over 14.0 million square feet of floor space. Durham County comes in second with 93 buildings and nearly 8.2 million square feet of floor space. Orange County is third with 38 buildings totaling 4.1 million square feet of floor space.

Buildings registered with the LEED program can be found across the central and southern portion of the region, but certified projects are largely confined to the Interstate 40 corridor. Energy Star commercial buildings are almost exclusively the domain of Wake, Durham, and Orange counties. Food Lion is the leader in Energy Star certified supermarkets with 90 out of the region's 110 certifications in this category. A surprising finding is that the Research Triangle region is the only region in North Carolina without a single Energy Star certified school.

**Exhibit 71: Research Triangle region commercial and government energy efficient buildings.**




*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 72: Research Triangle energy efficient projects and square feet in urban and rural counties.**

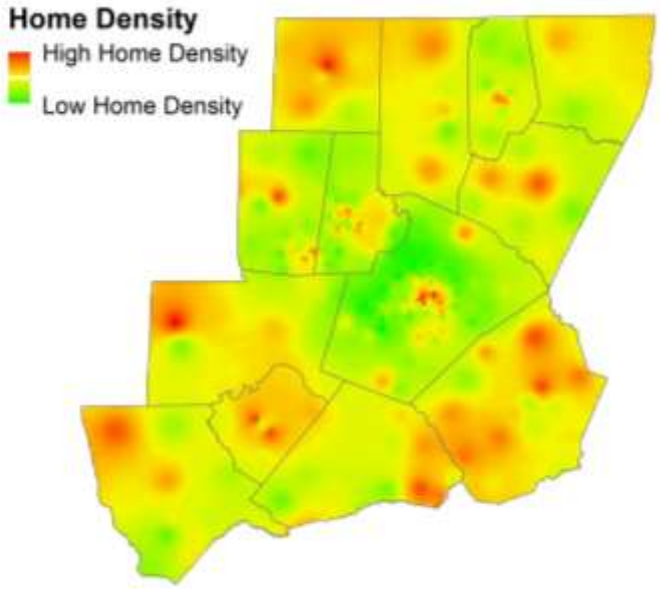
| | Rural Counties | | Urban Counties | | Research Triangle | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 13 | 672,088 | 119 | 11,874,259 | 132 | 12,546,347 |
| LEED Certified | 3 | 629,831 | 60 | 5,920,001 | 63 | 6,549,832 |
| Energy Star - K-12 School | 0 | 0 | 0 | 0 | 0 | 0 |
| Energy Star - Commercial | 1 | 5,100 | 47 | 6,138,494 | 48 | 6,143,594 |
| Energy Star - Supermarket | 41 | 1,470,792 | 69 | 2,695,887 | 110 | 4,166,679 |
| **Region Total** | **58** | **2,777,811** | **295** | **26,628,641** | **353** | **29,406,452** |

*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

## *8.3 Potential for Residential Energy Efficiency*

The Research Triangle region has the second largest total number of homes in North Carolina at nearly 800,000 buildings. While the region has the newest housing stock of any region, there are still over 170,000 homes built prior to 1970 that may be potential candidates for residential energy retrofits. Further, over half of these homes reside in Wake and Durham counties and appear to occur in dense clusters (see Exhibit 73).

**Exhibit 73: Probable density of homes built prior to 1970 in the Research Triangle region.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

There are less manufactured homes in the region, but they exist in large enough numbers to provide additional opportunities for residential retrofits (see Exhibit 74). For example, in several instances more than one in five homes in rural counties are manufactured homes (see Exhibit 12). These opportunities also exist in significant numbers in the urban counties found in the region. Multiple unit housing can be found in urban counties, creating localized potential for district or campus energy systems, particularly in conjunction with area commercial office buildings.

**Exhibit 74: Housing type in Research Triangle region.**

| Housing Type | Number | Share |
|---|---|---|
| Single Unit | 539,774 | 69% |
| 2 to 10 Units | 85,808 | 11% |
| More than 10 Units | 86,525 | 11% |
| Manufactured Housing | 84,963 | 11% |

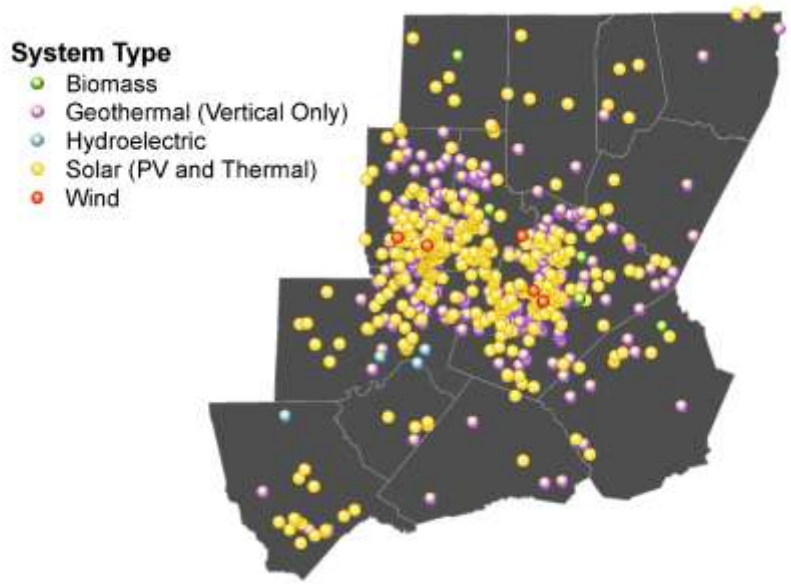
*Source: U.S. Census Bureau.*

## *8.4 Registered Renewable Energy Facilities*

Every renewable energy technology is represented in 614 projects that exist across the Research Triangle region (see Exhibits 75 and 76). The region maintains a collective capacity of over 79 megawatts from renewable technologies. Biomass contributes the greatest capacity with nearly 61 megawatts of installed capacity. Both solar and hydroelectric exceed 9 megawatts of capacity in the region. In terms of installed systems, solar energy leads with 341, primarily rooftop, systems. Vertical geothermal ranks projects second with 254 systems.

Within technologies, the largest registered projects are a 55 megawatt biomass co-firing unit, a 4.4 megawatt hydroelectric facility, and a 1.3 megawatt solar system. Several residential wind systems exist in the region, but contribute limited capacity. Person County has the largest registered capacity with 9 systems contributing

**Exhibit 75: Location of registered renewable energy systems in the Research Triangle region.**




*Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

**Exhibit 76: Registered renewable energy systems in the Research Triangle region.**

| | Rural Counties | | Urban Counties | | Research Triangle | |
|---|---|---|---|---|---|---|
| Technology | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 2 | 55.000 | 3 | 5.950 | 5 | 60.950 |
| Geothermal | 50 | N/A | 204 | N/A | 254 | N/A |
| Hydroelectric | 4 | 6.785 | 1 | 2.500 | 5 | 9.285 |
| Solar | 111 | 1.238 | 230 | 8.097 | 341 | 9.335 |
| Wind | 0 | 0.000 | 9 | 0.018 | 9 | 0.018 |
| **Region Total** | **167** | **63.023** | **447** | **16.565** | **614** | **79.588** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

over 55.5 megawatts. Orange County ranks second in registered capacity with 87 systems contributing 28.6 megawatts. Wake County ranks third with 117 systems registered for 9.3 megawatts of capacity.

Residential scale solar systems comprise the largest portion of the registered units in the Research Triangle region. All counties contain at least one registered solar systems. While Wake County has over 106 systems, an abundance of small units in Chapel Hill make the town one of the most densely developed areas for solar energy in North Carolina. In contrast to the Charlotte region, the Research Triangle region has comparatively few registered solar systems that exceed one megawatt in capacity.

In addition to solar, the Research Triangle region has a large vertical geothermal presence. Nearly half of the systems are registered in Wake County, which also has the largest number of boreholes at 544. Orange County ranks second with 63 vertical systems and 277 boreholes. Durham ranks third for number of vertical systems with 28 projects, but the system profile is substantially different with only 59 boreholes, indicative of smaller residential systems.

Biomass in the region generally comes from landfill gas to energy systems (see Exhibit 8). Hydroelectric is limited to small older systems, although there are several proposals under consideration at the Federal Energy Regulatory Commission to add a hydroelectric unit to the existing dam at Falls Lake. In addition, several universities, including Duke University, North Carolina State University, and University of North Carolina at Chapel Hill operate campus steam systems fueled by fossil energy. These units are noteworthy because they have high operating efficiencies through use of both electrical and thermal energy. The system at the University of North Carolina is scheduled to transition their fuel from coal to biomass by 2020.

## *8.5 Training, Support, and Community College Assets*

*(See Appendix 7 for detailed maps and tables of Research Triangle region assets)*

Central Carolina and Durham Technical Community Colleges offer degrees in Sustainable Technologies. Several others have the potential to develop energy efficiency or renewable energy focused units as part of the community college system's Curriculum Improvement Project (CIP)—a process that adds clean energy components to existing degrees. Johnston, Piedmont, and Vance-Granville Community Colleges already offer degrees in HVAC, Electrical Systems, and Industrial Systems. The remaining colleges listed in Appendix 7 offer at least one of these three degrees. In addition, Central Carolina Community College is the only community college in North Carolina that offers an alternative fuels degree.

The Research Triangle region has four resource conservation and development (RC&D) councils, which are active in 11 of the 13 counties in the region. However, both the Four Rivers and Tar-Neuse RC&D councils are still in formation and may not be a viable partner at the moment. Person and Harnett counties are currently not part of any RC&D council, which may put them at a disadvantage for resources.

The Research Triangle region is home to at least 20 training and support assets. One of the major assets is the North Carolina Solar Center, which is one of North Carolina's three state energy centers. The Center is based at North Carolina State University and houses numerous programs, including the U.S. Department of Energy's Southeast Clean Energy Application Center and Database of State Incentives for Renewables and Efficiency (DSIRE). North Carolina State University also is home to a Small Business Technology and Development Center (SBTDC) and several applied research centers, including the FREEDM smart grid center. Vehicle related assets exist in the Research Triangle region with the Biofuels Center of North Carolina, Piedmont Biofuels, and the Advanced Vehicle Research Center.

## *8.6 Strengths, Weaknesses, Opportunities, and Threats*

The Research Triangle region has multiple assets that position it to continue to be the leader in clean energy in North Carolina. One area that has received international recognition is the extensive presence of a smart grid industry cluster. The region has a robust number of firms that span research, development, manufacturing, and service providers of smart grid solutions.

With a robust and diverse clean energy cluster, many future opportunities exist for the region. For example, the region contains a significant number of registered residential solar systems and solar energy firms. As a result, solar installations are likely to expand in the urban counties of the region. More dispersed is the opportunity to pursue energy retrofits in the large stock of homes built prior to 1970 or manufactured homes. In addition, the region could explore energy efficiency options in public schools. The lack of a single Energy Star certified school is a sharp contrast to the Charlotte region, which receives national recognition for the significant development of energy efficient certified buildings. Finally, further evaluation of the urban waste resource stream may prove useful. The densely populated area will generate significant municipal and yard waste that can be used for energy recovery rather than landfill disposal.

Training and education assets are spread throughout the region and include several community colleges. Third party training and support assets are largely centered around Raleigh; however, there is comparatively good coverage across much of the region. One particular unique advantage of Wake County is the number of applied research centers associated with North Carolina State University.

Finally, an important focus for the region will be branding the region as the state's leading clean energy cluster, with a particular focus on smart grid and renewable energy assets. Strong branding is critical to distinguish the region from evolving branding efforts in the Charlotte and Advantage West regions.

### ***Strengths***

- Largest industry population in North Carolina.
- Largest county level cluster in Wake County.
- Presence of the North Carolina Solar Center at North Carolina State University.
- Largest number of registered renewable systems in North Carolina, especially for residential solar.
- Strong research and development assets through research universities and Research Triangle Park.
- Internationally recognized smart grid cluster.
- Generally, housing stock is proportionally newer than other similar regions of North Carolina.
- Diffuse energy efficient builder population.
- Large presence of geothermal installations.

### ***Weaknesses***

- Region lacks a single Energy Star certified school building.
- Must compete with Charlotte and Advantage West regions for clean energy branding.
- Outside of Energy Star certified supermarkets, energy efficient commercial and government buildings are concentrated in Durham and Wake County.

### ***Opportunities***

- Rooftop solar has a strong presence and additional opportunities for development exist.
- Multiple unit housing provide opportunities for district energy systems and large scale energy efficiency.
- Significant number of homes built before 1970 provide residential retrofit opportunities.
- Urban areas may generate both wood waste and municipal waste streams for energy recovery.

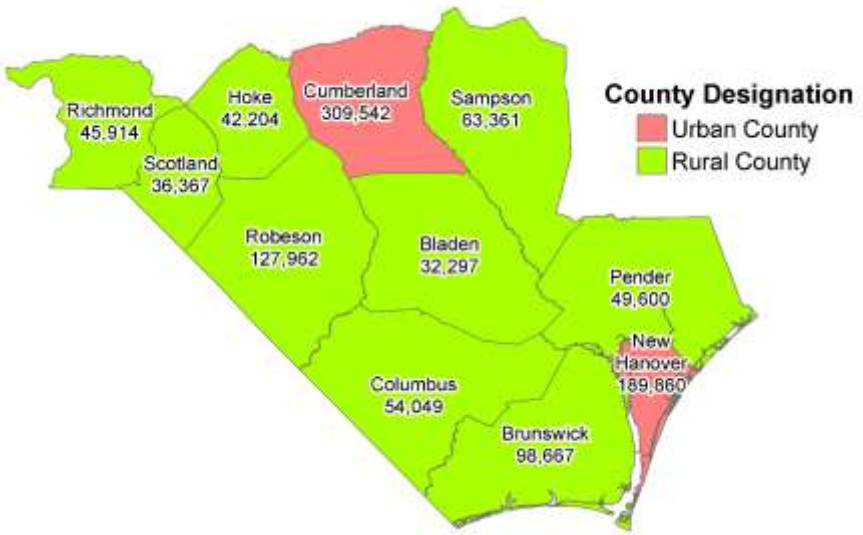
### ***Threats***

- Limited wind energy resource.
- Public perception of utilizing municipal waste for energy recovery and production may be negative.
- Limited hydroelectric resources.

# CHAPTER 9: SOUTHEAST REGION

- ★ **Strong clustering of firms in New Hanover County.**
- ★ **Strong solar and biomass resource base and presence of relevant firms.**
- ★ **High proportion of manufactured housing stock found in counties throughout region.**
- ★ **Established military presence at Fort Bragg in Cumberland County.**
- ★ **Received nearly $9.5 million in energy related ARRA funding, 96 percent allocated to energy efficiency.**

**Exhibit 77: County population and designation.**




*Sources: U.S. Census Bureau, NC Rural Center, NC Sustainable Energy Association.*

**Exhibit 78: Southeast region rankings compared to other North Carolina regions.**

| Overview of Existing Firms | Number of Firms | State Rank | Region Location |
|---|---|---|---|
| Renewable Energy | 22 | 5 |  |
| Energy Efficiency - Non Builder | 17 | 5 | |
| Energy Efficiency - Builder | 90 | 5 | |
| Smart Grid or Energy Storage | 2 | 5 | |
| **Region Total** | **131** | **5** | |

| Existing Commercial Energy Efficiency | Number of Buildings | State Rank | Project Square Footage | State Rank |
|---|---|---|---|---|
| LEED (Registered & Certified) | 157 | 3 | 12,417,038 | 3 |
| Energy Star (Certified) | 75 | 5 | 3,127,939 | 5 |
| **Region Total** | **232** | **3** | **15,544,977** | **4** |

| Potential for Residential Energy Efficiency | Homes Built Prior to 1970 | State Rank | Manufactured Homes | State Rank |
|---|---|---|---|---|
| Number of Units | 132,952 | 5 | 106,769 | 2 |

| Registered Renewable Energy Systems | Number of Systems | State Rank | System Capacity (MW) | State Rank |
|---|---|---|---|---|
| Biomass | 5 | 2 (T) | 196.43 | 1 |
| Geothermal | 77 | 5 | N/A | N/A |
| Hydroelectric | 1 | 7 | 0.8 | 7 |
| Solar | 40 | 6 | 3.29 | 7 |
| Wind | 3 | 4 | <0.01 | 4 |
| **Region Total** | **126** | **6** | **200.53** | **4** |

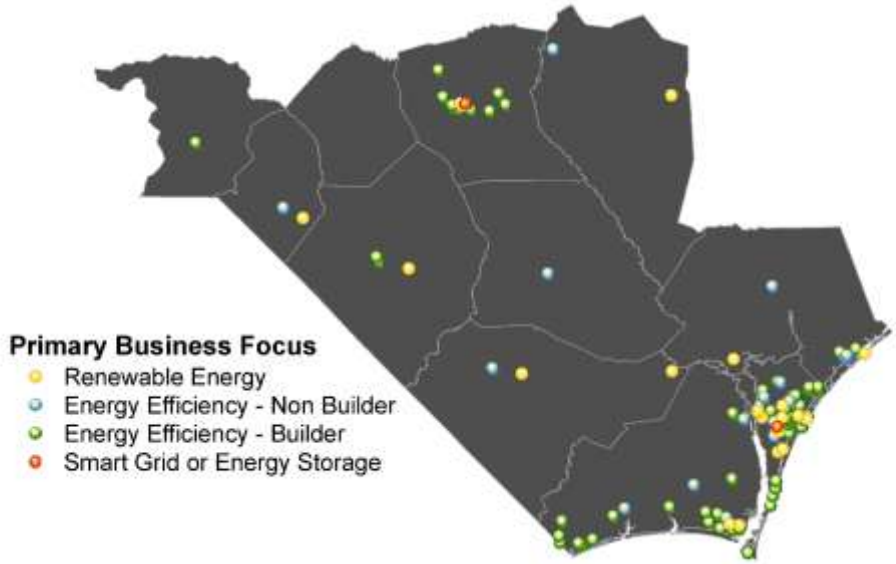
*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Source: NC Sustainable Energy Association.*

## *9.1 Overview of Existing Clean Energy Firms*

The Southeast region contains the primary location of 131 clean energy firms. While several business focus areas are well represented, including energy efficiency and solar, the region lacks firms across all business focus areas. Firms are largely clustered in New Hanover County, with a smaller sub group of energy efficient builders along the southern coast and in the Fayetteville area (see Exhibit 79).

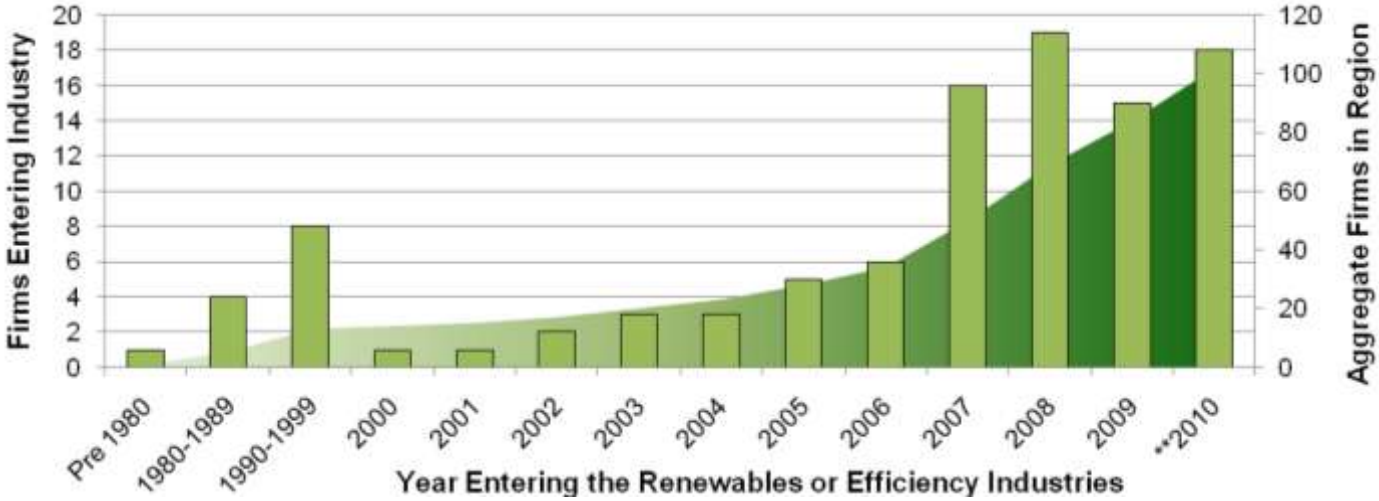
The 67 firms found in New Hanover County consist of 48 energy efficient builders and 8 solar firms. The county also has clean energy representation from biomass, general energy efficiency, and a smart grid firm. Brunswick County ranks second in the region with 30 firms, with 80 percent focused on energy efficient building. Cumberland County ranks third with 16 firms—nearly all are energy efficiency builders. The region has experienced a consistent expansion of clean energy firms over the last decade (see Exhibit 80). This growth has been fostered, in part, by coastal development and the emergence of a community of energy efficient builders.

**Exhibit 79: Clean energy firms with a primary location in the Southeast region.**




*Source: NC Sustainable Energy Association.*

**Exhibit 80: Evolution of clean energy firms in the Southeast region.**




*Notes: Exhibit only includes firms reporting a year of entry in the Energy Star program or annual North Carolina Renewable Energy and Energy Efficiency Industries Census; therefore, aggregate firms may be lower than total firms reported elsewhere. Data for 2010 is through August 31, 2010. Sources: EPA Energy Star Program, NC Sustainable Energy Association.*

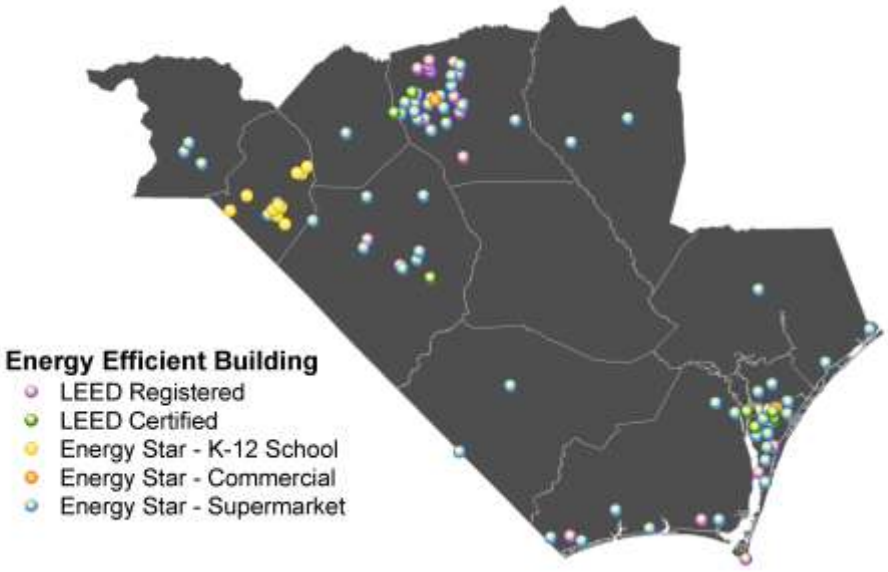
## *9.2 Existing Commercial and Government Energy Efficiency*

Almost every county in the Southeast region has at least one registered or certified energy efficient building—Bladen County is the sole exception (see Exhibit 81). In total, the region has 232 registered or certified energy efficient buildings in the LEED and Energy Star programs, totaling over 15.5 million square feet of floor space. LEED registered military buildings are a key contributor to these impressive numbers.

Cumberland County leads the region with 154 registered and certified buildings, totaling 11.3 million square feet. New Hanover County ranks second with 32 buildings and 2.2 million square feet. Within New Hanover and Cumberland counties, energy efficient buildings display notable clustering. Beyond these counties there is a considerable decline in the density of registered or certified buildings.

The Southeast region's 11 Energy Star certified schools occur in Scotland County. Food Lion is the regional leader in Energy Star certified supermarkets with 55 of the 61 certified supermarkets in the region. In Cumberland County, the significant presence of LEED registered buildings indicate a preference of the military to participate in the LEED program instead of the Energy Star certification program.

**Exhibit 81: Southeast region commercial and government energy efficient buildings.**




*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

**Exhibit 82: Southeast Region energy efficient projects and square feet in urban and rural counties.**

| | Rural Counties | | Urban Counties | | Southeast Region | |
|---|---|---|---|---|---|---|
| | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet | Number of Buildings | Total Square Feet |
| LEED Registered | 5 | 218,365 | 144 | 11,474,143 | 149 | 11,692,508 |
| LEED Certified | 2 | 2,800 | 6 | 721,730 | 8 | 724,530 |
| Energy Star - K-12 School | 11 | 770,391 | 0 | 0 | 11 | 770,391 |
| Energy Star - Commercial | 0 | 0 | 3 | 160,515 | 3 | 160,515 |
| Energy Star - Supermarket | 28 | 954,174 | 33 | 1,242,859 | 61 | 2,197,033 |
| **Region Total** | **46** | **1,945,730** | **186** | **13,599,247** | **232** | **15,544,977** |

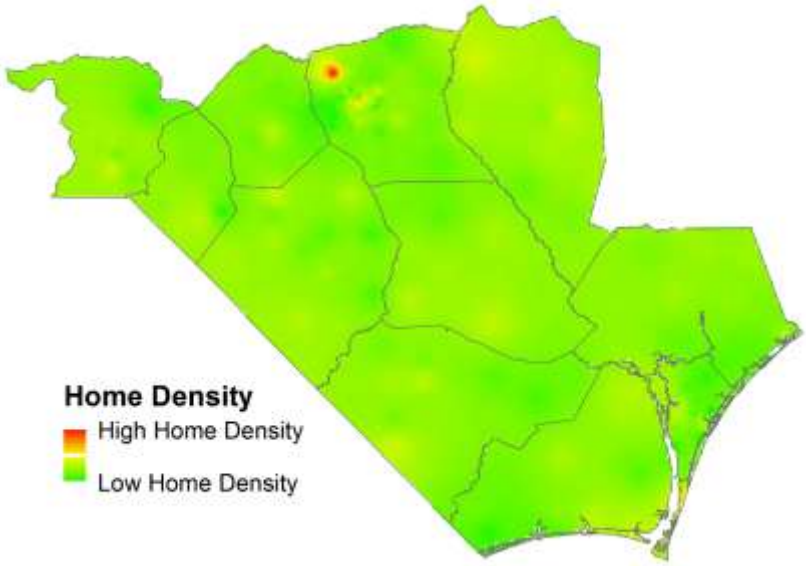
*Sources: EPA Commercial Energy Star Program, USGBC LEED Public Directory, NC Sustainable Energy Association.*

## *9.3 Potential Residential Energy Efficiency*

Opportunities for residential energy efficiency exist across the Southeast region, which has nearly 133,000 homes built prior to 1970 (see Appendix 1). While these opportunities are well dispersed, there is considerable variation between individual counties. For example, only 14 percent of the homes in Brunswick County are built prior to 1970, compared to 41 percent of homes in Columbus County. Due to the rural nature of the region, the housing stock predating insulation requirements in the building code is widely dispersed within the interior. The largest and most dense concentration occurs in Cumberland County (see Exhibit 83).

An equally important energy efficiency opportunity for the region is the high presence of manufactured homes in the region (see Exhibit 84). Manufactured homes exceed 29 percent of the housing stock in Bladen, Brunswick, Hoke, Pender, Robeson, and Sampson counties (see Exhibit 12). The high concentration of manufactured homes create a compelling case to pursue energy efficiency retrofits, with a potential focus on low income households who can spend over 50 percent of annual income on household energy expenditures.

**Exhibit 83: Probable density of homes built prior to 1970 in the Southeast region.**




*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

Opportunities within multiple unit buildings are relatively limited and county specific. Nearly 50 percent of housing that contain more than 10 units is in New Hanover County and accounts for 15 percent of the county's housing stock. Meanwhile, Cumberland County has a third of the housing containing 10 or more units.

**Exhibit 84: Housing type in the Southeast region.**

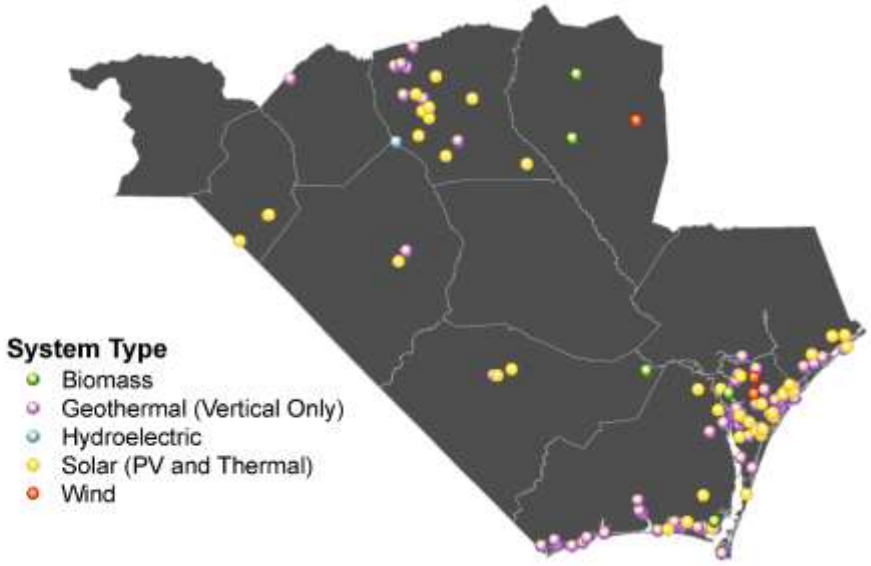
| Housing Type | Number | Share |
|---|---|---|
| Single Unit | 320,673 | 65% |
| 2 to 10 Units | 45,186 | 9% |
| More than 10 Units | 23,562 | 5% |
| Manufactured Housing | 106,769 | 22% |

*Source: U.S. Census Bureau.*

## *9.4 Registered Renewable Energy Facilities*

Solar, wind, biomass, and hydroelectric systems are all present in the Southeast region (see Exhibit 85). The region has over 200 megawatts of capacity from 126 renewable energy systems. Biomass accounts for the large majority of this capacity with over 196 megawatts, followed by solar energy (see Exhibit 86). In terms of registered projects, vertical geothermal systems lead with 77 projects, followed by solar and biomass.

**Exhibit 85: Location of registered renewable energy systems in the Southeast region.**




*Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

**Exhibit 86: Registered renewable energy systems in the Southeast region.**

| | Rural Counties | | Urban Counties | | Southeast Region | |
|---|---|---|---|---|---|---|
| Technology | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) | Number of Projects | Total Capacity (MW) |
| Biomass | 4 | 186.028 | 1 | 10.400 | 5 | 196.428 |
| Geothermal | 31 | N/A | 46 | N/A | 77 | N/A |
| Hydroelectric | 0 | 0.000 | 1 | 0.800 | 1 | 0.800 |
| Solar | 16 | 1.969 | 24 | 1.322 | 40 | 3.291 |
| Wind | 1 | 0.002 | 2 | 0.006 | 3 | 0.008 |
| **Region Total** | **52** | **187.999** | **74** | **12.528** | **126** | **200.527** |

*Notes: Geothermal data only includes vertical systems; solar data includes solar thermal in the number of systems but does not assign a system capacity value. Sources: North Carolina Utilities Commission, North Carolina Department of the Environment and Natural Resources, Appalachian State Wind Node, NC Sustainable Energy Association.*

The largest system is a 110 megawatt biomass cofiring combined heat and power facility in Brunswick County supplying process stream to a manufacturing facility. The largest solar project is a 1.9 megawatt system and the largest hydroelectric unit is a small 800 kilowatt system. Wind systems are limited to residential turbines.

Nearly half of the vertical geothermal systems are in New Hanover County, and another 23 installations are in Brunswick County. Cumberland County ranks third with 9 vertical geothermal systems. These figures may be misleading as the military, with a significant presence in Cumberland County, may also be pursuing horizontal ground loop systems, which are not reported in North Carolina.

The second largest share of projects comes from residential solar installations. Two utility scale solar projects exist—a 1.9 megawatt unit in Scotland County and a 1.2 megawatt unit in New Hanover County. The region is also home to North Carolina's only operating facility recovering energy from waste located in New Hanover County. Several of the other large biomass units are combined heat and power plants, representing a highly efficient means for generating energy through the use of both electrical and thermal energy.

There is limited development of the strong swine and poultry waste resources that exist in the region. These resources must be converted to energy as a requirement of the North Carolina Renewable Energy and Energy Efficiency Portfolio Standard (REPS). Wind development is limited to residential wind turbines. Utility scale opportunities exist in both the onshore and offshore environments.

## 9.5 Training, Support, and Community College Assets

*(See Appendix 8 for detailed maps and tables of Southeast region assets)*

Cape Fear Community College offers a degree in Sustainable Technologies. Several others have the potential to develop energy efficiency or renewable energy focused units as part of the community college system's Curriculum Improvement Project (CIP)—a process that adds clean energy components to existing degrees. Richmond and Robeson Community Colleges already offer degrees in HVAC, Electrical Systems, and Industrial Systems. The majority of the remaining colleges listed in Appendix 8 offer at least one of these three degrees.

The Southeast region has two resource and conservation development (RD&C) councils, which are active in six of the 11 counties. Several counties do not belong to any RD&C council which may put them at a competitive disadvantage by reducing available support for clean energy programs. In addition, third party training assets are present in New Hanover County including both Building Performance Institute (BPI) and Residential Energy Network (RESNET) potential opportunities. The only identified resources in the interior of the region are the two Small Business Technology and Development Centers (SBTDC).

## 9.6 Strengths, Weaknesses, Opportunities, and Threats

### Strengths

- Established industry clusters in both the northern and southern portions of the region.
- Diversity of biomass fuels, including comparatively large swine and poultry waste bases.
- Strong presence of energy efficient builders along coast.
- Relatively strong installed capacity of biomass despite low overall number of firms.
- Established coastal geothermal presence.

### Weaknesses

- Interior region lacks significant industry presence.
- No identified companies with a focus on wind or hydroelectric resource development.
- Commercial and government energy efficiency activities largely confined to Wilmington and Fayetteville.

### Opportunities

- Large presence of electrical cooperatives may improve financial attractiveness of clean energy investments.
- Strongest solar energy resource in North Carolina.
- Large percentage of manufactured homes creates energy retrofit opportunities.
- Abundance of open space may favor development of utility scale solar projects.
- Existing base of LEED registered buildings that have not progressed to certification energy systems in Fayetteville.
- Integration of hydroelectric units at existing locks.

### Threats

- Disposable income may be limited in interior region, inhibiting clean energy investments.
- Development of offshore wind resource may be inhibited by restrictions from competing uses.
- Regulatory changes may alter the swine and poultry generation requirements in the REPS and limit development of this resource base.
- Securing capital for renewable and efficiency projects may be more difficult in rural region.

The Southeast region has elements in place for continued growth of clean energy industries. However, clean energy firms are highly clustered in two areas of the region, while the clean energy opportunities are highly diffuse. More so than any other region, electrical cooperatives dominate the landscape resulting in consumers paying higher electric rates and annual expenses relative to other North Carolina consumers. Coupled with high proportions of manufactured homes and moderate numbers of homes built prior to 1970, residential energy efficiency could be a lasting and substantial economic development opportunity for the region. In the absence of disposable income though, capitalizing on these opportunities may be difficult. Innovative financing mechanism, such as revolving loan funds or on-bill financing, may be needed to assist and encourage consumers to pursue retrofit opportunities.

Commercial and government energy efficiency may be limited because of the rural nature of the region; however, there are two clear areas of opportunity: Energy Star K-12 schools and supermarkets. These types of buildings can be found in all counties and have well established energy profiles. The Southeast region can follow the experience of other regions and capitalize on these opportunities.

Despite the strong solar resource, especially along the southern coast, development of systems has been limited. This likely results from a combination of low population densities and observed consumer preference for geothermal systems instead of solar. Coastal vacation homes may be an ideal market for the future growth of residential solar as property owners may have discretionary income at their disposable. These systems could sell electricity to electric utilities even when the vacation home is unoccupied.

Training and education assets exist in the region, but are largely concentrated around Wilmington. The community college system has multiple colleges well positioned to incorporate clean energy training elements.

# APPENDIX 1: HOUSING AGE BY REGION AND COUNTY

The following tables accompany the regional maps highlighting the probable locations of homes built prior to 1970. The total number of homes built prior to 1970 can be evaluated against the regional maps for a rough approximation of county specific business opportunities for energy retrofitting.

The percentages in each table highlight the proportion of homes built prior to 1970 in each county. Tables are presented in the same order as the regional sections. The county level rows are read from left to right; while the urban versus rural comparison is read from top to bottom.

## Advantage West Region Housing Stock

| Rank | County Name | Pre 1970 Homes | Post 1970 Homes | Pre 1970 Percent | Post 1970 Percent |
|---|---|---|---|---|---|
| 1 | Buncombe County | 39,456 | 67,751 | 37% | 63% |
| 2 | Burke County | 15,647 | 23,577 | 40% | 60% |
| 3 | Caldwell County | 13,814 | 22,102 | 38% | 62% |
| 4 | Henderson County | 13,416 | 36,193 | 27% | 73% |
| 5 | Haywood County | 12,710 | 19,114 | 40% | 60% |
| 6 | Rutherford County | 12,573 | 19,162 | 40% | 60% |
| 7 | Wilkes County | 10,992 | 19,746 | 36% | 64% |
| 8 | McDowell County | 7,664 | 12,006 | 39% | 61% |
| 9 | Watauga County | 7,558 | 19,506 | 28% | 72% |
| 10 | Jackson County | 7,013 | 16,594 | 30% | 70% |
| 11 | Macon County | 6,004 | 17,117 | 26% | 74% |
| 12 | Ashe County | 5,845 | 9,406 | 38% | 62% |
| 13 | Transylvania County | 5,564 | 11,673 | 32% | 68% |
| 14 | Cherokee County | 4,371 | 11,842 | 27% | 73% |
| 15 | Madison County | 4,365 | 6,354 | 41% | 59% |
| 16 | Yancey County | 3,491 | 6,238 | 36% | 64% |
| 17 | Polk County | 3,473 | 5,719 | 38% | 62% |
| 18 | Mitchell County | 3,449 | 4,470 | 44% | 56% |
| 19 | Avery County | 3,437 | 8,474 | 29% | 71% |
| 20 | Alleghany County | 2,459 | 3,953 | 38% | 62% |
| 21 | Swain County | 2,085 | 5,020 | 29% | 71% |
| 22 | Graham County | 1,761 | 3,323 | 35% | 65% |
| 23 | Clay County | 1,437 | 3,988 | 26% | 74% |
| | Urban Share | 39,456 | 67,751 | 21% | 19% |
| | Rural Share | 149,128 | 285,577 | 79% | 81% |
| | **Region Summary** | **188,584** | **353,328** | **35%** | **65%** |

*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

## Charlotte Region Housing Stock

| Rank | County Name | Pre 1970 Homes | Post 1970 Homes | Pre 1970 Percent | Post 1970 Percent |
|---|---|---|---|---|---|
| 1 | Mecklenburg County | 90,819 | 298,021 | 23% | 77% |
| 2 | Gaston County | 35,073 | 52,154 | 40% | 60% |
| 3 | Rowan County | 22,578 | 36,609 | 38% | 62% |
| 4 | Catawba County | 21,962 | 44,968 | 33% | 67% |
| 5 | Cabarrus County | 20,867 | 46,353 | 31% | 69% |
| 6 | Iredell County | 18,153 | 48,685 | 27% | 73% |
| 7 | Cleveland County | 15,995 | 26,868 | 37% | 63% |
| 8 | Union County | 11,657 | 55,317 | 17% | 83% |
| 9 | Stanly County | 10,698 | 16,449 | 39% | 61% |
| 10 | Lincoln County | 7,690 | 23,132 | 25% | 75% |
| 11 | Anson County | 5,217 | 5,299 | 50% | 50% |
| 12 | Alexander County | 4,223 | 11,042 | 28% | 72% |
| | Urban Share | 191,299 | 478,105 | 72% | 72% |
| | Rural Share | 73,633 | 186,792 | 28% | 28% |
| | **Region Summary** | **264,932** | **664,897** | **28%** | **72%** |

*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

## Eastern Region Housing Stock

| Rank | County Name | Pre 1970 Homes | Post 1970 Homes | Pre 1970 Percent | Post 1970 Percent |
|---|---|---|---|---|---|
| 1 | Wayne County | 16,645 | 34,001 | 33% | 67% |
| 2 | Pitt County | 16,010 | 56,041 | 22% | 78% |
| 3 | Onslow County | 13,922 | 51,479 | 21% | 79% |
| 4 | Nash County | 12,163 | 28,793 | 30% | 70% |
| 5 | Wilson County | 11,963 | 21,969 | 35% | 65% |
| 6 | Lenoir County | 11,534 | 16,428 | 41% | 59% |
| 7 | Craven County | 11,365 | 32,587 | 26% | 74% |
| 8 | Edgecombe County | 9,720 | 15,494 | 39% | 61% |
| 9 | Carteret County | 9,601 | 35,993 | 21% | 79% |
| 10 | Duplin County | 7,895 | 13,483 | 37% | 63% |
| 11 | Greene County | 2,676 | 4,870 | 35% | 65% |
| 12 | Pamlico County | 2,441 | 4,340 | 36% | 64% |
| 13 | Jones County | 1,825 | 2,854 | 39% | 61% |
| | Urban Share | N/A | N/A | N/A | N/A |
| | Rural Share | 127,760 | 318,332 | 100% | 100% |
| | **Region Summary** | **127,760** | **318,332** | **29%** | **71%** |

*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

## Northeast Region Housing Stock

| Rank | County Name | Pre 1970 Homes | Post 1970 Homes | Pre 1970 Percent | Post 1970 Percent |
|---|---|---|---|---|---|
| 1 | Halifax County | 11,431 | 14,546 | 44% | 56% |
| 2 | Beaufort County | 8,095 | 15,547 | 34% | 66% |
| 3 | Pasquotank County | 6,569 | 9,438 | 41% | 59% |
| 4 | Northampton County | 4,641 | 6,237 | 43% | 57% |
| 5 | Martin County | 4,566 | 6,550 | 41% | 59% |
| 6 | Hertford County | 4,288 | 5,673 | 43% | 57% |
| 7 | Dare County | 4,211 | 28,113 | 13% | 87% |
| 8 | Bertie County | 3,946 | 5,104 | 44% | 56% |
| 9 | Washington County | 2,936 | 3,238 | 48% | 52% |
| 10 | Chowan County | 2,634 | 3,809 | 41% | 59% |
| 11 | Perquimans County | 2,112 | 3,931 | 35% | 65% |
| 12 | Currituck County | 1,950 | 11,840 | 14% | 86% |
| 13 | Gates County | 1,741 | 2,648 | 40% | 60% |
| 14 | Hyde County | 1,394 | 1,908 | 42% | 58% |
| 15 | Camden County | 1,295 | 1,678 | 44% | 56% |
| 16 | Tyrrell County | 873 | 1,159 | 43% | 57% |
| | Urban Share | N/A | N/A | N/A | N/A |
| | Rural Share | 62,682 | 121,419 | 100% | 100% |
| | **Region Summary** | **62,682** | **121,419** | **34%** | **66%** |

*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

## Piedmont Triad Region Housing Stock

| Rank | County Name | Pre 1970 Homes | Post 1970 Homes | Pre 1970 Percent | Post 1970 Percent |
|---|---|---|---|---|---|
| 1 | Guilford County | 68,600 | 140,974 | 33% | 67% |
| 2 | Forsyth County | 55,148 | 97,088 | 36% | 64% |
| 3 | Alamance County | 23,279 | 40,531 | 36% | 64% |
| 4 | Davidson County | 22,706 | 46,035 | 33% | 67% |
| 5 | Randolph County | 18,690 | 40,856 | 31% | 69% |
| 6 | Rockingham County | 18,022 | 24,672 | 42% | 58% |
| 7 | Surry County | 13,254 | 19,130 | 41% | 59% |
| 8 | Yadkin County | 6,835 | 9,907 | 41% | 59% |
| 9 | Stokes County | 6,004 | 14,438 | 29% | 71% |
| 10 | Montgomery County | 5,052 | 9,743 | 34% | 66% |
| 11 | Davie County | 4,677 | 12,633 | 27% | 73% |
| 12 | Caswell County | 3,750 | 6,425 | 37% | 63% |
| | Urban Share | 169,733 | 324,628 | 69% | 70% |
| | Rural Share | 76,284 | 137,804 | 31% | 30% |
| | **Region Summary** | **246,017** | **462,432** | **35%** | **65%** |

*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

## Research Triangle Region Housing Stock

| Rank | County Name | Pre 1970 Homes | Post 1970 Homes | Pre 1970 Percent | Post 1970 Percent |
|---|---|---|---|---|---|
| 1 | Wake County | 53,902 | 285,641 | 16% | 84% |
| 2 | Durham County | 34,005 | 81,682 | 29% | 71% |
| 3 | Johnston County | 14,664 | 47,502 | 24% | 76% |
| 4 | Orange County | 12,948 | 41,858 | 24% | 76% |
| 5 | Harnett County | 10,399 | 34,689 | 23% | 77% |
| 6 | Moore County | 8,536 | 32,169 | 21% | 79% |
| 7 | Lee County | 6,786 | 16,587 | 29% | 71% |
| 8 | Vance County | 6,779 | 12,188 | 36% | 64% |
| 9 | Chatham County | 6,390 | 19,147 | 25% | 75% |
| 10 | Franklin County | 5,909 | 17,885 | 25% | 75% |
| 11 | Person County | 5,564 | 11,374 | 33% | 67% |
| 12 | Granville County | 5,546 | 15,982 | 26% | 74% |
| 13 | Warren County | 3,316 | 7,232 | 31% | 69% |
| | Urban Share | 100,855 | 409,181 | 58% | 66% |
| | Rural Share | 73,889 | 214,755 | 42% | 34% |
| | **Region Summary** | **174,744** | **623,936** | **22%** | **78%** |

*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

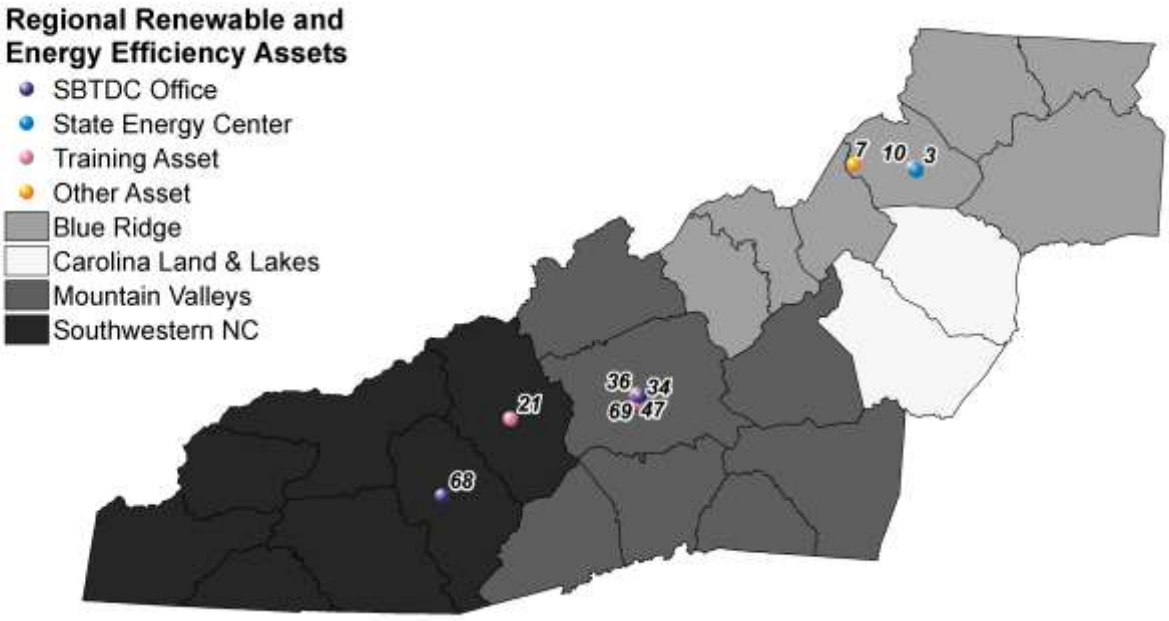
## Southeast Region Housing Stock

| Rank | County Name | Pre 1970 Homes | Post 1970 Homes | Pre 1970 Percent | Post 1970 Percent |
|---|---|---|---|---|---|
| 1 | Cumberland County | 37,956 | 96,760 | 28% | 72% |
| 2 | New Hanover County | 24,778 | 72,929 | 25% | 75% |
| 3 | Robeson County | 14,906 | 34,981 | 30% | 70% |
| 4 | Brunswick County | 10,326 | 62,350 | 14% | 86% |
| 5 | Columbus County | 10,067 | 14,640 | 41% | 59% |
| 6 | Richmond County | 8,837 | 13,029 | 40% | 60% |
| 7 | Sampson County | 8,470 | 17,687 | 32% | 68% |
| 8 | Pender County | 5,411 | 19,576 | 22% | 78% |
| 9 | Scotland County | 5,067 | 10,184 | 33% | 67% |
| 10 | Bladen County | 4,505 | 11,404 | 28% | 72% |
| 11 | Hoke County | 2,629 | 13,198 | 17% | 83% |
| | Urban Share | 62,734 | 169,689 | 47% | 46% |
| | Rural Share | 70,218 | 197,049 | 53% | 54% |
| | **Region Summary** | **132,952** | **366,738** | **27%** | **73%** |

*Sources: U.S. Census Bureau, NC Sustainable Energy Association.*

# APPENDIX 2: ADVANTAGE WEST REGION ASSET SUMMARY

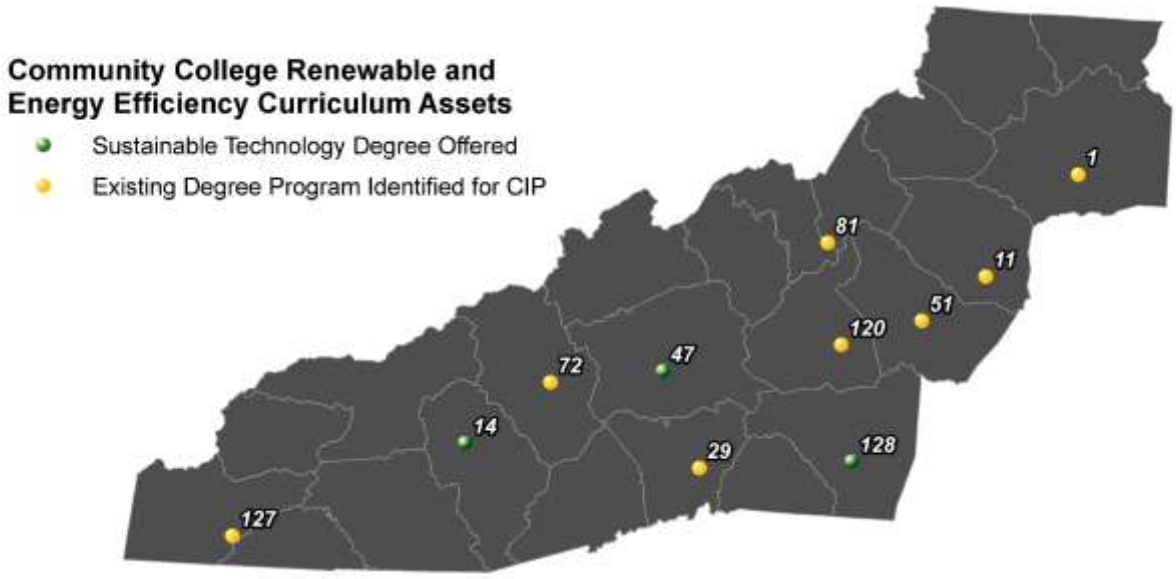
## Advantage West Region—Training & Support Assets




| ID | Asset Name | Trainings Offered | | | Infrastructure Element | | |
|---|---|---|---|---|---|---|---|
| | | BPI | NABCEP | RESNET | Energy Center | SBTDC | Other |
| 3 | Appalachian State University | - | yes | - | yes | yes | - |
| 7 | Beech Mountain | - | - | - | - | - | Small Wind Testing Center |
| 10 | Building Performance Engineering | yes | - | yes | - | - | - |
| 21 | CLEAResult Consulting, Inc. | yes | - | - | - | - | - |
| 34 | Green Opportunities, Inc. | yes | - | - | - | - | - |
| 36 | Home Energy Partners | yes | - | yes | - | - | - |
| 47 | Organic Think | - | - | trainer on staff | - | - | - |
| 68 | Western Carolina University | - | - | - | - | yes | - |
| 69 | Western Carolina University - Asheville | - | - | - | - | yes | - |

*Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

## Advantage West Region—Community College Assets

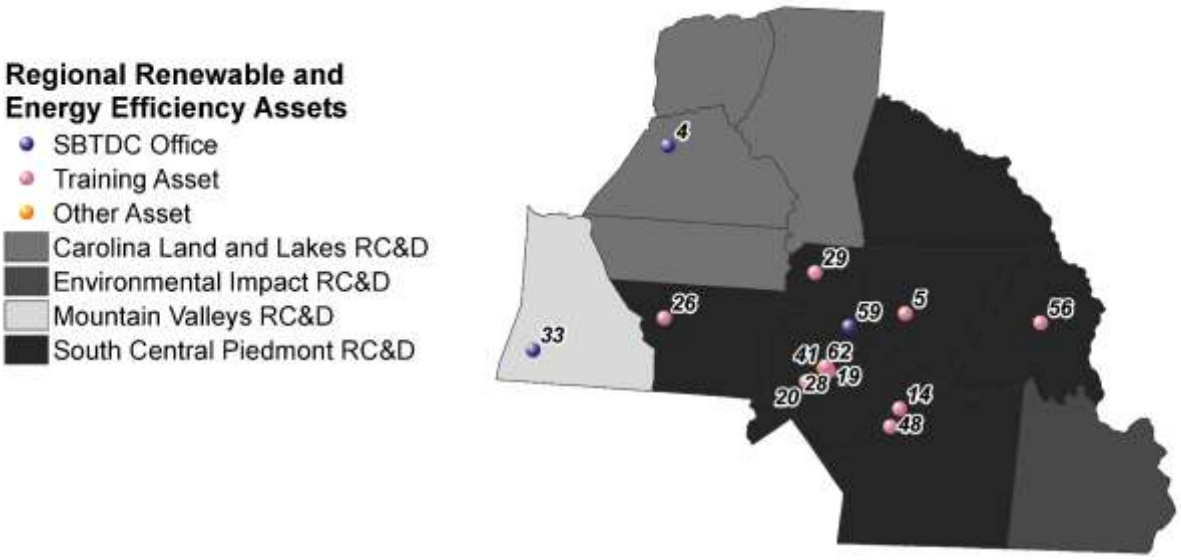



| ID | Community College | Sustainable Technology Degree | Degrees Identified as CIP Candidates | | |
|---|---|---|---|---|---|
| | | | HVAC | Electrical Systems | Industrial Systems |
| 47 | AB Technical Community College | yes | yes | yes | yes |
| 29 | Blue Ridge Community College | - | yes | yes | yes |
| 11 | Caldwell Community College | - | - | yes | yes |
| 72 | Haywood Community College | - | yes | yes | yes |
| 128 | Isothermal Community College | yes | - | yes | yes |
| 81 | Mayland Community College | - | yes | yes | yes |
| 120 | McDowell Technical Community College | - | yes | yes | yes |
| 14 | Southwestern Community College | yes | yes | yes | - |
| 127 | Tri-County Community College | - | yes | yes | - |
| 51 | Western Piedmont Community College | - | | - | yes |
| 1 | Wilkes Community College | - | - | yes | yes |

*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC OneMap, NC Sustainable Energy Association.*

# APPENDIX 3: CHARLOTTE REGION ASSET SUMMARY

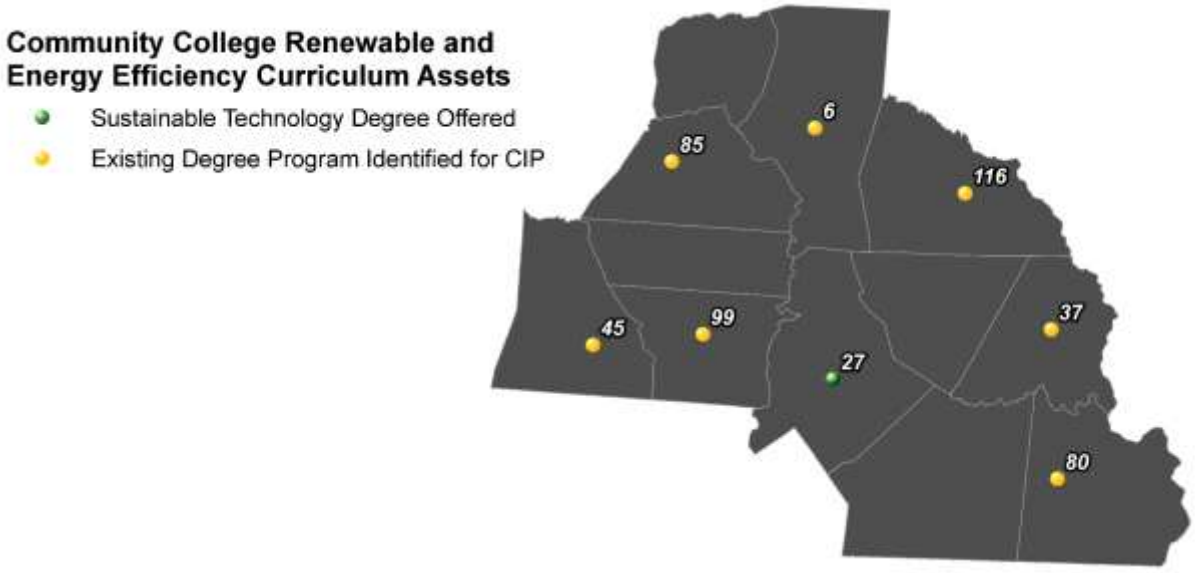
## Charlotte Region—Training & Support Assets




| ID | Asset Name | Trainings Offered | | | Infrastructure Element | | |
|---|---|---|---|---|---|---|---|
| | | BPI | NABCEP | RESNET | Energy Center | SBTDC | Other |
| 4 | ASU - Hickory | - | - | - | - | yes | - |
| 5 | Apple Blossom Insulators | yes | - | yes | - | - | - |
| 14 | Carolinas Energy Associates | yes | - | - | - | - | - |
| 19 | Central Piedmont C.C. | - | yes | - | - | - | - |
| 20 | Charlotte Electrical JATC | - | yes | - | - | - | - |
| 26 | Energy Wise Solutions | - | - | trainer on staff | - | - | - |
| 28 | Envision: Charlotte | - | - | - | - | - | Smart Grid Pilot Program |
| 29 | Everblue Energy Inc. | yes | yes | yes | - | - | - |
| 33 | Gardner-Webb University | - | - | - | - | yes | - |
| 41 | National Solar Trainers | - | - | - | - | - | IREC Listed solar training |
| 48 | Performance Point | - | - | trainer on staff | - | - | - |
| 56 | Stanly Community College | yes | - | - | - | - | - |
| 59 | UNC Charlotte | - | - | - | - | yes | EPIC & IDEA Centers |
| 62 | U.S. Green Building Council Charlotte Chapter | - | - | - | - | - | USGBC Regional Chapter |

*Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

## Charlotte Region—Community College Assets

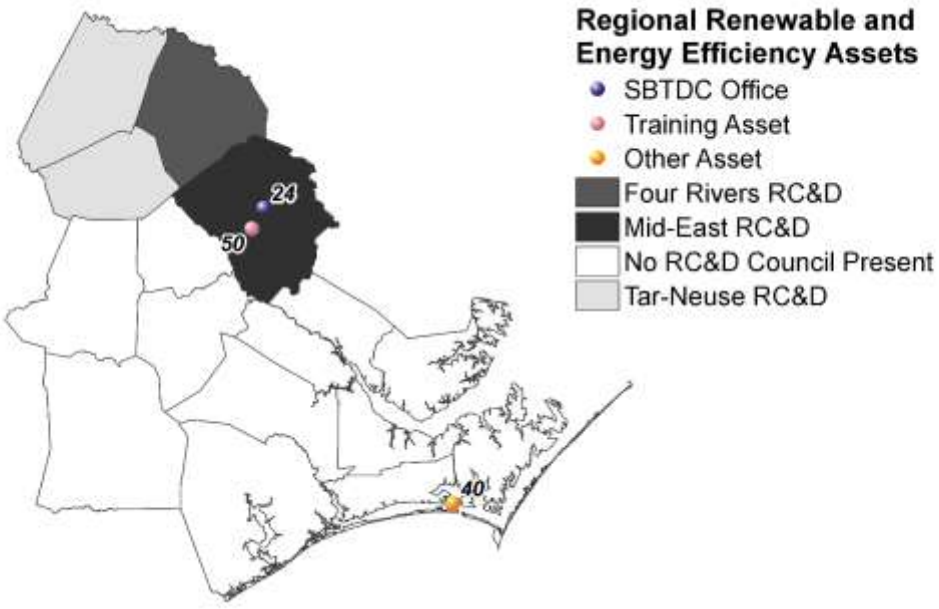



| ID | Community College | Sustainable Technology Degree | Degrees Identified as CIP Candidates | | |
|---|---|---|---|---|---|
| | | | HVAC | Electrical Systems | Industrial Systems |
| 85 | Catawba Community College | - | yes | yes | yes |
| 27 | Central Piedmont Community College | yes | yes | yes | - |
| 45 | Cleveland Community College | - | yes | yes | yes |
| 99 | Gaston Community College | - | yes | yes | yes |
| 6 | Mitchell Community College | - | yes | yes | - |
| 116 | Rowan-Cabarrus Community College | - | yes | yes | - |
| 80 | South Piedmont Community College | - | yes | yes | yes |
| 37 | Stanly Community College | - | - | - | yes |

*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC One-Map, NC Sustainable Energy Association.*

# APPENDIX 4: EASTERN REGION ASSET SUMMARY

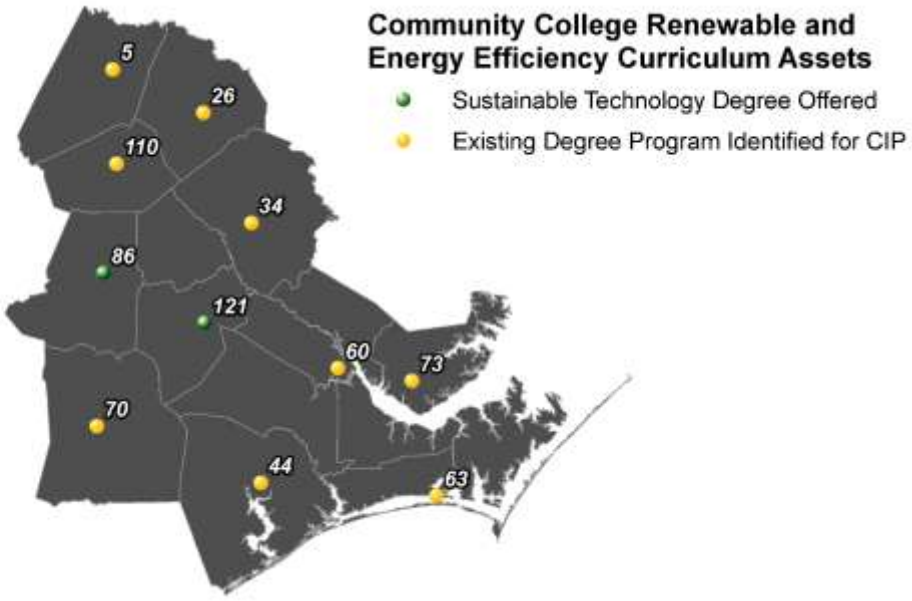
## Eastern Region—Training & Support Assets




| ID | Asset Name | Trainings Offered | | | Infrastructure Element | | |
|---|---|---|---|---|---|---|---|
| | | BPI | NABCEP | RESNET | Energy Center | SBTDC | Other |
| 24 | East Carolina University | - | - | - | - | yes | - |
| 40 | Port of Morehead City | - | - | - | - | - | Potential offshore wind hub |
| 50 | Pitt Community College | yes | - | - | - | - | - |

*Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

## Eastern Region—Community College Assets

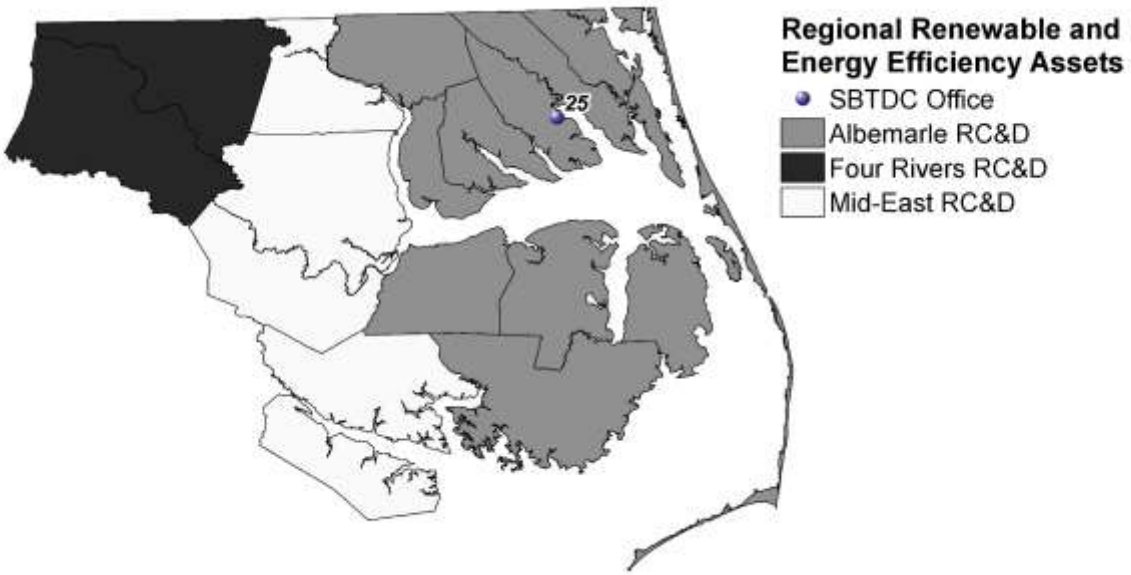



| ID | Community College | Sustainable Technology | HVAC | Electrical Systems | Industrial Systems |
|---|---|---|---|---|---|
| 63 | Carteret Community College | - | - | - | - |
| 44 | Coastal Community College | - | yes | yes | - |
| 60 | Craven Community College | - | - | - | - |
| 26 | Edgecombe Community College | - | - | yes | yes |
| 70 | James Sprunt Community College | - | - | yes | - |
| 121 | Lenoir Community College | yes | - | - | - |
| 5 | Nash Community College | - | - | yes | yes |
| 73 | Pamlico Community College | - | - | yes | - |
| 34 | Pitt Community College | - | yes | yes | yes |
| 86 | Wayne Community College | yes | yes | - | yes |
| 110 | Wilson Community College | - | yes | yes | - |

*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC OneMap, NC Sustainable Energy Association.*

# APPENDIX 5: NORTHEAST REGION ASSET SUMMARY

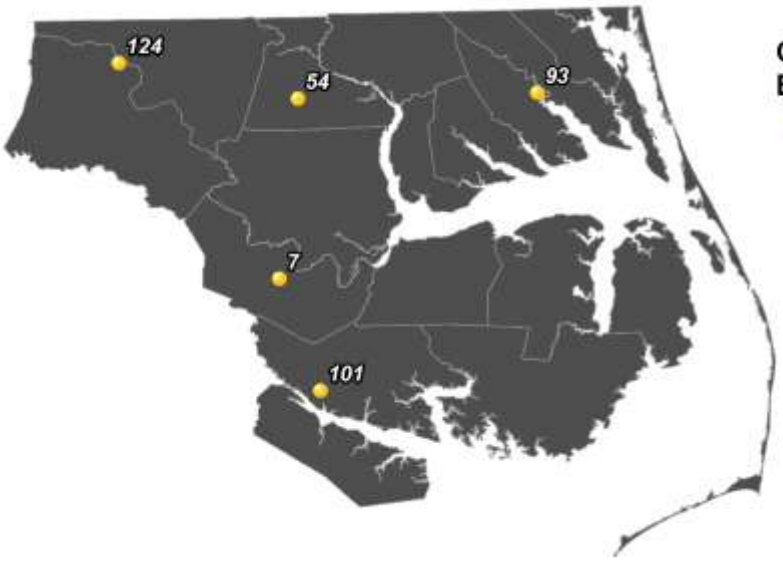
## Northeast Region—Training & Support Assets




| ID | Asset Name | Trainings Offered | | | Infrastructure Element | | |
|---|---|---|---|---|---|---|---|
| | | BPI | NABCEP | RESNET | Energy Center | SBTDC | Other |
| 25 | Elizabeth City State University | - | - | - | - | yes | Center for Green Research and Evaluation |

*Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

## Northeast Region—Community College Assets




**Community College Renewable and Energy Efficiency Curriculum Assets**

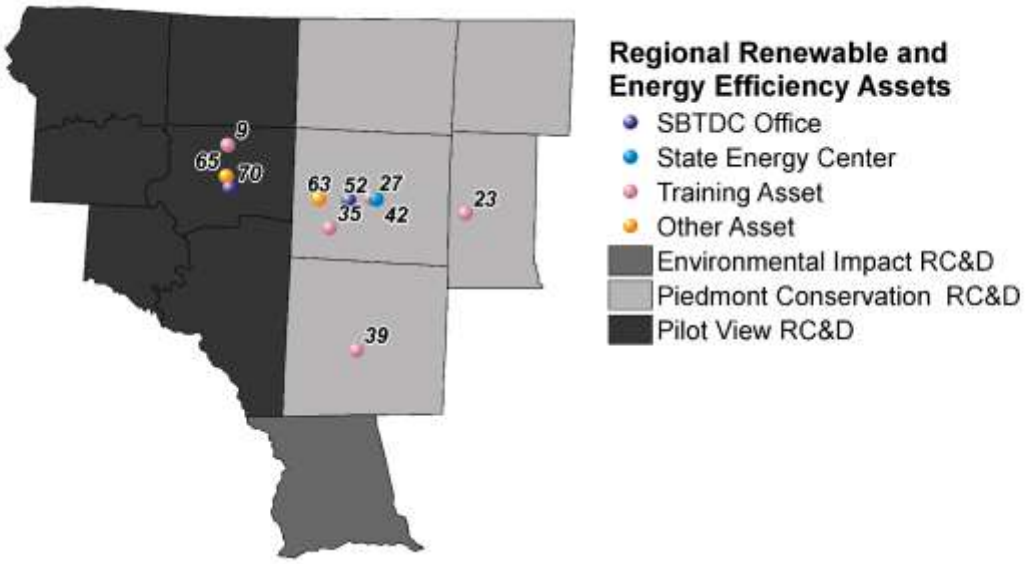
Existing Degree Program Identified for CIP

| ID | Community College | Sustainable Technology Degree | Degrees Identified as CIP Candidates | | |
|---|---|---|---|---|---|
| | | | HVAC | Electrical Systems | Industrial Systems |
| 101 | Beaufort County Community College | - | - | yes | - |
| 93 | College of the Albemarle | - | yes | yes | - |
| 124 | Halifax Community College | - | - | - | yes |
| 7 | Martin Community College | - | yes | yes | yes |
| 54 | Roanoke-Chowan Community College | - | yes | - | yes |

*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC OneMap, NC Sustainable Energy Association.*

# APPENDIX 6: PIEDMONT TRIAD ASSET SUMMARY

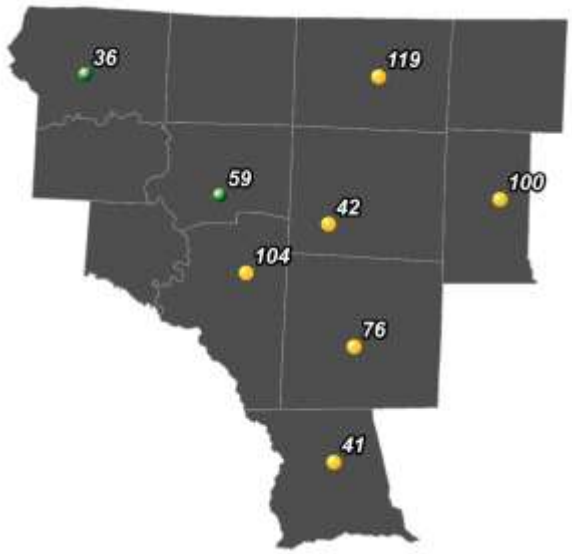
## Piedmont Triad Region—Training & Support Assets




| ID | Asset Name | Trainings Offered | | | Infrastructure Element | | |
|---|---|---|---|---|---|---|---|
| | | BPI | NABCEP | RESNET | Energy Center | SBTDC | Other |
| 9 | BTK Building Inspections & Energy Analysis | yes | - | - | - | - | |
| 23 | E3 Building Concepts | - | - | yes | - | - | |
| 27 | Environmental Solutions Group | - | - | trainer on staff | - | - | |
| 35 | Guilford Technical Community College | - | yes | - | - | - | |
| 39 | Michael Guy Ltd. | - | - | trainer on staff | - | - | |
| 42 | NC A&T State University | - | - | - | yes | yes | |
| 52 | SBTDC Headquarters -West | - | - | - | - | yes | |
| 63 | U.S. Green Building Council Triad Chapter | - | - | - | - | - | USGBC Regional Chapter |
| 65 | Wake Forest University | - | - | - | - | - | Center for Nanotechnology & Molecular Materials |
| 70 | Winston-Salem State University | - | - | - | - | yes | |

*Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

## Piedmont Triad Region—Community College Assets




**Community College Renewable and Energy Efficiency Curriculum Assets**

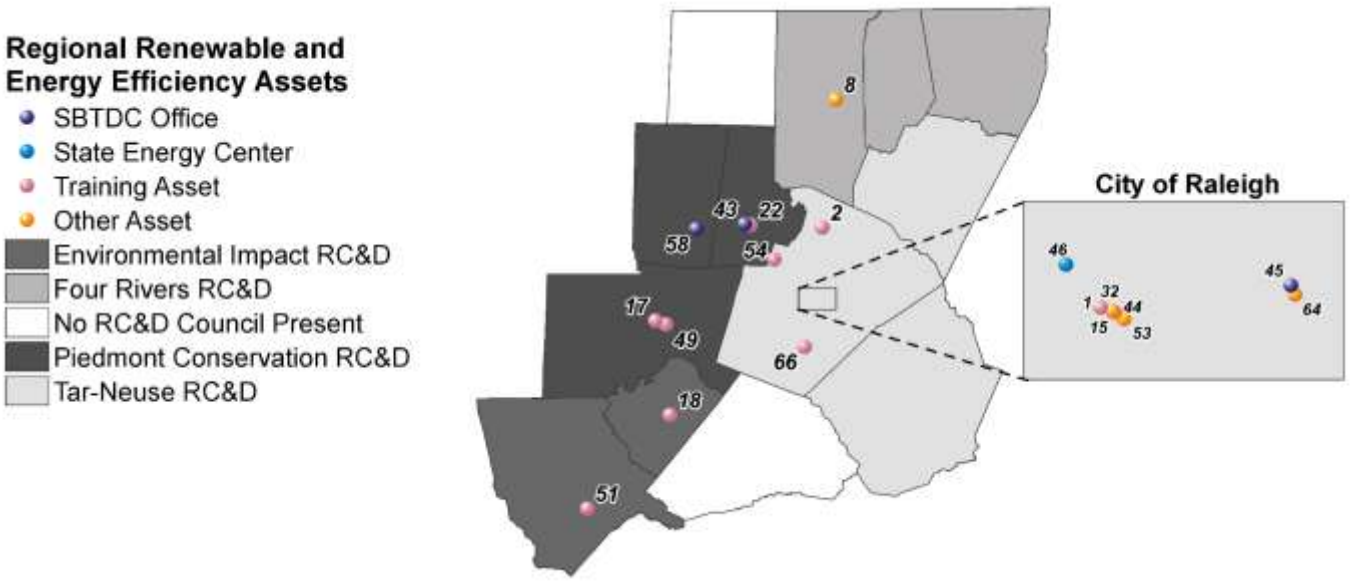
- Sustainable Technology Degree Offered
- Existing Degree Program Identified for CIP

| ID | Community College | Sustainable Technology Degree | Degrees Identified as CIP Candidates | | |
|---|---|---|---|---|---|
| | | | HVAC | Electrical Systems | Industrial Systems |
| 100 | Alamance Community College | - | yes | - | yes |
| 104 | Davidson County Community College | - | yes | - | yes |
| 59 | Forsyth Community College | yes | yes | yes | yes |
| 42 | Guilford Technical Community College | - | yes | yes | yes |
| 41 | Montgomery Community College | - | - | yes | yes |
| 76 | Randolph Community College | - | - | yes | yes |
| 119 | Rockingham Community College | - | yes | yes | yes |
| 36 | Surry Community College | yes | yes | yes | yes |

*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC OneMap, NC Sustainable Energy Association.*

# APPENDIX 7: RESEARCH TRIANGLE ASSET SUMMARY

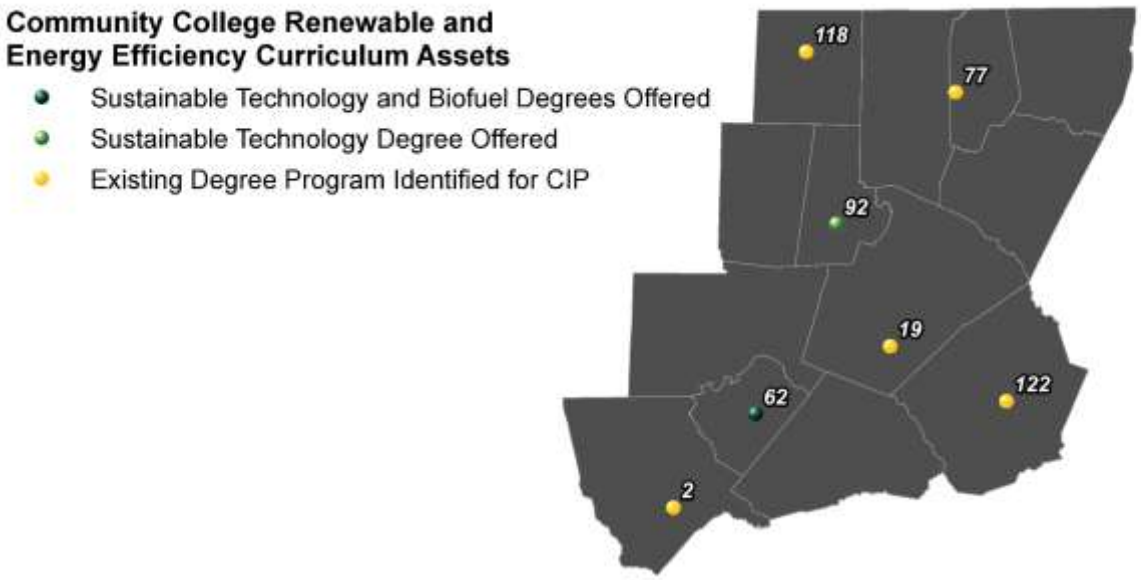
## Research Triangle Region—Training & Support Assets




| ID | Asset Name | Trainings Offered | | | Infrastructure Element | | |
|---|---|---|---|---|---|---|---|
| | | BPI | NABCEP | RESNET | Energy Center | SBTDC | Other |
| 1 | Advanced Energy | yes | - | yes | - | - | |
| 2 | Advanced Vehicle Research Center | - | - | - | - | - | Vehicle Conversion Training |
| 8 | Biofuels Center of North Carolina | - | - | - | - | - | |
| 15 | Center for Bio Energy | - | - | - | - | - | |
| 17 | Central Carolina - Pittsboro | - | yes | - | - | - | |
| 18 | Central Carolina - Sanford | yes | - | - | - | - | |
| 22 | Durham Technical | - | yes | - | - | - | |
| 32 | FREEDM Center | - | - | - | - | - | |
| 43 | NC Central University | - | - | - | - | yes | |
| 44 | NC State Nano Energy Lab | - | - | - | - | - | |
| 45 | NC State University | - | - | - | - | yes | |
| 46 | North Carolina Solar Center | - | - | - | yes | - | |
| 49 | Piedmont Biofuels Center | - | - | - | - | - | Biofuel Training |
| 51 | Sandhills Community College | - | - | - | - | - | Wind Apprenticeship |
| 53 | Silicon Solar Consortium (SiSoC) | - | - | - | - | - | |
| 54 | Southern Energy Management | - | - | trainer on staff | - | - | |
| 58 | UNC at Chapel Hill | - | - | - | - | yes | |
| 64 | U.S. Green Building Council Triangle Chapter | - | - | - | - | - | USGBC Regional Chapter |
| 66 | Wake Technical | yes | - | - | - | - | |

*Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

## Research Triangle Region—Community College Assets

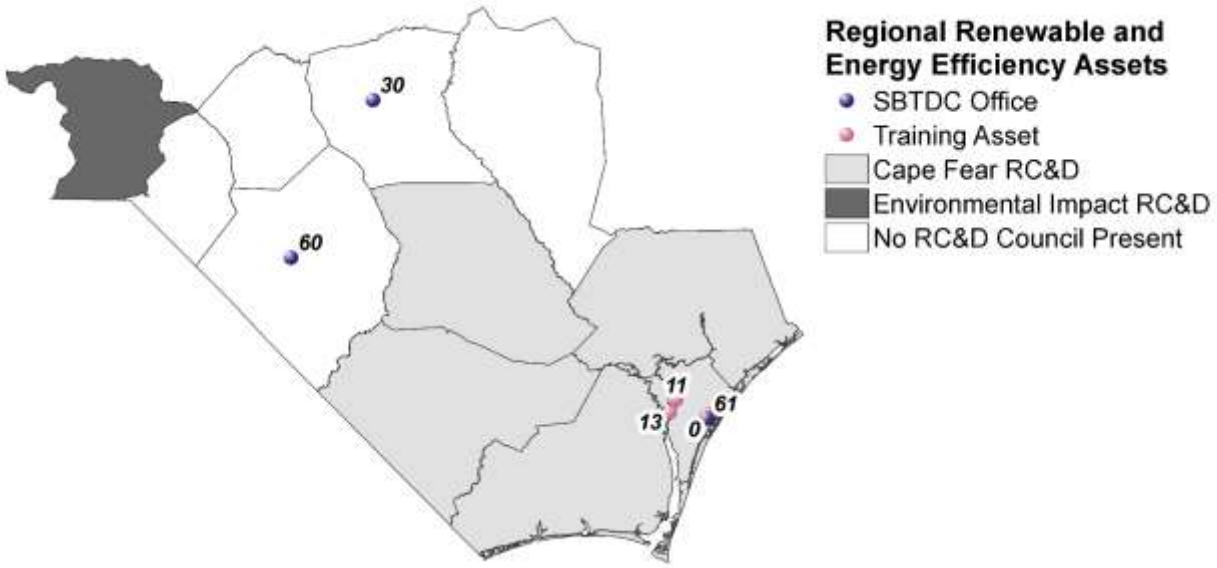



| ID | Community College | Sustainable Technology Degree | Degrees Identified as CIP Candidates | | |
|---|---|---|---|---|---|
| | | | HVAC | Electrical Systems | Industrial Systems |
| 62 | Central Carolina Community College | yes | - | - | yes |
| 92 | Durham Technical Community College | yes | - | yes | yes |
| 122 | Johnston Community College | - | yes | yes | yes |
| 118 | Piedmont Community College | - | yes | yes | yes |
| 2 | Sandhills Community College | - | - | - | yes |
| 77 | Vance-Granville Community College | - | yes | yes | yes |
| 19 | Wake Technical Community College | - | yes | yes | - |

*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC OneMap, NC Sustainable Energy Association.*

# APPENDIX 8: SOUTHEAST REGION ASSET SUMMARY

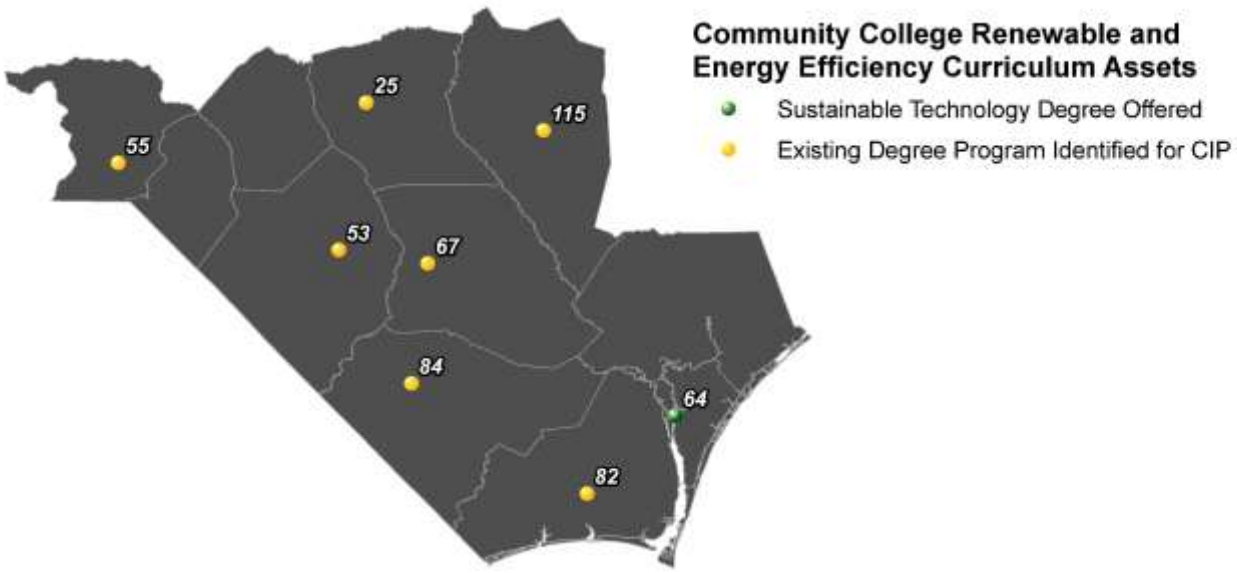
## Southeast Region—Training & Support Assets




| ID | Asset Name | Trainings Offered | | | Infrastructure Element | | |
|---|---|---|---|---|---|---|---|
| | | BPI | NABCEP | RESNET | Energy Center | SBTDC | Other |
| 0 | Above and Beyond Energy | - | - | trainer on staff | - | - | - |
| 11 | Building Performance Specialists | - | - | trainer on staff | - | - | - |
| 13 | Cape Fear Green Building Alliance | yes | - | - | - | - | - |
| 30 | Fayetteville State University | - | - | - | - | yes | - |
| 60 | UNC Pembroke | - | - | - | - | yes | - |
| 61 | UNC Wilmington | - | - | - | - | yes | - |

*Sources: Building Performance Institute (BPI), North American Board of Certified Energy Practitioners (NABCEP), Residential Energy Services Network (RESNET), Small Business Technology and Development Center (SBTDC), Interstate Renewable Energy Council (IREC), NC Department of Commerce, NC Sustainable Energy Association.*

## Southeast Region—Community College Assets




| ID | Community College | Sustainable Technology Degree | Degrees Identified as CIP Candidates | | |
|---|---|---|---|---|---|
| | | | HVAC | Electrical Systems | Industrial Systems |
| 67 | Bladen Community College | - | - | yes | yes |
| 82 | Brunswick Community College | - | - | - | - |
| 64 | Cape Fear Community College | yes | yes | yes | yes |
| 25 | Fayetteville Technical C.C. | - | yes | yes | - |
| 55 | Richmond Community College | - | yes | yes | yes |
| 53 | Robeson Community College | - | yes | yes | yes |
| 115 | Sampson Community College | - | - | - | yes |
| 84 | Southeastern Community College | - | yes | yes | - |

*Note: The Curriculum Improvement Project (CIP) is a community college system wide effort to integrate renewable energy and energy efficiency elements within the framework of existing degree offerings. Sources: North Carolina CIP Program, NC OneMap, NC Sustainable Energy Association.*

# APPENDIX 9: DATA COLLECTION & METHODOLOGY

All maps and spatial analysis were conducted using ESRI's ArcINFO 10, made available to the North Carolina Sustainable Energy Association (NCSEA) though ESRI's Non-Profit organization grant program. All maps presented in this report are intended for educational and informational purposes only. Information is accurate to the best of NCSEA's ability, and is presented in good faith.

In instances where third party maps are used, NCSEA georectified and clipped the original image to North Carolina boundaries for visual purposes only. No additional analytic processing was undertaken to preserve the integrity of the original work.

**All original NCSEA generated location shapefiles were created using the hierarchy:**

1. Visually confirmed spatial coordinates using orthophotos, Google, and Bing maps.
2. Government department provide spatial coordinates.
3. Geocoded street addresses using the North Carolina Integrated State Road Network (ISRN).
4. Random placement within the overlapping combination of zip code, county, and municipal boundaries. (This step affected less than three percent of any dataset, and most instances less than one percent. In all instances, resolution is accurate to a minimum of the county level.)

NCSEA collected data for processing and analysis from the following sources:

**Population and Housing information:**

- Downloaded from U.S. Census Bureau Fact Finder website. Data derived from combination of the American Community Survey and Decadal Census information.

**Residential Housing Density Maps:**

- Inverse distance weighted from the census tract centroid. No geostatistical corrections were undertaken. (Individuals interested greater detail, including the inherent limitations in these maps, or for more refined assessments should contact Rich Crowley with NCSEA's Geospatial Analysis Unit.)

**Electric Service Territory Map:**

- North Carolina Electrical Cooperative (NCEC) territories downloaded from: http://www.ncemcs.com/downloads/territoryMap.pdf.
- Out of state based cooperatives digitized from multiple third party sources.
- Approximate municipal service territories derived from the North Carolina Department of Transportation's Municipal Boundaries map available at http://www.ncdot.org/it/gis/DataDistribution/DOTData/default.html.

**North Carolina Biomass Primer Map:**

- 2001 Land Use / Land Cover (LULC) raster downloaded, processed, and reclassified from the U.S. Geological Survey Seamless Map server at http://seamless.usgs.gov.

**North Carolina Landfill Gas System Map:**

- Landfill locations were downloaded from NC OneMap at http://www.nconemap.com; landfill status was revised to reflect the most recent version of the Environmental Protection Agency's (EPA) Landfill Methane Outreach Project status database.
- Map includes systems that are generating heat only.

**Solar Technology Primer Map:**

- Original annual solar radiance at 10km cells with flat plate at latitude tilt map from the National Renewable Energy Laboratory's solar mapping website at: http://www.nrel.gov/gis/images/map_pv_us_annual10km_dec2008.jpg.
- Georectified and processed by NCSEA.

**Wind Technology Primer Map:**

- Rectified and processed from Wind Powering America mapping website at: http://www.windpoweringamerica.gov/pdfs/wind_maps/us_windmap_80meters.pdf.
- Map displayed is the annual average wind speed at 80 meters for 2.5km cells.

**North Carolina Clean Energy Firm Primary Locations:**

- Geocoded from NCSEA's proprietary industry census database.
- To qualify for inclusion in NCSEA's database firms have to meet at least one of the following criteria:
    1. 50% staff time spent on renewable or energy efficiency activities
    2. 50% of revenue derived from renewable or energy efficiency activities
    3. At least $25,000 in economic gains directly attributable to renewable energy and energy efficiency activities

**Commercial Energy Efficiency Projects:**

- Geocoded from combination of the U.S. Green Building Council's Leadership in Energy and Environmental Design (USGBC LEED) project public directory and EPA's Commercial Energy Star Database.
- LEED project directory accessed November 2010; Energy Star project directory accessed January 2011.

**Renewable Energy Projects:**

- The majority of addresses geocoded from NCSEA's proprietary database of North Carolina Utilities Commission SP, E, RET, EMC, and EC historical filings though January 2010
- Additional coding from third party sources including Energy Information Administration, EPA, North Carolina Department of Environment and Natural Resources, Federal Energy Regulatory Commission filings, and the Appalachian State University Wind Map.
- With the exception of solar thermal, renewable energy projects that are only generating heat (e.g. some of the landfill gas systems) may not all have been identified for inclusion in the project maps.
- Collection of renewable energy systems (excluding geothermal) data was completed January 2011, geothermal was completed in April 2011. Systems registered after these dates do not appear in this version of the data book and will be included in future updates.
- When NCSEA is aware a registered project was not constructed, or has become inactive, it was not counted or mapped in this report.

**Community College Assets:**

- Community college location Base shapefile from North Carolina OneMap.
- Community college specific Curriculum Improvement Project information courtesy of Andy McMahan.

**Training and Support Assets:**

- Geocoded from multiple sources including http://www.bpi.org; http://www.nabcep.org; http://www.resnet.us; http://irecusa.org; http://www.sbtdc.org; http://www.nccommerce.com and other third party sources.

**Rural County Map:**

- Modified from the North Carolina Rural Economic Development Center's rural and urban county designation map.

# APPENDIX 10: ADDITIONAL RESOURCES

***North Carolina State and Regulatory Resources:***

Low Income Energy Assistance Programs - liheap.ncat.org/profiles/NC.htm
North Carolina Department of Commerce - www.nccommerce.com
North Carolina Electrical Cooperatives - www.ncelectriccooperatives.com
North Carolina GreenPower - www.ncgreenpower.org
North Carolina General Assembly - www.ncga.state.nc.us
North Carolina Public Power - www.ncpublicpower.com
North Carolina Renewable Energy Tracking System - www.ncrets.org
North Carolina State Energy Office - www.nccommerce.com/energy
North Carolina Utilities Commission - www.ncuc.net

***North Carolina Information and Trade Resources:***

Advanced Energy - www.advancedenergy.org
Appalachian State Energy Center – energy.appstate.edu
Center for Energy Research Technology - cert.ncat.edu
North Carolina Community College System - www.ncccs.cc.nc.us
North Carolina Farm Energy Efficiency Project - www.ncfarmenergy.org
North Carolina HealthyBuilt Homes - healthybuilthomes.org
North Carolina Solar Center – www.ncsc.ncsu.edu
    DSIRE Database - www.dsireusa.org
North Carolina Sustainable Energy Association – www.energync.org

***Southeast Region Information Resources:***

Southeast Agriculture & Forestry Energy Resources Alliance – saferalliance1.wordpress.com
Southeast Energy Efficiency Alliance - www.seealliance.org
    Industrial Program - www.seeaindustrial.org

***Federal Regulatory and Database Resources:***

U.S. Department of Energy – www.doe.gov
    Energy Efficiency and Renewable Energy - www.eere.energy.gov
    Energy Information Administration - www.eia.gov
    Industrial Assessment Center - iac.rutgers.edu/database
    National Laboratories and Technology Centers - www.energy.gov/organization/labs-techcenters.htm
    Smart Gird Information Clearing House - www.sgiclearinghouse.org
Federal Energy Regulatory Council - www.ferc.gov
National Renewable Energy Laboratory - www.nrel.gov
Natural Resource Conservation Service - www.nc.nrcs.usda.gov
U.S. Census Bureau - www.census.gov
U.S. Environmental Protection Agency - www.epa.gov
    AgSTAR - www.epa.gov/agstar
    eGRID - www.epa.gov/egrid
    Energy Star - www.energystar.gov
    LMOP - www.epa.gov/lmop

***National Information and Trade Resources:***

American Council for an Energy-Efficient Economy - www.aceee.org
American Council on Renewable Energy - www.acore.org
American Wind Energy Association - www.awea.org
Building Code Assistance Project - bcap-energy.org
Efficiency First - www.efficiencyfirst.org
Electric Power Research Institute – www.epri.com
Interstate Renewable Energy Council - irecusa.org
National Association of Home Builders NABHGreen - www.nahbgreen.org
Regulatory Assistance Project – www.raponline.org
Small Wind Certification Council - www.smallwindcertification.org
Solar Energy Industries Association - www.seia.org
U.S. Green Building Council - www.usgbc.org

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# 2011 BOARD OF DIRECTORS



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**Rich Crowley** is Manager of Market Research and Spatial Analysis at the North Carolina Sustainable Energy Association. He manages market intelligence research and develops innovative spatial tools to analyze clean energy trends and clean energy market dynamics.

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