Renewable Energy in North Carolina

Diane Cherry and Shubhayu Saha

Many factors influence development of renewable energy sources: a state's energy prices, energy infrastructure, energy demand, and energy intensity. Some encourage development, others discourage it. In the past, energy production in North Carolina has favored a dependence on imported fossil fuels. The dependence has been based on low energy prices, lack of statutory mandates to encourage development of renewable energy sources, and a fairly energy-intensive economy. It has been buoyed by reliable, secure energy sources.

However, in the face of higher energy prices and harm to the natural environment from local air pollution and global climate change, North Carolina and many other states have turned to renewable energy sources. These states have legislated a "Renewable Energy Portfolio Standard" (REPS), a mechanism requiring electric energy suppliers to produce from renewable sources a specific percentage of the electricity that they sell to retail customers. As such statutory mandates are passed, states have an opportunity to encourage the growth of a nascent renewable energy industry and its supply chain. To take full advantage of this opportunity, though, North Carolina must address a variety of technical, regulatory, financial, and political challenges.

This article describes North Carolina's traditional choices of energy supply, including the state's past production of renewable energy. It also outlines current state policies that encourage development of renewable energy sources, and discusses North Carolina's renewable energy capacity in the form of wind power, biomass fuel, and solar power. The article concludes with lessons from other states, and challenges and opportunities for North Carolina to grow its use of renewable energy resources.

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North Carolina's Traditional Choices of Energy Supply

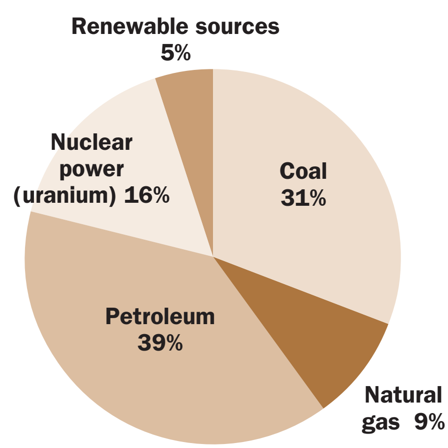
Historically, North Carolina has depended on imports from other states for nearly all its energy supply. The state neither produces nor has reserves of fossil fuels—coal, oil, natural gas, and uranium—on which its energy sector predominantly relies. Further, the state has no crude oil refinery capacity. The cost of imported fossil fuels represents roughly 28 percent of the total cost of producing electricity for North Carolina because of the state's complete reliance on energy supplies from other states.[1] The majority of the coal that North Carolina burns comes from Kentucky and West Virginia; the majority of the refined fuel oil and natural gas, from Texas and Louisiana; and the majority of the uranium, necessary to produce nuclear energy, from West Virginia.[2]

The Energy Information Administration (EIA) database offers the following snapshot of North Carolina's energy supply in 2005 (for a graphic presentation of the data, see Figure 1):

- Petroleum provides the largest share, 39 percent, devoted almost entirely to transportation.
- Coal provides 31 percent, with nearly all of it related to electricity generation.
- Nuclear power provides 16 percent. (North Carolina is one of the top nuclear-power-producing states, ranking sixth among the thirty-one with nuclear capacity. Nuclear power provides about 19 percent of electricity for the United States as a whole, but 34 percent of electricity in North Carolina.)
- Natural gas provides 9 percent.
- Renewable energy sources make up the smallest share, 5 percent.

Continued reliance on fossil fuels for North Carolina's energy needs has at least two drawbacks. First, reliance on oil from politically unstable countries has strong national security implications. North Carolina residents are vulnerable to fluctuations in gasoline prices as a result of macroeconomic and geopolitical shocks. In a July 2007 report prepared by the Natural Resources Defense Council, North Carolina ranked twenty-first in percentage of annual per capita income spent on gasoline. The average North Carolina driver

Figure 1. **Contribution of Various Sources to North Carolina's Energy Supply, 2005**



Source: Data from Energy Information Administration, "Table 7: Energy Consumption Estimates by Source, Selected Years, 1960–2005," www.eia.doe.gov/emeu/states/sep_use/total/use_tot_nc.html.

spends $1,373 per year.[3] This statistic raises considerable concern, given the recent escalation of gas prices.

North Carolina depends on fossil-fuel supplies from other states.

Second, North Carolina is vulnerable to the environmental impacts of the continued use of fossil fuels for energy production and use. Some likely effects are a rise in sea levels on the developed coastline, more extreme weather events, and increased air pollution from automobiles and coal-fired power plants. Air pollution already has reduced visibility in the North Carolina mountains, imposed frequent ozone-alert days on the state's cities, and harmed public health—for example, through the increased incidence of childhood asthma.

Given these drawbacks to reliance on conventional energy sources, many states have turned to renewable energy sources to meet energy demand.

The majority of North Carolina's renewable energy has historically come from hydroelectricity owned by utility companies. From 1990 to 2006, the amount of electricity generated by each of North Carolina's fuel sources was fairly steady (see Figure 2).[4] The distribution will look different in the future, given recent action by the North Carolina General Assembly (discussed later).

In 2003, the North Carolina Utilities Commission approved the establishment of NC GreenPower as a statewide program of green energy financed by the state's investor-owned utilities and administered by Advanced Energy, an independent nonprofit corporation. The goal of NC GreenPower is to add green energy to the state's power supply. The program accepts financial contributions from North Carolina citizens and businesses. For every $4 contributed to the program, it pays $3 (in the form of 100 kilowatt hours of renewable energy) to independent producers supplying green power.[5]

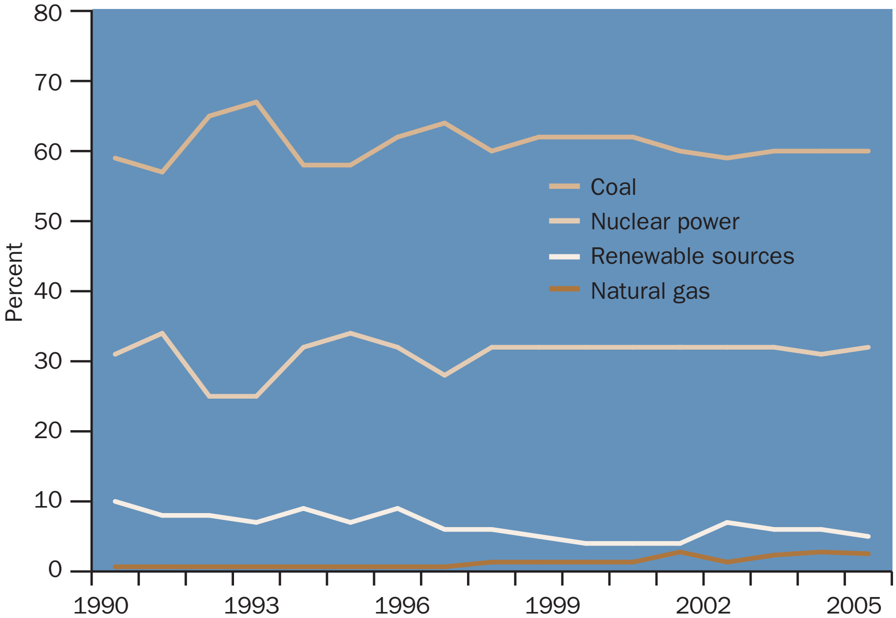
The program has had some small success, but it has not done much to expand the renewable energy market in the state because it is voluntary and depends on contributions. Historically, NC GreenPower producers have generated roughly 20 million kilowatt hours per year, but this contribution is minuscule compared with that from conventional energy sources.[6]

North Carolina's Current Energy Policies

As noted earlier, North Carolina's renewable energy production can be enhanced or mitigated by several factors: prices, infrastructure, demand, and intensity.

The primary factor influencing choice of energy supply is price, which is determined by supply and demand in the context of existing knowledge, technology, and regulations. Relative prices drive production, consumption, and investment decisions and explain why North Carolina, like the rest of the nation, has historically relied heavily on fossil fuels: they are less expensive. Because renewable energy technologies are newer and not widespread in commercial application, the cost of gener-

Figure 2. **Contribution to Electricity Generation in North Carolina, by Fuel Source, 1990–2005**



Source: Data from Energy Information Administration, "Table 12: Electric Power Sector Consumption Estimates: 1960–2005, North Carolina," www.eia.doe.gov/emeu/states/sep_use/eu/use_eu_nc.html.

ating them, it is argued, is relatively higher than the cost of generating the traditional sources.

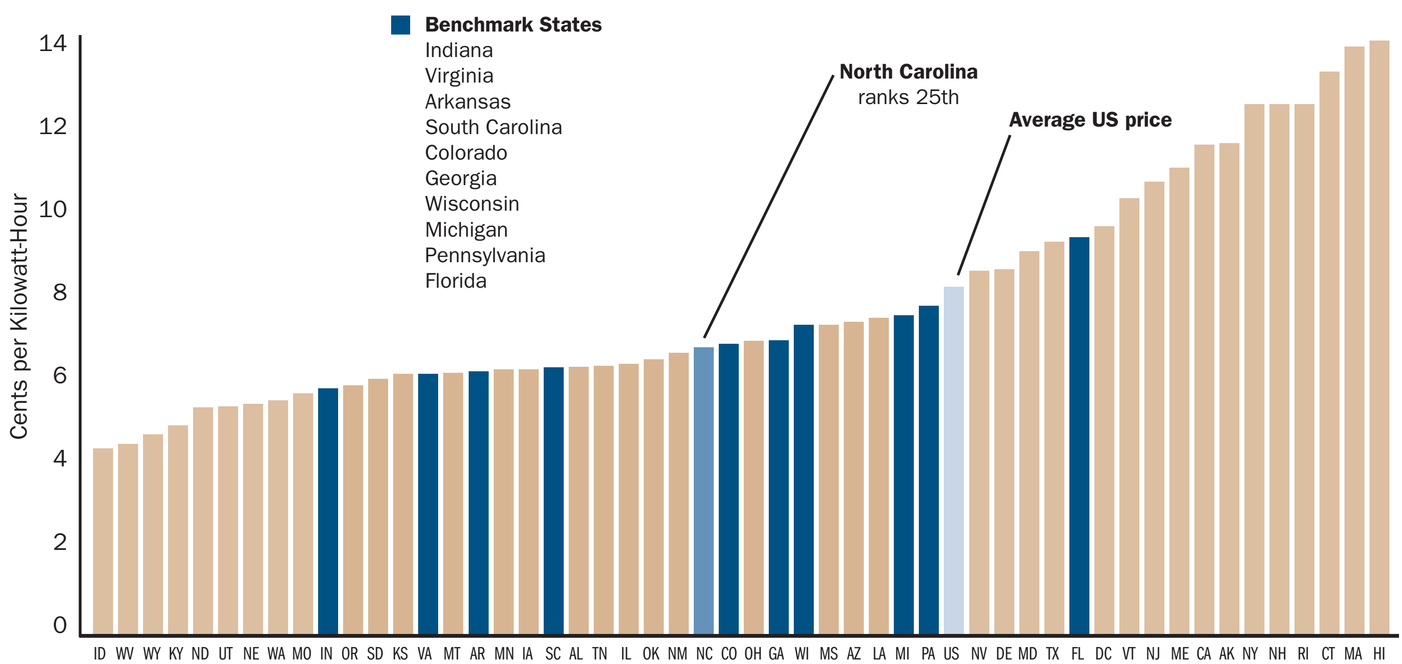
The state's existing infrastructure supports the conventional supplies of energy. It is a major constraint facing North Carolina as policy makers consider the state's future energy course.

North Carolina's energy prices are lower than the national average but higher than those of its neighbors, Virginia and South Carolina (see Figure 3). In terms of industrial makeup and competitiveness, the benchmark states identified in Figure 3 are similar to North Carolina and should be a basis for comparison. To the extent that North Carolina will compete for industrial companies against these states, energy prices may be a consideration.

The energy infrastructure also affects potential production and use of renewable energy sources. North Carolina does not yet have the infrastructure for "distributed generation"— generation of energy close to the point of use — which is critical to expansion of renewable sources. Further, all the existing transmission lines are owned by the state's largest electric utilities. Indeed, the whole southeastern regional grid is maintained through the monopolistic market, making a change in the generation and transmission system difficult. So the structure of the electric industry may be a barrier to distributed generation.

Regarding demand, North Carolina expects nearly four million additional residents by 2030, so it will have to accommodate energy demand from a growing population. Increased energy demand will cause higher prices and may make renewable energy more attractive compared with conventional choices.

Figure 3. **Average Retail Price of Electricity in All Sectors, by State, 2006**



Source: Adapted from Dan Peaco, La Capra Associates, "Competitiveness under Constraints: The Electric Utility Industry, National Context and Lessons from Other States" (paper prepared for the Institute for Emerging Issues, April 27, 2007). "Benchmark states" are North Carolina's competitors, those with which it compares itself.

Finally, the "energy intensity" of a state—that is, how much existing industrial customers rely on energy per unit of gross domestic product (GDP)—also affects the attractiveness of renewable energy compared with conventional sources. In the United States, North Carolina ranks thirty-fourth in energy intensity, meaning that only seventeen other states have more energy-intensive economies. By and large, these states' economies rely on fossil fuels for their energy needs (see Figure 4). Low electricity prices often discourage adoption of energy efficiency and renewable energy. States such as California and Massachusetts, long recognized as leaders in energy efficiency and the use of renewable energy, cannot be easily compared with North Carolina because North Carolina's economy is much more energy-intensive and the state enjoys lower energy prices.

North Carolina's energy prices are lower than the U.S. average but higher than those of neighbors Virginia and South Carolina.

The aforementioned impacts on use of renewable energy naturally affect formation and implementation of energy policy in North Carolina. North Carolina's energy context consists of above-average energy prices for the Southeast, a historical reliance on conventional energy sources, and an industry fairly energy-intensive compared with that in other states.

Against this backdrop, in 2007, North Carolina became the first state in the Southeast to pass a REPS.[7] The standard is based in part on an analysis from an outside study by La Capra Associates and others, commissioned by the state Environmental Review Commission.[8] A REPS is achieved through phased-in requirements of a target percentage of renewable energy. It helps support the market for renewable energy sources within a state because it mandates that electricity providers use a certain amount of renewable energy over time. The statute applies to all investor-owned utilities, electric companies, and rural cooperatives. The federal government has considered a number of REPS proposals and amendments, but to date, neither the House nor the Senate has passed one.

North Carolina enacted a variant of the REPS that promotes energy efficiency as well as renewable energy. The statute has three distinct goals:

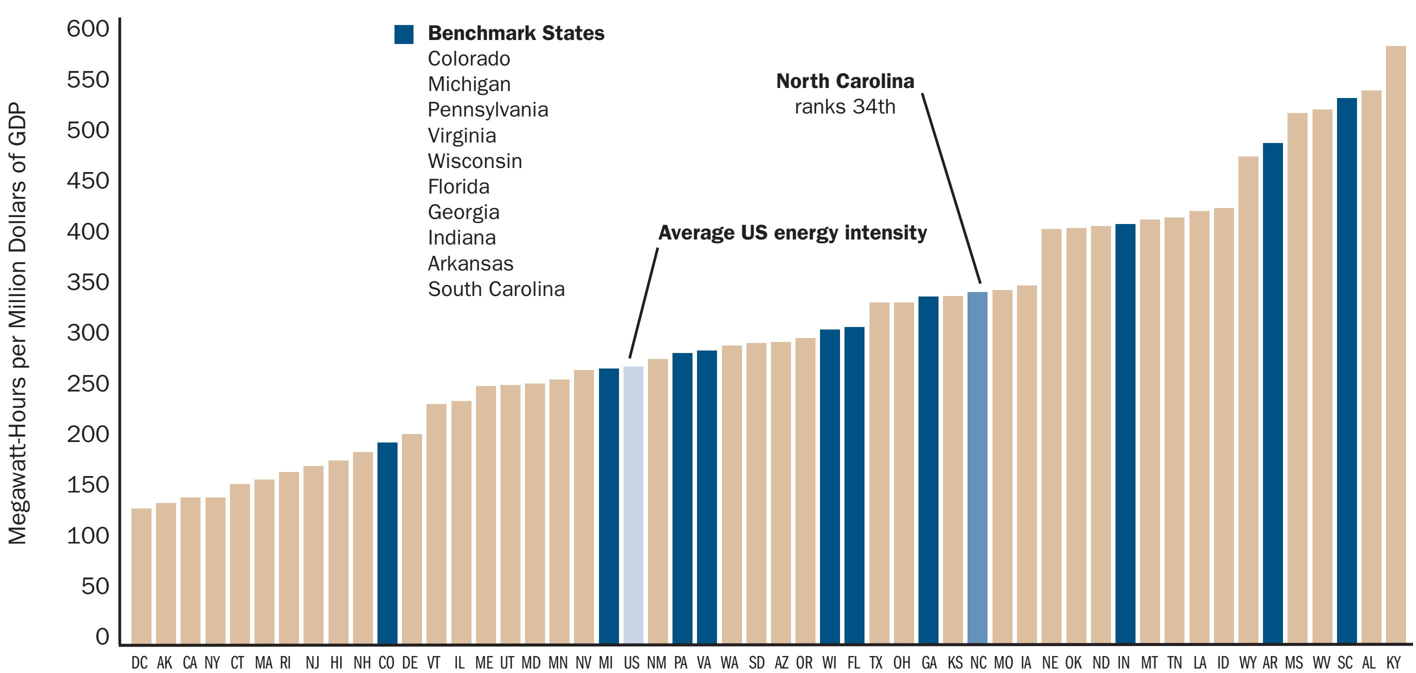
- To diversify the resources used to meet the energy needs of consumers
- To provide greater energy security through use of in-state resources
- To provide improved air quality for citizens of North Carolina

The requirements are meant to be phased in over time, with a 12.5 percent requirement for investor-owned utilities to be met by 2021 and a 10 percent requirement for electric membership corporations and municipalities that sell electric power in the state, to be met by 2018. For Duke Energy and Progress Energy, the two principal investor-owned utilities in North Carolina, energy efficiency measures can provide up to 5 percent of the REPS.

In addition to creating these benchmarks, the REPS provides for set-asides from three other renewable energy sources: solar power, 0.2 percent total generation by 2018; swine waste, 0.2 percent total generation by 2018; and poultry litter, 900,000 megawatt hours by 2014.

Many REPS programs, including the one recently established in North

Figure 4. **Megawatt Hours Consumed per Million Dollars of Gross Domestic Product, 2006**



Source: Adapted from Dan Peaco, La Capra Associates, "Competitiveness Under Constraints: The Electric Utility Industry, National Context and Lessons from Other States" (paper prepared for the Institute for Emerging Issues, April 27, 2007). GDP = gross domestic product. "Benchmark states" are North Carolina's competitors, those with which it compares itself.

Carolina, use tradable "renewable-energy certificates" (RECs) to increase the flexibility and reduce the cost of compliance with the standard, and to facilitate tracking of compliance. A REC is created when a megawatt hour of renewable energy is generated. It can be traded separately from the electricity that is generated. REC transactions create a supplemental revenue stream for owners of renewable energy businesses and allow suppliers to demonstrate compliance with the REPS by purchasing RECs rather than purchasing renewable electricity directly. A strong REC market encourages the development of a renewable energy industry within a state because a financial payoff is evident for investments made by a developer of a renewable energy source.

Renewable Energy Capacity in North Carolina

The La Capra study highlighted the potential capacity for additional renewable energy in North Carolina beyond the existing base of approximately 2,000 megawatts of electricity, consisting primarily of 1,400 megawatts of utility-owned hydroelectricity. The study estimated that an additional 3,400 megawatts could feasibly be developed, primarily from onshore wind power and from "biomass fuel" (fuel created from wood and agricultural waste).[9] This estimate does not include any offshore wind or solar energy potential because of the lack of authorized (permitted) offshore facilities in the United States and the high costs associated with solar energy resources.

The challenges associated with development of North Carolina's renewable resources are many. Successful implementation of the REPS statute will require considerable attention to overcoming these obstacles.

Wind Power

Among all renewable energy technologies, wind power is currently the most cost-competitive when compared with traditional technologies for production of fossil-fuel-based energy. In fact, around the world, wind power is the fastest-growing energy source. Denmark has the most experience with wind power. Half of its energy comes from offshore wind facilities.[10]

According to the American Wind Energy Association, at the beginning of 2007, the United States had a total of 2,600 megawatts of installed wind power capacity, equivalent to about three or four large coal-fired power plants. Installations in the last quarter of 2007 brought the year's total to 5,244 megawatts. Between 2000 and 2007, the amount of electricity that the country got from wind more than quadrupled, but wind projects still generate less than 1 percent of the nation's electricity. Texas has the greatest wind-energy production of any state, followed by California, Minnesota, Iowa, and Washington.[11]

Wind energy in North Carolina has great potential but faces legal restrictions.

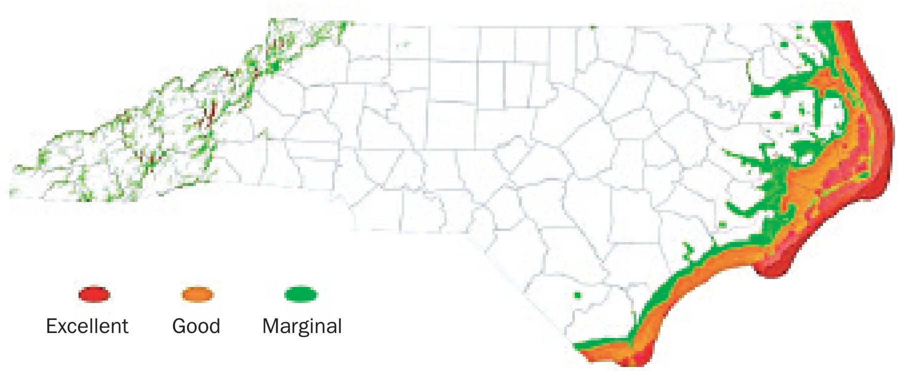
North Carolina offers one of the most promising locations on the East Coast for wind power. Locations along ridgelines in its mountains and near its sounds and coastal areas show the greatest potential (see Figure 5). But despite the excellent opportunities of each region, challenges exist in siting wind turbines.

The first challenge is a regulatory barrier called the North Carolina Mountain Ridge Protection Act, which has restricted building on North Carolina's mountain ridges above 3,000 feet. Although the intention of the law is to maintain the natural beauty of North Carolina's mountains, it creates obstacles for wind energy, given an interpretation of the original statute issued by the North Carolina Attorney General's Office. The best wind areas in western North Carolina fall into zones protected by the Mountain Ridge Protection Act. No other states have laws resembling North Carolina's law as it has been interpreted. States such as Maine and Vermont have allowed mountain projects. These states are attempting to address wind projects on ridgelines in a broader way than project by project. Ridges are sensitive in any state, but having a broad law that prohibits wind energy is another matter.

While North Carolina state lawmakers debate the future of wind power and the impact of the Mountain Ridge Protection Act on such development, local lawmakers have begun taking matters into their own hands. In August 2006, Watauga County became the first in the state to address the siting of wind facilities, with development requirements and a local permitting process for limited turbine development.

Also in 2006, a firm called Northwest Wind Developers proposed North Carolina's first commercial-scale wind farm, in Ashe County. This 50-megawatt development—enough electricity to power 15,000 homes—would have included 25–28 wind turbines, with each turbine extending nearly 400 feet from the base to the tip of the blade. Ashe County does not have any zoning ordinances, and the proposed wind facility did not have to comply with any local land-use zoning. However, like all public projects, the project had to ob-

Figure 5. **Potential of Wind Power in North Carolina**



Source: Data from NC OneMap (accessed November 27, 2007), www.nconemap.com/default.aspx?tabid=286.

tain a certificate of public convenience and necessity from the North Carolina Utilities Commission. Eventually, the Utilities Commission dismissed the project because it was incomplete, but opposition came from local residents who feared that the giant turbines would damage tourism and harm real estate values. In the aftermath of that event, the Ashe County commissioners adopted a new ordinance regulating the size and the placement of wind power systems in unincorporated areas of the county.

In June 2007, the western North Carolina resort town of Blowing Rock banned wind turbines because of concerns that the towers would obstruct mountain views. Other counties may follow suit, compounding existing statutory barriers with a low level of public acceptance of wind development projects in western North Carolina.

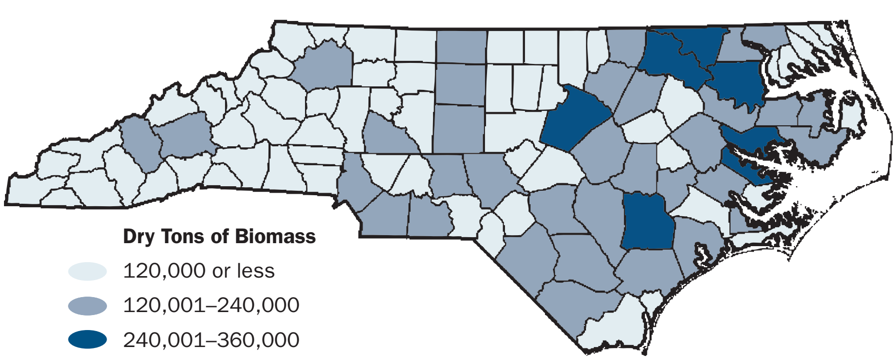
Wind facilities can be sited in three other locations: the coastal plain, state waters, and federal waters, offshore. Each location has its own local, state, and federal jurisdictional requirements.

The best potential for wind power in North Carolina is near the ocean or the sound close to transmission lines for electricity distribution (see Figure 5). However, high winds and water turbulence can easily damage ocean-based and coastal wind turbines. Thus, inland coastal regions or sites around the sounds are much more attractive. Making sounds even more appealing is the ease of acquiring permits for the largely undeveloped land.

Any offshore (more than three miles out) wind-power project in North Carolina would trigger federal permitting requirements, administered by the U.S. Army Corps of Engineers and by the U.S. Environmental Protection Agency (through the Clean Water Act), as well as North Carolina's regulatory mechanism (through the Coastal Area Management Act, CAMA). To date, there has not been a successful offshore wind project in the continental United States, but the proposed Cape Wind project off the coast of Massachusetts is currently in the permitting process. If successful, it would begin manufacturing and construction of turbines in 2010. Offshore wind power also has been pursued in Delaware, where Bluewater Wind wants to build the country's biggest offshore wind farm several miles out from Rehoboth Beach. Further, a New York–based firm has submitted the first proposal for a major wind farm off the Rhode Island coast. Projects off the coasts of New York and Texas are in various stages of planning and development, so the first United States offshore wind project will probably be forthcoming in two to three years.

Onshore wind-power projects in North Carolina require permitting through the CAMA process and must meet any county zoning and construction requirements. North Carolina is currently considering three such projects around Morehead City. Most recently, the Golden Wind Farm has sought permission from the North Carolina Utilities Commission to build three windmills in Carteret County that would generate 4.5 megawatts of electricity, for about nine hundred residences. In the wake of those proposals, in March 2008 the Carteret County Commissioners issued a nine-month moratorium on issuing permits to build windmills, to allow the county time to develop and consider regulations. But whether wind power will become a viable renewable resource in North Carolina remains to be seen.

Figure 6. **Potential for Biomass Fuel in North Carolina, by County**



Source: From Alex Hobbs, "Use of Agricultural and Forest Waste as a Distributed Generation Power Resource in North Carolina" (Raleigh: North Carolina Solar Center, April 27, 2005), www.energy.appstate.edu/reed/docs/hobbs.pdf.

Biomass Fuel

North Carolina has abundant underused biomass distributed across the state. The La Capra study found wood and agricultural waste to have the largest potential to contribute to a REPS.[12] According to an assessment by the North Carolina Biomass Council, woody biomass and agricultural waste could provide almost 1,100 megawatts of electrical capacity.[13] Even though the practical potential for wind power in North Carolina may be greater in terms of megawatt capacity, biomass facilities, with a higher "capacity factor," are likely to contribute a larger share of the energy. The capacity factor of a power plant is the amount of energy it actually produces, divided by the total amount of energy it could have produced operating at full capacity over a specified time period.

Many counties in North Carolina have biomass potential (see Figure 6). The counties with the lowest per capita income tend to have economies based on agriculture and therefore stand to benefit the most from biomass fuel development.

The wide distribution of biomass in North Carolina makes clear that the future of distributed generation must take center stage. Distributed generation implies smaller plants close to the source of input.

Unlike midwestern states such as Iowa, where corn and soybeans are currently the biofuels feedstock of choice, North Carolina has a comparative advantage in "lignocellulosic biomass"—plant fibers containing lignin and cellulose—and animal waste. In total forest acreage, North Carolina ranks fourth in the country. According to 2004 statistics, North Carolina ranks second in hog and pig production (behind Iowa).[14] Of the potential energy that could be generated using biomass, 57 percent could come from forest resources, and 10 percent from animal waste (see Table 1).

Solar Energy

Solar energy is not as cost-effective as wind power, but it is likely to gain national market share in the years ahead and within North Carolina, given the set-aside requirements in the REPS.

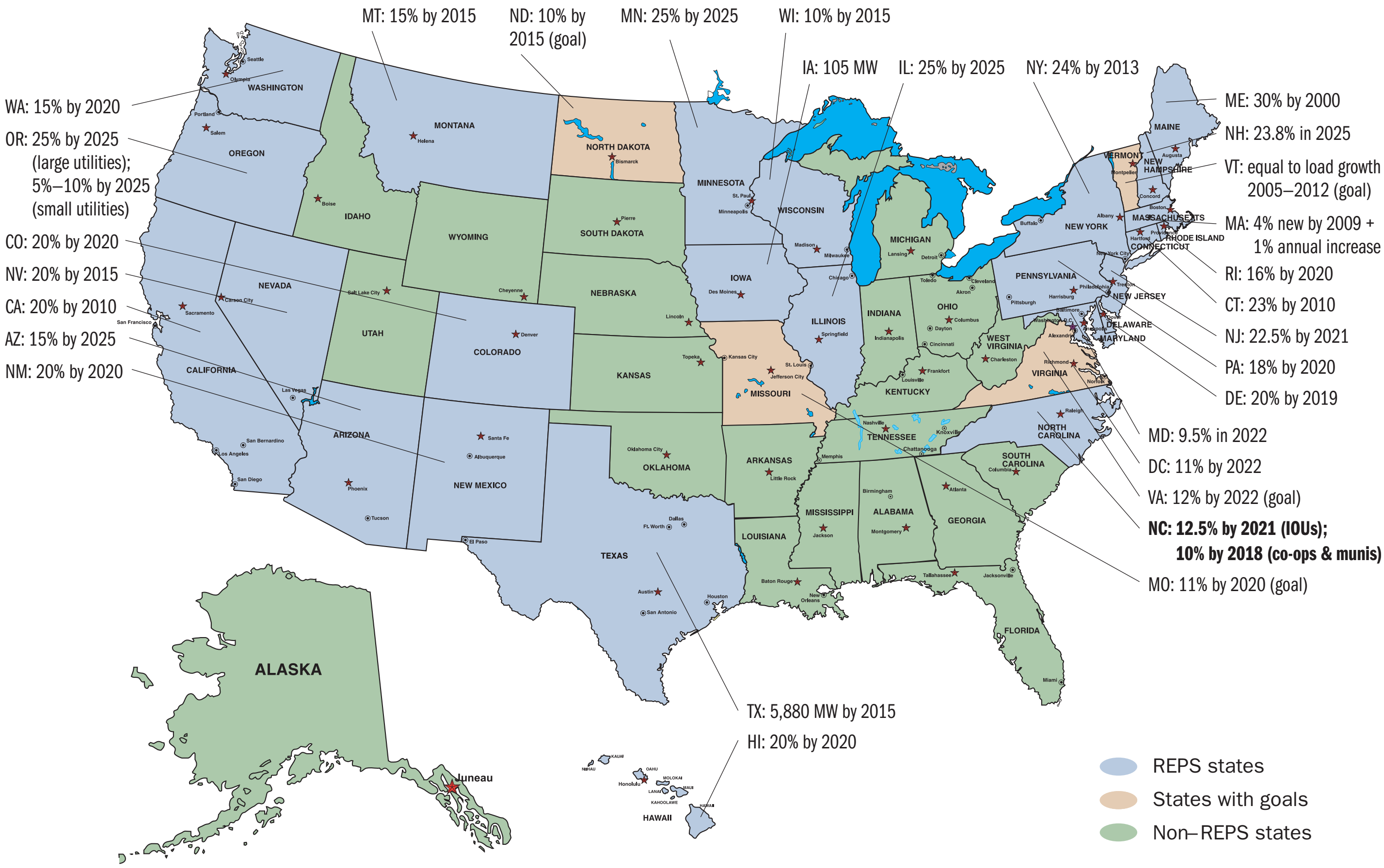
Table 1. **Key Biomass Resources in North Carolina**

Biomass Resources	Quantity	Units	Total Energy† (Trillion BTUs)	Ethanol (Gallons/year)	Biodiesel (Gallons/year)	Electricity§ (MW)
Softwood	1,894,305	Tons/year	32.20			314
Hardwood	2,061,063	Tons/year	35.04			342
Pulpwood	4,779,566	Tons/year	81.25	382,365,280‡		
Wheat Straw	60,413	Tons/year	0.94			9
Corn Stover	963,494	Tons/year	14.26			139
Corn Grain	78,125,000	Bushels/year	15.04	195,312,500		
Sweet Potato	24,500,000	Bushels/year	1.39	18,014,000		
Soybeans	39,420,000	Bushels/year	7.16		60,480,000	
Yellow Grease	115,000,000	Pounds/year	1.18		10,000,000	
Animal Rendering	323,400,000	Pounds/year	5.10		43,120,000	
C&D Wood Waste	897,784	Tons/year	15.26			149
MSW Wood Waste	836,779	Tons/year	14.22			139
Poultry Litter	1,415,988	Tons/year	10.77			105
Hog Waste	9,900,000	Hogs	9.53			93
Landfill Gas	30	Landfills	15.44			150
Total			**259**	**595,691,780**	**113,600,000**	**1,440**
% of NC Consumption (fossil energy, gasoline, diesel, and electricity respectively)			**10.25%**	**10.12%**	**7.70%**	**6.00%**
Energy Crops*						
Canola	300,000	Acres	4.26		36,000,000	
Hulless Barley	300,000	Acres	4.23	54,480,000		
Industrial Sweet Potato	35,000	Acres	1.95	25,360,000		
Switchgrass	263,132	Tons/year	4.21	21,050,560		
Hybrid Poplar	302,909	Tons/year	5.15			50
New Total			**277**	**696,587,046**	**146,600,000**	**1,490**
New % of NC Consumption (fossil energy, gasoline, diesel, and electricity respectively)			**10.95%**	**11.83%**	**10.20%**	**6.60%**

Table 1 includes the biomass resources available in North Carolina and potential energy crop production. *Derived from replacing 1/2 of North Carolina's winter wheat acres with canola, the other 1/2 with hulless barley, doubling the sweet potato acreage with industrial types, and planting all 104,000 acres of conservation land with switchgrass and hybrid poplar. †Only the energy content of the gallons produced was included for biofuels feedstock. ‡If ethanol is produced at 80 gallons per ton. §Note that more power could be produced per unit of biomass if the biomass is co-fired, but that was not included here.

Source: Reprinted from Ben Rich, *The North Carolina Biomass Roadmap: Recommendations for Fossil Fuel Displacement through Biomass Utilization* (Raleigh: North Carolina Biomass Council, 2007), 12, www.saferalliance.net/renewsouth/North%20Carolina%20Biomass%20Roadmap%202007.pdf.

Figure 7. **States with a REPS or a Renewable Energy Goal, 2007**



Source: Updated from La Capra Associates, GDS Associates, and Sustainable Energy Advantage, *Analysis of a Renewable Portfolio Standard for the State of North Carolina* (Boston: La Capra Associates, 2006), www.ncuc.commerce.state.nc.us/rps/NC%20RPS%20Report%2012-06.pdf. REPS = renewable energy portfolio standard. MW = megawatts. IOUs = investor-owned utilities. Co-ops = cooperatives. Munis = municipally owned utilities.

Solar energy can be used to heat homes with panels on the roof (either through the photovoltaic effect or by the heating of a transfer fluid to produce steam to run a generator) and through hot water systems or other heating technologies.

As of 2006, the total installed capacity of solar hot water systems was 105 gigawatts-thermal, and growth was 10–15 percent per year. China is the world leader in deployment of solar hot water systems, with 80 percent of the market, but Israel is the per capita leader in use of solar hot water, with 90 percent of homes using this technology.[15] As with wind energy, the United States is significantly behind other countries in the use of solar energy.

Solar energy faces considerable challenges, though. First, on average, every square meter exposed to direct sunlight will receive about 1 kilowatt hour of solar energy per hour. However, sunlight provides useful energy for only about six to seven hours per day because during the early and late hours of the day, the angle of the sun's light is too low. This circumstance creates a need to store energy.

Second, the capital cost of installation of solar panels and hot water storage and piping is high. The financial payback may be two to three years out for solar hot water heaters, longer for solar photovoltaic systems.

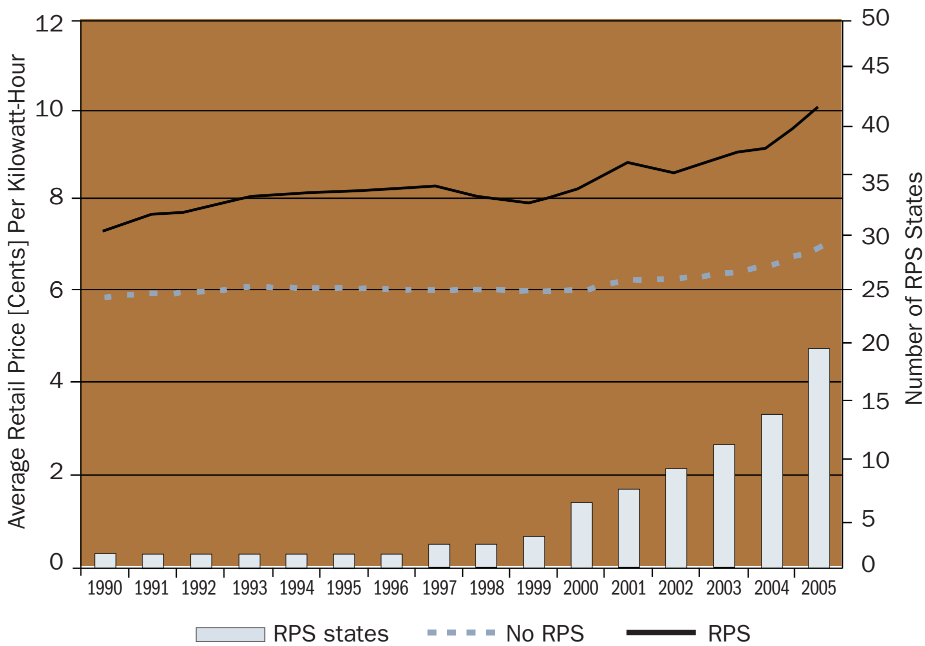
Third, many do not regard solar panels on the roof as attractive. With the passage of the REPS statute, however, homeowner associations may not use convenants or other provisions to restrict solar panels on roofs, as they could in years past.

According to Michael Shore, co-owner of FLS Energy, a solar technology company located in Black Mountain, North Carolina, three or four companies in the state operate solar energy on a commercial scale doing large projects, and about twenty-five small companies install solar energy as a byproduct of their business.[16]

FLS Energy, in fact, recently completed installation of one of the nation's largest hot-water systems at the Proximity Hotel in Greensboro, North Carolina. Designed to become the greenest hotel in the country, the Proximity has one hundred solar panels on its roof.

FLS Energy is working with homeowners, businesses, and others in the western part of the state to make solar hot water a mainstream option. Shore believes that business owners need education to realize the benefits of a solar system. Financial incentives through the renewable energy tax credit (discussed in more detail later) and a federal tax credit are making solar energy more attractive. North Carolina, though, still trails behind California, Colorado, and New Jersey, which are poised to become major solar-power states.

Figure 8. **Effect of a REPS on Average Annual Electricity Rates**



Source: Reprinted from Daniel Hansen, Laurence Kirsch, and Michael O'Sheasy, "An Analysis of the Effect of Renewable Portfolio Standards on Retail Electricity Prices," 4, www.caenergy.com/downloads/Hansen_Kirsch_OSheasy_RPS_Price_Effect.pdf. RPS = REPS, renewable energy portfolio standard.

Lessons from Other States: Challenges and Opportunities for North Carolina

Given this backdrop on renewable energy resources in North Carolina, what can the state learn from other states' experience?

Renewable Energy Markets

REPSs now have been enacted in more than twenty states (see Figure 7). The statutes differ substantially from one state to the next, and the standards vary on the basis of structure, size, application, eligibility, and administration. The standards typically apply to regulated investor-owned utilities and energy service providers. More than half of the REPS states are in "deregulated markets" —that is, markets with a new regulatory framework for the retail sale of electricity that covers the production of power and separates the sale of energy from the delivery of it. However, REPSs are increasingly appearing in monopoly markets as well, as is the case in North Carolina. Approximately one-third to one-half of the electricity portfolio mix in the United States now is covered by a state REPS or a required renewable energy percentage.[17] Operating experience with the policy is growing, but few states have more than five years' experience. The potential impact, however, is several thousand megawatts of new renewable energy capacity.

The most successful states in renewable energy have several characteristics in common, such as new development of renewable energy sources, a strong enforcement mechanism, and reasonable and stable costs. These states include Texas, with several thousand megawatts of wind power installed since its statute was enacted in 1999, and Iowa and Minnesota, both of which have met wind power and biomass fuel mandates.

North Carolina faces two challenges, which may limit the overall success of its REPS. First, the majority of states with REPS have set aside funds to support renewable energy sources on a large scale. North Carolina has not done so. Massachusetts and New York, for example, have a public benefits fund in their statutes, which raises revenue through a small surcharge per kilowatt hour for investment in renewable energy technologies. North Carolina's investment in renewable energy technologies will depend on the actions of Duke Energy and Progress Energy and the findings of current research at the state's higher education institutions.

The second challenge is the enforcement mechanisms in the North Carolina statute. Although the statute requires the North Carolina Utilities Commission to promulgate rules regarding enforcement, without a clear commitment from the commission to enforce the statute with monetary penalties, the statute will function more like a goal than a requirement. Some states require utilities to make "alternative compliance payments" if they do not procure sufficient amounts of renewable energy, with penalties ranging from $20 per megawatt hour to more than $50 per megawatt hour. States with these enforcement mechanisms naturally have better compliance and often are the ones that have long-term contracts with renewable energy suppliers.

Two other factors, though, will positively affect North Carolina's future market for renewable energy: (1) rising costs of production for conventional energy sources and (2) tax credits for renewable energy. North Carolina can expect energy demand to begin to outpace energy supply (assuming that no efficiency measures are successful) by about 2015. What role renewable sources will play in the future mix of energy supply remains unknown, but the rising cost of coal and nuclear energy sources makes renewable sources more attractive. Higher costs for traditional power plants will be passed on to ratepayers, and renewable sources will become more cost-competitive by comparison.

For example, in late 2004, Duke Energy started planning a pair of coal-fired power plants to replace several built years ago at Cliffside. In May 2005, the company told the North Carolina Utilities Commission that it wanted to spend approximately $2 billion to build two 800-megawatt units. But eighteen months later, Duke Energy said that the cost had risen to $3 billion. The North Carolina Utilities Commission eventually agreed to Duke Energy's building only one of the plants. In May 2007, Duke Energy said that one coal plant would cost $1.83 billion, an increase of more than 80 percent from the original estimate.[18] Nuclear-power construction projects would face the same fate because the required building materials—copper, nickel, stainless steel, and concrete—are rising in cost.

North Carolina has a renewable energy tax credit that helps finance an installed system (35 percent of the cost of the installed system, up to $2.5 million per project), and federal tax credits are available as well. Both the rising costs for conventional energy sources and the tax credits positively affect the market for renewable energy. However, the state will fall far short of its potential in the renewable energy market because of (1) the lack of a public benefits fund for developing promising technologies into commercial application, (2) the uncertain future of a REC market—an important trading platform for renewable energy firms looking to finance their investment—and (3) the unknown future of distributed generation, energy storage technologies, and the management of a southeastern regional grid.

> **The top ten states for investment in energy efficiency are in the Northeast or on the West Coast.**

Rate Impacts of North Carolina's REPS

State REPS policies could have substantial impacts on electricity markets, ratepayers, and local economies. Unfortunately, the actual costs (and benefits) of state REPS policies have not been compiled in a comprehensive fashion, in part because of the early stage of policy implementation and limited data. Nonetheless, in most instances, there is little evidence of a sizable impact on average retail electricity rates.

The impact of a REPS on retail electricity rates in North Carolina is a contested issue. According to the La Capra study, a 5 percent REPS would increase average retail electricity rates by less than 1 percent.[19] Other reports looking at retail-rate impacts of renewable energy adoption offer a similar conclusion. For example, a "meta-analysis" (a systematic study of the results of prior studies) conducted by the Lawrence Berkeley National Laboratory found that 70 percent of states that had adopted a REPS forecast increases in retail electricity rates of no greater than 1 percent.[20] The general conclusion that may be drawn is that most studies thus far do not foresee dramatic increases in retail electricity rates after REPS adoption. These predictions corroborate the conclusions of the La Capra study.

The EIA has investigated the possible impacts of existing state REPS programs on a regional basis. It projects modest electricity price impacts both regionally and nationally—plus or minus 1 percent when compared with a case in which no REPS has passed.[21]

For a comparison of average electricity rates for REPS and non–REPS states, see Figure 8. The bars at the bottom of the figure show the number of REPS states in each year. Both REPS and non–REPS states experienced an increase in average prices starting in 2000. However, the rate of increase for REPS states was higher following the year 2000.

Often, though, states that have faced higher electricity prices have adopted REPS legislation. As an example, natural gas prices have increased substantially since 2000, and the increase has encouraged California and several states in New England to turn to the REPS as one solution. Southern states as a whole, though, have historically had lower electricity prices and therefore are notably not well represented among the REPS states in Figure 7.

Energy Efficiency

The Southeast is presented with an important opportunity to take action on energy efficiency to supplement its efforts to develop renewable energy sources. A recent report by the American Council for an Energy-Efficient Economy developed a comprehensive ranking of state-level energy efficiency policies, the State Energy Efficiency Scorecard for 2006. The scorecard graded each state on actions taken to adopt energy-efficient programs and ranked states on the basis of their progress in eight categories of energy efficiency policy: (1) spending on utility and public benefits programs; (2) energy-efficiency resource standards (which require utilities to meet targets for electric and gas energy savings); (3) combined heat and power (use of a power station to generate electricity and power; in cogeneration, thermal energy is not wasted); (4) building energy codes (codes for energy efficiency in constructing and maintaining buildings); (5) transportation policies; (6) standards for efficiency of appliances and equipment; (7) tax incentives; and (8) state investment in research and development.[22]

According to the report, the top ten states for energy efficiency investments are California, Connecticut, and Vermont (tied for first); Massachusetts; Oregon; Washington; New York; New Jersey; and Rhode Island and Minnesota (tied for ninth).[23] The clear winners are in the Northeast and on the West Coast, in part because of their limited in-state supplies of conventional energy resources. By contrast, the states that are ranked lower (which include most of the Southeast, including North Carolina) have an abundant supply of inexpensive traditional energy sources. However, as the prices of coal, oil, and natural gas continue to rise and as global climate change gains traction in the public consciousness, more and more states will turn to energy efficiency as a sound investment measure.

North Carolina's largest investor-owned utilities have recently made tremendous investments in energy efficiency. Duke Energy has proposed to reduce growth in power demand by 1,700 megawatts in four years through a program called Save a Watt. Customers will pay for the program with an energy efficiency "rider" that will be included in their power bill and adjusted annually. Energy efficiency programs will cost customers only about 90 percent of what a new power plant would cost. As energy efficiency results are realized, Duke Energy will retire up to 800 megawatts of older coal plants.[24]

For its part, Progress Energy has announced that it will displace 2,000 megawatts of power through demand-side management and energy efficiency programs. In addition, it will not propose any new coal plants during a two-year period of energy efficiency evaluation.[25]

Economic Development Opportunities in the New Energy Economy

North Carolina can and should capitalize on the economic development opportunities inherent in the new energy economy. This economy will likely create new industries, companies, and jobs while helping address important environmental problems. The public and private sectors must engage in a discussion that leads to explicit strategies for state and local government involvement in the transformation.

Evidence suggests that policies such as REPSs, energy efficiency requirements, and biofuels standards can expand the economy and increase employment through a reallocation of resources away from imported energy. New energy sources cultivated within the state (such as biomass and solar power) and increased measures of energy efficiency are more labor-intensive than the traditional sources they displace. "Sector-specific" economic opportunities—development of entirely new areas of comparative advantage at the state level, based on production and delivery of low-carbon energy sources—including research networks, manufacturing, construction and installation, and maintenance, as well as associated services such as finance, legal arrangements, and the brokering of RECs, can make North Carolina a leader in the Southeast and bring jobs to the state.

The states and the region that have been successful in this endeavor—California, Texas, and New England—have the following characteristics in common: strong demand, adequate physical infrastructure, a local labor pool, access to early-stage equity investment, a supportive tax and regulatory environment, and appropriate roles for state government in building up these foundations. North Carolina has the ability to lead if it capitalizes on the opportunities before it.

Notes

1. Todd Cherry, "Energy Supply Issues in North Carolina" (paper prepared for the Institute for Emerging Issues, April 2007), http://ncsu.edu/iei/programs/energy-environment/resources/documents/energy-supply.pdf).
2. Ibid.
3. Natural Resources Defense Council, *Addicted to Oil: Ranking States' Oil Vulnerability and Solutions for Change* (New York: Natural Resources Defense Council, July 2007), http://docs.nrdc.org/air/air_07061901a.pdf.
4. For more information about the data, visit www.eia.doe.gov/cneaf/electricity/st_profiles/north_carolina.html.
5. For more information about NC GreenPower, visit www.ncgreenpower.org.
6. Ibid.
7. S.L. 2007-397, Act of Aug. 20, 2007, available at www.ncleg.net/EnactedLegislation/SessionLaws/HTML/2007-2008/SL2007-397.html.
8. La Capra Associates, GDS Associates, and Sustainable Energy Advantage, *Analysis of a Renewable Portfolio Standard for the State of North Carolina* (Boston: La Capra

Aspects of Energy Use and Capacity in North Carolina

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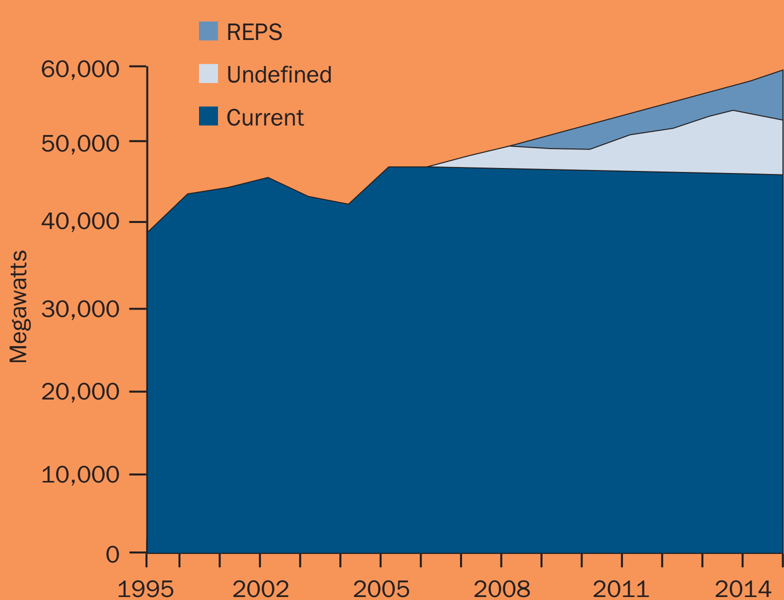
Chart 7. **Historical and Projected Needs for Electricity-Generating Capacity in North Carolina, 1995, 2000–2015**



Sources: Data from 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* (Raleigh: North Carolina Utilities Commission, October 2007), www.ncuc.commerce.state.nc.us/reports/report.htm; S.L. 2007-397, ncleg.net/Sessions/2007/Bills/Senate/HTML/S3v6.html. Capacity is displayed in terms of summer peak demand.

The potential output of electricity-generating equipment is called "capacity." In 2007, North Carolina companies had about 48,000 megawatts (MW) of capacity. That is, if the entire capacity were to operate for one hour, it would generate 48,000 megawatt-hours (MWh) of electricity. As the state grows, the demand for electricity increases, so the state's capacity to generate or acquire electricity must increase. The "Undefined" portion of the figure reflects capacity needs anticipated by electric service providers. The "REPS" portion reflects renewable energy and energy efficiency capacity as mandated in SL 2007-397, the state's new law on standards for renewable energy and energy efficiency. Duke Energy and Progress Energy together have about 95 percent of the electricity-generating capacity in the state, serving 1,730,000 and 1,200,000 customers, respectively. Dominion North Carolina Power serves about 116,000 customers and generates about 5 percent of state power. Nineteen percent of sales are to wholesale markets, mostly cooperatives and municipally owned electric utilities.

Associates, 2006), www.ncuc.commerce.state.nc.us/rps/NC%20RPS%20Report%2012-06.pdf.

9. Ibid.

10. For more information on the Danish wind industry, visit www.windpower.org, the website of the Danish Wind Association, a nonprofit group whose purpose is to promote wind energy within Denmark and abroad.

11. American Wind Energy Association, "Installed U.S. Wind Power Capacity Surged 45% in 2007: American Wind Energy Association Market Report" (press release, January 17, 2008), www.awea.org/newsroom/releases/AWEA_Market_Release_Q4_011708.html.

12. La Capra Associates et al., *Analysis of a Renewable Portfolio Standard*.

13. Ben Rich, *The North Carolina Biomass Roadmap: Recommendations for Fossil Fuel Displacement through Biomass Utilization* (Raleigh: North Carolina Biomass Council, September 2007), www.saferalliance.net/renewsouth/North%20Carolina%20Biomass%20Roadmap%202007.pdf.

14. *See*, for example, the history of North Carolina's hog industry at www.duke.edu/web/mms/90hogfarming.

15. Worldwatch Institute, *Renewables 2007: Global Status Report* (Paris, France: Renewable Energy Policy Network for the 21st Century, December 2007), www.ren21.net/pdf/REN21_GSR2007_Prepub_web.pdf.

16. Michael Shore (co-owner of FLS Energy), interview by Diane Cherry, October 2007.

17. U.S. Department of Energy, Energy Efficiency and Renewable Energy, State Activities and Partnerships, "States with Renewable Portfolio Standards" (June 2007), www.eere.energy.gov/states/maps/renewable_portfolio_states.cfm.

18. Matthew Wald, "Costs Surge for Building Power Plants," *New York Times*, July 10, 2007, www.nytimes.com/2007/07/10/business/worldbusiness/10energy.html.

19. La Capra Associates et al., *Analysis of a Renewable Portfolio Standard*.

20. Ryan Wiser et al., "The Experience with Renewable Portfolio Standards in the United States," *Electricity Journal* 20, no. 4 (May 2007): 8–20; Ryan Wiser et al., "Renewables Portfolio Standards: A Factual Introduction to Experience from the United States," LBNL-62569 (manuscript submitted to *Electricity Journal*, April 2007), http://eetd.lbl.gov/ea/EMS/reports/62569.pdf.

21. Energy Information Administration, *Impacts of a 15-Percent Renewable Portfolio Standard*, Report no. SR-OIAF/2007-03 (Washington, DC: Energy Information Administration, 2007), www.eia.doe.gov/oiaf/servicerpt/prps/index.html.

22. American Council for an Energy-Efficient Economy, "State Energy Efficiency Scorecard for 2006," www.aceee.org/pubs/e075.htm.

23. Ibid.

24. Duke Energy, "Energy Efficiency Joins Nuclear, Coal, Natural Gas and Renewables to Meet Duke Energy's Growing Customer Demand" (press release, May 7, 2007), www.duke-energy.com/news/releases/2007050701.asp.

25. Progress Energy, "Progress Energy Carolinas Sets Goal of Doubling Efficiency Savings to 2,000 MW" (press release, June 1, 2007), www.progress-energy.com/aboutus/news/article.asp?id=16202.

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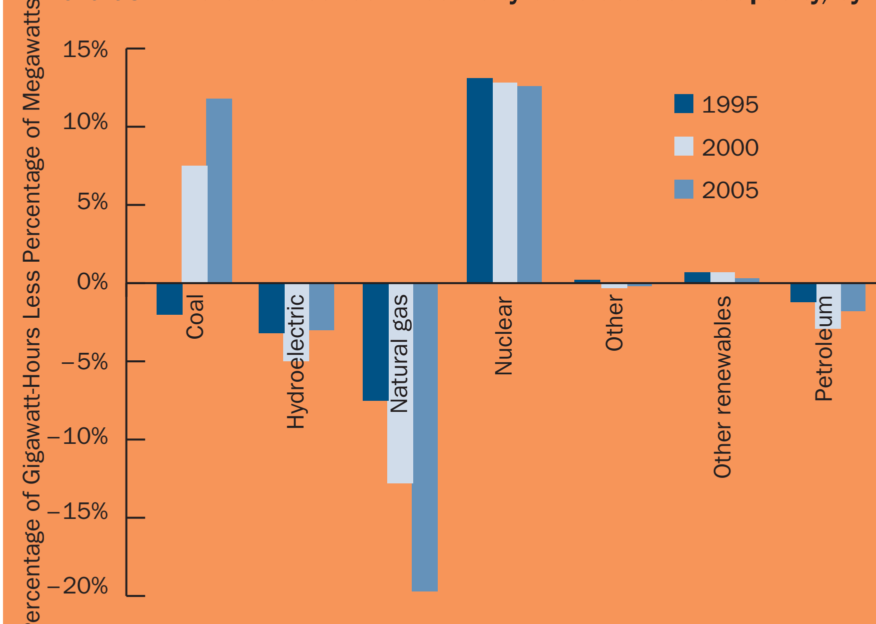
Chart 8. **Difference Between Electricity Generation and Capacity, by Source, 1995, 2000, and 2005**



Electricity generation depends on how often and how long each unit of electricity-generating capacity operates. Electric utilities determine how much electricity to generate on the basis of the demand for electricity, the price of fuels, and other factors. Electricity sources with a negative value in the figure have a higher share of generating capacity than of overall electricity generation. Coal and nuclear electricity-generating equipment represents "base-load generating capacity," or equipment that typically operates around the clock. Additional generating capacity, called "peak-load capacity," is used to meet short-term fluctuations in demand, such as those from air conditioners in the summer. The majority of peak-load capacity is fueled by natural gas, as demonstrated by the low rates of capacity use in the figure.

Source: Data from U.S. Department of Energy, Energy Information Administration, "North Carolina Electricity Profile," table 5, "Electric Power Industry Generation by Primary Energy Source, 1990 through 2006," www.eia.doe.gov/cneaf/electricity/st_profiles/ north_carolina.html. "Other" includes nonbiogenic municipal solid waste, batteries, chemicals, hydrogen, pitch, purchased steam, sulfur, tire-derived fuels, and miscellaneous technologies. It also includes "pumped storage hydroelectric," which is "hydroelectric power produced during times of peak power demand using water that was pumped to a reservoir during times of low power demand." "Glossary," www.eia.doe.gov/glossary/glossary_p.htm. "Other renewables" includes biogenic municipal solid waste, wood, black liquor, other wood waste, landfill gas, sludge waste, agriculture byproducts, other biomass, geothermal energy, solar thermal energy, photovoltaic energy, and wind.