North Carolina State Energy Plan 2003

The 2003 North Carolina State Energy Plan represents the diligent efforts of the Energy Policy Council, the North Carolina State Energy Office and its consultants, key stakeholders from around the state, and the public at large. The provisions of the State Energy Plan emerged from an open, collaborative process. However, not all members of the Energy Policy Council agreed with all of the provisions of the plan. As such, the policies and programs recommended by the plan are best viewed as the majority opinion evolving from considerable dialog on virtually every issue.

This effort is sponsored by the State Energy Office, North Carolina Department of Administration and the U.S. Department of Energy, with State Energy Program funds, in cooperation with Appalachian State University. However, any opinions, findings conclusions, or recommendations expressed herein are those of the authors and do not necessarily reflect the views of the U.S. Department of Energy.

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North Carolina
State Energy Plan
June, 2003
Revised November, 2004

Prepared for the

North Carolina Energy Policy Council

By the

State Energy Office

North Carolina Department of Administration

And

Appalachian State University Energy Center

STATE OF NORTH CAROLINA
OFFICE OF THE GOVERNOR
20301 MAIL SERVICE CENTER
RALEIGH, NC 27699-0301

MICHAEL F. EASLEY
GOVERNOR

Dear Fellow North Carolinians,

I am pleased to present the 2003 State Energy Plan for North Carolina. Energy heats and cools our homes, powers our vehicles and runs our businesses, farms and factories. It is critical to our state's economic strength and its environmental health that we provide our citizens with a sustainable energy future. The 2003 State Energy Plan provides a set of programs and policies to guide that future.

The North Carolina Energy Policy Council, which consists of members of my administration, legislators and key energy stakeholders, developed this plan. I am grateful for their diligence and commitment to this effort. Eighteen months in the making, this strategic plan drew input from state and national energy policy experts and from hundreds of individual North Carolinians. The plan is comprehensive in its scope and inclusive in its development.

The Energy Policy Council has outlined ambitious programs and policies that build upon our existing energy strengths and develop new energy approaches. The plan balances our need for a reliable energy supply to power the future growth of our economy with the need to protect the quality of our environment. Implementation of these recommendations will help our economy, improve our environment and increase the sustainability of our energy supply.

With kindest regards, I remain

Very truly yours,

Michael F. Easley

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Abbreviations

AFV	Alternative-Fueled Vehicles
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
DENR	Department of Environment and Natural Resources
DOA	Department of Administration
DOT	Department of Transportation
DHW	Domestic Hot Water
DSM	Demand Side Management
ECM	Energy Conservation Measure
EIA	Energy Information Administration
EMC	Electric Membership Cooperative
EPC	Energy Policy Council
EPWG	Energy Policy Working Group
HARRP	Heating Air Repair or Replacement Program
HVAC	Heating, Ventilation and Air Conditioning
IOU	Investor-Owned Utility
kWh	Kilowatthours
LIHEAP	Low-Income Housing Assistance Program
LoGESO	Local Government Energy Savings Organization
MMBtu	Million Btu
MPG	Miles Per Gallon
MSW	Municipal Solid Waste
MTBE	oxygenation additive for gasoline
Muni	Municipal Electric
MWh	Megawatthours
NCSU	North Carolina State University
NCUC	North Carolina Utilities Commission
NO_x	Nitrogen Oxide
PBF	Public Benefits Fund
PV	Photovoltaics (solar-electric panels)
PVE	Petroleum Violation Escrow
RPS	Renewable Portfolio Standard
SEO	State Energy Office
SO_2	Sulfur Dioxide
TBtu	Trillion Btu
TVA	Tennessee Valley Authority
UNC	University of North Carolina
VMT	Vehicle Miles Traveled
WAP	Weatherization Assistance Program

2004 Revised State Energy Plan Action Items

State Energy Plan in Action

In 2003 and 2004, North Carolina's State Energy Office (SEO) has refocued its activities to reflect the recommendations of the State Energy Plan. Thus, meeting the Energy Plan's recommendations has become the central direction of the SEO.

The SEO has also determined that monitoring the impacts of its programs and policies is a critical need. Contractors are required to complete Contract Impact Reports that summarize how each project impacts energy use, environmental emissions, jobs, and income allocated by county. An initial evaluation of expenditures and energy savings provided input into a preliminary assessment of the overall economic impact of the activities of the SEO. The assessment is part of an ongoing effort to determine which programs and projects are most effective at promoting energy efficiency and development of renewable resources in the state.

Revised Action Items

During the initial year of implementing the plan, SEO worked with the Energy Policy Council, which oversees its activities, to review the priorities of the recommendations in the State Energy Plan. The Executive Summary describes how 15 recommendations were selected as high priority Action Items during development of the Energy Plan, as described in the Plan's Executive Summary. After careful review, the Energy Policy Council in September, 2004, approved the following as the revised list of Action Items for 2004 to 2005:

Energy, Economic, and Environmental Issues

Exec-1 The North Carolina Department of Commerce and the State Energy Office should encourage and support economic development of energy-related enterprises whose products are intended to increase energy efficiency or use renewable resources, such as providers of specialized insulation and window products, heating and air conditioning equipment and controls, distributed generation equipment, solar and wind energy equipment, biofuels, and fuel cells.

Exec-2 The State Energy Office should communicate the energy research, development, demonstration, and deployment projects being performed in the state to the North Carolina Department of Commerce for its recruiting and economic development strategy.

Exec-3 North Carolina should prepare its economy for the emerging national and international greenhouse gas marketplace so North Carolina companies are prepared to win in a greenhouse gas trading system. Establishing baseline greenhouse gas emissions and setting state objectives are two ways that the state can begin to prepare for this new market

Alternative Fuels from Biomass

Exec-4 North Carolina should support the development of an alternative fuel industry through dedicated funding and grant matching of promising alternative fuel projects. These efforts should include agricultural waste processing facilities, biodiesel and ethanol refineries, and fueling stations for alternative-fueled vehicles, production incentives for farmers and refiners, incentives for highly

efficient or alternative-fueled vehicles, distribution credits for biofuels distributors, buydown program for incremental costs of purchasing biofuels, and education and awareness programs. Developmental efforts should focus on raising feedstock production levels and insuring 35 publicly accessible refueling stations in the state have alternative fueling infrastructure by 2007. In particular, the Energy Policy Council supports a state mechanism to pay for alternative fuels development via special fees, tax credits, and other sources.

Exec-5 Based on the results of ongoing research and development studies, the North Carolina General Assembly should pursue strategies that convert animal waste into environmentally sound energy sources.

Alternative Energy Sources

Exec-6 The General Assembly should consider adopting net metering for application to all electric utilities in the state.

Exec-7 The General Assembly should evaluate a renewable portfolio standard (RPS) that complements the NC GreenPower program and fosters the development of a renewable electricity market. The RPS would require that all electric utilities increase the percentage of total distributed electricity that comes from renewable sources, such as hydroelectric, wind, solar, waste-derived fuels, and agricultural fuels.

Exec-8 The General Assembly should reexamine existing legislation and regulations as pertains to barriers and strategies to develop wind energy while still protecting North Carolina's natural beauty.

Exec-9 The State Energy Office should assess and propose incentives and regulatory or administrative measures for development of renewable electricity generation facilities, solar water heating, passive and active solar space heating, and daylighting.

Exec-10 The General Assembly should require that all electric utilities in North Carolina provide generation disclosure of fuel mix percentages and emissions statistics on sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury annually by bill insert and via website. The disclosure information should clarify to the consumer the environmental impact of residential electricity use.

Energy Use in the Public Sector

Exec-11 State agencies and universities, with coordination by the North Carolina Department of Administration, should reduce energy consumption in existing state buildings to save 20% by 2008, 4% per year or more for the next 5 years. The State Energy Office should submit an annual report to the Energy Policy Council, the Governor's Office, the State University System and other major energy users in North Carolina that provides data on energy saved in state buildings and universities by source and cost, energy efficiency activities undertaken in these buildings, the approximate investment in energy efficiency measures, and the overall economic costs and benefits of the program.

Exec-12 Working in conjunction with the State Construction Office and the State Property Office, the State Energy Office should analyze available data, and report on the energy savings attributable to the new requirements on life-cycle cost analyses of the $3.1 billion higher education building program currently underway across the state, as well as future projects. The State Construction Office should

recommend that new and existing buildings are individually metered for electricity, natural gas, steam, chilled water, and water, to facilitate studies of building energy use and allow comparison with existing buildings not subject to life-cycle cost analysis. Benchmarks for energy intensity, Million BTUs per Gross Square Feet, for various asset types should be used, as well as Energy Star ratings for offices, dormitories, and hospitals. The State Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer life-cycle cost procedure to the extent possible with available building utility data.

Exec-13 North Carolina should facilitate efforts of local governments to finance energy efficiency and renewable energy projects; specifically, allow bundling of multi-jurisdictional energy efficiency projects to achieve economies of scale and improve opportunities for financing, restructure the underwriting provisions of the State Energy Office's low-interest energy loan program, and provide training in energy efficiency measures to building managers in local government buildings.

Energy Use in the Residential Sector

Exec-14 North Carolina State Government should continue to support a strong low-income weatherization program. The state should review the effectiveness of energy conservation programs conducted through the weatherization program and analyze opportunities for improvements. The State Energy Office should develop programs, in addition to weatherization, to address energy-efficient housing in the low-income sector. The State Energy Office should investigate technologies, incentives, financing options, and regulatory issues regarding minimum efficiency requirements for manufactured housing and promote Energy Star manufactured homes.

Funding for Energy Programs

Exec-15 The General Assembly should review options, such as a Public Benefits Fund (PBF)or other means, to enable funding of the recommendations in the State Energy Plan.

Recommendations Moved Up to Action Items (September 16, 2004)

Exec-16 (formerly 10-1 plus commercial reference)

The State Energy Office should increase funding appropriate agencies in the state to expand technical assistance and analysis efforts to reduce energy use by the industrial sector and, when funds are available, to the commercial sector in North Carolina. Funding should also be provided for follow-up efforts to facilitate implementation of cost effective technologies, including making contacts with vendors to procure bids, assisting with performance contractors, developing sample specifications, and providing other technical assistance. The State Energy Office should investigate and analyze alternative incentives to increase the implementation of efficiency and renewable energy measures, including low interest loans, performance contracts, and incentive payments. The outreach and technical assistance program should support ongoing efforts to reduce water usage in industrial and municipal operations and, if funds are available, to commercial operations.

Exec-17 (formerly 11-2 and 11-3)

State agencies should convert at least 10% of their entire fleet to high efficiency (over 40 miles per gallon) or alternative-fueled vehicles by 2005 and 20% by 2010. The North Carolina Department of Transportation should provide supporting fueling infrastructure.

Exec-18 (formerly 12-9)

The State Energy Office should support development of a comprehensive information outreach program for consumer questions about saving energy and using renewables in their homes and businesses; information hotline via a toll-free telephone number; informative Web Page containing a wide array of publications available on-line; resources that include up-to-date information on renewables and energy efficient buildings, industrial facilities, and vehicles, as well as data on energy sources in the state; information on energy-producing facilities; environmental information related to energy consumption; and other energy-related information.

Exec-19 (formerly 12-13)

North Carolina should require that K-12 students learn about energy. Energy issues should be incorporated into the end-of-grade tests. The SEO should provide educational materials , training, and activities for current classroom teachers and K-12 students.

Exec-20 (formerly 8-4)

The State Energy Office should organize a statewide effort to develop criteria for a residential high performance building program to reduce the life cycle cost of new and existing buildings. The criteria should utilize provisions from other successful high performance programs, including Energy Star, programs developed by Advanced Energy Corporation, NC Healthy Built Home, Southface Energy Institute's Earthcraft Home, U.S. Department of Energy's Building America, and others.

North Carolina State Energy Plan

Executive Summary

North Carolina's General Assembly established the Energy Policy Council in 1975 as a means of addressing state-specific energy issues and concerns. The 1992 North Carolina Energy Plan was the Energy Policy Council's last examination of energy use, energy production, and environmental concerns in our state. As state and national energy issues have changed in the past 10 years, a more recent and detailed version of North Carolina's energy plan was requested by the Energy Policy Council.

As a starting point, the Energy Policy Council formed a working group from among its members, representing key energy and environmental interests, to develop updated energy policy and program recommendations. The Energy Policy Working Group began by adopting a set of objectives (listed in the sidebar). North Carolinians from all walks of life provided input to the Energy Policy Working Group in the following ways:

- Nine days of sessions featuring state energy experts, as well as regional and national specialists, on specific energy issues;
- Input from over 25 stakeholders affected by energy consumption and supply, including members of industry, low-income groups, homebuilders, community planners, petroleum suppliers, automobile retailers, bankers, renewable energy experts, and farmers; and
- Written and verbal comments on energy issues from about 300 North Carolinians via 4 public input sessions held across the state.

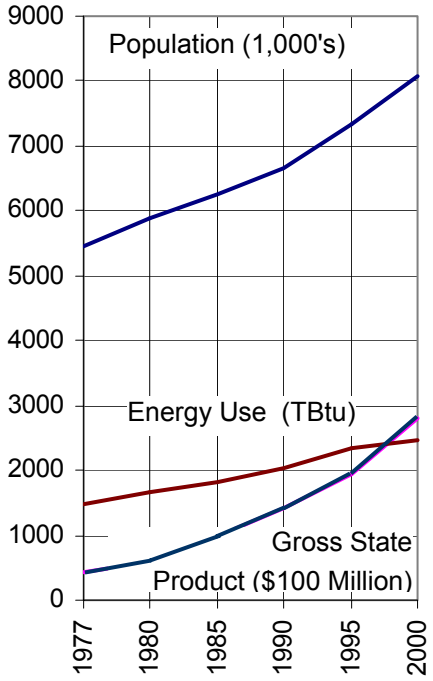
The Energy Policy Working Group recorded and organized the input received and, after months of extensive deliberation, provided a draft set of recommended policies and programs to the Energy Policy Council in January, 2003. The Council discussed the recommended policies and programs and approved 93 measures, as set forth herein, that meet the plan's objectives. The policies and programs approved by the Energy Policy Council primarily addressed the following sectors and issues in the state:

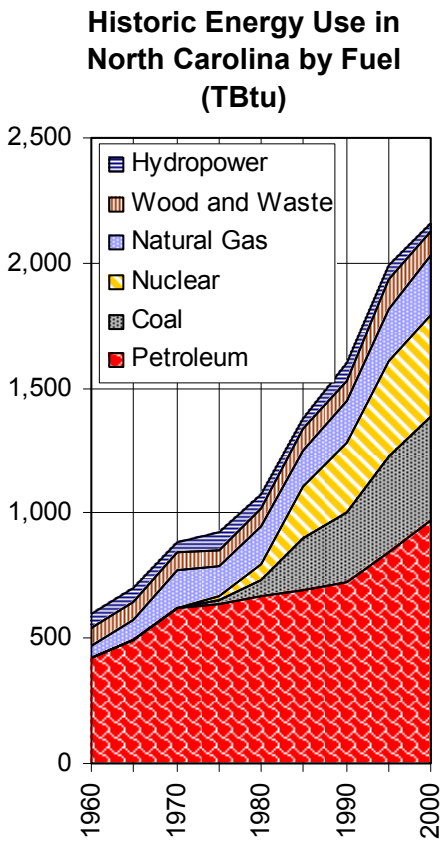
- Energy, Economics, and the Environment
- Fossil and Nuclear Fuels
- Electric Utilities and Energy Use
- Alternative Fuels from Biomass
- Alternative Energy Sources
- Energy Use in the Public Sector

Objectives of the North Carolina State Energy Plan

- Insure energy reliability for North Carolinians;
- Improve the public health and environmental quality of our state;
- Develop policies that promote wise land use;
- Implement strategies supportive of a sound North Carolina economy;
- Develop an achievable sustainable energy strategy for North Carolina; and
- Implement a strategy by which the state can lead by example.

NC Energy Use, Population & Gross State Product





- Energy Use in the Residential Sector
- Energy Use in the Commercial Sector
- Energy Use in the Industrial Sector
- Energy Use in the Transportation Sector
- Energy Education and Research
- Funding for Energy Policies and Programs

Immediate Action Items

The Energy Policy Council reviewed the entire list of 93 policies and programs to determine which measures would require action by the Governor, North Carolina General Assembly, North Carolina Utilities Commission, or other regulating or administrative agency. From the entire list, the Energy Policy Council recommends the following 15 key legislative, regulatory, and administrative policies for action in 2003 and 2004:

Energy, Economic, and Environmental Issues

Exec-1 The North Carolina Department of Commerce and the State Energy Office should encourage and support economic development of energy-related enterprises whose products are intended to increase energy efficiency or use renewable resources, such as providers of specialized insulation and window products, heating and air conditioning equipment and controls, distributed generation equipment, solar and wind energy equipment, and fuel cells.

Exec-2 The State Energy Office should communicate the energy research being performed in the state to the North Carolina Department of Commerce for its recruiting and economic development strategy.

Exec-3 The North Carolina Department of Environment and Natural Resources should create a greenhouse gas registry to track emissions of carbon dioxide and other greenhouse gases, to establish baseline greenhouse gas emissions, and to demonstrate reductions in greenhouse gas emissions for potential greenhouse gas trading systems depending upon the availability of funding.

Alternative Fuels from Biomass

Exec-4 North Carolina should support the development of an alternative fuel industry through dedicated funding and grant matching of promising alternative fuel projects. These efforts should include agricultural waste processing facilities, biodiesel and ethanol

refineries, fueling stations for alternative-fueled vehicles, production incentives for farmers and refiners, incentives for highly efficient or alternative-fueled vehicles, and education and awareness programs. Developmental efforts should focus on raising feedstock production levels and insuring all 100 counties in the state have alternative fueling infrastructure by 2007. In particular, the Energy Policy Coun cil supports a state program to pay for alternative fuels development via a $1 to $2 fee applied to annual vehicle registration fees.

Exec-5 Based on the results of ongoing research and development studies, the North Carolina General Assembly should pursue strategies that convert animal waste into environmentally sound energy sources.

Alternative Energy Sources

Exec-6 The General Assembly should consider adopting net metering for application to all electric utilities in the state.

Exec-7 The General Assembly should evaluate a renewable portfolio standard (RPS) that complements the NC GreenPower program and fosters the development of a renewable electricity market. The RPS would require that all electric utilities increase the percentage of total distributed electricity that comes from renewable sources, such as hydroelectric, wind, solar, waste-derived fuels, and agricultural fuels.

Exec-8 The General Assembly should reexamine the Mountain Ridge Protection Act as it pertains to wind energy while still protecting North Carolina's natural beauty.

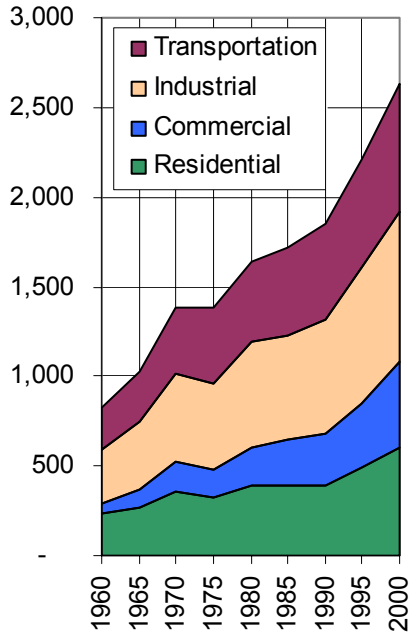
Exec-9 The State Energy Office should assess and propose incentives and regulatory or administrative measures for development of renewable electricity generation facilities, solar water heating, passive and active solar space heating, and daylighting.

Exec-10 The General Assembly should require that all electric utilities in North Carolina provide generation disclosure of fuel mix percentages and emissions statistics on sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury annually by bill insert and via website. The disclosure information should clarify to the consumer the environmental impact of residential electricity use.

Energy Use in the Public Sector

Exec-11 State agencies and universities, with coordination by the North Carolina Department of Administration, should reduce energy

Historic Energy Use in North Carolina by Sector (TBtu)



The largest single sector in terms of total energy use (including the energy consumed to generate electricity for the sector) is industrial at 31% of the total. Transportation is second largest with 28% of total energy use. The residential (23%) and commercial (18%) sectors, if combined, would demonstrate that the largest energy use in the state is in buildings at 41%.

Energy efficiency, although not specifically an energy source, is projected to have reduced national energy needs by 31% between 1975 and 1999.

consumption in existing state buildings to save 20% by 2008, 4% per year or more for the next 5 years. The State Energy Office should submit an annual report to the Energy Policy Council, the Governor's Office, the State University System and other major energy users in North Carolina that provides data on energy saved in state buildings and universities by source and cost, energy efficiency activities undertaken in these buildings, the approximate investment in energy efficiency measures, and the overall economic costs and benefits of the program.

Exec-12 Working in conjunction with the State Construction Office, the State Energy Office should monitor, analyze, and report on the energy savings attributed to the new requirements on life-cycle cost analyses of the $3.1 billion higher education building program currently underway across the state, as well as future projects. The State Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer life-cycle cost procedure.

Exec-13 North Carolina should facilitate efforts of local governments to finance energy efficiency and renewable energy projects; specifically, allow bundling of multi-jurisdictional energy efficiency projects to achieve economies of scale and improve opportunities for financing, restructure the underwriting provisions of the State Energy Office's low-interest energy loan program, and provide training in energy efficiency measures to building managers in local government buildings.

Energy Use in the Residential Sector

Exec-14 North Carolina State Government should continue to support a strong low-income weatherization program. The state should review the effectiveness of energy conservation programs conducted through the weatherization program and analyze opportunities for improvements. The State Energy Office should develop programs, in addition to weatherization, to address energy-efficient housing in the low-income sector.

Funding for Energy Programs

Exec-15 The General Assembly should review options, such as a Public Benefits Fund or other means, to enable funding of the basic services provided by the State Energy Office and the recommendations in the State Energy Plan.

Chapter 1: Introduction

At the dawn of the new millennium, energy issues dominated the front pages of newspapers across the country. The new presidential administration proposed a revised national energy policy. California's newly restructured utility system experienced critical energy shortages during two consecutive summers. Our nation's largest energy trading and investment corporation went into bankruptcy amid severe financial and accounting problems. In North Carolina, energy consumers endured a spike in fuel prices during the winter of 2000. These issues were then compounded by the tragic terrorist events of September 11, 2001, which forced all citizens to take stock of their personal security as well as the security of our nation's energy resources.

In addition, the nation and the state are now facing difficult economic times. North Carolina's struggling economy is affecting the abilities of state agencies, municipalities, counties, and educational systems to provide their services effectively. Several major industries in North Carolina—specifically textiles, furniture manufacturing, and tobacco—are experiencing financial hardships due to demand reductions and overseas competition. Rising energy costs further complicate industrial production and operation requirements, often threatening the ability of businesses to continue in operation.

North Carolina has not engaged in a detailed evaluation of energy issues since 1992. Consequently, a thorough examination of the state's energy resources, as well as our energy policies, is timely and pertinent to insuring the continued success and stability of North Carolina's economy. Additionally, the state's current energy-related environmental policies require similar examination in order to preserve the health of our citizens and protect the natural beauty of North Carolina's mountains, beaches, and wildlife.

The sidebar lists important recent developments regarding energy and environmental issues in the state. In light of these developments and the emerging importance of energy as both a state and national issue, North Carolina's Energy Policy Council has devised the 2003 State Energy Plan.

The main purpose of the State Energy Plan is to provide policymakers with a clear picture of how North Carolina's energy needs are currently being met, how energy use patterns can be improved, what can be done to develop new energy resources, and how such efforts should be funded. The Energy Policy Council recommends that the State Energy Plan fulfill these 6 objectives:

- Insure energy reliability for North Carolinians;
- Improve the public health and environmental quality of our state;
- Develop policies that promote wise land use;

Over the past several years, North Carolina has responded proactively to energy supply and research issues in the state:

- The General Assembly appointed a commission in the late 1990s to examine restructuring of the state's electric utility industry.
- The North Carolina Utilities Commission approved a green pricing program, called NC GreenPower, through which consumers across the state will be able to purchase a portion of their electric needs from renewable sources.
- Major initiatives have been underway to increase the availability of natural gas throughout the state.
- The state's investor-owned utilities continue to provide reliable, regionally competitive electricity through careful growth strategies.
- State universities, research centers, and nonprofit organizations continue energy research, development, and deployment efforts examining innovative approaches for providing clean, reliable, and sustainable energy future.
- The General Assembly passed the Smokestacks Bill, signed into law by Governor Easley in June of 2002, that will significantly reduce emissions from coal-fired power plants over the next 30 years.

- Implement strategies supportive of a sound North Carolina economy;
- Develop an achievable sustainable energy strategy for North Carolina; and
- Implement a strategy by which the state can lead by example.

The Planning Process

The Energy Policy Council appointed an Energy Policy Working Group to conduct research on energy issues in the state and to develop recommendations for energy-related policies and programs. Beginning in December, 2001, the Energy Policy Working Group initiated a series of working sessions that brought state and national experts together for 9 days of "Expert Sessions" over a 3-month period. During the summer of 2002, Energy Policy Working Group support staff conducted a comprehensive evaluation of North Carolina's current energy situation and developed a database summarizing energy policies in other states. Representatives of national energy-related organizations and agencies provided technical information regarding new energy technologies and alternative fuel sources, while federal and state policymakers provided updates on the status of different policy approaches being considered by the Energy Policy Working Group. Individual stakeholders representing organizations affecting energy supply and use in North Carolina also contributed their ideas and concerns about potential policies.

The members of the Energy Policy Working Group prioritized the numerous ideas expressed during the 9 days of expert presentations. They then sought the opinions of other energy experts, stakeholders, and the general public. Four public input sessions were held across the state in late September and early October. About 300 North Carolinians submitted comments that Energy Policy Working Group support staff summarized and categorized. The tallied comments on a number of key issues are shown in Table 1.

Between October 2002 and January 2003, the Energy Policy Working Group and the Energy Policy Council discussed, revised, and approved many of the policies and programs recommended during the months of information gathering. The State Energy Plan was approved by the Energy Policy Council in May 2003. The chapters in this plan list the 93 recommendations of the Energy Policy Council, numbered by chapter. The Energy Policy Council identified 15 of the recommendations as key policy action items for 2003 to 2004, as listed in the Executive Summary. They are designated throughout the plan by the "Exec" prefix.

Table 1:
Summary of Recommendations from Public Input Sessions

Policy	Agree/ Disagree
Implement a Public Benefits Fund	181/ 7
Implement a Renewable Portfolio Standard	178/ 8
Provide net metering for renewable electricity facilities	2/ 6
Provide disclosure of sources of electricity for electric utilities	1/ 1
Increase efficiency requirements in North Carolina buildings and industry	7/ 0
Increase funding for weatherization	4/ 0
Support development of nuclear power	4/ 3
Reduce greenhouse gas emissions that contribute to climate change	14/ 0
Increase efficiency in public facilities	9/ 0
Support Smart Growth initiatives in the state	4/ 0

Energy Consumption in North Carolina

Many of the issues affecting both our economy and national security involve energy. Fifty-five percent of the petroleum on which our nation's economy relies is imported from abroad. Over 28% of the oil imported into the United States is from Persian Gulf countries, specifically, Bahrain, Iran, Iraq, Kuwait, Qatar, Saudi Arabia, and the United Arab Emirates. Another 9% of imported oil comes from Nigeria and 14% from Venezuela. A total of 52% of imported oil comes from countries that are members of OPEC (1-1). Our power plants, pipelines, storage facilities, transmission systems, and other energy facilities are potential targets for those wishing to inflict harm on our citizens and our economy.

Currently, North Carolina imports virtually all of its fuel resources. These imports represent an annual financial diversion of about $6 billion, some of which could be used to develop domestic, alternative energy resources.

North Carolina also faces serious concerns regarding its natural environment. Air pollution has reduced visibility levels in our western mountains by 60% to 80% over the past 50 years. Additionally, acid rain and other forms of air and water pollution are damaging many species of trees and plants. Furthermore, our cities suffer frequent "Ozone Alert" days, on which pollution and particulate levels are at harmful levels. This is a particularly serious issue, as the asthma is the number one cause of hospitalization, reason for lost school days, and health care cost for children in the state. An estimated 33% to 50% of asthma cases are due to air pollution. (1-2)

Figure 1 tracks energy use, population, and state economic income over the past 40 years. Energy consumption has increased more rapidly on a percentage basis than population, but less rapidly than our state economy. Between 1977 and 2000, population grew 1.7% annually, energy use increased 2.3% per year, and gross state product expanded at a remarkable 8.4% annual rate.

Figure 2 shows historical total energy use in the state's economy in trillion Btu (TBtu) per year. Total energy includes the energy required to generate electricity for each sector. In 2000, petroleum provided 39% of energy use in the state, most of which was consumed by the transportation sector. Coal provided 29% of total energy needs, of which 93% went to generate electricity. Nuclear energy contributed 17% of total energy used while natural gas provided 10%. Renewable energy sources, primarily hydroelectric energy and wood waste, yielded the remaining 5**%** (1-3).

Figure 3 shows the energy use breakdown by sector in 2000. The largest single sector in terms of total energy use (including the energy consumed to generate electricity for the sector) is industry at 32% of the total.

Figure 1:
NC Energy Use, Population and Gross State Product

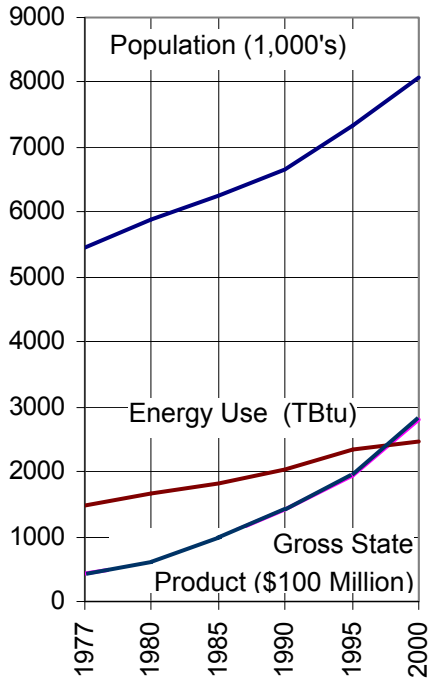


Figure 2:
Total Energy Consumption in North Carolina (TBtu)

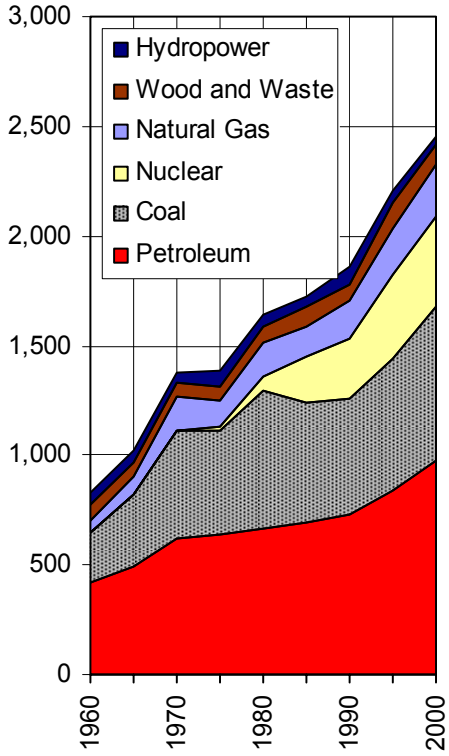


Figure 4:
Net Energy Consumption in North Carolina by Source (TBtu)

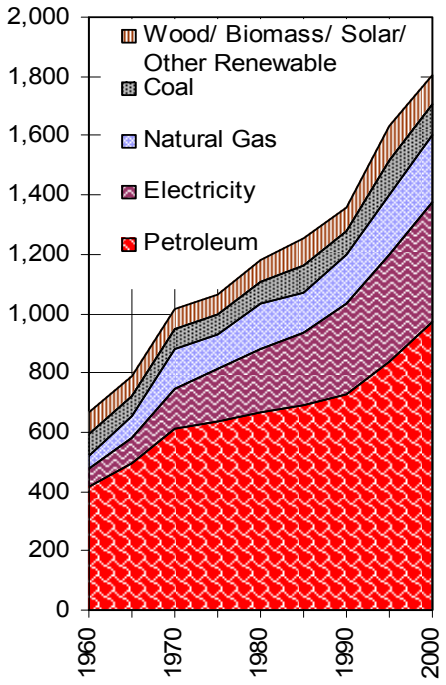
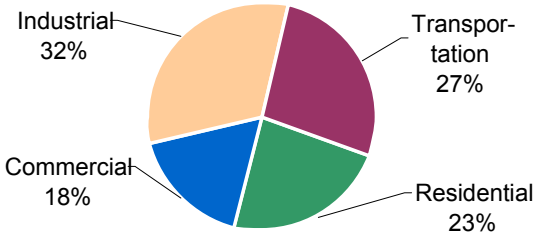


Table 2:
Percentage Increases in Annual Energy Consumption

Energy Source	1970-1980	1980-1990	1990-2000
Coal	1.2%	7.6%	-5.4%
Natural Gas	1.9%	0.7%	3.2%
Petroleum	1.8%	0.9%	2.8%
Renewable Fuels	0.1%	1.2%	-1.0%
Electricity	3.1%	3.5%	2.8%

Figure 3:
North Carolina Energy Consumption by Sector in 2000



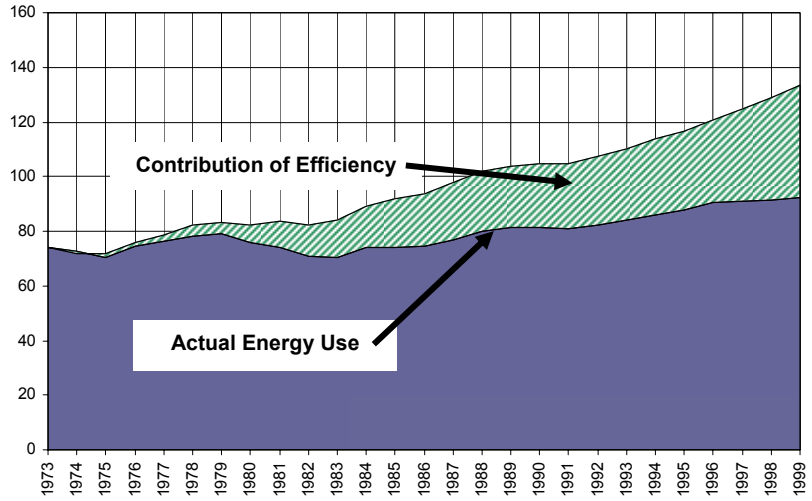
Transportation is second largest with 27% of total energy use. The residential (23%) and commercial (18%) sectors, when joined into a combined buildings sector, use 41% of energy resources in the state.

Figure 4 gives a different view of energy consumption in North Carolina by showing electricity as an energy source in itself and not including the energy used for power generation. For example, coal consumption is only shown for direct use by industry, commercial buildings, and residences, not for its contribution to electrical power production. Petroleum and electricity dominate net energy consumption in the state, providing 77% of energy needs in 2000, with petroleum providing 54% of total energy and electricity contributing 23%.

Table 2 shows energy consumption growth rates in North Carolina over the past 20 years. The high rate of growth of petroleum and electricity use has significantly impacted North Carolina's economy and environment. Air pollution from automobiles and coal-fired power plants has the most serious impact on air quality, most noticeably in the form of increased cases of asthma and other respiratory illnesses. Recent institution of air emission restrictions, the Smokestacks Bill and EPA's Tier II standards, will certainly help imp rove air quality in the state. Reducing use of fossil fuels via improved efficiency and non-polluting renewable sources is another important strategy for protecting the state's environment.

One energy source that does not appear in standard energy consumption data is energy efficiency. As shown in Figure 5, the Alliance to Save Energy has estimated that energy efficiency reduced projected national energy needs in 1999 by 31%. Thus, efficiency has played a crucial role in protecting our environment and reducing our reliance on strategic foreign sources of energy. The Alliance to Save Energy projects that businesses related to energy efficiency comprise a $21 billion industry nationally (1-4).

Figure 5:
National Energy Supply Including Efficiency (TBtu)



Source: Alliance to Save Energy. 2002.

Likewise, demand-side solar systems such as daylighting, passive heating and cooling, and solar hot water systems are typically not accounted for, but also contribute to reduced energy demands.

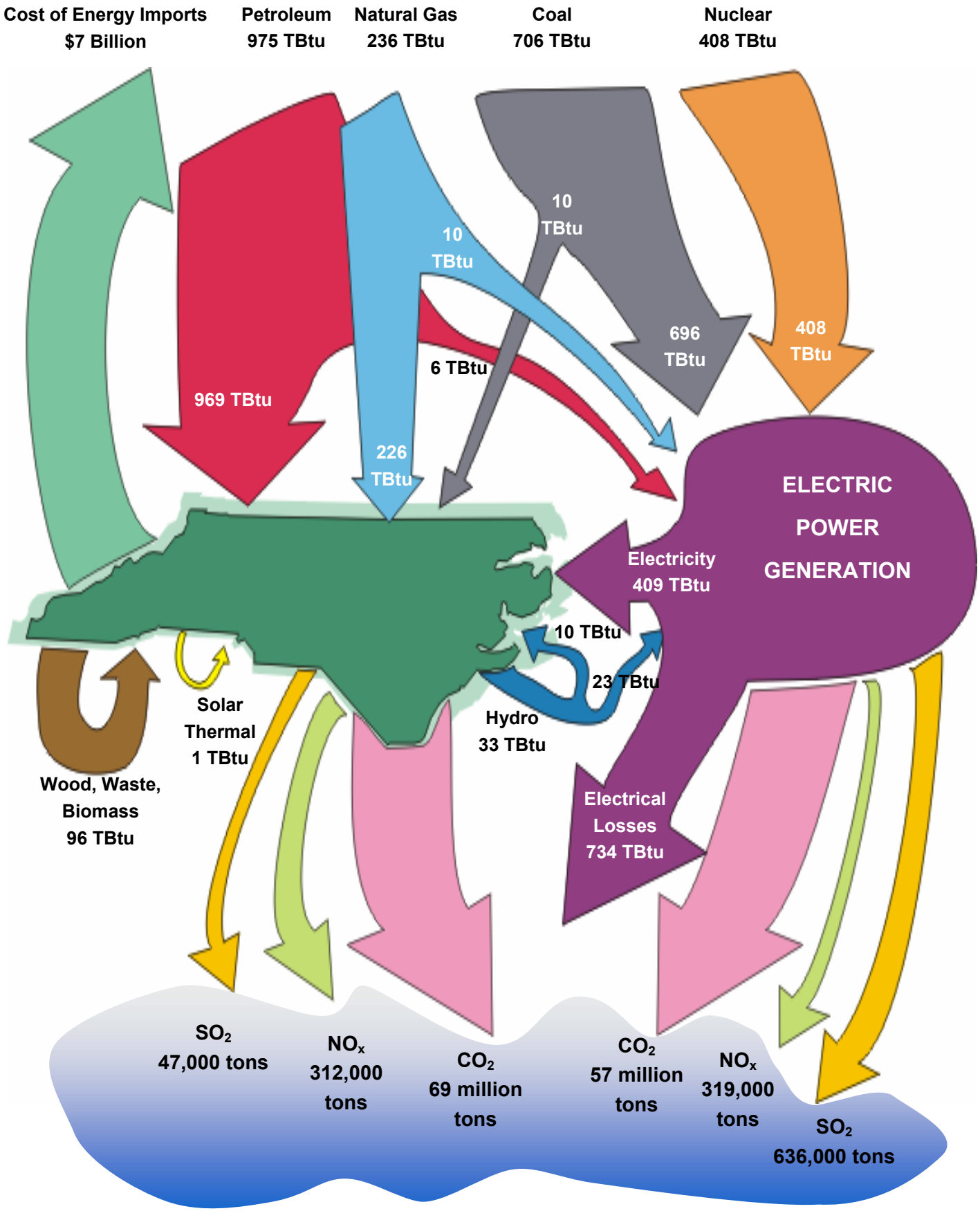
Figure 6 on page 10 depicts the flow of energy sources into North Carolina in 2000, the consequent production of air pollutant emissions, and the cost of energy imports flowing out of the state. Key impacts shown in the figure include:

- Total annual imports: 2,425 trillion Btu;
- In-state production: 130 trillion Btu (all renewable);
- Approximate cost of fuel imports: $7 billion per year;
- Sulfur dioxide emissions: 683,000 tons;
- Nitrogen oxide emissions: 631,000 tons; and
- Carbon dioxide emissions: 126 million tons.

Energy Infrastructure Security Issues

If the state is to maintain a reliable energy supply, it is essential that this critical infrastructure system remain secure from both natural and man-made disasters. As North Carolina imports nearly all resources needed for energy production, our state is particularly vulnerable to disruptions in fuel supply. North Carolina could improve the current energy supply situation by developing additional in-state energy resources and consequently enhance energy security and increase economic development.

Figure 6:
Energy Consumption, Imports, and Emissions in North Carolina in 2000



In discussing infrastructure security, a distinction must be drawn between *preventing* a disaster and *responding* to a disaster. In terms of prevention, state experts on emergency management point out that the state of North Carolina has little authority in this area. Since the majority of infrastructure involved in delivering energy is owned by the private sector, it is fundamentally the responsibility of the owners of the nuclear plants, pipelines, transmission and distribution systems, and conventional power generation facilities to secure these assets from potential disaster. (1-5)

The State of North Carolina has prepared an Energy Emergency Plan that contains the following detailed actions and responsibilities in case an emergency occurs that affects energy supplies or facilities in the state:

(1) Assessing energy system damage, energy supply, demand, and requirements to restore such systems;

(2) Assisting local and state departments and agencies in obtaining fuel for transportation and emergency operations;

(3) Administering statutory authorities, as needed, for energy priorities and allocations;

(4) Assisting energy suppliers in obtaining information, permits, equipment, specialized labor, fuel, and transportation to repair or restore energy systems;

(5) Recommending local and state actions that will save fuel resources;

(6) Providing energy emergency information, education, and conservation guidance to the public;

(7) Coordinating information with local, state, and federal officials and energy suppliers regarding available energy supply recovery assistance programs;

(8) Providing technical assistance involving energy systems;

(9) Recommending to the State Coordinating Officer and the Federal Coordinating Officer priorities to help restore damaged energy systems;

(10) and Coordinating fuel and power requests for assistance received from county Emergency Operation Centers.

The Energy Emergency Plan focuses on responses to emergency situations given current energy supply systems in the state. A critical issue for the state to consider is whether security concerns warrant redesign or relocation of energy facilities to minimize threats from either natural or manmade disasters. This is particularly important in light of heightened alerts of terrorist threats against U.S. power plants and other critical energy infrastructure.

Infrastructure for the state's energy supply system includes:

- Rail lines that transport coal and other fuels to generating plants and storage facilities in the state and the future transfer of nuclear waste to appropriate storage facilities;
- Electric transmission and distribution lines, as well as substations;
- Natural gas, propane, and oil pipelines transporting fuel to fuel wholesalers, as well as utilities, industrial, commercial, and residential customers;
- Dams providing hydroelectric power; and
- Power plants using coal, natural gas, petroleum, wood wastes, and nuclear fuels in North Carolina.

Chapter 2: Energy, Economics, and the Environment

Energy and the State's Economy

Since one of the major aims of the State Energy Plan is to promote economic development, achieving reliable supplies of energy at reasonable and stable prices emerges as a central goal. In 2000, North Carolinians spent over $19.3 billion on energy, representing 7% of Gross State Product. On a per capita basis, each citizen spent $2,394 on energy consumption during that year (2-1, 2-2). Clearly, energy expenditures are a major item on the state's and its citizens' economic agenda.

Cost of Energy

North Carolinians spend most of their energy dollars fueling their cars and powering their homes, companies, and industries. Table 3 compares the cost of electricity in North Carolina to regional neighbors and the nation by sector. North Carolinians paid a higher average price across sectors than our regional neighbors but a lower average price than the nation as a whole. Fortunately, electricity rates in North Carolina have been relatively stable during the past decade.

Table 4 shows the disproportionate burden that energy costs place on those least able to afford them. Households earning less than $25,000 annually pay about as much for energy as those earning $50,000. In residential units whose occupants earn less than $10,000 per year, energy bills constitute 18% of their total annual income.

Table 3:
Average Monthly Electricity Bill by Sector and Location, 2000

	Residential		Commercial		Industrial	
	¢ / kWh	Monthly Bill ($)	¢ / kWh	Monthly Bill ($)	¢ / kWh	Monthly Bill ($)
North Carolina	7.97	87	6.36	380	4.58	10,398
South Atlantic	7.70	85	6.29	445	4.16	7,419
United States	8.24	73	7.43	455	4.64	7,813

Source: EIA, Electric Sales and Revenue, 2000, Table 1
South Atlantic states include DE, MD, DC, WV, VA, NC, SC, GA & FL

Table 4:
Energy Bills and Household Income

House-hold Income	Average Annual Energy Bill	Energy Bill as % of Income
Under $10,000	$1,350	18%
$10,000 to 25,000	$1,300	7%
$25,000 to 50,000	$1,400	4%
$50,000 to 75,000	$2,100	3%
over $75,000	$2,700	3%

Source: Energy Information Administration, U.S. Department of Energy.

Table 5:
NC Employment by Sector
1995-2000 (thousands of jobs)

Employment	1995	2000	Change 95-00
Food & Kindred Products	56	53	-4.8%
Tobacco Products	18	14	-21.0%
Textile Mill Products	198	143	-27.9%
Apparel	64	36	-43.8%
Paper & Allied Products	25	24	-2.8%
Printing & Publishing	32	34	6.2%
Chemical & Allied Products	50	49	-2.4%
Rubber & Misc. Plastics	39	41	6.7%
Misc. Manufacturing	8	8	3.7%
Total Non-Durable Goods	**490**	**403**	**-17.7%**
Lumber & Wood Products	42	41	-1.0%
Furniture & Fixtures	79	76	-3.3%
Stone, Clay, Glass	23	22	-5.7%
Primary Metal Industry	16	19	18.2%
Fabricated Metal	33	37	12.1%
Industrial Machinery	69	68	-0.9%
Electronic Equipment	61	60	-1.6%
Transportation Equipment	33	37	12.0%
Total Durable Goods	**356**	**361**	**1.4%**
Total Manufacturing	**845**	**764**	**-9.7%**
Construction	175	232	32.7%
Transportation & Utilities	162	180	10.6%
Wholesale Trade	181	201	10.9%
Retail Trade	620	693	11.7%
Finance, Ins., Real Estate	145	182	25.8%
Services	713	931	30.4%
Government	533	603	13.1%
Total Non-Manufacturing	**2,530**	**3,021**	**19.4%**

Source: North Carolina Department of Commerce

Economic Change in North Carolina

It is conventional wisdom that, just like the national economy, North Carolina's economy is currently in a transitional stage, moving from one heavily dependent on manufacturing and agriculture to one concentrated in services and the high technology sectors. Despite this trend, the state's economy still depends on traditional forms of economic production. In 2000, North Carolina's agricultural economy ranked 9th in the nation and its manufacturing employment ranked 8th. During the period 1990 to 2000, the North Carolina economy grew from a Gross State Product of $136.3 billion to $273.5 billion, representing the 11th fastest growing state in the nation. During the same decade, the state's per capita income improved from 35th place in the nation in 1990 to 32nd in 2000 (2-1).

Energy and North Carolina's Environment

Clean energy for North Carolinians has become a critical issue in recent years. The past decade has witnessed a dramatic increase in emissions of air pollutants from energy use, including nitrogen oxides (NO_x), sulfur dioxide (SO_2), particulates, greenhouse gases, such as carbon dioxide (CO_2) and methane, mercury, and others. The cost of air pollution in terms of human health alone has been dramatic:

- A number of studies compare ground-level ozone in states based on exceedances of the 8-hour ozone standard. However, states with more ozone monitoring equipment tend to have more reported exceedances. The U.S. Public Interest Research Group uses "unhealthy smog days" as a criteria to attempt to correct for states with more monitoring stations. North Carolina ranked sixth nationally in number of smog days in both 2000 and 2001. (2-3, 2-4)
- According to the American Lung Association, several million North Carolinians live in areas subject to frequent smog alerts.
- In 1998, 240,000 asthma attacks statewide were triggered by ozone, according to a study conducted by ABT Associates. Just as repeated sunburns may increase a person's chance of getting skin cancer, repeated exposure to ozone can cause permanent damage to a person's lungs and immune system. (2-5)

Contributors to the high level of air pollutants include the increasing number of vehicle miles traveled in the state, coal-fired power plants, energy use in industrial facilities, and the extensive use of construction, farming, and other off-road equipment (2-6).

Fortunately, both the state and the nation have taken action on air pollution issues. The recently enacted "Smokestacks Bill" (SB 1078) is a critical step towards protecting the quality of the state's air (2-6). The legislation sets a cap on coal-fired power plant emissions that will result in more than a 70% reduction in NO_x emissions year-round within the next 10 years. Coal-fired power plants will also have to cut their SO_2 emissions 50% by 2009 and 75% by 2013. The Tennessee Valley Authority, whose coal-fired plants have negatively affected air quality in North Carolina, has also followed suit. In November 2002, TVA announced its approval of a $1.5 billion contract to install pollution-control equipment at 4 TVA fossil plants that will improve air quality throughout the region. Scrubbers will be installed at TVA's Paradise, Bull Run, Colbert, and Kingston fossil plants by 2011, with installation of additional scrubbers as determined by TVA.

Figures 7 and 8 show the dramatic impact that the Smokestacks Bill will have on sulfur dioxide and nitrogen oxide emissions – a potential decline of almost 80% in sulfur dioxide and 50% in nitrogen oxides – assuming no additional generation using coal. However, Figure 9 shows that CO_2 emissions will continue to increase into the foreseeable future. The only viable options at present for reducing CO_2 emissions appear to be increasing efficiency and switching to energy sources that generate considerably less CO_2, such as nuclear energy, hydropower, solar energy, wind energy, and biomass energy sources.

By implementing regulations and incentives which enforce and encourage clean-air technologies, North Carolina has helped preserve the state's natural resources, improved the quality of life for its residents, and retained industries which are responsibly managing harmful emissions.

The U.S. Environmental Protection Agency has set new standards for automobiles. Termed "Tier II Levels," these regulations will effectively reduce air pollutants from new vehicles if they are fully implemented as follows:

- The Tier II regulations will phase in over a 6-year period (2004-2009) and mandate extremely low levels of tailpipe emissions over the "useful life" (120,000 miles) of an automobile.
- The regulations will decrease NO_x emissions 76% by 2030 – a total reduction of 29,582 tons of NO_x.
- The Tier II standard also requires lowering the sulfur content in gasoline to 30 ppm, beginning in 2004 with full compliance required by 2005. This requirement will improve the performance of catalytic converters in automobiles.

The above developments will improve the quality of air in many areas of the state. Also, increasing energy efficiency will allow the state to continue its

Figure 7: Projected SO_2 Emissions from North Carolina Electric Power Plants (Tons)

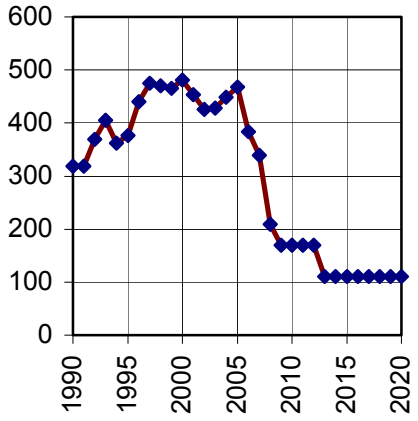


Figure 8: Projected NO_x Emissions from North Carolina Electric Power Plants (Tons)

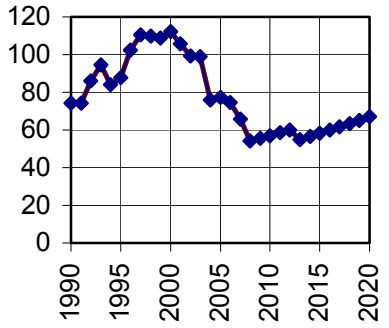
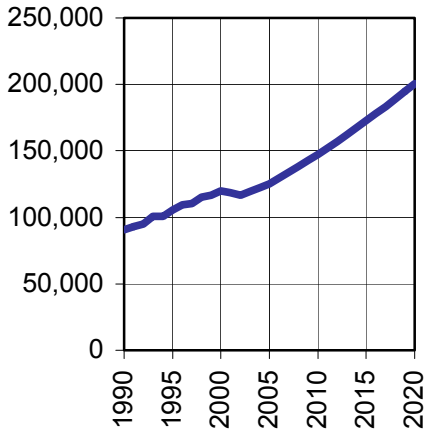


Figure 9: Projected CO_2 Emissions from North Carolina Electric Power Plants (Million tons)



strong economic growth while reducing pollution levels across all sectors. Additionally, supporting the growth of the renewable energy industry will help to improve the environment. Key future environmental considerations related to energy use in North Carolina include strategies for the reduction of the following pollutants:

- Carbon dioxide (CO_2), methane, and other greenhouse gases which contribute to global climate change. The impacts of climate change on North Carolina's economy could include rising shoreline levels, disruption of growing seasons, reduction in tourist trade, and deterioration of forests.
- Nitrogen oxides (NO_x) and other volatile organic compounds which contribute to several pollutant sources including ozone and fine particulates.
- Sulfur dioxide (SO_2) emissions which cause increased acidity of rainfall and combine with other chemicals in the air to form fine particulates. Particulate emissions are responsible for a variety of respiratory health problems, specifically asthma and bronchitis. Particulate emissions have also substantially reduced visibility levels in our western mountains, which could ultimately have negative financial implications for North Carolina's tourist economy.
- Rising levels of mercury pollution which have effectively destroyed many of North Carolina's lakes and streams. Mercury is a known carcinogen and accumulates in fish and other water species. It is then transferred up the food chain to birds and ultimately, humans.

Policies and Programs for Energy and the Environment

The Energy Policy Council recommends the following policies regarding energy and the environment in North Carolina. The Council also has a number of recommendations related to economic development, which are included in Chapter 10: Energy Use in the Industrial Sector.

Exec-3 The North Carolina Department of Environment and Natural Resources should create a greenhouse gas registry to track emissions of carbon dioxide and other greenhouse gases, to establish baseline greenhouse gas emissions, and to demonstrate reductions in greenhouse gas emissions for potential greenhouse gas trading systems depending upon the availability of funding.

2-1 North Carolina should study opportunities for carbon sequestration in the agricultural, forestry, and other sectors. The immediate encouragement of these efforts will also insure these North Carolina industries will be ready to participate in national or international carbon trading programs as they are developed.

Chapter 3: Fossil and Nuclear Fuels

North Carolina relies on fossil fuels for most of its energy needs. As shown in Figure 10, in 2000 petroleum supplied 39% of the energy used in the state, natural gas supplied 10%, coal supplied 29%, nuclear supplied 17%, and renewable energy sources supplied 5%. This chapter concerns fossil fuels and nuclear energy. Renewable energy sources are discussed in Chapters 5 and 6.

Natural Gas in North Carolina

Natural gas contributes about 10% of total energy use in the state according to Figure 10, while it provides about 23% of national energy use. Thus, in North Carolina, natural gas has historically played a smaller role in meeting energy demands than in many other states. However, new natural gas pipelines under construction will increase its consumption in all sectors.

Figure 11 shows that the industrial sector is the primary consumer of natural gas, using 49% of the total. The residential sector consumes 24% of total use, while commercial buildings, with 17% of natural gas use, are also significant consumers. (3-1) Historically, the electric utility and transportation sectors used very little natural gas, although this situation has recently been changing. The U.S. Energy Information Administration's North Carolina Profile shows the number of megawatts of gas-fired utility generation increased at an annual growth rate of 22.5% from approximately 1% in 1990 to 7.3% in 1999. Currently, as many as 14 natural gas-fired plants with over 9,000 MW of generation capacity are being considered for North Carolina, which will necessitate additional interstate pipeline capacity (3-2).

Petroleum in North Carolina

Figure 10 indicates that petroleum supplied 39% of the energy needs of the state. Figure 12 shows that motor gasoline (53%) and distillate fuel (22%) led petroleum fuels in 2000, with 75% of the total consumption. Motor gasoline consumption expanded at a 2.3% annual rate between 1990 and 2000, while use of distillate fuel grew at a 3.8% annual rate.

Figure 10:
North Carolina Energy Use in 2000 (2,453 TBtu total)

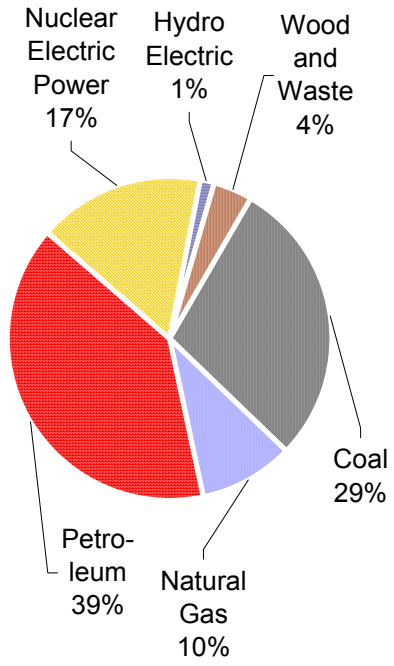


Figure 11:
Natural Gas Use (TBtu)

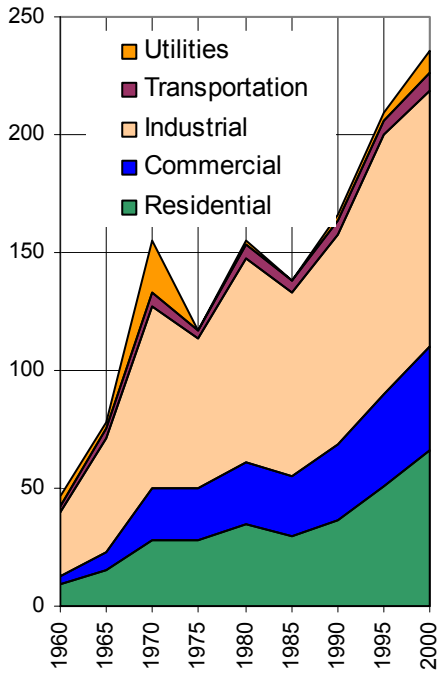
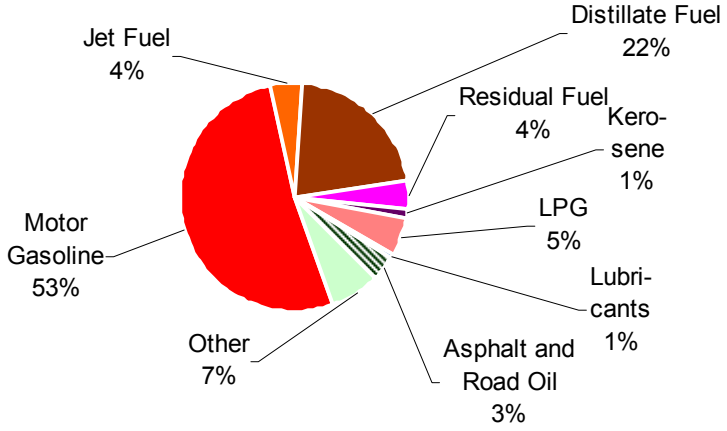


Figure 12:
2000 Petroleum Use by Fuel Type in North Carolina
(977 TBtu total)



Propane in North Carolina

Propane is a by-product of 2 other refining processes: natural gas processing and petroleum refining. Propane naturally occurs as a gas at atmospheric pressure but is typically liquefied for transport and storage. Propane has a variety of uses: heating homes, heating water, cooking, drying clothes, fueling gas fireplaces, and as an alternative fuel for vehicles. Propane is also used to make petrochemicals, which are the building blocks for plastics, alcohols, fibers, and cosmetics.

Residential and industrial sectors dominate propane demand with 90% of total consumption. Residences used 49% of total state propane consumption in 2000, while industrial facilities used 41% of the total.

Coal in North Carolina

Electric utilities consume most of the coal in the state – 93% of total coal consumption in 2000 (3-1). Table 6 shows that the state now has 14 utility-owned, coal-fired power stations. Surrounding states, especially Kentucky, Georgia, Virginia, South Carolina, West Virginia, and Tennessee, rely significantly on coal for electric power generation as well. According to environmental experts, prevalent combustion of coal, particularly in older power plants not yet subject to enhanced air pollution control requirements, has damaged our natural ecosystems, including most notably Mount Mitchell. The recently passed Smokestacks Bill will reduce emissions of sulfur dioxide and nitrogen oxides from coal-fired plants 50% by 2009 and progressing to 75% by 2013 when fully implemented.

Table 6:
NC Utility-Owned
Coal Fired Power Plants &
Generation Capacity

Utility	Plant	County	Capacity (MW)
PEC	Roxboro	Person	2,462
PEC	Mayo	Person	745
PEC	LV Sutton	New Hanover	613
PEC	Lee	Wayne	407
PEC	Asheville	Buncombe	392
PEC	Cape Fear	Chatham	316
PEC	Weather-spoon	Robeson	176
Duke	Belews Creek	Stokes	2,240
Duke	Marshal	Catawba	2,090
Duke	GG Allen	Gaston	140
Duke	Cliffside	Cleveland	760
Duke	Buck	Rowan	369
Duke	Dan River	Rocking-ham	276
Duke	Riverbend	Gaston	454
Total Utility-Owned Generation Capacity			11,440

Nuclear Energy Use

Nuclear fuel used to generate electricity is perhaps the most controversial energy source in the nation. While normal operation of nuclear plants produces virtually no air pollution, waste storage issues and the threat of a nuclear accident are serious concerns for many North Carolinians. The approval of the Yucca Mountain nuclear waste storage facility will provide a repository for nuclear waste currently stored in North Carolina. Since September 11, 2001, nuclear power plants, as well as fuel and waste shipments, are subject to even greater scrutiny and heightened security measures to prevent terrorist attacks.

Table 7 shows current nuclear power plants in the state. In 2001, nuclear power generation provided approximately 38% of Progress Energy Carolinas' total generation, 48% of Duke Power's total generation, and 32% of NC Power's generation.

Table 7:
NC Utility-Owned Nuclear Power Plants & Generation Capacity

Utility	Plant	County	Capacity (MW)
PEC	Brunswick	Brunswick	1,631
PEC	Harris	Wake	860
Duke	McGuire	Mecklen-burg	2,200
Total Utility-Owned Generation Capacity			4,691

In-State Energy Production

North Carolina imports virtually all of its energy resources, particularly its fossil and nuclear fuels. There would be potential economic and other benefits to increased production of in-state sources of energy. However, development of offshore oil and natural gas reserves is not presently considered feasible, in part due to environmental concerns. The main other energy resources in North Carolina are renewables, such as wind, solar, hydro, and biomass.

Energy Supply Policies and Programs

The following recommended policies and programs are related to the supply of conventional energy sources – primarily fossil fuels and nuclear energy. Many of the policies regarding energy supply are national in scope and thus beyond the purview of North Carolina. The Energy Policy Council has only included policies that the state could undertake.

3-1 The State Energy Office should work with propane dealers, the natural gas industry, electric utilities, key members of the agricultural sectors, and others concerned with alternative fuels to assess each fuel's role in the future of alternative-fueled vehicles in the state and consider how to improve the support structure via fuel supply stations.

3-2 The state should insure high priority for fuel supply by NC Department of Transportation emergency crews during weather and other emergencies – especially for strategic snow removal.

3-3 North Carolina should develop reciprocal agreements between state agencies in adjoining states (departments of motor vehicles, state energy offices, and state emergency response teams) on allowable hours of service for tanker and truck drivers during emergency situations (with clear definition of an emergency situation).

Chapter 4: Electric Utilities & Energy Use

Figure 13 shows energy use in the electric utility sector. While nuclear energy assumed an increasing share of electricity production in the 1980s, coal maintained and extended its historic dominance in the 1990s. In 2000, coal provided about 61% of energy used to generate electricity in North Carolina, nuclear power provided about 36%, hydroelectric plants supplied 2.5%, and natural gas and petroleum each supplied less than 1% (4-1)

Consumption of electricity in North Carolina has expanded at a 3.6% annual rate over the past decade while peak demand for electricity has grown at about a 3% annual rate. In the next ten years, electricity consumption is forecast to increase at about 2.3% annually, while the summer peak will grow about 1.7% per year. (4-5)

The Structure of the State Electricity Market

North Carolina's retail electrical customers are served by 3 investor-owned utility companies (IOUs), 32 electric membership corporations (EMCs), and 74 municipality or university-owned electric distribution companies (Munis). The privately-owned IOUs, and to a much lesser degree the EMCs and Munis, are regulated in this state by the North Carolina Utilities Commission.

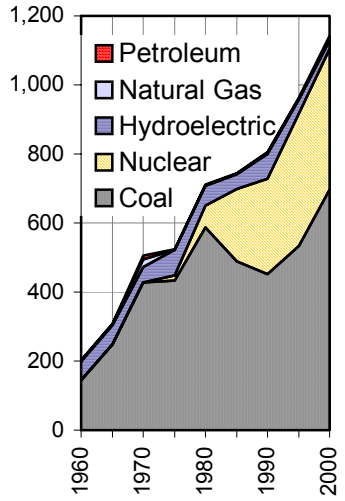
Table 8 shows a breakdown of North Carolina's electricity sales. The 2001 sales are somewhat lower than those of 2000 due to reduced industrial load

Table 8:
Electricity Sales in North Carolina, 2000-2001

	NC Retail GWh*		NC Wholesale GWh*		Total GWh Sales* (All States)	
	2001	2000	2001	2000	2001	2000
Progress	33,745	34,747	12,355	13,868	53,561	56,653
Duke Power	51,921	53,726	5,917	6,718	79,685	84,767
NC Power	3,585	3,359	1,658	1,709	74,520	76,155
EMCs		13,415				13,415
Munis	11,404	11,674			11,404	11,674

*GWh = 1 million kWh
Source: *Annual Report of the North Carolina Utilities Commission*, July 2002; U.S. Energy Information Administration, *Electric Sales and Revenue 2000; Electricities 2001 Annual Report.*

Figure 13:
Energy Use in Utility Sector (TBtu)



North Carolina's Electricity Market

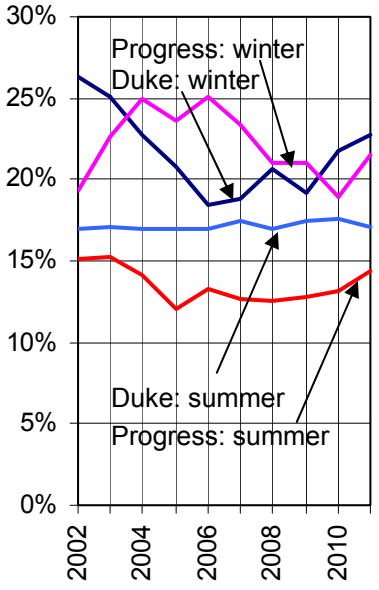
- In 2000, almost 95% of the electricity generated and sold within the state was supplied by Duke Power and Progress Energy Carolinas. Approximately two-thirds of the utility retail business of both Duke and Progress Energy is within North Carolina, with the remainder in South Carolina.
- Approximately 20% of the IOUs' total electric sales in the state are to wholesale markets, consisting primarily of EMCs and Munis.
- 27 of the 32 EMCs serving North Carolina customers have headquarters within the state. Together, they serve 860,000 customers in 93 of the state's 100 counties. 26 EMCs are members of the North Carolina Electric Membership Corporation (NCEMC), the second largest electric cooperative in the United States based on revenues.

Table 9:
Energy Resources for Electricity Production by Fuel Type for 2001

	Progress	Duke	NC Power
Coal	50.1%	48.7%	41.3%
Nuclear	38.4%	47.8%	32.0%
Hydro	0.4%	0.0%	3.8%
Oil and Natural Gas	1.6%	0.1%	8.9%
Purchased Power	9.5%	3.4%	14.0%

Source: *Annual Report of the North Carolina Utilities Commission*, July 2002.

Figure 14:
Projected Reserve Margins for Electric Utilities



Source: *Annual Report of the North Carolina Utilities Commission*, July 2002.

and more moderate weather. Duke Power and Progress Energy Carolinas operate 95% of in-state generation, but EMCs, Munis, and NC Power sell approximately 25% of the electricity generated. Munis and EMCs own a significant percentage of 2 nuclear facilities, parts of several coal-fired power plants, and peaking plants that burn oil or natural gas.

Table 9 shows the actual energy production by energy source for the IOUs. Coal and nuclear power remain the dominant sources, with hydroelectric power, natural gas, and fuel oil playing a rather insignificant role. Although oil and gas plants provide a considerable percentage of total capacity, they are primarily peaking plants and do not produce much electricity. It should be noted that the chart is for system-wide production. Thus, the capacity shown for Duke Power and Progress Energy includes a number of electric power facilities located in South Carolina, and NC Power's data includes all of its facilities, the bulk of which are located in Virginia. As more natural gas power plants begin operation in the state, the percentage of electricity derived from natural gas will increase significantly.

Reserve Capacity

To assure reliable service, utility companies are required to maintain a margin of generating capacity available to their system to cover both scheduled interruptions of service (typically maintenance and refueling) and unscheduled interruptions (typically mechanical failures). Utility companies' plans for meeting loads are reviewed annually by the North Carolina Utilities Commission in Integrated Resource Plan proceedings. The amount of generating reserve needed to maintain a reliable power supply is a function of the unique characteristics of a utility system, including load shape, unit sizes, capacity mix, fuel supply, maintenance scheduling, unit availabilities, and strength of the transmission interconnections to other utilities. Projected summer reserves between 2002 and 2011 for the 3 IOUs are:

- Progress Energy Carolinas 12.1 to 15.2%
- Duke Power 17.0 to 17.6%
- NC Power 12.5 to 13.5%

Figure 14 displays the percentage reserve capacity reported by Duke Power and Progress Energy through 2011. The data indicates that Duke Power plans for higher reserve margins than Progress Energy for the peak summer months. Winter margins are typically higher, peaking at slightly over 25% in the near term and generally drifting downward over the time period.

Demand Side Management

Electric utilities have 2 means of meeting increases in customers' electricity demands: supply side management and demand side management. Supply side management consists of the utilities' plans and programs to increase the supply of electricity to meet the anticipated increases in demand, mainly through construction of new power plants. Demand Side Management (DSM) attempts to reduce the demand for electricity or to shift it to times away from the system peak so that the need for additional generation capacity is minimized. The plans of the IOUs and EMCs for meeting forecasted electricity demand are available to the public and are currently reviewed by the North Carolina Utilities Commission in an annual integrated resource planning proceeding.

Typical DSM options have included:

- Thermal efficiency in new and existing homes
- Residential high-efficiency heat pumps
- Interruptible residential central air conditioners/water heaters
- Commercial energy-efficient lighting, heating, and air conditioning in new and existing buildings
- Commercial thermal energy storage
- High-efficiency off-street security lighting
- Industrial energy audits with incentives for efficiency improvements
- Industrial time-of-use rates
- Large-load curtailment during peak load periods
- Remote-controlled voltage reduction

To motivate customers to implement these options, utilities have offered financial incentives such as reduced electrical rates, rebates on the customers' bills, rebates for purchase and installation, and low-interest loans.

Demand side management programs were popular in the 1980's and early-to-mid 1990's. For example, in 1995, Progress Energy predicted a reduction of about 10.6% in system peak for the year, increasing to 13.4% in 2009 through demand side management activities. (4-7)

Electric utilities in North Carolina have changed the way in which they report the contribution of DSM programs. In the early and mid-1990s, reported DSM savings included all electric utility efforts to reduce the demand for electricity. However, in recent reports, DSM savings included only electric capacity that could be controlled directly by the utility – considerably less than the total of all DSM programs. This change in reporting procedures makes it difficult to compare previous projections of DSM programs with current estimates. Utility representatives agree that DSM programs have declined.

North Carolina Public Staff Viewpoint on Demand Side Management in 1990

"The Public Staff believes that special ratemaking treatment of DSM is appropriate in order to encourage utilities to aggressively invest in DSM resources. This special treatment includes three key elements: (1) the recovery of certain incurred costs associated with operating DSM programs; (2) the recovery of "lost" revenues resulting from energy efficiency programs; and (3) an additional financial incentive, or bonus, for exemplary DSM accomplishments."

Source: Docket No. E-100, Sub 64, Stipulation between the Public Staff and Duke Power Company

Table 10:
Progress Energy Carolinas 1995 DSM Forecast Reference Case for North Carolina (Summer MW Reduction)

	1995	2000	2005	2009
Residential	**429**	**591**	**749**	**852**
Load Control (from above)	216	345	481	571
Time-of-Day Rates	22	27	32	34
High Efficiency HP and AC	24	35	39	41
Home Energy Loan/ Conservation Discount	34	39	42	43
Common Sense Home	132	145	156	163
Commercial	**157**	**206**	**285**	**329**
Audit	58	77	124	149
Energy Efficient Design	97	125	155	172
Thermal Storage	3	4	6	7
Industrial	**564**	**667**	**753**	**804**
Large-Load Curtailment	212	236	254	268
Time of Use Rates & Thermal Storage	116	138	149	158
Audit/ Energy Efficient Plants	236	294	350	379
Total	**1,151**	**1,464**	**1,787**	**1,986**

Source: CP&L Integrated Resource Plan, April, 28, 1995.

In the past, utility DSM program had support of millions of dollars. In 1997, Duke predicted DSM program costs of about $66 million for the year, $38 million for 2002, and about $39 million for 2011. In 1994, Progress Energy Carolinas forecast DSM management costs of $44 million, $47 million, and $48 million for the years 1994 through 1996. Thus, the annual costs of DSM programs for both utilities combined were in the $80 to $100 million range, equivalent to about one mil for every kWh sold in the state.

There are several reasons for the decline in DSM programs offered by utilities: 1) electric utility restructuring appeared imminent, so many utilities sought to lower costs in order to increase their competitive edge, 2) the cost of peak power plants, such as gas turbines, has become so low that they are less expensive than reductions in peak demand from DSM programs, and 3) some DSM programs were not able to provide the peak demand savings projected.

Electric Industry Restructuring in North Carolina

North Carolina's response to the electricity restructuring movement of the mid-1990s was the establishment in April 1997 of the Study Commission on the Future of Electric Services in North Carolina (Senate Bill 38). The details of this study commission and its process in examining restructuring are discussed in the sidebar. Following 3 years of hearings, the study commission adopted recommendations that would allow fully competitive retail electric service as of January 1, 2006, with retail choice available to up to 50% of each power supplier's load as of January 1, 2005. Recovery of stranded costs for IOUs would be addressed through a rate freeze effective through December 31, 2004. These plans have been placed on hold, however, due to problems encountered with restructuring efforts in California and elsewhere.

Electric Utility Policies and Programs

The following policies and programs are recommended by the Energy Policy Council regarding the electric utility industry. Several other chapters also contain policies relevant to the utility industry.

4-1 The North Carolina Utilities Commission is encouraged to promote policies that create diversity in energy supply such as natural gas, solar energy, wind energy, biomass, and hydrogen from renewable sources with particular emphasis on in-state energy development.

4-2 The North Carolina Utilities Commission is encouraged to consider increasing the availability of real-time pricing.

4-3 In determining the real costs of fuels, the North Carolina Utilities Commission is encouraged to consider the cost of externalities in economic analysis of supply resources.

4-4 The State Energy Office should explore the development of combined heat and power (CHP) technologies.

4-5 Because the December, 2002, ice storm raised public interest in use of distributed generation (i.e., in facilities used as public shelters, residential housing, etc.), the State Energy Office should study distributed generation and appropriate applications.

The Study Commission on the Future of Electric Services in North Carolina

- The 30-member study commission is composed of legislators, various industry representatives, utilities, and other stakeholder representatives.
- In 1997, it was charged with examining the cost and adequacy of electrical service in the state and exploring the implications of restructuring on a host of issues ranging from reliability to environmental implications.
- In 1998, the study commission contracted with Research Triangle Institute to serve as its principal consultant for in-depth research on a number of complex issues related to the current and future structure of the utility industry in North Carolina.
- Following 3 years of hearings, the study commission developed plans for restructuring; however, they were put on hold due to problems with other states' restructuring efforts.

Chapter 5: Alternative Fuels from Biomass

North Carolina's biomass resources from the agricultural and waste management sectors are a leading potential source of energy in the state for both electricity generation and direct use as a fuel. According to the U.S. Department of Energy, an estimated 15.8 billion kWh of electricity could be generated each year using renewable biomass fuels in North Carolina. This is enough electricity to fully supply the annual needs of 1.6 million average homes, or 39% of the residential electricity use in North Carolina. These biomass resource supply figures are based on estimates for 6 general categories of biomass: mill and forest residues, municipal solid waste and landfill gas reclamation, urban residues and wastewater treatment plants, animal waste and agricultural residues, and energy crops. (5-4)

Each year, North Carolina produces approximately:

- 5 million dry tons of mill residues
- 2 million dry tons of forestry residues
- 1 million dry tons of urban residues
- 1.1 million dry tons of agricultural residues

Mill and Forest Residues

Wood energy continues to lead the United States in biomass energy production and accounts for 80% of the biomass market. Wood waste comes from logging operations, industrial processes, construction activities, yard waste, and disposal of wood products such as pallets. In North Carolina, wood and wood wastes produced 1.5 million megawatt-hours of electricity in 1999 representing almost 1/3 of total net renewable production. The industrial sector is the largest user of wood waste in the form of mill residue. In fact, wood and wood wastes provide over 11% of North Carolina's industrial energy needs. Common industrial uses of wood and forestry residues include on-site electricity generation and process heat.

Municipal Solid Waste and Landfill Gas Reclamation

Local governments can capture the energy content of municipal solid waste (MSW) through direct combustion in boilers for either process heat or electricity generation. In some cases, pulverized MSW has been mixed with coal in coal-fired power plants. The mix is usually 10% MSW and 90% coal. The city of Wilmington utilizes a 100% MSW direct-combustion system to produce over 7.5 MW of electricity. However, in North Carolina, most MSW is transported to landfills.

Burning MSW is the least environmentally favorable method of extracting energy content from this particular resource. The resultant particulate and gas emissions counter the trend toward cleaner smokestack emissions in the state.

Alternatively, the gas emitted from landfills, which is composed of roughly 55% methane, represents a significant opportunity to augment the state's

While able to contribute less than 1% of annual natural gas and propane consumption of 229 TBtu, methane reclamation does provide the following benefits:

- Livestock operations around the state, including dairy, beef, swine, and poultry, currently produce the equivalent of 143 billion Btu of recoverable methane.
- The recovery of methane through digester technology alone equates to a cumulative emission reduction of 86,610 tons of greenhouse gases by 2010.
- The recovered methane could generate about 130 million kWh annually (0.11% of North Carolina's consumption) which would create an additional emission reduction of 113,000 tons of greenhouse gases.

energy supply. Economics are most attractive for direct use at those landfills which already possess the ability to collect gas. A landfill located within 6 miles of an end user can deliver fuel for up to 50% less than natural gas.

Electrical generation opportunities also exist, but are less economically attractive. However, electricity generated from landfill gas does have an important potential market with the emergence of the NCGreenPower program, which is described on page 40. North Carolina currently has 5 direct-use projects in operation and a 6th project soon to come online. Presently, the U.S. Environmental Protection Agency's Landfill Methane Outreach Program (LMOP) has a total of 36 candidate landfills in North Carolina under consideration for development, most for direct use. (5-9)

Fuels from Agriculture

Methane from Agricultural Wastes

The benefits of harvesting methane from swine, poultry, and dairy waste are numerous and most importantly, create a renewable cycle of production. Researchers at North Carolina State University are examining both the potential for energy recovery from animal waste and the best technologies for producing marketable fuels.

Table 11:
Potential Energy Production from Animal Waste in North Carolina

	Average # animals	Total lb per day	Direct Combustion Annual Energy	Annual Biogas Production
	(1,000)		(Trillion Btu)	(Trillion Btu)
Swine	9,600	6,144,000	14.6	6.3
Broilers	100,000	3,500,000	8.3	-
Turkeys	17,000	2,200,000	5.2	-
Hens	15,000	750,000	1.8	-
Dairy Cattle	120	1,200,000	2.8	-
Beef Cattle	900	6,300,000	14.9	-
Total			**47.7**	**6.3**

Source: Dr. Len Bull, North Carolina State University, April, 2003.

Recovering 40 to 50 trillion Btu of fuel from animal waste each year could be a major economic benefit for farmers. The potential income would range from $50 to $100 million per year while helping solve the environmental impacts of animal waste disposal.

Ethanol and Biodiesel from Energy Crops

Ethanol and biodiesel, liquid fuels ideal for vehicles and in some cases electricity production, are the primary fuels obtained from biomass resources. Both fuels are produced widely across the nation, but not as yet in North Carolina.

Biodiesel comes primarily from soybeans and recycled restaurant grease. It enjoys popularity as a fuel in many agriculture-intensive states. Biodiesel provides a number of environmental benefits, namely reduced emissions. Biodiesel can be mixed with regular diesel or utilized as the primary fuel.

North Carolina Department of Transportation (NC DOT) operates a total of 8,250 on-road vehicles and 3,250 off-road vehicles for a total of 11,500 vehicles. Biodiesel is the primary alternative fuel that NC DOT utilizes. An estimated 600,000 gallons of B20 (20% biodiesel and 80% distillate diesel fuel) were used by NC DOT in 2002. Since introducing B20 in Division 5 (Wake, Durham, Person, Granville, Vance and Franklin counties) in April 2002, over 345,000 gallons have been used.

Across the state, biodiesel use by the NC DOT is expected to rise. NC DOT was instrumental in facilitating a statewide purchasing contract for both B100 and B20 in 2001. Local governments, as well as public and private educational institutions, are able to purchase from the state contract. NC DOT currently operates 20 alternative fuel refueling sites around the state. In addition to biodiesel use, NC DOT has 167 alternative-fueled vehicles operating on either E-85, compressed natural gas, or propane. The agency purchased 44 propane-fueled pickups in 2002. (5-16)

In January 2003, the Triangle J Council of Governments introduced an incremental cost rebate program to assist fuel suppliers in Wake and Durham Counties with the additional costs of supplying alternative fuels, namely biodiesel and ethanol. The program provides $256,000 in funding, primarily from the NC DOTs Congestion Mitigation Air Quality program and the State Energy Office.

Ethanol Scenario for North Carolina

Ethanol is perhaps the best known alternative fuel. Agriculture-intensive states, primarily in the Midwestern United States, have implemented minimum blending requirements for all motor fuels sold in the state.

The Renewable Fuels Association summarizes the current status of the ethanol industry in the United States as follows:

- Ethanol increases the value of a bushel of corn.
- Ethanol production is the third largest use of U.S. corn, consuming about 7% of the nation's corn crop.
- 2001 U.S. ethanol production levels of 2.3 billion gallons were second only to Brazil, which produced 4 to 5 billion gallons.
- Ethanol production adds $4.5 billion to U.S. farm income annually.
- More than 900,000 farmers are members of ethanol production cooperatives. Since 1990, farmer-owned cooperatives are responsible for over 50% of ethanol production.
- One bushel of corn yields around 2.5 gallons of ethanol in addition to other valuable feedstocks and sweeteners, such as dry distiller's grains.
- The current Federal subsidy, at $0.54 per gallon, makes it possible for ethanol to compete as a gasoline additive.

Source: Renewable Fuels Association, www.ethanolrfa.org

Minnesota, which introduced a statewide oxygenated fuel program last October and enjoys a nearly 100% ethanol-blended fuels market, currently requires a 10% blend of ethanol for all gasoline sold in the state. A theoretical scenario of what would be involved in implementing a 10% ethanol requirement for North Carolina is as follows:

- North Carolina motorists currently use around 5.3 billion gallons of motor gasoline each year.
- Approximately 1,900 acres of corn are needed to produce 1 million gallons of ethanol.
- North Carolina corn production in 2001 was around 710,000 acres – primarily for animal feedstocks.
- If 10% of motor fuel consumed each year was replaced with locally produced ethanol, North Carolina farmers would be planting at least 1 million acres of ethanol-dedicated field corn.
- To achieve a 10% ethanol-use scenario in North Carolina would require a 130% increase in corn production for North Carolina farmers and a 10% increase in total farm acreage from current levels.
- Additionally, the production of dry distiller's grains could be a significant feedstock resource for North Carolina's animal industry.

North Carolina farmers currently use more corn for livestock feeding purposes than is grown in the state. If a 10% ethanol use scenario is to be realized, the supply issue must be addressed in such a manner that current feedstocks are not depleted. Statistically, the required land may be difficult to dedicate to corn production. However, promoting the benefits of corn as a fuel supply could change current land use priorities. On an interim basis, corn may be available from nearby states such as South Carolina and Virginia. Ideally, demand for ethanol could help surmount production cost and land use issues.

Ethanol Infrastructure and Environmental Concerns

As January, 2002 report, completed for the U.S. Department of Energy, assessed the infrastructure requirements, including transportation, distribution and marketing issues, for an expanded ethanol industry. The report concluded, "No major infrastructure barriers exist" to expanding the U.S. ethanol industry production to 5 billion gallons. Additionally, the report found that the necessary logistics modifications can be achieved cost-effectively.

Although ethanol is a clean-burning fuel that is 100% renewable, ethanol refineries have the potential to create pollutants. It is important that efforts to expand ethanol production be coupled with stringent pollution control

mechanisms in order that the benefits of alternative fuels are not negated by increased pollution levels. Most pollutants from both ethanol production and combustion can be controlled. In fact, when used as a motor gasoline additive, ethanol does reduce tailpipe emissions of carbon monoxide and other toxins. This is particularly important as MTBE, a gasoline oxygenation additive for which ethanol can substitute, has been banned in 17 states due to groundwater contamination issues. The federal government may act to ban MTBE nationwide. The main remaining environmental question is the how ethanol combustion affects NO_x emissions.

Alternative Fuels Policies and Programs

The many varieties of alternative fuels offer advantages for the state, but their cost and potential environmental impacts must be considered. Agricultural interest groups, such as the Farm Bureau, support expansion of alternative fuels, primarily for two reasons: 1) to provide a new market for agricultural produce, such as corn, and 2) to attract farmer interest and investment in alternative fuel production plants.

The following policies and programs are recommended by the Energy Policy Council regarding alternative fuels for North Carolina. The measures with the prefix "Exec" are action items given high priority for 2003 to 2004.

Exec-4 North Carolina should support the development of an alternative fuel industry through dedicated funding and grant matching of promising alternative fuel projects. These efforts should include agricultural waste processing facilities, biodiesel and ethanol refineries, fueling stations for alternative-fueled vehicles, production incentives for farmers and refiners, incentives for highly efficient or alternative-fueled vehicles, and education and awareness programs. Developmental efforts should focus on raising feedstock production levels and insuring all 100 counties in the state have alternative fueling infrastructure by 2007. In particular, the Energy Policy Council supports a state program to pay for alternative fuels development via a $1 to $2 fee applied to annual vehicle registration fees.

Exec-5 Based on the results of ongoing research and development studies, the North Carolina General Assembly should pursue strategies that convert animal waste into environmentally sound energy sources.

5-1 The State Energy Office should establish a panel to lead a detailed assessment of the potential for an alternative fuels industry in NC. The assessment should focus on the realistic potential for each type of alternative fuel, the economic and

environmental costs and benefits, and recommendations for developing the industry.

5-2 The State Energy Office and other relevant state agencies should develop and implement a pilot project converting hog waste to methane or other fuels for the production of electricity.

5-3 The State Energy Office, Attorney General's Office, and Department of Environment and Natural Resources should assess and propose incentives for farmers to convert animal and crop wastes into energy.

5-4 The State Energy Office, Department of Agriculture, and Department of Environment and Natural Resources should support landfill methane gas projects through direct grants and loans based on need, as well as technical assistance.

Chapter 6: Alternative Energy Sources

Alternative energy sources include traditional renewable energy sources as well as innovative new technologies, such as fuel cells. The previous chapter explored renewable fuels derived from agriculture and waste resources. This chapter examines direct use of alternative energy sources for either providing electricity or other energy-related services, such as daylighting, hot water, space heating, or space cooling. Dozens of states across the country are investing in the promise of renewable energy with new policies and programs designed to enhance their development. Historically, North Carolina has been a leader in the field of renewable energy. However, significant development and implementation efforts must continue in order to keep pace with national developments. In addition to educational programs, the Energy Policy Council considered measures such as renewable portfolio standards, net metering, and new incentives for renewable energy sources.

As discussed in the Chapter 4 on electric utilities, electrical peak demand in the state grew 3% annually from 1980 to 2000 and is expected to slow to approximately 1.5% to 2% per year from the present through 2011 (4-6). Due to recently slower economic growth in the state, this forecast is likely to drop. While most utility representatives and regulators have expected that future generation will be provided primarily by natural gas-fired power plants, recent forecasts of higher natural gas prices may change utility planning to include coal-fired and nuclear power plants.

The 9,000 MW of electricity generation proposed for construction in North Carolina could be diversified to include renewable energy resources. Because the majority of renewable electricity could be derived from in-state resources, their use would reduce imports of fossil fuels and provide an economic development opportunity for a new industry – the renewable energy industry. In addition, most renewable energy sources have few, if any, air emissions, thus decreasing emissions of CO_2, NO_x, and other pollutants.

Alternative energy sources include:

- Solar energy, including solar thermal, daylighting, and photovoltaics
- Wind energy
- Water-derived power, including hydroelectric, tidal, wave, and ocean thermal gradient-derived electricity
- Waste-derived power, covered primarily in the previous section
- Agricultural energy sources, including crops burned directly as a source of energy and those converted into another fuel source
- Fuel cells

Solar Energy

Many North Carolina residents already use solar energy for their homes and businesses. They employ the sun's energy in 4 primary ways: solar thermal, passive solar heating and cooling, daylighting, and photovoltaics.

Solar Thermal

Solar thermal collectors and other solar devices capture the energy of sunlight to heat air, water, or other fluids. Examples of solar thermal strategies and technologies include:

Research conducted by the National Renewable Energy Laboratory in 1999 demonstrated a customer preference and willingness to pay more, if necessary, for cleaner energy sources.

Renewable Energy Tax Incentives

- North Carolina offers a personal/ residential tax credit of 35% for the cost of a variety of renewable energy systems.
- Commercial and industrial business owners can take advantage of a 35% state renewable energy credit.
- The federal government offers a 10% tax credit to commercial businesses that invest in or purchase solar or geothermal property in the United States.
- The federal Renewable Energy Production Credit provides a credit, now worth 1.8 cents per kWh, for electricity generated by wind, closed-loop biomass, or poultry waste during the first 10 years of operation.
- The federal government offers five-year accelerated depreciation for solar, wind, and geothermal property placed in service after 1986. In addition, the Job Creation and Worker Assistance Act of 2002 allows businesses to take an additional 30% depreciation on solar, wind, and geothermal property purchased after September 10, 2001 and before September 11, 2004, given that it is placed in service before January 1, 2005.

Source: www.dsireusa.org

Solar Water Heating and Pooling Heating – According to the U.S. Energy Information Administration, solar thermal collector shipments increased 23% from 1993 to 2000, adding 8.4 million square feet of solar capacity. The residential sector consumed 89% of total shipments and continues to be the primary market for solar thermal technologies. Solar collectors – devices that capture the sun's energy and use it to heat water or air – currently have two main purposes: domestic water heating and swimming pool heating. (6-4)

The amount of energy collected by a solar thermal system is proportionate to the amount of direct sunlight it receives. Solar thermal collectors function relatively well in North Carolina's diffused sunlight.

Historically, tracking the number of solar installations in North Carolina has been difficult, largely due to the lack of data collection by the North Carolina Department of Revenue. Recently, the state has begun compiling data on solar energy systems whose owners take advantage of the state's Renewable Energy Tax Credit. Another major constraint to expansion of the solar thermal technologies in North Carolina is the limited development of the solar industry. Although many of the state's current solar businesses have made a long-term commitment to the future of solar technology, there has been little growth or investment in the industry over the past decade. The sole exception has been the emergence of Solargenix Energy, formerly a subsidiary of Duke Energy, which is planning to market solar thermal systems actively.

Solar Space Heating & Cooling – Medium-temperature solar collectors used for space heating operate similarly to solar water heating systems. Solar space heating systems typically have more solar collectors, larger storage units, and more sophisticated control systems than their water heating counterparts.

Solar energy can also be utilized to meet cooling and refrigeration demands. Using active solar cooling systems for cooling and refrigeration can utilize collected solar heat all year, which significantly increases the cost effectiveness and energy contribution of solar installations. These systems are typically sized to provide 30% to 60% of a building's cooling requirements. Except for passive solar cooling strategies, solar-driven absorption systems are currently the most commonly used approach to solar cooling.

Solar Thermal Electricity – When concentrated with lenses or mirrors, sunlight can generate temperatures high enough to boil water or drive various types of heat engines, such as steam engines. The resulting steam can be used to produce electricity much like steam turbines in coal-fired power plants. A number of electric generation systems driven by solar energy are now

operating around the country. Large megawatt solar thermal systems currently provide a superior economic return to photovoltaic systems that are more suited to maintaining smaller, more distributed loads.

Passive Solar Heating and Cooling

Passive solar buildings capture sunlight to help provide space heating and, in some cases, water heating needs. They also control sunlight and use other approaches to keep buildings cooler during the summer. Passive solar features include windows that are properly oriented toward the south; concrete, brick, and other heavy building materials for thermal storage; and shading strategies to avoid summer overheating problems. Passive solar homes are by far the commonly utilized solar energy system in North Carolina.

Passive solar buildings can have comparable costs as similar, non-solar structures and yet save significantly on heating and cooling costs while providing improved comfort and quality of light. The main constraints are lack of awareness and consumer demand along with inadequate training and interest among residential and commercial designers, builders, and developers.

Daylighting

Daylighting designs use light from the sun to complement or replace artificial lighting. While daylighting can be applied to virtually any building, it is much more effective when considered during the initial design phase. Key elements of daylighting systems include:

- Well-designed window and roof monitoring systems that permit controlled sunlight into the building interior while reducing the cooling loads of the structure;
- Light shelves and other design features that help disperse light into the interior; and
- Daylighting controls for artificial lighting systems inside the building. These controls dim or turn off electric lighting in response to the amount of daylight within the room.

Daylighting systems reduce the cost of lighting, cooling, and, in some cases, heating. While most daylighting projects have been successful in saving energy and yielding excellent returns on investment, some systems, such as those utilizing uncontrolled skylights, have proven ineffective. Thus, the designer must have training in the art and science of daylighting to fully understand effective daylighting systems and techniques.

Daylighting can provide several benefits to building owners and occupants:

- Comfortable, naturally lit work areas increase occupant and owner satisfaction. Studies have found higher rates of productivity and reduced absenteeism in daylit buildings.
- Daylit spaces may lease at better-than-average rates.
- Daylit lease properties typically have lower tenant turnover rates.
- Lighting and its associated cooling energy use constitute at least 30% to 40% of a commercial building's total energy use. Daylighting is the most cost-effective strategy for targeting these uses. Both annual operating and mechanical system first costs can be substantially reduced.
- A landmark study conducted by the Pacific Gas and Electric Company found that students perform better in daylit school buildings, several of which have been constructed in North Carolina.

Source: www.pge.com

Photovoltaics

Photovoltaic devices work much differently than solar thermal systems. Rather than capturing the heat energy of the sun's rays, they use solar radiation to create a flow of electrons. As such, they generate electricity directly.

Photovoltaics, already cost-effective in certain remote applications, are undergoing research to reduce the cost per peak watt of electricity generated in on-grid applications. The effort has taken three directions: increasing the efficiency of current technology, developing new technologies that cost less to produce per peak watt generated, and improving manufacturing processes.

Some of the new technologies are dual-functional, thus improving their economics. For example, a roof system could use photovoltaics to produce electricity while also serving as the roof itself. These building-integrated solutions are now used extensively throughout Europe.

One advantage of solar energy systems that reduce electrical demand in summer is that they produce the most output on the sunniest days, which are typically when the highest electric utility demand exists. Thus, by their nature, solar energy systems cut electrical demand during peak periods in North Carolina.

National organizations promoting photovoltaics have identified 3 significant components in the photovoltaic industry that currently prevent extensive market penetration of this renewable technology: technical, market, and institutional barriers (6-22).

1. Research and Development (Technical Issues):
    - Manufacturing costs must decline dramatically, and manufacturing infrastructure must improve in order to achieve higher yields in production. In general, the cost per kWh from PV systems needs to drop via a combination of improved efficiency and lower costs of production.
    - The cost and reliability of Balance of System (BOS) components, including batteries, charge controllers, and inverters, must be improved.

2. Market Opportunities (Market Issues):
    - Consumers need to be educated on the value and benefits of photovoltaics
    - Installation and maintenance professionals must be properly trained and familiar with photovoltaic components
    - Building-integrated photovoltaic technologies (which incorporate photovoltaics into roofing and other construction

components) must come out of their experimental stage of development and enter the marketplace

- Brand name awareness must be established to help drive the domestic market.

3. Policy and Institutional Initiatives (Institutional Issues):
   - The industry requires uniform interconnection standards in all 50 states, as well as net metering agreements.
   - High insurance requirements, as well as standby and interconnection charges from utilities, often make installations cost-prohibitive in North Carolina. A number of other states have developed standards that relieve the institutional burden of these requirements.

Wind Energy

Wind power generation is the fastest growing electricity generation technology in the world, outpacing coal, nuclear, and natural gas-fueled power plants. Figures 15 and 16 describe the rapid increase in wind energy capacity. The United States currently possess 18% (4,300 MW) of worldwide installed capacity, second only to Germany's 37% (8,700 MW). In 2001, the United States added 1,700 MW of wind capacity, second to Germany's addition of 2,695 MW (6-8).

Of the 10 wind classes that exist based upon average annual wind velocities, the continental United States possesses only the first six. However, class 5 and 6 sites, which are abundant in North Carolina's western mountains, are now able to generate electricity in the range of $0.03 to $0.04 per kWh – competitive with new coal and natural gas generation. Additional class 3 and 4 sites are located in the mountains and along the coast of the eastern seaboard. The federal Production Tax Credit (PTC), which pays providers $0.018 per kWh of wind energy generated and is adjusted for inflation annually, coupled with North Carolina's 35% Renewable Energy tax credit (maximum $250,000 for wind generation), further improve the economics of wind generation. (6-5)

According to the Energy Efficiency and Renewable Energy Network, North Carolina has the capacity to produce 8 million MWh – about 7% of current electricity consumption in the state – using wind technology in Class 3 and higher sites. In order to compensate for existing development, environmentally sensitive areas, and other land-use conflicts, this estimate excludes 50% of total forests, 30% of total farmland, and 10% of total rangelands (6-7).

Figure 15: Growth in Global Wind Capacity (MW)

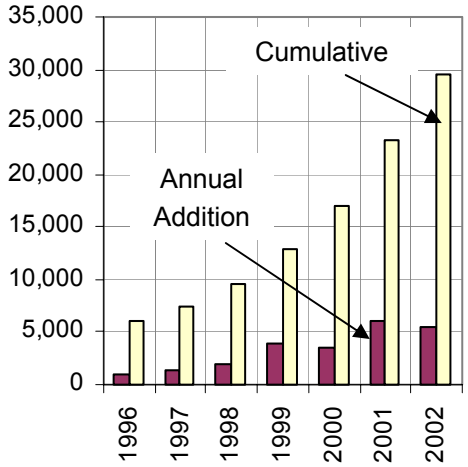


Figure 16: Wind Energy Capacity (MW)

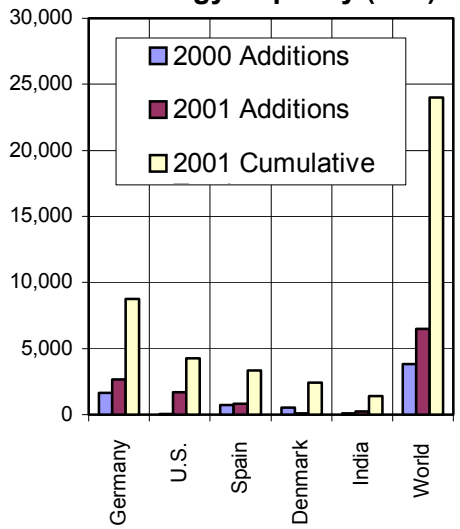


Table 12: Benefits of Wind Farms in the United States

10 billion	kWh per year
1 million	# homes powered
7.5 million	tons CO_2 displaced
4,000	equivalent acreage of forest to absorb CO_2

Source: American Wind Energy Association

Table 13:
Cost of U. S.
Hydroelectric Generation

Capital Cost ($/kW)	$1,700 to 2,300
Operation Cost ($/kWh)	$0.004
Maintenance Cost ($/kWh)	$0.002
Total Cost ($/kWh)	$0.024
Operating Life	50+ years
Capacity Factor	40-50%
Average Size	31 MW

Source: U. S. Department of Energy

Table 14:
Distribution of Potential
Hydropower Sites
in North Carolina

Capacity of Facilities	# of Sites
Under 100 kW	13
100 kW to 499 kW	22
500 kW to 999 kW	13
1 MW to 4.9 MW	24
5 MW to 9.9 MW	5
10 MW to 24.9 MW	11
25 MW to 49.9 MW	4
50 MW to 99.9 MW	1

Source: *U.S. Hydropower Resource Assessment for North Carolina*, Idaho National Engineering and Environmental Laboratory, October, 1997.

While cost remains a factor, the single largest barrier to wind technology in North Carolina is the ability to site wind machines in areas with the greatest wind resources – namely the high ridges in Western North Carolina. The Mountain Ridge Protection Act of 1983, commonly referred to as the Ridge Law, was designed to prohibit the construction of unsightly structures taller than 35 feet on North Carolina ridges above 3,000 feet in elevation. Although exclusions exist for telecommunications towers, electrical *transmission f*acilities, structures of a "relatively slender" nature, "minor" vertical protrusions, and even "windmills," the North Carolina Attorney General recently stated that electrical *generation* equipment is in violation of the Ridge Law. Unless modified, this interpretation effectively prohibits development of those sites with the best wind resources in North Carolina.

Hydroelectric

According to the U.S. Department of Energy Hydropower Program, conventional hydroelectric generating facilities tripled between 1921 and 1940 and again between 1940 and 1980. At present, about 12% of the United States' electricity needs are met with hydropower (6-14). That represents about 80,000 MW of conventional capacity and 18,000 MW of pumped storage.

Hydropower represents the primary renewable energy supply from utilities in North Carolina. In 1999, hydroelectric plants supplied over 3.5 million MWh of electricity – about 3.5% of total state electricity sales – much of it for peaking power (6-12).

Hydroelectric generation typically requires less initial capital than coal and nuclear facilities, but more than natural gas. However, it is typically the most economical source of electricity in terms of actual costs of generation. In fact, at less than $0.025 per kWh, the total cost of hydroelectric generation is the cheapest source of electricity currently available for North Carolina. However, the growing awareness of hydropower's environmental implications has slowed expansion in the past few decades (6-13).

The Idaho National Engineering and Environmental Laboratory, under contract by the U.S. Department of Energy, conducted an assessment of North Carolina's undeveloped hydroelectric generation potential. The study found 93 sites with approximately 508 MW of undeveloped generation capacity. Although 76 MW represents the greatest capacity of any site, 77% of the potential sites would generate less than 5 MW, as shown in Table 14 (6-14). The 508 MW of additional hydroelectric generation would provide about 2 million MWh of electricity -- approximately 1.3% of all generation in North Carolina.

The most significant barriers to additional hydroelectric power for North Carolina are the drought experienced during the last four years and the expiration of avoided cost contracts between electric utilities and owners of hydropower facilities. Additionally, hydropower's environmental impact on the ecology of the operation site has been a significant barrier to new development. However, there has been a shift away from large-scale projects to less intrusive low-head, small and micro-hydro projects. Moreover, technological advancements have helped mitigate the impact on aquatic species. At large, proposed dam sites, it is both difficult and expensive to procure licenses for new and existing projects. In addition, there is often considerable opposition from environmental groups. In fact, the U.S. Energy Information Administration forecasts decreased hydroelectric capacity due to regulatory actions that limit capacity at existing projects. Rapidly growing demand for water intended for irrigation, industrial processes, cooling water for fuel-fired electric power plants, and human needs may pose a further limit on expanding hydroelectric capacity.

Biomass for Electricity Generation

North Carolina's biomass resources from the agricultural and waste management sectors are a leading potential source of energy in the state. Table 15 shows that 26 million MWh of electricity could be generated using renewable biomass fuels in North Carolina – enough to supply about 20% of total electricity use in North Carolina. Potential biomass energy sources for electricity generation include urban residues, mill residues, forest residues, agricultural residues, and energy crops. Municipal solid waste (MSW), landfill gas (LFG), and animal waste also offer potential sources of generation. The cost of electricity generation for landfill gas averages about $1,050 per kW of installed capacity and as low as $20 per MWh. The fuel sources themselves are discussed in greater detail in Chapter 4: Alternative Fuels from Biomass. Currently, a 100-MW coal plant can be retrofitted to co-fire with 15% biomass for about $260 per kW of installed capacity (6-19).

Biopower, electricity generation from biomass, must overcome several barriers before widespread adoption can occur. First, a viable supply infrastructure must exist in order to supply potential plants with the massive amount of feedstock they require on a daily basis. In addition to the logistical problems of preparation and transportation, biomass generation facilities must often compete with other industries for fuel. Moreover, the lack of familiarity with biomass generation can drive up project costs during all phases of the operation and is often sufficient to prevent its adoption. Finally, biomass co-firing can be difficult in coal-fired power plants where selective catalytic reduction (SCR) equipment has been installed to control emissions.. Approximately 70% of coal-fired plants are capable of biomass

Table 15:
North Carolina
Biomass Potential

Fuel	Million Tons / yr	Million kWh/ yr
Municipal Solid Waste[1]	13	8,573
Mill Residues[2]	5.0	6,484
Animal Waste[3]	4.0	3,824
Forest Residues[2]	2.0	1,939
Energy Crops[2]	1.6	1,794
Agricultural Residues[2]	1.1	1,202
Urban Waste[2]	1.1	1,196
	Million Tons MSW	**Million kWh/ yr**
Landfill Gas[4]	143.9	1,007
TOTAL		**26,019**

[1] www.bioproducts-bioenergy.gov

[2] www.bioenergy.ornl.gov/resourcedata

[3] Len Bull, NC State University, personal communication

[4] www.epa.gov/lmop/seek/curves.pike.pdf

co-firing, the majority of which are candidates for SCR. Unfortunately, the high alkali content of biomass feedstocks poses contamination risks for the equipment and represents a significant hurdle to overcome in order for this particular technology to gain acceptance.

Studies performed by the Business Communications Company estimates the following near term markets for fuel cells:

- $850 million – electric power
- $750 million – motor vehicles
- $200 million – portable electronic equipment
- $200 million – military/aerospace
- $400 million – other

Fuel Cells

Fuel cells use hydrogen or hydrogen-derived from other fuels, such as methanol, ethanol, natural gas, gasoline, or diesel fuel, to produce electricity. Fuel cells can also be supplied by biomass, wind, solar power, or other renewable sources. Fuel cells today are running on many different fuels, even gas from landfills and wastewater treatment plants.

According to Allied Business Intelligence Inc., the current $40 million stationary fuel cell market will grow to more than $10 billion by 2010, and the overall fuel cell energy capacity will increase by a factor of 250, with global stationary fuel cell energy capacity jumping to over 15,000 MW by 2011 from just 75 MW in 2001 (6-23).

The future market for fuel cells appears promising. North Carolina should continue to monitor the technology's development. Fuel cell manufacturing companies have located in the state, so it is especially important for the state to attract and assist these industries for economic development reasons.

Alternative and Renewable Electricity Programs

The potential impacts of building-related solar thermal and daylighting technologies are included in the projections in the residential, commercial, and industrial chapters. Renewable electricity is in its infancy in North Carolina, and interest in electricity generation from wind energy systems, landfill gas, photovoltaic systems, solar thermal electricity, and other sources is growing.

NC GreenPower

The NC GreenPower program, recently approved by the North Carolina Utilities Commission, is an important development for the future of renewable electricity in the state. The program's objectives are to:

- improve the quality of the environment;
- increase the amount of generation from renewable sources;
- maximize the amount of investment in renewable generation; and
- maximize the number of participants.

The NC GreenPower program will allow electric utility customers to purchase electricity from renewable sources. Two "products" will be offered:

- The first is a mass-market product with an anticipated price of $4 per block of 100 kWh available for purchase by any North Carolina electrical energy consumer. It offers electricity generated by facilities using solar, wind, and methane-from-biomass to deliver power to North Carolina's electric grid. This resource mix has higher costs of production, which is why it costs more than the second product. This premium product has been accredited by the Center for Resource Solutions in California, the lead national organization for certifying green power programs.
- The second product offers a lower cost alternative, $2.50 per 100 kWh block, for large-volume consumers who purchase at least 10,000 kWh (100 blocks) of the product per month. The resource mix for this product consists of existing and new generating facilities using solar, wind, small hydro, and all types of biomass.

A number of utilities in other states have adopted green pricing programs, similar to NC GreenPower. However, North Carolina's program is unique in that it is a statewide program; most of the others are provided by specific electric utilities, such as the Green Switch program offered by TVA.

Renewable Portfolio Standards

In order to force accelerated development of renewable electricity generation, 14 states have instituted renewable portfolio standards (RPS), which require that a certain percentage of a state's electricity generation comes from new renewable sources. Table 16 summarizes some of the RPS programs around the country.

If North Carolina established an RPS requiring that new forms of renewable energy provide 10% or more of electricity needs by 2020, the state would have to address several key issues, including:

- Development of interconnection rules and standards for independent power producers;
- Regulatory requirements and rules for a RPS;
- Opposition by some key groups to mandated development of renewable electricity sources; and
- Potential development barriers to renewable electricity technologies.

The NC GreenPower program will hopefully serve as a catalyst to develop procedures, policies, and technologies to overcome these obstacles.

Table 16: Summary of Renewable Portfolio Standards

	Year	Required % or capacity
Arizona	2012	1.10%
Con-necticut	2009	6% to 13%
Hawaii	2010	9%
Illinois	2020	15%
Iowa	n/a	105 MW
Maine	n/a	30%*
Massa-chusetts	2009	4%
Minnesota	2015	10%
Nevada	2013	15%
New Jersey	2013	4%
New Mexico	n/a	5%
Pennsyl-vania	n/a	2%
Texas	2008	2000 MW
Wisconsin	2010	2.20%

* Electricity in Maine is already 50% renewable.

Alternative and Renewable Energy Policies

Alternative and renewable electricity issues are complex because of the required linkage with the existing utility network. However, many states have adopted highly successful measures to foster development of in-state renewable electricity resources. The Energy Policy Council recommends the following policies and programs for North Carolina. The measures with the prefix "Exec" are action items given high priority for 2003 to 2004.

Exec-6 The General Assembly should consider adopting net metering for application to all electric utilities in the state.

Exec-7 The General Assembly should evaluate a renewable portfolio standard (RPS) that complements the NC GreenPower program and fosters the development of a renewable electricity market. The RPS would require that all electric utilities increase the percentage of total distributed electricity that comes from renewable sources, such as hydroelectric, wind, solar, waste-derived fuels, and agricultural fuels.

Exec-8 The General Assembly should reexamine the Mountain Ridge Protection Act as it pertains to wind energy while still protecting North Carolina's natural beauty.

Exec-9 The State Energy Office should assess and propose incentives and regulatory or administrative measures for development of renewable electricity generation facilities, solar water heating, passive solar heating and cooling, active solar space heating and cooling, and daylighting.

Exec-10 The General Assembly should require that all electric utilities in North Carolina provide generation disclosure of fuel mix percentages and emissions statistics on sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury annually by bill insert and via website. The disclosure information should clarify to the consumer the environmental impact of their electricity use.

6-1 A Solar Schools Program should be developed and incorporate renewable electricity generation, solar water heating, and daylighting to reduce fossil fuel use by schools, improve the quality of education, provide a real-world energy training lab, and make our citizens more aware of the potential for renewable resources.

6-2 The State Energy Office should work with the state's professional licensing boards to develop a certification program for renewable energy installers.

Chapter 7: Energy Use in the Public Sector

From lighting our school buildings, to heating our hospitals, to fueling our police cruisers, North Carolina spends a significant amount of money each year on public sector energy bills. Precisely how much energy is used by all the public entities in the state is a difficult question to answer. Only since 1997 have state government accounting systems allowed for a department-by-department reporting of what state government pays for different energy sources. This uncertainty is complicated by the lack of information collected on energy consumption for local governments.

State Government Energy Use

Public records indicate that the state government spent almost $180 million on energy bills in 1997 and $187 million in 1999. As shown in Figure 17, the cost of energy and fuel, excluding gasoline, in 2002 was $179 million. Electricity is the dominant source of energy, providing 65% of the total. Natural gas and LPG (propane) provide 14%, coal 13%, and fuel oil 7% of the total (7-1).

Figure 18 shows that the University System is the largest consumer of energy in North Carolina's state government, with over half of expenditures devoted to the 16 institutions and their administration. Among the universities, University of North Carolina (UNC)-Chapel Hill and North Carolina State University (NCSU) together consume over half of the total university expenditure, at $40 million and $20 million respectively. This does not include the UNC hospitals, which are funded separately. UNC hospitals, if included in the University category, would cause an increase of about $8 million annually. Interestingly, the only university using any coal is UNC-Chapel Hill, which spent a little over half of its 2002 energy bill ($23 million) on its coal-fired cogeneration facility.

Looking to the future, with the passage of the higher education bonds in 2000 representing $3.1 billion in additional buildings and renovations at state community colleges and universities, the higher education share of energy expenditures will undoubtedly increase. Therefore, the design and construction of new and renovated buildings should have energy efficiency as a top priority.

Local Government Energy Use

During the 1999 to 2000 time period, the state's 3 most prominent organizations focusing on local governments joined forces to assess what they might do to reduce their energy expenditures. The North Carolina

Figure 17: FY02 Energy Cost Profile for State Activities (Total = $179 million)

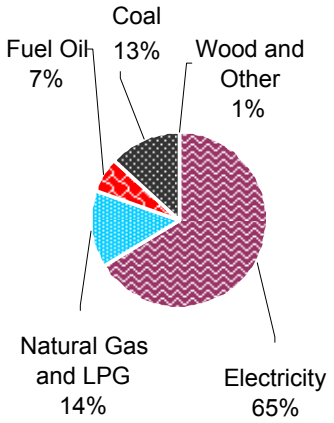
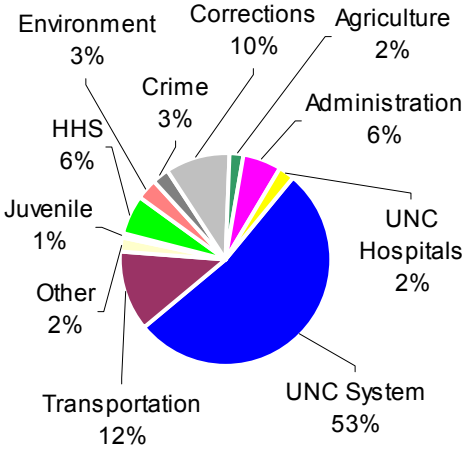


Figure 18: FY02 Breakdown of Energy Costs by State Agency (Total = $179 million)



Findings of the Local Government Energy Savings Organization (LoGESO) energy study:

- 100 counties, 539 municipalities, and 117 school districts purchase energy in NC.
- These jurisdictions spend over $225 million on energy each year.
- Current utility company rate structures "do not address the unique needs and load factors associated with most of the local government energy usage and requirements," such as street lighting, water pumping, and lower rates for schools.
- Fewer than 25% of potential energy efficiency opportunities had been realized in the pilot sites focused on by the study. This was due, in part, because the small size of many energy efficiency projects did not attract competitive bids from established firms due to the high cost of assembling a bid.
- Few local jurisdictions tracked and reported energy use and expenditures.
- Based upon the consultant's experience elsewhere, North Carolina local governments could experience a 5-10% reduction in purchased energy with an aggressive energy reduction program. This would mean an estimated $50 million in savings over a five-year period.

League of Municipalities, North Carolina Association of County Commissioners, and North Carolina Association of School Boards formed a collaborative association named LoGESO (Local Government Energy Savings Organization). LoGESO contracted with a nationally recognized public sector energy consulting firm (Public Energy Partners) to assess steps their respective constituents might do to conserve energy and to operate more efficiently (7-2).

Unfortunately, these projected savings are only estimates since no comprehensive data exists on the number of local government buildings (with the exception of schools), their size, energy bills, energy utilization, or energy source. A statewide inventory of each public facility owned or leased by county and municipal government, including K-12 schools and community colleges, would serve as an important resource for developing energy-saving strategies. The net result of the inventory could be a calculation of average energy costs and/or energy used per square foot for each facility in order to establish a baseline against which future energy conservation measures could be measured. The state of South Carolina has mandated such reporting through statute, Section 48-52-620 (E), since 1992, and its Energy Office has reported energy consumption data annually since 1993 on all public facilities. North Carolina used to have a similar requirement which should be evaluated for implementation if warranted.

Public Schools

There are 117 individual school districts across the state, with each responsible for paying its own energy bills. Within these districts reside 2,112 individual schools enrolling 1.3 million students. Since the state's population has been growing over the past decades, the number of school facilities has also been growing in an effort to keep pace. For example, during the 1999-2000 school year alone, over $1.2 billion in capital outlay was budgeted for primary and secondary school expansions (7-1).

As shown in Figure 19, during FY 2000, these 117 school districts reported spending $152 million in energy bills for their facilities (transportation expenses are not included here). Over the next year, public schools reported spending $176 million, representing an increase of 15.5% from the previous year. Since the data is not available on actual energy consumption, it is not possible to determine if this increase was primarily due to changes in prices, weather, consumption patterns (including energy used for increased ventilation in school buildings), or accounting practices. The bottom line is that the cost of energy represents a significant drain on local resources.

An additional aspect of energy use in educational facilities is the fuel used to transport children to and from their schools via both personal vehicles and

school buses. The total cost of student transportation is a substantial portion of the total cost of energy for education. Increased pedestrianism, as well as increased bus usage, could save substantially on total energy consumption.

Public Sector Recommended Policies and Programs

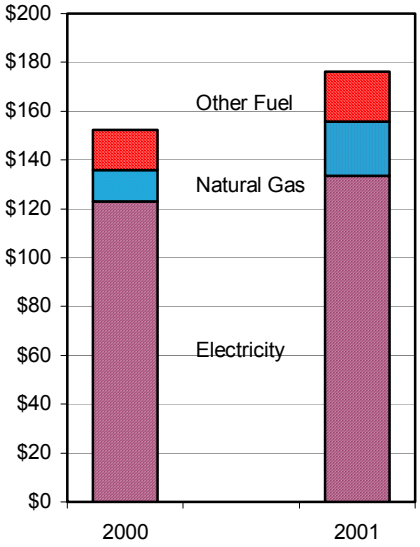
The public sector is of key importance to the State Energy Plan for several reasons, including: (1) substantial potential exists for saving energy, (2) energy savings will help reduce the state budget shortfall and decrease the cost of government, (3) a firm commitment to improving the energy efficiency of state government will show that the state means to lead by example, and (4) reducing energy consumption will help improve the state's environmental quality. The Energy Policy Council recommends the following policies and programs for North Carolina's public sector. The measures with the prefix "Exec" are action items given high priority for 2003 to 2004.

Exec-11 State agencies and universities, with coordination by the North Carolina Department of Administration, should reduce energy use in existing state buildings to save 20% by 2008, a reduction of 4% per year or more for the next 5 years. The State Energy Office should submit an annual report to the Energy Policy Council that provides data on energy saved in state buildings and universities by source and cost, energy efficiency activities undertaken in these buildings, the approximate investment in energy efficiency measures, and the overall economic costs and benefits of the program.

Exec-12 Working in conjunction with the State Construction Office, the State Energy Office should monitor, analyze, and report on the energy savings attributed to the new requirements on life-cycle cost analyses of the $3.1 billion higher education building program currently underway across the state, as well as future projects. The State Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer life-cycle cost procedure.

Exec-13 North Carolina should facilitate the efforts of local governments to finance energy efficiency and renewable energy projects; allow bundling of multi-jurisdictional energy efficiency projects to achieve economies of scale and improve opportunities for financing, restructure the underwriting provisions of the State Energy Office's low-interest energy loan program, and provide training in energy efficiency measures to building managers in local government buildings.

Figure 19: Energy Bills in K-12 Schools ($ million)



Source: NC State Energy Office and NC Department of Public Instruction

7-1 North Carolina statutes should require that designers of all new public buildings provide estimates of projected energy consumption and energy costs for the building prior to construction.

7-2 The State Energy Office should work with the North Carolina Department of Public Instruction to review prototype school designs listed on the Department of Public Instruction's Web page and determine how best to integrate improved, more efficient designs.

7-3 The North Carolina Department of Administration should implement high performance building guidelines developed for North Carolina in all new public buildings and also develop and implement high performance guidelines for new public housing.

7-4 The North Carolina Department of Administration should develop performance contracting procedures and other ways to finance energy efficiency projects for state and local governments, university and public school systems, and public housing. The Department of Administration should provide technical support to implement performance contracting projects and provide quality assurance.

7-5 State agencies should lead by example by establishing a certain minimum level of electricity to be derived from renewable sources, such as the North Carolina GreenPower program, or via installation of state-owned renewable energy projects.

7-6 North Carolina Department of Administration should require that all state facilities with motors larger than 5 horsepower to develop a motor maintenance program.

7-7 Local governments should be encouraged to implement the above actions and other energy efficiency programs.

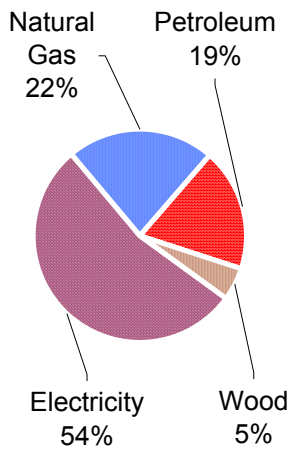
Chapter 8: Energy Use in the Residential Sector

In 2000, residences in North Carolina used 23% of the total energy consumption in North Carolina. Because the sector concerns virtually every citizen of the state in a direct way, energy use in residences remains a key focus of those concerned with energy efficiency.

Figure 20 shows that the major energy sources for residences are currently electricity (54% of total energy use), natural gas (22%), and petroleum (19%). Wood energy supplies 5% of residential needs. Other sources, which provide less than 1% of the energy demand in the sector, include coal and solar energy (8-1). Of course, as shown earlier in Figure 5 in Chapter 1: Introduction, energy efficiency has played an important role in reducing total energy consumption in the sector, although it does not appear as an actual source of energy.

Table 4, shown previously in Chapter 2: Energy, Economics, and the Environment, details an important issue for the poor in our state. Those on very low incomes (less than $10,000 per year) spend about 18% of their annual disposable income on energy bills. Households earning $10,000 to $25,000 pay about 7% of their income for energy, while those earning over $25,000 pay only 3% to 4%. Thus, energy costs represent a particular economic drain for the economically disadvantaged.

Figure 20: Residential Energy Source Breakdown for 2000 (159 TBtu Total)



Residential Energy End Use

North Carolinians use energy in many ways in their homes, primarily for heating, cooling, and hot water. The fact that 70% of North Carolina's hot water needs are currently met through electricity indicates a significant potential for solar domestic water heating and heat pump water heaters (8-5). Implementing these technologies into new residential construction could provide a substantial reduction in monthly consumer energy expenditures and reduced electric power plant emissions.

Energy use per household declined between 1970 and 1990, but began to rise during the early and mid 1990's. However, in the late 1990's, per household use began to decline again.

The primary residential energy uses, as shown in Table 17, are for heating, cooling, hot water, and appliances.

- Electricity provides about half of space heating, 59% of hot water, and virtually all cooling, lighting, and appliance energy needs.
- Natural gas supplies 39% of space heating and 38% of hot water.
- Propane and kerosene supply 7% of space heating and 3% of hot water.
- Fuel oil provides about 3% of space heating.

Table 17:
Estimated 1997 Energy Consumption by End Use and Source for the EIA South Census Region (Million Btu per household)

End Use	Electricity	Natural Gas	LPG/ Kerosene	Fuel Oil	Totals
Space Heating	34.2	26.7	4.9	2.1	67.9
Space Cooling	18.7	0	0	0	18.7
Water Heating	18.9	12.1	1.0	0	32.0
Refrigerator	12.0	0	0	0	12.0
Lighting, Other Appliances	49.0	6	1.0	0	56.0
Totals	**132.7**	**44.8**	**6.9**	**2.1**	**186.6**

Source: www.eia.doe.gov, South Census Region data

Increases in Population and Number of Households

North Carolina's growing economy and pleasant climate have made it an attractive site for businesses and people to relocate. Consequently, the state's population and number of households have grown steadily. Between 1990 and 1995 alone, the number of households grew 8.5%. Housing starts in the state increased approximately 16% between 1997 and 1999, but decreased nearly 13% in 2000, with 74,800 new starts.

Over 15.2 million homes in the southern region of the United States were built before 1970 (8-5). Retrofitting these older homes with energy efficient insulation, lighting and windows could yield significant savings in consumer energy expenditures and provide increased employment.

In North Carolina, manufactured homes constitute about 15% of total housing units. Most producers of manufactured homes provide energy efficient models. One manufacturer offers an energy efficient upgrade that includes improved windows, higher insulation values, and more efficient heating and cooling systems for only $695. The unit should save over $200 per year – a payback period of less than 4 years.

While the manufactured home industry provides options for energy efficient models, most existing units, as with site-built homes, are in need of energy improvements. However, energy efficiency features in existing manufactured homes are more difficult to install than in standard homes. The difficulty is typically compounded by the fact that most manufactured home occupants do not have disposable income for energy improvements. Finally, the shorter life span of a manufactured home tends to deter efficiency improvements.

Efficiency Measures for Residences

The residential sector possesses tremendous opportunity for reducing energy use. Fortunately, many energy efficiency measures are cost effective and provide additional advantages to the owner, such as improved comfort and increased home durability, as well as benefits to the state, such as reduced environmental emissions, lower fuel imports, and the economic benefit of direct expenditures for energy-saving products. More efficient new homes usually cost marginally more than comparable less efficient homes. However, efficient homes have reduced costs of home ownership, because the annual energy savings far exceed the additional annual mortgage costs.

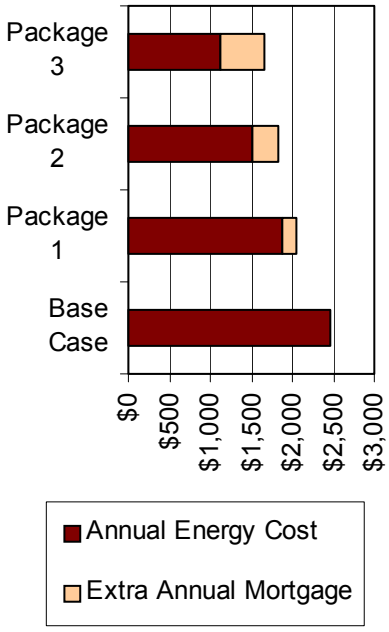
Economics of Energy Efficiency Measures

Figure 21 shows the annual energy costs and the extra annual mortgage costs for a sample home with 4 efficiency levels. The base case home uses more energy than the other 3 options, and as the figure shows, has the greatest annual cost. The 3 efficiency packages are progressively more expensive, adding to the annual mortgage case. However, each package is less expensive overall because of the increasing savings on annual energy bills. Unfortunately, the owners of most new homes in the state are not capturing these savings. Thus, rather than representing the state-of-the-art in construction, most new homes become candidates for energy retrofit measures.

Promoting energy efficient construction and renovation successfully in the state requires a concerted effort between the State Energy Office, building designers, construction trade groups, financial institutions, code enforcement agencies, electric and natural gas utilities, energy research and implementation organizations such as Advanced Energy Corporation, design and construction departments of colleges and universities, and state and local governments. By implementing policies that require enhanced performance levels in new homes, the state can be assured of creating a higher quality, high-performance housing stock that more efficiently utilizes energy resources.

Figure 21:

Economic Analysis of Energy Efficiency Measures for a New Home



*Base Case-no efficiency measures
*Package 1-improved insulation, air & duct sealing, low-e windows
*Package 2-all above measures, high efficiency HVAC, passive solar heating, energy-efficient lighting/water heater
*Package 3-all above measures, solar water heating

Currently, there are no federal or North Carolina tax credits which specifically target energy efficiency. Developing tax credits and other incentives for renewable and energy-efficiency measures in existing homes will help improve energy performance and increase housing values. Additionally, the development of mortgage programs that support higher efficiency homes will make initial energy efficiency investments possible for homebuyers at all income levels.

Affordable Housing in North Carolina

The State Energy Office, Advanced Energy Corporation, North Carolina Homebuilders Association, various financial institutions, and other organizations have worked jointly to develop an improved, higher performance, affordable home program in the state. This initiative has helped build and finance hundreds of homes with lower energy bills, higher comfort levels, and increased durability compared to typical homes built for low-income households.

Residential Energy Savings Potential

Figure 22: Residential Energy Use Scenarios (net energy use – TBtu)

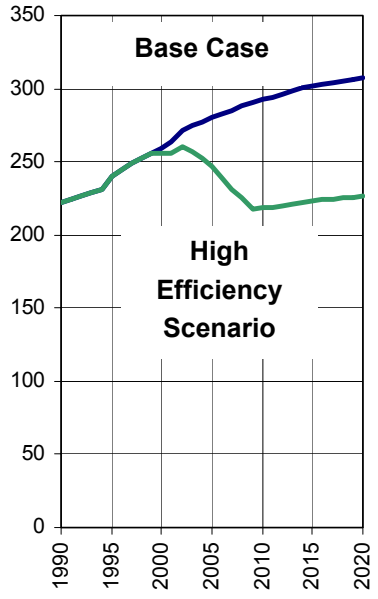


Figure 22 shows two scenarios of projected energy use in the residential sector – a base case that follows current trends and a high efficiency scenario that assumes an aggressive implementation of efficiency measures in new and existing homes. The high efficiency scenario shows a marked drop in residential energy use; in fact, energy consumption in 2020 virtually mirrors that in 1990.

The high efficiency scenario assumes the following:

- In new construction, homes that save 30% or more of energy use in conventional new homes will take over the new home market, phasing in gradually from 2004 to 2010.
- In existing homes, occupants will implement energy-efficiency measures including such features as increased insulation, double-paned windows, hot water conservation measures, improved duct sealing, efficient lighting, and programmable thermostats.

North Carolina's utilities, as well as some private companies, have offered incentive programs for new, energy efficient homes. Examples of relatively ambitious new home programs include the E-300 Program at Greenville Utilities and Progress Energy's new Energy Efficient Home Program. Hopefully, other utilities in the state will either upgrade their existing home programs or development new programs to encourage more efficient new construction.

In order for the energy efficiency of the residential sector to increase, the home financing industry must become involved. Fortunately, Fannie Mae, the federal lending agency, has developed a loan program for homes that meet high efficiency guidelines. The Fannie Mae Energy Efficient Mortgage reduces downpayment requirements for new homes that meet the guidelines for the U.S. Department of Energy and U.S. Environmental Protection Agency's Energy Star home program. The Residential Energy Services Network is conducting a project to increase availability and use of energy efficient mortgages in North Carolina.

Residential Energy Policies and Programs

The following policies and programs for the residential sector are recommended by the Energy Policy Council for implementation in North Carolina. The measures with the prefix "Exec" are action items given high priority for 2003 to 2004. While these policies alone will not achieve the level of savings depicted in the high efficiency scenario shown above, they will provide a starting point for improving the efficiency of residences in the state.

- Low-Income Weatherization

Exec-14 North Carolina State Government should continue to support a strong low-income weatherization program. The state should review the effectiveness of energy conservation programs conducted through the weatherization program and analyze opportunities for improvements. The State Energy Office should develop programs in addition to weatherization to address energy efficient housing in the low income sector.

- Energy Codes in New Construction

8-1 The State Energy Office should conduct a study on current compliance levels of residential and commercial buildings with the North Carolina state energy code. The study should make recommendations for improvements in compliance procedures and for energy code changes that are in the best interests of the state.

8-2 The State Energy Office should create an Energy Code Enforcement Assistance Program to provide additional energy code enforcement and outreach officials to serve across the state. The state should consider whether adding a state surcharge on all local building permit fees to support the program is feasible.

- Manufactured Homes

8-3 The State Energy Office should investigate technologies, incentives, financing options, and regulatory issues regarding

minimum efficiency requirements for manufactured housing. At a minimum, the State Energy Office should encourage new manufactured homes to comply with the critical components of the state energy code for site-built residential units and promote Energy Star manufactured homes. The program should include a comprehensive statewide training program on the benefits and details of higher efficiency units.

- High Performance Homes

8-4 The State Energy Office should organize a statewide effort to develop criteria for a high performance building program to reduce the life cycle cost of new and existing buildings. The criteria should utilize provisions from other successful high performance programs, including Energy Star, programs developed by Advanced Energy Corporation, Southface Energy Institute's Earthcraft Home Program, the U.S. Department of Energy's Building America program, and others.

8-5 The State Energy Office should develop a comprehensive, statewide promotional campaign for high performance buildings.

8-6 The State Energy Office should continue its work to formulate and advance mortgage-based incentives for high performance new homes.

- Training

8-7 The State Energy Office should provide training on high performance buildings to builders, subcontractors, architects and engineers, landscape architects, code enforcement officials, utility representatives, building investors, developers, financial institutions, real estate professionals, appraisers, home inspectors, renovation contractors, educators, and prospective homeowners.

8-8 The State Energy Office should provide training for building professionals on specific targeted technologies including residential daylighting, solar water heating, heat pump water heaters, new insulation products, and advanced HVAC systems and controls.

Chapter 9: Energy Use in the Commercial Sector

The commercial sector, as defined in this document, is comprised of privately-owned commercial buildings, public buildings, large multi-family dwellings, facilities for non-profit organizations, and religious buildings. The bulk of energy used by the commercial sector is for heating, cooling, and lighting; with lower energy use for domestic hot water, refrigeration, cooking, electronic equipment, and other operations.

The commercial sector consumed about 18% of total energy use in North Carolina in 2000, including generation losses from electric power plants. Public buildings, discussed in greater detail in the Chapter 7: Energy Use in the Public Sector, also comprise a portion of commercial energy use.

Figure 23 shows the following energy resource mix for North Carolina's commercial sector in 2000:

- Electricity provides about 65% of total energy needs, totaling 133.3 TBtu.
- Natural gas supplies 22% for a total of 44.4 TBtu.
- Petroleum provides 11% for a total of 23.3 TBtu.
- Coal and renewable sources (primarily wood) each provide about 1% of energy needs totaling 2.7 TBtu and 1.8 TBtu, respectively.

Figure 24 shows that natural gas and electricity supplied only 31% of total net energy needs to the sector in 1960, but now they provide about 87% of total net energy needs (22% natural gas and 65% electricity). Table 18 on the next page shows the estimated breakdown of commercial energy sources by end use.

Figure 23: 2000 Commercial Energy Use by Source (TBtu)

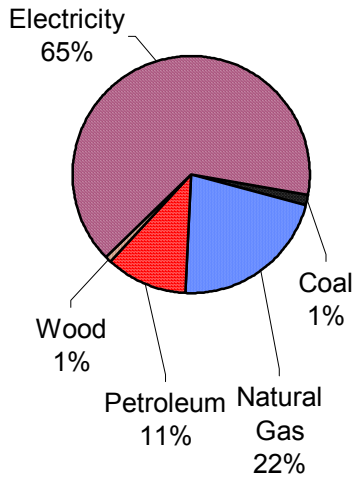
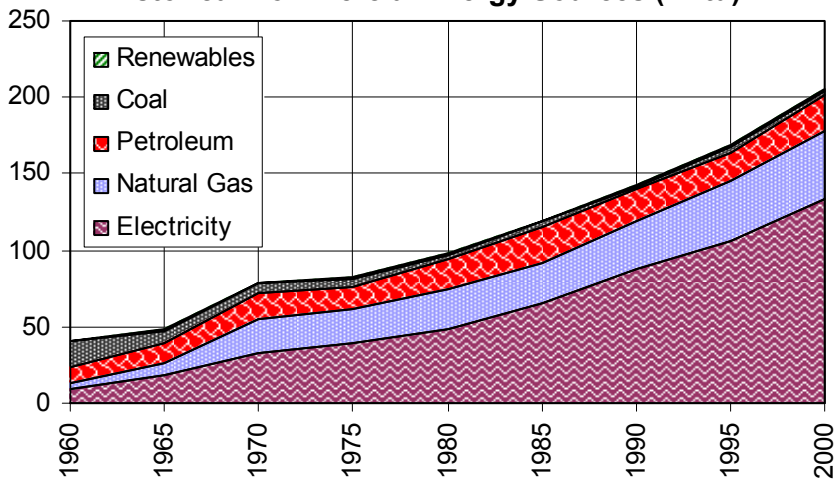


Figure 24: Historical Commercial Energy Sources (TBtu)



Efficiency strategies for commercial buildings include:

- Building Energy Efficiency
- Lighting Efficiency and Daylighting
- Heating and Cooling System Efficiency
- Alternative Energy Options
- Hot Water Efficiency

Figure 25:
Energy Use in Commercial Buildings in NC (TBtu)

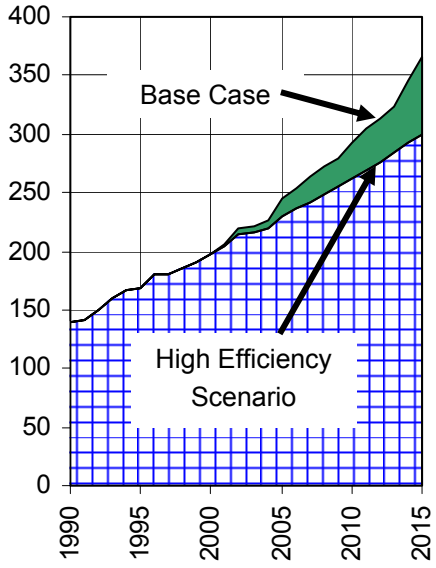


Table 18:
Breakdown of Commercial Energy Sources and End Uses

	Electricity	Natural Gas	Petroleum	Coal	Renew-ables
Space Heating	40%	45%	10%	2%	3%
Space Cooling	99%	1%	0%	0%	0%
Water Heating	73%	21%	4%	1%	1%
Lighting	100%	0%	0%	0%	0%
Electronic Equipment and Appliances	100%	0%	0%	0%	0%

Commercial Efficiency Strategies

The commercial sector has a high potential for improving efficiency in both existing and new buildings. Insuring energy reliability, promoting wise land use, and improving environmental quality are directly related to energy efficient construction codes and techniques.

Energy Efficiency and Renewable Energy Scenario

Achieving a substantial reduction in commercial energy use will require considerable improvement in buildings. Figure 25 shows the potential impact of a scenario that seeks to reduce energy consumption 20% below projected 2015 levels, saving 43 TBtu in that year. The scenario assumes aggressive implementation of the following cost effective technologies in new and existing commercial buildings:

- A growing percentage of new buildings, totaling 20,000 to 30,000 structures over the next 12 years, would take advantage of energy-saving designs and technologies, such as improved windows and insulation systems, daylighting, more efficient lighting systems and controls, improved heating and cooling systems, and better controls. The scenario assumes that the program would ramp up dramatically and achieve a 65% market penetration of buildings built during the next 12 years.
- Existing buildings would adopt similar measures, with 2% to 32% market penetration of different energy technologies depending on their economic payback.. The scenario assumes implementation of the following energy improvements:
  - 5,000 to 6,000 will add insulation to roofs and walls.
  - 6,200 will install replacement windows or additional glazing.

- 3,000 will adopt daylighting measures.
- 7,000 buildings will replace incandescent lighting with fluorescent; 12,500 will replace less efficient fluorescent lighting with electronic ballasts and lower wattage lamps; and 4,000 will improve the efficiency of exterior lighting.
- 7,200 buildings will add maintenance and repair programs for their heating and cooling systems, and 12,000 buildings will improve their current maintenance and repair programs.
- 8,800 heating and cooling systems will be outfitted with economizers; 10,000 will improve duct and pipe insulation; 5,400 will select more efficient systems to replace older systems that are functioning poorly; and 5,400 buildings will add energy management systems.
- 12,000 buildings will have various types of water heating improvements installed.
- 1,000 buildings will retrofit open display freezers, while 6,700 will improve operation of existing freezers.
- 13,500 buildings will replace office equipment and appliances with more efficient models.
- 4,200 buildings will install solar water heating systems, and 900 will put in solar space heating systems.

Energy Codes in the Southeast

The institutional structure of commercial projects often confounds those seeking to develop high-efficiency facilities. Typically, building developers, along with their designers and investors, are not connected financially with the organization that will actually pay the energy bills. Construction and development costs are usually the primary concerns, while energy costs are inherited by the building's eventual tenants or management organization.

Energy costs are usually dwarfed by the other expenses of operating buildings, with personnel costs comprising the bulk of expenditures. Consequently, energy expenditures are simply not the first concern of many property owners. With little obvious incentive to enhance the building's energy performance, most designers and builders are content to meet only the minimum restrictions imposed by the energy code. However, research conducted by the Rocky Mountain Institute and others show that employees in energy efficient and daylit buildings have higher rates of productivity and greater job satisfaction (9-6).

In some cases, the designer is quite diligent in evaluating and reporting on code compliance. In other projects, particularly when efficiency is not a high priority, only a cursory analysis of code compliance is performed. No

research has been performed in North Carolina to determine how well the commercial energy code is being implemented and enforced.

Commercial Energy Policies and Programs

The following policies and programs for the commercial sector are recommended by the Energy Policy Council for implementation in North Carolina. While they alone will not achieve the level of savings depicted in the high efficiency scenario above in Figure 25, they will provide a starting point for improving the efficiency of commercial buildings in the state.

9-1 The State Energy Office should work with appropriate state agencies to provide a design review service that focuses on energy-efficient components and holistic, high-performance, design strategies for new commercial buildings. The design review procedure should include a systematic life-cycle cost analysis of a variety of energy technologies and strategies for each project. The service should seek to upgrade new buildings to meet high performance building guidelines developed statewide.

9-2 The State Energy Office should promote and develop guidelines for performance contracts, conduct workshops, and provide technical assistance on developing performance contracting documents.

9-3 The State Energy Office should research current and proposed incentive programs in North Carolina and other states and develop a state commercial energy incentive program for consideration.

9-4 The State Energy Office should promote the use of and provide training for commercial building energy analysis software to assist building owners with evaluating the best energy efficiency measures to implement in existing state buildings and other commercial structures.

9-5 The State Energy Office should develop an energy audit program for existing commercial buildings to assist building managers with implementing the most energy efficient and cost effective improvements for commercial renovation projects.

Chapter 10: Energy Use in the Industrial Sector

North Carolina's industrial sector used 712 TBtus of energy in 2000, or about 32% of the total energy used in the state. Because the sector requires such a high percentage of total energy consumption (the highest in the state), developing policies that support industrial energy efficiency is crucial to meeting the goals of the State Energy Plan.

Figure 26 illustrates that industry has followed a relatively consistent pattern in its historical use of fuels. Over the past 40 years, electricity, wood and waste, petroleum, and natural gas have supplied fairly even percentages of total energy needs.

Figure 27 shows that, at present, petroleum is the major supplier of energy to the industrial sector. Petroleum, electricity and natural gas provide about 32%, 20%, and 18% of fuel needs, respectively, while coal, wood, and waste contribute a significant 30%. Note that wood and waste products alone provide 13% of industrial energy needs.

The major change in industrial fuel mix over the past 40 years has been a substantial drop in the amount of coal used in the sector balanced by a rise in the use of natural gas and electricity. With the upcoming arrival of new

Figure 27:
Industrial Energy Use by Fuel in 2000

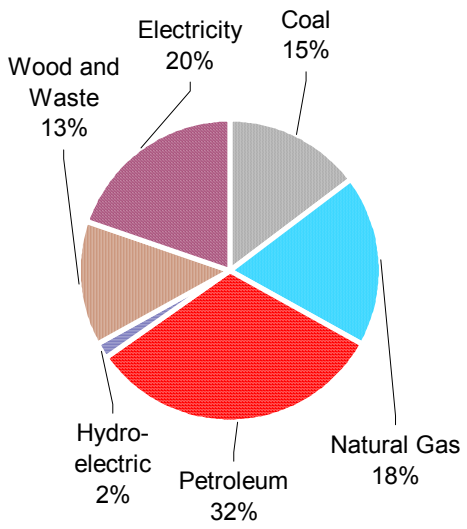
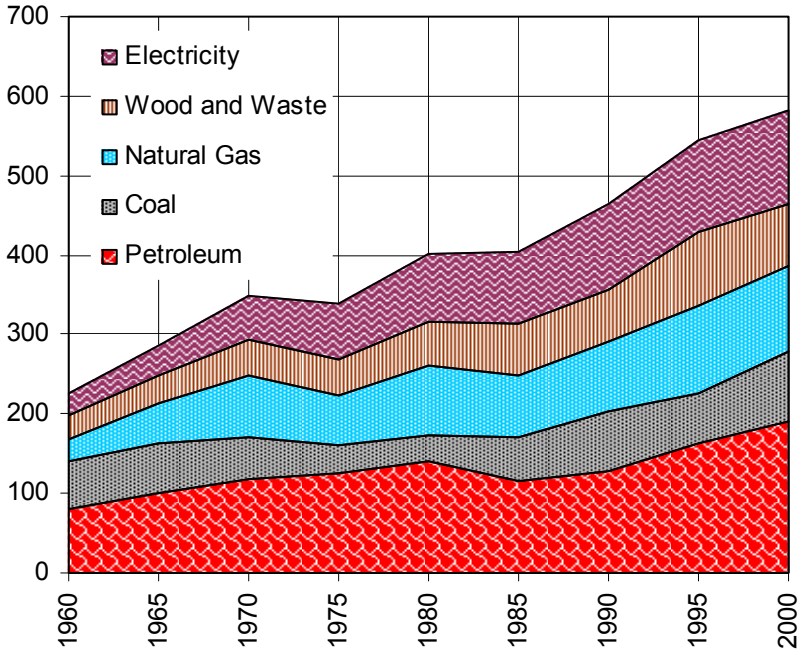


Figure 26:
Historical Fuel Use by North Carolina Industry (592 TBtu Net Energy)



Source: Energy Information Administration, U.S. Department of Energy

Table 19: Percent of Industrial Energy Use by End Use Category

	National	South Region
Other	1.34%	1.29%
Refrigeration	1.19%	1.18%
Lighting	1.19%	0.89%
Electricity	1.37%	1.85%
Electro-Chemical	1.69%	1.32%
Heating, Cooling, Ventilation	3.91%	2.53%
Machine Drive	9.57%	8.53%
Boiler Fuel	20.56%	21.92%
Process Heat	22.94%	23.65%
End Use Not Reported	36.23%	36.84%

Table 20: Estimated Energy Consumption by End Use – North Carolina, 1999

	End Use %	Energy Use (TBtu)
Lighting	1.3%	6.8
Refrigeration	1.3%	6.8
Other	0.9%	4.7
Electro-Chemical	1.8%	9.5
Electricity Generation	1.3%	6.8
Heating, Cooling, Ventilation	2.5%	13.1
Machine Drive	8.5%	44.7
Boiler Fuel	21.9%	115.0
Process Heat	23.7%	124.5
End Use Not Reported	36.8%	193.3

natural gas pipelines in North Carolina, the market share of natural gas should increase.

Historical Use of Energy by End Use

To accurately determine and evaluate energy efficiency measures in the industrial sector, it is important to know the specific end uses involved in industrial processes in the state. The U.S. Energy Information Administration (EIA) reports national and regional data on the end uses by fuel.

Table 19 summarizes EIA end-use data for both the nation as a whole and for the southern region, which includes the states from Texas eastward and Kentucky southward. Note that the end use percentages are quite similar for all categories. Unfortunately, the end use category with the highest percentage for the nation and region is "End Use Not Reported." Industries chose not to report certain data, citing that it might violate privacy concerns.

The two highest end uses reported were process heat and boiler fuel, with machine drive (mainly motors), and heating and cooling showing moderate use. Minor end uses included the use of electro-chemical processes, facility lighting, refrigeration and process cooling, and several other needs.

Based on the breakdown in Table 19, projected energy use by end use in North Carolina's industries is shown in Table 20. The 3 major end uses – machine drive, boiler fuel, and process heat – consume about 284 TBtu. This amounts to 54% of total industrial energy use and 17% of total consumption by all sectors.

Saving Energy in Industrial Facilities

Energy saving improvements for industry are typically grouped into 4 primary categories:

1. General energy-saving technologies: technologies which are applicable to all manufacturing sectors. Examples are high-efficiency lighting and computer control of air conditioning.
2. Industry-specific energy-saving technologies.
3. Energy management activities: examples include energy audits, load control, and full-time energy managers.
4. Other innovative approaches: changing processes or developing new approaches for industrial development, such as industrial ecosystems.

Some key considerations in developing policies and programs targeted at the industrial sector include:

- What energy saving technologies and management activities should be considered for implementation by manufacturing industries in North Carolina?
- To what extent have these energy saving measures already been adopted?
- What government policies and actions can be effective in encouraging efficiency improvements in the industrial sector?

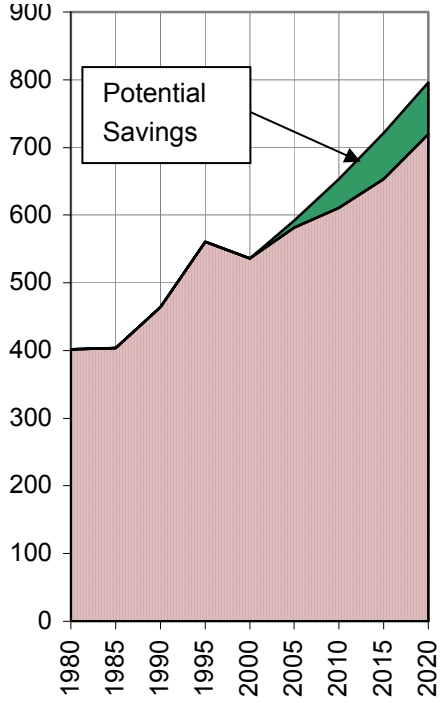
Projections of Savings from Industrial Energy Policies

A study conducted by national energy labs, including Oak Ridge National Lab, Lawrence Berkeley National Lab, and the National Renewable Energy Lab, concluded that nationwide energy savings of 7.4% in the industrial sector could be achieved by the year 2020 by implementing moderate energy saving programs (10-16). With a more aggressive approach, savings of 16.5% by year 2020 were deemed possible. These savings excluded the effects of increased CHP (combined heat and power, or co-generation). With moderate implementation of combined heat and power plants (CHP), the national labs' report estimated that national energy savings of 450 TBtus could be achieved by 2020. Under the aggressive program, an estimated 2,367 TBtus would be saved. Their "business as usual" scenario estimated 41,000 TBtus of energy used by the industrial sector in 2020. Thus, an additional 1.1% of energy could be saved in the moderate scenario and an additional 5.8% in the aggressive scenario with CHP implementation.

Figure 28 shows the potential impact of the policies recommended for the industrial sector of North Carolina. The scenario assumes:

- In existing industrial facilities, total savings of 8.5% on energy consumption are possible.
- In new facilities, savings averaging 12% can be achieved.
- The total savings projected in the year 2020 are about 10% below the Base Case projection.

Figure 28: Projected Savings from Policies in Industrial Sector (TBtu)



Industrial Efficiency Success Story: Compressed Air System

Company: Southeastern Container, Enka, NC

Summary: Based on an energy survey conducted by North Carolina's Industrial Extension Service, Southeastern Container made improvements to its compressed air system with two 800 horsepower compressors. The payback period and lifetime savings are quite positive.

Project Implementation Costs:	$80,000
Annual Energy Cost Savings	$180,000
Simple Payback:	0.44 yrs
Demand Savings:	189 kW
Annual Energy Savings:	7,400,000 kWh

Source: *Compressed Air System Modifications Improve Efficiency at a Plastics Blow Molding Plant*, U.S. Department of Energy, http://www.oit.doe.gov/bestpractices/factsheets/ southeasterncontainer.pdf

Industrial Energy Policies and Programs

The following policies and programs are recommended by the Energy Policy Council for the industrial sector. The measures with the prefix "Exec" are action items given high priority for 2003 to 2004. While they alone will not achieve the level of savings depicted in the high efficiency scenario above, they will provide a starting point for improving the efficiency of industrial facilities in the state.

- Industrial Energy Assessment and Efficiency Programs

10-1 The State Energy Office should increase funding for industrial efficiency programs to enable the Industrial Extension Service, Industrial Assessment Service, Advanced Energy Corporation's industrial efficiency programs, and other similar programs in the state to expand technical assistance and analysis efforts to reduce energy use by the industrial sector in North Carolina. Funding should also be provided for follow-up efforts to facilitate implementation of cost effective technologies, including making contacts with vendors to procure bids, assisting with performance contractors, developing sample specifications, and providing other technical assistance. The State Energy Office should investigate and analyze alternative incentives to increase the implementation of industrial efficiency and renewable energy measures, including low interest loans, performance contracts, and incentive payments. The outreach and technical assistance program should support ongoing efforts to reduce water usage in industrial and municipal operations.

10-2 The State Energy Office should fund an Industrial Demonstration and Testing Program aimed at developing more efficient products and processes for North Carolina's industries. In addition, the Energy Office should convene industrial energy experts and industrial facility operators to create energy efficient solutions to targeted industrial processes that consume substantial energy in the state. Finally, the Energy Office should continue and expand its involvement in the federal Industries for the Future program.

10-3 North Carolina should evaluate whether facilities that repair or rewind motors should be certified or otherwise meet a state efficiency requirement.

- Incentives and Financing

10-4 The State Energy Office should develop rules for and conduct training programs on Performance Contracting for energy-related projects in industrial facilities.

10-5 North Carolina should create investment tax credits and other incentives for new and/or retrofitted manufacturing equipment to encourage modernization and efficiency improvements.

10-6 North Carolina should create tax credits for meeting high performance standards, including NEMA premium motors.

10-7 The State Energy Office should create a statewide voluntary challenge for industrial energy efficiency improvements.

10-8 North Carolina should create policies and regulations for distributed generation in the state, including incentives for deployment of "clean" distributed generation.

- Industrial Energy Technology Training

10-9 The State Energy Office should sponsor workshops on industrial energy efficiency around the state directed at industrial facility operators, design and process engineers, and owners. The workshops will describe the state-of-the-art in efficient technologies and describe the results of ongoing research efforts. The training effort should also address water-conserving practices around the state.

- Economic and Industrial Development Practices

Exec-1 The North Carolina Department of Commerce and the State Energy Office should encourage and support economic development of energy-related enterprises whose products are intended to increase energy efficiency or use renewable resources, such as providers of specialized insulation and window products, heating and air conditioning equipment and controls, distributed generation equipment, solar and wind energy equipment, and fuel cells.

Exec-2 The State Energy Office should communicate the energy research being performed in the state to the North Carolina Department of Commerce for its recruiting and economic development strategy.

10-10 The Department of Commerce should develop an industrial recruitment strategy to target appropriate industries to fit in resource efficient industrial developments (sometimes called industrial ecosystems).

10-11 In its recruitment efforts, the North Carolina Department of Commerce should give preference to industries that contribute to a more beneficial load curve and have minimal impact on the environment.

Chapter 11: Energy Use in the Transportation Sector

North Carolina's transportation sector, specifically, the movement of people (personal transportation) and goods and services (freight transportation) are included in this chapter. The transportation sector consumed 27% of total energy used in the state in 2000. Furthermore, the transportation sector represented one-third of total energy-related CO_2 emissions in 2000. The initiatives proposed for the transportation sector go beyond regulation-heavy policies and instead encourage individuals to take advantage of opportunities and incentives that reduce energy consumed by their vehicles.

Growth in energy consumption for the transportation sector has been outpacing overall energy consumption in the state. North Carolina must focus on increasing energy efficiency in the transportation sector to have any success in reducing total energy use in the state. Historically, there has been negligible economic incentive for individuals, businesses, and governmental entities to reduce transportation energy use. Typically, managers in buildings and industry can see a direct link between an investment in a more efficient device or practice and the resulting savings on energy bills. However, purchasers of vehicles are not used to comparing energy costs of different products. Also, vehicles differ in so many ways that energy efficiency is often an insignificant concern during the sales process. Costs such as a car's purchase price, registration fees, and insurance are immediately recognizable to consumers, but there are many hidden and intangible costs that are not factored into a purchase. These costs include decreased air quality, noise, inefficient land use due to the substantial requirements for road infrastructure, and losses in productivity associated with traffic congestion.

VMT Reduction Strategies

One of the primary reasons for increasing use of transportation fuels in North Carolina has been the rapid growth in vehicle miles traveled (VMT), or the total number of miles driven in the state each year. VMT have grown 3.9% per year in North Carolina over the past 21 years. VMT per capita have increased 2.2% annually, from 7,014 annual miles per capita in 1980 to about 10,933 annual miles per capita in 2000. (11-7)

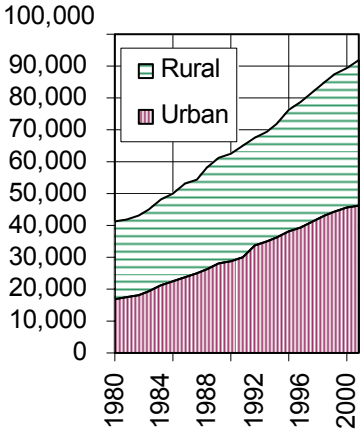
If more North Carolinians would ride a bus to work, walk to lunch, or eat lunch at their place of employment, shop at stores near their home or business, or otherwise strive to reduce the amount of time spent in their automobiles, transportation energy use could decrease significantly. Other benefits to the state and its citizens would include fewer vehicular accidents,

Transportation Energy Trends

- Motor gasoline still provides the bulk of transportation energy, although its percentage of the total has declined recently.
- Motor gasoline provided 78.3% of transportation energy use in 1960, reached a maximum share of 81.6% in 1976, but dropped to 61.8% in 2000.
- Diesel fuel increased its market share from 8% in 1960 to about 18.5% today.
- Jet fuel generally represents 5% of transportation energy use.
- Natural gas reached a market share of 1.6% in 1999, but held only 0.91% in 2000.
- In 2000, ethanol provided 3.3 TBtu, about 0.41% of total sector energy use.
- In 2000, North Carolina had 3.75 million registered automobiles.

Source: U.S. Energy Information Administration. http://www.eia.doe.gov/emeu/states/sep_use/tra/use_tra_nc.html.

Figure 29: North Carolina Vehicle Miles Traveled (million miles)



Source: *Highway Statistics, 2001.* U.S.Department of Transportation. 2002.

Principles of Smart Growth NC

- Regional solutions to transportation problems
- Increasing local flexibility to address growth issues
- Making efficient use of public resources

less traffic congestion, fewer delays for road maintenance due to reduced driving loads, more productive time, less time spent at service stations purchasing fuel, more exercise, and so on. Many other countries follow this more transportation-efficient lifestyle and maintain very high standards of living.

Mass Transit Use

Many North Carolina residents have the option to use some form of mass transit to meet at least a portion of their daily transportation needs. The state has several passenger rail lines for intercity travel and bus lines for either intercity or intracity travel. According to North Carolina's long-range transit plan, Transit 2001, the state's local transit system carried almost 40 million riders traveling over 438 million miles with over 1,900 buses and vans.

While mass transit has been moderately successful in the state, most citizens continue to rely on their private vehicles for their daily commutes, errands, and other transportation needs. Considering that the total urban VMT in North Carolina climbed to almost 95 billion miles in 2000, the 2.2 billion passenger-miles served by transit provided only 4% of the total miles traveled by North Carolinians.

Smart Growth and Energy Efficient Community Design

The design of most of North Carolina's towns and cities fails to encourage transportation efficiency via shorter shopping trips, increased pedestrian-friendly developments, and augmented mass transit use. This is due in large part to the trend in urbanization after World War II that favored the consumption of land for residential uses on the periphery of urban areas. Land-intensive suburban development increased the distances between homes, shopping facilities, schools, and places of employment. Longer distances made public transit, walking, and biking less desirable. In fact, more and more suburban shopping and office park areas do not have sidewalks or efficiently incorporated transportation planning in their design other than parking lots. Consequently, most citizens drive several miles to work or to centralized shopping centers with expansive parking areas.

"Smart Growth" is a trend in urban planning that seeks to continue community economic development while at the same time preserving and enhancing individuals' quality of life. Smart Growth projects attempt to design residential, business, retail, and education facilities in closer proximity to each other in order to reduce the need for lengthy automotive travel. In addition to lowering transportation requirements, these projects seek to enhance the feeling of community, provide stable economic futures for local businesses, and reduce crime rates.

Vehicle and System Efficiency

Vehicle Efficiency

While driving more miles each year, North Carolinians are doing so with increased efficiency, either through improved driving habits or the use of energy-efficient vehicles. Figure 30 shows that overall vehicle miles traveled per gallon of motor fuel used in the state has improved 33% since 1980, about a 1.4% improvement each year. In the past decade, the VMT per gallon improved only 6.5%, or 0.6% per year. In 2000, the overall VMT per gallon was 17.3 miles per gallon (11-5, 11-7).

The future bodes well for further improvements in vehicle efficiency. Options include hybrid vehicles as well as a multitude of improvements to conventionally fueled vehicles.

Mandating improved vehicular efficiency for automobile dealers or vehicle owners in North Carolina is not realistic. However, the state can mandate increased efficiency of state vehicles and increased purchase of vehicles that use alternative fuels, as is now required. To have an impact on the millions of vehicles purchased each year in North Carolina, a comprehensive educational and incentive program will be necessary.

Figure 31 shows the energy savings when purchasing a more efficient vehicle. The graph assumes that the owner drives the car 150,000 miles. The energy savings can be substantial. For example, a vehicle that consumes 50 miles per gallon (MPG) instead of 20 MPG (the middle line on the chart) will save $8,000 over the 150,000 miles of driving if the average price for gasoline is $1.80 per gallon. Note that the largest savings (the top line on the chart) occurs when choosing a 20 MPG vehicle instead of a 12 MPG vehicle.

System Efficiency

Transportation system efficiency attempts to provide free-flowing traffic networks, which will reduce gasoline consumption and air pollutant emissions. Steady, moderate-speed flows of traffic that are neither accelerating nor decelerating result in the highest fuel efficiency. Efficiency can be thought of from two perspectives: managing the demand for travel and managing the supply of transportation infrastructure. The demand for travel can often be addressed through Smart Growth development principles, as discussed on the previous page. The supply of transportation infrastructure (adequate roads, properly scheduled traffic lights) then serves to support traffic in such a manner that reduces the amount of time automobiles are in operation.

Figure 30:
Average Vehicle Miles Traveled per Gallon of Motor Fuel in North Carolina

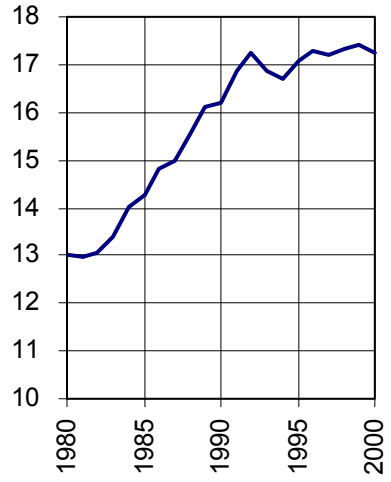
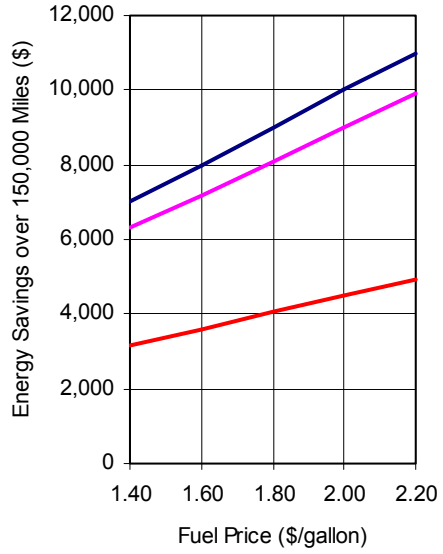


Figure 31:
Energy Savings of Vehicle Efficiency Improvements ($)



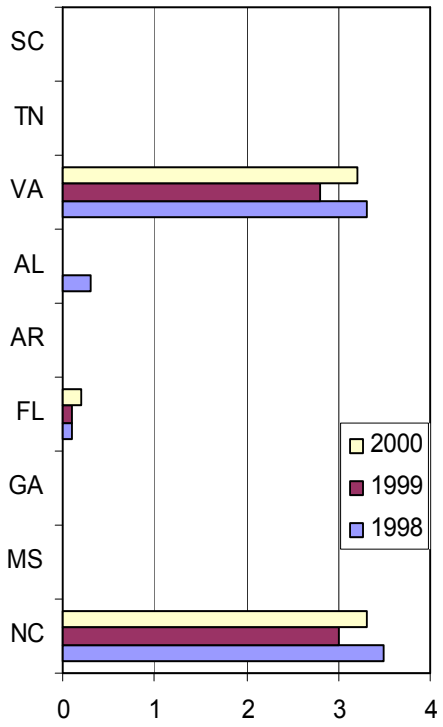
Key

Top line:
20 MPG over 12 MPG

Middle line:
50 MPG over 20 MPG

Bottom line:
40 MPG over 25 MPG

Figure 32:
Ethanol Consumption by Southeastern States (TBtu)



Source: U.S. Energy Information Administration. http://www.eia.doe.gov/emeu/states/sep_use/tra/use_tra_nc.html.

Alternative-fueled Vehicles

Alternative-fueled vehicles (AFVs) use fuels such as natural gas, propane, electricity, or ethanol. North Carolina had 12,787 alternative-fueled vehicles in use by 2002 (11-1). Alternative fuels derived from agricultural biomass sources are the most commonly used fuels today. Because the fuel sources can come from the domestic agriculture industry, they have compelling advantages in terms of national security and national and state economies. Alternative fuels most commonly used for transportation include:

- Biodiesel – B100 contains no petroleum and is produced from domestic sources such as soybean oil, vegetable oil, and recycled grease; B20 (20% biodiesel, 80% diesel) is the most commonly used version of this particular alternative fuel.
- Liquefied Petroleum Gas (LPG) – composed of 95% propane and 5% butane;
- Natural Gas – produced in liquid and compressed form. Natural gas fuel generates lower carbon monoxide and volatile organic compounds emissions than any other alternative fuel except electricity; and
- Ethanol – grain alcohol made from corn, sorghum, wheat, barley, sugarcane, and other biomass. Common ethanol blends are E-10 (10% ethanol, 90% gasoline) and E-85 (15% ethanol, 85% gasoline).
- Electric-powered and Hybrid (gas/electric) vehicles – use electric power directly. Electric vehicles utilize rechargeable battery packs as fuel. Hybrid vehicles combine electric power with fuel power for optimal efficiency.

Fuel Cells for Transportation

Fuel cells were discussed briefly in the Chapter 6: Alternative Energy Sources. The U.S. Department of Energy projects that if 10% of automobiles nationwide were powered by fuel cells using non-polluting energy sources, regulated air pollutants would drop one million tons per year, and 60 million tons of carbon dioxide emissions would be eliminated. DOE projects that the same number of fuel cell cars would cut oil imports by 800,000 barrels a day – about 13% of total imports. Fuel cells running on hydrogen derived from a renewable source will emit nothing but water vapor. Allied Business Intelligence (ABI) projects that fuel cell power will reach hundreds of thousands of vehicles by 2010 (11-6).

Proposed Legislation: HB 806 (2003-2005 Session)

HB806 proposes incentives for the public to purchase alternative-fueled vehicles and cost-sharing grants for fueling facility infrastructure. The bill calls for rebates, grants, and educational efforts to help increase the market penetration of alternative-fueled vehicles and infrastructure throughout the state.

Transportation Energy Policies and Programs

The overall goals of the State Energy Plan's transportation policies are to increase the use of efficient vehicles and alternative fuels. The state's fleets can have higher efficiency and increased use of alternative fuels. Incentives may move employees and their employers to favor use of mass transit, as well as more efficient fleet vehicles. Incentives and publicity programs that are practical and affordable can encourage consumers to select vehicles that provide higher miles per gallon.

It should be a priority of the State Energy Office to work in concert with North Carolina Department of Transportation to insure that policies and programs pertaining to alternate fuel use, mass transit, and transportation planning are implemented as soon as possible. Additionally, the State Energy Office should take the lead as a catalyst for bringing together the variety of plans and policies already drafted by numerous agencies and entities in the state of North Carolina.

11-1 The State Energy Office, Department of Revenue, and North Carolina Department of Transportation should assess and propose financial incentives for public and private employees who regularly ride mass transit systems and/or for their employers.

11-2 State agencies should convert at least 10% of their entire fleet to high efficiency (over 40 miles per gallon) or alternative-fueled vehicles by 2005 and 20% by 2010.

11-3 The North Carolina Department of Transportation should provide fueling capability for compressed natural gas, ethanol, biodiesel, and other alternative fuels at all state fueling stations by 2005.

11-4 North Carolina should implement light rail systems to serve transportation needs and direct development along higher population and employment corridors.

11-5 The State Energy Office should develop a statewide voluntary transportation efficiency program that rewards companies who qualify through a publicity and promotion program. The program

Allied Business Intelligence projects the national impacts of switching to fuel cells:

- If just 20% of cars used fuel cells, oil imports would be reduced by 1.5 million barrels every day.
- If every new vehicle sold in the U.S. next year was equipped with a 60-kW fuel cell, it would double the amount of available electricity.
- 10,000 fuel cell vehicles running on non-petroleum fuel would reduce oil consumption by about 7 million gallons per year.
- Allied Business Intelligence estimates that, by 2010, automotive fuel cells will have a nearly 4% market share — a total of 800,000 vehicles.
- Market penetration in 2010 could rise as high as 1.2 million vehicles, representing 7.6% of the total U.S. new car market.

Source: *Fuel Cell Vehicles to Number 800,000 by 2012. Allied Business Intelligence, 2003.*

would have the goals of increasing mass transit use and pedestrianism, increasing efficiency of commuter vehicles, increasing efficiency of company fleets, increasing use of alternative-fueled vehicles by company fleets, and allowing smaller parking facilities for those who demonstrate success.

11-6 The State Energy Office should provide technical assistance for local authorities to increase ridership on local transit systems.

11-7 The State Energy Office and the North Carolina Department of Transportation should become involved in ongoing statewide efforts to develop Smart Growth community design and redesign programs that increase pedestrianism, reduce personal vehicle miles traveled, and increase mass transit use. Smart Growth and Smart Roads programs also provide other benefits such as reduced urban and suburban congestion, lower commuting times, decreased air emissions, and increased productivity.

11-8 The State Energy Office should develop information resources on Smart Growth and energy efficiency that emphasizes the many advantages of the Smart Growth concept. The goal is to require developers, planners, and designers to consider energy use when evaluating future development projects. The information resources should also describe the concept of Smart Roads that seeks to relieve congestion by promoting the safe flow of traffic at increased average speeds.

11-9 The State Energy Office should conduct a statewide consumer campaign designed to encourage the purchase of more efficient vehicles or alternative-fueled vehicles, improve maintenance to increase vehicle efficiency, increase pedestrianism, and reduce vehicle miles traveled. The program should be coordinated with the state's automotive retailers' associations.

11-10 The North Carolina Department of Administration should work with the Department of Transportation to develop a coordinated set of strategies intended to reduce vehicle miles traveled (VMT) and increase the operating efficiency of vehicles within state government. The agencies should set specific target goals for VMT reductions.

Chapter 12: Energy Education and Research

Historically, North Carolina has been committed to offering the highest level of educational opportunity to its citizens. Devoting approximately 40% of total state spending to its system of public schools, community colleges/technical institutes, and 16-campus university system, North Carolina is clearly committed to improving the quality of life for its citizens and advancing knowledge through its educational system. Improving knowledge about energy and how it is used is an important part of this educational picture.

North Carolina devotes approximately 40% of total state spending to its system of public schools, community colleges/ technical institutes, and 16-campus university system (12-2).

K-12 Education

In May 2001, the North Carolina Solar Center released a report for the State Energy Office outlining a strategy for systematically incorporating renewable energy education into the state's primary school system (12-3). Developed by a focus group of ten key stakeholders in energy education, the plan proposed 5 strategies:

- Installation and demonstration of renewable energy technologies;
- Training workshops for fifth grade teachers;
- Solar modular classroom demonstrations;
- Environmental education center partnerships; and
- An annual statewide event.

In May 2001, the North Carolina Solar Center released a report for the State Energy Office outlining a systematic strategy for incorporating renewable energy education in the state's primary school system.

Goals of the energy education plan focus on conservation, information, demonstration, partnership, and action. The State Energy Office would use organizations having experience in energy education to assist in developing and implementing educational programs in schools across the state.

The Energy Policy Council strongly recommends that students should be exposed to working energy technologies in their school buildings. Daylit rooms, state-of-the-art heating and cooling systems, solar water and space heating devices, renewable electricity systems, and a variety of innovative energy efficient construction products are examples of the technologies that are important to install in school buildings throughout the state.

Research program areas recommended for North Carolina:

- Economic analysis of energy and environmental policies
- Renewable energy and energy efficiency improvements
- Industrial process energy efficiency
- Job creation and retention in the energy area
- Building systems, such as roof systems that integrate power production, moisture control, thermal energy collection, and insulation
- Advanced fuel cells, fuel cells that use propane for rural areas
- Land planning and energy use
- Energy efficient manufactured housing
- Improving energy decision-making in the marketplace
- Energy education in schools—awareness and training in industry schools, etc.
- Biogas
- Distributed generation and grid interconnection studies
- Embodied energy analysis
- Agricultural wastes
- Coastal and mountain wind power
- Daylighting and high performance designs for buildings
- Tidal and wave energy
- Clean coal technologies

Research, Demonstration, Renewable Energy Promotion

The sidebar lists some of the research areas that the Energy Policy Council has targeted as having the highest priority. At present, the State Energy Office and other organizations in North Carolina have provided funding for several of the research projects listed. The state should seek to expand and improve on existing research efforts in order for North Carolina to be established as a leader in energy research nationwide.

One limitation to securing larger research grants and contracts from national research organizations, such as the U.S. Department of Energy, the National Science Foundation, and the U.S. Environmental Protection Agency, is the lack of matching funds to support the cost share that is often required. If the state could form a cost-share pool with guidelines on its use, universities and other research institutions could generate considerable additional research activity. The research efforts would help the state in numerous ways, ranging from economic development to long-term environmental benefits accruing from development of new energy technologies.

Energy Education and Research Policies and Programs

The Energy Policy Council recommends the following programs and policies regarding energy education and research for implementation in North Carolina:

12-1 The State Energy Office should develop and sponsor training programs for community colleges and universities in fields related to energy efficiency and high performance buildings.

12-2 The State Energy Office should assist in the coordination of energy education programs with museums and help create an energy museum "on wheels" using existing resources, such as the Science House at NCSU or the Museum of Life Science, wherever possible.

12-3 The State Energy Office should sponsor regional "renewable demonstration centers" or, whenever possible, use existing ones (e.g. demonstration centers such as the North Carolina Solar House and the EnergyXchange, museums such as the Museum of Life and Science, and science centers such as Discovery Place).

12-4 The State Energy Office should create energy internships or apprenticeships for graduating college students and high school students to create the next generation of energy professionals.

12-5 The State Energy Office should provide a statewide award (e.g., a college scholarship) for the most outstanding energy-related science demonstration/experiment at the state science fair.

12-6 The State Energy Office and the UNC System should help the Education Departments of colleges and universities develop coursework for junior and senior undergraduates and graduate students in energy education.

12-7 The State Energy Office and the state's colleges and universities should help Community Colleges and other vocational schools develop coursework in energy efficiency and renewable energy to help spur the industry; such as training carpentry students in energy efficient, passive solar building design and construction. Include this training in voc-tech courses in high schools.

12-8 The State Energy Office should provide training to licensed professionals in the homebuilding industry focusing on energy efficiency and renewable energy sources to promote industry awareness and implementation of these technologies.

12-9 The State Energy Office should support development of a comprehensive information outreach program for consumer questions about saving energy and using renewables in their homes and businesses; information hotline via a toll-free telephone number; informative Web Page containing a wide array of publications available on-line; resources that include up-to-date information on renewables and energy efficient buildings, industrial facilities, and vehicles, as well as data on energy sources in the state; information on energy-producing facilities; environmental information related to energy consumption; and other energy-related information.

12-10 North Carolina should encourage schools to reduce school operating budgets by installing energy efficiency and renewable energy systems.

12-11 The State Department of Public Instruction should consider reinstituting its energy budget program, which provided guidelines for energy use per square foot by type of school.

12-12 The State Energy Office should work in partnership with the State Department of Public Instruction to plan school energy-related initiatives and include a representative for energy-use in school facilities on the Energy Policy Council.

12-13 North Carolina should require that K-12 students learn about energy. Energy issues should be incorporated into the end-of-grade tests.

12-14 The State Energy Office should sponsor a program to install solar equipment or other sustainable energy technologies on school buildings in every school district in the state.

12-15 The North Carolina Community College System should require that the community colleges' curricula provide a building science course, an energy design course for drafting programs, and a solar/renewable energy technology class.

12-16 The State Energy Office should establish a central repository for energy information. This energy data and policy analysis center should develop baseline information on energy consumption by state and local governmental entities. The center should also provide policy analysis for existing and proposed state energy policies.

12-17 The State Energy Office should conduct a comprehensive analysis of the existing Renewable Energy Tax Credits and determine if these credits should be expanded to include efficiency measures.

12-18 The North Carolina Energy Policy Council should update the State Energy Plan every five years and conduct a review of implementation of the plan on an annual basis.

12-19 State government departments and public universities should report their energy consumption and expenditures by fuel type on an annual basis to the State Energy Office.

12-20 Every two years, the State Energy Office should complete an assessment of energy use in public buildings to determine whether efficiency programs are having a significant impact on energy consumption.

12-21 Working in conjunction with the State Construction Office, the State Energy Office should monitor, analyze, and report on the energy savings attributed to the new requirements on life-cycle cost analyses of the $3.1 billion higher education building program currently underway across the state, as well as future projects. The State Energy Office should be responsible for maintaining records that track the consequences of subjecting new public facilities to the newer life-cycle cost procedure.

12-22 The State Energy Office should take the lead in conducting a statewide inventory of each public facility owned or leased by county and municipal government including K-12 schools and community colleges.

Chapter 13: Funding for Energy Policies and Programs

The Need For Energy Program Funding in North Carolina

North Carolina's State Energy Office is at a critical juncture. Currently, the State Energy Office allocates approximately $13.4 million in supporting educational programs and research/demonstration projects focused on energy efficiency and renewable energy technologies and applications (13-10). While the office receives financial support from the U.S. Department of Energy for its key staff members and a small number of its projects, it has relied on Petroleum Violation Escrow (PVE) funds to pay for a variety of technical assistance, research, training, education, and development projects valued across the state. It has been these funds that are responsible for helping to reduce the demand for energy, cut pollution, increase jobs, and further technologies and knowledge essential for a sustainable energy future. Unfortunately, the Petroleum Violation Escrow funds will be depleted in the next few years.

Examples of the types of programs that the State Energy Office supports are as follows:

- Affordable, energy efficient homes – Weatherization; affordable new home program; manufactured home programs;
- Building efficiency – energy code and high performance building training and development; market transformation programs, including green building, Energy Star, Building America, and Rebuild America; building research projects;
- Industrial efficiency – Industrial Extension Service; Industrial Assessment Service; Industries for the Future; training and research programs;
- Public sector – policy development related to buildings and motor fleets; building analysis and program development; utility bill analysis; training and education;
- Renewables – evaluation and research; training and education; demonstration projects; waste recovery projects including landfill gas recovery and animal waste-to-fuel systems; and
- Transportation – alternative-fueled vehicles; vehicle-related programs; infrastructure development for alternative fuels.

Table 21:
North Carolina
Weatherization Program Funding

Year	2000	2001	2002	2003
Department of Energy	2.82	2.80	4.21	5.44
LIEBG* Weatheri-zation	2.99	2.68	2.68	3.46
HARRP	with WAP	with WAP	1.25	1.61
Petroleum Violation Escrow	2.60	1.30	1.00	n/a
Total	**8.41**	**6.78**	**9.15**	**10.51**
% Annual Increase from 2000	-	-19%	4.3%	7.7%

* LIEBG – Low-Income Energy Block Grant

For low-income programs, the state has relied upon the federal Weatherization Assistance Program (WAP), which assists low-income homeowners in installing energy efficiency improvements in their homes, and the Low Income Home Energy Assistance Program (LIHEAP), which helps low income citizens in meeting their utility expenses.

North Carolina currently receives $19.9 million from the Federal Low Income Energy Block Grant. In 2001, the majority of the fund was allocated as follows in millions of dollars (13-10):

- Low Income Home Energy Assistance Program $8.1
- Crisis Intervention $5.8
- Weatherization Assistance Program $2.0
- Heating Air Repair or Replacement Program (HARRP) $1.3
- Administration $2.0

As shown in Table 21, the state's Weatherization program will grow 25% (7.7% annually) between 2000 and 2003 not counting any contribution from Petroleum Violation Escrow (PVE) funds (13-10). U.S. Department of Energy support will expand 93% (25% annually), while Low Income Energy Block Grant funding for weatherization and HARRP will grow 70% (19% per year). As Petroleum Violation Escrow funds dwindle over the next 2 to 4 years, the contribution from this source of funding is uncertain; thereafter, it will no longer be available.

Chapter 12: Energy Education and Research discussed an additional need – to provide matching funds for federally-funded energy research and demonstration programs. Typically, federal energy grant programs require a 25% to 50% matching contribution from non-federal sources in order to receive federal support. North Carolina's lack of available funding for grant matching often limits the ability of research organizations in the state to pursue energy research and demonstration projects.

Public Benefits Fund

The Energy Policy Council has discussed many options for continuing to support important existing energy programs, as well as establishing sources of funding for new programs. The financial mechanism debated most often by the Energy Policy Council has been a public benefits fund (PBF).

A PBF is a mechanism to help fund statewide programs targeted at energy efficiency, renewable energy, low-income assistance, and research and development. PBFs are usually implemented as part of a state's overall restructuring of its electricity market. Twenty-two states and the District of

Columbia have enacted PBFs over the past 6 years (13-12). To date, North Carolina has not implemented a PBF .

Typically, public benefit programs are funded by a fee paid by utility ratepayers, termed a system benefits charge (SBC) or wires charge. Four states use other mechanisms for supporting some portion of their PBFs. The highest reported SBC charge is in Connecticut at 4.0 mills/kWh while the lowest is 0.3 mills/kWh in Delaware and New Mexico. In the 21 states that have determined their rates, the overall average is 1.57 mills/kWh, and the average weighted by total kilowatt-hours covered by the PBF in each state is 0.93 mills/kWh. These surcharges generate a significant amount of money ranging from over $525 million in California (3.0 mills) to a low of $2.6 million in Delaware. (13-12)

In North Carolina, using 2001 as a baseline with statewide electricity consumption of approximately 115 million MWh, a 1.0 mill wires charge would generate in the neighborhood of $115 million. If the state used the national average of 1.57 mills, the PBF would generate $181 million. It is important to recognize that these figures are annual amounts and will grow as electricity usage increases.

Many of the programs provided by a PBF are similar to those in a utility demand side management program. However, utility demand side management programs in North Carolina have declined in recent years, as described in Chapter 3: Electric Utilities and Energy Use.

Throughout 2001 and into spring 2002, the North Carolina Utilities Commission investigated the desirability of a *voluntary* PBF upon request of the Study Commission on the Future of Electric Service in North Carolina. The voluntary aspect meant that utility customers could elect to pay extra on their power bills to support such a fund, which would provide funding for programs seeking to improve energy efficiency, assist low-income households, and develop renewables. The structure of the voluntary fund would be totally different from a wires charge, which assesses an additional fee per kWh on electric utility bills, and is the approach that the EPC debated. While the Utilities Commission recommended that the study commission not adopt a voluntary PBF check-off program at that time, its report left open the issue of a mandatory PBF funded through a wires charge.

The concerns expressed by opponents of a PBF are that it would duplicate existing voluntary programs already offered by the Investor Owned Utilities for low-income assistance and energy research now conducted through Advanced Energy Corporation, it would amount to a tax on energy consumption, it would fall disproportionately on large industrial consumers, and its administration would be problematic.

Table 22: Public Benefits Funds by State, May 2002

State	Year Enacted	Mills/ kWh	Million $/year
Arizona	1996	0.94	28.0
California	1996	3.0	525+
Connecticut	1998	4.0	117.7
Delaware	1999	0.3	2.6
District of Columbia	2000	0.8	8.0
Illinois	1997	0.7	83.0
Maine	1997	2.3	22.7
Maryland	1999	0.6+	34.0+
Massachu-setts	1997	3.2	160.0
Michigan	2000	0.5	50.0
Montana	1997	1.1	14.0
Nevada	1997	TBD	TBD
New Hampshire	1996	2.0	17.3
New Jersey	1999	1.96	129+
New Mexico	1999	0.3	5.0+
New York	1996	1.5	150.0
Ohio	1999	0.8	115.0
Oregon	1999	1.9	60.0
Pennsylvania	1996	0.8	98.0
Rhode Island	1998	2.6	16.5
Texas	1999	1.0	237.0
Vermont	TBD	TBD	TBD
Wisconsin	1999	2.2	111.2

Source: ACEEE, Summary Table of Public Benefit Funds and Electric Utility Restructuring, May 2002. www.aceee.org

Therefore, in the development of an appropriate funding mechanism for North Carolina which addresses the generally recognized goals of supporting energy efficiency programs, developing a more robust renewable energy industry, helping low-income families pay their utility bills, and supporting research and development, it is imperative that such a mechanism be targeted to non-duplicative programs, with provision for relief of undue financial burdens, and with a simple and transparent administrative structure.

Public Benefit Funds in Other States

The most thorough evaluation of the impact of Public Benefit Programs was conducted by the American Council for an Energy Efficiency Economy (ACEEE), which reviewed all the programs in existence as of November 2001. The study found,

> "Of course, this broad picture of success with public benefit funds does not mean that there haven't been some lessons learned from negative experiences as well. One of the major lessons in that respect has been the importance of writing clear legislative language regarding the funding and operation of public benefits programs. More than one state has experienced significant delays due to arguments over the meaning of ambiguous wording in their legislation. Similarly, there have been times where policy conflicts between different branches or agencies of government have held up public benefit program implementation.
>
> On balance, however, the experience to date with the public benefit funds has been quite positive. Most importantly, they have proven to be a very effective strategy for sustaining energy efficiency improvements in restructured electricity markets. While it is still early in the process and further monitoring and evaluations are necessary, the results thus far indicate that the creation and use of a public benefit funding mechanism can be an effective policy approach." (13-12)

Funding Energy Policies and Programs

The Energy Policy Council recommends the following policy regarding funding of energy programs in North Carolina. It was recommended as a high priority measure for action by 2004 in the Executive Summary,

Exec-15 The General Assembly should review options, such as a Public Benefits Fund or other means, to enable funding of the basic services provided by the State Energy Office and the recommendations in the State Energy Plan.

References

Chapter 1: Introduction

1-1 U.S. Energy Information Administration. "Report on Petroleum Imports." www.eia.doe.gov. U.S. Department of Energy. 2003.

1-2 Ballentine, Dr. Clay. "Air Pollution and Health." Presentation at the 4th Governors' Summit on Air Quality: A Regional Responsibility. Charlotte, NC. May 10, 2002.

1-3 U.S. Energy Information Administration. *State Energy Data Report 2000*. www.eia.doe.gov. U.S. Department of Energy. 2003.

1-4 Prindle, Bill. Presentation to North Carolina Energy Policy Working Group. The Alliance to Save Energy. March, 2002.

1-5 Bishop, Frank M. and Donald E. Milsten, Ph.D. *North Carolina Energy Emergency Plan* (draft). National Association of State Energy Officials. North Carolina State Energy Office. 2003.

Chapter 2: Energy, Economics and the Environment

2-1 *U.S. Statistical Abstracts*. U.S. Government Printing Office. 2002.

2-2 U.S. Energy Information Administration. *State Energy Data Report 2000*. www.eia.doe.gov. U.S. Department of Energy. 2003.

2-3 U.S. Public Interest Research Group. *Danger in the Air, Unhealthy Smog Days in 2000*. January, 2001.

2-4 U.S. Public Interest Research Group. *Danger in the Air, The 2001 Ozone Season Summary*. August, 2002.

2-5 Abt Associates. *Out of Breath, Health Effects from Ozone in the Eastern United States*. October, 1999.

2-6 Nicholson, Brock M., P.E. "Air Quality and Energy: Relationship and Recommendations". Presentation to Energy Policy Working Group. January, 2002.

2-7 U.S. Environmental Protection Agency. "Air Pollution Effects." http://www.epa.gov/ebtpages/airairpollutioneffects.html.

2-8 North Carolina Division of Air Quality. www.daq.state.nc.us. North Carolina Department of Environment and Natural Resources.

2-9 Buescher, Paul and Kathleen Jones-Vessey. *Childhood Asthma in North Carolina*. State Center for Health Statistics. North Carolina Public Health. Raleigh, NC. March, 1999.

Chapter 3: Fossil and Nuclear Fuels in North Carolina

3-1 U.S. Energy Information Administration. *State Energy Data Report 2000*. www.eia.doe.gov. U.S. Department of Energy. 2003.

3-2 Public Staff, North Carolina Utilities Commission. *Report to the North Carolina Utilities Commission on Investigation of Electric Generation Infrastructure*. Docket No. E-100, Sub 92. July 2002.

3-3 National Energy Technology Lab. "The Clean Coal Technology Compendium." http://www.lanl.gov/projects/cctc/. U.S. Department of Energy.

3-4 U.S. Energy Information Administration. *Annual Coal Report, 2001*. U.S. Department of Eneryg. www.eia.doe.gov/cneaf/coal/page/acr/acr_sum.html. April, 2003.

3-5 U.S. Energy Information Administration. *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2001*. U.S. Department of Energy. http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/ crude_oil_natural_gas_reserves/cr.html. March, 2003.

3-6 Public Staff, North Carolina Utilities Commission. *Status and Expansion of Natural Gas Service Within the State*. www.ncuc.commerce.state.nc.us/reports/report.htm#Public%20Staff. May, 2002.

Chapter 4: Electric Utilities and Energy Use

4-1 U.S. Energy Information Administration. *State Energy Data Report 2000*. www.eia.doe.gov. U.S. Department of Energy. 2003.

4-2 U.S. Energy Information Administration. *Electricity Prices in a Competitive Environment: Marginal Cost Pricing of Generation Services and Financial Status of Electric Utilities*. August, 1999.

4-3 American Council for an Energy Efficient Economy. "State Scorecard on Utility Energy Efficiency Programs." April, 2000.

4-4 North Carolina Utilities Commission. *Long Range Needs for Expansion of Electric Generation Facilities for Service in North Carolina*. July, 2002.

4-5 North Carolina Utilities Commission. *Comments of the North Carolina Utilities Commission on the Standard Market Design and the Structure Working Paper*. Docket No. RM01-121-000. April, 2002.

4-6 North Carolina Utilities Commission. *Annual Report of the North Carolina Utilities Commission*. July, 2002.

4-7 Integrated Resource Plans for Progress Energy Carolinas and Duke Power Company.

Chapter 5: Alternative Fuels from Biomass

5-1 U.S. Energy Information Administration. *State Energy Data Report 2000*. www.eia.doe.gov. U.S. Department of Energy. 2003.

5-2 Iowa Department of Natural Resources. "2002 Renewable Energy Resource Guide." www.state.ia.us/dnr/energy/pubs/irerg/index.htm.

5-3 Iowa Department of Natural Resources. "Ethanol." www.state.ia.us/dnr/energy/programs/ethanol.

5-4 Energy Efficiency and Renewable Energy. *North Carolina Bioenergy Resources*. U.S. Department of Energy. www.eere.energy.gov/state_energy/tech_biomass.cfm?state=NC.

5-5 North Carolina Solar Energy Center. *Database of State Incentives for Renewable Energy (DSIRE)*. National Renewable Energy Lab and U.S. Department of Energy. March, 2002.

5-6 State Energy Office Minnesota Department of Commerce. *Minnesota's Potential for Electricity Production Using Manure Biogas Resources*, Final Report. April, 2003.

5-7 The Renewable Fuels Association. *Ethanol Industry Outlook. 2003, Building a Secure Energy Future*. www.ethanolrfa.org/outlook2003.html.

5-8 U.S. Dairy Association. "1997 Census of Agriculture: Harvested Cropland Acreage Data – States." www.nass.usda.gov/research/crop_97.html.

5-9 U.S. Environmental Protection Agency. *A Primer on Developing North Carolina's Landfill Gas Utilitzation Potential*. EPA 430-R-00-010. wastenot.enr.state.nc.us/swhome/nclfg.pdf.

5-10 Renewable Energy Policy Project. "Bioenergy." www.repp.org/bioenergy.

5-11 Agricultural Statistics Division. North Carolina Department of Agriculture & Consumer Services. *Crops Statistics*. www.ncagr.com/stats/crops.htm. 2003.

5-12 Alternative Fuels Data Center. U.S. Department of Energy. www.afdc.doe.gov.

5-13 Borel, Karen. "Building Alternative Fuel Networks in the Southeast." U.S. Environmental Protection Agency, Region 4. November, 2002.

5-14 Powell, Alan. "Cleaner Vehicles, Cleaner Fuel, Cleaner Air." U.S. Environmental Protection Agency, Region 4. November 2002.

5-15 "Landfill Gas Opportunities." http://pdf.wri.org/gpmdg_corporate_guide_02.pdf.

5-16 N.C. Department of Transportation. Presentation on Biodiesel Fuels. http://www.ncdot.org/public/speeches/biofuelspresentation03_03.html.

Chapter 6: Alternative Energy Sources

6-1 Nicholson, Brock, P.E. "Air Quality and Energy: Relationship and Recommendations." Presentation to Energy Policy Working Group. January, 2002.

6-2 Sustainable Energy Development Authority. *Distributed Energy Solutions-Cost and Capacity Estimates for Decentralized Options for Meeting Electrical Demand.* New South Wales, Australia. www.seda.nsw.gov.au. February, 2002.

6-3 Rose, Yang. *The Economic Impact of Coal Utilization in the Continental United States.* U.S. Department of Energy, Environment and Minerals. June, 2002.

6-4 Energy Information Administration. "2000 Annual Solar Thermal and Photovoltaic Manufacturing Activities." U.S. Department of Energy. http://www.eia.doe.gov/cneaf/solar.renewables/page/solar/solarphoto_tab.html.

6-5 North Carolina Department of Revenue. *Guidelines for Determining Tax Credits for Investing in Renewable Energy Property.* http://www.dor.state.nc.us/practitioner/individual/directives/renewableenergyguidelines.html

6-6 Solar Services, Inc. *Tax Credits and Incentives for Owners of Solar Heating Systems.* http://www.solarservices.com/taxbreak.html

6-7 Heschong Mahone Group, "Daylighting in Schools – An Investigation into the Relationship between Daylighting and Human Performance." Pacific Gas & Electric Company. 1999.

6-7 Energy Efficiency and Renewable Energy. *North Carolina Wind Resources.* U.S. Department of Energy. www.eere.energy.gov/state_energy/tech_wind.cfm?state=NC.

6-8 Elliot, D.L. , C.G. Holladay, W.R. Barchet, H.P. Foote, and W.F. Sandusky. *Wind Energy Resource Atlas of the United States.* Pacific Northwest National Laboratory. U.S. Department of Energy. October, 1986.

6-9 National Renewable Energy Laboratory. "Wind." http://www.eia.doe.gov/cneaf/solar.renewables/page/wind/wind.pdf.

6-10 Energy Educators of Ontario. "Energy Factsheet, Hydroelectric Power." http://www.iclei.org/EFACTS/HYDROELE.HTM. 1993.

6-11 "Solargenix Energy, The Natural Power for Good." www.dukesolar.com.

6-12 U.S. Energy Information Administration. *State Energy Data Report 2000.* www.eia.doe.gov. U.S. Department of Energy. 2003.

6-13 National Renewable Energy Laboratory. "Introduction to Hydroelectric Power." http://www.nrel.gov/clean_energy/hydroelectric_power.html.

6-14 Idaho National Engineering and Environmental Laboratory. *U.S. Hydropower Resource Assessment for North Carolina.* Idaho Falls, Idaho 83415. http://hydropower.inel.gov/state/nc/nc.pdf. October, 1997.

6-15 Sterzinger, George, Fredric Beck, and Damian Kostiuk. *The Effect of Wind Development on Local Property Values.* Renewable Energy Policy Project. http://www.crest.org. May, 2003.

6-16 U.S. Environmental Protection Agency. "Global Warming – Impacts, Hydropower." www.epa.gov/globalwarming/actions/cleanenergy/hydropower.

6-17 Duke Power Company. "Solar Power Using Photovoltaics." http://www.dukepower.com/content/default2.asp?wpn=dp13a13.

6-18 Sandia National Laboratory and National Renewable Energy Laboratory. "Concentrating Solar Power and Sun Lab." www.eere.energy.gov/sunlab/.

6-19 Haq, Zia. *Biomass for Electricity Generation,* www.eia.doe.gov/oiaf/analysispaper/biomass. July, 2002.

6-20 State Energy Office Minnesota Department of Commerce. *Minnesota's Potential for Electricity Production Using Manure Biogas Resources*, Final Report. April, 2003.

6-21 Miller, Burke "Daylighting on the Cutting Edge in Utah," *Solar Today.* August, 1997.

6-22 National Center for Photovoltaics. http://www.nrel.gov/ncpv/.

6-23 Allied Business Intelligence. "Fuel Cell Vehicles to Number 800,000 by 2012, According to ABI." Oyster Bay, New York. www.alliedworld.com.

Chapter 7: Energy Use in the Public Sector

7-1 North Carolina State Energy Office. Personal Communication. Utility Savings Initiative Project. 2002 and 2003.

7-2 Local Government Energy Savings Organization. "Creation of the Local Government Energy Savings Organization." http://www.ncacc.org/logesofactsheet.htm.

7-3 Brown, Matthew H. "Reducing Energy Bills in Public Buildings". *NCSL Legislative Report*. vol.25, #17. December, 2000.

7-4 Lawrence Berkley National Laboratory. "Containing the Effects of Chemical/Biological Agents in Buildings." *EETD News*. vol.3, #3.

7-5 U.S. Energy Information Administration. "CCTI Tax Initiative". Report #: SR/OIAF/99-01.U.S. Department of Energy. http://www.eia.doe.gov/oiaf/archive/climate99/tax.html. February, 2002.

Chapter 8: Energy Use in the Residential Sector

8-1 U.S. Energy Information Administration. *State Energy Data Report 2000*. www.eia.doe.gov. U.S. Department of Energy. 2003.

8-2 Appalachian State University. *North Carolina's Sensible Greenhouse Gas Reduction Strategies*. Department of Geography and Planning. Boone, North Carolina. 2000.

8-3 Advanced Energy Corporation. "Affordable Housing: Built with SystemVision™." www.advancedenergy.org/buildings/outreach/affordable_housing.html.

8-4 U.S. Energy Information Administration. *Annual Energy Outlook 2001. Office of Integrated Analysis and Forecasting*. U.S. Department of Energy. Washington, D.C. 2002.

8-5 U.S. Energy Information Administration. *1997 Residential Energy Consumption and Expenditures*. Office of Energy Markets and End Use. U.S. Department of Energy. Washington D.C. 1999.

Chapter 9: Energy Use in the Commercial Sector

9-1 Jagemar, Lennart.1995. *Energy Efficient HVAC Systems in Office Buildings*. Center for the Analysis and Dissemination of Demonstrated Energy Technologies. CADDET Analysis Support Unit. The Netherlands.

9-2 U.S. Energy Information Administration. *Commercial Buildings Energy Consumption and Expenditures*. Office of Energy Markets and End Use. U.S. Department of Energy. Washington D.C. 1995.

9-3 U.S. Energy Information Administration. *A Look at Commercial Buildings in 1995: Characteristics, Energy Consumption and Energy Expenditures*. Office of Energy Markets and End Use. U.S. Department of Energy. Washington, D.C. 1998.

9-4 U.S. Energy Information Administration. *Commercial Buildings Energy Consumption and Expenditures, 1995*. Office of Energy Markets and End Use. U.S. Department of Energy. Washington D.C. 1999.

9-5 Office of Energy Efficiency and Renewable Energy. "Building Technologies Program." U.S. Department of Energy. http://www.eere.energy.gov/buildings/index.cfm.

9-6 Romm, Joseph, J and William D. Browning. *Greening the Building and the Bottom Line, Increasing Productivity through Energy-Efficient Design*. Rocky Mountain Institute and U.S. Department of Energy.

Chapter 10: Energy Use in the Industrial Sector

10-1 American Council for an Energy Efficient Economy. *Summary of Public Benefit Funds and Electric Utility Restructuring*. May, 2002.

10-2 Appalachian State University, Department of Geography and Planning. *The North Carolina Greenhouse Gas Emissions Inventory for 1990, Volume 1: Report*. Boone, NC. 1996.

10-3 Alsema, E.A. "Energy Requirements and CO_2 Mitigation Potential of PV Systems." Presentation at the BNL/NREL Workshop. *PV and the Environment 1998*. Keystone, CO. 1998.

10-4 Applied Reasoning, Inc. *Inflation Rate Data*. July, 1999.

10-5 Alliance to Save Energy. *Update* (10): 2. Washington, DC. 1999.

10-6 California Energy Commission.*Greenhouse Gas Emissions Reduction Strategies for California, Volume 1, Executive Summary*. Sacramento, CA. 1999.

10-9 North Carolina Solar Energy Center. *Database of State Incentives for Renewable Energy (DSIRE)*. National Renewable Energy Lab and U.S. Department of Energy. March, 2002.

10-10 Industrial Assessment Center. *Manual for Industrial Energy Audits*. Rutgers University: New Brunswick, NJ. 1995.

10-11 Laitner, Skip, John DeCicco, Neal Elliott, Howard Geller, and Marshall Goldberg. *Energy Efficiency as an Investment in Ohio's Economic Future*. American Council for and Energy-Efficient Economy. Washington, D.C. 1994.

10-12 Moore, Taylor. "Global Energy Future." *EPRI Journal* (Fall). Palm Springs, CA: Electric Power Research Institute. 1999.

10-13 McGuffey, Robert. "North Carolina Policies and Programs for Energy Efficiency and Renewable Energy". *Proceedings of the Energy Policy Symposium*. Honolulu, Hawaii. November, 2000.

10-14 Natural Gas Supply Association. Natural Gas Information and Educational Resources Website. April, 1999.

10-15 North Carolina State Energy Office Web Site, Business and Industry Page. www.energync.net/Energy2/bus_ind.htm. October, 2002.

10-16 *Scenarios for a Clean Energy Future*. ORNL/CON-476. November, 2000.

10-17 Standard and Poor's DRI. *North Carolina Energy Outlook, 1998*. Lexington, MA. 1999.

10-18 Union of Concerned Scientists. *DSM Renewable Technologies and Applications: Phase 1 Report*. Boston, MA. 1994.

10-19 U.S. Bureau of the Census. North American Industry Classification System (NAICS) information page.

10-20 U.S. Bureau of the Census. *Statistics of U.S. Business: North Carolina*. April, 1999.

10-21 U.S. Energy Information Administration. *State Electricity Profiles: North Carolina*. U.S. Department of Energy. Washington, D.C. 1997.

10-22 U.S. Energy Information Administration. *Manufacturing Consumption of Energy 1994*. U.S. Department of Energy. Washington, D.C. 1995.

10-23 U.S. Energy Information Administration. *Changes in Energy Intensity in the Manufacturing Sector 1985-1994*. U.S. Department of Energy. Washington, D.C. 1995.

10-24 U.S. Energy Information Administration. "Table N6.2, End Uses of Fuel Consumption, 1998". 1998.

10-25 U.S. Energy Information Administration. "Table C10.3, Number of Establishments by Useage of Energy-Saving Technologies for Specific Industries, 1998". 1998.

10-26 U.S. Energy Information Administration. www.eia.doe.gov. 2002 to 2003.

10-27 U.S. Environmental Protection Agency. *Climate Wise Rules for Industry*. Washington, D.C. 1997.

10-28 Vermont Department of Public Service. *Fueling Vermont's Future: Comprehensive Energy Plan and Greenhouse Gas Action Plan, Volume 2*. Montpelier, VT. 1998.

10-29 Wisconsin Department of Natural Resources. *Wisconsin Greenhouse Gas Emission Reduction Cost Study, Report 3: Emission Reduction Cost Analysis, Volume 1: Text*. Madison, WI. 1998.

10-30 Consortium for Energy Efficiency, Inc. *Motor Decisions Matter*.

10-31 U.S. Department of Energy. "Compressed Air System Economics, Compressed Air Systems Fact Sheet #9." Compressed Air Challenge.

10-32 U.S. Department of Energy. "Compressed Air System Modifications Improve Efficiency at a Plastics Blow Molding Plant."

Chapter 11: Energy Use in the Transportation Sector

11-1 North Carolina Department of Transportation. www.dot.state.nc.us.

11-2 Sexton, Kenneth G. *Atmospheric Photchemistry Studies of Pollutant Emissions from Transportation Vehicles Operating on Alternative Fuels*. UNC School of Public Health, Department of Environmental Sciences.

11-3 Brown, Matthew H. State *Alternative Fuel Incentives: A Decade and More of Lessons Learned.* NCSL Legislative Report. February, 2001.

11-4 Salveson, David. "Smart Growth and the New Economy." Presentation for for Energy Policy Working Group. February, 2002.

11-5 U.S. Energy Information Administration. http://www.eia.doe.gov/emeu/states/sep_use/tra/use_tra_nc.html.

11-6 Allied Business Intelligence. *Fuel Cell Vehicles to Number 800,000 by 2012, According to ABI.*

11-7 Federal Highway Administration. *Highway Statistics, 2001.* U.S. Department of Transportation. 2002.

Chapter 12: Energy Education and Research

12-1 National Energy Education Development. *Energy Exchange.* March, 2002.

12-2 North Carolina Office of State Budget and Management. *Total State Operating Budget from all Sources by Department 2000-2001.* July, 2001.

12-3 Hoert, Megan and Robert Stevens. *Renewable Energy Education: A Statewide Plan for North Carolina's K-12 Learners.* 2001.

Chapter 13: Funding for Energy Programs

13-1 Bolinger, Porter, Wiser. *Comparing State Portfolio Standards/System Benefits Change under Restructuring.* January, 2002.

13-2 Brown, Matthew H. "The Electric Industry: State and Federal Jurisdiction." *NCSL Legislative Report.* October, 2001.

13-3 Rewey,Christie. "State Incentives for Energy Efficiency." *NCSL Legislative Report*, vol. 26 #3. April, 2001.

13-4 Rewey, Christie "Clean Air Policy: A Primer on State Implementation Plans." *NCSL Legislative Report*, vol. 26 #9. September, 2001.

13-5 New York State Energy Research and Development Authority. "Preserving Energy-Related Public Benefits Programs." www.nyserda.org/sepsection2-5.pdf. June, 2002.

13-6 Wisconsin Legislative Staff. "New Law on Electric Utility Regulation – The "Reliability 2000" Legislation (Part of 1999 Wisconsin Act 9)." Information Memorandum 99-6. Madison, Wisconsin www.legis.state.wi.us/lc/jlc99/im99_6.pdf. December, 1999.

13-7 Raynor, Michelle. *California Energy Commission Survey of Public Benefit Programs of Public-Owned Utilities in California.* June, 1999.

13-8 Beck, Fredric, Damian Kostiuk, Tim Woolf, and Virinder Singh, *Powering the South – A Clean and Affordable Energy Plan for the Southern United States.* Renewable Energy Plolicy Project and Synapse Energy Economics. Washington, D.C. January, 2002.

13-9 Southern States Energy Board. *Legislative Digest 2001.* 2002.

13-10 North Carolina State Energy Office. Personal Communication. 2002.

13-11 North Carolina Solar Energy Center. *Database of State Incentives for Renewable Energy (DSIRE).* National Renewable Energy Lab and U.S. Department of Energy. March, 2002.

13-12 American Council for an Energy Efficient Economy. *Summary of Public Benefit Funds and Electric Utility Restructuring.* May, 2002.

13-13 State Energy Plans from Arkansas, California, Florida, Hawaii, Illinois, Iowa, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nevada, New Mexico, New York, North Carolina, Oregon, South Carolina, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin.

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