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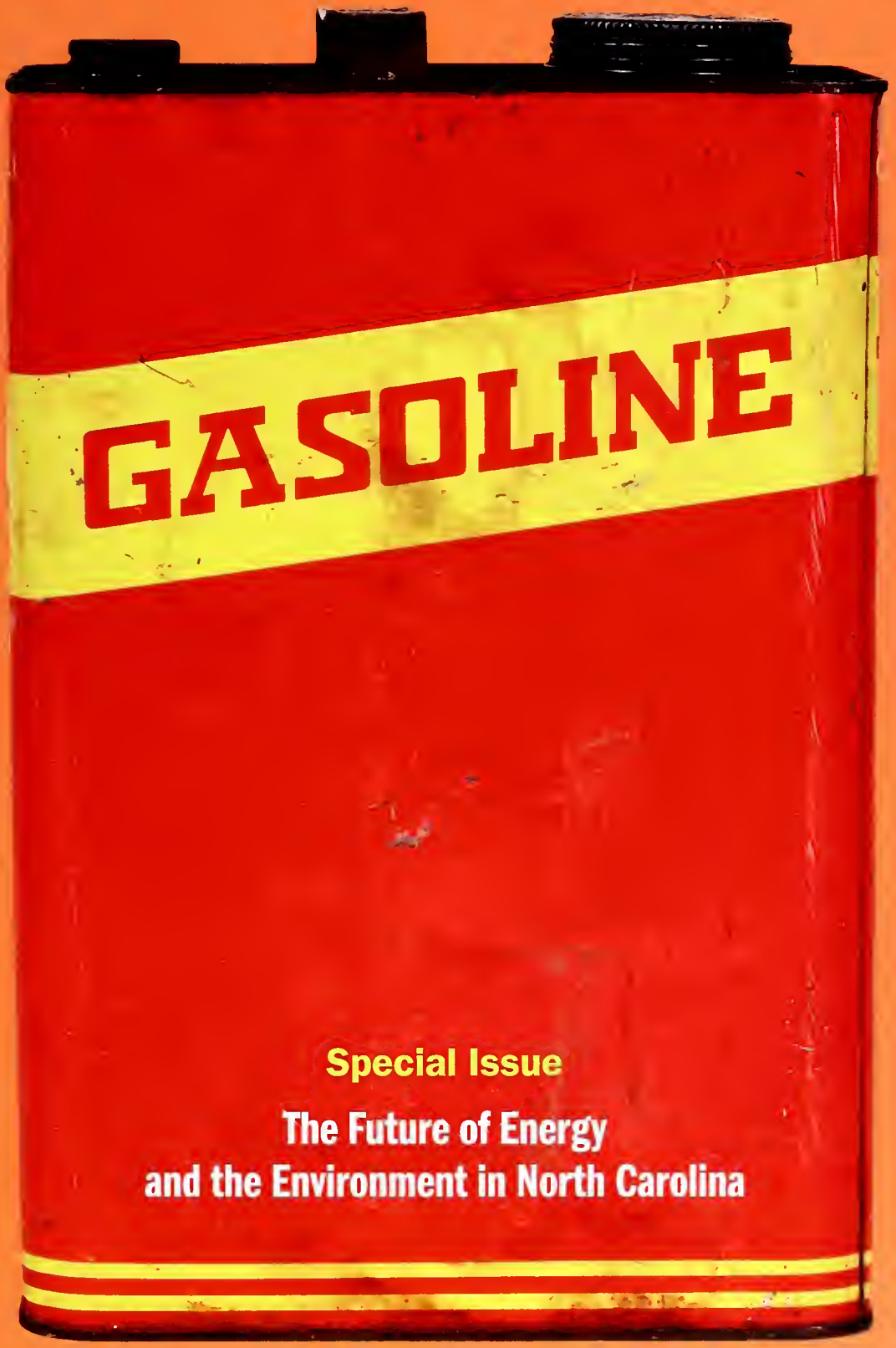

Special Issue

The Future of Energy and the Environment in North Carolina

Popular Government

James Madison and other leaders in the American Revolution employed the term "popular government" to signify the ideal of a democratic, or "popular," government—a government, as Abraham Lincoln later put it, of the people, by the people, and for the people. In that spirit *Popular Government* offers research and analysis on state and local government in North Carolina and other issues of public concern. For, as Madison said, "A people who mean to be their own governors must arm themselves with the power which knowledge gives."

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Popular Government

Spring/Summer 2008 • Volume 73, Number 3

We are pleased to offer North Carolina citizen leaders and government officials a special issue of *Popular Government* devoted to energy and the environment. With gasoline prices high and rising, and with vigorous debates taking place in the state and the nation about renewable energy sources, we think that you will find this set of six articles timely and useful.

The articles benefit from ten charts that are distributed across the issue. The charts were prepared by Dr. Dennis Grady and Jason Hoyle of the Energy Center of Appalachian State University, www.energy.appstate.edu.

Environmental and energy issues are complex. Further, they involve government at the national, state, and local levels; affect a wide range of business and consumer issues; and are critical to everyone's future. The state's energy choices in the next few years will shape the quality of life of North Carolinians for generations to come.

—Richard B. Whisnant and John B. Stephens, coeditors

ON THE COVER *Gasoline has been central to the mobility of people and goods in North Carolina. Will a new fuel source replace it in the twenty-first century?*

Feature Articles

Departments

Meeting the Challenge of Climate Change in North Carolina

Douglas Crawford-Brown

With the publication of the 2007 summary report of the Intergovernmental Panel on Climate Change (IPCC), global scientific agreement—not unanimous but overwhelmingly consistent—has emerged that human society has become a significant driver of the climate.[1] The potential impact of global climate change on North Carolina is perhaps the most daunting environmental challenge facing the state. The challenge comes from a number of key issues on which policy and other decisions must be made:

- Greenhouse gases linked to climate change are both natural and made by society. Society's contributions sit on top of a very large cycle of carbon in the environment. This fact may lead people to believe that actions in their communities are insignificant. However, North Carolina consists of the communities within it, and the collective actions of these communities, made possible by help from local and state government leaders, ultimately yield solutions to climate change.
- North Carolinians emit greenhouse gases in pursuit of important human needs: warmth, employment, the industrial products that make their lives enjoyable, and more. Policy responses must find ways to reduce emissions without sacrificing quality of life. A policy that fails to recognize this simple reality will not be sustainable.
- All North Carolinians are part of the cause of—and the solution to—climate change. Changes must come from all levels: the nation, the state, communities, energy sectors, institutions, and individuals. These actions must be coordinated because changes at one level can either enhance or prevent changes at other levels.
- There is significant uncertainty about the extent to which human activity brings about climate change, the effectiveness of any changes people might make, and the impacts of climate change on North Carolina. This uncertainty must be recognized and admitted, or people will cease to trust decision makers. Two possible sins are involved: the sin of failing to admit to uncertainty and the sin of hiding behind that uncertainty to avoid taking actions.

The author is director emeritus of the UNC Institute for the Environment and senior sustainability adviser for Pell Frischmann, a London firm. Contact him at dcrawford-brown@pellfrischmann.com.

This article is designed to help communities across North Carolina sort through these issues. It is organized around a series of questions that communities might face in choosing a path forward. Readers who find the questions interesting and want to explore answers as they decide how their own communities should respond are invited to contact the UNC Institute for the Environment for advice and assistance.[2]

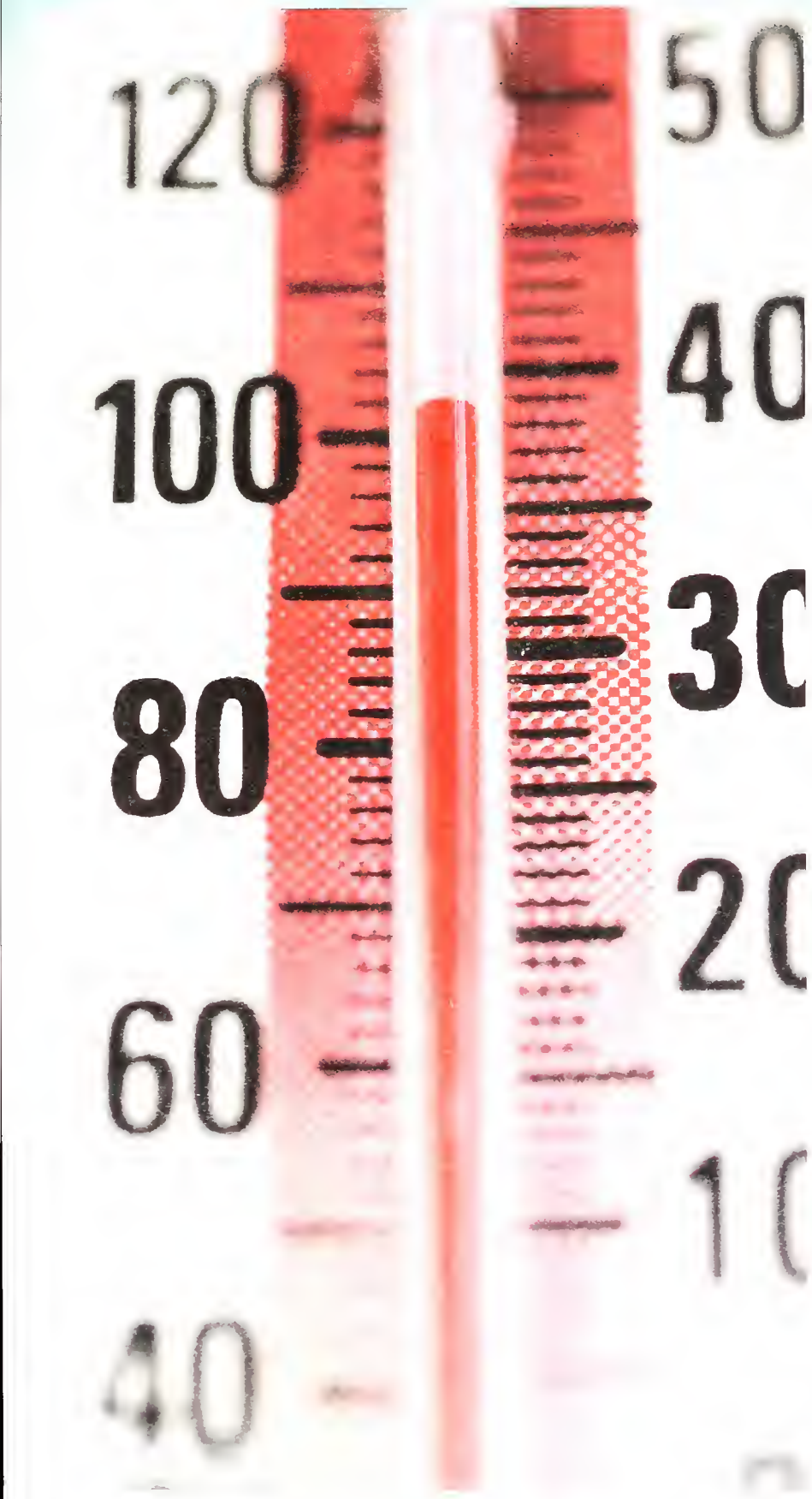
North Carolina exports almost $10 billion per year in energy costs.

Why Should There Be Any Action?

The science of climate change has grown immensely over the past twenty years. What began as a concern of only a few scientists, mired in profound uncertainty, has emerged as agreement among the vast majority of the scientific community. A few skeptics argue that society is having little or no impact on the climate, but the judgments of these few must be weighed against the conclusions of literally every major scientific organization in the world, including the U.S. National Academy of Sciences. The picture is not yet fully clear (it never is in science), but the threat of inaction is real and potentially troubling for North Carolina (see Figures 1a and 1b).

The impetus for action does not come only from concerns about climate change. The emission of greenhouse gases in North Carolina results largely (although not entirely) from the use of energy to power homes, businesses, and cars. Even if a policy maker does not believe in climate change or is not concerned about the effects it might bring, he or she must ask other key policy questions. Is there concern about the rising costs of energy in the homes, the businesses, or the communities of North Carolina? Is there a search for "energy security"—that is, a reduction of the state's dependence on other states or nations to power its economy? (North Carolina exports almost $10 billion per year in energy costs. These costs could be recaptured for use in economic development for North Carolina businesses.) In counties devastated by the loss of the tobacco and manufacturing sectors, are there opportunities to develop companies focused on the new sustainable energy systems?

An answer of yes to any of these questions leads to policy choices that focus on bringing sustainable energy supplies to North Carolina. These choices will at the same time produce



precisely the change in the state's energy system needed to combat climate change. North Carolina can be thought of as a community of consumers of material and energy, providers of materials and energy, and regulators that control the stage for this process. All the members of this community must be engaged to develop effective strategies, for all provide causes and solutions.

It is not yet clear what the exact impacts of climate change will be on North Carolina or when they might be expected to hit, but the scientific community is quite confident that the impacts will be sufficiently profound to warrant action now. For this reason, making climate change policies is best thought of as buying insurance against impacts.

The likely impacts include the following:

- A rising sea level that eventually will cover some of the most valuable coastal land in the state
- An increase in summer heat waves that are responsible for heat-related deaths
- An increase in pollutants such as ozone that are produced at higher temperatures
- An increase in extreme weather events such as hurricanes—a particular worry in North Carolina because the state sits at the center of the path of hurricanes moving up from the Atlantic
- Strong fluctuations in the availability of water, with both prolonged droughts and flooding from storms
- Increases in infectious diseases and allergies (and a longer allergy season)

- An array of economic hits, including loss of valuable land at the coast, a decline in the tourist industry, business interruptions due to extreme weather, and increasing health care costs associated with the changing rates of disease

As just one of many possible examples, a recent report for the National Commission on Energy Policy estimates that sea-level rise alone will result in the loss of almost $4 billion in real estate along the North Carolina coast before the end of the century.[3] All such costs will lower the economic efficiency of the state at precisely a time when it is going through profound economic changes due to the loss of its traditional economic base.

Who Should Take Action?

The joint U.K.–U.S. Community Carbon Reduction Program, with an arm in the United States run through the UNC Institute for the Environment, identifies six levels at which effective climate change policy must be addressed and coordinated in North Carolina (or anywhere): the nation, the state, communities, energy sectors, institutions, and individuals.[4] The need to tackle the problem at so many levels makes the creation of effective policy daunting.

The nation. Effective national policy is required to level the playing field across states and utilities. The policy undoubtedly will involve both a cap on emissions and creation of a "carbon market" or a "carbon tax." In a carbon market, companies that emit too much carbon dioxide would purchase additional emission quotas from companies that are emitting less than their quota. Under a carbon tax, every unit that emits carbon dioxide would pay a tax that would either go into a common pool to fund innovations in energy technologies or cause a rise in energy prices that would stimulate development of new technologies emitting less carbon dioxide.

Under either system, the price of carbon would need to be much higher than it currently is to stimulate the market ($50–$100 per ton rather than the present value of less than $10 per ton). Further, a patchwork of inconsistent strategies across states, coupled with an emerging national power grid that will allow North Carolinians to buy their energy from anywhere in the country, will pose a real problem for utilities based in this state. These utilities have stepped forward recently to solve environmental problems, but not all utilities in other states in the region have

Figure 1a. **Estimated and Desired Maximum Amounts of Carbon Dioxide in the Atmosphere with No Reductions in the Rate of Growth of Emissions over the Next 110 Years**

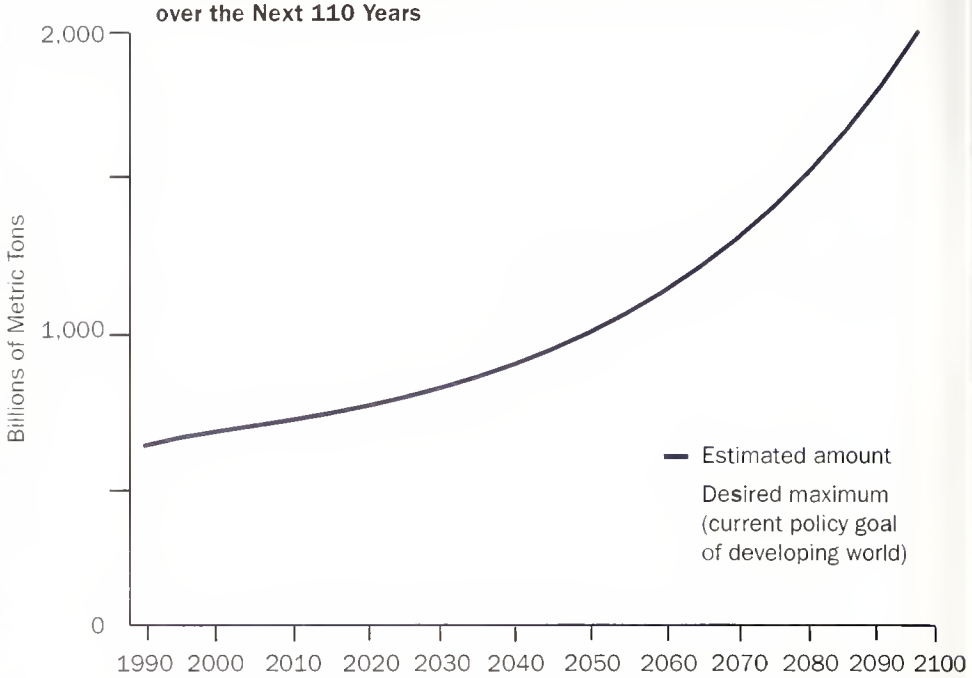
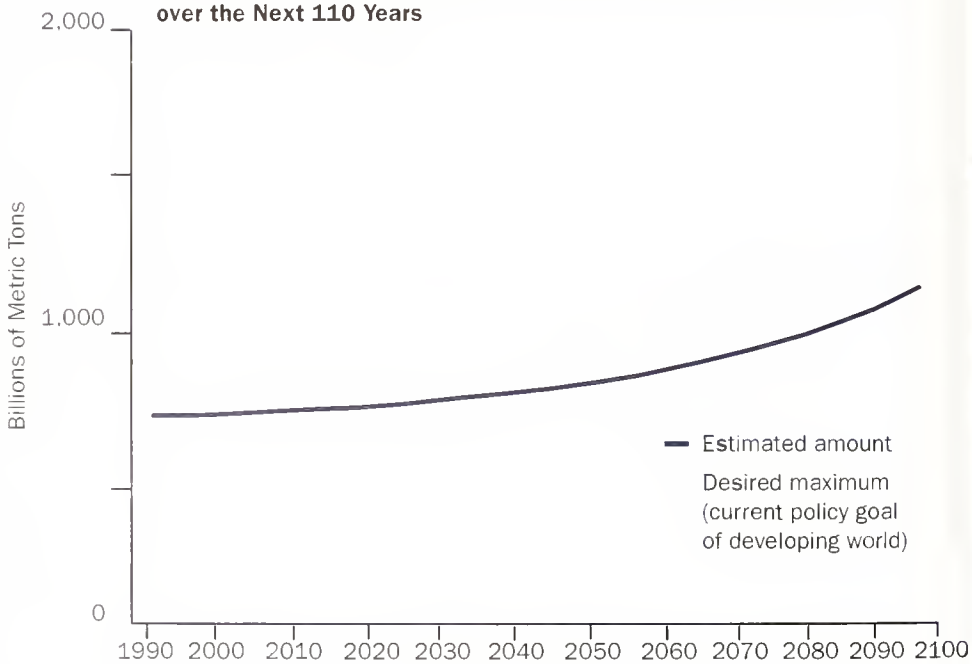


Figure 1b. **Estimated and Desired Maximum Amounts of Carbon Dioxide in the Atmosphere with 60% Reductions in the Rate of Growth of Emissions over the Next 110 Years**



Source: Based on a model published in Douglas Crawford-Brown and Sarah LaTocca, "Teaching Systems Principles and Policy Applications Using a Reduced-Scale Global Warming Model," *Journal of Geoscience Education* 54 (2006): 101–120.

taken comparable steps. As a result, North Carolina utilities will be attempting to sell electricity at rates above those of utilities in other southeastern states, and the public will vote in the market. State legislators should consider whether and how to support national policies aimed at leveling this playing field.

The state. The state government is quickly creating policies directed at the parts of the climate change problem it controls directly. The largest step has been the formation of the North Carolina Climate Action Plan Advisory Group and the North Carolina Legislative Commission on Global Climate Change, which are considering a series of strategies:[5]

- A Renewable Energy Portfolio Standard (REPS), which now has been passed by the legislature, requiring that about 12 percent of the state's energy be supplied through renewable sources that reduce the effective emission of greenhouse gases either by using wind and solar and hydrological resources or by recapturing emissions in new plant growth in biofuels. There would be some allowance for improvements in energy efficiency as a way to meet this goal.
- Tightened requirements on the energy efficiency of state buildings, including those of the school system, which can reduce their energy use by 25–50 percent.
- Stimulation of the biofuels industry, which is both an environmental and an economic boon if done correctly (that is, without adversely affecting air quality in the state, given that many biofuels increase the amount of ozone).
- Changes in the building codes to require high efficiency in all new buildings constructed in the state.
- Provisions for increased public transport that will reduce the number of miles driven in personal vehicles in the state.

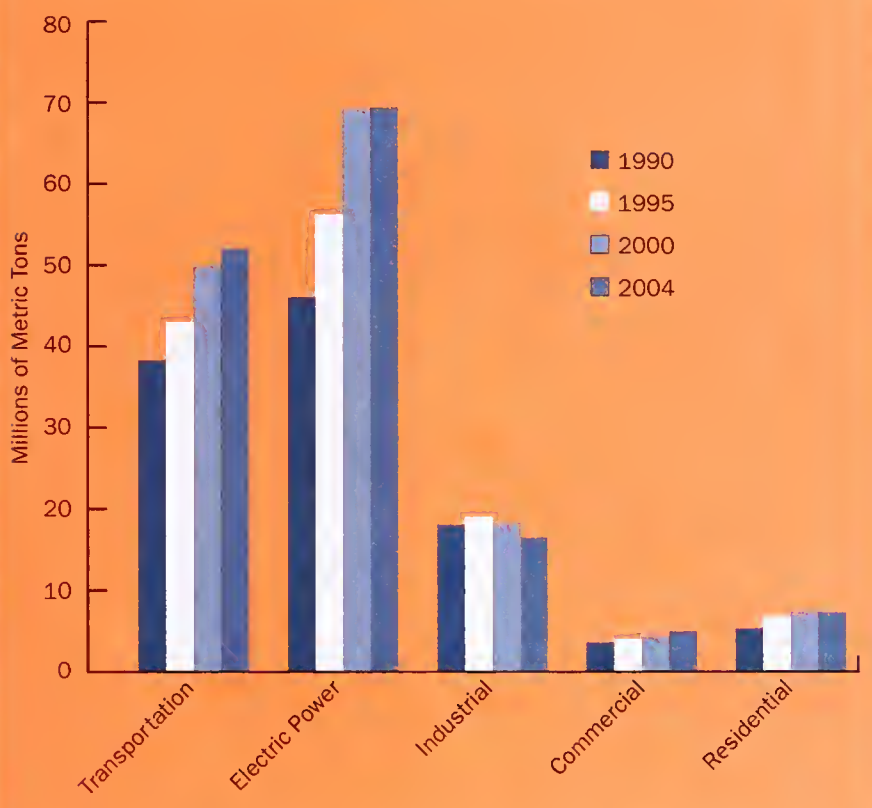
Communities. The amount of energy consumed depends critically on the design of communities: how they are laid out over the landscape, how they are connected by transportation systems, and so forth. More intelligent designs that group the locations that supply crucial human needs—housing, employment, shopping, and school—satisfy the same needs at greatly reduced levels of energy use. By properly co-locating places to live, work, shop, and go to school, communities can reduce their transportation emissions by 30–70 percent. In so doing, they can reach levels more typical of European communities, which produce one-half to one-third of the carbon dioxide per person that typical American communities do.

Most North Carolina communities were born during the era of the car. Simply erasing these communities and starting over would not be sustainable. But as new development arises, it can be along the lines of sustainable development, and older communities can be

Aspects of Energy Use and Capacity in North Carolina

Dennis Grady and Jason Hoyle

Chart 1. **Carbon Dioxide Emissions in North Carolina, by Sector, 1990, 1995, 2000, and 2004**



Greenhouse gas emissions from energy in North Carolina were about 150 million metric tons in 2004, an increase of 35 percent from the amount in 1990. The fastest-growing source of greenhouse gas emissions was the electric utilities, with a 50 percent increase between 1990 and 2004. However, implementation of clean air requirements has resulted in little change in total greenhouse gas emissions by electric utilities since 2000.

Source: Data from U.S. Environmental Protection Agency, "Climate Change—Greenhouse Gas Emissions, Energy CO2 Emissions by State," www.epa.gov/climatechange/emissions/state_energyco2inv.html.

greatly improved by bringing in support services (shops, new businesses, and so forth) to enhance the existing layout. Again, the message of climate change policy is not that communities must stop meeting needs. It is that they must meet needs much more sustainably than they currently do. The main power of communities in this regard is in permitting and zoning, offering many opportunities to assist in the development and the redesign of North Carolina.

Communities will need partners at the state level, however, to accomplish such ambitious changes. For example, the Department of Transportation could work with these communities on the system of roads, using department funds to create not only new roads for personal cars but facilities for walking and biking.

Energy sectors. A community also may be thought of as an interacting group of energy users: residential, commercial, industrial, and transportation. In fact, the various scientific organizations, including the Energy Information Agency, organize their databases on U.S. energy use in this way.[6] Effective policies can focus on any or all of these sectors, marshalling the sectors' resources to tackle climate change.

The most effective strategies at this level involve both the demand and the supply side. Utilities in North Carolina already are improving energy efficiency in their customers' homes and businesses.[7] Their efforts will be much more effective if joined on the demand side by equally aggressive state- and community-wide campaigns to improve the efficiency of residential, business, and industrial-sector operations. Communities can identify "champions" that will mobilize actions within their sectors. For example, the Chapel Hill Restaurant Group has taken the lead in the commercial sector by building in Durham the first restaurant in North Carolina striving for certification by the LEED (Leadership in Energy and Environmental Design) organization. Similar champions are arising in every community of North Carolina, providing a base of business and governmental leaders who will help push through needed improvements.

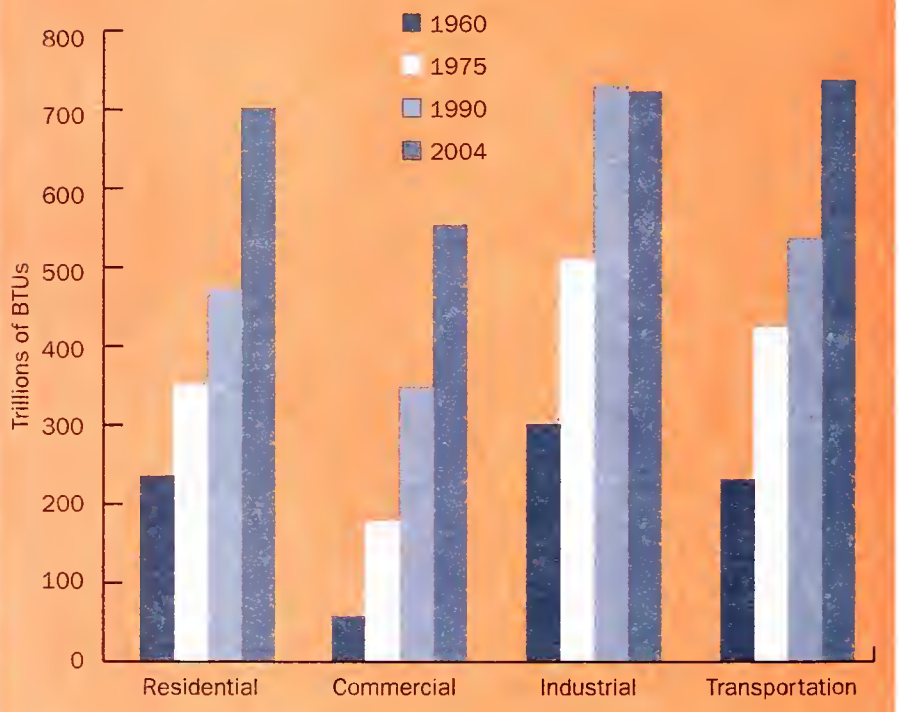
Institutions. One of the most powerful ways to move communities forward is to engage the institutions that are the major sources of greenhouse gases. In Chapel Hill, the municipal government has partnered with the University of North Carolina at Chapel Hill to form the first town-gown carbon-reduction demonstration project in the United States. Through this partnership, Chancellor James Moeser has set an ambitious goal of reducing campus emissions by 60 percent as of 2050, both by changing the campus infrastructure and by encouraging campus employees to reduce emissions in their daily lives. Further, town and gown have made the system of buses free, increasing bus ridership dramatically over the past several years. This change in turn has reduced emissions from the transportation sector.

Chapel Hill is far from alone on this front. Similarly exciting efforts can be found in Salisbury through the actions of Catawba College, in Boone through the efforts of Appalachian State University, and in other college towns. The university and community college

Aspects of Energy Use and Capacity in North Carolina

Dennis Grady and Jason Hoyle

Chart 2. **Total Energy Consumption in North Carolina, by Sector, 1960, 1975, 1990, and 2004**



Energy consumption in North Carolina rose at a compound annual rate of 2.7 percent from 1960 through 2004. Consumption in the commercial sector increased at nearly double the state's average, but the commercial sector remains the least-consuming one. Consumption in the residential and transportation sectors rose about 2.5 percent per year. In 2004, transportation became the leading energy-consuming sector in North Carolina.

Source: Data from U.S. Department of Energy, Energy Information Administration, "State Energy Consumption, Price, and Expenditure Estimates," www.eia.doe.gov/emeu/states/_seds.html.

system in North Carolina can become a powerful tool for moving communities forward as the campuses themselves adopt strategies to tackle climate change and reduce energy costs.

Individuals. At the base of the entire system of material and energy use in the state lie the consumers, the citizens of North Carolina. Like most other large environmental problems, climate change is most effectively tackled when it is understood as the responsibility of all parts of the community, including the individuals who ultimately drive the market through their daily decisions. To stimulate changes at the individual level, programs by the UNC Institute for the Environment, the Environmental Protection Agency, Environmental Defense, Duke Energy, and Progress Energy help consumers understand how and when they are producing greenhouse gases; how they can reduce the emissions through changes in their daily lives; where they can obtain the needed goods and services in their local communities; and how they can monitor their energy and material use so that they can see whether their actions have been effective.

There is an emerging sense in North Carolina of the possibility of sustainable development and growth.

Experience in the Community Carbon Reduction program suggests that even individuals who are committed to making changes in their lives to reduce carbon emissions quickly run into roadblocks in finding solutions and the resources to put the solutions in place. They do not know which actions are most cost-effective. They do not know where to find green goods and services. So the state must develop a system for informing the public about the ways to identify the most effective strategies for reducing emissions in daily life and for helping them find the resources to implement the changes.

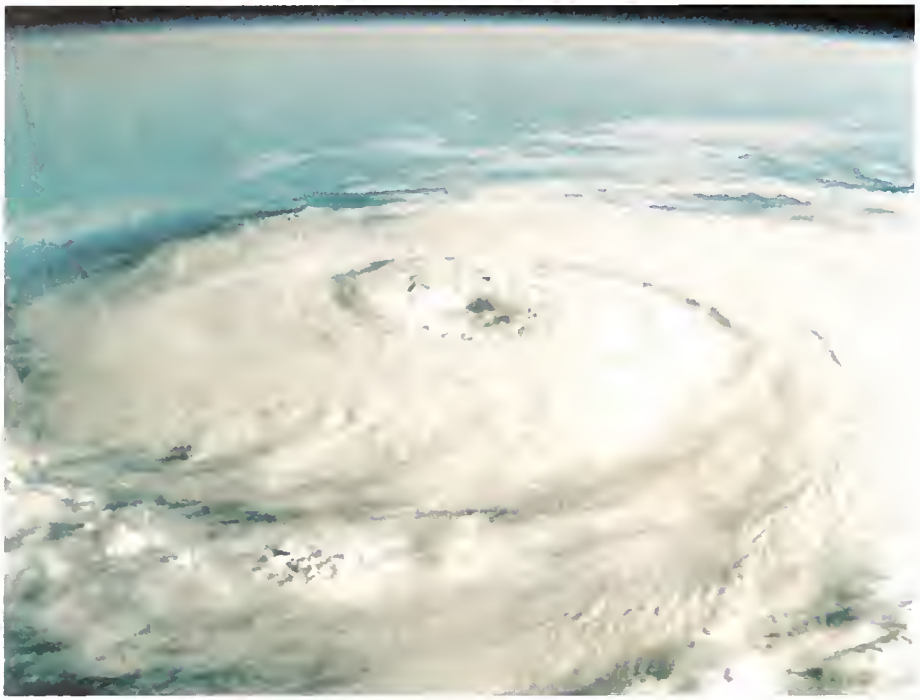
A good way to think about the six levels of climate change strategies in North Carolina is that each level is both an actor and a stage. For example, the town of Chapel Hill and UNC at Chapel Hill produced a strategy (free buses) that is reducing emissions in the transportation sector. In doing this, they are acting. But their actions also produce a stage on which individuals find it easier to use the option of buses. And what town councilor would continue to support a free bus system at the expense of taxpayers if individuals were not choosing to use buses? Those individuals set the stage (voting) on which the councilors will make their decisions.

How Can Policy Makers Allocate Resources to Adaptation or Mitigation?

Policy makers in the state are faced with finding resources for three initiatives linked to climate change policy: (1) reducing greenhouse gas emissions, (2) increasing the ability of plant life to absorb those emissions, and (3) preparing communities for whatever climate change does occur despite best efforts to stop it. The discussion so far has focused on reducing emissions, the core strategy to ensure that greenhouse gases do not build up to unacceptable levels. This strategy can be enhanced through a statewide effort to conserve forests and cropland, such as the One North Carolina Naturally program of the Department of Environment and Natural Resources.[8] By conserving and even regrowing significant tracts of land that have the capacity of absorbing and sequestering carbon dioxide, the state can in part offset its emissions, with the bonus of using this absorption as a base of revenue in the emerging carbon market.

Running a program of conservation in the state is a real challenge. There are dozens of major conservation groups, each with its own interests: recreational land, farms, source water, and so on. Coordinating the efforts of the groups will allow their collective resources to be tightly focused on the lands that provide the greatest potential for carbon capture and sequestration (such as forests). Add to this an increased willingness of conservation groups to work with developers, and vice versa, and there is an emerging sense in North Carolina of the possibility of sustainable development and growth. Sustainability as a tool for preventing climate change recognizes that the goal of society is not to prevent development or conservation, but to develop where it makes sense ecologically and to conserve areas that are crucial for reaching the goal of sequestering carbon dioxide.

Clearly, though, despite the best efforts of society, some climate change will take place anyway because of the vast amounts of carbon dioxide already stored in the oceans and the soils from past emissions. Even if all human societies completely stopped all carbon dioxide emissions, the stored carbon would go back into the atmosphere and raise levels for at least the next 100–200 years (although to levels lower than



More violent storms may be a product of climate change.

what humanity will see if it does not stop the emissions). So at least some of the impacts of climate change are in North Carolina's future, regardless of the choices made now on reducing emissions or increasing sequestration.

How can the state's communities become better able to withstand these threats as they arise? Communities need better land-use policies to ensure that houses and businesses are not placed in the most vulnerable areas near the coast. They need better emergency plans for coping with storms, including working with the Department of Transportation on evacuation paths. They need a medical system prepared to deal with increases in heat waves or flooding or a rise in allergies, or at least a system alert to these issues and regular updates as situations arise. They need to begin linking their water systems so that drought in one part of the state can be solved by water flowing from elsewhere.

All of these are strategies of adaptation to a world that is not completely under society's control. They do not solve the problem of greenhouse gas emissions, but they do ensure that communities will remain around long enough to come up with effective solutions. Policy makers can begin a process now that will give North Carolinians the greatest chance of responding to the world when it does reveal itself completely. As Dwight Eisenhower once said in a different context, "In preparing for battle I have always found that plans are useless, but planning is indispensable." The nation, North Carolina, communities, energy sectors, institutions, and individuals are rapidly developing such a planning process. Each of these players must determine how it will fit into that process, both as actors that reduce the threat of climate change directly and as creators of stages on which others will act.

How Can North Carolinians Set Priorities?

In the end, there is much to be done in North Carolina, with costs to everyone from efforts to stop climate change and from failure to stop it (potentially much larger). Both costs are large, so policy makers must not stumble too much at the beginning and must direct limited resources toward the most cost-effective solutions. Doing anything less will compromise the sustainability of North Carolina environmentally (with potential impacts of climate change), economically (with potentially reduced economic vitality), and socially (with the worst impacts—both environmental and economic—falling on those least able to bear them).

How can the possible policies be ranked? What will be the criteria, and how can a policy maker use them, given the newness of this enterprise?

The first step is to recognize that the state does not need a single ranking for *all* the policies. Some will be national policies, some state policies, some community policies, and so on. They are not necessarily drawing on the same pool of limited resources. There should be separate rankings for policies aimed at each of the six levels of actors and stages.

In some areas, multiple actors on multiple stages must make a full-blown effort, coordinated to maximum effect according to the needs, the goals, and the resources of the different players. Four such areas are, in no particular order, utility reform, energy efficiency, innovations in transportation, and community resiliency. Perhaps some readers will take on one or more of these as a personal challenge.

Utility reform. North Carolinians currently enjoy relatively low rates for electricity compared with the large population centers in the Northeast and California. This advantage has been a boon to consumers and manufacturers. However, many other states have significantly higher rates while maintaining a stronger economy than North Carolina does. Rates will undoubtedly rise in the future as carbon taxes kick in, making them better reflect the climate change impacts of energy production. With or without carbon taxes, rates will rise because of the REPS, but that rate increase is capped. The real question is whether it will be enough.

The rise will stimulate the market in green energy technologies, including the market in carbon taxes and trading mentioned earlier, although at a cost of rising prices for the goods produced through energy use. Absent such a rise in prices, however, the utilities have little incentive to invest in sustainable technologies and the infrastructure that must go along with it.

The pressure for a rise in prices is being met by a reform of the rules of the North Carolina Utilities Commission, allowing for considerations other than simply keeping rates as low as possible for consumers. Under a carbon-constrained economy, the Utilities

Commission will be called on to set rates that will both be affordable and lead to investments in sustainable energy technologies. This means that the price of carbon emissions will need to rise above $50 per ton. Consumers can expect to pay more to manufacturers and retailers for goods. Their paying more may ensure that the people who are least able to afford rising energy prices (the energy poor in the state) are not unduly burdened.

Energy efficiency. The energy system in North Carolina (indeed, in all the United States) currently uses only about one-third of the energy generated. The rest (more than 60 percent) goes to waste heat (such as heat from electricity transmission lines) that serves no human purpose. Improving the efficiency of the system could go a long way toward a goal of reducing emissions by 60 percent before 2050.

Part of the challenge of energy demand and climate change is to build adaptable, resilient communities.

Groups and individuals, however, need to make the investment in energy efficiency, as European countries have done to great effect. This will require investments by energy consumers in more efficient home heating, lighting, and so on. It will require investments by the utilities in power plants and transmission and distribution systems. It will require a stimulus from the state government making energy efficiency measures mandatory, beginning with its own buildings. The utilities all have made a firm commitment to helping their customers improve efficiency (the "fifth fuel," to use the words of Duke Energy), both as a way of satisfying the REPS requirements and as part of a load-leveling strategy (a goal of smoothing the demand for electricity across the seasons and the day).

Innovations in transportation. These innovations will be of two types: innovations in the vehicles themselves and innovations in the system of public transit. The kinds of vehicles in the fleet of North Carolina and the ways they are powered will see significant changes in the coming decades. There is merit in the idea floated by all the utilities to change the fleet of vehicles to plug-in hybrids. These hybrids store energy at night, when electricity is not needed for many of the core uses and the price is low, and use it during the day to power vehicles. When there is peak demand, these same vehicles can be plugged back into the grid to offset the need for new power plants to "kick in." This in turn will require significant investments in the technologies of energy storage, technologies being developed today in the state's major universities and industries.

Even as the vehicles are improved, however, a need will remain for a much better system of public transit, including regional light rail or guided buses, and significantly more opportunities to live in communities designed for walking and biking. Then people will need to get out of their cars and use those alternatives.

Such a development may sound infeasible in a state designed around sprawl and the automobile, and boasting the most miles of roads per capita in the nation, but the state can no longer ignore this solution as roads become more clogged and people spend increasing numbers of hours trapped on highways. Businesses will support this movement, for it is their employees who are spending so much time idling in traffic and showing up at work tired and angry.

Community resiliency. As mentioned, climate change impacts will occur whether policy changes take place immediately or in the far future. Communities must be ready to respond to the changes, creating the networks of monitoring systems, alarms, evacuation plans, and emergency medical treatment to ensure minimal impacts when storms and heat waves associated with climate change hit. Responding will require a massive investment in the water distribution system, made all the more expensive by the fact that the current distribution systems in most communities of North Carolina are not only inadequate, but antiquated and failing. Such an investment will require that planners think deeply before allowing any new development in vulnerable areas that will be most affected by the extreme climate events that accompany climate change. It will no longer be feasible to build in these vulnerable areas, such as along the coast, only to have the investments wiped out and new buildings constructed to repeat the cycle. The municipalities will, however, need support from a range of governmental and other partners to enforce the uses of zoning and permits that form the basic tools in this movement toward resiliency.

Conclusion

Many other policies could be described, filling the entire magazine. But there is no point in making more lists or developing further plans. What is needed now in North Carolina is a process of planning for the future that brings together all six levels of climate change actors and their stages, and that marshals the immense talents and resources in the communities and the governance systems of this state. The challenge is daunting, but the time to act is now.

Notes

1. *See* Intergovernmental Panel on Climate Change, *Climate Change 2007: Synthesis Report, Summary for Policymakers* (Geneva, Switzerland: Intergovernmental Panel on Climate Change, 2007), www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf.

2. UNC Institute for the Environment, www.ie.unc.edu.

3. Okmyung Bin et al., *Measuring the Impact of Climate Change on North Carolina Coastal Resources* (Washington, DC: National Commission on Energy Policy, March 2007), econ.appstate.edu/climate/NC-NCEP%20final%20report.031507.pdf.

4. For a description of the Community Carbon Reduction Program, *see* the Institute's website at www.ie.unc.edu/content/research/cred/index.html.

5. *See* North Carolina Climate Action Plan Advisory Group, www.ncclimatechange.us, and North Carolina Legislative Commission on Global Climate Change, www.ncleg.net/gascripts/DocumentSites/browseDocSite.asp?nID=14.

6. Energy Information Agency, www.eia.doe.gov.

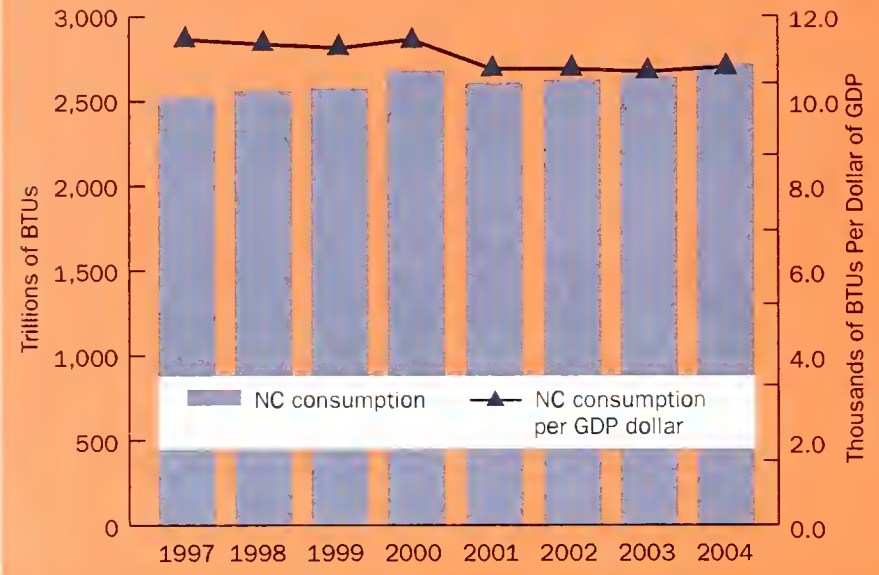
7. Consider, for example, Duke Energy's Fifth Fuel campaign on energy efficiency, described at www.duke-energy.com/investors/publications/annual/ar-2006/new-energy-equation/solving/fifth-fuel.html.

8. N.C. Department of Environment and Natural Resources, One North Carolina Naturally, www.enr.state.nc.us/officeofconservation.

Aspects of Energy Use and Capacity in North Carolina

Dennis Grady and Jason Hoyle

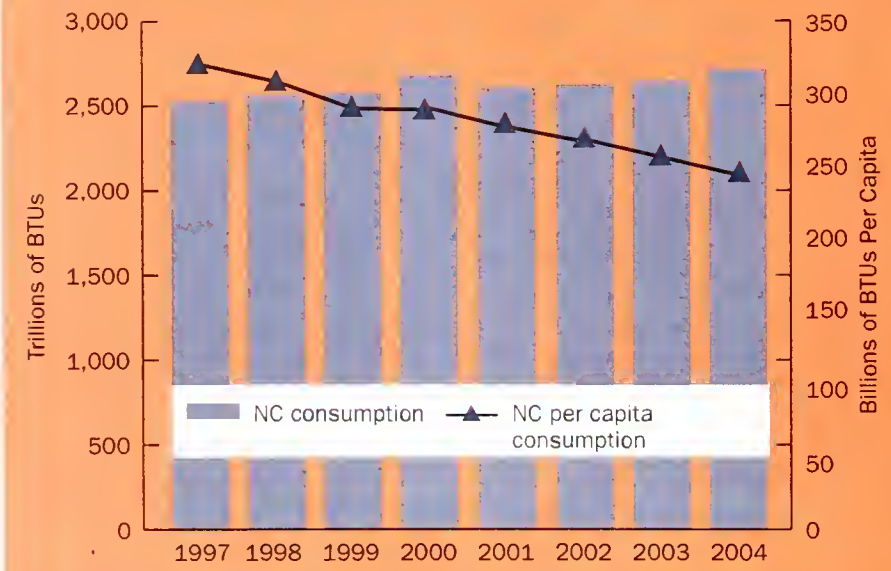
Chart 3. **Energy Intensity in North Carolina (Consumption Per Dollar of State GDP), 1997–2004**



North Carolina's total energy consumption increased from 1997 through 2004, but not as fast as its economy grew. With the exception of 1999–2000, the number of energy units (BTUs) used for each dollar of state gross domestic product (GDP) decreased, meaning that North Carolina's economy became increasingly less energy-intensive. The increase in energy productivity was largely due to the decline of the manufacturing share of the state's economy, from more than 26 percent in 1997 to less than 20 percent in 2004. During the same period, the economic shift resulted in greater output in the service sector, which uses considerably less energy.

Sources: Data on consumption from U.S. Department of Energy, Energy Information Administration, "State Energy Consumption, Price, and Expenditure Estimates," www.eia.doe.gov/emeu/states/_seds.html; data on state GDP from U.S. Department of Commerce, Bureau of Economic Analysis, "Regional Economic Accounts, Gross Domestic Production by State," www.bea.gov/bea/regional/gsp/.

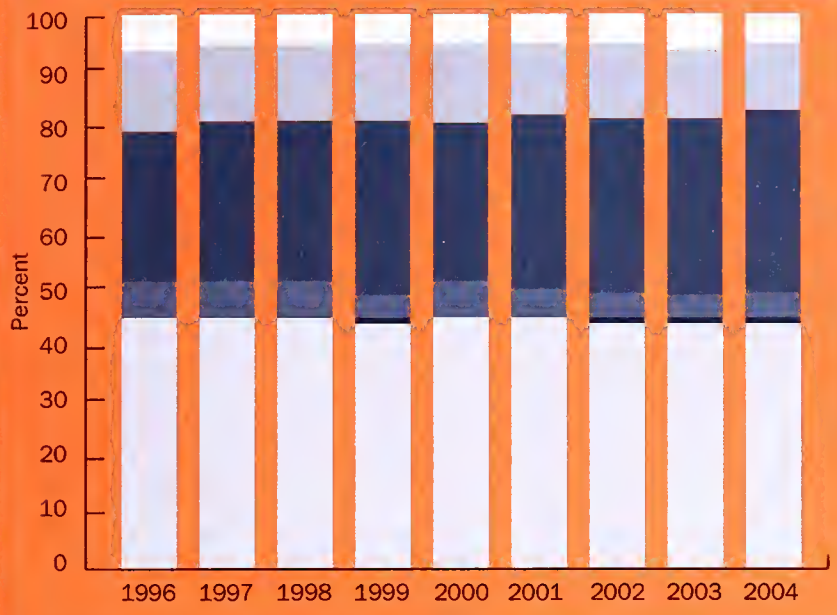
Chart 4. **Energy Intensity in North Carolina (Consumption Per Capita), 1997–2004**



Per capita consumption of energy in North Carolina declined by about 3.5 percent from 1997 through 2004, while the state's total consumption increased more than 7.5 percent. The increases in per capita consumption in years 2000 and 2004 were due to large increases in economic output and a corresponding increase in energy demand.

Source: Data from U.S. Department of Energy, Energy Information Administration, "State Energy Consumption, Price, and Expenditure Estimates," www.eia.doe.gov/emeu/states/_seds.html.

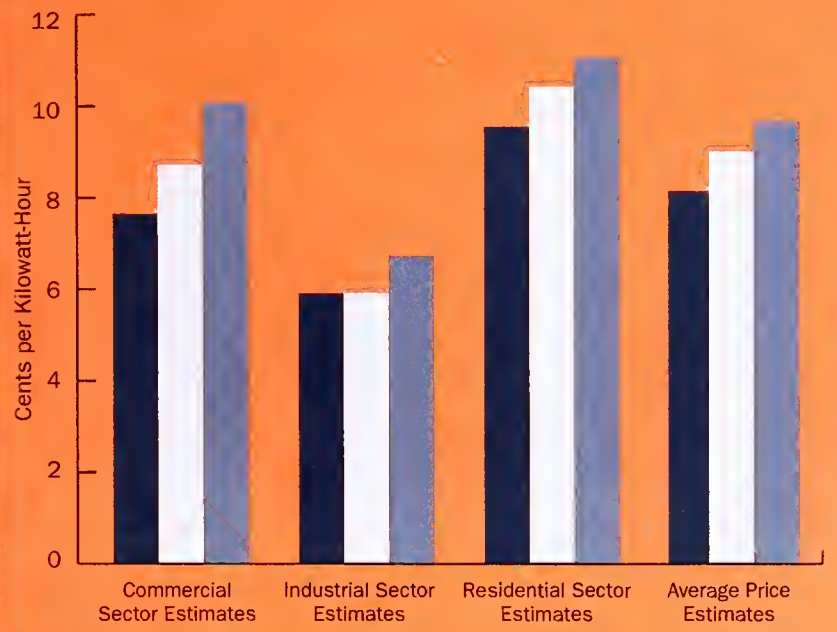
Chart 5. **Energy Consumed in North Carolina, by Source, 1996–2004**



The sources of energy consumed in North Carolina changed little from 1996 through 2004. Almost 50 percent of the state's energy came from coal, about 30 percent from gasoline, and about 10 percent from natural gas.

Source: Data from U.S. Department of Energy, Energy Information Administration, "State Energy Consumption, Price, and Expenditure Estimates," www.eia.doe.gov/emeu/states/_seds.html.

Chart 6. **Electricity Price by Sector, North Carolina, the South Atlantic Region, and the United States, July 2007**



North Carolina has some of the lowest electricity prices in the South Atlantic region and in the nation. Prices may vary considerably at different times of the day and according to agreements between large users and electricity providers. The chart does not reflect these variations because data on them are not available.

Source: Data from U.S. Department of Energy, Energy Information Administration, *Electric Power Monthly* (October 2007), http://tonto.eia.doe.gov/ftproot/electricity/epm/02260710.pdf. The South Atlantic region as defined by the U.S. Census Bureau includes Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, and West Virginia.

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

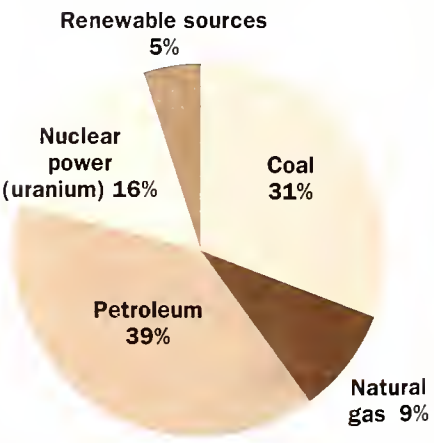
Historically, North Carolina has depended on imports from other states for nearly all its energy supply. The state neither produces nor has reserves of fossil fuels—coal, oil, natural gas, and uranium—on which its energy sector predominantly relies. Further, the state has no crude oil refinery capacity. 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.

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.

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

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]

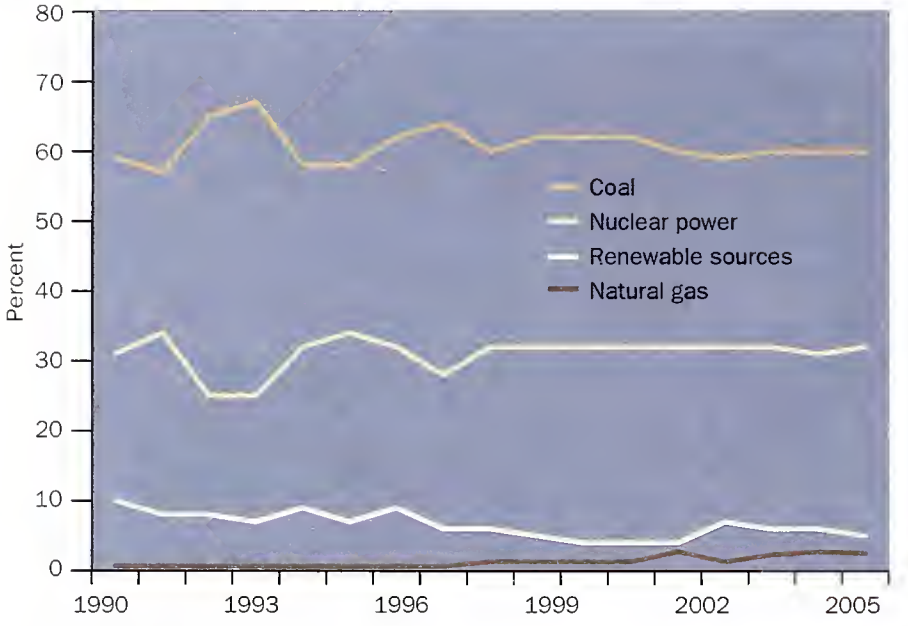
The program has had some small success, but it has not done much to expand the renewable energy market in the state because it is voluntary and depends on contributions. Historically, NC GreenPower producers have generated roughly 20 million kilowatt hours per year, but this contribution is minuscule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

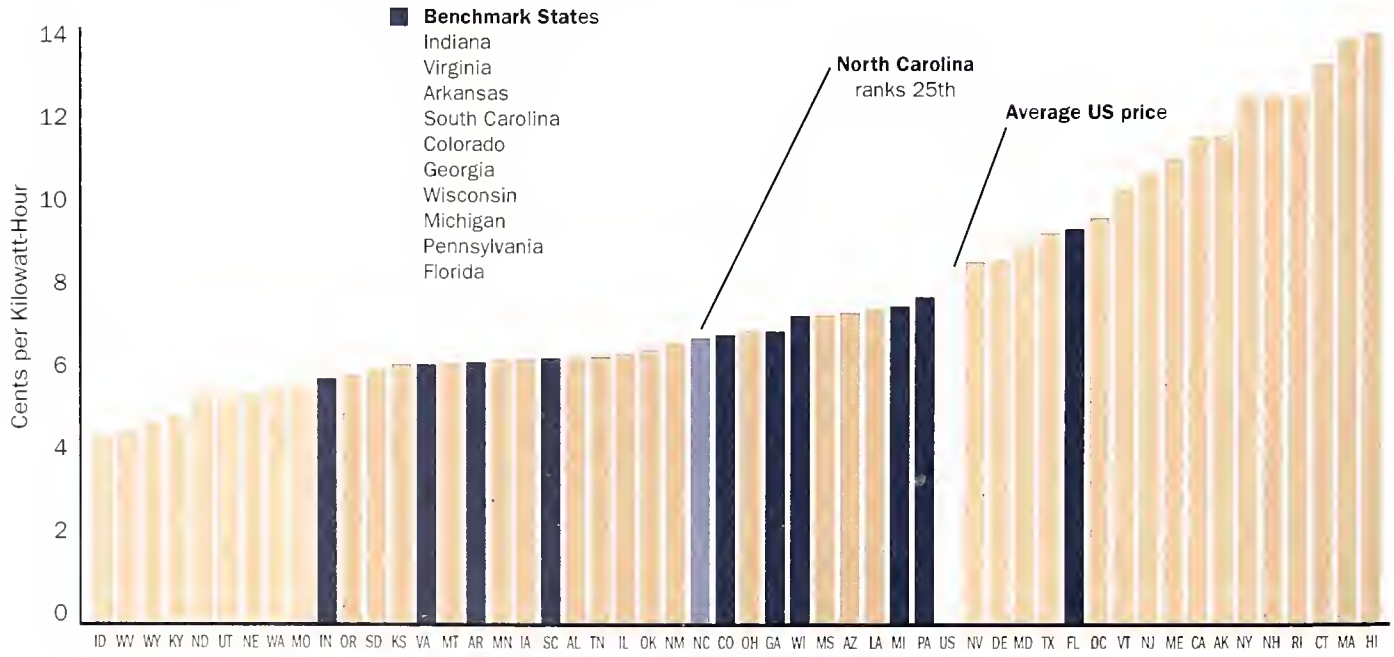
The state's existing infrastructure supports the conventional supplies of energy. It is a major constraint facing North Carolina as policy makers consider the state's future energy course.

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:

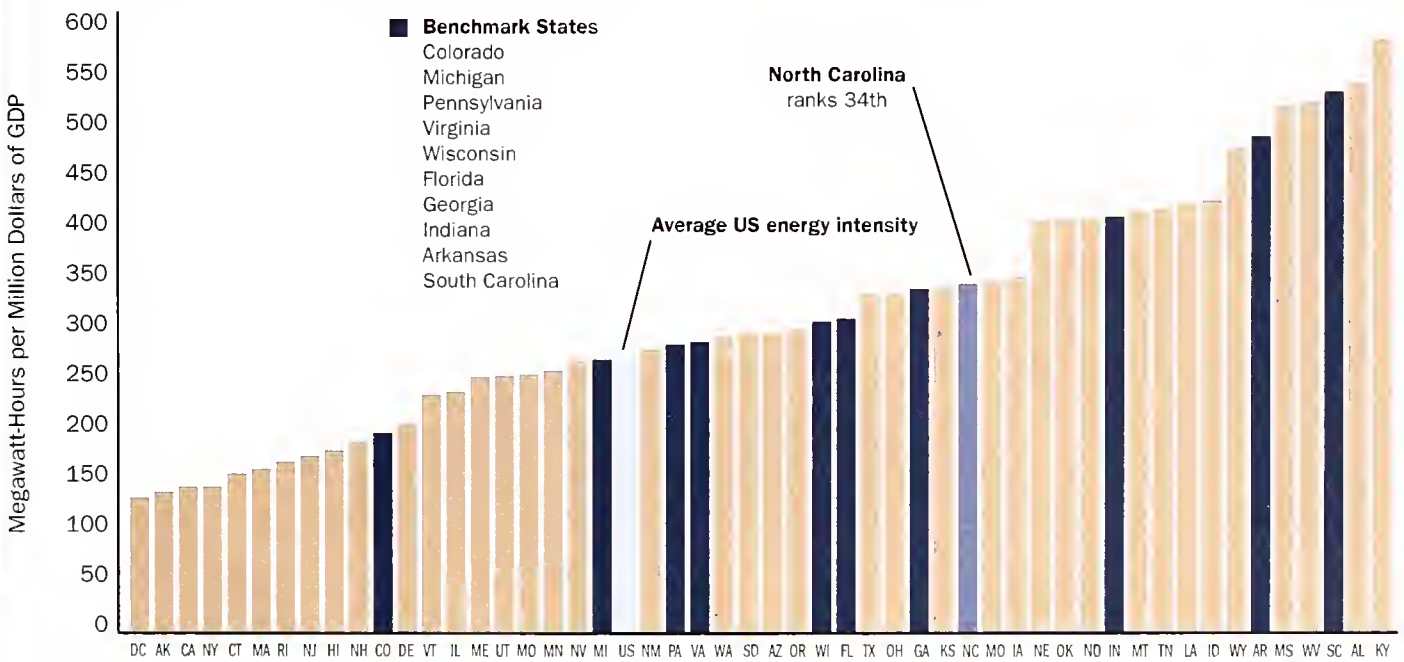
- To diversify the resources used to meet the energy needs of consumers
- To provide greater energy security through use of in-state resources
- To provide improved air quality for citizens of North Carolina

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.

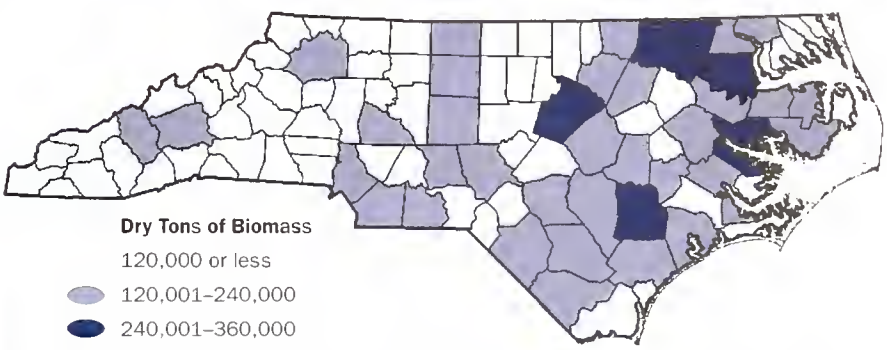
Wind facilities can be sited in three other locations: the coastal plain, state waters, and federal waters, offshore. Each location has its own local, state, and federal jurisdictional requirements.

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.

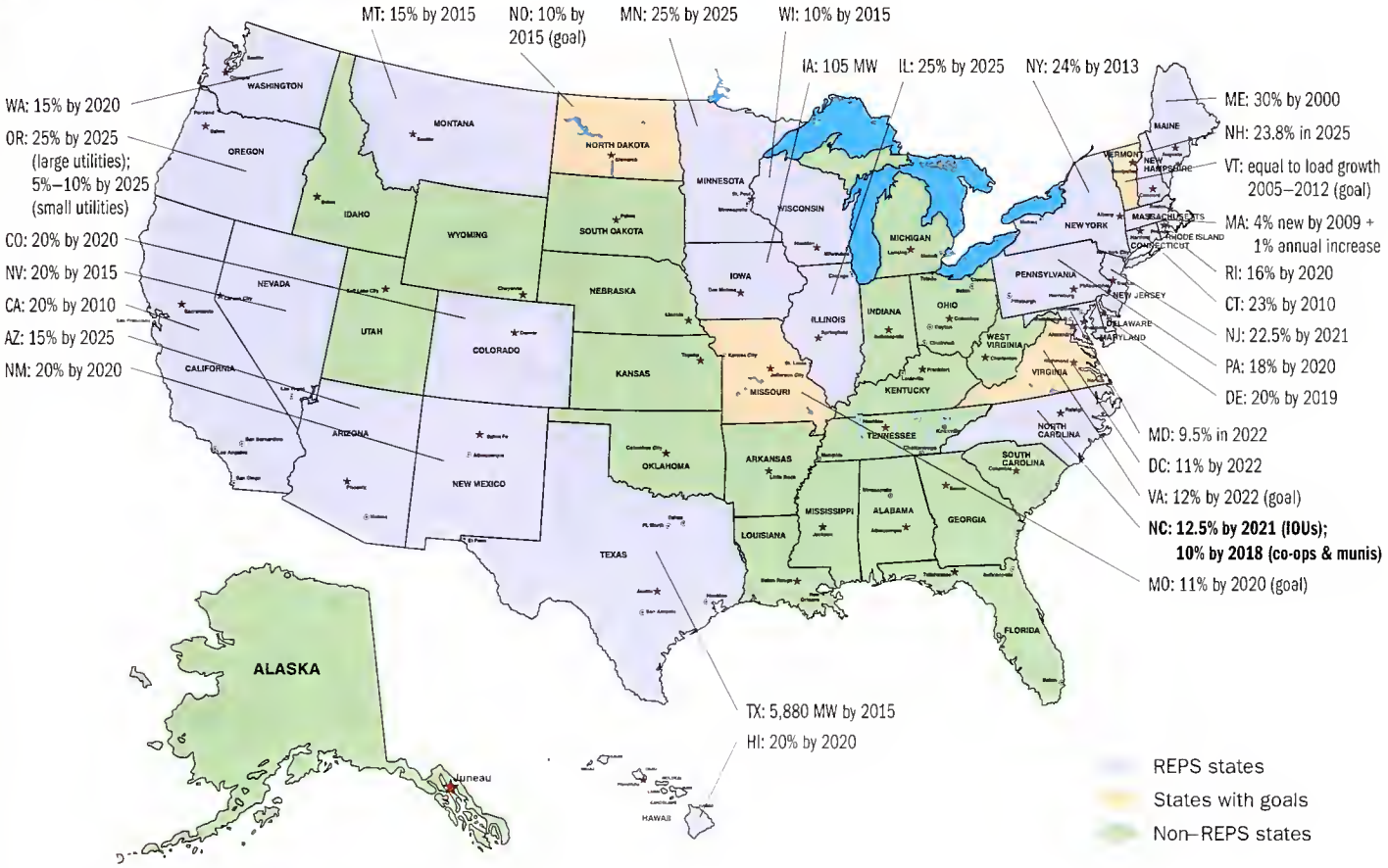
Table 1. **Key Biomass Resources in North Carolina**

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.

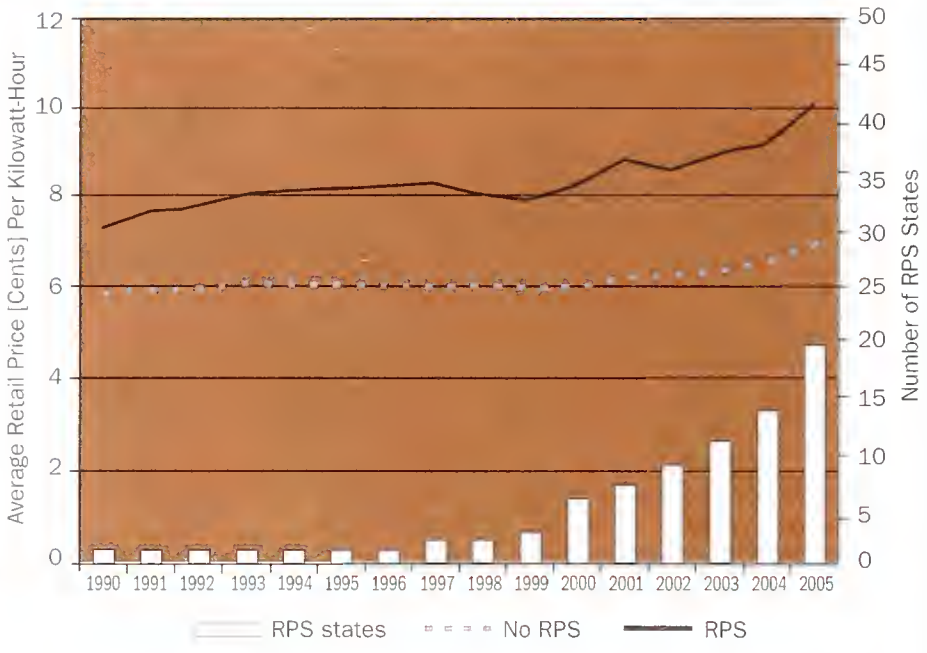
Third, many do not regard solar panels on the roof as attractive. With the passage of the REPS statute, however, homeowner associations may not use convenants or other provisions to restrict solar panels on roofs, as they could in years past.

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.

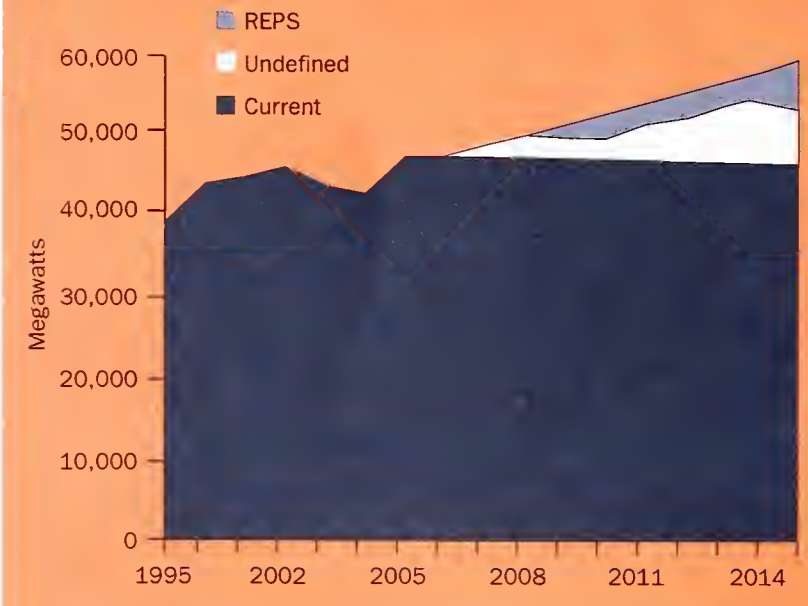
Notes

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

Dennis Grady and Jason Hoyle

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.

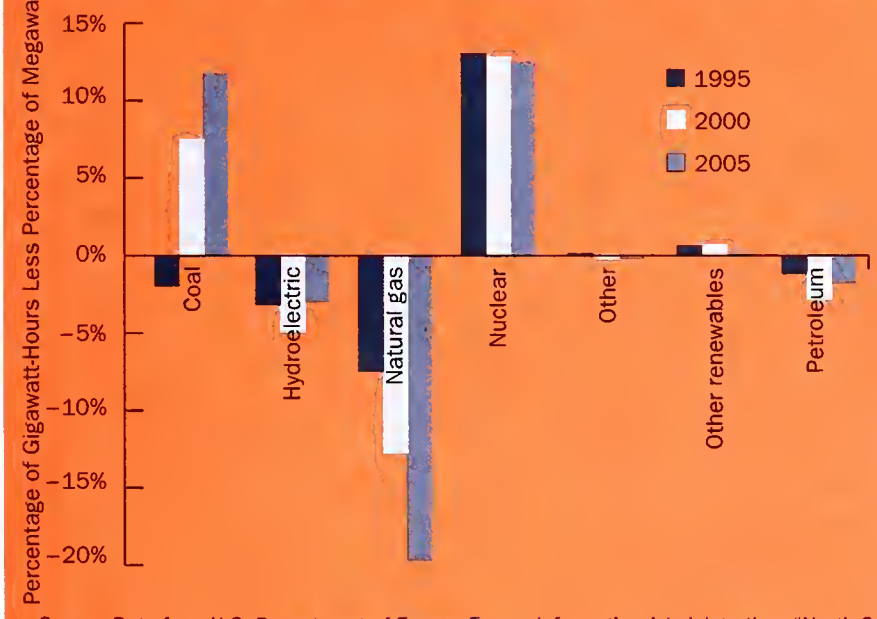
24. Duke Energy, "Energy Efficiency Joins Nuclear, Coal, Natural Gas and Renewables to Meet Duke Energy's Growing Customer Demand" (press release, May 7, 2007), www.duke-energy.com/news/releases/2007050701.asp.

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.

Aspects of Energy Use and Capacity in North Carolina

Dennis Grady and Jason Hoyle

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.

A Balanced Strategy for Meeting North Carolina's Growing Energy Needs

Mike Hughes

Peering through the front window of a typical 1,600-square-foot North Carolina home in 1975, a person might have seen a family gathered in the shag-carpeted living room, huddled around its only TV (a 19-inch console) to watch *The CBS Evening News with Walter Cronkite* or M*A*S*H as a window-mounted air conditioner hummed in the background.

Two years after the first Arab oil embargo, the state's 5.5 million residents, like the rest of the country, were focused on energy conservation and rising gasoline prices. Yet signs of growth were visible in the new highways and schools being built and in the new sources of electricity under construction and planned.

In just thirty years, the typical household has increased its energy consumption by nearly one-half.

Fast-forward to 2008 and take a peek inside the typical new home of today. It has grown by half, to more than 2,400 square feet, on average. The residents have twenty-four-hour news and entertainment via the Internet, which they access by computers in several rooms in the house or through the large-screen plasma TV in the living room. And from the kitchen to the bedrooms, electronics are in widespread use, making the lives of about nine million North Carolinians more enjoyable, convenient, and productive.

In only about three decades, the typical household served by Progress Energy Carolinas (formerly Carolina Power & Light) has increased its energy consumption by 46 percent, from about 9,700 kilowatt-hours per year to more than 14,200.

All signs point to continued growth. The same attractive factors that brought many of the state's current residents to North Carolina are drawing tens of thousands of new families and businesses every year. By 2030, North Carolina is expected to surpass Michigan and Ohio to become the nation's seventh-largest state, with a population of more than twelve million. Moreover, new advanced electronics are becoming part of mainstream America every day.

Meanwhile, the world has become much more aware of global climate issues and the factors that affect climate change. In the United States, Americans recognize the growing value of energy independence, as well as fuel and technology diversity.

Thus, North Carolinians find themselves at a crossroads, with new energy realities that they all must confront together.

As a utility, Progress Energy is committed to securing North Carolina's energy future by making sure that electricity remains available, reliable, and affordable and is produced in an environmentally sound manner. In partnership with the state and with communities, the company is moving forward with a balanced strategy for meeting future energy needs. The balance includes a strong commitment to energy efficiency; aggressive and cost-effective investments in renewable energy sources and emerging energy technologies; and construction and operation of state-of-the-art power plants.

The region cannot rely exclusively on one component or another. The balance is critical. Progress Energy has been very active on all three fronts.

Energy Efficiency

In May 2007, Progress Energy, which serves 1.4 million households and businesses, announced the doubling of its efficiency goal from 1,000 to 2,000 megawatts. The goal is ambitious—reducing electricity consumption in the company's service area by the equivalent of six combustion-turbine power plants. The company is proposing several new conservation and demand-side management programs to the North Carolina Utilities Commission this year, and it will evaluate the programs' effectiveness and participation rates continually to determine their viability in further reducing demand for electricity.

To advance the effort, Progress Energy has started a consumer education program, Save the Watts. Interest in the program has raised traffic on the company's energy-efficiency website almost 300 percent. Customers are looking for ways to save money and be more efficient.

In a related move, the company has announced a commitment not to propose any new coal plants during a two-year period of energy-efficiency evaluation.

In matters of efficiency, customers have the most critical role. Success calls for active participation on a large scale, and it requires not only understanding but also changes in energy use and behaviors. Many Progress Energy customers already participate in efficiency

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programs. The company's goal is to develop additional programs that will work well with customers' lifestyles in 2008 and beyond.

As part of its requests for program approval from the Utilities Commission, and consistent with the renewable energy portfolio standard (REPS) recently enacted by the General Assembly, Progress Energy will seek appropriate incentives. The incentives will address the new energy realities that all North Carolinians are facing. Utilities make money by selling electricity. Efficiency programs result in reduced sales. Currently, there are no incentives to encourage utilities to invest in efficiency programs. This situation needs to change if Progress Energy is to implement a sustainable business model.

Progress Energy likes an incentive model that is based on sharing the savings. Under this model, the costs and the benefits of efficiency programs are evaluated together, and customers and the company share the benefits. The greater the energy savings, the greater the reward for customers and the company. This approach is transparent and allows the Utilities Commission to review the costs and the benefits each year. The company believes that the model will encourage a true partnership between Progress Energy and its customers to find the programs that really work and are sustainable.

Renewable Energy Sources

The second front in Progress Energy's strategy is to develop renewable energy sources. The company is working aggressively to implement the REPS in a manner that makes economic sense for the state. It expects to purchase up to 1 million megawatt-hours from renewable energy sources in 2012, the year in which the REPS takes effect.

In 2007, Progress Energy issued a request for proposals for renewable energy. The proposals received thus far have largely confirmed the results of an independent study completed for the Utilities Commission last year. That study, conducted by LaCapra Associates, indicated that the state has limited renewable resources on which to draw.

Progress Energy received more than two dozen initial proposals from renewable energy providers and prospective projects, totaling more than 600 megawatts of potential capacity. The sources include the sun, biomass, and wind. The total is about half the size of a new nuclear plant. Technologies relying on the sun and wind depend on the sun shining and wind blowing, so they would operate only about 30 percent of the time, unlike a nuclear plant that can run 95 percent of the time or more.

Many of the proposals were incomplete, and several biomass-energy proposals appeared to depend on the same fuel supply. Thus, not all of them will be viable. Progress Energy is probing more deeply to determine what is truly achievable and at what cost.

Today these proposals also are very expensive—close to 25 cents per kilowatt-hour for solar power, assuming a tax break, and 50 cents per kilowatt-hour without an incentive. Either price is more than five times the cost of generating electricity in a nuclear or coal-fired power plant.

With the exception of biomass, the proposals that Progress Energy has received all involve intermittent (rather than continuous) generation of power. So, to provide the same level of electric-system reliability that customers experience today, renewable energy sources such as sun and wind would require utilities to maintain backup plants, resulting in a considerably higher overall cost for customers.

Possible New Nuclear Plants

Even if all 600-plus megawatts of renewable energy projects become viable, and even if customers achieve the additional 1,000 megawatts of energy efficiency in the next decade, Progress Energy's projections indicate that new power plants will be needed in 2018 and beyond. That is why it is critical to move forward on all three energy fronts, including the real possibility of new nuclear-power generation.

In February 2008, Progress Energy filed an application for a second reactor at the Harris Nuclear Plant in Wake County in order to preserve the opportunity to construct additional nuclear-power generating capacity if it is needed. The action does not commit the company to a new plant but helps ensure that this important option remains viable for meeting future energy needs.

Progress Energy's projections show a need for more "baseload power"—plants that run continuously to meet

the basic level of customer energy demands—in the next ten to twelve years. That might sound like a long time, but in utility terms, it is not. The regulatory process will take years, as will construction, so the company has to start planning now. Just as municipal and state governments cannot wait for gridlock to begin planning roads, schools, and other infrastructure, Progress Energy must plan now for the region's energy future.

Progress Energy has a state-mandated responsibility to meet the state's needs, and the company believes that nuclear energy must continue to be a key part of a diverse and reliable resource mix. Nuclear energy is carbon-free and the safest, most economical way to generate large-scale energy for North Carolina, and it is the state's best option for new plants.

Conclusion

These are the new energy realities: The state is growing fast. Demand for electricity is growing fast. Tomorrow's homes will likely be bigger than today's, and the drawing-board electronic technologies of 2008 will be commonplace and widespread in a decade. North Carolina's cities are becoming larger, and the need for reliable, affordable, and environmentally sound energy will continue to increase.

Balancing these priorities and the many important perspectives represented in North Carolina is a big challenge. Progress Energy is committed to pursuing each of the critical components of its balanced energy strategy in partnership with customers and communities to ensure that when today's children and their children flip the switch in the decades ahead, the lights continue to come on.

Energy and the Environment: Resources for North Carolina Citizens and Leaders

For readers interested in contacting organizations referred to in this issue, or in exploring options for energy efficiency and environmental protection, the following sources have useful information.

This resource page also is available online at www.sog.unc.edu/popgov.

American Council for an Energy-Efficient Economy *www.aceee.org/*
See especially the report *State Energy Efficiency Scorecard for 2006.*

ICLEI—Local Governments for Sustainability *www.iclei.org/*
ICLEI was founded as the International Council for Local Environmental Initiatives. It now goes by the name above. North Carolina members are Carrboro, Chapel Hill, Durham, and Orange County.

NC GreenPower *http://ncgreenpower.org/*
This nonprofit organization works to improve the environment through voluntary, tax-deductible donations for renewable energy. Through their monthly electricity bills, participants contribute $4 for every 100 kilowatt hours of electricity they use.

North Carolina Climate Action Plan Advisory Group *www.ncclimatechange.us/*

North Carolina Cool Cities *http://coolcities.us/*
Participants as of April 2008 are Asheville, Black Mountain, Boone, Brevard, Canton, Carrboro, Chapel Hill, Charlotte, Clyde, Concord, Durham, Flat Rock, Fletcher, Franklin, Gastonia, Greenville, Highlands, Hillsborough, Raleigh, Salisbury, Surf City, Wake Forest, Wilmington, Winston-Salem, and Woodfin.

North Carolina State Energy Office *www.energync.net/*
The website includes the 2005 State Energy Plan.

North Carolina Utilities Commission *www.ncuc.commerce.state.nc.us/*
This is the website of the regulator for the largest electricity generators.

State Government Operations *www.ncprojectgreen.com/*

U.S. Green Building Council *www.usgbc.org/*
From the main page, follow links to Resources, then Government Resources, then Tools for Governments and Schools.

Energy from Nonfossil Fuels

Energy Center, Appalachian State University *www.energy.appstate.edu/*

North Carolina Solar Center, North Carolina State University *www.ncsc.ncsu.edu/*

North Carolina Wind Energy Site, Appalachian State University *www.wind.appstate.edu/*

Major Investor-Owned Electric Utilities in North Carolina

Duke Energy *www.duke-energy.com*

Dominion North Carolina Power *www.dom.com/about/companies/ncpower/index.jsp*

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Transportation, Energy, and the Environment in North Carolina

Anne Tazewell

More than a billion dollars a day goes to line the pockets of nations that "do not particularly like us," as President George W. Bush puts it. In 2005, North Carolina ranked tenth in the United States in expenditures on gasoline—$9.9 billion.[1] Add to that the more than $2 billion that North Carolinians are spending for diesel fuel, and the state is edging up to expenditures of $12 billion annually on fuels that it neither produces nor refines. Along with increasing fuel prices, per capita vehicle miles traveled are expected to surpass the state's projected growth in population, so what North Carolinians spend for transportation-related fuels probably will continue to increase exponentially. Whereas stationary power sources have diversified into natural gas, coal, uranium, and, more recently, renewable energy sources such as the sun and wind, the U.S. transportation sector (cars and trucks) is still 96 percent reliant on petroleum.

The reliance would not be such a problem if oil were to remain cheap, stay in U.S. control, and be environmentally preferable to the alternatives. But none of these prospects are likely. When world oil production peaks—and reasonable evidence indicates that the world is in the midst of this peak now—oil will increasingly go up in value as the remaining supply becomes more difficult to extract and get to market. As it is now, Americans are consuming three barrels of oil for every new barrel that is discovered, putting the world in the position of depleting known reserves at an alarming rate, given how dependent the world is on oil. U.S. oil production peaked in 1970, forcing the nation to

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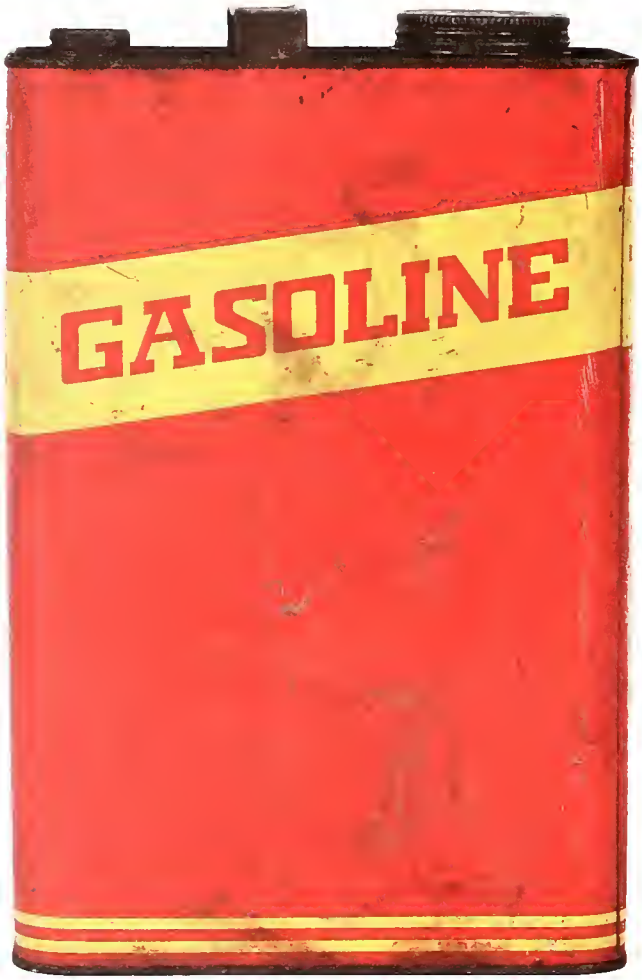


rely more on imported oil, much of it from unstable parts of the world. The disturbing fact is that with just 5 percent of the world's population, the United States consumes more than 25 percent of the world's oil production. This is not a good position for North Carolina or the United States to be in. But as Saudi Arabia's former Minister of Oil, Ahmed Saki Yamani, said in 2000, "The Stone Age came to an end not for a lack of stones, and the oil age will end, but not for a lack of oil."

Currently, twenty-four of North Carolina's counties do not meet national standards for air quality.

Climate change and air-quality concerns are equally important drivers for a new age of transportation energy alternatives. One-quarter of North Carolina counties do not meet national air-quality standards for either ozone or particulate matter. This number will expand next year as the U.S. Environmental Protection Agency (EPA) ratchets down the acceptable level of emissions to protect human health better.

A greater challenge, however, could be emissions that are currently unregulated in the United States. Carbon dioxide, created primarily through the burning of fossil fuel, is the primary culprit of the greenhouse effect and all its attendant problems.

For transportation decision makers, there are more opportunities and more reasons than ever before to exercise freedom of choice. With the rise in availability of alternative fuels and advanced transportation technologies, North Carolina governments have a choice of actions that they can take to support the four E's: emission reductions, environmental enhancement, energy diversity, and economic development.

This article explores the alternative fuels available today, such as biodiesel, ethanol, natural gas, propane, and electricity, and it offers guidelines for deciding which to choose, depending on the intended application. Further, the article discusses retrofitting of existing vehicles, and hybrid-electric vehicles, two advanced transportation technologies that also can help reduce critical emissions. The article then offers examples of innovations in North Carolina's own backyard. Finally, it describes national and state incentives, policies, and programs, and discusses some conservation measures, all of which suggest ways in which North Carolina governments can chart the course ahead.

Alternative Fuels Available Today

Biofuels such as biodiesel and ethanol hold tremendous promise for North Carolina and have gained a lot of trac-

tion recently because of the potential to produce and use them in state. Although the state has no petroleum refineries or oil wells, biofuels must still be compared with petroleum because they are blended with and used as a replacement for petroleum. Low-carbon fuels such as natural gas and propane reduce emissions and can help stabilize budgets because they cost less than conventional transportation fuels. Although they are fossil fuels, natural gas and propane are cleaner and more abundant in the United States than petroleum is. These biofuels and low-carbon fuels offer opportunities for fuel diversity that North Carolina government fleets can incorporate today.

Biofuels

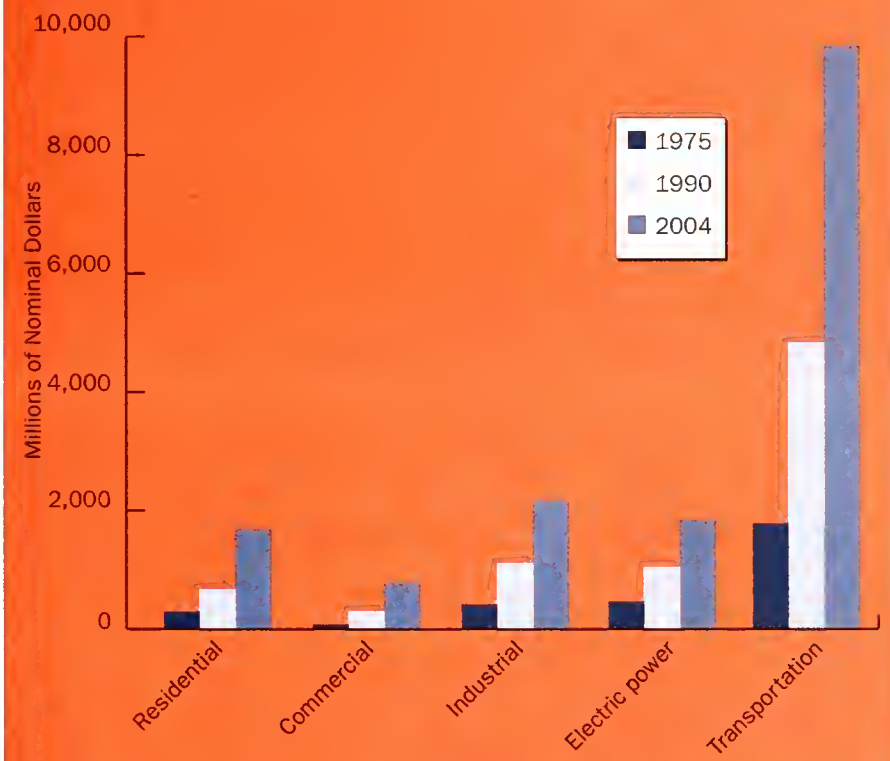
Biodiesel

Few people had heard of biodiesel in 1999, when the North Carolina Department of Transportation began sending its tanker trucks to Florida to pick up the renewable fuel. Now the state has multiple production facilities and commercial service stations, and municipalities from Asheville to Wilmington are using it. North Carolina has seen a great expansion in the use of biodiesel, in part because it is a "pour and go" technology. That is, if a car has a diesel engine, it can use biodiesel. Unlike other alternative fuels, biodiesel does not require any special

Aspects of Energy Use and Capacity in North Carolina

Dennis Grady and Jason Hoyle

Chart 9. **Total Expenditures on Primary Energy, by Sector, 1975, 1990, and 2004**



Expenditures on primary energy have risen consistently for the past several decades. These are expenditures for fuels such as coal, petroleum, and natural gas. Neither renewable energy sources, such as wind or sun, nor electricity is included. Following the trend in energy consumption, the commercial sector has shown the largest increase, with an annual growth rate of 7.7 percent from 1975 through 2004. However, it remains the smallest sector in total expenditures on primary energy. For the most part, each sector's share of state expenditures remained relatively constant from 1975 through 2004. Transportation expenditures represented the majority of expenditures throughout the period, with about a 60 percent share.

Source: Data from U.S. Department of Energy, Energy Information Administration, "State Energy Consumption, Price, and Expenditure Estimates," www.eia.doe.gov/emeu/states/_seds.html.

Biodiesel Producers and Plant Capacity

Blue Ridge Biofuels
109 Roberts Street
Asheville, NC 28801
828.253.1034
1–2 million gallons per year

Evans Biodiesel
2301 Industrial Park Drive
Wilson, NC 27894
252.237.1898
4 million gallons per year

Foothills Bio-Energies
815-D Virginia Street S.W.
Lenoir, NC 28645
828.759.7101
5 million gallons per year

Gortman Biofuel
617 Waughtown Street,
Building 200, Bay 25
Winston-Salem, NC 27107
336.731.2599
100,000 gallons per year

North Carolina BioFuels
1607 Chase Circle
Roanoke Rapids, NC 27870
252.589.8280
1.5 million gallons per year

Patriot Biodiesel (formerly Oak Biodiesel, High Point)
Greensboro
336.209.0728
(not in production yet at new location)

Piedmont Biofuels
P.O. Box 661
Pittsboro, NC 27312
919.321.8260
1 million gallons per year

refueling equipment. It can be used in place of conventional petroleum diesel as 100 percent biodiesel—B100—or in any blend from B2 (2 percent biodiesel/98 percent petroleum diesel) up, with little or no modification to existing vehicles or infrastructure.

In low blends, such as B2, biodiesel acts as a lubricant for ultra-low sulfur diesel (ULSD). ULSD was widely introduced in fall 2006 to help trucks meet more stringent federal emission standards that went into effect with model year 2007 vehicles. Sulfur contaminates the catalysts used in the large filters that remove most of the particulate matter in diesel exhaust. So the amount of sulfur in diesel was reduced significantly in ULSD. However, when sulfur is removed, diesel loses its "lubricity," its capacity for reducing friction. So an additive is necessary. Adding B2 to ULSD restores the lubricity, helping the fuel perform better in new engines.

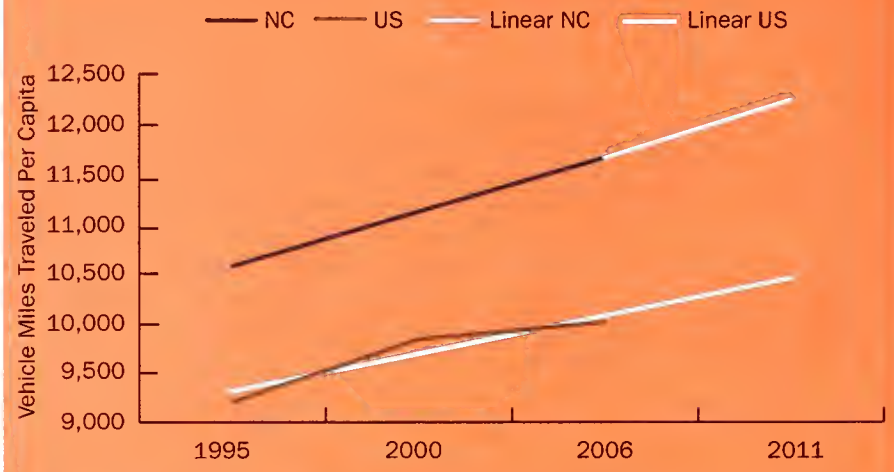
Biodiesel is not to be confused with straight vegetable oil. Biodiesel is pro-

Data collected between July 2007 and April 2008 indicate that Chapel Hill Transit is realizing, on average, a 51 percent increase in fuel economy with its hybrid-electric buses, as compared with its conventional diesel buses.

Aspects of Energy Use and Capacity in North Carolina

Dennis Grady and Jason Hoyle

Chart 10. **Historical and Projected Vehicle Miles Traveled Per Capita, North Carolina and the United States, 1995–2011**



The average North Carolinian drives more than the average American. The overall rate of vehicle miles traveled in the United States has been leveling, but North Carolina's trajectory has changed little in the past decade.

Sources: Data from U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics* (Washington, DC: Federal Highway Administration, 1995, 2000, 2006); U.S. Census Bureau, *Statistical Abstract of the United States 2006* (Washington, DC: U.S. Census Bureau, 2006), www.census.gov/compendia/statab/. "Linear" means the trendline as calculated by Excel.

Chapel Hill Transit

duced when a fat such as soy oil, animal renderings, or waste vegetable oil is catalyzed and mixed with methanol. The process removes glycerin (which can gunk up fuel lines and engines) and yields biodiesel. Biodiesel can be used in any diesel engine without modification, whereas a diesel vehicle running on straight vegetable oil must have an additional fuel tank and/or preheat the oil so that it will flow smoothly through the system. Also, biodiesel is recognized by the federal government as an alternative fuel, whereas straight vegetable oil is not.

Biodiesel is the only fuel to have passed EPA's rigorous health-effect testing. It is nontoxic and safe to handle, and has a much higher flashpoint than petroleum diesel—260 degrees versus 117 degrees. Finally, it burns more cleanly than petroleum diesel, reducing sulfur associated with acid rain, particulate matter linked to heart and respiratory diseases, and other emissions of concern.

With all these benefits, why is biodiesel not more widely used? The two main reasons are (1) concerns about vehicle warranties and (2) price. Warranties are a source of confusion for many would-be biodiesel users. They should not be. Although engine manufacturers may recommend that certain fuel be used in particular engines, they do not warranty fuel use. So if an automobile owner has a fuel-related problem from using B20 (or ULSD, for that matter), he or she should go back to the supplier of the bad fuel, not to the vehicle manufacturer. A federal law, the Magnuson-Moss Warranty Act, prohibits a manufacturer from voiding a warranty for use of an additive, which biodiesel is considered to be.[2] So even though any complications with biodiesel would not be covered by the engine warranty, fueling with biodiesel will not void the engine warranty.

Chapel Hill Transit

Biodiesel is not widely used because of its price and concerns about vehicle warranties.

Still, fleet managers are concerned and with good reason. Poor-quality biodiesel is a primary concern of the industry. Biodiesel users must have confidence that the fuel they are supplied meets the American Society of Testing Materials D6751 standard. The standard ensures the quality of B100 that is mixed with petroleum diesel. If a quality issue arises with biodiesel, a reputable supplier will stand by its product and assist the customer in identifying and correcting the problem.

The cost of biodiesel can vary widely, depending on the price of the feedstocks that went into making it and the transportation costs required to get it from the producer to the user. For governmental entities, B20 is available in all one hundred of North Carolina's counties on a statewide purchasing contract. Also, fleets can purchase B100 directly from seven small production facilities in North Carolina and "splash-blend" it in a fuel tanker with petroleum diesel to make B20, the blend most commonly used (for a list of these facilities, see the sidebar on page 29). To do this, one would load a 7,500-gallon tanker with 6,000 gallons of diesel at the petroleum terminal and 1,500 gallons of B100 (20 percent of a 7,500-gallon tanker) at a biodiesel production facility. The B100 will mix sufficiently with the diesel en route to the fuel storage tank. From there, it can be used directly in on- and off-road equipment.

Most operations that use biodiesel do not install any additional infrastructure. Rather, they switch to a biodiesel blend using existing equipment.

Because biodiesel is relatively easy to make and handle, "home brewers" across the state are making it in garages and back yards. In 2007 the state gave them more reason to do so by passing legislation that removed the motor fuels

tax on biodiesel made by an individual for use in his or her own noncommercial vehicle.[3]

Although B100 will not harm the environment if it is accidently spilled (it is considered an "insignificant" aquatic toxin by the National Institute of Occupational Safety and Health), biodiesel production is a chemical process that requires the handling of explosive and caustic materials. Safety standards and procedures are vitally important for large- and small-scale production, including proper storage of methanol and catalysts such as sodium hydroxide, proper disposal or recycling of water used in washing biodiesel, and a plan for use of the glycerin byproduct. With biodiesel production soaring across the United States, finding more valuable uses for glycerin is an important consideration for production facilities. Researchers at North Carolina State University's College of Engineering are refining crude glycerin with catalysts and enzymes to find more value-added products from biodiesel production. One of the state's commercial production facilities, Blue Ridge Biofuels in Asheville, is experimenting with glycerin as a fuel in a boiler application, and another, Piedmont Biofuels, is selling glycerin for use in a wastewater treatment facility.

By supporting use, distribution, and production of biodiesel, local governments in North Carolina are helping the biodiesel industry gain experience and secure biodiesel's future as a viable transportation fuel. Since the North Carolina Department of Transportation began using biodiesel in 1999, there has been a wide expansion of its use. In 2006, more than a dozen municipalities, multiple state agencies, three school systems, two transit agencies, and more than forty service stations used 2.5 million gallons of B100.[4]

Ethanol

Like biodiesel, ethanol is a renewable fuel made from organic materials, biodiesel from oils, and ethanol from sugar. The United States produces most of its ethanol from corn. North Carolina is a net importer of corn to feed its livestock industry, so the long-term viability of an ethanol industry in this state depends on developing high-yield, high-sugar crops, such as sweet potatoes, and on freeing up sugars from the cell walls of wood waste and crops such as switch grass to produce "cellulosic ethanol."

Range Fuel, a Georgia plant that broke ground in November 2007, uses a two-step thermochemical process to convert wood waste and forest residues into ethanol. It is not yet clear when the process will be profitable enough to be widely adopted, but the race is on, particularly in the Southeast, an area abundant in cellulosic materials. Spurred by federal grants and incentives from the federal 2005 Energy Policy Act, researchers are working aggressively to bring costs down so that cellulosic ethanol can be competitive with ethanol derived from corn.

Researchers are working hard to make cellulosic ethanol competitive in price with corn-based ethanol.

Ethanol is widely used across the United States in two blends, E10 and E85. E10 (10 percent ethanol/90 percent regular unleaded gasoline) can be used in any gasoline-powered vehicle. In many states that require reformulated gasoline, E10 is used as an oxygenate in place of methyl tertiary-butyl ether, a proven groundwater contaminant and a probable carcinogen. "Reformulated gasoline," known as RFG, is gasoline blended to reduce smog-forming and toxic pollutants of the air. The federal Clean Air Act requires that RFG be used in the cities with the worst smog pollution to reduce harmful emissions that cause ground-level ozone. The law also specifies that RFG contain oxygen (2 percent by weight). Methyl tertiary-butyl ether and ethanol are the two most commonly used substances that add oxygen to gasoline.

Marketers in North Carolina are voluntarily using E10, which is nontoxic, because its 113 octane rating allows it to be blended with regular gasoline to make a premium fuel. Moreover, there is a 51-cent federal tax credit for blending ethanol and gasoline. Consequently, marketers that provide an E10 blend can claim a 5.1-cent tax credit for every gallon used.

Ethanol also is used in E85-capable flex fuel vehicles (FFVs). FFVs run on either E85 (70–85 percent ethanol/30–15 percent gasoline, depending on the season) or straight gasoline. Fuel sensors adjust the input to the vehicle.

Currently, six million-plus FFVs are operating in the United States, more than 120,000 of them in North Carolina. In model year 2008, U.S. auto manufacturers are offering about thirty FFVs at no extra cost to consumers. A first for this year is three FFVs that often are used in law enforcement: the Ford Crown Victoria with a 4.6-liter engine, the Chevy Impala with a 3.9-liter engine, and the Chevy Tahoe with a 5.3-liter engine.

Manufacturers of FFVs receive credits to offset fines that they would otherwise receive for low rates of fuel economy. So the automotive industry has some inherent incentives to continue expanding its FFV offerings.

Although FFVs do not cost any more than gasoline-only vehicles, they require more fuel to go the same distance that vehicles operating on gasoline can go, because ethanol has about 30 percent less energy per gallon than gasoline does. This differential can result in, on average, a 20 percent loss in fuel economy. However, experts say that if manufacturers developed vehicles to run only on E85, or if they engineered FFVs to run more efficiently when burning E85 than when burning gasoline, they could eliminate much of this loss.

In the meantime, ethanol prices and federal tax credits are making E85 less expensive than regular unleaded gasoline at the state's eleven commercial stations. The need to refuel more often with E85 can be somewhat offset by its lower cost. In addition, a new statewide contract makes E85 available in all one hundred counties.

Although fuel prices are subject to volatility and predicting the future is anything but safe, fall 2007 prices on the state contract for E85 ran 40 cents less than the price of gasoline, and prices are expected to stay lower for the foreseeable future. However, with California and Florida talking about starting to use E10 and with distributors generally

Refueling Stations in North Carolina for CNG Vehicles

Station Name	Address	City	Contact Phone	Customers	Payment
City of Asheville	45 McCormick Pl.	Asheville	828.259.5700 or 828.259.5702	GP	PK/CC
NC–CNG	2618 Hendersonville Rd.	Arden	828.210.8146	GP	CC
Butner Federal Prison	Old Hwy. #75	Butner	919.575.5000, ext.1207	SO	I
Town of Chapel Hill	6850 Millhouse Rd	Chapel Hill	919.969.5142	SL	I
Piedmont Natural Gas	4301 Yancey Rd.	Charlotte	704.364.3120, ext. 4392, or 704.525.5585	GP	I
Town of Garner	610 Rand Mill Rd.	Garner	919.772.7600, ext. 31 or 32	SL/GP	GP = Cash SL = I
PSNC Energy	800 Gaston Dr.	Gastonia	704.810.3282	GP	PK
Piedmont Natural Gas			*Station Being Moved*		
City of Hickory	1441 9th Ave. NE	Hickory	828.323.7574	GP	CC
Orange County Public Works	680 NC 86 North	Hillsborough	919.245.2628	GP	CC
Davidson County Garage	925 N. Main St.	Lexington	336.242.2250	GP	CC
PSNC Energy	600 W. Cabarrus St.	Raleigh	919.836.2428	GP	PK
City of Raleigh	4120 New Bern Ave.	Raleigh	919.250.2733	GP	PK/CC
City of Winston-Salem	650 Stadium Dr.	Winston-Salem	336.727.2507	GP	I
Dept. of Transportation	300 Craft Dr.	Winston-Salem	336.896.7021	SL	PK

Source: North Carolina Department of Environment and Natural Resources, Division of Air Quality, "You Must Plan Your Trip When Driving a CNG Vehicle," http://daq.state.nc.us/motor/cng/refuel.shtml. Customers: GP = general public; SL = state and local government only; SO = state only. Payment: C = cash; CC = credit card; I = invoice; PK = Pro-Kee (a key system).

beginning to use more E10 and E85, supplies are tightening. Further, corn prices are going up. Consequently, the United States will start importing more Brazilian ethanol, and that will help stabilize prices. New U.S. plants, including cellulose-based plants, also will help increase supply.

One of the challenges with ethanol is that it cannot be shipped through a pipeline because of its water-loving nature. With no production yet in North Carolina, ethanol is coming in by rail and truck, slowing expansion into the marketplace. This situation is likely to change soon because at least two companies plan to begin producing ethanol in North Carolina in 2008.

Further, there is talk of expanding the capacity to store and distribute ethanol at North Carolina petroleum terminals.

Renewable fuels such as biodiesel and ethanol help diversify the state's fuel supplies, putting it on a path to less dependence on imported oil. Without oil production and refineries, the $10–$15 billion that North Carolina spends annually on petroleum does not yield the economic benefit that biofuel refineries do, even if some of the feedstocks for these refineries are imported from other states or nations. Although soy and corn—the current dominant feedstocks for biodiesel and ethanol—clearly will not be able to replace petroleum significantly, they will help carry North Carolina to a future in which additional feedstocks will offer better yields for less energy inputs.

Some opponents of biofuels argue that crops grown for fuel are taking food out of people's mouths and that this redirection of resources is the primary cause of rising food prices. This food-versus-fuel argument, although a potential concern for the future, is misleading. Many factors are responsible for the rise in food prices. One of them is the increase in oil prices.

Rising corn prices are good for farmers. A primary threat to U.S. agriculture today is the loss of farmland to development. One of the reasons farmland is being lost is that crop prices have been too low, and development pressures too high, for farmers to stay in agriculture. To address concerns that corn used to feed the ethanol boom is contributing to the world hunger problem, one could argue that the low prices for U.S. agricultural products overseas are making it more difficult for the world's hungry. Less developed countries find it hard to compete on the world market with subsidized (and therefore cheap) American grain.[5] As the largest U.S. agricultural crop, corn is generally in surplus, requiring government price supports. Therefore, to the extent that ethanol supports corn prices, costs to taxpayers are reduced.

Furthermore, most grain grown in the United States is used not to feed people but to feed animals that humans then eat. It takes seven to nine pounds of grain to make one pound of meat. The corn used in ethanol production is "field corn" used to feed livestock, not sweet corn, which humans eat. Moreover, the argument is not food versus fuel because the production of corn-based ethanol uses only the starch, leaving distillers grain, a valuable co-product that is suitable for animal feed. Studies conducted by university researchers for the National Corn Growers Association indicate that 10–15 percent of poultry feed and 20–50 percent of swine feed could be replaced with distillers grain.[6]

Burning one gallon of gasoline creates nineteen pounds of carbon dioxide.

Another valuable co-product, this one produced through soy farming, spurred investment in biodiesel production. Soy farmers invested heavily in launching the biodiesel market in the United States because of a chronic glut of soy oil resulting from much of the meal going to animal feed.

The state cannot grow its way out of its overreliance on petroleum. However, biofuels coupled with conservation can make a significant dent in the ten million barrels of oil imported daily into the United States.[7]

Biofuels and Petroleum: A Comparison

The costs of biofuels must be compared critically with the costs of what they are replacing—petroleum. There are commodity price supports for corn and soy, as well as tax credits for blending biofuels with petroleum, but there also are many hidden and not-so-hidden subsidies for petroleum. This subsidization hurts the economy and puts the United States in a vulnerable position. An October 2003 paper (updated in 2006) published by the National Defense Council Foundation thoroughly lays out some of the costs and concludes that Americans pay far more for petroleum than the price at the pump.[8] Even with government help, biofuels will never be able to compete on a level playing field because of the tremendous capital investment that already has been sunk into making the petroleum industry the most powerful in the world.

Another important reason to consider using biofuels is climate change. Burning one gallon of gasoline creates nineteen pounds of carbon dioxide. Being plant based, biodiesel and ethanol absorb carbon dioxide during the growing process, and that absorption offsets the carbon that they release through combustion. A National Renewable Energy Lab study of B100 in urban transit buses concludes that biodiesel can reduce carbon dioxide emissions by 78 percent, as compared with petroleum diesel, when using life-cycle analysis. "Life-cycle analysis" takes into consideration all the factors in fuel production. Petroleum does not have the same life-cycle benefits as plant-based fuels because its combustion releases carbon into the atmosphere that has been underground for millions of years.[9] Research also has shown that using full-life-cycle analysis, corn-based ethanol results in carbon dioxide reductions of 18–29 percent, and cellulosic ethanol, up to 86 percent.[10] Not only are greenhouse gases directly linked to fuel combustion, but the amount of fossil fuel energy used to process and transport the fuel to the end user is an important consideration in developing the means to reduce greenhouse gases.

Biodiesel has the highest "energy balance ratio"—the ratio of the energy used to create a fuel, to the energy created by it—of any fuel widely used in the United States. For every unit of fossil fuel energy used to grow and process soybeans into biodiesel, 3.2 units of energy are created to use in a diesel vehicle. Every unit of fossil fuel energy used to extract and refine crude oil into petroleum diesel yields only 0.83 units of energy—a negative energy balance. Ethanol's energy balance is not quite as stellar as biodiesel's, but it is better than gasoline's. For corn-based ethanol, 1.34 units of energy are created for every unit of fossil fuel input, compared with 0.81 units for gasoline.[11]

Low-Carbon Fuels: Natural Gas and Propane

Not all fossil fuels are created equal. Fossil fuels are compounds that contain carbon atoms and hydrogen atoms, with

energy embedded in the bonds between the atoms. The carbon-to-hydrogen ratio affects a fuel's properties, the amount of impurities (other elements such as sulfur) it contains, and the amount of carbon it releases in combustion. Two fossil fuels with low carbon-to-hydrogen ratios are natural gas and propane.

Natural Gas

With one carbon atom and four hydrogen atoms, natural gas is the cleanest fossil fuel, with almost no impurities. Because it is gaseous, though, it must be compressed for use in vehicles. The Honda Civic GX, a "dedicated natural gas" vehicle (meaning a vehicle that operates only on natural gas), produces almost no emissions. In fact, the EPA has repeatedly ranked the GX as the "cleanest internal combustion vehicle" on the road today. Unfortunately, it also is the only light-duty compressed natural gas (CNG) vehicle being offered directly from the factory by an auto manufacturer.

Through vehicle retrofitters, other CNG vehicles are available as dedicated or "bi-fuel" (meaning that they have two fuel systems and can switch from one to the other). Many light- and medium-duty vehicles such as sedans, pickups, and vans can be retrofitted to operate on natural gas by companies that have certification from the EPA to adapt specific makes and models. TransEco Energy Corp., recently opened in Asheville, is one such company. Adapting a gasoline vehicle is not unlike adding a custom moon roof. Arrangements are made through the dealer where the vehicle is purchased, and the CNG fuel system carries a warranty just as any new vehicle does.

North Carolina has fifteen CNG stations operated by a wide range of local, state, federal, and utility providers (see the sidebar on page 33). At least eleven are open to the public, but only six of these accept credit cards. At others, users pay by invoice or use a key system.

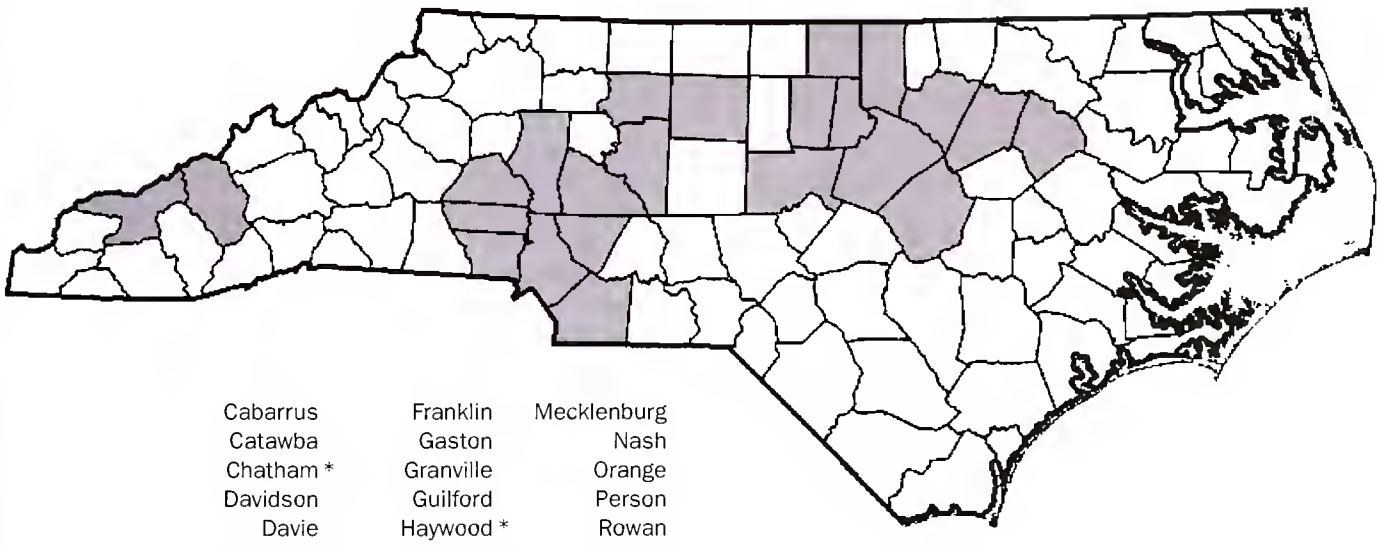
Fueling with natural gas may be done either as a fast fill, which takes 3–5 minutes (much as fueling with gasoline does), or as a time-fill, which takes 6–8 hours and is typically employed by fleets that park their vehicles overnight in a specific location.

Developing refueling infrastructure for CNG does not have to be an expensive undertaking. It can begin with a small refueling appliance manufactured by FuelMaker, which costs $35,000 and can time-fill two to five vehicles at a time. FuelMakers are easy to site and install because they are rated as appliances. In California and New York, FuelMaker has introduced the Phill, a home refueling appliance. For about $4,000, vehicle owners who have natural gas at their homes now can fuel their vehicles overnight with a small apparatus mounted in their garage.

Propane

Often referred to as propane, liquefied petroleum gas (LPG) is a byproduct of natural gas and crude oil refining. LPG shares many of the clean-burning characteristics of natural gas. However, being liquefied, it does not have to be compressed. Thus its refueling infrastructure is similar to that for petroleum

Figure 1. **North Carolina Counties Not Meeting National Standards for Ambient Air Quality**



Cabarrus	Franklin	Mecklenburg
Catawba	Gaston	Nash
Chatham *	Granville	Orange
Davidson	Guilford	Person
Davie	Haywood *	Rowan
Durham	Iredell *	Swain *
Edgecombe	Johnston	Union
Forsyth	Lincoln	Wake

*Represents partial counties. The nonattainment portions of both Chatham and Iredell counties are defined by townships from the Census: in Chatham County, Baldwin, Williams, New Hope, and Center; in Iredell County, Davidson and Coddle Creek. The nonattainment portions of Haywood and Swain counties are the Great Smoky Mountains National Park boundary. For information about the standards, see North Carolina Solar Center, Clean Fuel Advanced Technology, *Mobile Emissions and the Environment: An Overview and What We Can Do Now* (Raleigh, NC: Clean Fuel Advanced Technology, North Carolina Solar Center, n.d.), www.engr.ncsu.edu/ncsc/transportation/docs/Factsheets/Mobile_Emissions_Environment.pdf.

fuels. Many of the companies that adapt vehicles to use CNG convert vehicles to operate on propane. Worldwide, more than 14 million vehicles run on CNG or LPG. Ironically, although the Cummins Consolidated Diesel Company in Rocky Mount, North Carolina, manufactures a very clean-burning CNG engine for use in heavy-duty vehicles such as large trucks and buses, CNG sales for such vehicles are almost nonexistent in the state. The market for the engines is surging in other parts of the world, such as China and India, where many of the engines are shipped.

There are many reasons to take a second look at CNG and LPG for North Carolina. Besides the benefit in cleaner air, the costs of these low-carbon fuels consistently track lower than those of gasoline and diesel. Moreover, large fleets can lock into long-term contracts that assure them of prices lower than those for conventional petroleum fuels and, if volume is significant enough, offer them refueling infrastructure for no cost.

A good example of a company making a business decision to use alternative fuels is Schwan's, of Marshall, Minnesota. Schwan's delivers frozen foods in almost all fifty states, including North Carolina. The company has relied on propane to fuel its fleet of delivery trucks for more than twenty-two years. Today, 7,000 of the 7,500 vehicles in its fleet are dedicated propane medium-duty trucks.

Schwan's, a national purveyor of frozen foods, has used propane to fuel its delivery trucks for more than twenty-two years.

U.S. auto manufacturers do not produce vehicles that operate solely on these tried-and-true low-carbon fuels because traditional petroleum fuels have been inexpensive enough that fleet managers and consumers alike have not generated sufficient demand. As air quality and fuel diversity become more important priorities, CNG and LPG gain in viability.

North Carolina currently has twenty-four counties that do not meet national ambient air-quality standards (see Figure 1). Furthermore, the North Carolina Division of Air Quality estimates that by 2009 the greatest source of oxides of nitrogen—a primary component of ground-level ozone—will be cars and trucks. Ozone, a lung irritant, is created when oxides of nitrogen and volatile organic compounds mix in the presence of sunlight. CNG and LPG vehicles reduce oxides of nitrogen by 50–85 percent, compared with gasoline-powered vehicles.

Retrofitting of Existing Vehicles

It is starting to happen: less dirty black smoke billowing from trucks and buses. New federal standards for heavy-duty diesels require a startling reduction in emissions by 2010. Specifically, allowable emissions for oxides of nitrogen must be reduced by 92 percent of 2004 levels, and allowable emissions for particulate matter, by 90 percent. Three technologies are available to help meet the standard for particulate matter: diesel particulate filters, diesel oxidation catalysts, and diesel multi-stage filters.

Starting with model year 2007, all new heavy-duty trucks come with "diesel particulate filters" (DPFs), ceramic devices that collect particulate matter in the exhaust stream. The high temperature of the exhaust heats the ceramic structure and allows the particles inside to break down (or oxidize) into less harmful components. This technology can be retrofitted on North Carolina's "legacy fleet," its diesel workhorses that can serve for up to thirty years before being retired.

DPFs require annual maintenance because the particulate matter accumulates on a honeycomb-like inner structure that must be cleaned. As fleets add new trucks and this technology becomes more commonplace, larger municipalities may invest in their own cleaners. Now technology providers will take dirty filters for off-site cleaning, so it is

important to have a "swing filter" on hand to keep the vehicle on the road while the dirty one is being cleaned. Other options are possible for fleets that do not want to deal with annual maintenance and the cost of DPFs, which can run from $5,000 to $10,000 each. However, DPFs are the "gold standard" for reducing particular matter emissions on 1994–2006 engines. Up to 90 percent of particulate matter is removed, including the solid carbon core.

"Diesel oxidation catalysts" (DOCs) use a chemical process to break down pollutants in the exhaust stream into less harmful components. These devices are rated by the EPA as removing between 25 percent and 40 percent of particulate matter. DOCs remove only the soluble organic fraction of a typical particle, not the elemental carbon that is increasingly being linked to heart and lung diseases. However, DOCs are relatively inexpensive at $600–$1,000 each and require no maintenance. They also are good choices for off-road equipment because, unlike DPFs, they do not require ULSD.

"Diesel multi-stage filters" (DMFs) might be a good compromise between DPFs and DOCs in certain applications. DMFs use a two-stage metallic filter to trap and reduce particulate matter. Each stage consists of alternating layers of corrugated and fleece-like metal that is coated with a catalyst. At a lower cost than DPFs, DMFs remove up to 50 percent of particulate matter, can be used in 1991–2002 engines, and require the use of ULSD, but do not require any maintenance.

In government fleet operations, school buses are a primary target for diesel retrofitting. Children's lungs are not fully developed, making the impact of breathing dirty air greater. With asthma as the number one cause of absence from school and with schools' federal funding based on attendance, cleaning up school bus exhaust makes both environmental and economic sense.[12] A bill that passed the General Assembly in 2007 will provide $2.5 million to help retrofit school buses in the twenty-four North Carolina counties that do not meet federal air-quality standards. The program, to be launched by the North Carolina Division of Air Quality in fall 2008, will provide funding to install retrofit technologies that remove the greatest amount of emissions.

All the retrofit technologies can be coupled with crank-case ventilation systems (CCVs). A CCV reduces emissions of hydrocarbons and particulate matter produced from the engine crankcase or the oil pan area, and this reduction dramatically improves in-cab air quality. CCVs are not installed alone but coupled with other technologies such as DPFs and DOCs. For an approximate add-on cost of $500 each, CCVs can significantly enhance emission reductions and should be used whenever other technologies are used, particularly on school buses.

Hybrid-Electric and All-Electric Vehicles

Hybrid-vehicle technologies have captured the attention of the automotive industry, with cumulative sales in the United States rising from just 9,300 in 2000 to more than 350,000 through 2007.[13] A "hybrid-electric vehicle" uses both an electric motor and an internal combustion engine to propel itself. Hybrids capture energy that is normally lost through braking and coasting to recharge batteries, which in turn power the electric motor without the need for plugging in. Hybrids have the potential to use electricity to power onboard accessories or to provide outlets to plug in appliances or tools.

Currently, fourteen hybrid models are available, ranging from sedans to luxury vehicles. All have the potential to achieve greater fuel economy and lower emissions than conventional gasoline-engine vehicles.

The newer additions to the hybrid lineup have been larger, more expensive vehicles. Hybrids cost more—on average, about $6,000 more than conventional vehicles. This incremental cost is more easily absorbed in higher-priced vehicles.

However, by hybridizing larger vehicles, the automobile industry loses some fuel-economy benefits. For example, a five-passenger Toyota Prius averages 50–55 miles per gallon, compared with a typical passenger vehicle on the road today, which gets half that. On the other hand, a seven-passenger Toyota Highlander hybrid gets 25–27 miles per gallon, just a few more than the gasoline-powered Highlander, which gets 18–24 miles per gallon.

UNC–Charlotte

Among the possible transportation-related strategies to mitigate the effects of climate change, improving fuel economy is the single greatest step that the United States can take today.[14] With the transportation sector responsible for more than 30 percent of U.S. greenhouse gas emissions, matching vehicles to the tasks they must perform can conserve considerable fuel.

Plug-in hybrids are a promising avenue for the future of passenger vehicles, but at present they are available only through a retrofit that voids the original warranty. Nonetheless, owners of hybrid vehicles like the Toyota Prius are buying kits that allow them to replace their car's existing battery with an array of batteries and then use plug-in technology to charge the batteries

and get more mileage in the all-electric mode. Moreover, by charging the battery overnight with off-peak electricity, they can help even demand for electric power.

Plug-in hybrids already have made inroads in the school bus market through the initiative of Advanced Energy, a Raleigh-based nonprofit organization that launched a national consortium to bring the first hybrid school buses to market in 2006. These first-generation buses are expected nearly to double the fuel economy of diesel-powered buses, from 6.5 miles per gallon to 12 miles per gallon, and to reduce emissions significantly. Only twenty have been produced so far. Potential consumers hope that the incremental cost will drop substantially from the more than $140,000 premium being paid now.

Unlike hybrid school buses, all-electric and hybrid-electric transit buses have been in production for several years by multiple manufacturers. North Carolina transit agencies in Chapel Hill, Charlotte, and Winston-Salem are gaining experience with them, and those agencies' counterpart in Durham plans to join the market soon.

North Carolina stands to gain from the increasing interest in hybrids when Design Line, an international bus company currently manufacturing in New Zealand, starts making hybrid buses in a state-of-the-art factory near Charlotte. Charlotte Douglas International Airport has two Design Line hybrid buses in operation already. However, the industry as a whole is hampered by the significant price tag for the increased fuel economy and reduced emissions that hybrids offer.

As the steep cost for new technologies depresses their adoption rate, neighborhood electric vehicles (NEVs) are moving ahead in popularity among North Carolina municipalities, universities, and parks because they can cost less than a new gasoline vehicle. NEVs have zero tailpipe emissions and are plugged into a standard 110-volt outlet. They must be licensed and are legal to drive on roads zoned up to 35 miles per hour, making them an excellent choice for campus and downtown uses. Beginning at less than $7,000, these vehicles can, in some cases, replace a gasoline-powered vehicle at less cost.

For More Information

For fact sheets on biofuel retail locations and distributors, green fleet policies, and fleet assessments, visit the website of the North Carolina Solar Center's Clean Transportation program, www.cleantransportation.org, and click on Transportation Home/Fact Sheets.

The University of North Carolina at Charlotte is an NEV success story. It currently operates fifty-six NEVS serving a variety of functions on campus, including groundskeeping, maintenance, parking-services ticketing, parking-lot management, student services, housekeeping, and construction. Not only is the university saving the environment, but it is saving money—an estimated $3,800 per vehicle—by eliminating fuel costs and reducing maintenance.

UNC at Charlotte is a success story for neighborhood electric vehicles.

Incentives, Policies, and Programs

North Carolina is fortunate to have a handful of incentives, programs, and policies in place to lead the way to a more sustainable future.

The North Carolina Division of Air Quality provides about $800,000 annually through the Mobile Source Emission Reduction Grant Program for projects that directly reduce transportation-related emissions. An annual call for proposals is held from October through December, with awards made the following spring.

With $2 million in funding from the North Carolina Department of Transportation, the State Energy Office, and the North Carolina Division of Air Quality, the Clean Fuel Advanced Technology project also provides direct funding for transportation-related projects to reduce emissions in the state's twenty-four counties that do not meet air-quality standards. A three-year initiative administered by the North Carolina Solar Center at North Carolina State University, the project supports education and outreach as well.

A third program of direct funding was recently launched with $1 million provided by the 2007 General Assembly to the North Carolina Department of Commerce for green-business grants. Spurred by the Lieutenant Governor's Office, the program seeks to expand access to biofuels by North Carolina fleets and individuals, and to expand energy-efficient and environmentally friendly construction businesses.

Government managers and elected officials can map their course by getting involved with Clean Cities coalitions in the Asheville, Charlotte, and Triangle regions. Sponsored by the U.S. Department of Energy, these coalitions of public and private stakeholders seek to expand the use of alternative fuels to reduce the nation's dependence on imported oil.[15] Through regular meetings of stakeholders, they provide a wealth of opportunity for networking and information exchange. With more than ninety coalitions nationwide, Clean Cities also serves as a gateway to activities on the national scene.

The Clean Transportation Program at the North Carolina Solar Center hosts North Carolina Mobile CARE (Clean Air Renewable Energy), an initiative to recognize exemplary efforts at expanding the use of alternative fuels and advanced technologies in North Carolina. Through fleet surveys and individual consultations, Mobile CARE also provides local governments with an opportunity to take stock of where they stand and receive technical assistance on charting a path to reduced emissions and increased energy diversity.

There are other initiatives as well. The Cool Cities campaign, led by the Sierra Club, is enlisting municipalities across the state in reducing greenhouse gas emissions.[16]

All fleets can benefit from examining the paths outlined in this article, bearing in mind that small steps will eventually add up to a big difference.

The state is leading by example with a requirement that vehicles in fleets larger than ten displace petroleum use by 20 percent by 2010. Attaining the goal of displacing approximately 5 million gallons of petroleum use began by establishing a baseline of fuel use in fiscal year 2004–5. The next step is to incorporate alternative fuels into the mix. Examples include the use of E10 instead of regular gasoline at all North Carolina Department of Transportation fuel sites (at least one in every county) and, by the end of 2008, the use of a mix of B20 and conventional diesel instead of 100 percent conventional diesel at these sites.

Conservation and energy efficiency also are playing a role. By reducing the amount of time spend idling, the North Carolina Department of Environment and Natural Resources' fleet of trucks in the Soil and Water Conservation program has cut fuel consumption by 43 percent. Conservation, whenever possible, always makes dollars and sense. Along with alternative fuels and advanced technologies, energy efficiency will carry North Carolina and the nation down the road to a more secure economy and an enhanced environment.

Conclusion

Rising fuel costs, increased concern for the environment due to climate change, and interest in providing clean air for the next generation—all are compelling reasons to consider alternative fuels, advanced transportation technologies, and practices to promote conservation. There is no perfect solution or one-size-fits-all answer, and there may never be. Nonetheless, there are tremendous opportunities now to introduce fuel and technology diversity into the transportation arena that will enhance the economy and the environment (for resources, see the sidebar on page 38). It is important to get started by exploring the options, developing a plan, and sharing the results with others. By beginning with fuel conservation—downsizing vehicles to the smallest vehicle suitable for the job, planning trips, and reducing idling time—North Carolinians can save money, which can then be devoted to exploring the options outlined in this article. Biofuels, low-carbon fuels, and advanced vehicle technologies such as all-electric cars, hybrid-electric cars, and diesel retrofits all are here now and can serve the state for years to come.

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Saving Energy in Urban Areas: Community Planning Perspectives, 1978

Raymond J. Burby III

The United States faced rapidly escalating energy prices in the 1970s with the creation of OPEC and the occurrence of the "oil crisis." Two related articles by Dr. Raymond Burby offer a historical perspective on how building design and community design can and should, but do not always, respond to the realities of the energy markets. The first article is a reprint of Burby's analysis in a 1978 planning newsletter. The second article presents his reflections thirty years later on what has changed and what has not. —Coeditors

Urban environments account for a major portion of total energy consumption in the United States. Energy use in urban areas is in large part a function of where we live and the ways in which we live, both of which have been shaped by the unprecedented personal mobility associated with the automobile and an abundance of low-cost fossil fuels. As these fuels have become more precious and energy costs have begun to rise, researchers have started to explore ways in which we can build more energy-efficient communities. This article summarizes some of the findings that have emerged to date and highlights major remaining, unanswered questions.

Energy Conservation in Buildings

The basic building blocks of the urban environment are the structures in which we live, work, and pursue our daily activities. Because space heating and cooling in buildings consume about 20 percent of the nation's energy, building design and operation have been major research targets. Initial study results suggest that large savings in building energy use are possible through structural and equipment modifications, but that achieving the savings will be difficult.

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In a recent study prepared for the U.S. Department of Housing and Urban Development, Hittman Associates, Inc. simulated the energy requirements of four types of residential structures—single-family detached, townhouse, low-rise apartment, and high-rise apartment—that were typical of those being built in each of eleven geographical locations with varying climates, design practices, energy prices, and income levels.[1] This analysis indicated that single-family residences required the most energy for heating and cooling, followed in turn by townhouses, high-rise apartments, and low-rise apartments. For each type of residential unit being built, energy savings between 30 and 60 percent could be achieved through technically feasible modifications in design and construction. Key modifications to current practices included reducing the glass area by approximately 25 percent; using double glazing or reflective glass; installing weatherstripping and caulking; increasing wall, floor, and ceiling insulation; and utilizing more efficient heating and cooling systems.

Similar energy savings, ranging from 11.3 percent in single-family dwellings to 59.7 percent in office buildings, will accompany adoption of the American Society of Heating, Refrigeration, and Air Conditioning Engineers standard (ASHRAE 90-75) for new construction.[2] An economic analysis of related standards indicates that by the year 2000 fuel bill reductions will exceed additional construction costs by almost $8 billion, with a benefit/cost ratio for energy-conserving construction standards of 2.9.[3]

Lack of Incentives for Builders

Given that relatively large energy savings are possible in new construction, why are the new methods not being adopted more rapidly? One reason is the fragmented character of the building and development industry. With tens of thousands of architects, general contractors, and home builders, and an army of associated subcontractors involved in new building construction, new ideas, no matter how beneficial, will take time to be diffused throughout the industry. A second reason is related to the economics of the construction industry. Often buildings are built by one person or firm to be sold or rented to another person who pays the energy costs of building operation. As a result, builders may try to improve their competitive position by sacrificing energy efficiency in an effort to reduce the "first cost" of structures to a minimum.[4] A third reason is simply inertia. In the construction industry, however, "business as usual" is frozen into place through building codes, minimum property standards, and the various handbooks for smaller builders. All of these factors create tremendous resistance to change.

Improving Energy Efficiency

Efforts to improve the energy efficiency of new buildings have focused on producer and consumer education and the addition of energy conservation components to federal minimum property standards and state and local building codes. Most of the major trade and professional associations connected with the building industry have published guides to improved building energy

efficiency. To increase consumer demand for energy-efficient buildings, regulations have been proposed that would require energy labeling on heating and cooling equipment and the disclosure of building energy operating costs when building ownership is transferred. At the federal level, the Energy Conservation and Production Act requires the Department of Housing and Urban Development to develop thermal efficiency standards for new buildings by 1980. These standards are to be adopted by the states and implemented through local building codes.

The effectiveness of programs and approaches for energy conservation in new buildings is difficult to assess at this early point. However, several problems are evident. The Council of State Governments has noted that with the current replacement period of twenty-five years for housing units, it will be decades before savings achieved through energy-efficient new buildings contribute substantially to reduced national energy demand. The Council has also indicated that even though the states revise their building codes, "problems of local code enforcement give little reason to expect that code modification will soon result in significant energy savings in buildings."[5] Finally, voluntary adoption of improved building materials and methods is hindered by the industry fragmentation and consumer resistance to paying higher first costs noted above and by financial intermediaries' reluctance to include the additional costs of energy conservation in the value of buildings for mortgage lending purposes. Clearly, energy conservation in buildings cannot be limited to new buildings. Recognizing this, federal, state, and local policies have been developed to encourage owners of existing buildings to invest in retrofitting and the adoption of solar equipment and to make changes in building operation. Hirst and Carney indicate that energy savings resulting from federal efforts to achieve the national goal of insulating 90 percent of all residences are double the savings possible with new construction standards.[6] As with new construction standards, reductions in fuel bills will substantially exceed increased capital costs, with a projected benefit/cost ratio of 1:9. Measures being considered to meet the national goal include tax credits for retrofits, increased funding of existing low-income weatherization programs, inauguration of a rural home weatherization program, and recruitment of utility companies to assist customers in weatherizing structures.

Programs that have been suggested for state and local governments parallel those of the federal government, but also include energy extension agents to provide technical assistance to building owners; real estate tax exemptions to relieve property owners of increased tax liability due to improvements to increase the energy efficiency of their buildings; higher tax and/or utility rates for inefficient structures; and various consumer information and education programs to increase awareness and knowledge of energy conservation practices. It has also been suggested that state and local governments could contribute to energy conservation by providing tax and other incentives for the recycling of older buildings which might otherwise be demolished. In this way the energy already expended in building construction and the public infrastructure serving older neighborhoods and districts could be saved.

New Lifestyles

None of the changes discussed to this point involves the lifestyles of building occupants. However, studies show that most of the energy saved through efficient construction and by retrofit investments can be lost through wasteful building operating practices. In Twin Rivers, New Jersey, for example, researchers found that even after adjusting for differences in building orientation and other physical characteristics, twice as much energy was consumed in some three-bedroom townhouses when compared with other identical units.[7] On the other hand, energy-conscious building operations can result in substantial additional energy savings: a savings of 15 percent, on average, by setting back thermostats to 68 degrees Fahrenheit in winter; a 7 percent savings by setting thermostats to 60 degrees at night; a 6 to 12 percent savings by setting back water heat from 145 to 120 degrees Fahrenheit; and a 10 to 15 percent savings by maintaining furnace and air conditioning units at maximum efficiency by annual checkups.[8]

Policies designed to produce changes in building operation include information and education programs and increases in energy prices. The latter, which has been shown to be very effective in reducing energy consumption in buildings, however, has been criticized severely because it

might discriminate against renters, lower income groups, and others who cannot easily change from energy-inefficient to energy-efficient residences and who have limited ability to retrofit or change their energy consumption patterns.[9] This problem could be alleviated, of course, through tax rebates, in which case the effect of price increases would be to transfer income from high to low energy users.

Energy Conservation through Neighborhood Design

Groups of dwelling units combine with various supporting facilities and services to form urban neighborhoods. Although most attention to energy conservation in urban areas has focused on individual buildings, additional opportunities to save energy are present in the mix and intensity of neighborhood land uses, types and orientations of dwelling units and other buildings, landscaping, and internal circulation patterns. According to a U.S. Department of Energy official, energy savings through the energy-conscious design of new neighborhoods could result in a 5 percent reduction in national energy consumption by the year 2000.[10] Achieving this saving, however, would require major changes in land developer behavior and the attitudes of consumers and local officials.

As noted earlier, different types of dwelling units have different energy requirements. Single-family detached dwellings, because they have more exposed surface area and greater thermal conduction and air infiltration, consume significantly more energy for heating and cooling than townhouses or apartments. Based on typical building construction in eleven metropolitan areas, Hittman Associates, Inc. calculated the following relative values for dwelling unit heating and cooling energy requirements (single-family detached equals 100):[11]

	Heating	Cooling
Single-family detached	100	100
Townhouse	53	95
Low-rise apartment	43	108
High-rise apartment	39	109

Since almost two-thirds of the nation's existing stock of year-round dwelling units is in single-family detached buildings, significant energy savings should be possible if the proportion of households living in other types of dwelling units can be increased. For example, in comparing prototypical thousand-dwelling unit neighborhoods, the Real Estate Research Corporation found that gas and electricity requirements would be about 25 percent less in a neighborhood composed of equal numbers of single-family, townhouse, garden apartment, and high-rise apartments than in a neighborhood composed solely of single-family detached units.[12] Although the task of inducing significant numbers of households to change their housing preferences might appear to be Herculean, increasing construction and financing costs, in combination with demographic trends toward smaller families, may over time lead to greater acceptance of higher density residences.

In addition to changing the mix of housing types, there are a number of other ways to save energy through neighborhood design. One is to provide for neighborhood commercial land uses. For example, in Portland, Oregon, it has been estimated that by resurrecting the neighborhood grocery store of bygone days, the number of automobile shopping trips can be reduced by 15 percent, and the average length of shopping trips can be reduced by 25 percent.[13] In Davis, California, a community that is nationally known for its attention to energy-conserving neighborhood and community planning, it has been estimated that by reducing the required width of residential streets and increasing street landscaping, outside temperatures can be reduced by 10 degrees Fahrenheit in the summer, which will produce a 50 percent reduction in the amount of electricity required for air conditioning.[14] Air conditioning loads can also be reduced by orienting subdivision lots to maximize window exposures on the south and east sides, preserving deciduous landscaping which screens south-facing windows, and orienting units to take advantage of cooling summer breezes. Additional energy can be saved in the neighborhood through the provision of bicycling and walking paths—estimated to produce a 2 percent reduction in shopping, recreation, and school vehicular trips in Portland, Oregon—and by the optimum placement of street lighting.[15] Finally, neighborhoods can be designed to preserve "access to the sun" (solar access) so that optimum use can be made of solar energy systems.[16]

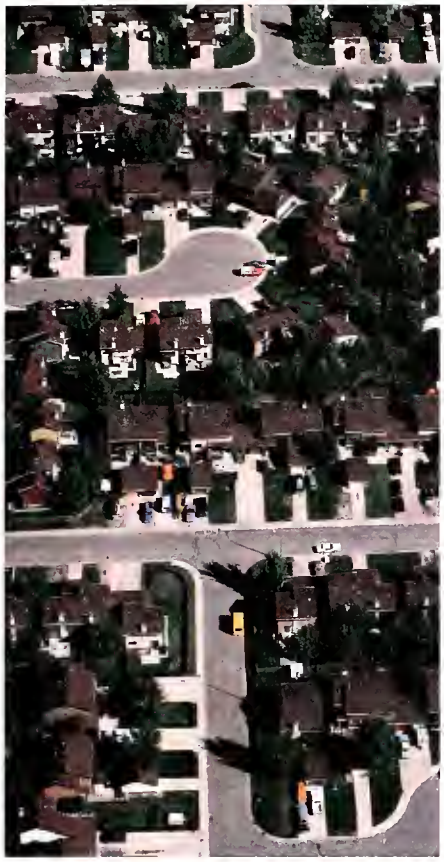
Resistance to Change

Although significant energy savings through neighborhood design seem to be possible, their realization will be extremely difficult. Major decisions about neighborhood design are made by builder/developers, local governments, and the housing consumers who influence both developer and governmental decisions. A recent national market survey of prospective home purchasers found that 97 percent would first attempt to purchase a single-family detached home rather than a townhouse or condominium apartment. The same survey revealed that new home buyers were extremely wary of solar heating and solar water heating. Only 8 percent would purchase solar heating (36 percent would consider it), and 7 percent reported they would purchase solar hot water heating (38 percent would consider it), if they were offered as options by builders.[17]

Given the lack of any clear market signals, builders and developers are naturally hesitant about venturing into energy-conserving development projects. This hesitancy is reinforced by the risks and potential financial costs associated with securing permits from local government for a development plan which requires variances from existing zoning and subdivision regulations. Although some communities, such as Davis, California, have formulated energy-conserving land development plans and regulations, as Harrington has observed, local governments have little incentive to promote energy conservation, since the benefits (extra energy resources) of local sacrifices in preferred lifestyles and development practices will accrue to the nation and not to the locality.[18]

Energy Conservation and Urban Form

At the community and metropolitan scale of development, urban form becomes an important aspect of the



planner's perspective on energy conservation. Urban form refers to the overall spatial configuration or structure of an urban area. Aspects of urban form that are related to energy conservation include the overall scale and density of the community, overall spatial arrangement of development, and the configuration of individual land uses. By manipulating these various aspects of urban form, it has been estimated that community energy consumption can be reduced by 3 to 10 percent by the year 2000.[19] Short-term estimates indicate that national energy consumption can be reduced by about 3 percent by 1985 through the adoption of energy-efficient patterns of urban development.[20] However, because the required changes in urban form imply even greater changes in lifestyle than required by energy-efficient buildings and neighborhood design, achievement of the potential savings is extremely problematic.

Urban Density and Energy Efficiency

Some studies have indicated that the size of an urban area is related to energy consumption. For example, data collected for the U.S. Department of Transportation's Nationwide Personal Transportation Study indicate that household travel for work- and nonwork-related trips reaches a peak in cities in the 5,000–25,000 population range and then tapers off steadily as city size increases. Other research suggests that medium-size urban centers of 25,000–100,000 population offer energy-conserving advantages over smaller and larger centers, but these conclusions are tentative and highly qualified.[21]

The evidence with regard to overall urban density and energy conservation is more firmly established. Energy savings in buildings through higher density development were discussed above. Savings in transportation energy requirements also occur. Shopping and employment areas should tend to be located closer to residential areas, with consequent reduction in travel; high density development makes it possible to use more energy-efficient modes of transportation.[22] In addition, higher density development may result in savings in energy required for utility systems, since shorter transmission lines are required to serve a given population and economies of scale may be achieved in larger, more efficient production plants.[23]

Spatial Planning and Land Use

A number of studies have examined the energy implications of alternative spatial arrangements of urban development. They indicate that a number of aspects of spatial structure must be considered, including the shape of the urban area (whether it is a concentric ring around one center, polynucleated with a number of centers, or linear), the extent to which it is compact or sprawling, and the degree of population and employment concentration. Although the studies tend to agree that the sprawl pattern of development is the least energy-efficient, there is little agreement about the most efficient pattern, in part because of differing study objectives and methods. For example, one study concluded that a "dense center" pattern of development was most efficient, while another found that polynucleated urban structures hold more promise for energy conservation than other spatial arrangements.[24]

Neighborhood grocery stores could significantly reduce shopping trips by car.

Another aspect of urban form that has implications for energy conservation is the configuration of individual land uses. Although research results are far from conclusive, it is generally believed that energy can be saved by mixing and integrating residential, commercial, industrial, and other land uses. In this case, savings stem from (1) sharing energy-consuming mechanical and electrical services, as well as other facilities, such as parking lots; (2) operating economies that can be achieved through centralization; and (3) reducing distances needed to travel from one land use to another, such as from home to work, shopping, and leisure activities.

It has also been suggested that better integration of land uses can make possible more efficient coordination of energy resources in urban areas. Integrated community energy systems can be developed which coordinate various energy services, such as electricity, cooling, heating, hot water, solid and liquid waste treatment, and others in such a way that the energy that is now wasted in producing one service is used as fuel for other services. For example, by locating electric generating stations within communities to make use of waste heat, system efficiencies as high as 85 percent can be achieved—far above the 35 percent efficiency typical of current electrical generating plants.[25]

A variety of policies have been proposed in order to achieve the energy savings that are possible in community development. They include (1) better coordination of urban growth and the provision of electrical services to achieve the savings potential of integrated systems; (2) location of community facilities and employment areas near residential areas and location of higher density housing near activity centers in order to reduce transportation energy consumption; (3) promotion of cluster development with walking paths and mixed-use development projects to achieve transportation and operating economies; (4) curtailment of sprawl development patterns

through coordinated utility extension policies and other means; and (5) greater commitment to public modes of transportation. Although major technical and institutional obstacles must be overcome before integrated community energy systems are adopted, other policies for achieving energy conservation through community development are very familiar to those who have followed the evolution of urban planning over the past three decades. Similar policies have been proposed in order to achieve more cost-effective and environmentally sound communities. Delays in their adoption are due primarily to political factors, rather than legal or technical considerations.[26]

Cluster development with walking paths and mixed-use development projects could save energy.

Conclusion

This brief article has highlighted a number of opportunities for conserving energy in the course of urban development and redevelopment. A host of others, related primarily to energy consumption for urban transportation, could be mentioned. While researchers pursue additional ways to save energy in urban areas, it is essential that those already discovered be adopted more rapidly by the individuals and firms who play key roles in urban development processes and by communities. Educational efforts focused on home owners, professional architects and planners, developers, builders, and the building trades are well under way, and a number of energy conservation manuals have been produced. The potential effectiveness of these and other methods of promoting the adoption of energy conserving urban development practices and policies, however, is not well understood. Social science research can make a major contribution to the correction of this deficiency. By indicating the key factors related to individual and community adoption of energy-efficient policies and practices and suggesting policies to influence the factors in desired directions, the vision of energy-efficient communities may be brought one step closer to the realization.

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Community Planning Perspectives on Saving Energy in Urban Areas: Thirty Years Later

Raymond J. Burby III

The falling price of energy (in inflation-adjusted dollars) throughout the 1980s and 1990s considerably slowed concerted progress in energy conservation. A front-page issue from 1975 to 1985, energy conservation drew little attention and virtually no public support after that. In 1989, for example, I asked a research assistant to survey the city and county governments that had been leading lights in energy conservation and energy efficiency a decade earlier. None of them still maintained the programs that they had started, and none had any staff working on energy issues.

In other words, all the progress that was made in the 1970s and early 1980s just disappeared.

Nevertheless, some good things have happened that reduce energy consumption, though not in the name of energy efficiency. In this article, I look at progress made since publication of my 1978 article.

Energy Conservation in Buildings

Much has been accomplished in energy conservation in buildings through regulation, incentives, and education. Mandated federal standards of energy efficiency were critical in upgrading building codes' provisions for energy efficiency. Power companies' energy efficiency programs, such as load-control programs and free or low-cost energy audits of buildings, also have been important. The various tax credits for investments in energy efficiency by homeowners have been effective too. Further, federal, state, and local programs providing assistance to low- and moderate-income households to improve the energy efficiency of their homes have been significant and largely successful for homeowners.

Some progress has been made, but not nearly enough, in using solar energy in buildings, through either active or passive solar-energy measures.

Another area of limited progress exists in retrofitting the existing stock of rental housing to improve energy efficiency. Rental units in buildings constructed before the energy-efficiency upgrades in building codes (that is, before 1980) are a serious problem. Little progress has been made in persuading building owners to invest in improved energy efficiency, except possibly in the case of buildings owned by local public housing authorities, which have had access to funds from the U.S. Department of Housing and Urban Development for upgrades.

Energy Conservation through Lifestyle or Behavior Changes

I do not know how much has been accomplished in conserving energy through lifestyle or behavior changes. People probably are more conscientious about turning down thermostats than they used to be. Little seems to have been accomplished in reducing transportation energy consumption. The speed limit of 55 miles per hour, mandated in the 1970s, worked well but was unpopular and as a result was lifted. Throughout the 1990s, Americans bought gas-guzzling autos, trucks, and sports utility vehicles. Few people now walk anywhere or use other modes of transportation.

Energy Conservation through Neighborhood Design

The New Urbanism movement has resulted in some neighborhoods that are very energy-efficient, but the relative proportion of dwellings built in New Urbanism communities to total dwelling units is low. Also, the viability of some New Urbanism innovations that can reduce energy consumption, such as neighborhood commercial facilities, has yet to be proven. Many of these enterprises probably will not survive because people still drive to shop, rather than walk to closer commercial facilities.

I see more mixed-use developments that combine commercial and residential facilities, but they probably are a small proportion of new commercial development projects overall. The same is true of transit-oriented developments that cluster commercial and residential land uses near mass transit lines.

There is little evidence of neighborhood design being used to gain passive solar advantages. Also, little progress has been made in revision of subdivision regulations to require layouts that maximize the potential for gains in passive solar energy (although some places have done this, such as Boulder, Colorado).

Further, little evidence exists that district heating schemes have been used in many places. At least, I do not know of any such schemes built in the past twenty-five years in the United States.

Energy Conservation and Urban Form

Overall, not much progress has been made in diminishing urban sprawl. It continues to be the predominant urban form in a number of metropolitan areas, particularly in North Carolina.

Nevertheless, progress on this front is being made, even if slowly. About one hundred metropolitan areas have programs in place at various scales (town, county, and metrowide) to limit urban sprawl. Unfortunately there are only a few metrowide examples, such as in Portland and other metropolitan areas in Oregon.

Increasing density along transportation routes is important to foster greater viability for alternatives to the automobile. It is occurring in a number of places, but neighbors living in single-family units often resist higher-density development, so bringing about change is a struggle. Its prospects can be enhanced if arterial routes, transit, and adjacent multifamily housing precede the development of single-family housing along transit corridors.

Little progress has been made in revising subdivision regulations to help maximize gains from use of passive solar energy.

Conclusion

In sum, community planning measures of various kinds have contributed to improved energy efficiency in urban areas since I wrote about this subject thirty years ago. But the promise of using land-use planning measures to improve energy efficiency in large measure has not been realized.

What does the future hold? Much depends on the price of energy relative to the price of other goods and services. If the record-high prices of the past year are sustained over time, there may be political support for the adoption of state and local government regulations requiring energy-efficient housing and community development practices. In fact, home and community builders will be increasingly likely to adopt such measures on their own in response to consumer demand, without government coercion.

To the degree that high energy prices are a short-term phenomenon, a repeat of the experience of the 1970s and 1980s seems likely. Currently, high energy prices are based on the poor performance of the dollar against other currencies and the extraordinary demand for energy brought about by unsustainably high rates of economic development in China, India, and other developing countries. If the dollar begins to perform better and rates of growth slow, the rate of increase in energy prices also may slow. If so, the current interest in energy conservation and energy efficiency will fade, the private sector will return to business as usual, and cities and counties will find it impossible to force the development of housing and communities that save rather than waste energy.

Heath Retires

On February 28, Milton S. Heath Jr. celebrated retirement from fifty years on the School of Government faculty. At the celebration, Bill Ross, secretary of the North Carolina Department of Environment and Natural Resources, presented Heath with the Order of the Long Leaf Pine award on behalf of Governor Mike Easley. The award is the highest civilian honor given by the State of North Carolina.

Heath's career in public service spanned some of the most important years in the history of use and protection of environmental and natural resources. As legal counsel to several North Carolina House and Senate standing committees from 1967 to 1983, Heath helped pioneer significant environmental legislation on water use, dam safety, environmental policy, coastal area management, control of pesticides and oil and hazardous substances, and protection of mountain ridges.

Heath joined the Institute of Government in 1957 in natural resources and environmental law. Soon after beginning to teach state and local public officials, he added courses in environmental law for graduate students at UNC at Chapel Hill and Duke University. Heath has consulted in countries from England to Kenya and written on air pollution control in Germany and Canada. He is the author or the coauthor of four books, numerous articles and professional papers, and eight law review articles.

Bill Ross (left) presents the Long Leaf Pine award to Milton Heath.

In January 2008, Heath was inducted into the North Carolina Association of Soil and Water Conservation Districts Hall of Fame, complementing his election in 2005 to the Southeastern States Association of Soil and Water Conservation Districts Hall of Fame. He received the 2007 J. M. Jarrett Award from the Environmental Health Section of the North Carolina Public Health Association for his excellent work "in the environmental health field as a proponent, teacher, and leader." Also in 2007, he received his second Newton Underwood Award for Excellence in Teaching from the UNC at Chapel Hill School of Public Health.

At the retirement ceremony, School of Government Dean Michael R. Smith announced the launch of an endowment fund to create the Milton S. Heath Jr. Environmental Lecture at the School. The endowed lecture, Smith said, "will continue the remarkable tradition of teaching and learning that Milton has embodied for more than five decades."

Gifts to the new endowment may be made to the SOG Foundation, CB# 3330, Knapp-Sanders Building, Chapel Hill, NC 27516. Call 919.966.9780 for more information.

Faculty and Alumna, School, Earn National Awards

Faculty members Maureen M. Berner and Frayda S. Bluestein and MPA Program alumna Heather Martin are the 2008 recipients of the prestigious Louis Brownlow Award, which was presented in March at the national conference of the American Society for Public Administration. Given annually since 1961, the Brownlow Award recognizes the best *Public Administration Review* article written by a practitioner. The award-winning article, "Documenting Disparity in Minority Contracting: Legal Requirements and Recommendations for Policy Makers," was published in the May–June 2007 issue of the journal.

The National Conference of Specialized Court Judges, part of the American Bar Association's Judicial Division, has selected the School of Government to receive its coveted 2008 Judicial Education Award. The award recognizes the School's efforts in providing high-quality judicial education and training to district court judges. Faculty member Cheryl Daniels Howell, who specializes in education for North Carolina's district court judges, will accept the award on behalf of the School at a ceremony in August in New York City. The School also received this award in 1998.

Cheryl D. Howell

Sanders Honored for Contributions to State Constitution

John Sanders (right) accepts the John McNeill Smith Jr. Award from School of Government faculty member Michael Crowell.

John L. Sanders, who directed the Institute of Government from 1962 to 1973 and from 1979 to 1992, was honored in February with the North Carolina Bar Association's 2008 John McNeill Smith Jr. Constitutional Rights and Responsibilities Section Award.

The section established the award to honor a person who has demonstrated extraordinary commitment to the ideals embodied in the Constitution of the United States and the Constitution of North Carolina. The presentation was made by Michael Crowell, professor of public law and government at the School of Government, who submitted the nomination.

Sanders was the principal staff person for the 1968 North Carolina State Constitution Study Commission, which produced the state's present constitution. "For decades he has been recognized as one of the most knowledgeable people in the state on the history and meaning of the state constitution." Crowell said.

Sanders retired from the School faculty in 1995.

City Officials Study Essentials

Nearly 700 mayors, council members, administrators, and attorneys attended the 2008 Essentials of Municipal Government course, which was offered at six locations across the state from January through March.

The Essentials course provides new and veteran municipal officials with an introduction to the responsibilities, the challenges, and the opportunities inherent in leading and governing North Carolina cities. For the first time, a one-day advanced course for veteran municipal and county leaders was offered concurrently.

The School of Government offers sincere thanks and appreciation to Food Lion, which provided major support and scholarships for the course, and to the North Carolina League of Municipalities (NCLM), the North Carolina City and County Management Association, the Local Government Federal Credit Union, and the NCLM Local Leadership Foundation for additional support. These important contributions allow the School to offer the Essentials course at the lowest possible price and respond effectively to the educational needs of municipal leaders.

An Essentials course for county commissioners will be offered after the county elections in late 2008. To learn more, visit www.sog.unc.edu/courses/0640.

Ninety-Five Graduate from 2007–2008 Municipal and County Administration Courses

Representing municipalities from Kitty Hawk to Waynesville and counties from Gates to Haywood, ninety-five graduates celebrated their successful completion of the Municipal and County Administration courses in April 2008.

The intensive eight-month program serves city and county managers, department heads, and other officials whose responsibilities require a comprehension of functions beyond their individual areas of specialization. Course participants gain a better understanding of the relationships among activities or departments and the contributions of specific laws, programs, and functions to the achievement of the overall mission of a local government.

Mujeeb Shah-Khan, assistant city attorney for Charlotte, received the George C. Franklin Award, presented by the North Carolina League of Municipalities. Dan Porter, planning director for Camden County, received the Edwin M. Gill Award, presented by the North Carolina Association of County Commissioners.

More than 2,500 officials have graduated from the Municipal Administration Course since its inception in 1954, and more than 1,200 officials, from the County Administration Course since its inception ten years later. For more information, visit www.sog.unc.edu/programs/mcap, or call Brian Newport at 919.966.6880.

Faculty Member Stephens Visits China

Imagine that you are watching TV news about protests in Tibet and suddenly the screen goes blank and the sound stops. School of Government faculty member John B. Stephens experienced this form of government censorship during a trip to China in March 2008. Over a two-week period, Stephens visited the cities of Shanghai, Chengdu, and Xiamen to learn more about ways in which China affects the United States and what that might mean for North Carolina government and community leaders.

In the month before his trip to China, Stephens arranged for fourth and fifth graders in the dual-language Chinese-English program at Glenwood Elementary School (Chapel Hill) to be the teachers for 100 adult students in the 2008 Municipal and County Administration courses. Also, Steven Levine, UNC at Chapel Hill Asian Studies professor emeritus, spoke on the challenges and the opportunities in North Carolina's connections to China.

Stephens spent a week traveling with Leaders Quest, a private organization that seeks to "enable people in positions of influence to stand in the shoes of others, to understand the impact of their decisions, to make wiser decisions, and to build a better world." One of its cofounders, Fields Wicker-Miurin, is a North Carolina native and daughter of the late Jake Wicker, a School faculty member from 1955 to 2003. Political protests in Tibet began during that week, and Stephens experienced blocked websites and obstructed media coverage of the turmoil. "While we might complain about U.S. TV shows and news reporting, I had never experienced that kind of censorship," he said.

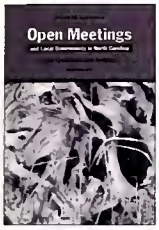
Later in his trip, Stephens met with public administration faculty and lectured on the U.S. presidential campaign at the University of Electric Sciences and Technology in Chengdu and at Xiamen University, where UNC at Chapel Hill sponsors a fall-semester study-abroad program for undergraduate students. At Xiamen University, he also lectured on the U.S. system of environmental mediation in policy making, regulation development, and conflict resolution.

Financial support for the trip was provided by the School of Government and UNC at Chapel Hill's Kenan-Flagler Business School and Center for Global Initiatives.

MPA Graduation

The School congratulates the twenty-four Master of Public Administration students who graduated from the two-year degree program on May 10, 2008. Front row (left to right): Heather Chartier, Andrea Cain, Julie Walden, Heather Scarbrough, Wilson Cho, Laura Jensen, John King, Kate Shem. Middle row (left to right): Sean Coffey, Shannon Byers, Jackie Ashley, Heather Strickland, Carol Hickey, Randall Lyons, Justin Amos, Peter Franzese. Back row (left to right): Nicholas Dula, Shawn Purvis, Ryan Ewalt, Ryan Davidson, Steven Buter, Glenn Barnes. Not pictured: Jamie McColl, Michael Stepanek.

Off the Press



Open Meetings and Local Governments in North Carolina: Some Questions and Answers

Seventh edition, 2008 • $15.00*
David M. Lawrence
This guidebook details the provisions of North Carolina's open meetings law in a question-and-answer format and sets out the text of the law. For related information, see *Local Government Law Bulletin* no. 103, "Closed Sessions under the Attorney-Client Privilege."

North Carolina Guardianship Manual

2008 • $50.00*
John L. Saxon
This manual discusses the role and the responsibilities of attorneys who are appointed to represent allegedly incapacitated respondents in adult guardianship proceedings. It summarizes and analyzes relevant provisions of North Carolina's guardianship law (Chapter 35A of the North Carolina General Statutes) and discusses in depth the standards for determining incapacity, the procedure for appointment of guardians, and other significant aspects of guardianship proceedings.

Immigration Consequences of a Criminal Conviction in North Carolina

2008 • $45.00*
Sejal Zota and John Rubin
Using a step-by-step approach to the immigration consequences of a criminal conviction, this essential guide explains the different types of immigration status and the various criminal convictions that trigger deportation. Included is a detailed chart of immigration consequences of various North Carolina offenses and a removable, laminated checklist highlighting the key consequences.

Bits and Bytes

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Visit the Publications section of the School's website at www.sog.unc.edu and search by keyword or author's last name.

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Public Management Bulletin no. 3, March 2008
John B. Stephens

Zoning Amendments in North Carolina
Special Series no. 24, February 2008
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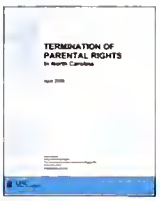
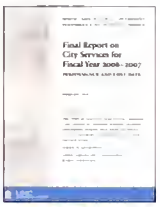


Termination of Parental Rights in North Carolina

2008 • $20.00 (print edition)*
Janet Mason
Updated in April 2008, this publication is an outline of North Carolina law governing termination of parental rights, with references to relevant statutes and cases. It is available as a print edition and as a free, downloadable PDF from the School's website at www.sog.unc.edu.



Final Report on City Services for Fiscal Year 2006–2007: Performance and Cost Data

2008 • $15.00*
Prepared by Dale J. Roenigk
This report presents performance and cost data for fiscal year 2006–2007 for sixteen North Carolina cities participating in the North Carolina Benchmarking Project. It covers the service areas of residential refuse collection, household recycling, yard waste/leaf collection, police services, emergency communications, asphalt maintenance and repair, fire services, building inspections, fleet maintenance, and human resources.

Eminent Domain and Local Government in North Carolina: Law and Procedure

2008 • $26.00*
Charles Szypszak
In a new format focusing on law and procedure, this publication provides an overview of the complex area of the law known as eminent domain, as it has been addressed in North Carolina's statutes and interpreted and applied by the courts. The book also offers basic guidance concerning the required procedures. It is a resource for local government officials and their attorneys, judges and lawmakers, and property owners seeking a better understanding of eminent domain.

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