Chapter 7: Residential Sector

Overview

The residential sector includes the many types of dwellings in which North Carolinians live. The sector concerns new and existing residences that encompass the broad range of single family standard homes, manufactured homes, and multi-family buildings. The objective of the state energy plan is to delineate policies and programs that will increase the efficiency of both new and exiting dwellings in order to maximize our energy resources and preserve North Carolina's environmental quality.

In 1960, residences in North Carolina used almost 38% of total net energy in North Carolina; however, by 1970, the sector used only 22%, and today consumes about 16% of total net energy use in the state, as shown in Figure 7-1. Net energy use refers to total fuel and electricity consumption other than that used to generate electricity. 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 7-2 shows historical energy use by sector in North Carolina and Figure 7-3 shows the breakdown by fuel in 1999. Figure 7-2 depicts the rapid growth of electricity and natural gas with the simultaneous decline of coal and wood. Note that during the latter 1990s, use of energy remained relatively constant, despite a boom in both the state's economy and housing industry. Petroleum, which includes three important energy sources, distillate fuel oil, kerosene, and propane, continues to provide a healthy 19% of total energy use.

Table 7-1 shows the historical growth rate of residential energy sources, while Table 7-2 demonstrates how the market share of each energy source has changed over the past several decades. Once again,

Figure 7-1: 1999 Energy Breakdown by Sector (1,678 Trillion Btu total)

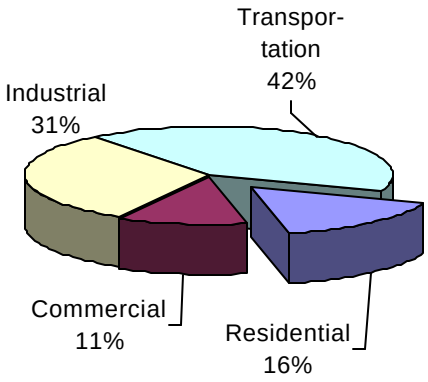


Figure 7-3:
Residential Energy Source Breakdown for 1999

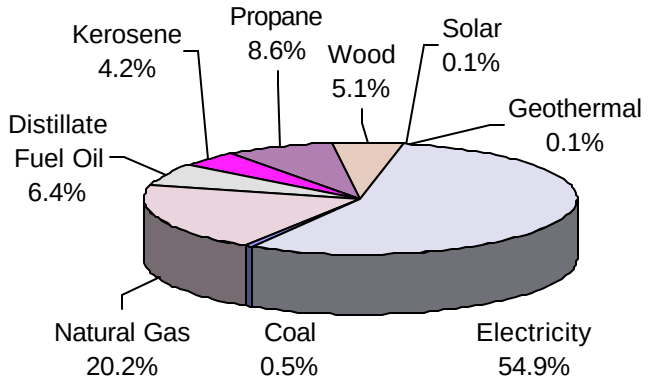


Table 7-1:
Annual Historical Growth Rate of Residential Energy Sources

	1960-1999	1980-1990	1980-1999	1990-1999
Coal	-4.7%	-0.7%	-0.7%	-0.8%
Natural Gas	4.8%	0.5%	2.3%	4.7%
Distillate Fuel Oil	-1.7%	-6.6%	-4.2%	-1.9%
Kerosene	-4.2%	-6.5%	-1.6%	3.9%
Propane	3.3%	4.0%	4.1%	4.6%
Wood	-2.9%	-0.5%	-0.8%	-1.3%
Electricity	5.3%	3.1%	3.0%	3.1%
Solar/ Geother-mal*	n/a	n/a	n/a	n/a

* Could not be calculated from data available

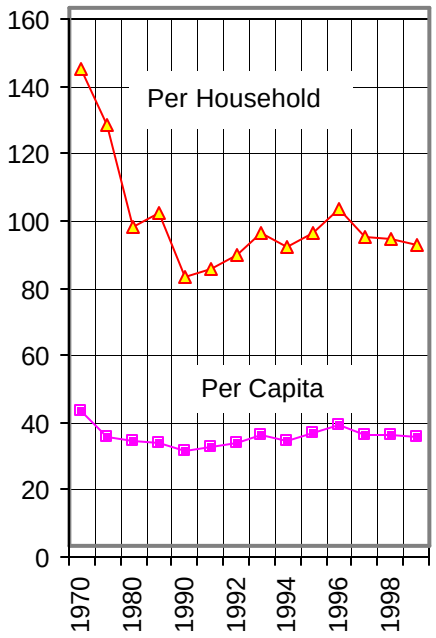
electricity in particular has witnessed rapid growth, along with natural gas. In fact, electricity use represented only about 11% of total energy use in the sector in 1960 and now provides 55%. Natural gas use went from 5% in 1960 to 20% in 1999. Coal and wood consumption have declined severely. The petroleum category, which includes distillate fuel oil, kerosene, and propane, suffered decline in market share from 55% to about 20%, but remains an important source of energy for residences today, primarily for space heating and in the case of propane, for water heating.

Table 7-2: Market Share of Residential Energy Supply in North Carolina

	Coal	Natural Gas	Petroleum	Wood	Solar/ Renewable	Electricity
1960	4.7%	4.9%	55.2%	24.2%	*	10.9%
1965	2.5%	8.0%	57.7%	16.2%	*	15.6%
1970	1.6%	12.7%	53.8%	9.3%	*	22.6%
1975	1.5%	14.4%	40.2%	10.7%	*	33.2%
1980	0.7%	17.0%	33.2%	8.0%	*	41.1%
1985	0.8%	14.0%	29.7%	12.0%	*	43.5%
1990	0.7%	17.1%	21.0%	7.3%	0.1%	53.7%
1995	0.8%	19.3%	21.1%	7.7%	0.2%	51.0%
1999	0.5%	20.2%	19.2%	5.1%	0.1%	55.0%

* Denotes market share not know or under 0.1%
Source: *State Energy Data, 1960 – 1999*, U.S. E.I.A., 2001.

Figure 7-4: Energy Use Per Capita and Household



Per Capita Energy Use

Figure 7-4 shows that energy use per person and 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 capita use began to decline again. Reasons for the increase in the early and mid 1990's may include:

- Level energy prices reduced lifestyle energy conservation efforts, such as lowering thermostat settings in winter, turning the thermostat back at night, waiting to turn on the heating system until October or November, waiting to turn on the cooling system until late May, reducing hot water consumption, and using appliances efficiently.

- Winters were cooler and summers were warmer during the period.
- New construction and renovation of existing structures resulted in an increase in the average size of residences.
- Higher economic growth during the 1990's caused consumers to spend more on energy to support a more consumptive lifestyle.

Increases in Population and Number of Households

The number of occupied households obviously exerts pressure on total residential energy use. North Carolina's growing economy, pleasant climate, and excellent schools have made it an attractive site for businesses and people to relocate. As such, 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 in 1996 ranked 5th in the nation in both value and number (U.S. Bureau of the Census 1996).

Additionally, ***over 15.2 million homes in the southern region of the United States were built before 1970 (USEIA 1997). Retrofitting these older homes with energy efficient insulation, lighting and windows could represent significant savings in consumer energy expenditures as well as providing increased employment levels.***

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 upgrade to improved windows, higher insulation values, and more efficient heating and cooling systems for only $695. The unit should save over $150 per year – a payback period of less than 5 years.

While the manufactured home industry provides energy efficient models, most existing units, as with site-built homes, are in need of energy upgrades. However, energy efficiency features in manufactured homes are more difficult to install than in standard homes. The difficulty of installation is compounded by the fact that most manufactured home occupants do not have disposable income for energy improvements. In addition, the shorter life span of a manufactured home tends to deter efficiency improvements, which may require years to achieve energy savings to pay back the initial cost to the consumer.

Residential Energy End Use

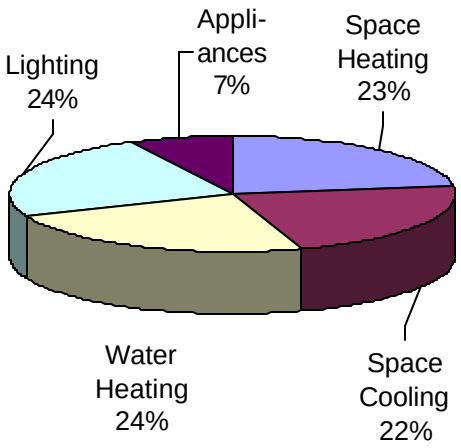
North Carolinians use energy in many ways in our homes. The primary uses, as shown in Figure 7-5 and Table 7-3, are for heating, cooling, and hot water. However, as homes have improved insulation levels and increased the efficiency of heating and cooling systems, auxiliary needs

The overall growth rate from 1970 to 1990 for energy and economic indicators in North Carolina:

- *Residential Energy Use – Grew 23%*
- *Population – Grew 51%*
- *Households – Grew 92%*
- *Energy Use per Capita – Decreased 19%*
- *Energy Use per Household – Decreased 36%*
- *New homes over 3,000 sq. ft. increased from 0.8 million in the 1980's to over 1.3 million in the 1990's across the U.S.*

…Over 15.2 million homes in the southern region of the United States were built before 1970 (USEIA 1997). Retrofitting these older homes with energy efficient insulation, lighting and windows could represent significant savings in consumer energy expenditures as well as providing increased employment levels.

Figure 7-5: North Carolina Residential Energy End Use by % (1999)



The fact that 70% of North Carolina's hot water needs are met through electricity indicates a significant potential for heat pump water heaters and solar domestic water heating. Implementing these technologies into new residential construction could provide a substantial reduction in monthly consumer energy expenditures and reduce electric power plant emissions.

for appliances and lighting have increased in importance.

- Electricity provides about half of space heating needs, 70% of hot water, and virtually all of space cooling, lighting and appliance energy use.
- Natural gas supplies 17% of space heating and 20% of hot water.
- Propane and kerosene supply 12% of space heating and 9% of hot water.
- Fuel oil provides about 12% of space heating.

The fact that 70% of North Carolina's hot water needs are met through electricity indicates a significant potential for heat pump water heaters and solar domestic water heating. Implementing these technologies into new residential construction could provide a substantial reduction in monthly consumer energy expenditures and reduce electric power plant emissions.

Table 7-3: Estimated Energy Consumption by End Use and Source in 1997 (Million Btu per household)

End Use	Electri-city	Natural Gas	LPG/ Kerosene	Fuel Oil	Totals
Space Heating	17.5	13.7	2.5	1.1	34.8
Space Cooling	33.2	0	0	0	33.2
Water Heating	21	13.4	1.1	0	35.5
Lighting	35.9	0	0	0	35.9
Appliances	35.8	9.6	1.7	0	11.3
Totals	**143.4**	**36.7**	**5.3**	**1.1**	**150.7**

Source: EIA, South Census Region

Efficiency Measures for Residences

The residential sector represents tremendous opportunity for reducing energy use. Fortunately, many energy efficiency measures are cost effective and provide additional benefits from a statewide view. For example, a more efficient new home will usually cost a little more than a comparable less efficient home. However, the cost of home ownership for the efficient home will actually be less than for the less efficient home because the annual energy savings are far greater than the additional annual costs of a mortgage.

As Table 7-4 shows for a typical home, the more efficient home generates thousands of dollars in energy savings over the life of the mortgage. Even when the additional down payment is factored into the cash flow, the home experiences a net positive cash flow within one or two years.

Table 7-4:
Cash Flow for a Sample Energy-Efficient New Home

	Standard	Energy-Efficient			
Year	Annual Energy Cost	Extra Mortgage Cost	Annual Energy Cost	Total Cost	Cumulative Savings
1	1,200	526	850	1,376	(176)
2	1,218	166	863	1,029	13
3	1,236	166	876	1,042	208
4	1,255	166	889	1,055	407
5	1,274	166	902	1,068	613
10	1,372	166	972	1,138	1,725
20	1,592	166	1,128	1,294	4,412
30	1,848	166	1,309	1,475	7,796

Figure 7-6 shows annual costs of mortgage and energy for a sample home with four efficiency levels. The base case home uses more energy than the other three, and as the figure shows, has the greatest annual cost. The three efficiency packages are progressively more expensive, adding to the annual mortgage case. Yet each package is less expensive overall because of the increasing savings on annual energy bills. Unfortunately, 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.

Figure 7-7 shows an example of the cash flow from investing in energy retrofit -- applying efficiency measures to existing homes, which can

Figure 7-6: Economic Analysis of Energy Efficiency Measures for a New Home

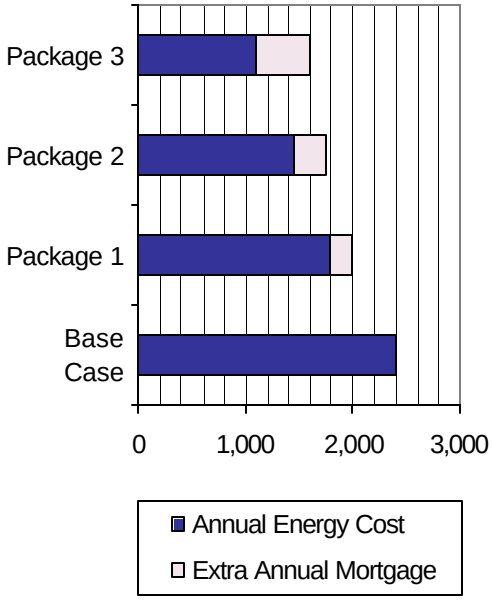


Figure 7-7:
Economic Analysis of Energy Retrofit Opportunities*

Year	Savings (Cost)	Cumulative Savings (Costs)
0	-1800	
1	300	(1,500)
2	306	(1,194)
3	312	(882)
4	318	(564)
5	325	(239)
10	359	1,485
15	396	3,388
20	437	5,489

* Example assumes investing $1,800 for retrofit wall insulation, duct sealing, air sealing, and a programmable thermostat saves at least $300 per year. Energy costs are assumed to escalate 2% annually.

offer similar economic benefits to new construction. There are three primary financing options for the owner – cash payment, a short-term loan, or a second mortgage. After 20 years, the 1,800 has produced cumulative net energy savings of about $5,500.

Figure 7-8: Energy Efficiency Scenarios: Energy Use (TBtu)

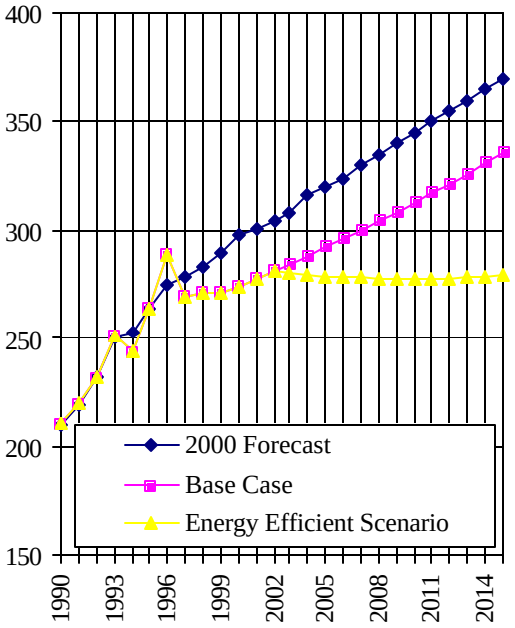
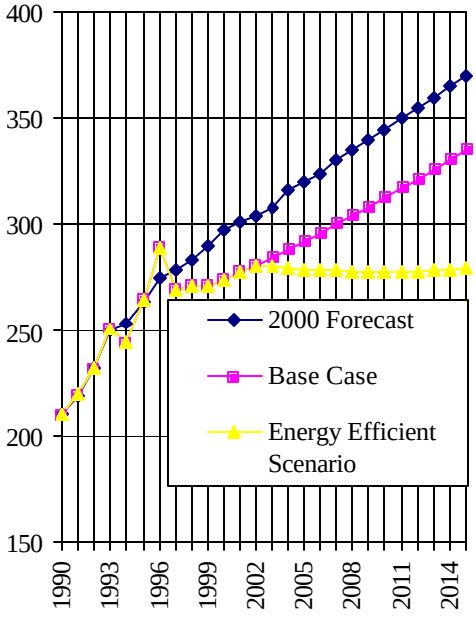


Figure 7-9: Energy Efficiency Scenarios: CO2 Emissions (Million Tons)



Energy Efficient Scenario

Figure 7-8 depicts three projections of energy use in the residential sector. The 2000 forecast was based on data up to 1996. At that point in time, per capita energy use was on the increase. However, as discussed earlier, energy use per capita dropped during the latter 1990's. The revised Base Case forecast takes into account more recent data. The two trends point out the highly variable nature of energy forecasting. The Energy Efficient Scenario assumes that energy efficiency and renewable energy measures can reduce energy use in 2015 by 20% of 1999 consumption.

Based on projections of energy use by fuel type, Figure 7-9 shows carbon dioxide emissions over the same time period. In both figures, the Energy Efficient Scenario shows a near leveling of energy use and CO_2 emissions in the residential sector. Of course, achieving the results of the Energy Efficient Scenario assumes a massive effort to retrofit existing residential structures and substantially increases the efficiency of new residences.

The reductions in residential energy use in the energy efficient scenario resulted primarily from energy efficiency measures in existing homes and more efficient new homes, including improvements in the following areas:

- Improved insulation and windows
- Air sealing
- Shading
- Duct sealing and insulation
- HVAC efficiency
- Lighting efficiency
- Hot water efficiency measures and heat pump water heaters
- Solar water heating systems
- Passive solar heating in new homes
- More efficient appliances

Without a concerted and unified effort on the part of state government, private industry, and North Carolina's citizens, there is no possibility that the scenario shown earlier will become reality. The policy options described below indicate the type of effort required.

Residential Sector Policy Options

Residential Energy Efficiency Gap

As is the case with the commercial and industrial sectors, the residential sector experiences what could be termed an "Energy Efficiency Gap." The term refers to the fact that ***in both residences under construction and those that are occupied, highly cost-effective technologies that reduce energy costs are not being installed. In many cases, the payback period for these efficiency measures is less than two years.*** Clearly, the building sector is not effectively minimizing the Life Cycle Costs of homes.

. . . in both residences under construction and those that are occupied, highly cost effective technologies that reduce energy costs are not being installed. In many cases, the payback period for these efficiency measures is less than two years.

As discussed earlier, purchasers of new homes can obtain the lowest Life Cycle Costs by investing in a wide range of efficiency features, which may increase the purchase price, but lower annual payments for the mortgage and energy costs from the first year on.

Owners of most existing homes have available a variety of cost effective investments in energy efficiency. However, consumers face a variety of obstacles in making a wise choice of the best energy measures for their homes:

- Determining the highest priority measures depends on the home's design, current energy features, occupant's operating practices and owner's preferences. In many cases, the only way to truly discover the most important technologies to install is to have an expert conduct an energy audit.
- While the state is probably richer in energy expertise than most other states in the region, there is not a clearly defined energy auditor profession. In addition, the cost of a full energy audit – usually $200 at a minimum – is in itself a constraint.
- Many subcontractors in the state, such as insulation companies, heating and cooling equipment dealers, and general contractors, are quite knowledgeable in their field, but do not have expertise in other aspects of energy efficient, high performance buildings.
- The field of energy efficient buildings changes rapidly and many contractors and subcontractors are not aware of recent developments.

While financing for efficiency improvements can often be obtained through lending organizations, either as short-term loans or second mortgages, most financial institutions do not provide loans targeted for energy efficiency improvements. Thus, homeowners are sometimes not aware that their energy projects can be paid for over time to make them more affordable. In addition, loan departments typically are not able to assess the impact of efficiency improvements on occupant energy bills in order to counsel them about the wisest use of their loan.

The challenge facing the state of North Carolina is to provide

mechanisms to correct these market flaws in order to bolster the efficiency of new and existing homes. Those involved in energy efficiency work are well aware that it is much cheaper and more effective to make new homes as efficient as possible rather than waiting for remodeling to occur.

The policies described in this section are designed to make full use of existing state institutions and organizations so as to minimize additional infrastructure requirements. Many of the policies discussed have been successfully implemented over the past two decades in other states.

Mandatory New Home Programs -- Residential Energy Codes

The State Energy Office should work in concert with the Department of Insurance and the Building Codes Council to examine the energy code and implement more stringent efficiency measures.

Much of the savings for the Energy Efficiency Scenario in Figure 7-4 comes from new buildings. A critical first step was the recent adoption of the International Energy Conservation Code. However, one development in North Carolina's code adoption process was the elimination of the requirement that windows in the warmer climatic zones of North Carolina have provisions to reduce transmission of sunlight in summer. The requirement, if interpreted strictly as written, provided little energy savings. The lack of energy savings is due to the fact that poorly planned shading reduces energy bills in the summer but increases winter heating bills. However, there are highly cost-effective window strategies available for new homes that could be included in the code.

Residences constructed under current state energy codes will not accomplish the goals for the energy efficiency scenario. To succeed in a meaningful reduction, the following changes would be required:

- Enforce air-sealing requirements.
- Require window insulation values with U-0.4 or lower and solar heat gain fractions of 0.40 or less.
- Require more efficient heating and cooling systems.
- Require fully sealed ductwork.
- Require increased installation of efficient lighting systems in new residences.
- Achieve better control over energy-using devices by setting minimum energy efficiency standards for all electrical equipment installed in new homes.

The State Energy Office should work in concert with the Department of Insurance and the Building Codes Council to examine the energy code and implement more stringent efficiency measures. Specific requirements should provide demonstrated positive economic returns. In developing a more stringent code, a minimum payback period (perhaps 8 years) or rate of return (perhaps 8% annually) should be set by regulating organizations with input from businesses, designers,

contractors, utilities, and the general public.

Other energy code policies shall include the following:

- Provide performance testing at the end of construction.
- Develop code amendments that require a whole house systems approach, i.e., all of the home's components shall be selected for optimum efficiency to meet high performance goals.

The State Energy Office should become integrally involved with the Building Codes Council and its Energy Committee in order to monitor new energy code developments and provide input into the energy code process. Assigning the State Energy Office a permanent slot on the Building Codes Council would ensure that energy efficiency receives special recognition in development of future code provisions. The Energy Office should work with the North Carolina Department of Insurance on acceptable procedures to monitor energy code compliance in the new home industry for units in all market sectors.

The North Carolina State Energy Office shall work with the state Department of Insurance to improve enforcement of existing energy codes and adoption into code of cost effective energy efficiency measures in new homes. Specific policies concerning code enforcement include the following:

- Continue to provide training for code enforcement officials through workshops and other programs on the science and construction of high performance homes.
- Require knowledge of efficiency and high performance building issues in HVAC and Code Enforcement Official licensing exams. Require code enforcement officials to have continuing education on energy issues.
- Investigate recommended increase in building permit fees to improve energy code enforcement.

The North Carolina State Energy Office shall work with the state Department of Insurance to improve enforcement of existing energy codes and adoption into code of cost effective energy efficiency measures in new homes.

Mandatory New Home Programs -- Public Sector Buildings

North Carolinians on limited incomes are the least able to afford energy bills. Utilities have sought to assist them with their payments by providing equalized bills throughout the year. Unfortunately, energy bills for households with lower incomes still have higher energy bills per square foot than those with moderate income. Thus, new housing units targeted for the lower income sector – termed affordable housing -- must be as efficient as possible.

All housing receiving state funding shall meet North Carolina Energy Star standards. An Energy Star Partners Committee should be formed to promote Energy Star homes, appliances, electronic products and other energy-efficient measures in North Carolina. The committee shall meet quarterly to discuss and assess statewide

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activities to promote the North Carolina Energy Star label. The Energy Star program discussed in the following sections contains a cost effective package of efficiency measures that should reduce energy bills 30% to 50% below those for typical new housing units. The requirement would encompass single-family, duplex, and multi-family units.

The State Energy Office will work with state organizations involved in energy efficient affordable housing, including Advanced Energy Corporation, North Carolina A & T, Appalachian State University, Habitat for Humanity, and others involved in affordable housing to encourage private and non-profit housing organizations to adopt the Energy Star standard for their homes as well. The North Carolina Housing Finance Agency has developed a partnership with Advanced Energy to combine AEC's SystemVision energy-use guarantee program with NCHFA's New Homes Program and Self-Help Housing Program for low-income homebuyers. This program provides specific requirements for energy-efficient construction and guarantees annual heating and cooling costs.

In general, meeting the requirements of Energy Star in affordable homes should be possible for little additional cost due to the compact nature of most of the home plans for this sector. Advanced Energy Corporation estimates an added cost of $2,500 per home for these additional Energy Star measures (Katz). The extra mortgage cost would be about $200 per year and the energy savings would most likely exceed $400 annually.

The State Energy Office shall work with HUD to establish minimum efficiency guidelines for manufactured housing sold in North Carolina.

Mandatory New Home Programs – Manufactured Homes

In North Carolina, 25% to 35% of new housing starts are manufactured homes. Currently, the minimum efficiency levels required are set by the U.S. Department of Housing and Urban Development (HUD). While manufactured homes tend to be less efficient than site-built homes, many manufacturers of these units offer energy efficient packages. ***The State Energy Office shall work with HUD to establish minimum efficiency guidelines for manufactured housing sold in North Carolina.***

Because the units have shorter life spans than site-built homes, some efficiency measures may not be as cost effective as others. However, most manufacturers offer units with an ample insulation package, tighter construction, higher efficiency heating and cooling systems, and improved duct air tightness and insulation. The U.S. Department of Energy and Environmental Protection Agency have set Energy Star standards for the industry. Manufactured housing units shall include prominent energy-use labels on the structure that detail expected energy use and cost figures.

The state shall consider setting up a council to address energy efficiency in manufactured housing since several groups around the state are working in the area. North Carolina A&T and other researchers have investigated more efficient units and some utilities

have efficiency programs offering incentives for upgraded models.

Mandatory Existing Home Programs – Energy Ratings for Homes Being Sold

It is difficult for those shopping for a home to determine the efficiency of their candidate homes. Often, the primary clues are printouts of monthly utility bills and reports from building inspectors, whose main focus is the structural integrity and current condition of the home. Unfortunately, neither approach provides a way to compare the efficiency of homes. The only way to obtain a reliable comparison is via an energy audit or a home energy rating.

The State Energy Office should work with members of the construction, realty, and financing industry to develop procedures for providing an energy rating for homes that are currently on the market. In addition to providing the prospective homeowners with the energy rating for the home, they should also produce a checklist of current efficiency levels in the home, along with efficiency levels that meet code in North Carolina.

The State Energy Office should work with members of the construction, realty, and financing industry to develop procedures for providing an energy rating for homes that are currently on the market.

Voluntary New Home Policy -- Develop North Carolina Energy Star Home Standard

Energy Star is a voluntary national program managed jointly by the U.S. Environmental Protection Agency and the U.S. Department of Energy. The program has been highly successful in developing and promoting a recognizable label for appliances and electronic equipment for homes and businesses. The program now sets guidelines for buildings as well.

One major advantage of a NC Energy Star Home program is that the state already has an excellent history of developing programs for high performance buildings. Advanced Energy Corporation, located in Raleigh, has been instrumental in helping builders, developers, and mechanical contractors improve homes and small commercial buildings in the state. AEC also is working with a number of national homebuilding corporations on high performance standards for their homes. Other groups and individuals, including researchers at the North Carolina Solar Center; professors at North Carolina State University, North Carolina A&T, Appalachian State University Energy Center, University of North Carolina at Charlotte, East Carolina University, and other universities; consultants at Southface Energy Institute – North Carolina and numerous other organizations, have performed training and outreach work directed to reduce energy consumption in both residential and commercial buildings.

The requirements for a NC Energy Star Home would include not only minimum levels of insulation, air sealing, duct insulation and sealing, efficient appliances, and other efficiency measures, but also a battery of tests to ensure that targeted levels of air tightness, ventilation, and duct sealing are met. In addition, there would be specific requirements for

The North Carolina State Energy Office should convene a representative Working Group of homebuilders, energy efficiency specialists, mortgage lenders, appraisers, insulation subcontractors, heating and air conditioning subcontractors, and consumer product manufacturing and sales companies to develop standards for a statewide Energy Star home program.

heating and cooling systems to ensure they are sized, designed, and installed properly. Some of the provisions and testing would help provide for high quality indoor air.

A current example of "Energy Star" construction can be seen in the national program "Environments For Living." The EFL program prescribes development criteria for new home construction that addresses air sealing, proper HVAC system sizing, duct sealing, ventilation issues and insulation quality issues. The EFL program also requires testing of all mechanical systems in new homes to insure energy efficiency standards are being met. The first EFL subdivision in North Carolina is currently underway in Raleigh and is being managed by Barton Development. As the EFL program gains momentum, so will the general awareness level in consumers and builders regarding energy efficient construction requirements.

The Energy Star Home program would include a rating system for new homes. Many states in the nation have established Home Energy Rating Systems (HERS) that use energy raters to assess the efficiency of a new or existing home and assign an energy rating. The rating correlates to the Energy Star Home program.

In addition to establishing the criteria for a North Carolina Energy Star Home and developing a rating system, the Energy Star Home program would necessitate the following:

- Design and implement a training and certification program for mechanical and insulation contractors that is appropriate for all climatic zones in the state.
- Develop an industry of certified home energy inspectors who objectively and expertly evaluate the energy performance of homes via visual inspection, air leakage testing, pressure testing, and duct leakage testing. Testing should be required during design, construction and at completion.
- Design and implement a program to monitor the inspection industry.
- Seek incentives for Energy Star homes provided by builders, utility companies, and financial institutions; in particular, the incentives could pay for the inspection and testing procedures.
- Examples of Energy Star incentives may include 1) a cash rebate to the homeowner or builder of $300-$600, 2) a state tax credit with a cap of $1 per square foot of heated space and 3) reduced interest rates on Energy Star home mortgages with the state providing 1% of the cost. Electric utility programs in the past have used the cash rebate to encourage energy efficient construction. There are several advantages of direct payments:
- A $300 to $600 payment would most likely be less than a tax credit. For example, if the state offered a 25% tax credit for

achieving an Energy Star rating, the additional costs would be $2,500 and up. The tax credit on $2,500 is $625.

- ❖ With direct payments, the state would not have to verify the actual extra costs of compliance.
- ❖ Tax credits may allow builders or homebuyers to "pad" the extra costs and increase their credit.
- ❖ There is less likelihood of fraudulent practices with a direct payment that plagued the Federal Tax Credit program in the 1980s.
- ❖ In discussions with a national builder of apartments, an incentive of only $75 per unit ($50 per "ton" of air conditioning) was sufficient for them to build apartments to energy efficiency standards in cities where utilities offered "Good Cents" programs. The cash payment alone was not the reason for their interest; they were also attracted to the publicity value of having the "Good Cents" logo in their advertisements. The same incentive in residences would range from $150 to $300 in average-sized homes.

- ♦ Assist the industry and related fields with continued training and certification programs that are continually updated with state-of-the-art information.
- ♦ Design and implement a homeowner education program that would educate new homeowners on how to best manage their home's energy use.

Voluntary New and Existing Residences -- Utility Demand-side Management Programs

During the past two decades, many electric and gas utilities have designed and implemented programs intended to reduce demand for energy and consequently save on the cost of supplying energy. In fact, utilities have been one of the leading institutions providing incentives for cost effective energy efficiency and solar energy strategies. However, the utility industry is currently in flux due to uncertainties about current deregulation efforts. Many demand side programs have been canceled in recent years as utilities prepare for a more competitive future.

The North Carolina Utilities Commission should require utilities in the state to develop and implement demand-side management plans that reduce energy use in new and existing residences.

Utility programs included incentives and low-interest loans for insulation and window efficiency, sealing air leaks and duct leaks, lighting efficiency, refrigerators, and maintaining or replacing heating and cooling systems. The programs in some states were quite successful, but few have achieved market penetrations over 10%.

Electric utilities in North Carolina have both existing and new programs targeting residential energy efficiency. For example, Carolina Power and Light has a new efficiency program with elements

aimed at new homes, manufactured housing, and existing homes.

The North Carolina Utilities Commission should require utilities in the state to develop and implement demand-side management plans that reduce energy use in new and existing residences. The programs should be consistent with the requirements of the North Carolina Energy Star Program. Of course, the programs should be applied judiciously within the present regulatory framework so as not to reduce the regional cost-competitiveness of North Carolina's utilities.

Voluntary Existing Homes Program – Energy Star Standard

The number of existing homes in North Carolina far exceeds the number of new homes that will be constructed over the next ten years. The State Energy Office should develop an Energy Star Program for these units. The elements of this program would include:

- A rating system similar to that for new homes.
- A method of prioritizing energy retrofits on existing units that provides a clear, concise checklist for consumers.
- Training programs for energy raters and building contractors.
- Incentives for homeowners to qualify their homes as meeting Energy Star criteria such as discounts on the cost of energy-efficiency improvements or logistical assistance with energy testing.

Currently, there are no energy audit programs in place in North Carolina. Electric and gas utilities, as well as some private companies, have offered energy audits of existing homes to evaluate the most cost effective improvements. North Carolina should develop a mechanism for offering comprehensive energy audits under the umbrella of the North Carolina Energy Star program that specifically targets existing homes. Encouraging continued energy audits will benefit all parties concerned with reduced demand loads for utilities and lower energy expenditures for homeowners. The best audits use diagnostic tools, such as blower doors and duct testing fans. While a comprehensive audit provides excellent information to the client, it does not guarantee that the recommended energy measures will be installed. Consequently, the State Energy Office should continue to wok with utilities to ensure that, when energy testing is done, the necessary improvements are implemented.

The North Carolina State Energy Office will develop an Energy Star Program for existing homes, working with a representative group of energy experts, consumer organizations, renovation contractors, HVAC dealers, insulation contractors, lending organizations, utilities, and others involved in the field.

The North Carolina State Energy Office will develop an Energy Star Program for existing homes, working with a representative group of energy experts, consumer organizations, renovation contractors, HVAC dealers, insulation contractors, lending organizations, utilities, and others involved in the field. In addition, the Energy Office and its committee will develop a procedure to generate a checklist indicating current energy features of the home and a prioritized list of recommended energy efficiency options. The checklist should be available to prospective homebuyers prior to

closing. Hopefully, the homebuyer will elect to obtain additional financing to make energy efficiency improvements. The objective of the program is to increase awareness of and market penetration of efficiency improvements to existing homes. Qualifying homes would receive a North Carolina Energy Star certificate.

The existing home efficiency program should include a mechanism to provide a list of energy efficiency measures in priority order based on characteristics of the home. The program could either use existing software, or develop software specifically to meet the programs goals.

In order to earn the energy savings provided in the aggressive scenario, the Energy Star program would have to achieve maximum penetration into the residential sector. Policy options that provide the best chance of maximizing market capture include:

- Requiring a Home Energy Rating on every house sold, similar to mandatory radon testing.
- Providing direct financial incentives, such as tax credits or rebates, for Energy Star homes at the mortgage closing.
- Promoting the Energy Star program heavily throughout the state to increase consumer recognition of the Energy Star logo.

Energy Star Mortgages

Lending institutions have an interest in decreasing energy use in buildings, as the resulting lower bills reduce the annual cost of building ownership. Traditionally, home mortgage approval only considers the loan payment (principal and interest), property taxes, and insurance. Some mortgage lenders, as well as federal lending bodies such as FNMA, offer incentives for homes with improved efficiency. For example, the *Home Performance Power Initiative* was developed by Fannie Mae to help increase resource-efficient construction and home ownership. This program includes low and zero-down payment mortgages that utilize the savings of energy conservation in the loan evaluation process. Consequently, lenders can use this monthly savings to qualify a borrower for a larger mortgage. Mortgages available through the Home Performance Power initiative have low or no down payment required, as well as a three percent borrower contribution for closing costs that can come from a gift, grant, the borrower's own funds or other sources. These mortgages can also be used in conjunction with manufacturer and utility rebates available for Energy Star homes and can also be applied towards closing costs.

The mortgage programs promoted by Fannie Mae's *Home Performance Power Initiative* are available to homeowners of all income levels. North Carolina lending institutions supporting FNMA programs include Bank One, Cendant Mortgage Corp., Central Carolina Bank/Trust, Citizen's Bank FSB, Country Wide Home Loans, and numerous other lending institutions. The State Energy Office should

strive to promote these types of mortgage incentives so as to encourage the implementation and awareness of energy efficient new home construction in North Carolina.

Many building owners are constrained from purchasing the home they desire because they cannot quite qualify for the loan because their income is too low to afford the projected mortgage payments. Lending institutions that increase the debt-to-income ratio assume that the energy savings from the more efficient home will more easily allow homeowners to afford their mortgage payments. However, the program should be monitored to make certain that the homebuyers who elect to qualify are not financially strapped by a mortgage that is at the maximum affordable level..

It is crucial for the success of these programs that energy audits are performed on Energy Star homes prior to closing and the resultant data be provided to the lending institution. This procedure is necessary in order to verify the actual savings that energy-efficient construction produces. Consequently, the lending institution will be better able to assess whether or not increased debt-to-income ratios are feasible.

North Carolina's State Energy office should work with the Energy Star committee to formulate and promote mortgage-based incentives for new homes that have fulfilled Energy Star requirements.

North Carolina's State Energy Office should work with the Energy Star committee to formulate and promote mortgage-based incentives for new homes that have fulfilled Energy Star requirements. These programs should include, but not be limited to:

- Full use of existing federal loan programs to encourage homes qualifying as NC Energy Star homes
- Providing incentives for mortgage lenders to either reduce the interest rate or lower the down payment requirements on qualifying NC Energy Star homes.

The State Energy Office should also include work with lending institutions to fund the efficiency measures in existing homes. The loan program should contain guidelines to ensure proper selection and installation of energy retrofit technologies.

Low-Income Weatherization

North Carolina's Department of Health and Human Services should strengthen the Low Income Weatherization program and continue its work to optimize the energy efficiency work being performed in the field..

North Carolina's Department of Health and Human Services should strengthen the Low Income Weatherization program and continue its work to optimize the energy efficiency work being performed in the field. The State's weatherization program is currently seeking to improve the protocol used by weatherization agencies located around the state in order to provide the most cost effective energy savings. The state should continue these improvement efforts, set goals for the number of homes to be weatherized over the next ten years, and annually evaluate how to improve operations and service more homes and other dwelling units.

The North Carolina Department of Health and Human Services also operates the Low Income Energy Assistance Program (LIEAP), which provides financial support to pay energy bills for those who are

economically disadvantaged. The purpose of LIEAP funding is to insure those with low incomes are not inadvertently disconnected from electricity and natural gas utilities during winter and summer.

While LIEAP provides a valuable service, it does not save energy. In fact, the program actually increases energy use, but for a very important reason – to provide comfort and prevent health problems during extremely cold or hot weather. In order to make LIEAP disbursements as cost effective as possible, recipients should receive training on low-cost, no-cost measures to save energy in their home. For example, during energy audits conducted on homes in North Carolina, auditors noted that wintertime thermostat settings in homes exceeded 80 degrees F. Lowering the thermostat setting to 72 degrees could save 40 to 50% on heating bills. Educating consumers about the importance of reasonable thermostat settings would allow substantial savings.

The North Carolina Low Income Energy Assistance Program should expand its pool of resources through a substantial development effort. While most of the funding should provide financial support for paying utility bills, 10% to 20% should be used for outreach efforts to reduce energy bills by employing low-cost or no-cost energy programs.

The North Carolina Low Income Energy Assistance Program should expand its pool of resources through a substantial development effort. While most of the funding should provide administrative and financial support for paying utility bills, 10% to 20% should be used for outreach efforts to reduce energy bills by employing low-cost or no-cost energy programs.

Energy Tax Credits

North Carolina has maintained solar energy income tax credits for many years. This tax credit was expanded in 1999 to include all renewable energy sources. Well designed credits provide a win-win situation, as the reductions in state taxes from homeowners claiming the income tax credit are compensated for by taxes on increased state income from companies that install energy measures, as well as additional taxes generated as homeowners spend the energy savings they earn each year. ***The State Energy Office should conduct a comprehensive analysis of the Renewable Energy Tax credit and an expanded tax credit to include efficiency measures.***

The State Energy Office should conduct a comprehensive analysis of the Renewable Energy Tax credit and an expanded tax credit to include efficiency measures.

The revenue impacts could be substantial, as shown below:

- The state energy efficiency tax credit would directly reduce state revenues, however, sales of efficiency measures in the state would increase income, increase profits, and increase state tax revenues.
- Reduced energy use would decrease imports of energy, increase income in the state, potentially increase profits from industry due to increased sales, and thus increase state tax revenues.
- Additional income in the state (from sales of efficiency measures and decreased imports of energy) could result in a multiplier effect that would further increase incomes, profits, and state tax revenues.
- Utilities would incur reductions in income, which would have a

consequent reduction in incomes, profits, and tax revenues.

A study on a set of augmented Renewable and Efficiency State Energy Tax Credits would examine issues such as:

- Historical impact of the Renewable Tax Credit on the state's economy and energy use
- Review of similar studies in other states
- Development of assessment tools designed to estimate the impact of energy savings on state income and tax revenues
- Analysis of the multiplier effect related to reductions in residential energy use
- Impact of a tax credit on investment in energy efficiency improvements
- Evaluation of "free riders"—those who already planned to invest in efficiency improvements, but received the tax credit anyway.

The State Energy Office should also consider why there is not more widespread use of the renewable tax credit in the state…the State Energy Office should determine and help develop strategies to foster increased purchase and installation of solar water heating, passive/active space heating and photovoltaic technologies.

The State Energy Office should also consider why there is not more widespread use of the renewable tax credit in the state. Through outreach programs, cooperative work with the North Carolina Solar Center, the North Carolina Sustainable Energy Association, companies in the solar industry, and other groups, ***the State Energy Office should determine and help develop strategies to foster increased purchase and installation of solar water heating, passive/active space heating and photovoltaic technologies.***

Training and Education Programs

Achieving improved efficiency in North Carolina can only occur if those involved in the residential construction industry are better informed and trained. The entire spectrum of designers, builders, code enforcement officials, subcontractors, realtors, and appraisers needs to learn the key ingredients of an energy-efficient home that provides high performance to its occupants. Educational programs should include:

- Energy efficiency classes at community colleges and universities around the state.
- Licensing procedures for relevant designers, code enforcement officials, general contractors, heating and cooling dealers, realtors, appraisers, and home inspectors.
- Workshops organized for specific types of audiences.
- Consumer education via the mass media, workshops, and home shows.

Specific policies concerning education and training include:

- Contact NC Department of Public Instruction to find out

mechanisms for curriculum change to integrate energy education into more courses and grade levels.

- Use incentives and education to get building owners, contractors, and designers to use more efficient technologies in buildings, including exterior lighting, interior lighting, and reflective roofs.
- Develop and implement a public relations campaign and training program on low cost, high impact measures in new construction (e.g. duct systems).

Technical Assistance

Technical assistance activities provide training, evaluation and assessment, outreach, or direct assistance to those interested in increasing the efficiency of residential buildings in North Carolina. Fortunately, the state has a number of training-related organizations and activities with national and indeed international reputation. These organizations include Advanced Energy Corporation, the North Carolina Solar Center, and Southface Energy Institute – North Carolina, as well as faculty at several of the state's universities.

The state makes use of federal funding to sponsor workshops and other outreach programs on more efficient residences. North Carolina should not only continue supporting these programs but also seek to expand its efforts to secure continued funding for energy efficiency projects. Of course, more training efforts could be conducted through private channels, or with joint sponsorship and encouragement of state agencies. For example, the North Carolina Department of Insurance annually conducts several meetings with the state's mechanical inspectors. In recent years, the meetings have included sessions on energy codes, energy efficient heating and cooling systems, and other energy-related topics.

The state makes use of federal funding to sponsor workshops and other outreach programs on more efficient residences. North Carolina should not only continue supporting these programs but also seek to expand its efforts to secure continued funding for energy efficiency projects.

Conclusion

Promoting and enabling energy efficient construction and renovation within the state needs to be a concerted effort between the State Energy Office, the construction and mechanical trade groups, banking/lending institutions and state/local governments. By implementing policies that require minimum building performance levels in new homes, the state can be assured of a high-quality, high-performance housing stock that efficiently utilizes domestic energy resources. The continued support of tax credits and other incentives for energy efficiency measures in existing homes will insure housing values stay at an optimum level. Additionally, the development of mortgage programs that support Energy Star requirements will make initial energy efficiency investments possible for all income levels of homebuyers.