Chapter 8: Commercial Sector

The commercial sector includes the wide variety of facilities used by businesses, organizations, and government agencies, including office buildings, hotels and multi-story apartments, beauty salons, bookstores, shopping malls, dry cleaners and home improvement centers. The bulk of energy used by these buildings is for heating, cooling, and lighting, with additional use for domestic hot water, refrigeration, cooking, electronic equipment, and other operations.

Figure 8-1 shows that the commercial sector consumed about 11% of net energy use in North Carolina in 1999. Net energy use does not include generation losses from electric power plants.

Figure 8-2 reveals the following distribution of energy sources for the commercial sector in 1999:

- Electricity provides about 66% of total energy needs, totaling 127 Trillion Btu
- Natural gas supplies 21% -- 39 trillion Btu total
- Petroleum provides 11% -- 20 trillion Btu
- Coal and renewables (primarily wood) each provide a little over 1% of energy needs -- 2.4 trillion Btu and 1.9 trillion Btu respectively

Historically, the commercial sector has grown increasingly dependent on electricity. As Figure 8-3 shows, electricity provided only 22% of commercial energy use in 1960. Natural gas and electricity combined supplied only 31% to the sector in 1960, but now they provide 87% of total energy needs.

Figure 8-3: Historical Commercial Energy Sources

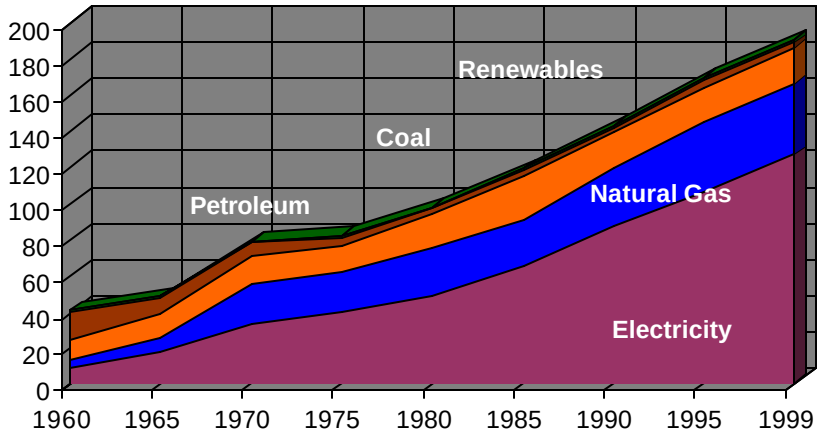


Figure 8-1: 1999 Energy Breakdown by Sector (1,678 Trillion Btu total)

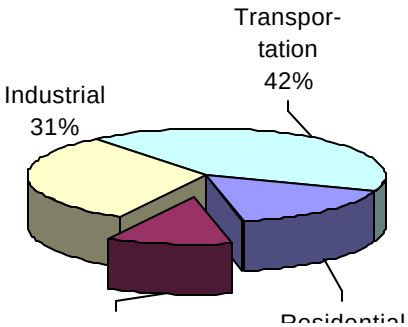
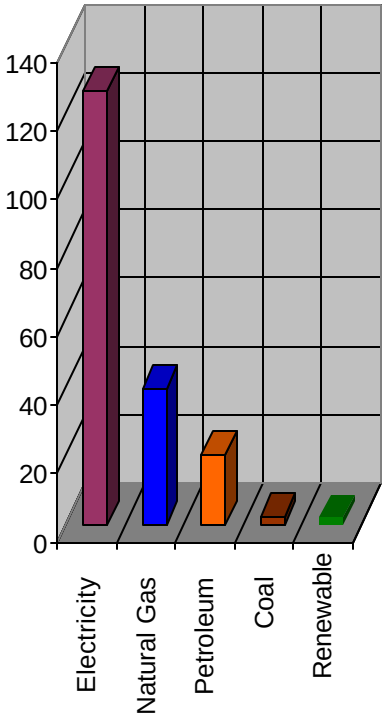


Figure 8-2: 1999 Commercial Energy Use by Source (Trillion Btu)



The North Carolina State Energy Plan considers the commercial sector to have a high potential for improving efficiency in both existing and new buildings.

The Greenhouse Gas Mitigation study conducted by Appalachian State University (2000) investigated how commercial buildings used various energy sources for different end uses. The study found the breakdown shown in Table 8-1. The primary end uses are space cooling, space heating, and lighting, with electricity providing a substantial amount of space heating and virtually all of cooling and lighting.

Table 8-1:

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%			
Water Heating	73%	21%	4%	1%	1%
Lighting	100%	0%			
Electronic Equipment and Appliances	100%	0%			

Commercial Efficiency Strategies

The North Carolina State Energy Plan considers the commercial sector to have a high potential for improving efficiency in both existing and new buildings. The objectives of ensuring energy reliability, promoting wise land use, and improving environmental quality relate directly to energy efficient construction codes and techniques.

The Greenhouse Gas Mitigation Strategy conducted by Appalachian State created scenarios for future energy use in the commercial sector based on "business-as-usual" and "aggressive efficiency" approaches. The aggressive efficiency scenario incorporates the strategies described below into commercial buildings based on the economic payback of the strategy and the current estimated market penetration of the measure. The strategies with the best return on investment are assumed to generate a higher market penetration in the future than those with lower economic returns.

Existing Buildings: Thermal Efficiency Strategies

- Buildings with walls having open cavities -- either open framing studs or concrete block with open cores -- are candidates for retrofit using blown-in foam insulation.
- Window shading strategies should be employed, such as installing

reflective films on windows, replacing windows with units having lower Solar Heat Transmission Coefficients, mounting outside shade screens, adding overhangs/awnings to the exterior and planting shade trees.

- Retrofitting traditional commercial roof structures with improved insulation.
- Improving air sealing around windows, doors, elevator shafts and other openings in the building envelope.
- According to the Greenhouse Gas Mitigation Study, the total savings for all of the envelope measures—insulation, air sealing, and shading—could be about 9,300 billion Btu/year, or a decrease of 12% in commercial energy use.

Existing Buildings: Lighting Efficiency Measures

- Replace existing incandescent and halogen lighting with energy efficient fluorescent lighting.
- Replace standard fluorescent with energy efficient fluorescent (T-8 lamps and electronic ballasts) lighting.
- Install lighting control equipment to reduce the amount of lighting in vacant spaces where not needed. In addition to the savings on lighting energy, more efficient lighting will reduce space cooling needs, as well as the operating time of central blowers.
- Increase the use of controlled daylighting.
- Total energy savings from lighting efficiency measures could be about 2.2 billion Btu/year, a 16% improvement in energy consumption.

Existing Buildings: HVAC Efficiency Measures

New standard heating and cooling equipment can be 20 to 30% more efficient than HVAC units 15 years old and older. Higher efficiency units may double the savings.

- Energy Management Systems (EMS) automatically operate the heating and cooling system of a building, along with other components, such as lighting. EMS systems will also monitor energy use and help reduce bills by reducing the peak use of electricity.
- Increase duct and pipe insulation and repair all leaks – either air or liquid.
- Optimize the performance of economizers or air handling systems that bring in outdoor air for "free cooling" during mild weather.
- Total energy saving from all of the HVAC measures could be about 1,800 billion Btu/year, or a 14% decrease in energy use.

…Considerable air quality improvements can be realized through new construction techniques and increasingly efficient equipment.

Existing Buildings: Hot Water System and Equipment Efficiency Measures

- Hot water systems in commercial buildings typically use circulating

systems to provide heated water at any time to any faucet or other outlet in the building. There are several efficiency measures that can be applied including water-saving fixtures and appliances, increased insulation on water heating equipment and piping, reducing unintended circulation of hot water, and replacing equipment with more efficient units.

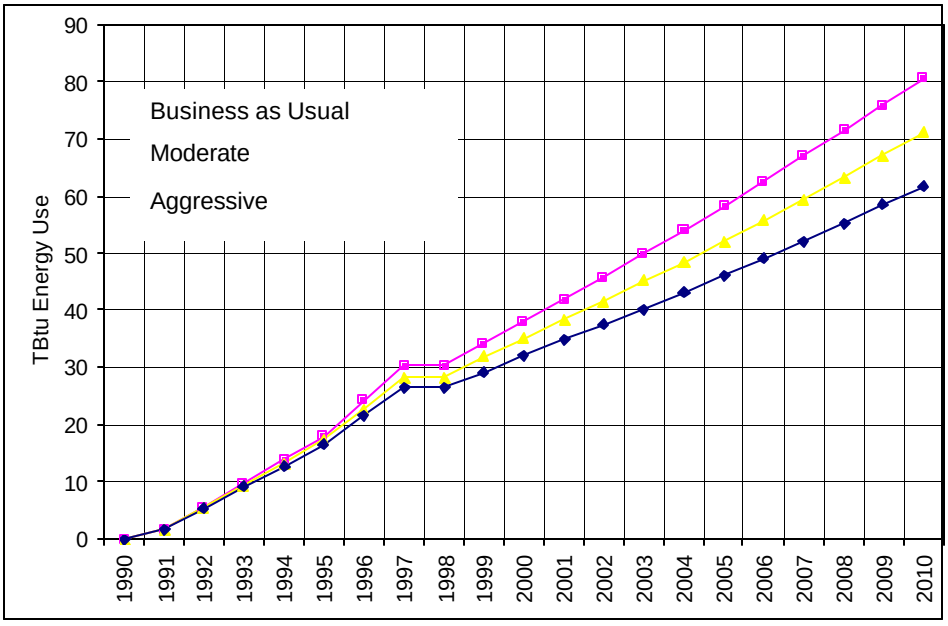
- Appliances and electronic equipment range from grocery store freezers to highly sophisticated computer systems. An increasing array of equipment is available with the EnergyStar label. Whenever existing buildings upgrade, selecting more efficient models is usually cost effective.
- Total savings from appliance efficiency measures in commercial buildings could be about 125 Billion Btu/year.

New Commercial Buildings: Thermal Efficiency, HVAC Efficiency, Alternative Energy Options, Hot Water Efficiency

New commercial building construction offers numerous opportunities to institute new energy savings. Because this is a fast-growing sector in North Carolina and is one of the heaviest users of electricity for lighting and heating and cooling, considerable air quality improvements can be realized through new construction techniques and increasingly efficient equipment. Nearly all of these strategies are listed in the discussions above, however, implementing them during new construction offers far greater efficiencies at less cost than attempting to retrofit existing buildings.

Figure 8-4 provides a forecast of energy use for new commercial buildings through year 2010, with three scenarios: basic case, moderate case, and aggressive case.

Figure 8-4:
Energy Use in New Commercial Buildings
(TBtu/ year)



Energy Efficiency and Renewable Energy Scenario

Figure 8-5 shows the results of a concentrated effort to reduce energy in commercial buildings. The scenario assumes that by 2015, the state's commercial buildings would save 20% of energy use in the sector in 1999 – about 43 TBtu saved in 2015. Figure 8-6 shows the impact on Carbon Dioxide emissions – a 15% reduction from the base case.

Energy Codes in the Southeast

The commercial sector possesses a structure that often confounds those seeking to develop higher efficiency facilities. In most commercial structures, the investor, designer, and builder are not typically connected with the organization that will actually pay for energy bills. Usually, construction/development costs are the primary concerns, and energy costs are inherited by the building's eventual tenants or management organization

In fact, energy costs are usually dwarfed by the other expenses of operating the building, 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 attempt to meet the currently enforced energy code.

Table 8-2:
Status of Commercial Energy Codes in the Southeast

States	Commercial Energy Codes in Effect
Virginia	ASHRAE/ IESNA 90.1-1989
Tennessee	ASHRAE 90A-1980 and 90B-1975, considering upgrade to IECC 2000
South Carolina	ASHRAE/ IESNA 90.1-1989
North Carolina	IECC 2000
Florida	ASHRAE/ IESNA 90.1-1989
Georgia	IECC 2000

ASHRAE/ IESNA 90.1 – national standards and codes devised by the American Society of Heating, Refrigeration, and Air Conditioning Engineers and the Illuminating Engineering Society of North America; standards promulgated in 1980, 1989, and 1999

IECC – International Energy Conservation Code

Figure 8-5:
Energy Use in Commercial Buildings in North Carolina (TBtu/year)

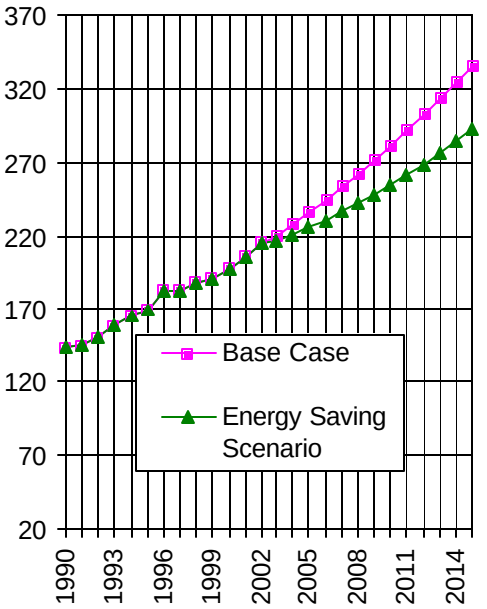
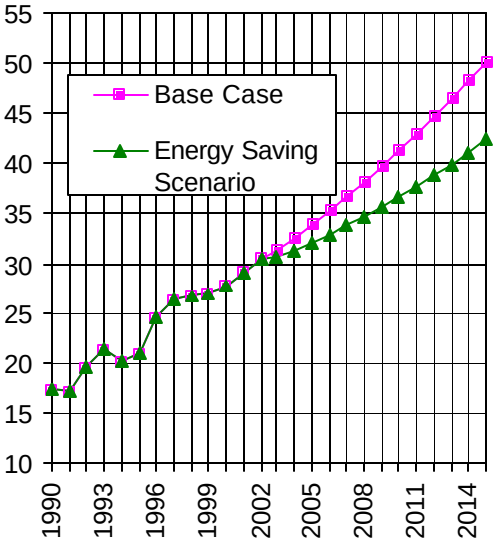


Figure 8-6: CO_2 Emissions from Energy Use in Commercial Buildings (TBtu)



The North Carolina State Energy Office should work with the North Carolina Department of Insurance on continued development and enforcement of Commercial Energy Codes . . . . . The State Energy Office should become involved in the code development process through the North Carolina Building Codes Council. Energy efficiency experts should attend meetings of the Council and its Energy Committee and provide feedback to the process.

The funds from the previously mentioned surcharge would be allocated to the State Energy Office to provide energy code enforcement assistance to major commercial growth areas – primarily the major municipalities in the state.

Unfortunately, problems exist with stringent energy code enforcement. City and county code enforcement agencies properly assign health, safety, and other aspects of buildings a higher priority than energy efficiency. The energy code is also more complex than most other codes. Thus, code enforcement officials have too little time, training, and priority to enforce the energy code fully. Instead, they often rely on the building's engineering design team to ensure compliance.

In some cases, engineers are quite diligent in evaluating and reporting on code compliance. In other projects, particularly when efficiency is not a high priority of the building investor and architect, only a cursory analysis of proper code compliance is performed. There is presently no study or procedure to determine how well the energy code is being applied in the field.

Commercial Sector Policy Recommendations

The North Carolina State Energy Office will work with the North Carolina Department of Insurance on continued development and enforcement of Commercial Energy Codes. The state recently adopted the International Energy Conservation Code, which requires that all new commercial buildings meet minimum efficiency standards. In order to enhance enforcement efforts, the Energy Policy Council will expect the Department of Insurance to require specific training on the energy code for its code enforcement officers.

In addition, the State Energy Office will seek to include questions concerning energy codes on licensing exams for code enforcement officials, as well as other licensed building-related professions in the state.

The State Energy Office should assist the North Carolina Building Codes Council in the development of a more energy efficient building code for the state. Energy efficiency experts should attend meetings of the Council and its Energy Committee and provide feedback to the process.

Via this effort, the State Energy Office should explore mechanisms to develop code amendments that require a whole building system approach to meet high performance goals (enforceable building code). Any additional costs for code enforcement procedures could be resolved by adding a small state surcharge on local building permit fees in order to support energy code enforcement.

The funds from the previously mentioned surcharge would be allocated to the State Energy Office to provide energy code enforcement assistance to major commercial growth areas – primarily the major municipalities in the state.

The Energy Code Enforcement Assistance Program will provide 4 to 8 energy code enforcement and outreach officials in the state. The responsibilities of energy code enforcement and outreach officials will be to:

- Train local code enforcement officials, designers, builders, and subcontractors on the energy code.
- Work directly with local building permit and inspection offices to

conduct plan reviews and inspections.

- Make recommendations for code changes as well as more streamlined enforcement procedures to the Department of Insurance and State Energy Office.

In addition to providing code enforcement and outreach officials, the State Energy Office will conduct periodic workshops for design and construction professionals on the details of the energy code and on high performance commercial buildings.

A North Carolina Commercial Building Rating System

The State Energy Office will develop and promote a North Carolina Energy Star rating system for new and existing commercial buildings that provides a model for comparing the energy efficiency of different types of structures. The program should complement existing programs in the state, such as the Triangle J High Perfomance Building Guidelines. The rating system will have an easily identifiable name and logo that will aid its promotion. Each year buildings that achieve the rating will be promoted via a statewide campaign. A rating system would also help to create brand identity for energy efficient buildings.

As part of this effort, the State Energy Office will develop a fairly simple assessment tool to assist building owners with evaluating the best energy strategies to implement. The tool will prioritize the most important energy-saving technologies for both new and existing buildings.

In addition, the State Energy Office will provide a design review service to help incorporate energy efficient components and designs into new commercial buildings. Architects, building investors, or engineers will be able to schedule an appointment or submit their preliminary plans via E-mail to the State Energy Office plan review team.

Through a series of workshops, the State Energy Office will educate designers and builders on the following key technologies:

- More efficient building envelope systems
- State-of-the-art window systems
- Efficient control of daylighting systems and daylighting design software
- Cost effective HVAC and lighting control systems
- Heat pump water heaters
- Heat recovery ventilation systems
- High efficiency heating and cooling systems
- Solar water heating and pool heating systems
- Integrated building systems that combine building envelope with energy production systems, such as building integrated solar electric or solar thermal technologies
- Life Cycle Cost analysis of options

In addition to providing code enforcement and outreach officials, the State Energy Office will conduct periodic workshops for design and construction professionals on the details of the energy code and on high performance commercial buildings.

Energy Audit Programs

The State Energy Office will develop an energy audit program for commercial buildings to assist building managers with implementing the most energy efficient and cost effective improvements to commercial construction projects. This proposed energy audit program could be administered by the State Energy Office and facilitated by existing energy audit firms in the private sector. By contracting these audits through the private sector, additional jobs and increased public awareness of energy efficiency issues would be created. Energy audit programs could also help track the benefits of energy-efficient building codes and the enforcement of existing codes. Data collected from these energy audit programs could then be used to show market penetration of energy efficient measures as well as measure realized gains from efficiency investments.

Shared Savings Programs/Performance Contracting

Shared savings programs and performance contracting provide funding for energy efficiency projects via the private market. The performance contractor installs the energy efficient technologies for minimal investment on the part of the building investor or owner and recaptures the principal by receiving some or all of the energy savings over several years. The State Energy Office will develop guidelines for successful performance contracts, conduct workshops, design and implement a targeted publicity campaign, and provide technical assistance on developing performance contracting documents and the promotion thereof.

Over the next year, the State Energy Office will research current and proposed incentive programs in North Carolina and other states and develop a proposed commercial energy incentive program.

Loans, Grants and Incentive Programs

Loans, rebates, a***n***d incentive programs could make energy efficient construction requirements more economically viable for builders to implement. State energy offices have been able to provide either direct matching payments or loans for energy conservation measures in some states. In addition, electric utilities have often been active in providing incentives for certain technologies in buildings. ***Over the next year, the State Energy Office will research current and proposed incentive programs in North Carolina and other states, and develop a proposed commercial energy incentive program.***

Conclusion

The state should strive to create a development climate that expects and enforces energy efficient design and construction of commercial buildings, as well as the retrofit of existing buildings. Creating a "whole-building" model in which all of the building's systems are optimized to work together will define the state's expectations within the marketplace. If there are clear guidelines for energy requirements and incentives that encourage implementation of energy efficient procedures, it will be more likely for energy efficient building systems to become the standard for new construction. The result will be better utilization of the state's economic resources, lower building operating costs, higher quality

facilities/businesses, more sustainable development practices and better-educated contractors/installers. All of these components together will create an exemplary model of commercial building practices in the southeast that will consequently better utilize North Carolina's energy resources.

References

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

Hirst, Eric, Jeanne Clinton, Howard Geller, and Walter Kroner. 1986. *Energy Efficiency in Buildings, Progress and Promise.* American Council for an Energy Efficient Economy, Washington, D.C.

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.

Nadel, Stephen, Michael Shepard, Steve Greenberg, Gail Katz, and Anibal T. De Almeida. 1992. *Energy Efficient Motor Systems: A Handbook on Technology, Program and Policy Options.* American Council for an Energy Efficient Economy. Washington, D.C. and Berkley, California.

U.S. Energy Information Administration (USEIA). 1995. *Commercial Buildings Energy Consumption and Expenditures*. Office of Energy Markets and End Use. U.S. Department of Energy. Washington D.C.

U.S. Energy Information Administration (USEIA). 1998a. *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.

U.S. Energy Information Administration (USEIA). 2002. Annual Energy Outlook 2001. Office of Integrated Analysis and Forecasting. U.S. Department of Energy. Washington, D.C.

U.S. Energy Information Administration (USEIA). 1999a. *Commercial Buildings Energy Consumption and Expenditures, 1995.* Office of Energy Markets and End Use. U.S. Department of Energy. Washington D.C. Available at http://www.eia.doe.gov/pub/pdf/consumption/031895.pdf/. Internet

U.S. Energy Information Administration (USEIA). 1999b. *State Energy Data Report, 1996.* Office of Energy Markets and End Use. U.S. Department of Energy. Washington D.C.

www.eren.doe.gov/buildings/commercial_roadmap