ENERGY EFFICIENCY IN HOMES: AN INTRODUCTION AND STUDY PROPOSAL

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ENERGY EFFICIENCY: AN OVERVIEW

In homes across the country, energy is wasted prolifically. In the winter, heat wafts out poorly-sealed windows, under doors, and through uninsulated attics. In the summertime, sunlight beams into the house, causing air conditioners to pump harder. Hall lights and television screens are left on all night. These inefficiencies, individually small, add up to serious money and resources.

Energy is generated by burning coal and other fossil fuels, and is sent to homes across America through power lines and fuel pipes. Energy inefficiency occurs when energy is wasted in its dissemination or its use. Wasted energy means wasted fossil fuels, materials that are difficult to extract and produce. Most important to consumers, wasted energy translates into wasted money. See the sidebar "Energy and the Environment" for more information.

As energy bills are second only to rent/mortgage in terms of economic causes for homelessness, promoting energy efficiency may be a successful strategy to increase financial stability. Consumers benefit from reduced spending on energy, but may be uninformed about these benefits, unable to take advantage of them, or unwilling to make the investment. Breaking these barriers to energy efficiency is a challenge for energy efficiency advocates.

There are several groups that are concerned with improving energy efficiency. These include all levels of governments; non-profit groups, such as environmental, consumer advocates, and poverty assistance groups; and power companies. Governments offer incentives to decrease energy bills and provide assistance to low-income renters and homeowners. Much of this assistance comes in the form of weatherization aid. Non-profit and industry also offer energy grants for low-income people.

Unfortunately, people who most need these services often do not take advantage of them. The authors of this report believe that many people do not have access to the information that they need to make decisions about energy efficiency. Thus, a case study was designed to better assess access to energy efficiency information, especially among low-income households. This paper will focus on a proposed case study in Chapel Hill and Carrboro, North Carolina, in addition to offering a broad perspective on issues related to residential energy efficiency.

Energy and the Environment

The environment is impacted in many ways, both directly and indirectly, from energy consumption and production. Below are just a few of the major environmental concerns, related to energy use:

Global Warming and Climate Change

The consequences of climate change are uncertain, but potentially catastrophic. According to the Energy Information Administration, energy production emits approximately 40 percent of US emissions of total carbon dioxide, a greenhouse gas.

Air Pollution

Air pollution leads to adverse health effects, especially in vulnerable populations. As asthma rates have climbed in recent decades, people have become more concerned about air pollution from coal-fired electricity plants.

Water and soil contamination

One only needs to remember the Exxon Valdez oil spill to understand the impacts that energy has on our oceans, lakes, and streams. Oil contaminants harm ecosystems in soil and water.

Source: Energy Information Administration.

DATA AND ENERGY EFFICIENCY MEASURES

Data on efficiency levels of United States households is not readily available. Little information exists that documents the proportion of households that are "energy efficient" or "energy deficient." Part of this may be due discrepancies in terminology. What makes a dwelling energy efficient? How often are buildings cited for needed upgrades? What proportion of residents take advantage of loan programs for improving energy efficiency? These questions are difficult to answer.

Basic consumption data, however, are available. Other information exists to help consumers and homeowners choose between efficient products. The following seeks to establish what is known about energy efficiency standards at the national, state, and local levels.

How is energy efficiency determined on a national scale?

Consumption Data

The Energy Information Administration (EIA), a statistical agency of the U.S. Department of Energy, tracks energy information on an annual basis. Several reports and studies by the EIA during the mid-1990s indicate the need for developing reliable criteria for determining energy efficiency in the residential sector[1].

A step in this direction is a 2005 report on Residential Energy Consumption Survey (RECS) data, collected in 2001. RECS is carried out by the EIA every four years; information collected includes data on energy consumption, household expenditures, and housing characteristics. Information from this survey measures energy intensity: how much energy households consume, per disposable income. Measurement of true energy efficiency is a complicated measure involving more factors. Intensity measures cannot accurately account for demographic variables, age and condition of structures, climate and weather, or even energy use per resident. According to the 2005 EIA report, energy intensity declined between 1980 and 2001. Figure 1 indicates that in 2001, US households spent less on energy, per disposable income, than households in previous years[2].

Figure 2 illustrates that overall, household energy use declined in terms of floor space categories. Homes in 2001 used relatively less energy than those of the same size in 1980. A number of different factors may be responsible for this change, including appliance upgrades, building technologies, and code standards. In addition, the average square footage of homes has been steadily rising in recent decades, counteracting any gains in efficiency as measured by floor space.

The EIA report warns that energy intensity measurement may not be a substitute measure for energy efficiency. Though EIA has illustrated a work plan for determining residential energy efficiency on a national scale, the agency has not taken any further action. As of this report, no comprehensive method for determining efficiency on a national scale was fully developed.

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[1] Residential Sector Energy-Efficiency Workshop. <www.eia.doe.gov/emeu/efficiency/residential_ws.htm> 13 February 1996.

[2] Battles, Stephanie J. and Behjat Hojjati. "Two Decades of U.S. Household Trends in Energy-Intensity Indicators: A Look at the Underlying Factors." <www.eia.doe.gov/emeu/efficiency/2005_IAEE.pdf> Energy Information Administration Report, 2005.

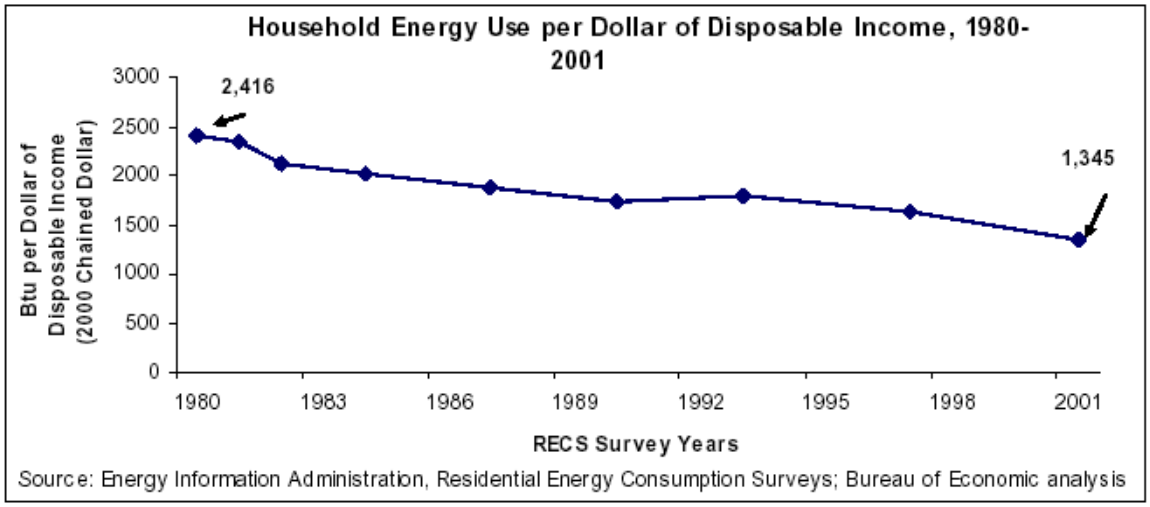

Figure 1: EIA data charts decrease in energy spending per dollar of disposable income between 1980-2001.

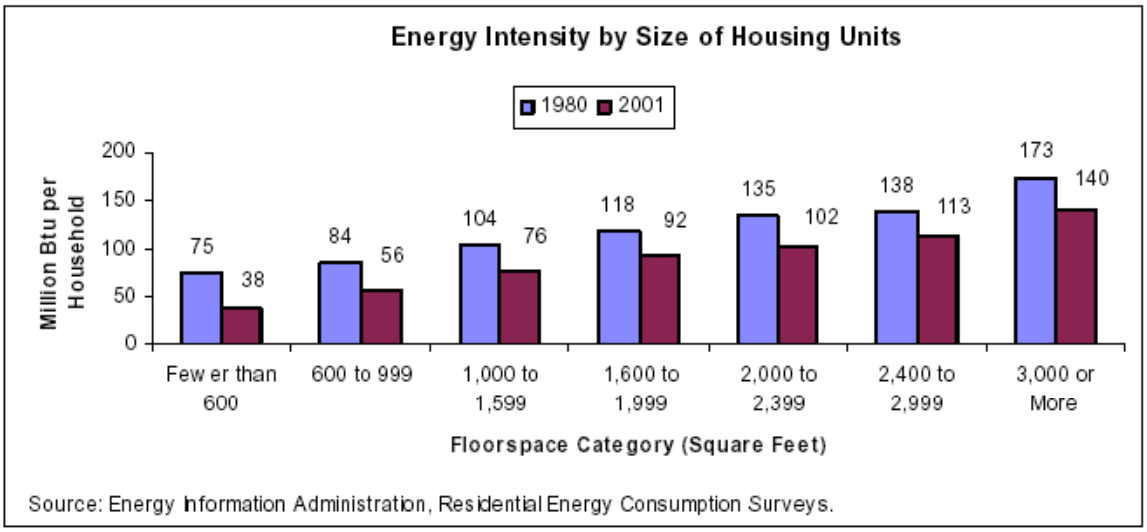

Figure 2: EIA data indicates an increase in energy efficiency from 1980-2001 as a function of floorspace.

Though the EIA has researched how to measure changing energy efficiency on a national scale, no such plan has been implemented.

Use of Efficient Products

Another federal agency is taking action to improve energy efficiency for consumers in a variety of sectors, including residential customers. The Energy Star Program, created in 1992 by the US Environmental Protection Agency (EPA), began as a voluntary labeling program designed to identify and promote energy efficient products. The Energy Star label is now used to identify energy-saving products in over 40 product categories such as appliances, lighting, and heating/cooling systems. A new category includes new or retrofit compliant residential homes. Energy Star

qualifying products operate on approximately 30 percent less energy than other products; a house equipped with Energy Star products will save average homeowners approximately $400 annually[3]. Over 360,000 Energy Star qualified homes were constructed as of 2004, with an annual savings of $200 million in energy costs. A new retrofit program, known as Home Performance with Energy Star, approved more than 11,000 homes with the Energy Star label in 2004. EPA estimated that 175 million Energy Star labeled products would be sold in 2005, along with new construction of 170,000 qualified homes[4]. The program is expanding the Home Performance with Energy Star program, which may serve as a reliable energy efficiency standard for future studies. It includes installation of Energy Star products in addition to duct sealing, insulation upgrades, and other repairs.

Innovative Building Design

Yet another federal agency seeking to improve residential energy efficiency is the Department of Energy (DOE). In cooperation with Building Science Corporation, a private company, the DOE is implementing the Building America program as a public-private partnership to improve residential energy efficiency through research. This program seeks to create energy efficiency through systems engineering and climate-specific building practices, a different approach from the one-size-fits-all EPA Home Performance with Energy Star program. The Building America program has worked with Habitat for Humanity to build energy efficient affordable housing, seeking to cut energy use in each home by 30 to 90 percent. Building America determines energy efficiency through building design, innovative technologies, and climate-specific approaches, including use of Energy Star products[5]. This ongoing research project is likely to create standards for new affordable housing, but to date, the program has not produced a substantial amount of affordable, energy efficient, housing stock.

How is energy efficiency measured in the state of North Carolina?

As at the national level, very little energy efficiency data is available on North Carolina residential units. The amount or cost of energy consumed by residential units, however, is readily available.

According to the Alliance to Save Energy, almost 40 percent of North Carolinians' energy bills will go toward heating costs in 2006. By 2007, average energy bills for North Carolina homes heated with natural gas will increase by a total of $240. Likewise, electric heating costs will rise by approximately $45[6]. The EIA also tracks data at the state level, but this information is limited

[3] Energy Star: The Power to Protect the Environment Through Energy Efficiency. <www.energystar.gov/ia/partners/downloads/energy_star_report_aug_2003.pdf> Environmental Protection Agency. EPA 430-R-03-008, July 2003.
[4] Climate Protection Partnerships 2004 Annual Report. <www.energystar.gov/ia/news/downloads/annual_report2004.pdf> Environmental Protection Agency. EPA 430-R-05-010, September 2005.
[5] Building Science Corporation: Building America website. <www.buildingscience.com/buildingamerica/default.htm> Accessed February 2006.
[6] Energy and Money-saving Tips for Consumers in North Carolina. Alliance to Save Energy. <www.ase.org/content/article/detail/2809> Accessed 30 January 2006.

to residential consumption and prices/expenditures; the agency does not perform an analysis with these figures[7].

The most comprehensive state resource in the area of state energy statistics is the North Carolina State Energy Plan, published in 2005. The report is a compilation of current data, trend analysis, and future projections for energy use in industrial, business, and residential sectors. The report also lays out a plan for managing energy consumption across sectors, including improving energy efficiency in the residential sector[8].

Most new homes in North Carolina's booming housing market do not incorporate specific energy efficient measures.

While the south is the largest housing growth market in the country, the North Carolina State Energy Plan indicates most new homes in North Carolina's booming housing market do not incorporate specific energy efficient measures[9]. Therefore, rather than representing the state-of-the-art in construction, most new homes become candidates for energy retrofit measures, such as those implemented by the national programs previously described. Not only are existing homes in need of energy-saving improvements, but new homes are candidates for improvement as well

This discrepancy shows a need for education and improvement at the state level. Possibilities exist for more stringent regulation of the booming North Carolina housing industry. Also lacking are consumer education resources that assist new homeowners in their product choices.

How is energy efficiency measured at the local level?

No comprehensive sources were found to analyze energy efficiency measures at the local level. A prime research ground for such a study could include the Triangle area, due to its mix of income classes, and old and new housing stock, along with a wealth of both single-family dwellings and rental units. Determination of efficiency on a unit-basis is possible through a technical audit performed by a private sector professional.

[7] State Energy Consumption, Price, and Expenditure Estimates (SEDS). Energy Information Administration website. <www.eia.doe.gov/emeu/states/state.html?q_state_a=nc&q_state=NORTH%20CAROLINA> Accessed 2 February 2006.
[8] North Carolina State Energy Plan, 2005. <www.energync.net/sep/docs/sep_12-04.pdf> Accessed 30 January 2006.
[9] Ibid.

LAWS AND POLICIES GOVERNING ENERGY EFFICIENCY

Sometimes the most effective way to achieve change is through regulation. Regulations occur at the national, state, and local level to encourage (or discourage) energy efficiency. The following is a look at what regulations currently exist, and where improvements can or should be made.

What factors are involved in regulating residential energy efficiency at the national level?

Code Compliance

All building codes are regulated by national guidelines, established by the International Code Council (ICC). States have the authority to choose which regulations to require within their boundaries, and many add rules or mandates not established at the federal level. The ICC establishes basic national standards through codes. The organization began in 1994 as a nonprofit organization dedicated to developing a single set of comprehensive and coordinated national construction codes. Prior to 1994, three different sets of construction codes existed in the United States, overseen by Building Officials and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), or the Southern Building Code Congress International (SBCCI). Today the three entities combine to form the ICC, whose codes are applied without regional limitations across the United States. ICC codes set standards for construction, health and safety, mechanics, zoning, and energy conservation[10].

Development of all building codes is an open process to all parties with a "vested interest" in the code. According to the ICC, this includes code officials, design professionals and consultants, trade associations, builders and contractors, manufacturers and suppliers, and government agencies. The "I-Code" development cycle is an ongoing, transparent 18-month process that includes a closed code development hearing, a lengthy public hearing process, and a final action hearing before a new code is adopted and published. Codes are typically updated every three years[11].

As one might guess, politics is present throughout the code development process. For example, in September 2005 the National Association of Home Builders (NAHB) successfully lobbied against a DOE-proposed change to increase residential insulation requirements. The NAHB estimated the increased requirement would cost consumers from $1,000 to $4,000 per new home constructed for an energy savings of only $15 per year[12]. This issue demonstrates the desire to attach savings costs to energy efficiency measures, especially at the regulatory level. Strong industry lobbies exist to encourage or stop legislations or codes that may encourage energy efficiency but hurt the bottom line. By demonstrating substantial cost savings to both consumers and industry, regulations are more likely to be adopted.

The International Energy Conservation Code (IECC), a code developed by the ICC, addresses energy efficient design guidelines for both residential and commercial buildings in the areas of

[10] International Energy Conservation Code and the International Code Council. <www.iccsafe.org/news/about> Accessed 30 January 2006.
[11] The ICC Code Development Process. <www.iccsafe.org/cs/codes/pdf/CD022704.ppt> February 2004.
[12] "Builders prevail against costly energy code change." National Association of Homebuilders website. <www.nahb.org> Accessed 30 January 2006.

envelope design, mechanical systems, lighting, and the use of new materials and techniques. The newest version of the IECC was published in 2006[13].

Energy code compliance, through the IECC is accomplished through three different approaches: prescriptive, trade-off, and performance. Through a prescriptive approach, a home meets minimum allowable standards set forth by the code, such as requirements for components such as windows, walls, and roofs. A trade-off approach allows enhanced energy efficiency in one area to combine with decreased efficiency in another. This "systems approach," allows a builder to demonstrate the overall design of a home is more efficient, overall, than a designated baseline. This is often required when using solar heating or other nontraditional components[14].

Legislation

A 1992 federal DOE initiative known as the Energy Policy Act required states to certify that their energy codes were updated to meet or exceed minimum levels of efficiency. This was a DOE-led initiative. Today the DOE continues to set rules and provide information, training, and tools for increasing energy efficiency and building codes. These activities are carried out by the DOE's Energy Efficiency and Renewable Energy office[15].

A recent update to legislation, the Energy Policy Act of 2005 (Public Law 109-58), is a statute signed into law in August 2005. The Energy Policy Act seeks to address growing energy problems and provide tax incentives and loans to both energy producers and consumers. Energy, as defined by the Act, is not limited to electricity; it also includes U.S. oil consumption and production, and approves an increase in Daylight Savings Time beginning in 2007.

Critics argue that the bill is merely subsidizes U.S. energy companies[16]. While this criticism may contain elements of truth, the Act also brings some benefits to taxpayers. It provides a 10 percent tax credit for people who pay for qualified energy efficiency improvements. These include insulation systems, exterior windows, exterior doors, and metal roofs. Additionally, the law provides a credit for costs related to residential energy property expenses. Eligible items include $50 for each advanced main air-circulating fan, $140 for each qualified natural gas, propane, or oil furnace or hot water heater, and $300 for each item of qualified energy efficient property. The downside to these benefits is the maximum credit for all taxable years is $500[17].

Other energy efficiency highlights of the Energy Policy Act include authorization of $3.4 billion per year from 2005 to 2007 for the Low Income Housing Energy Assistance Program (LIHEAP). Funding will increase for low-income weatherization programs and state energy programs to improve energy efficiency. The Act also expands the Energy Star program[18].

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[13] 2000 International Energy Conservation Code. <www.iccsafe.org/dyn/prod3800500.html> Accessed 12 April 2006.

[14] Why are There So Many Approaches for Energy Code Compliance? Building Energy Codes Resource Center. Article #120, 15 March 2005.

[15] Energy Efficiency Database. <www.iea.org/textbase/pamsdb/detail.aspx?mode=ee&id=1938> Accessed 2 February 2006.

[16] Grunwald, Michal and Juliet Eilperin. "Energy Bill Raises Fears About Pollution, Fraud." The Washington Post. 30 July 2005, p. A1.

[17] Highlights of the Energy Policy Act of 2005. Internal Revenue Service website. <www.irs.gov/newsroom/article/0,,id=153397,00.html> January 2006.

[18] Energy Policy Act of 2005. <http://energycommerce.house.gov/108/energy_pdfs_2.htm> Accessed 2 February 2006.

What state measures address residential energy efficiency?

Code Compliance

In North Carolina, the State Building Code Council is responsible for developing all state codes. The Commissioner of Insurance and staff of the Engineering Division also have input. Rule changes are considered on a quarterly basis, while final authority to adopt codes is the responsibility of the state legislature. Like the code development process at the ICC, the state process is an open process with public hearings[19]. The State Building Code Council adopted the 2000 IECC with amendments specific to North Carolina in 2001. While the state sets the standard, it is the responsibility of local government units to enforce building codes through the inspection and permitting processes.

Legislation

In 2003, the state of North Carolina adopted a new State Energy Plan, the first since 1992. The 2003 plan detailed ninety-two recommendations to provide guidance to state-initiated activities. Upon reexamination of original action items, the Energy Policy Council revisited the plan in 2003 and approved a revised list of Action Items for the 2004-2005 fiscal year. Recommendation 14 suggests the state government continue to support its low-income weatherization program and review the effectiveness of projects. Additionally, the Recommendation seeks to address energy-efficient housing in the low-income sector. The last part of this recommendation advises the State Energy Office to investigate minimum efficiency requirements for manufactured homes, including Energy Star homes[20].

What local initiatives encourage energy efficiency?

In compliance with North Carolina State Law, Chapel Hill has adopted the 2002 International Building Code, which includes the 2002 IECC and North Carolina amendments. Wording in the Housing Code, Chapter 9 of the municipal code, refers specifically to encouraging "energy efficiency" during construction and development. However, specific requirements for energy efficient design do not exist in the town code[21].

It should be noted that a separate Energy Conservation Ordinance requires all town-owned buildings be designed to achieve a goal defined by the Green Building Council's Leadership in Energy and Environmental Design (LEED) program[22]. LEED is a national certification program used to recognize commercial buildings that incorporate environmental design practices. A LEED residential design standard does not yet exist; it is currently under development[23]. This ordinance is unique in North Carolina, though it only regulates municipally owned buildings. Public housing built or owned by the Town of Chapel Hill is not required to meet this standard.

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[19] North Carolina DOE Status of State Energy Codes. DOE Energy Efficiency and Renewable Energy website. <www.energycodes.gov/implement/state_codes/index.stm> Accessed 12 April 2006.

[20] North Carolina State Energy Plan. 2005 Revised Edition. <www.energync.net/sep/docs/sep_12-04.pdf> Accessed 30 January 2006.

[21] Municipal Ordinance, Town of Chapel Hill. 25 June 2005. <www.municode.com/services/mcsgateway.asp?sid=33&pid=19952> Accessed 3 February 2006.Municipal Ordinance, Town of Chapel Hill. 25 June 2005. <www.municode.com/services/mcsgateway.asp?sid=33&pid=19952> Accessed 3 February 2006.

[22] Ibid.

[23] LEED. U.S. Green Building Council website. <www.usgbc.org> Accessed 12 April 2006.

BARRIERS TO ENERGY EFFICIENCY

This section of our report will discuss current barriers to energy efficiency from several perspectives: behavioral, design-oriented, and market-oriented. The first perspective concerns predominant attitudes toward energy efficiency among consumers and the depth of consumers' knowledge about energy efficient practices within the household. The second perspective concerns barriers to energy efficiency that stem from the design of products themselves. Finally, the third barrier this section will explore concerns the marketplace, and especially, ways that government regulation may, according to some authors, impede energy efficiency in public utilities.

Behavioral Barriers

Based on the sources that we have consulted, there are several factors that influence attitudes towards voluntary energy conservation in the household: the availability of information, the absence of or poor quality of financial incentives, and the prices of utilities.

One author submits that "if 'energy illiteracy' – lack of information regarding the severity and scale of energy problems, relative energy prices, and consumption alternatives – limits consumers' capacities to compare costs and formulate action plans [for the conservation of energy], then the delivery of higher-quality information might by expected to result in a greater conservation response"[24]. Based on this suggestion, we believe that greater access to the information resources outlined in the previous section of this report would help to alleviate the problem of 'energy illiteracy' to the extent it is a problem in the area of Chapel Hill that we propose to study. We also believe that an empirical study like the one outlined below would help illuminate, in general, the level of knowledge about fundamentals of energy efficiency among the pool of residents in our survey and, specifically, highlight particular problem areas where there is an egregious lack of basic information.

Greater access to the information resources outlined in the previous section of this report would help to alleviate the problem of "energy illiteracy."

Another group of authors suggest several reasons why consumers fail to take advantage of certain financial incentive schemes that would contribute to higher energy efficiency, or fail to act in ways that analysts believe are in their best financial interests. Some of these reasons include: lack of accurate information, confusion about the terms of the incentives, excessive time required to take advantage of the incentives, suspicious attitudes toward the organizations or corporations offering the incentives, lack of financial resources to put into incentive schemes that

[24] Lutsenhizer, Loren. "Social and Behavior Aspects of Energy Use," *Annual Review of Energy and the Environment* 18 (1993): 247-89. 253.

require an initial investment, and the "relative invisibility of conservation impacts."[25] To take one of these reasons as an example, many consumers lack the financial resources to take initial advantage of incentive programs such as rebate programs for retrofitted energy-efficient appliances or home improvements in which consumers pay first and then later receive a reimbursement for part of their investment. In other words, a certain amount of money is needed upfront for many of these programs, and the many lower-income households are therefore unable to participate.

Financial and Market-based Barriers

Some barriers to energy efficiency are products of the marketplace. Evidence suggests that there is an alarming "efficiency gap" between what is in the best economic interest of the consumer and his or her actual efforts to improve energy efficiency within homes. One study defines the "efficiency gap" in the following way: "The efficiency gap, a phrase now widely used in the energy-efficiency literature, refers to the difference between levels of investment in energy efficiency that appear to be cost effective based on engineering-economic analysis and the (lower) levels actually occurring"[26].

The most significant change in the market for energy in the United States today concerns the gradual deregulation of the industry in many states. There is now increased competition within the electricity industry, for example, that is changing the traditional structure of energy monopolies for the provision of power. Thus, the previously cited study claims that "In place of utility monopolies, markets will arise for a variety of products that we do not currently differentiate in the uni-dimensional product we call retail electric service. Consumers faced with these unbundled and competitively priced products will be able to choose freely among suppliers. Consumers' choices, rather than those of vertically integrated utilities, will reveal the appropriate balance between supply- and demand-side resources"[27].

Design Barriers

Many barriers to energy efficiency arise from the design of products and of homes and buildings. Fortunately, in recent years, governments, corporations and organizations have invested enormous amounts of research in improving the design of products, appliances, buildings, and so on. Many of these barriers, therefore, are gradually being overcome. It is still uncertain, however, when this research will become widespread enough to become mainstream within the current lineup and products and services.

There are several basic principles that contribute to energy efficient building practices. An energy efficient building or home incorporates features of design that maximize use of natural or renewable energy sources. These features decrease both the amount of energy needed within the structure as well as pollution, and in the meantime save money for the consumer. While some principles of energy efficient design and construction entail greater costs initially, and move

[25] Stern, P. C., Aronson E., Darley, J., et al. "The effectiveness of incentives for residential energy-conservation," *Evaluation Review* 10 (1986): 147-76.
[26] Golove, William G. and Joseph H. Eto. "Market Barriers to Energy Efficiency: A Critical Reappraisal of the Rationale for Public Policies to Promote Energy Efficiency," Energy & Environment Division, Lawrence Berkeley National Laboratory, March 1996: 6.
[27] Ibid, xi.

many consumers and business-owners less likely to make the initial investment, in the long run enacting these measures yields significant energy and cost savings.

Currently there is a rapidly growing market for energy efficient design in the United States. There are several fundamental features of energy efficient design that builders should increasingly incorporate into their building practices:

- daytime living areas with large north-facing windows to receive unobstructed winter sun
- internal planning to create zones which allow you to only heat or cool those rooms in use
- windows which are appropriately sized and shaded to reduce summer heat gain
- where large areas of glass are needed, use high performance glazing such as double glazing, and be careful to provide adequate summer shading
- adequate insulation in walls, ceilings and floors
- good draught proofing
- cross ventilation for summer cooling
- efficient heating systems that heat different zones at different times, enabling you to heat only the rooms you are using rather than heating the whole house
- efficient hot water systems and fittings
- efficient lighting and appliance
- landscape design that optimizes shading to create cool and comfortable conditions.

CHAPEL HILL, NC ENERGY AND AFFORDABILITY

North Carolinians may have different or at least more specific energy concerns than those of residents of other states. It is important to understand these concerns when targeting the improvement of energy efficiency in North Carolina. Hot and humid summers and relatively warm winters require a greater use of air conditioning, especially during the summer months. Equally the cooler winter temperature in the mountains of western North Carolina increase heating costs in the winter compared to those on the southeast coast. Climate greatly affects energy consumption and costs. Also, a citizen may lack access to the information they need to reduce energy consumption. The information is obtainable but in many cases it is difficult to find and confusing to decipher. This section attempts to answer some of the most basic energy information questions anticipated by a resident of Carrboro and Chapel Hill, North Carolina.

Are energy rates for various companies freely available?

Duke Energy and Progress Energy are the main energy providers for Chapel Hill and Carrboro. These companies provide, on their websites, information regarding energy rates for North Carolina customers in general. Information on rates is available based on a variety of criteria, including whether or not one is using residential or commercial services. Rates are also based on the level of efficiency of an individual's home. Both companies, Duke Energy and Progress

Energy, provide lengthy documents on their respective websites that outline their rates. In many cases the information is presented in one of a number of charts that can be both difficult to understand and tedious to read.

What is the most important thing to know about the energy rates?

Progress Energy provides a variety of payment plans to their customers[28]. It is important to understand that although the basic customer charge per month remains the same throughout the year, the energy charge per a kilowatt-hour (kWh) changes depending upon the time of year. Thus energy rates are higher in the summer and lower in winter. For instance under the most basic plan at Progress Energy, the charge per kWh during the winter months (November – June) is a full cent ($0.01) cheaper than in the summertime (July – October). The increased demand in summer, on account of the increased use of air conditioners, fans, etc., results in the higher rates. Another payment option allows the consumer to increase the base payment (a monthly payment that does not change from month to month). In this scenario the charge per a kWh is increased during on-peak service, but is considerably cheaper during off-peak service. Such a rate would help consumers who do not use as much energy in the summer time (either by not having an air conditioner or by not constantly running it). All of these payment schedules are obtainable on the internet. The internet is a valuable resource but how often it is used by energy customers to budget their monthly energy costs or to corroborate their monthly energy bills is an analysis which could be presented in the prospective case study outlined below.

Like Progress Energy, Duke Energy provides rate schedules on their website. Duke Energy's rates change depending upon what time of year it is. Rates are generally cheaper from November to June and increase in the peak summer months from July to October. Rates also change according to the amount of energy consumed. Thus, at regular intervals of kilowatt-hours, charges are generally increased. Another important category offered by Duke Energy is that the company rewards consumers whose homes meet EnergyStar criteria. Thus, energy efficiency not only saves money because less energy is consumed, but energy efficiency also saves money by effectively lowering rates[29].

Of vital importance is that both Progress Energy and Duke Energy provide a variety of payment options for their customers. Consumers, depending on their own individual energy needs, can decide which rate schedule best fits their needs. For some it may make sense to pay a slightly

[28] www.progress-energy.com/aboutenergy/rates/NCScheduleRES-3.pdf. These rates are for single-phased service, which refers to the type of service provided to residential customers as defined on the webpage: "The types of service to which this Schedule is applicable are alternating current, 60 hertz, either single-phase 2 or 3 wires or three-phase 4 wires, at Company's standard voltage of 240 volts or less." Three-phase Service adds $9.00 to the single-phase service bill. Each of the following three schedules is taken directly from the Progress Energy website and only minor changes to format have been made. Other energy rate schedules can be found at: www.progress-energy.com/aboutenergy/rates/NCScheduleR-TOUE-3.pdf. and www.progress-energy.com/aboutenergy/rates/NCScheduleR-TOUD-3.pdf.

[29] http://www.dukepower.com/aboutus/rates/ncrates/NCScheduleRS.pdf. There are other categories available for billing based on certain complex specifications of water heating requirements. The rate provided in the above table is "Category 1" the most common. Only changes to format have been made. The material is reproduced from the Duke website. Other schedules can be found at: http://www.dukepower.com/aboutus/rates/ncrates/NCScheduleRE.pdf. This schedule states that a variety of requirements be met, including that an "environmental space conditioning system and a separate electric water heater must permanently be installed." And www.dukepower.com/aboutus/rates/ncrates/NCScheduleES.pdf. This service requires that the home complies with EnergyStar standards.

higher base rate and a lower kWh rate than for others. But, in some cases the customer does not have a choice. Many of the payment schedules provided by Duke Energy and/or Progress Energy may be beyond the financial control of the customer. For example, at Duke Energy the rates for an EnergyStar rated home are cheaper than for a home that does not meet the standards. But the cost to upgrade one's home to meet EnergyStar standards may not be possible. In some cases then, while the monthly rate may be less, the cost to the customer to ensure the availability of such a rate may not be feasible. The amount of time it would take the customer to recoup the losses of upgrading their home through the monthly savings may not be worth it.

Is help available to increase home energy efficiency?

A variety of state and national programs provide resources for customers interested in increasing the energy efficiency of their homes, whether they are motivated by environmental, health or financial concerns. Some of the available resources, all of which are outlined in detail on the internet, are described in general below.

The North Carolina Division of Social Services (DSS), a division of the Department of Health and Human Services (DHHS), provides energy assistance to residents in need. The DSS provides funds through the Low Income Energy Assistance Program (LIEAP), which "is a Federally-funded program that provides for one-time cash payments to help eligible families pay their heating bills. This payment is usually received in February of each year"[30]. To be eligible, households must meet the following criteria: (1) "have at least one U.S. citizen or non-citizen who meets the eligibility criteria"; (2) "meet an income test"; (3) "have reserves at or below $2,200"; (4) "be responsible for their own heating bills"[31]. In order to apply for this funding, residents must contact their local DSS office. The Orange County Department of Social Services provides assistance to residents of Carrboro and Chapel Hill[32].

The North Carolina Division of Social Services also provides the Crisis Intervention Program[33]. This federally-funded program shares many of the requirements and application procedures of the LIEAP, but the Crisis Intervention Program also states that funds are available in the summer for cooling costs as well as in the winter for heating costs.

The North Carolina Department of Health and Human Services also provides low-income citizens with a Weatherization Assistance Program directed through the Office of Economic Opportunity. The Program helps "low-income citizens save energy and reduce expenses through the installation of energy conservation materials, the implementation of energy efficiency measures in their homes and energy education"[34]. Eligibility is heavily restricted but according to the Office's own website "the 3500 families that benefit from the program annually save an average of $218 in energy costs per year throughout the lifetime of the installed measures"[35]. That is a little less than $20 a month, not a huge amount of savings, but enough to make a

[30] www.dhhs.state.nc.us/dss/energy/index.htm. Accessed March 3, 2006.
[31] www.dhhs.state.nc.us/dss/energy/index.htm. Accessed March 3, 2006.
[32] The complete address for the Orange County Department of Social Services is: Orange County Department of Social Services, 300 West Tryon Street Hillsborough, NC 27278, State Courier#:02-91-13
(919) 245-2800 / Fax: (919) 644-3005.
[33] www.dhhs.state.nc.us/dss/crisis/index.htm. Accessed March 3, 2006.
[34] www.dhhs.state.nc.us/oeo/weather.htm. Accessed March 3, 2006.
[35] www.dhhs.state.nc.us/oeo/weather.htm. Accessed March 3, 2006.

difference. On the other hand, in 2000 there were over three million households in the entire state of North Carolina[36]. Helping 3500 families should only be measured as the beginning.

Does Duke Energy or Progress Energy provide any assistance?

Both Progress Energy and Duke Energy provide loans, either directly or through reputable lending agencies, to those customers who wish to finance home improvements that will enhance the energy efficiency of their home[37].

How important is energy efficiency in North Carolina?

Energy efficiency is good for everyone. Furthermore, the state has an interest in energy efficiency. According to the North Carolina State Energy Plan, the North Carolina State Energy Office "allocates approximately $13.4 million in supporting educational programs and research/demonstration projects focused on energy efficiency and renewable energy technologies and applications"[38]. Funding is provided to a variety of programs and areas, including "affordable, energy efficient homes", "building efficiency", "industrial efficiency", "the public sector", "renewables", and "transportation"[39]. For the purposes of the present project the full description found in the State Energy Plan of the first two categories is worth noting. The affordable, energy efficient homes section involves "weatherization; affordable new home program; [and] manufactured home programs." The building efficiency section involves the "energy code and high performance building training and development; market transformation programs, including green building, Energy Star, Building America, and Rebuild America; [and] building research projects." The state and its citizens are only starting to get involved in energy efficiency. Problems, however, still exist.

It is important to note that the state of North Carolina is concerned that the chasm between funds and programs is growing such that in the coming years North Carolina energy programs such as those listed above will be in need of drastic new funding measures.[40] One possibility for increasing the funding would be the development of a Public Benefits Fund (PBF) that would be essentially a tax on the consumer that could be used to fund such programs. Such a consideration has its opponents and proponents.[41] Lost in all of these programs may be the low-income citizen, not only unaware of the looming funding crisis but perhaps unaware of the existence of such helpful programs. This intended case study, outlined below, intends to illustrate, at least from a small sample in Chapel Hill and Carrboro, the level of knowledge the average citizen has about such programs and what barriers are stopping them from attaining such funding, if and when it is needed.

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[36] Census figures provided by http://quickfacts.census.gov/qfd/states/37000.html.

[37] http://www.dukepower.com/forhome/products/energyloan.asp and http://www.progress-energy.com/custservice/carres/financing/index.asp. Both accessed 3 March 2006. Information regarding their programs and others across the state of North Carolina and the United States can be found in easy to understand charts found at http://www.simplyinsulate.com/asp/c_summary.asp.

[38] North Carolina State Energy Plan, prepared by the State Energy Office, North Carolina Department of Administration and Appalachian State University Energy Center, Revised edition January 2005, p. 73.

[39] For a full list which incorporates these above categories as well as brief descriptions regarding each one see the North Carolina State Energy Plan (2005): 73.

[40] North Carolina State Energy Plan (2005): 74.

[41] North Carolina State Energy Plan (2005): 74 – 76.

PROPOSED STUDY

The preceding literature review shows that energy efficiency has consequences for our environment, our communities, and our citizens. A review of educational materials demonstrates that area agencies are attempting to disseminate the information necessary for citizens to address these consequences. The next step is to evaluate whether the information is reaching the right people and whether they are able to, or interested in, adapting to more energy efficient lifestyles.

In the following pages, we propose a potential case study that would enable policy makers, energy providers, and advocates in Chapel Hill and Carrboro measure the impact of energy efficiency. First, we identify a potential study area. Second, we propose a general study design. Third, we outline a suggested methodology for carrying out the study. Fourth, we discuss potential risks and benefits associated with the study. Fifth, we make some analytical suggestions. Finally, we describe some of our expected findings.

Description of Study Area

We selected four neighborhoods in Chapel Hill and Carrboro, North Carolina. The residences are in the 2000 US Census Blocks 1004, 1021, 1022, and portions of 1019, all in the North Carolina 107.3 Tract. Blocks were chosen based on density and diversity of population, according to race, age, and the proportion of renters and homeowners. Our goal was to identify residences that would paint a broad picture of the community, not simply students, and not simply affluence.

Study Design

The next step is to conduct a survey and follow-up interviews with residents in the aforementioned neighborhoods. The questionnaire would attempt to gauge residents' attitudes toward energy use as well as their knowledge of energy efficient improvements and available assistance programs. In addition to questions regarding rent or owner status, type of energy used, and annual income (to establish some measure for socio-economic status), residents would also be asked to respond to the following statements:

- My heating bills cause me financial hardship.
- Actions that I take to improve my home will have an effect on my energy bills.
- I make an effort to reduce my heating bill.
- I know of online resources for information about energy efficiency.
- I am aware of public funding for emergency assistance with energy bills.
- I have sought assistance from these programs.

The original questionnaire could be followed with an in-depth interview to learn more the specific knowledge that respondents have about actions, information, and available aid.

A small sample size would be sufficient since the focus is specific to the Chapel Hill/Carrboro community. While a large survey would, of course, be useful, even a small sample could provide a useful snapshot of the types of energy used and if use and payment differ for homeowners and renters. One could also analyze the effects of income and homeownership status on attitudes toward energy efficiency and the likelihood of taking specific action toward making home improvements or seeking aid (or even the awareness of available aid).

Suggested Methodology

We developed the following methodology for carrying out the above study design. These steps could be carried out by even a small group of community researchers.

Procedure:

- A researcher will knock on a door and invite the resident to participate in a survey. (See attached questionnaire and script.)
- If resident is willing to participate, researcher will read the consent language and obtain oral consent before proceeding with questions. (See attached questionnaire and script.)
- If resident is not willing to complete survey, researcher will invite resident to complete the survey independently within 10-20 minutes. After this time, the researcher will go back to the residence to collect the survey. If the resident has not yet completed the questionnaire, a self-addressed stamped envelope and copy of the survey and an unattached entry form for the raffle will be provided.
- After completing the survey in person, the respondent will be invited to fill out a raffle form containing first name and phone number entries.
- Survey respondents will also be invited to participate in a short interview. (See attached script.) Researchers will record answers on the interview guide. The conversations will not be recorded. Interviewing information will be coded using arbitrary ID numbers. No personal information will be gathered or recorded during the interview process, and individuals will not be identified in any published material.

Benefits and Risks

As a consequence of participating in the study, individuals may increase their awareness of home energy efficiency, which may then result in lower home energy bills. Individuals may learn about programs aimed at helping to increase home energy efficiency or offsetting energy costs. These individuals may then be more inclined to participate in such programs. On a broader scale, society may have more access to pertinent information regarding residential energy efficiency from the publication of any results. This information could be useful particularly to organizations interested in assessing the effectiveness of energy efficiency and energy support outreach efforts.

Individuals participating in the study will remain anonymous. Those conducting interviews should not record any personally identifying information, including names or addresses. In the report, individual responses should be agglomerated, and would therefore not be traceable to a particular home or person. No identifying characteristics should be disclosed. The only risk to subject confidentiality is breach of confidentiality by the researchers.

Suggestions for Analysis

Survey responses could be tabulated and analyzed using any statistical software package. Researchers could compile frequency distributions and perform other descriptive analyses to describe the sample of the community. If response rate allows, more advanced statistical techniques, including regressions, could capture the effects of income, homeownership status,

and other variables. The interview responses could be coded and analyzed for commonalities or used simply as anecdotal support.

Study expectations

Census tract 107.3 comprises portions of Carrboro and Chapel Hill. It is less affluent that surrounding census tracts, with a media income of $28,108 (compared to $59,874 for Orange County overall) and a poverty rate of 18.5% (compared to 6.2% for the county overall). The tract's population is 25% foreign born, and a foreign language is spoken in 27.3% of homes, compared to 9.1% and 11.9% county wide. Within census tract 107.3, we chose census blocks 1004, portions of 1019, 1021, and 1022, which are diverse in terms of age, race, and household size.

We anticipated that renters would be less concerned about rising energy costs and less likely to have taken any measures to reduce these costs than homeowners. Homeowners are more invested in the quality of their homes and any improvements they make to their homes increases their value. Also, homeowners can make material changes to their homes without needing to consult another party (landlord). Also, an increase in how long an occupant has lived in their home would correlate positively with efforts to improve energy efficiency. We expected few renters who do not pay their energy bills to have attempted to improve their home's energy efficiency.

We expected some positive correlation between an occupant's low income and efforts to reduce heating bills, as those with less money would be more concerned with keeping their costs as low as possible. However, as described in the barriers section of this report, efforts to improve energy efficiency often require financial outlays for materials and labor, which may not be available for low-income residents. Also, it is likely that the presence of a large foreign born population would lessen the number of people trying to reduce heating costs. We presume that a significant portion of the low income population is foreign born. The majority of that population would be comprised of renters, and they, relative to English-speaking renters, would have less extensive or successful communication with their landlords, impeding collaborative efforts to improve energy efficiency. In addition, if assistance provided by energy companies is detailed in billing statements, then a lack of language skills would prohibit comprehension of that information.

We also expected slightly more people who heat their homes with oil or natural gas to pursue improved energy efficiency. The rising cost of oil is generally cited as a main cause of increased heating bills in discussions of energy costs in the media. Thus, those who heat their home with electricity would be less likely to presume that rising oil costs will lead to an increase in their energy costs.

Also, we expected that the percentage of people who took measures to improve the energy efficiency of their homes would be significantly less than those who claim that their energy costs create a financial hardship. This question can only be adequately addressed through qualitative interviews. There could be a multitude of reasons for this disparity, including general ignorance about energy efficiency and what factors affect it and what could be done to improve it; a lack of familiarity with or faith in government or other institutions offering assistance; or a general lack of the intellectual sophistication and personal organization necessary for completing improvements. These reasons may mirror educational and economic patterns, with a rise in education and economic class mirroring increased ability to make changes to improve energy efficiency.

QUESTIONNAIRE AND IN-DEPTH INTERVIEW SCRIPT

"Hi my name is _____ . I'm a graduate student at UNC conducting a research study about home energy costs. We estimate that approximately 250 will participate in this study. Your participation is completely voluntary. This means that you do not have to participate in this survey unless you want to. If you participate today, you'll be entered into a raffle for a $50 gift certificate to Harris Teeter. Can you spare a moment of your time?"

All the information I receive from you will be strictly confidential and anonymous. You may decline to answer any of the questions.

This study is being paid for by the Weiss Urban Livability Fellowship Program. You may contact the director of this program if you have questions or concerns

Do you have any questions for me before we proceed?

May I begin asking you questions?

If yes:

"Great. This should take no more than 2 minutes. I will ask you a series of short multiple-choice questions, and ask you to select the option that you feel best fits your views. Do you understand?"

If no:

"Thank you for your time. Have a great day."

If yes:

Proceed with questionnaire.

"Have you got time for a few more open-ended questions? This should take no longer than 10 minutes, and is also completely anonymous."

If yes:

Proceed with in-depth interview questions.

"If you're interested in the raffle, please fill out this form with first name and phone number. This form will not be linked with your answers, and will be destroyed after the raffle."

If no:

"Thank you for your time. Have a great day."

ENERGY EFFICIENCY QUESTIONNAIRE

How many people (adults and children) live in the household?

1 2 3 4 5 6 7 8 9 10+

How long have you lived at this location?

< 1 year 1-2 years 3-5 years 5-10 years > 10 years

Do you rent or own your home?

Rent Own

If you rent, who pays for your energy bills?

You (renter) Landlord

How do you heat your home? (circle all that apply)

Oil Natural Gas Electric Other _____

What do you estimate the average monthly energy cost is?

< $30 < $50 < $75 < $100 < $200 > $200

Have you or your landlord completed improvements to your home to increase energy efficiency and lower your energy bills?

Yes No

Please state whether you strongly agree, somewhat agree, neither agree nor disagree, somewhat disagree, or strongly disagree with the following questions:

"My heating bills cause me financial hardship."

Strongly Agree Somewhat Agree Neutral Somewhat Disagree Strongly Disagree

"Actions that I take on my home will have an effect on my energy bills."

Strongly Agree Somewhat Agree Neutral Somewhat Disagree Strongly Disagree

"I make an effort to reduce my heating bill."

Strongly Agree Somewhat Agree Neutral Somewhat Disagree Strongly Disagree

Please note that these surveys are completely anonymous and data will not be linked to you in any way.

Which of these best describes your household income?

< $8,000 $8,000-$15,000 $15,000-$25,000 $25,000-$35,000 $35,000-$45,000 > $45,000