

Chapter 11: 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 on energy and its many facets is an important part of this educational picture.

Among the energy research innovations for which North Carolina is noted is the development of the Alternative Energy Corporation (now Advanced Energy), chartered in 1980 and funded through one of the nation's first voluntary utility line charges. The AEC was created by the North Carolina Utilities Commission to explore alternative ways of producing electricity and to be more effective with the electricity already being used. Advanced Energy is governed by a Board of Directors appointed by the governor of North Carolina and the member utilities. In addition to creating means for sustainable energy-efficient economic development for the ratepayers of North Carolina, AE operates as a fee-for-service consultant to clients across the nation.

Another cutting edge energy endeavor was the creation of the NC Solar Center in 1988 as a unique partnership among state government, NC State University, and the solar industry. The Solar Center's comprehensive array of outreach, extension, and applied research programs quickly vaulted it to recognition as one of the premier solar centers in the country. Among its many programs are serving as the host of the nation's database of incentives for renewable energy (DSIRE), providing technical assistance to other states for utility interconnection for photovoltaic systems, operating the NCSU Solar House which serves as an educational showcase facility hosting more than 20,000 visitors a year, and an extensive publications program. The Solar Center also engages in special reports on various subjects associated with renewable energy, one of which will be discussed later in this report.

In an effort to facilitate the work of energy researchers across the State's university system, the State Energy Office has served as the convener of the Energy Technical Advisory Group (ETAG). ETAG is composed of faculty and staff from institutions including NC State University (NC Solar Center), NC A&T State University, UNC Charlotte, East Carolina University, Research Triangle Institute, Advanced Energy, and Appalachian State University, representing disciplines spanning engineering, architecture, building science, public policy, and environmental sciences. ETAG serves as a forum for information exchange and collaborative research among the energy research and academic community members and meets quarterly at member institutions.

K-12 Education

Already across the state, numerous elementary and secondary school

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**North Carolina Department of
Public Instruction
Energy Curriculum
Module Objectives**

Science Goals

The learner will:

1. Develop an understanding of the nature of science;
2. Demonstrate an understanding of the relevance of topics in science to his or her own life;
3. Develop an understanding of energy; and
4. Develop an understanding of natural resources and the environment.

Knowledge Goals

Students will demonstrate an understanding and application of:

1. The laws of conservation;
2. Physics concepts and their relationship to current societal and environmental issues;
3. Safe laboratory practices;
4. The heat equivalent of work; and
5. Units used to measure energy.

Skills Goals

Students will:

1. Analyze and communicate information;
2. Formulate models and hypotheses;
3. Solve problems using mathematical models and formulas;
4. Conduct investigations and experiments that demonstrate the relationship between different forms of energy;
5. Prepare and present the findings of investigations and research using tables, graphs, diagrams, or models;
6. Analyze and explain changes within a system;
7. Compare and contrast events, data, or systems; and
8. Demonstrate attributes of character in individual and group work.

For a complete description of the module, see

<http://www.dpi.state.nc.us/nccep/lp/lp21.html>

teachers are incorporating energy related materials into their classrooms, and some are being assisted financially through special utility sponsored programs. For example, North Carolina's 28 electric cooperatives have awarded more than \$400,000 in Bright Ideas grants this year to the state's classroom teachers. Bright Ideas encourages creative classroom teaching by funding special projects of up to \$2,000 for teachers in grades K-12.

Approximately 320 teachers across North Carolina received the grants for special projects this year, and at least 70,000 students will benefit from enhanced educational experiences. Since the program began in 1994, more than \$2.5 million in educational grants have been awarded to teachers across the state of North Carolina. It is important to note that the Bright Ideas projects, though funded by electrical coops, do not have to focus on energy topics.

In addition, the North Carolina Department of Public Instruction has developed an energy curriculum module that may be incorporated within elementary school science classes, which is described in the sidebar.

In May 2001, the North Carolina Solar Center released a report for the State Energy Office outlining a strategy for incorporating renewable energy education in the state's primary school system in a systematic fashion. (Hoert, Megan and Robert Stevens, 2001. Renewable Energy Education: A Statewide Plan for North Carolina's K-12 Learners). Based upon a focus group of ten key stakeholders in energy education, the plan that emerged envisioned five strategies:

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

Goals of the strategy focus on:

- ◆ Conservation:
 - To promote awareness of resource limitations.
 - To encourage responsible energy use and energy conservation in K-12 programs.
- ◆ Information:
 - To educate school-based interest groups, including students, parents, faculty, staff and other school decision-makers about energy alternatives.
- ◆ Demonstration:
 - To demonstrate energy awareness and conservation in school environments with renewable energy installations.

◆ Partnership:

- To initiate and sustain community partnerships in order to provide installation and support for renewable energy technologies.
- To demonstrate to K-12 learners a community commitment to renewable energy.
- To partner with the Department of Public Instruction to fulfill the curricular needs of the plan.

◆ Action:

- To support an energy-conscious public with an information base that stimulates sound decision-making and stewardship of local and global resources.

One of the partnerships envisioned within the strategy was to rely on the NEED (National Energy Education Development) program as a major source of content in the curriculum. The NEED Project is a nonprofit education association that has focused on teaching students and teachers about energy and has worked in several states at the system level. NEED designs and distributes hands-on, science based educational materials on energy for grades K-12, conducts student and teacher training conferences, provides evaluation tools, and offers a Youth Awards Program for Energy Achievement. NEED materials are designed to meet the National Science Education Content Standards, as well as many state standards of learning.

At the federal government level, the US Department of Energy manages the EnergySmart Schools program. EnergySmart Schools was founded in 1998. It is managed by DOE's Office of Building Technology, State and Community Programs, and operated through the program, Rebuild America. Rebuild America helps schools and other building operators create local partnerships to plan and implement cost-saving building improvements using energy efficiency and renewable energy. In February 2001, the program unveiled its first in a series of design guidelines for all climates including mild, hot and humid regions. The guidelines include the following topics:

- Site design
- Windows and daylighting
- Energy efficient building shell
- Renewable energy systems
- Lighting and electrical systems
- Mechanical and ventilation systems
- Environmentally sensitive building products and systems
- Water conservation
- Recycling systems and waste management
- Transportation

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The State Energy Office should initiate efforts to acquire funding to implement the recommendations of the NC Solar Center's report on Renewable Energy Education.

Currently, the State Energy Office allocates approximately \$13.4 million in supporting educational programs and research projects focused on energy efficiency and renewable energy technologies/applications. Some of the programs follow:

- Ethanol from Swine Waste
- Awareness and Marketing
- National Energy Education Development Program (NEED)
- Renewables in Schools
- Center for Energy Research and Technology
- High Performance Building Guidelines
- Local Government Buildings
- NC Energy Code Assessment and Training
- Boiler Efficiency Technical Assistance
- Energy Efficiency Program for Nonprofits
- Sustainable Community Development
- Alternative Fuels
- Fuel Cell and Micro Turbines
- Geothermal Heating and Cooling
- Million Solar Roofs Initiative
- North Carolina Solar Center

In addition, more than 240 community partnerships have been formed across the country, involving 2,000 schools. The program has national partners—businesses and other organizations that support school energy improvements nationwide. Both Rebuild America and its EnergySmart Schools effort share information and resources with other DOE programs affecting schools: Clean Cities, which focuses on alternatively fueled buses; the President's Million Solar Roofs Initiative, aimed at increasing use of solar technologies; the State Energy Program, a DOE grant program administered through state energy offices; and Energy Star®, a joint DOE/EPA program focused on building energy performance improvements. For a complete description of this federal program see <http://www.eren.doe.gov/energysmartschools>.

Policy Recommendations

The State Energy Office should work in partnership with the State Department of Public Instruction in facilitating energy education throughout the states 2,000+ elementary and secondary schools. Including a representative from DPI on the Energy Policy Council would be a step in that direction.

The State Energy Office should initiate efforts to acquire funding to implement the recommendations of the NC Solar Center's report on Renewable Energy Education. Special emphasis should be given to the recommendation to establish six Environmental Education Centers across the state to serve as a training and demonstration resource for teachers and students.

Research, Demonstration, Renewable Energy Promotion

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/applications. The two major funding streams for the SEO are derived from the Petroleum Violation Escrow (PVE) funds and the U.S. Department of Energy (DOE). The PVE funds arose out of a series of federal court settlements involving overcharging by petroleum companies in the 1970s and 1980s. Programs funded by the SEO span the building, industrial, transportation, and utility sectors. Some of the more noteworthy programs include:

Ethanol from Swine Waste (Wake County) -- Investigates the use of gasification technologies to convert swine waste, a major environmental pollutant, into fuel grade ethanol.

Awareness and Marketing (Statewide) -- Produces and disseminates information about energy efficiency for consumers, the agricultural community, the commercial/industrial sector, schools and local governments throughout North Carolina. Information is disseminated through various channels including the broadcast media, the Internet, and outreach and educational activities. For example, through the Agency for Public Telecommunications, the State Energy Office has produced television programs on flood recovery, alternative fuel vehicles, the EV Challenge,

renewable energy, and residential energy conservation.

National Energy Education Development Program (NEED) (Statewide) -- Designs educational activities and materials directed at K-12 public school students to promote an understanding of the economic and environmental trade-offs of energy consumption and production. Program includes up-to-date educational evaluation, recognition of achievement, and professional development for educators.

Renewables in Schools (Statewide) -- Seeks to demonstrate renewable energy technologies in K-12 public schools through hands-on applications, classroom activities, and technology demonstrations.

Center for Energy Research and Technology (Statewide) -- Supports the activities of the Center for Energy Research and Technology (CERT), an energy education institute at North Carolina A&T State University. Research focuses on energy use and energy efficiency in manufactured housing, solar electricity in public housing, and the development of fuel cells.

High Performance Building Guidelines (Statewide) -- Provides training and educational presentations about the High performance Guidelines recently developed by Triangle J Council of Governments in an attempt to construct more sustainable buildings. Targets policy-makers, designers and other professionals who design, build and manage public schools, state and local government buildings, and facilities at universities and community colleges.

Local Government Buildings (Statewide) -- Provides matching funds for costs associated with increasing the energy efficiency of local government buildings.

NC Energy Code Assessment and Training (Statewide) -- Evaluates the effectiveness of North Carolina's residential and commercial building energy codes by assessing energy code development and enforcement in the state. Provides training in energy codes for building inspectors and other professionals.

Boiler Efficiency Technical Assistance (Statewide) -- Conducts boiler surveys in plants to identify needed improvements. Trains plant personnel on how to solve boiler efficiency problems and promotes state-of-the-art equipment to maintain optimum boiler efficiency.

Energy Efficiency Program for Nonprofits (Statewide) -- Will assist nonprofit agencies in implementing measures to reduce their energy costs, thereby expanding available funds for services and programs.

Sustainable Community Development (Statewide) -- Will increase communities' awareness of and commitment to sustainable development with a focus on economic well being, renewable energy, energy efficiency, environmental health, waste minimization and improvements in quality of life.

Alternative Fuels (Statewide) -- Promotes and introduces the use of alternative transportation fuels to the public and private fleet management sectors of North Carolina, including compressed natural gas, propane,

ethanol, electricity, hydrogen, and biological materials.

Fuel Cell and Micro Turbines (Eastern North Carolina) -- Will investigate the viability of distributed generation technology, generating electricity from fuel cell and micro-turbine technologies using methane gas from animal waste. This technology minimizes energy loss and uses waste heat.

Geothermal Heating and Cooling (Central North Carolina) -- Compares the energy used by an advanced geothermal heat pump to a conventional heat pump, installed in adjacent mobile classroom units.

Million Solar Roofs Initiative (Durham, Guilford, Orange, Watauga Counties) -- Promotes use of solar energy technologies at the local level through local steering committees, education, training and demonstrations.

North Carolina Solar Center (Statewide) -- Provides support for a center offering a range of comprehensive technical and educational services designed to advance the use of solar technologies. The N.C. Solar Center also demonstrates solar applications at the NCSU Solar House and an adjoining test site.

Other Research Efforts

In addition to these programs funded through the SEO, a large scale and innovative research endeavor is underway at the Animal and Poultry Waste Management Center at NC State University, assessing alternative ways of dealing with the State's hog waste problem. Currently, under a settlement with the State's two largest hog producers, Smithfield Farms will commit \$15 million for the development of environmentally superior technologies for the management of swine waste and to facilitate the development, testing and evaluation of potential technologies on company-owned farms. Under a similar agreement reached in October 2000, Premium Standard is providing an additional \$2.5 million. In both cases, the funding is to be used to develop alternatives to the lagoon and spray field system now used in North Carolina to treat waste from hog farms. In a presentation to the Energy Policy Working Group, Dr. Leonard Bull identified seven potential procedures currently under investigation to convert swine waste to energy. While still in its infancy, this research program should be carefully monitored to assess if significant biofuel potential exists in this program.

Final Policy Recommendation Concerning Research Programs

Over the next few years the funding stream supporting the programs funded by the SEO will be depleted. It is imperative that these programs and others that are focused on making North Carolina less dependent on imported energy and less reliant on fossil fuels that pollute the environment be supported in the future. In order to accomplish this, ***the General Assembly should enact a public benefits fund.*** Details of the fund are discussed in the next chapter.

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