<u>DEED Executive Summary</u>

Demonstration of Energy-Efficient Developments (DEED) Program

AMERICAN PUBLIC POWER ASSOCIATION

Project Title: Survey to Determine Most Effective Programs that Can Assist Low Income Customers with Energy Use Reduction

Background:
Gainesville Regional Utilities (GRU) and the University of Florida's Program for Resource Efficient Communities (PREC) designed this project to help GRU identify and overcome the barriers to delivering energy efficiency services in the most cost effective manner to low income residential customers. This is important since low income households typically spend a disproportionate amount of their income on utility bills (Power, 2005), and reaching these customers with energy-efficiency improvement programs has been more challenging than delivering similar services to higher-income customers.

Recommendations Based on Survey Results:
The results from this research project reinforce previous studies and the focus of the current best energy efficiency programs around the nation (Brown et al. 1994; Kushler et al. 2005). Primarily these overlapping energy efficiency programmatic needs include the building envelope (weatherization improvements to the air barrier and thermal barrier), the HVAC system (especially sealing air handlers and ductwork in unconditioned spaces and periodic equipment maintenance), and behavioral/educational programs.

One additional major finding of this study was that renters' bills were higher than owners' bills for the surveyed respondents. The implications and recommendations related to this finding are detailed in section 12.4 of the full report.

Within this study, nearly all of the respondents (98%) are concerned about energy costs in their homes. And 74% are very concerned. However, 87% of respondents said they are not aware of any programs to help them reduce their energy cost burden. Though low income energy efficiency programs targeted for specific households have shown success nationally and internationally (Brown et al. 1994; Davidson and Wilson 2006; Kushler et al. 2005), programs targeted to all customers, such as high efficiency central air conditioner or solar water heater rebates,,do not appear to successfully reach low income households.

Recommendations from the report focus on:

- Which incentives are more successful than others and why (building envelope and HVAC systems)
- How these incentives and other programs might be altered to better reach low income households (modify billing information to better reflect energy use comparisons and how costs impact lifestyle, consideration of coupons or vouchers in lieu of rebates for specific improvements; create programs that

reward behavioral efficiency improvements in addition to building structural/system improvements; regulat; and collaborate to offer low-interest loans for the more expensive building improvements), and,

- Consideration of broader scale ideas for market transformation that may be worth considering for further investigation and implementation (developing new data reporting, monitoring and marketing interfaces for improved market transformation and non-utility-based initiatives such as a GIS-based database and/or a mobile energy efficiency education vehicle to target groups more effectively than individuals).

Additional details on recommendations can be found in section 12 of the full report.

Table 1: Demand Side Management Recommendations

Category of Influence	» ***DSM Goal*** ▪ **Recommended Action**
INCENTIVES	» *Improve building envelope performance of existing low income homes* • **Add Insulation.** 89% of homes surveyed had inadequate levels of insulation in the attic. Adding insulation will slow the amount of heat loss and reduce the energy needed to maintain a comfortable temperature. • **Address the Whole House.** 45% of all homes surveyed were in need of weatherization, but there is more to addressing energy usage then just weatherization. A program which addresses the entire home at the same time is necessary in order to truly address low income high energy user's needs.
	» *Improve HVAC and mechanical system performance in low income homes* • **HVAC and Mechanical Maintenance.** 42% of homes surveyed showed relatively poor upkeep of their HVAC systems, dirty air filters, uninsulated refrigerant lines, dirty/blocked evaporator coils, blocked condenser units. Properly maintaining existing HVAC systems reduces energy needed to maintain a comfortable temperature. • **Repair/Replace Ductwork.** Incentivize repairs to leaky ductwork and air handlers, platforms, and closets. In some cases duct work is beyond reasonable repair and it is more appropriate to make use of ductless (mini-split) heat pump systems when replacing existing HVAC system or installing HVAC in homes currently without central heat or AC. • **Provide Better Controls.** Offering customers the option to control current mechanical systems, such as HVAC temperature and water heating temperature which can lead to decreased energy usage.
	» *Help make efficiency financially feasible for low income customers* • **Coupons or Buy Downs.** Provide coupons in lieu of rebates for lower priced items such as CFLs, weather-stripping, Energy Star appliances, etc. • **Customized Residential Rebate.** Complement and/or replace existing rebates with tiered and categorized rebates/rewards based on total energy and water use reductions as compared to a moving average. • **Low Interest Loans.** Low income customers typically do not have enough savings to cover major equipment replacements or repairs, even after rebates are applied. Banks are not always willing to offer small enough loans to cover these replacements or repairs. A program to help facilitate low loan amounts would help low income customers purchase higher cost energy efficiency upgrades, and allow them to pay for the loans with the savings from their utility bills.

EDUCATION	» *Expand efforts to modify behavior and drive market efficiency transformation* • **Provide Usage Information.** Determine what information is helpful to customers in making energy efficiency decisions. As a first step, explore providing more detailed usage history on customers' bills. As a long term goal develop a web-based GIS tool which can benchmark individual performance against larger geographical areas. • **Mobilize Education.** Design and deploy a mobile efficiency center that can travel to local events, churches, community centers, and other major gathering places to bring educational materials, coupons and other useful items to customers.
	» *Expand and/or modify existing education programs to maximize impact* • **Provide the Goal.** Provide customers with optimal energy-efficiency targets for their homes by detailing power and water use expectations for homes that perform relatively well to allow customers to gauge their use and possibly modify their own performance expectations. • **Evaluate Current Education.** Evaluate existing educational materials and ensure that it is meaningful and useful for the target population. Focus groups and other forms of market research will be needed before conclusions are reached.
	» *Expand and/or modify existing programs to achieve optimal mechanical system and appliance performance* • **Checklists.** Make maintenance checklists available to customers where appropriate. Some ideas include webpage, bill inserts, and stand alone direct mail pieces. • **Manage Communications Channels.** Make sure that all appropriate communication channels are being utilized to communicate programs and information to low income customers. • **Group Energy Audits.** Complement existing individual energy audits with group information sessions (together with mobile efficiency center to allow for real-time feedback and evaluation).
REGULATORY	» *Advocate for regulatory change to improve mechanical system and appliance performance* • **Landlord Licensing.** Advocate modifications to landlord licensing process through adoption of appropriate incentives and regulations that address energy efficiency in rental homes. • **Landlord Maintenance.** Advocate requirement that all landlords perform mechanical system and appliance service/repairs at regular intervals (e.g., every 5 years or every 3rd tenant turnovers). • **Energy Efficiency Enforcement During Property Transactions.** Advocate requirement that all existing home sales include mechanical system and appliance service/repairs in closing and/or home inspection process, prior to completion of the sale. • **Improve Minimum Housing Code.** Adopt an advocacy role in the formation and revision of the minimum housing codes to support the implementation of sound building science, increase the market penetration of best practices, and remove the restrictions on local governments who choose to make their codes more restrictive than state standards from an efficiency standpoint.
GOALS	» *Existing programs and long-term goals: continue to improve DSM efforts, change behavior, drive market efficiency transformation* • **Continuous Review.** Continue to review effects of existing DSM programs around the country and apply lessons learned to GRU programs.

	• **Information Sharing.** Continue to encourage sharing of information between utilities to increase effectiveness of DSM throughout the utility industry at the state and national level.

The DEED study targeted low income households, and thus it addresses only one piece of the DSM puzzle. Results need to be compared to what is already known about the 'typical' customer to determine how to most effectively and efficiently allocate program funds and time among DSM program objectives. Comparison of these results and Btu intensities for low income households to general customers is a necessary next step to help better understand the unique properties of low income customers.

Comparison with GRU's 2006 Appliance Saturation Survey

Table 6 shows energy use and energy intensity statistics for the 169 low income single-family detached (SFD) households in the DEED survey and for 362 SFD households randomly sampled via GRU's annual appliance saturation survey.

Table 6: Summary Statistics for Total Energy Use and Energy Intensity (169 DEED Households vs. 362 Randomly Sampled GRU Customer Single Family Detached Households)

	DEED		SFD	
	Mean	St. Dev.	Mean	St. Dev.
kWh Total (kWh/month)	**1118**	767	**1134**	580
kWh Intensity (kWh/month/1000ft^2)	**878**	584	**680**	635
Therm Total (therm/month, DEED N=103)	**28.1**	17	**26.6**	17
Therm Intensity (therm/month/1000ft^2, DEED N=103)	**21.5**	14	**15.3**	10
Btu* Total (MMBtu/month)	**5.5**	3	**5.5**	3
Btu Intensity (MMBtu/month/1000ft^2)	**4.3**	2	**3.3**	2
Household Square Footage (conditioned area, ft^2)	**1333**	450	**1901**	776

*Btu conversion factors: (1kWh = 3412Btu), (1therm = 100,000Btu), (1MMBtu = 1millionBtu)

The similar total energy use and differing energy intensity across DEED and SFD households suggest that low income GRU customers are not using significantly more energy than their SFD counterparts. They are more energy intense because they tend to reside in significantly smaller households (almost 600 square feet smaller, on average[1]). Since they are disproportionately energy cost burdened, targeting low income customers with DSM programs to help them improve the efficiency of their homes and encourage conservation, is a high priority goal for GRU.

[1] Household square footage data for the DEED sample were taken directly from property appraiser records while those for the SFD sample are customer-reported estimates, so actual energy intensities for the SFD sample may differ from those listed here.

DEED Final Report

Demonstration of Energy-Efficient Developments (DEED) Program

AMERICAN PUBLIC POWER ASSOCIATION

1. **Official Project Title**: "Survey to Determine Most Effective Programs that Can Assist Low Income Customers with Energy Use Reduction"

2. **General Overview**

2.1: Background

Gainesville Regional Utilities (GRU) and the University of Florida's Program for Resource Efficient Communities (PREC) designed this project to help GRU identify and overcome the barriers to delivering energy efficiency services in the most cost effective manner to low income residential customers. This is important since low income households typically spend a disproportionate amount of their income on utility bills (Power, 2005), and reaching these customers with energy-efficiency improvement programs has been more challenging than delivering similar services to higher-income customers.

GRU is currently in a period of rising utility rates, which creates a significant financial burden for households constrained by low incomes. U.S. Department of Housing and Urban Development data indicate that 35 percent of households in Gainesville's Metropolitan Statistical Area (MSA) are housing cost burdened, meaning that they spend 30 percent or more of their gross income on housing costs (HUD, 2000). Since GRU is a municipal utility owned by the people it serves, it is of critical importance to address the needs of these cost burdened customers. This project allowed GRU to use first hand data collected from low income customers to determine the primary factors contributing to their energy use and to identify potential mechanisms appropriate for delivering energy efficiency services to low income customers.

The idea for this project began when GRU combined Geographic Information System (GIS) data with customers' energy usage data (measured in average monthly kWh per 1,000 square feet of conditioned living space) into a color-coded map that displayed high-intensity and low-intensity households. In examining this map, GRU and community members began to hypothesize that high-intensity households were clustered together. This led to examining whether the clusters corresponded with areas typically considered low income.

To determine this GRU overlaid census tracks where at least 50% of homes met U.S. Department of Housing and Urban Development (HUD) definition of low income, which is defined as 80% of median family income. This process revealed that although average energy intensity among low income households is relatively high, a fair portion of these households also perform relatively well compared to their low income household counterparts (i.e., their energy intensity is relatively low among this population). With these apparent low income household energy intensity patterns in mind, GRU and PREC designed a survey using empirical data to help answer the question: *What factors* *(structural features, mechanical system attributes, demographics, behavioral patterns, etc.) cause and/or allow some low income households to demand significantly less energy per square foot than others?*

2.2: Project Applicability to Other Utilities and Alternative Projects

The process of identifying areas or market segments with high energy intensities can be very useful for utilities interested in Demand Side Management (DSM). The resulting information can be used for marketing, applicability studies, potential savings studies and general communications. General communication was the least anticipated result when GRU began pursuing this project, although the level of public interest has been apparent GRU first produced the energy intensity map found in section 3.1. Energy intensity maps have become common place at public meetings and several citizens have poster sized print outs that they take to meetings around the region to share concerns on energy efficiency.

However it should be noted that the map in and of itself does not provide any solutions to high energy intensity. The in-home survey portion of the project is a necessary step to determine why certain homes perform better than others. This survey instrument could be administered by other utilities to help identify what characteristics within their own service territories determine energy intensity.

The survey could be administered as an in-home survey as it was in this project, by telephone or by mail. Obviously telephone and mail options would degrade the quality of some of the information and increase the error, but would result in significantly reduced costs which might also allow for an increased sample size. In the future GRU will incorporate aspects of this project into its biennial appliance saturation survey and use that instrument as a means of keeping information about low income customers up to date. This is only possible after having conducted this project and identifying which questions are most important to include in the appliance saturation survey.

It is also possible that other utilities could take sections of the survey for inclusion in currently administered surveys thus removing the need to conduct a stand alone survey. Since this would likely mean fitting the questions into the other survey's scope it would be important to carefully select which questions to ask, thus utilities may have to pre-select which aspects they were most interested in by looking at the results of this project first.

The recommendations detailed in section 12 could also be taken as is with no additional research by other utilities and tailored to other utilities' needs and conservation challenges.

2.3: Project Goals

To better understand why certain low income customers perform significantly better than others in their homes' energy efficiency, the immediate goals of this project were to 1) recruit a roughly equal number of participants from high energy intensity, low income (HL) and low energy intensity, low income (LL) GRU customers, 2) conduct a thorough in-home energy survey of these customers' homes, and 3) compare results across energy intensity groups, analyze them for statistically significant differences, and identify key determinants of energy intensity among these households. These goals were achieved, with 1) a total of 224 households (110 HL and 114 LL) agreeing to participate in the survey, 2) 187 households completing the survey (88 HL and 97 LL), and 3) a full data set for 169 low income single-family detached households analyzed to identify key factors contributing to energy intensity.

While these three goals were achieved as of December, 2006, the ultimate goal is to better address the energy efficiency needs of low income customers. This is an ongoing effort and GRU will continue to revisit the project results and recommendations for program development, evaluation and application.

2.4: Project Problems and Solutions

During the course of this study – from the planning stages to the analysis and reporting – several complications arose, none of which were insurmountable, but each of which altered the original project plan to some extent. Some of the problems are typical in survey research, while others were a result of unexpected administrative or staffing constraints.

First, delays where faced during implementation of the second phase of the recruiting survey: while the ideal follow-up to a mail-administered recruiting survey occurs immediately after receipt of respondents' information, there was an eight week delay between these two events due to insufficient planning of staff time required for the step. Hiring professional survey research staff to conduct the scheduling phase of the survey was considered, but these services were not available within budget. As a result, GRU and PREC combined efforts across staff assigned to the project and although initiation of the in-home surveys was delayed, over 200 surveys in total were successfully scheduled.

Second, because it was decided to conduct in-home surveys only during weekday business hours, some customers were likely excluded due to scheduling conflicts. When combined with the lack of a speedy follow-up to the mail-administered recruiting surveys led to not completing enough in-home surveys during the original timeline. It was decided that it was more important to collect a sufficient amount of valid data than to complete the project on its original timeline and the sampling and data collection phases of the project were extended until a sufficient number of surveys were completed.

Third, from the beginning of the project well into the data analysis phase, differences across high and low energy intensity customers were defined by *kilowatt-hour* demand per thousand square feet of conditioned space. While GRU was aware through the course of survey development that this measure accounted for *electric* demand only, the practical ramifications of this were not realized until preliminary data analysis revealed that the most important determinant of 'high' vs. 'low' energy users was the type of space heating and water heating systems they used in their homes. GRU attempted to correct this by comparing energy intensities only across high and low electric-only users, but this strategy effectively decreased the sample size by two-thirds. GRU determined that identifying natural gas usage for the respondent and merging it with the electric usage by using Btus (British Thermal Units) would be a more effective strategy. Once this was done, the energy intensity distribution of the DEED sample changed from bimodal to normal, so the analysis itself had to be modified as well. Rather than comparing two relatively distinct groups of energy users, the analysis was structured to investigate a relatively normally distributed population of low income customers and elucidate the key determinants of their respective energy intensities.

2.5: Recommendations / Lessons Learned

Several findings relevant for conservation programs resulted from this study. Many of the problems affecting the energy intensity of low income households have relatively easy, inexpensive solutions (e.g., insulating hot water pipes and installing weather-stripping) while others are rooted in customer behavior and can only be addressed through demand side management programs (e.g., outreach, education, partnering with community based non-profits). Some factors that emerged as important determinants of energy intensity can only be influenced *indirectly* through aggressive conservation programs and targeted outreach. For instance, rental households had significantly higher energy intensities than did owner-occupied households, which provides empirical data to support advocacy of stricter building, operation, and maintenance standards for rental properties.

Table 1 lists the suite of DSM goals and actions resulting from this project. Each recommendation falls into one of four general categories: incentives, education, regulatory and goals. Complete descriptions for each recommendation can be found in section 12 of this report.

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	loans to cover these replacements or repairs. A program to help facilitate low loan amounts would help low income customers purchase higher cost energy efficiency upgrades, and allow them to pay for the loans with the savings from their utility bills.
EDUCATION	» *Expand efforts to modify behavior and drive market efficiency transformation* • **Provide Usage Information.** Determine what information is helpful to customers in making energy efficiency decisions. As a first step, explore providing more detailed usage history on customers' bills. As a long term goal develop a web-based GIS tool which can benchmark individual performance against larger geographical areas. • **Mobilize Education.** Design and deploy a mobile efficiency center that can travel to local events, churches, community centers, and other major gathering places to bring educational materials, coupons and other useful items to customers.
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	around the country and apply lessons learned to GRU programs. • **Information Sharing.** Continue to encourage sharing of information between utilities to increase effectiveness of DSM throughout the utility industry at the state and national level.

The DEED study targeted low income households, and thus it addresses only one piece of the DSM puzzle. Results need to be compared to what is already known about the 'typical' customer to determine how to most effectively and efficiently allocate program funds and time among DSM program objectives. Comparison of these results and Btu intensities for low income households to historical customer records and general customer surveys is a necessary next step to help better understand the unique properties of low income customers.

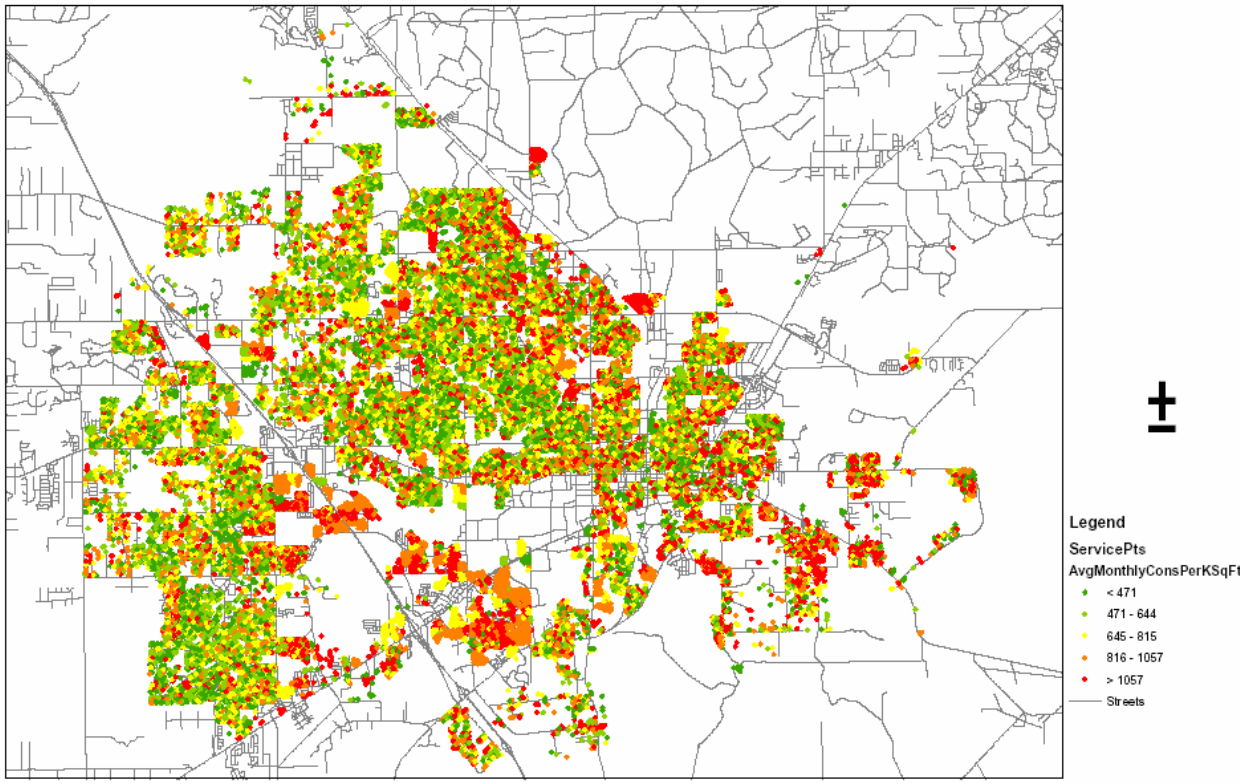
For the benefit of other public utilities considering a similar research study, the most important lessons learned from a research standpoint are to: 1) carefully define the explanatory variable so that it measures precisely that which it is intended to measure (i.e., it is valid) and so that the analysis can be tailored to most effectively inform potential programs; 2) invest sufficient lead time in the project development phase so that the tasks, timeline, staffing, funding, and alternate plans are clearly defined (i.e., anticipate and prepare for delays); and 3) tailor the survey instrument(s) so that it focuses on variables over which the utility already or potentially has some degree of control.

3. Project Purpose

3.1: Understanding Residential Energy Demand

In late 2005, GRU calculated energy intensity for each of it's customers' homes and then clustered them into five energy intensity groups. Energy intensity was expressed in kWh per 1000 square feet of conditioned space. These energy intensities were then mapped against corresponding service locations using GIS software (see below). In examining this map GRU and community members began to hypothesize that high-intensity households were clustered together. This lead to examining whether the clusters corresponded with areas typically considered low income.

Map 1.



GRU examined census tracks where at least 50% of homes met U.S. Department of Housing and Urban Development (HUD) definition of low income, 80% of median family income. This process revealed that although average energy intensity among low income households is relatively high, a fair portion of these households also perform relatively well compared to their low income household counterparts (i.e., their energy intensity is relatively low among this population). It was concluded that if the factors could be identified that influenced certain low income customers to have lower energy intensity; DSM programs could be established to address those specific factors.

3.2: Early Assumptions: Higher Energy Intensity among Low Income Customers

There is a profound shift in the results for high income customers vs. low income customers when absolute energy use is converted to energy intensity. This led GRU to focus on the service territory areas with high densities of low income customers and significant deviations from 'average' energy intensity. GRU Conservation analysts determined low income areas by making field visits to the neighborhoods where there were high intensity, red dot clusters and compared these areas to maps indicating Community Block Grant Development areas. Energy analysts then listed the factors they thought contributed to high bills in these locations, based on their frequent visits to the red dot cluster areas. Their lists included a range of potential factors, from the condition of the building envelope and appliances in the home to the behavior of residents. The preliminary list of thoughts for potential energy intensity determinants to be investigated in the DEED study included:

- *Number of people in the household* – in low income areas greater numbers of individuals live under the same roof to reduce costs
- *Age and type of construction* of the dwelling

- *Occupancy status (i.e., tenant vs. owner-occupied)* – little incentive for a landlord to care about energy usage by a tenant, so necessary repairs or upgrades to appliances and HVAC equipment are too often delayed or ignored completely
- *Age, condition, and number of appliances* – potentially tied to the lack of incentive for absentee landlords to upgrade appliances
- *Type of air conditioning/heating and the age of these systems*
- *Availability of natural gas*, which is often a more efficient energy source than electric
- *Lack of tree cover*
- *No price signal related to energy use* - increasing numbers of rental units include utilities in rent so the tenant never sees the bill or gets the appropriate price signal to modify behavior
- *Lack of knowledge about conservation opportunities and savings*

Given the wide range of factors that are likely to determine energy intensity in low income households, it was decided that the best way to lay the foundation for development of new conservation programs targeted at these customers was to first learn more about their homes and households – both the structures and the people in them. To do this it was necessary to go beyond the billing/energy use records, into the homes of the customers who are most vulnerable to rising energy costs and most in need of effective conservation programs. It was in responding to this need that GRU sought funding from APPA through the DEED grant and implemented, in collaboration with PREC, a thorough energy survey of low income customer households in Gainesville. Sections 7 and 8 describe the various components of the project and Section 10 presents data results and analysis.

3.3: Demand Side Management (DSM) Programs for Low Income Customers

Programs to address the energy challenges facing low income households and to encourage conservation and promote efficiency among the entire GRU customer population (Section 12) are being tailored based on the DEED survey results and analysis (Section 10). Given the intense competition for funding of programs to assist low income customers, it was important to collect data about these customers systematically to make the best use of limited resources and determine what if any outside funding sources are needed. These funding sources may include federal or state grants, low interest loans, bank loans targeted to community redevelopment, etc. Section 12 describes the applicability of GRU's DEED project to other utilities and gives detailed recommendations for achieving DSM goals.

4. Utility Name and Address

Sponsoring Utility: Gainesville Regional Utilities (GRU)
P.O. Box 147117
Gainesville, FL 32614-7117
Phone: (352)393-1483 Fax: (352)393-3480

5. Utility Description

Gainesville Regional Utilities (GRU) is a multi-service utility owned by the City of Gainesville and is the 5th largest municipal electric utility in Florida. GRU is a municipal electric, natural gas, water, wastewater and telecommunications utility system, owned and operated by the City of Gainesville, Florida. The GRU retail electric system service area includes the City of Gainesville and the surrounding urban area. GRU's distribution system serves approximately 124 square miles and 87,560 customers (2005 average).

Being owned by the people it serves gives GRU the ability to approach energy efficiency and low income customers from a unique perspective. GRU is focused on achieving maximum cost effective demand side management and views low income customers as a source of savings as well as the market segment most in need of assistance in order to achieve maximum energy efficiency.

Table 2: Gainesville Regional Utilities (GRU) Service and Generation Summary

Electric Customers	**87,560**
Residential	78,164
Commercial	9,378
Industrial	18
Natural Gas Customers	**31,704**
Water Customers	**64,692**
Wastewater Customers	**57,553**
Net Energy for Load 2005	**1,854 GWh**
Residential	888 GWh
Commercial	752 GWh
Industrial	189 GWh
Street and Highway Lighting	25 GWh
2006 Net Summer Generation Capacity	**611.33 MW**
Coal	228.40
Natural Gas	251.26
Nuclear	11.43
Landfill Gas to Energy	1.30

6. Key Personnel & Phone Numbers

Bill Shepherd Interim Manager, Energy and Business Services, GRU
Phone: (352)393-1483 E-mail: shepherdwj@gru.com
Oversaw and coordinated project.

Tara Thomas Conservation Analyst III, GRU
Phone: (352)393-1476 E-mail: thomastr@gru.com
Coordinated field surveys and field personnel.

Pierce Jones Professor and Director, PREC
Phone: (352)392-8074 Email: ez@energy.ufl.edu
Oversaw and coordinated relationship between PREC and GRU.

7. Project Description

7.1: Objectives

As outlined in GRU's original DEED grant proposal, three primary objectives, each contributing to the broader goals of GRU's conservation programs, guided this project:

1. To determine the major reasons that GRU residential low income customers on average have higher energy intensity compared to others. This was to be accomplished by evaluating both relatively low and relatively high energy users in the same area. The objectives of the survey research described in this report are tied directly to achieving this goal.
2. To develop or modify programs to assist these customers in reducing energy intensity. One new program being developed is The Low Income Whole House Improvement Program. This program will target low income, single family households who meet the high energy intensity definition. Improvements will include weatherization, repair or replacement of heating and cooling systems and/or other appliances; up to $2750 per home.
3. To develop a budget for these programs, a funding source and a timeline for implementation.

The research and results described in this report address all three project objectives. The first objective lays the foundation for successful program development, budgeting, funding and implementation. The project description that follows focuses primarily on the work done to identify key determinants of energy intensity among residential low income customers. The results of the DEED study are being used to develop or modify programs to assist low income customers in reducing their energy intensity (objective two). This component of the project is fundamentally dependent on achieving all elements of objective three.

7.2: Features Typically Affecting Residential Energy Intensity in Florida

The following are the typical energy end uses (in dollars) for an average North Florida home as calculated using the Florida Solar Energy Center's EnGauge energy modeling software.

Energy End Uses for a Typical Home in North Florida (3 bed / 2 bath @ 1,500 square feet):

- Cooling (19%)
- Hot Water (18%)
- Heating (16%)
- Refrigeration (12%)
- Lighting (11%)
- Dryer (6%)
- Stove (5%)
- Miscellaneous (13%)

In Florida's residential housing stock, central air conditioning and heating systems typically consume the largest portion of total energy demanded by the home (approximately 19%). With this in mind, it is expected that problems related to mechanical heating, ventilation and air conditioning (HVAC) systems will lead to less than optimal efficiency of these systems, and in turn, increased energy intensity among households with HVAC problems. For example, improperly sealed ductwork or air handler closets will cause inefficiencies in HVAC systems. Conditioned air will not be distributed properly, return air will not be preconditioned, and the structure will be negatively pressurized resulting in outside air infiltration. Even more fundamental is the effect that size of the structure and wall and floor material of the structure have on a home's energy use. In addition to building materials used in the structural envelope, attic insulation levels and roof color also influence the degree to which the interior of a home is protected against excessive heat gain from solar radiation. It is also worth noting that any energy using devices within the home, lights, appliances, etc., will not only use energy to operate but will also give off heat, adding to the load on the air conditioning system.

Electricity use (or plug loads) of specific appliances and devices is supported by hard data tested in a laboratory setting. For instance, compact fluorescent lamps use considerably less energy than incandescent lamps with the same light output. ENERGY STAR® qualified appliances typically use less energy than older appliances. Major differences in plug loads from household to household are often tied to frequency of use of these appliances by occupants.

Significant differences in energy demand across residential homes are also likely to be tied to occupants' behavior and energy awareness. How well do customers understand their home's systems and how to use them efficiently? How do customers tend to use energy within their homes (i.e., what and how intense are the major plug load and HVAC demands)? How can customers be motivated to pursue more efficient energy use habits or technologies? How responsive will customers be to new energy efficiency programs? These types of questions along with what is already known about major energy users in Florida homes serve as the foundation from which the DEED energy survey was developed.

7.3: Project Design

The effort to achieve the first DEED project objective, determining why low income customers often have high energy intensity, consisted of four major phases: 1) Survey Development 2) Survey Implementation 3) Data Analysis and 4) Reporting. The following sections describe the project design for each of these four work phases.

7.3a: Design Phase 1 – Survey Development

This research was designed so that using the resulting data key factors that distinguish low energy intensity, low income ('LL') households from high energy intensity, low income ('HL') households[*] could be identified. Comparing survey responses across these two groups of customers would allow for isolation of those variables for which there are significant differences across households in the two distinct energy intensity categories. In an effort to report statistically significant results and to have enough variability within the

[*] Households were coded as LL if their average monthly energy intensity from October, 2004 through September, 2005 was *less than* 454 kWh per 1000 square feet; they were coded as HH if their average monthly energy intensity during this period was *greater than* 1096 kWh per 1000 square feet.

data set to identify these factors with confidence, the sampling goal was to complete 200 usable in-home surveys, 100 for each energy intensity group.

Energy use and billing data was readily available for several thousand customers who fell into either the 'low' or 'high' energy intensity categories, and who potentially met U.S. Department of Housing and Urban Development (HUD) 2005 low income criteria for the Gainesville Metropolitan Statistical Area, as shown in Table 3. Multiple stage sampling of this data was used to recruit a target of 200 customers/households to participate in the in-home administered energy survey.

Table 3: HUD 2005 Gainesville, FL MSA Low Income Criteria

Household Size (number of residents)	Low Income (80% MFI*)
1	$30,000
2	$34,300
3	$38,600
4	$42,900
5	$46,300
6	$49,750
7	$53,150
8	$56,600

*Fiscal Year 2005 Median Family Income (MFI) = $53,550

Recruiting survey development

Because it would not be possible to achieve the DEED research objectives using a survey administered entirely by mail or telephone, it was decided during the research design phase to develop two distinct survey instruments: a very brief mail-administered recruiting survey and an in-depth, in-home energy survey. The in-home survey was supplemented with GRU's standard energy survey form and an appliance checklist. The purpose of the recruiting survey (Attachment A-2) was to invite randomly selected households from both 'low' and 'high' energy intensity households to participate in the in-home energy survey. To verify that households contacted and scheduled for in-home surveys met HUD's low income criteria, this mail-administered survey asked customers two necessary questions: 1) their 2005 gross household income and 2) the number of people living in their household. Two supplemental questions gauged respondents' concerns about home energy costs and asked for information about their current residence tenure. Respondents were also asked for their contact information (name and phone number) to cross-check with customer records and the best time that they could be reached by phone. These components were included to schedule an in-home survey with income-eligible customers.

An invitation letter (Attachment A-1) signed by the City of Gainesville's Mayor, Pegeen Hanrahan, was mailed along with the recruiting survey to introduce the goals of the project and explain how interested households could participate. As an incentive for participation, this invitation letter also informed customers that they would receive three free, energy efficient compact fluorescent lamps (CFLs) upon completion of the in-home energy survey. Respondents indicated a willingness to participate in the in-depth energy survey by returning the energy survey form. Those respondents were then screened to isolate those who met HUD's 2005 low income criteria from those who did not. Following the screening, the in-home surveys would then be scheduled via telephone. Before recruiting surveys were sent to new groups of customers who were selected from the low and high energy intensity group database, follow up telephone calls were made and replacement surveys were mailed to non-respondents.

In-home survey instrument development

The in-home energy surveys were used to collect the bulk of data to identify key determinants of energy intensity among high and low income households. This was an extensive survey instrument comprised of two core components: a verbally administered questionnaire developed for the purpose of this project (Attachment B) and GRU's energy survey action checklist (Attachment C). The joint questionnaire investigated information about the home as a structure, its occupants and their behavior, heating and cooling systems, water heating and appliances, lighting, home entertainment systems, and household demographics. Data collected by verbally administering this questionnaire to the respondents were also supplemented with information recorded by GRU's conservation analysts using a standard GRU Energy Survey Action Checklist. This form is used as a tool to rapidly assess the integrity of a home's structure and system, identify potential interventions to improve energy efficiency, and provide tips for conserving energy. All in-home surveys were administered by two teams of field interviewers; each team included a GRU conservation analyst and a University of Florida representative.

7.3b: Design Phase 2 – Survey Implementation

The objectives of this project phase were critical components of achieving the DEED sampling goals. These objectives were to: 1) successfully administer the recruiting survey (i.e., design and deliver it to the target population in a timely fashion and in a way that would maximize response rates); 2) schedule a sufficient number of in-home surveys so that enough data would be collected to conduct meaningful analysis and 3) administer the in-home surveys (i.e., proceed with the data collection) in a consistent and thorough manner. In defining the target population, it was decided to recruit only single-family detached homes due to the distinct structural characteristics that affect their energy performance and the small sample size.

To encourage participation in the survey, an incentive of three compact fluorescent lamps (CFLs) to be given to the customer upon completion of the in-home survey was offered. Later when it became clear that it would not be possible to achieve the originally targeted participation rate a $10 credit to all customers who completed an in-home survey was offered in order to increase the level of participation. The final recruiting protocol involved two direct mailings to potentially eligible customers followed by a minimum of three telephone calls to non-respondents.

7.3c: Design Phase 3 – Data Analysis

Objectives for the third phase of the project were to accurately enter all data collected, clean the data, recode as necessary and conduct the analysis in a fashion that would allow for identification of major differences across energy intensity groups. The methodology for this phase of the project was modified mid-way through data analysis because of an unexpected problem with the primary dependent variable. This change is discussed in detail in Section 10.

7.3d: Design Phase 4 – Recommendations and Reporting
The objectives of the final project phase were to synthesize results of the data analysis into the Final DEED Report and apply the recommendations contained herein to current programs. If and when other utilities wish to conduct similar research efforts the lessons learned from this study can offer guidance that may be relevant to other utilities' programs.

8. Project Dates

The term of this project consisted of four phases: 1) Survey Development 2) Survey Implementation 3) Data Analysis and 4) Reporting, with a proposed start date of October 2005 and a proposed completion date of June 30, 2006. As detailed in the March 2006 Quarterly Report, the effective start of the project was delayed by several months, beginning in December 2005, although project planning did begin as scheduled in October, 2005. Due to several unexpected delays during Phases 2 and 3 (detailed below), the project was completed six months later than initially anticipated, in December rather than June, 2006.

Table 4 outlines key events and corresponding dates for each phase of the research effort. Given the dynamic nature of survey research, there is necessary overlap between project phases within the project term. The sections that follow Table 4 describe the project dates in further detail and explain events that led to modification of the originally proposed project timeline.

Table 4: GRU DEED Project Dates

Phase 1: Survey Development	**Oct '05 – Mar '06**
Initial Planning	Oct '05 – Feb '06
Merging customer energy intensity and GIS data	Dec '05
Generating sample by energy intensity criterion	Feb '06
Developing recruiting survey	Jan – Feb '06
Developing in-home survey instrument	Jan – Mar '06
Phase 2: Survey Implementation	**Feb '06 – Aug '06**
Administering recruiting survey (via postal mail)	Feb – Apr '06
Scheduling in-home surveys (via telephone)	Mar – Aug '06
Administering in-home surveys	Apr – Aug '06
Phase 3: Data Analysis	**July '06 – Oct '06**
Data entry	July – Sept '06
Data cleaning	Sept – Oct '06
Preliminary data analysis	Sept – Oct '06
Final data analysis	Nov – Dec '06
Phase 4: Reporting	**Oct '06 – Dec '06**

8.1: Phase 1 Dates – Survey Development
As stated previously, this project was initiated in October 2005 through planning tied to the DEED grant itself. The effective term of the survey development was four months, with significant action tied to this phase occurring between December 2005 and March 2006. Phase 1 was completed in late March 2006 and data collection (i.e., in-home surveys) began on April 14, 2006.

8.2: Phase 2 Dates – Survey Implementation

At the beginning of the DEED research project the data collection goal was to complete all in-home energy surveys by early May 2006. By late June, while substantial data collection progress had been made from April to May it was clear that the target of 200 completed surveys would not be met. At this point, the Phase 2 completion date was changed to late August or early September 2006 and it was decided to attempt recruiting additional participants by going door to door to eligible households (in concert with continuing the phone calls to eligible customers) and either scheduling an in-home survey in person or conducting the energy survey on the spot if the customer was willing to do so. By the third week in August, a total of 226 surveys had been scheduled and 187 had been completed; because of customer cancellations or no-shows, 39 scheduled surveys were never administered.

While a good deal of time was invested in attempts to recruit additional survey participants, particularly in July and August, the return on these time investments was diminishing with each passing day: one hour of phone calling to eligible customers early in the sampling process would often yield a half dozen or more scheduled surveys while the same time invested in making phone calls during the summer months was likely to yield only one or, on a good day, two scheduled surveys. Door-to-door efforts were also proving to be very inefficient; on some days field staff spent five hours going door-to-door only to schedule one survey. Other indicators of these diminishing returns to time investment were the declining numbers of surveys scheduled and completed per week as time passed. Seventy-three percent of all surveys scheduled were done so in the first two months of Phase 2, and with 112 surveys completed during this time (60% of all surveys completed), the average number of in-home surveys completed each week was about a dozen. In the final two months of Phase 2, this average dropped to about nine per week and only 27% of surveys scheduled were done so during this time despite increased time spent making phone calls and going door-to-door to schedule surveys. On August 23, 2006, the decision was made to end the data collection effort so that the final phases of the project could be completed within a reasonable timeframe.

8.3: Phase 3 Dates – Data Analysis

The final count of completed surveys (unfiltered for housing type) was 187; 99 for LL customer households (two of which were recruited in the field) and 88 for HL households. When filtered to retain only single family detached homes (once screened for housing type, 18 were removed because they were multi-family), the final data set included 169 low income households (75 HL and 94 LL). The bulk of the data analysis (i.e., examining the data after entry, cleaning, and recoding) was conducted from late September through November 2006. Results of this analysis are detailed in Section 10 and are broken in three broad contexts: 1) sampling results, 2) key variables driving differences across energy intensity as these differences are measured in kilowatt-hours (kWh) per 1000 square feet, and 3) key variables driving differences across energy intensity as these differences are measured in British thermal units (Btu) per 1000 square feet.

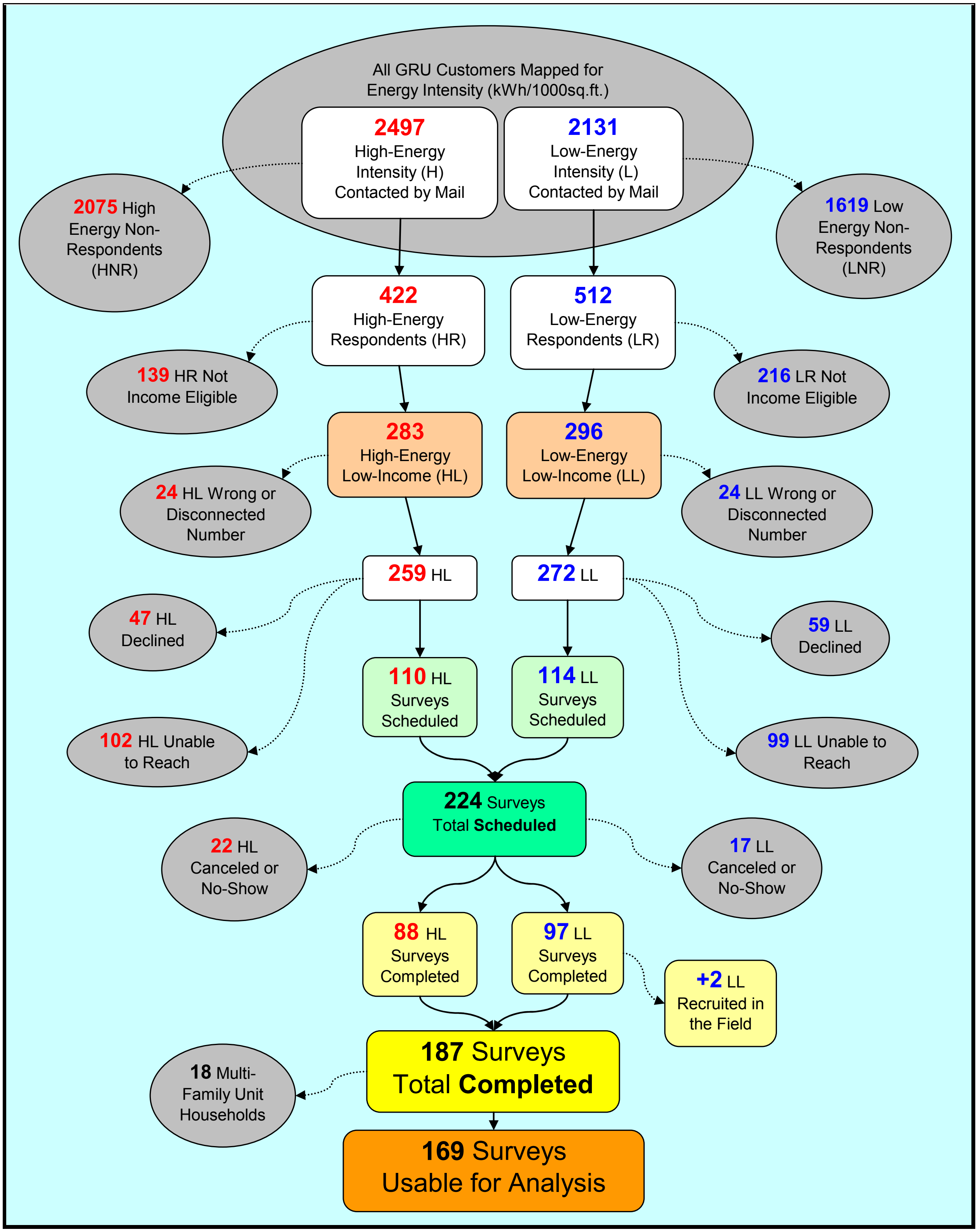
8.4: Phase 4 Dates – Recommendations and Reporting

Program recommendations based on the results of the final analysis are detailed in section 12. These recommendations are preliminary and will require further development before they can be implemented effectively. In an attempt to address various types of potential conservation programs, these recommendations are broken into four broad categories, incentives, education, regulation and goals.

9. Project Alternatives

Project alternatives consist of administering the survey instrument with a method other than in-home visits. The survey could be administered as an in-home survey as it was in this project, by telephone or by mail. Obviously telephone and mail options would degrade the quality of some of the information and increase the error but would result in significantly reduced costs which might also allow for an increased sample size. In the future GRU will incorporate aspects of this project into its biennial appliance saturation survey and use that instrument as a means of keeping information about low income customers up to date. This is only possible after having conducted this project and identifying what questions are most important to be included in the appliance saturation survey.

Figure 1: Energy Survey Sampling and Scheduling Schematic



10. Results to Date

The data collected during the course of this project leads to three main conclusions with regard to what factors are present within low income households that make some perform better than others. These three conclusions are:
1: Renters have higher energy intensities than owners.
2: Most problems occur either in the area of building envelope or HVAC. (See Table 9a)
3: Awareness and understanding of energy efficiency issues such as equipment maintenance and equipment settings are severely lacking.
Recommendations to address these three areas can be found in section 12.
Project results and findings are listed in detail below (sections 10.1-10.7).

10.1: Sampling Outcomes

The sampling goal for the DEED survey was to complete a specified number of in-home energy audits and energy use questionnaires for low income customers. So that the final data set would be representative of this target population, the goal for total completed, usable surveys was 200, with 100 of these conducted in low energy intensity households and 100 in high energy intensity households.

The final mail-administered recruiting survey and cover letter from the Mayor were approved on February 7, 2006. Beginning with the first round of mailings on February 17th and continuing over the following eight weeks, four groups of customers (4,628 customers in total, 2131 low and 2497 high energy intensity) were mailed the initial recruiting survey. An incentive of 3 CFL bulbs provided at completion of the in-home survey and a $10 credit on each household's utility bill was offered to encourage customer participation. A follow-up/reminder mailing was sent to each non-respondent customer approximately two weeks after the initial mailing had been sent.

The data collection phase of the survey began on April 14, 2006 and ended on August 23, 2006 with a total of 187 surveys completed during this time period. Of these, 99 were for low energy intensity households and 88 were for high energy intensity households. The 'DEED Sampling and Scheduling Schematic' (Figure 1) provides a visual outline of the sampling protocol and outcomes associated with each stage of this protocol. A narrative description of the sampling protocol and outcomes follows in section 10.2.

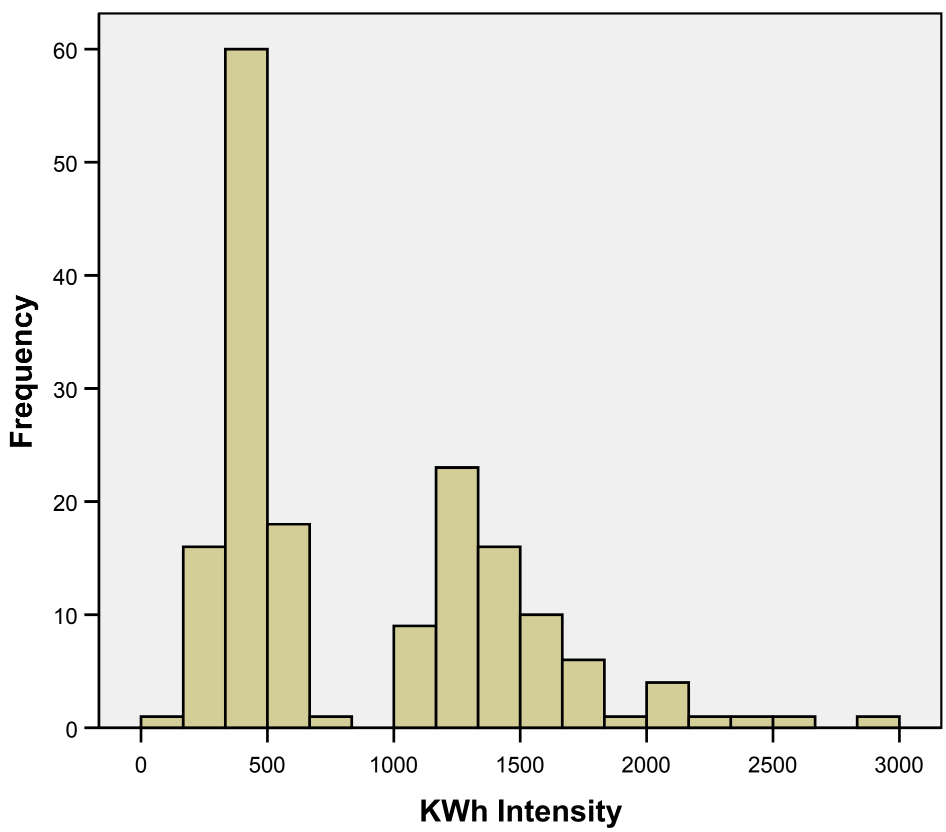
10.2: Scheduling Results

Shortly after the second round of survey mailings began, early March 2006, telephone calls were made to customers who returned the initial energy survey form. A minimum of three attempts were made to reach each of the customers eligible to participate in the survey. Forty-eight of the contact telephone numbers provided by customers on their returned energy form or recorded in customer billing information were disconnected, incorrect or missing. This brought the total pool of eligible customers down to 531 (272 LL and 259 HL). Of these 531, 106 (59 LL and 47HL) declined when invited over the phone to schedule the in-home energy audit. In addition, 201 customers were unreachable (i.e., there was no answer, messages were left and not returned, or the customer was not available), bringing the pool of survey candidates to 224 (114 LL and 110 HL). All of these customers scheduled a survey, but 39 of them (17 LL and 22 HL) either cancelled the appointment and never rescheduled or were not at home when the analysts arrived to conduct the survey. The remaining 97 LL and 88 HL households completed surveys and two customers recruited in the field completed surveys as well, bringing the total data set to 187 surveys completed. When respondents were screened for single-family detached criterion, data for 18 respondents who resided in multi-family homes were omitted. The final data used for the analyses included 169 low income, single-family detached households.

10.3: KWh Energy Intensity Data Analysis

As explained in the sampling design narrative (Section 7.3), the strategy to recruit approximately equal numbers of low and high energy intensity households to complete the DEED survey was adopted so that key factors differentiating these groups could be elucidated from the data analysis. Sampling the targeted population effectively imposed a bimodal distribution on the dependent variable, kWh/1000ft^2 (Figure 2), with 75 households falling into the 'high intensity' range (greater than 1096 kWh/1000ft^2) and 94 falling into the 'low intensity' range (less than 454 kWh/1000ft^2).

Figure 2: Bi-modal Distribution of kWh Energy Intensity (N=169 Households)



The most appropriate strategy for statistically explaining a bi-modally distributed dependent variable was to test for significant differences across low and high kWh energy intensity categories. To identify these differences, kWh energy intensities were cross-tabulated with those independent variables expected to be key explanatory variables (i.e., structural and building envelope features, mechanical system types, appliance age and use, occupant behavior, demographics, etc.) and Chi-square likelihood tests were conducted to measure statistical significance of explanatory factors[†].

10.3a: KWh Energy Intensity and Heating Systems

The critical finding of the analysis of kWh energy intensity data is that survey respondents who have electric rather than natural gas or liquid propane heating systems (space, water, and/or cooking) are predisposed to fall within the high kWh energy intensity category. Table 5a shows the respondent counts across these groups by primary space heating, water heating and oven/stove energy source. Counts highlighted in bold font indicate the energy intensity category in which the largest proportion of households fall for the specified energy type. For all three system types, electric users are more likely to fall within the high kWh intensity group. Chi-square ratio tests confirm that these likelihoods are statistically significant at the .000 level.

Table 5a: Major Energy Systems Across Low and High kWh Intensity Groups

	Low kWh Intensity	**High kWh Intensity**	**Total**
Total:	94	75	**169**
Primary Heating System (Chi-sq likelihood ratio Sig = .000, 27.28, 5df)			
Natural Gas	**62**	24	**86**
Electric Strip	12	**32**	**44**
Electric Pump	12	**15**	**27**
Liquid Propane	**4**	2	**6**
Water Heater (Chi-sq likelihood ratio Sig = .000, 36.75, 5df)			
Natural Gas	**64**	20	**84**
Electric	24	**53**	**77**
Liquid Propane	**2**	1	**3**
Oven/Stove Fuel (Chi-sq likelihood ratio Sig = .000, 18.33, 3df)			
Natural Gas	**33**	7	**40**
Electric	59	**66**	**125**

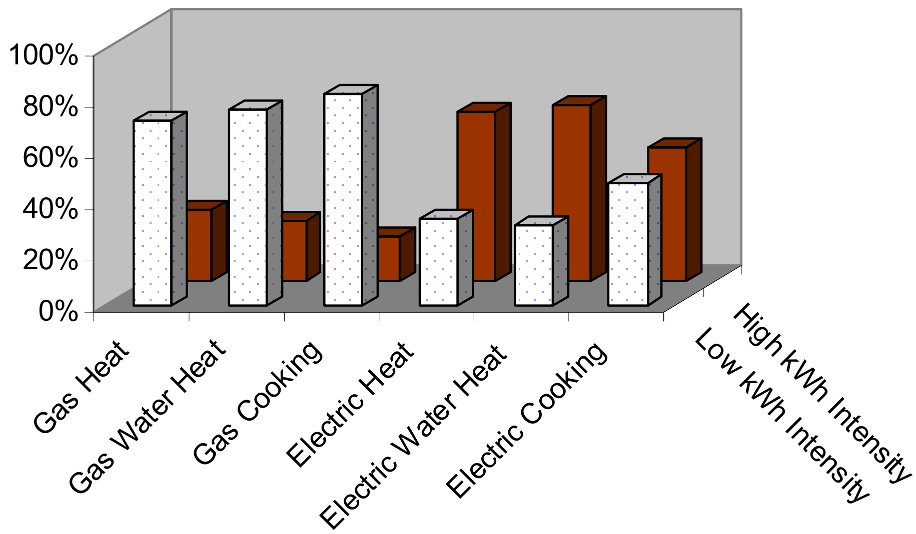
Table 5b presents the results of bivariate Kendall's tau-b tests for correlations between kWh intensity and electric systems: all three tests are significant at less than a .01 level, confirming the strong positive correlation between these key variables. Figure 3 illustrates this relationship graphically, showing for each system and energy type the percentage of households that fall in the high kWh intensity category vs. those that fall in the low kWh intensity category.

Table 5b: Kendall's tau-b Correlation Tests for kWh Intensity And Electric Space, Water, and Cooking Heat

kWh Intensity vs:	**Correlation**	**Significance**
Electric Space Heating	+.281	.000
Electric Water Heating	+.368	.000
Electric Oven or Stove	+.009	.009

[†] Although these analyses were done for several dozen independent variables, the complete results are not presented here because of reformulation of the dependent variable, and hence the statistical analysis. These modifications to the analyses are explained in Sections 10.4a and 10.4b.

Figure 3: Low vs. High kWh Intensity by Space Heat, Water Heat and Cooking Energy Sources (N=169 Households)



10.3b: Reformulating Dependent Energy Intensity Variable

The highly significant positive correlations between kWh intensity and electric heating is a logical result because kWh intensity, the dependent variable upon which the DEED 'high' and 'low' energy intensity customers were selected, accounts for only *electric* energy end uses. However, because the primary goal of the DEED survey was to identify key determinants of energy intensity regardless of energy source, using a more comprehensive measure of energy intensity as the dependent variable (i.e., one that accounts for both electric and natural gas demand for each household) would allow for more robust and valid statistical analysis. Therefore, two strategies for modifying the final data analysis were considered to achieve this goal and produce valid results useful for application to existing conservation programs.

First, data from only those households with electric space and water heating systems could be analyzed and tested for significant differences across kWh energy intensity groups. The drawback to this strategy was that there were only 58 households in the sample that met this electric system criteria, only 14 of which were low intensity, so it would be difficult to isolate key differences across energy intensity groups given the small sub-sample size. The strength was that it would be consistent with the original survey design and analysis approach, preserving the bimodal dependent variable distribution and allowing for examination of two distinct energy intensity groups of low income households.

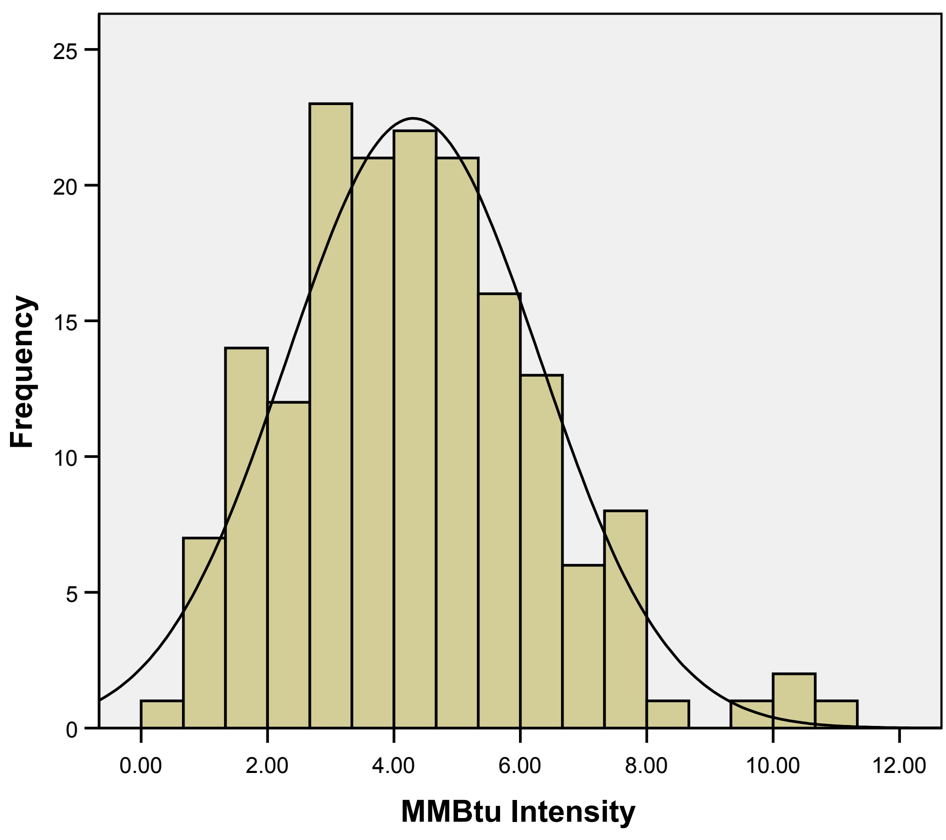
The second analysis option was to supplement electric energy data (kWh) with natural gas usage data (therms) for each of the 169 single-family detached households in the final sample. This was accomplished by converting kWh and therms to the common denominator of British Thermal Units (Btu) and merging the units into a new dependent variable, Btu intensity. Ideally, this would also be done for the entire population of GRU customers so that comparisons could be made between Btu energy intensities of low income customers and the average residential customer; this was not feasible within the timeframe of the DEED project. The primary benefit of merging kWh and Therm data in this fashion is that it produces a more complete energy intensity measure and the resultant distribution is a truer representation of household energy use for the typical low income GRU customer.

After evaluating these two options and with the goal of producing elucidating statistically valid and robust results, GRU opted to reformulate the key dependent variable, merging kWh energy intensity data with customers' corresponding therms data and converting them to average monthly millions of Btus (MMBtu) demanded per thousand square feet of conditioned space. The analysis that follows uses this updated, comprehensive measure of energy intensity, MMBtus/1000ft^2, as the primary dependent variable.

10.4: Btu Energy Intensity Data Analysis

Because MMBtu energy intensity is distributed normally across DEED households (Figure 4), household energy intensity means across independent variable categories were compared and correlations between MMBtu and independent variables were measured to identify key explanatory variables for energy intensity. For example, to test whether renters demand significantly more energy per square foot, renters' average MMBtu energy intensity was compared to home owners' average MMBtu energy intensity (with one-way analysis of variance, or ANOVA tests) and the magnitude and statistical significance of the relationship between these variables was measured by a Kendall's tau-b correlation test (appropriate for ordinal variables).

Figure 4: Normal Distribution of MMBtu Energy Intensity (N=169 Households)



10.5: In-Home Energy Survey Data - Descriptive Statistics and Analysis

Response data for each component and all questions of the in-home DEED survey for 169 low income, single-family detached households are presented in Attachment F (In-Home DEED Energy Survey, Summary Descriptive Data and ANOVA test statistics). In the attachment, Tables 1.1-3.15 and Tables 4.1-6.10 (Section F.1) correspond directly to questions from the verbally-administered survey (Attachment B) and show *respondent-reported* data. Tables 3.16a-3.16h (Section F.2) are presented at the end of the appliance data section of the verbally administered survey and correspond directly to data from the GRU appliance checklist (Attachment D), *as recorded by GRU's conservation analysts*. Tables 7.1-7.45 (Section F.3) correspond directly to data from the GRU Energy Action Survey Checklist (Attachment C), *also as recorded by GRU's conservation analysts*

In Attachment F, categorical energy intensity means are presented for ordinal variables and the mean for the independent variable category with the greatest magnitude of Btu intensity[‡] is highlighted in bold. One-way analysis of variance (ANOVA) tests across categorical energy intensity means were conducted for variables with at least 5% of responses in more than one category. Significance results, F-statistics, and degrees of freedom are presented for each of the tests conducted. Results significant at <.01 are flagged by ***, at <.05 by **, and at <.10 by *. Sections 10.5a and 10.5b give a detailed overview of these data by describing the homes, systems, occupants and behavior of the DEED sample households.

This section summarizes response and GRU-recorded data for the 169 low income households that participated in the in-home energy survey. It describes in detail the DEED households; their energy intensity, occupant demographics, building envelopes, mechanical systems, appliances and occupant behavior, providing a comprehensive picture that allows results of the statistical analysis to be interpreted logically[§]. Using SPSS software, the final dependent variable (MMBtus/1000sqft) was evaluated as it relates to an extensive set of independent and potentially explanatory variables. These independent variables were also examined for relationships with one another. The analysis was structured by first grouping independent variables into five relatively distinct 'types' of factors, each of which plays an important role in the energy intensity of DEED households: 1) Demographics 2) Home Structure/Building Envelope 3) Mechanical Systems/HVAC 4) Appliances, Lighting, and Entertainment and 5) Occupant Behavior.

10.5a: Total Energy Use and Energy Intensity

Table 6 (in addition to Tables 1a and 1b in Attachment E) shows energy use and energy intensity statistics for the 169 low income single-family detached (SFD) households in the DEED survey and for 362 SFD households randomly sampled via GRU's annual appliance saturation survey.

[‡] Section 10.3b explains why Btu intensities rather than kWh intensities are used in the results and statistical analyses.

[§] For the most refined data for specific independent variables of interest, refer to Attachment F.

Table 6: Summary Statistics for Total Energy Use and Energy Intensity (169 DEED Households vs. 362 Randomly Sampled GRU Customer Single Family Detached Households)

	DEED		SFD	
	Mean	St. Dev.	Mean	St. Dev.
kWh Total (kWh/month)	**1118**	767	**1134**	580
kWh Intensity (kWh/month/1000ft^2)	**878**	584	**680**	635
Therm Total (therm/month, DEED N=103)	**28.1**	17	**26.6**	17
Therm Intensity (therm/month/1000ft^2, DEED N=103)	**21.5**	14	**15.3**	10
Btu* Total (MMBtu/month)	**5.5**	3	**5.5**	3
Btu Intensity (MMBtu/month/1000ft^2)	**4.3**	2	**3.3**	2
Household Square Footage (conditioned area, ft^2)	**1333**	450	**1901**	776

*Btu conversion factors: (1kWh = 3412Btu), (1therm = 100,000Btu), (1MMBtu = 1millionBtu)

Between October 2004 and September 2005, DEED households used an average of 1118 kWh per month (electric demand) and 28.1 therms per month (natural gas demand), which equates to an average of 5.53 million Btus (MMBtu) per month. Total energy use among the DEED low income households does not deviate significantly from that of the average GRU residential customer as approximated by the SFD sample: DEED households used, on average, only 16 kWh *less* and 1.1 therms *more* per month than typical single-family detached households. However, when energy measures are averaged per 1000 square feet of conditioned space[**], DEED households exhibit higher energy *intensities* than the average GRU customer. Monthly energy intensities of DEED households exceed those of SFD by 218 kWh/1000ft^2 and 6.5 therm/1000ft^2 (or collectively, by 1.31 MMBtu/1000ft^2).

The similar total energy use and differing energy intensity across DEED and SFD households suggest that low income GRU customers are not using significantly more energy than their SFD counterparts. They are more energy intense because they tend to reside in significantly smaller households (almost 600 square feet smaller, on average). Since they are disproportionately energy cost burdened, targeting low income customers with DSM programs to help them improve the efficiency of their homes and encourage conservation, is a high priority goal for GRU.

10.5b: Demographics

Income: Most respondents (54% of 147 who responded to Q62) reported 2005 gross household incomes of $20,000 or less, while only 18% reported incomes greater than $30,000 during the same annual period. Using response category mid-points to calculate average income for this group of customers, average 2005 gross income was approximately $22,000. Median income for the sample was $20,000 or less, compared to the Gainesville, FL MSA 2005 median family income of $53,550. DEED respondents, on average, are well below the HUD low income criteria, and those with incomes less than $20,000 are significantly more likely to rent than own their homes (Kendall's tau-b correlation Sig =.021).

[**] Household square footage data for the DEED sample were taken directly from property appraiser records while those for the SFD sample are customer-reported estimates, so actual energy intensities for the SFD sample may differ from those listed here.

Occupancy: Most DEED households (81%) are owner-occupied. Sixty percent are one- or two-person households, while 27% are from households with three or four occupants and 13% are from households with five or more occupants. Btu energy intensities are highly correlated with the number of residents per household: the direct bivariate Pearson's correlation between these variables is +.254 and is statistically significant at .000. Renter-occupied households have, on average, more occupants (Kendall's tau-b correlation Sig =.000), fewer senior citizens (Kendall's tau-b correlation Sig =.000), and more children (Kendall's tau-b correlation Sig =.003) than do owner-occupied households.

When the number of residents is controlled, renter-occupied households have energy intensities significantly greater than owner-occupied; 5.14MMBtu/1000ft^2 for renters vs. 4.12MMBtu/1000ft^2 for owners (Kendall's tau-b correlation Sig =.098). Table 7 shows detailed energy use and energy intensity data for renter- vs. owner-occupied DEED households. For all energy measures, rentals consumed more than owner-occupied households. Another factor – in addition to the higher occupancy rates – driving renter-occupied households' energy *intensity* statistics up is that rented homes in the DEED sample are an average of 82 square feet smaller than owned homes (although this correlation is only significant at a .259 level).

Table 7: Total Energy Use and Energy Intensity Means, Renter- vs. Owner-Occupied

	All	Owned	Rented	Difference (Rent-Own)
kWh Total (kWh/month)	1118	1069	1329	**260**
kWh Intensity (kWh/month/1000ft^2)	878	824	1109	**285**
Therm Total (therm/month, N=17)	28.1	27.5	31.1	**3.6**
Therm Intensity (therm/month/1000ft^2, N=17)	21.5	21.1	23.2	**2.1**
Btu* Total (MMBtu/month)	5.53	5.33	6.36	**1.03**
Btu Intensity (MMBtu/month/1000ft^2)	4.20	4.12	5.14	**1.02**
Household Square Footage (conditioned area, ft^2)	1333	1348	1266	**-82**

Tenure and residency: Most customers (63%) are relatively long tenured residents of Gainesville, having lived in their current homes for more than five years, while 8% are relatively new residents, having lived in their homes for one year or less. Controlling for number of people in the home, there is a positive and statistically significant correlation between years of residence tenure and energy intensity. Ninety-seven percent of respondents are permanent residents, spending at least nine months per year in their Gainesville home, and only 7% expected to move from their residence within a year of having completed the survey.

Concern, awareness and action: The majority of respondents (98%) are concerned about energy costs in their homes, 74% of them indicating that they are *very* concerned. Those who said that they are only *somewhat* concerned about energy costs had average energy intensities .56 MMBtu/1000ft^2 (13% less) than those who are *very* concerned, however this difference is only statistically significant at a .20 level (One-way ANOVA). When asked what they feel has the largest impact on their household's energy use, respondents named most often (in 43% of cases) air conditioning or cooling of the home, a factor which ranks as the top energy end use for a typical home in North Florida. Table 8 lists all factors identified as key contributors to energy use in the home. Relatively few respondents named factors other than cooling the home, but the factors that were named are still important energy end users.

Table 8: Factors Respondents Feel Have Largest Impact on Household Energy Use (Q63)

	N	% of all respondents
Air conditioning/cooling systems	73	43.2
Appliances	35	20.7
Heat/heating systems	27	16.0
Water heating	23	13.6
Lighting	16	9.5
Electronics	13	7.7

Almost half of respondents (46%) said they had made changes to their homes or had modified their behaviors in the past year to make their homes more energy efficient, yet energy intensities do not vary between those who made changes and those who did not (4.30 vs. 4.32 MMBtu/1000ft^2). Despite the fact that all of the DEED participants met HUD low income criteria, 87% of respondents said they are not aware of any programs to help them reduce their energy cost burden. Concern about energy costs, action to improve home energy efficiency and awareness of energy assistance programs does not differ across renters and owners.

10.5c: Home Structure/Building Envelope

Home age: The age, type, and condition of a home's building envelope define the baseline for how energy-efficient a household can be. Seventy-six percent of homes in the DEED sample are at least twenty years old; 12% of respondents surveyed did not know when their home was built. Older homes tend to have higher energy intensity, when controlling for people per household, but this correlation (+.091) is not statistically significant (Sig = .242). The age of the home is indirectly and significantly correlated with home ownership (Kendall's tau-b Stat = -.266, Sig = .000). This statistic indicates that rental homes, which tend to be more energy intense, are significantly older than owner-occupied homes, so the age and related structural conditions of the home are likely to have a marginal, but still adverse, effect on renters' energy intensity.

Structure type and insulation: Sixty-six percent of DEED homes are concrete block structures while the rest are wood frame, and wall structure is significantly correlated with home age; i.e., wood frame homes are typically older than concrete block homes (Kendall's tau-b Stat = -.254, Sig = .001). Most homes' walls (59%) and floors (93%) are not insulated, and homes lacking wall insulation have significantly higher energy intensities than homes with insulated walls (One-way ANOVA Sig = .043). Ninety-four percent of DEED homes have attics, and 94% of homes with attics have insulation, but 89% of these have an R-13 or lower level of insulation (US DOE recommends R-30) and 69% have no insulation on their attic access covers. Lower Btu energy intensities are directly correlated with attic and attic cover insulation, as expected, but these correlations are only marginally significant (Kendall's tau-b Sig = .143 and .073, respectively).

Roof color: Roof color is statistically correlated with energy intensity (Kendall's tau-b Sig = .044 when controlling for people per household), with darker roofed homes and those with red or orange roofs in particular having significantly higher energy intensities than lighter-colored roofs.

Doors and windows: The 'typical' DEED home has mostly wooden exterior doors (60% of all doors) and single-paned, single-hung (62%) or awning (14%) windows. Homes with windows in poor condition (36%), windows needing shade or cover (20% of homes), and doors and/or windows needing weather stripping (45%) all have higher Btu energy intensities than homes without these problems, but the direct correlations between energy intensity and these variables are only marginally significant (Kendall's tau-b Sig = .073, .226, and .159, respectively).

Orientation and shade: Other structural factors that can affect a home's energy intensity include the orientation of the structure and the amount of shade that landscaping provides the home. Most homes in the DEED sample (54%) are oriented in the most energy-efficient way, with the longest side of the home facing south (or north). Forty percent have a west (or east) axis orientation, but these homes do not have significantly different energy intensities than other DEED homes. Most homes receive only partial shade from trees, and those that receive no shade in the morning have higher energy intensities than those that receive some or total shade, but again these differences are not statistically significant, even when controlling for the number of people per household.

10.5d: Mechanical Systems/HVAC

Cooling systems: In a typical North Florida home, cooling typically accounts for the largest portion of residential energy end use, so the types and performance of cooling systems are expected to affect a home's energy efficiency. Seventy-seven percent of DEED homes have a central air conditioning system, 29% have one or more window or wall air conditioning units, and 82% have one or more ceiling fans for decentralized space cooling. Most central cooling systems (62%) are controlled by a standard thermostat and 20% are controlled by a programmable electronic thermostat. Five households surveyed (3%) have ceiling fans as their only cooling source, and homes with four or more ceiling fans (46% of all homes) have significantly lower energy intensities than homes with fewer ceiling fans (One-way ANOVA Sig = .031). These results suggest that in more efficient households, residents may use ceiling fans as their primary cooling source and central air conditioning as a secondary cooling source.

Although the energy intensity means ANOVA test for the primary cooling variable (Attachment F, Section 4, Table 7.42) is not statistically significant, homes with central air conditioning systems have higher average energy intensities (4.46 MMBtu/1000ft^2) than homes with alternative cooling systems (3.73 MMBtu/1000ft^2 average for homes with pump systems and 3.83 MMBtu/1000ft^2 average for homes with window or wall air conditioning units). Perhaps the most important factor affecting a central cooling system's efficiency is the location of the distribution ducts. Homes with ductwork in the attic have significantly higher Btu energy intensities than those with ducts in conditioned space (One-way ANOVA Sig = .096).

Heating systems (space and water): Hot water and space heating are the second and third largest energy end uses in a typical North Florida home. DEED households are almost evenly split in their use of natural gas and electric water heaters (51% and 46%, respectively) and in their distribution of newer and older water heaters (35% five years old or newer and 27% ten years old or older). There is some evidence of a positive correlation between household energy intensity and water heater age, with the ANOVA test significant at .128 and homes with water heaters over 20 years old with an average Btu energy intensity of 5.20 MMBtu/1000ft^2.

For the purposes of space heating, 52% of DEED households have natural gas furnaces, 27% have electric resistance systems, and 17% have central heat pumps. Sixty-six percent of primary heating systems are controlled by a standard thermostat and 21% are controlled by a programmable thermostat. The ANOVA test for this primary heating variable (Attachment F, Section 4, Table 7.43) indicates that homes with heat pump systems are significantly less energy intense than those with electric resistance systems (3.81 vs. 4.65 MMBtu/1000ft^2 means, respectively, ANOVA Sig = .078). Similar to the results for primary cooling distribution systems, homes with heating distribution systems in the interior, conditioned space of the home have lower energy intensities, on average, than homes with heating distribution systems in the attic (ANOVA Sig = .130).

Heating, ventilation, and air conditioning (HVAC) operations and maintenance problems also affect the energy efficiency of homes. Several of the problems identified by GRU conservation analysts (summarized in Table 9a) are significantly correlated with higher Btu intensities in DEED homes. Systems with damaged condenser coils, dirty air handler coils, and leaky ducts all correlate with significantly more energy intense households (Kendall's tau-b correlations significant at .051, .006, and .054, respectively). The ANOVA results shown in Tables 7.2, 7.8, and 7.11 (Attachment F3, Section 1) are consistent with these correlation tests.

10.5e: Appliances, Lighting, and Entertainment

Appliances: Ninety-eight percent of DEED households had some form of refrigeration, typically (91%) a combination refrigerator/freezer. Data on the age of refrigeration units were not collected, but GRU conservation analysts did record that 61% of homes have an inefficient refrigerator. In addition, the ANOVA test shows that homes with inefficient refrigerators have significantly higher Btu energy intensities than homes with efficient ones (Sig = .001). Most households (92%) have a clothes washing machine, and most (70%) are less than 10 years old. Eighty-three percent of DEED households also have a clothes dryer, and again, most (67%) are less than ten years old. Seventy-five percent of DEED households have an electric range or oven and 24% have a natural gas range, and energy intensities do not differ significantly across these methods of cooking.

Lighting: Standard incandescent bulbs are the most common form of light bulbs used in DEED homes (98% of homes reported lighting at least a portion of their homes with standard incandescent bulbs), but 20% of respondents also reported using compact fluorescent bulbs for at least 25% of the interior lighting of their homes. Respondents, on average, light two rooms for six hours a day. Exterior flood lights are used by 85% of households, are typically (in 62% of households) controlled by an interior switch, and are in use for an average of 3 hours per night.

Entertainment: DEED households have, on average, three televisions, 31% have four or more televisions and 27% have at least one large-screen television. Most also have a DVD/VHS player (76%) and a personal computer (58%).

10.5f: Occupant Behavior

Energy use behavior in the home is one of the most difficult variables for utility companies to influence, but it is also the variable over which low income customers may potentially have the most control of to reduce their energy intensities. Understanding customers' behavioral tendencies can be useful for designing effective DSM programs.

In 12% of DEED households, at least one resident regularly works from home, compared to households where none of the residents work from home, Btu energy intensities are slightly higher. In 66% of these households, at least one resident is typically at home all day during the work week. Occupants tend to set their air conditioning thermostats lower than recommended in the summer (average setting of 76 degrees Fahrenheit compared to the recommended 78 degrees) and higher than recommended in the winter (average setting of 72 degrees compared to the recommended 68 degrees). In typical DEED households, an average of five loads of laundry are washed per week, with 21% of respondents indicating that they 'frequently' or 'always' use hot water when they do their laundry. Sixty-two percent of respondents said that they never hang clothes to dry. Occupants also tend to take longer showers than GRU recommends, an average of 11 minutes per shower.

When the number of people per household is controlled for, behaviors that are significantly correlated with Btu intensity include hours of television per day (Sig = .009) and frequency of microwave use (Sig = .070).

10.6: Overview: Prevalence of Energy-Related Problems

Significant numbers of DEED households exhibited structural, mechanical, maintenance, or behavior-related energy inefficiencies. Table 9a lists the twenty most prevalent energy problems in DEED households, as recorded by the GRU conservation analyst using the Energy Action Checklist. Inadequate insulation of the building envelope and mechanical systems is a common problem among these households: 93% of raised floors are not insulated; 89% of attics are insulated below GRU recommended levels; 59% of walls are not insulated; 56% of water heater pipes are not insulated; 31% of attic access covers are not insulated; and 28% of air conditioner refrigerant lines are not insulated. Other common problems are related to systems' and appliances' operations and maintenance. Sixty-one percent of households had dirty refrigerator coils, 45% had doors and/or windows that need to be weather stripped or caulked, 17% had dirty air handler coils, and 15% had inadequate temperature drop across air handler coils. 39% of the DEED homes had leaky ducts and 33% had leaks in the air handler cabinet, support platform, and/or air handler closet. Finally, problems tied to occupant's behavior were prevalent: air filters were dirty or improperly installed causing air to by-pass the filter in 42% and 13% of homes, respectively; thermostats were set at temperatures lower than those recommended by GRU for summer months in 29% of homes; fans were left on in unoccupied rooms in 28% of homes; water heater temperatures were set higher than recommended in 21% of homes; and windows needed shades or coverings in 20% of homes.

Table 9a: Common Energy Problems among Low Income Households

Problem	% of homes	N	of possible
1. Raised floors not insulated	93%	66	71
2. Attic insulation inadequate (average R-13 vs. recommended R-30)	89%	133	150
3. Refrigerator coils dirty	61%	103	169
4. Walls not insulated	59%	42	71
5. Water heater pipes not insulated	56%	91	164
6. Doors and windows need weather stripping and/or caulking	45%	76	169
7. Air filter is dirty	42%	54	130
8. Ducts have leaks	39%	59	152
9. Windows are in poor condition	36%	60	166
10. Air handler, support platform, or air handler closet has leaks	33%	50	152
11. Attic access cover not insulated	31%	46	150
12. Cooling thermostat set too low	29%	40	139
13. Fans on in unoccupied rooms	28%	39	139
14. AC refrigerant line not insulated	28%	36	130
15. Hot water temperature set too high	21%	35	164
16. Windows need shading or covering	20%	33	169
17. Air handler coil is dirty	17%	22	130
18. Inadequate temperature drop across coils (ideal drop 8-12°F)	15%	20	130
19. Air is by-passing air filter	13%	17	130
20. Water heater pipes are rusty, corroded, or leaking	12%	19	164

Table 9b shows the prevalence of household conditions potentially affecting energy intensity *as reported by the respondent rather than as recorded by the GRU conservation analyst.* Most of these conditions are consistent with those listed in Table 4a, but others are related to occupant behavior and awareness. Most respondents do not change their thermostats for sleeping hours (65% in summer months and 54% in winter months) and many do not change them before leaving the home (38% year-round). A majority of respondents (87%) are not aware of programs to help them lower their energy costs.

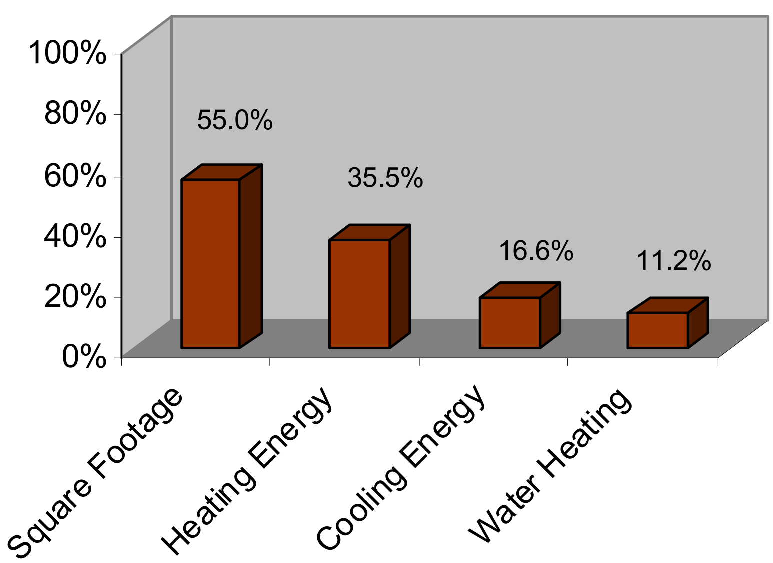
Table 9b: Household Conditions Potentially Affecting Energy Intensity
(As reported by respondent)

Condition	% of homes	N	of possible
1. Respondent unaware of available energy assistance programs	87%	146	168
2. Raised floors not insulated	78%	35	45
3. Thermostat not changed while sleeping (summer months)	65%	89	136
4. Thermostat not changed while sleeping (winter months)	54%	83	154
5. Windows need weather stripping and/or caulking	44%*	1021	2324
6. Thermostat not changed while away (summer months)	38%	57	149
7. Thermostat not changed while away (winter months)	38%	58	154
8. Water heater is more than 10 years old	34%	46	134
9. Doors need weather stripping	33%*	166	500
10. Home is not shaded by trees (afternoon hours)	28%	47	167
11. Clothes dryer is more than 10 years old	25%	30	122
12. Air filter is not replaced as recommended	23%	31	134
13. Home is not shaded by trees (morning hours)	23%	38	167
14. Clothes washing machine is more than 10 years old	22%	30	139
15. No cooling thermostat	18%	30	169
16. No heating thermostat	13%	22	169
17. Attic not insulated	9%	11	124

* Percentage of total windows and doors in all 169 households because variable included multiple counts per respondent.

By administering one component of the survey verbally and another as a checklist completed by GRU conservation analysts, respondent-reported data can be compared to data verified by the GRU analysts and discrepancies can be identified Figure 5 summarizes the extent to which respondents were unfamiliar with important energy-related features of their homes. Most (55%) either did not know or stated the wrong approximate square footage (plus or minus 250ft^2) of their home and many did not know the source of energy for their home's space heating (36%), cooling (17%), and water heating (11%).

Figure 5: Percentage of Respondents Unfamiliar with
One or More Energy-Related Features of Their Home



10.7 Analysis Results Summary

Table 10 lists the key explanatory variables for Btu intensity across DEED households and their corresponding bivariate correlations (Pearson's for continuous variables and Kendall's tau-b for ordinal variables) with $MMBtu/1000ft^2$.

Table 10: Btu Intensity: Key explanatory variables

Independent Variable	Correlation Coefficient	Significance Level
Residents per household***	+0.254	0.000
Occupancy status (ownership)***	-0.167	0.008
Occupancy tenure*	+0.132	0.086
Home age	+0.064	0.437
Conditioned area (square feet)***	-0.242	0.002
Building envelope insulation**	-0.148	0.016
Attic insulation R-value*	-0.110	0.077
Roof color*	+0.111	0.059
Lack of weather stripping	+0.089	0.159
Poor windows*	+0.114	0.073
Windows need shade or cover	+0.076	0.226
HVAC problems**	+0.180	0.019
Dirty air handler coil**	+0.160	0.011
Condenser coil damaged	+0.103	0.103
Duct leaks	+0.101	0.109
Refrigerator coils dirty***	+0.192	0.002
Air filter changed infrequently or not at all***	+0.250	0.003
Number of showers per week***	+0.196	0.013
Hours of exterior light use*	+0.147	0.066
Hours of entertainment system use**	+0.190	0.013

*** statistically significant at the .01 level
** statistically significant at the .05 level
* statistically significant at the .10 level

11. Project Status

As of submission of this report, the terms of the project are considered fulfilled, GRU will continue to use the DEED survey data and results to assist with DSM program development and will consider recommendations as described in Section 12 below.

12. Project Applicability and Recommendations

According to the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, "low income families spend up to 14% of their annual income on energy versus 3.5% spent in most other households. This results from their lower total income and the fact that low income housing tends to be less energy efficient" (US DOE 2006). The need for effective low income energy efficiency programs will only get stronger as energy prices trend upward.

The results from this research project reinforce previous studies and the focus of the current best energy efficiency programs around the nation (Brown et al. 1994; Kushler et al. 2005). Primarily these overlapping energy efficiency programmatic needs include the building envelope (weatherization improvements to the air barrier and thermal barrier), the HVAC system (especially sealing air handlers and ductwork in unconditioned spaces and periodic equipment maintenance), and behavioral/educational programs.

One additional major finding of this study was that renters' bills were higher than owners' bills for the surveyed respondents. The implications and recommendations related to this finding are detailed in the regulatory portion of this report section.

Within this study, nearly all of the respondents (98%) are concerned about energy costs in their homes. Fully, 74% of them indicating that they are very concerned. However, 87% of respondents said they are not aware of any programs to help them reduce their energy cost burden. Though low income energy efficiency programs targeted for specific households have shown success nationally and internationally (Brown et al. 1994; Davidson and Wilson 2006; Kushler et al. 2005), incentives and rebates not targeted for specific households, such as high efficiency central air conditioners or solar water heaters, are not necessarily reaching the low income household market segment.

The details and recommendations that follow focus on:

- Which incentives are more successful than others and why (building envelope and HVAC systems),
- How these incentives and other programs might be altered to better reach low income households (modify billing information to better reflect energy use comparisons and how costs impact lifestyle, consideration of coupons in lieu of rebates for specific improvements; create programs that reward behavioral efficiency improvements in addition to building structural/system improvements; and collaborate to offer low-interest loans for the more expensive building improvements), and,
- Consideration of broader scale ideas for market transformation that may be worth considering for further investigation and implementation (developing new data reporting, monitoring and marketing interfaces for improved market transformation and non-utility-based initiatives such as a GIS-based database and/or a mobile energy efficiency education vehicle to target groups more effectively than individuals).

12.1: Summary of Ideas and Recommendations:

Table 1: Demand Side Management Recommendations

Category of Influence	» *DSM Goal* ▪ Recommended Action
INCENTIVES	» *Improve building envelope performance of existing low income homes* • **Add Insulation.** 89% of homes surveyed had inadequate levels of insulation in the attic. Adding insulation will slow the amount of heat loss and reduce the energy needed to maintain a comfortable temperature. • **Address the Whole House.** 45% of all homes surveyed were in need of weatherization, but there is more to addressing energy usage then just weatherization. A program which addresses the entire home at the same time is necessary in order to truly address low income high energy user's needs. » *Improve HVAC and mechanical system performance in low income homes* • **HVAC and Mechanical Maintenance.** 42% of homes surveyed showed relatively poor upkeep of their HVAC systems, dirty air filters, uninsulated refrigerant lines, dirty/blocked evaporator coils, blocked condenser units. Properly maintaining existing HVAC systems reduces energy needed to maintain a comfortable temperature. • **Repair/Replace Ductwork.** Incentivize repairs to leaky ductwork and air handlers, platforms, and closets. In some cases duct work is beyond reasonable repair and it might be more cost effective to make use of ductless (mini-split) heat pump systems when replacing existing HVAC system or installing HVAC in homes currently without central heat or AC. • **Provide Better Controls.** Offering customers the option to control current mechanical systems, such as HVAC temperature and water heating temperature which can lead to decreased energy usage. » *Help make efficiency financially feasible for low income customers* • **Coupons or Buy Downs.** Provide coupons in lieu of rebates for lower priced items such as CFLs, weather-stripping, Energy Star appliances, etc. • **Customized Residential Rebate.** Complement and/or replace existing rebates with tiered and categorized rebates/rewards based on total energy and water use reductions as compared to a moving average. • **Low Interest Loans.** Low income customers typically do not have enough savings to cover major equipment replacements or repairs, even after rebates are applied. Banks are not always willing to offer small enough loans to cover these replacements or repairs. A program to help facilitate low loan amounts would help low income customers purchase higher cost energy efficiency upgrades, and allow them to pay for the loans with the resulting savings on their utility bills.
EDUCATION	» *Expand efforts to modify behavior and drive market efficiency transformation* • **Provide Usage Information.** Determine what information is helpful to customers in making energy efficiency decisions. As a first step, explore providing more detailed usage history on customers' bills. As a long term goal develop a web-based GIS tool which can benchmark individual performance against larger geographical areas. • **Mobilize Education.** Design and deploy a mobile efficiency demonstration center that can travel to local events, churches, community centers, and other major gathering places to bring educational materials, coupons and other useful items to customers.

	» *Expand and/or modify existing education programs to maximize impact* • **Provide the Goal.** Provide customers with optimal energy-efficiency targets for their homes by detailing power and water use expectations for homes that perform relatively well to allow customers to gauge their use and possibly modify their own performance expectations. • **Evaluate Current Education.** Evaluate existing educational materials and ensure that it is meaningful and useful for the target population. Focus groups and other forms of market research will be needed before conclusions are reached. » *Expand and/or modify existing programs to achieve optimal mechanical system and appliance performance* • **Checklists.** Make maintenance checklists available to customers where appropriate. Some ideas include webpage, bill inserts, and stand alone direct mail pieces. • **Manage Communications Channels.** Make sure that all appropriate communication channels are being utilized to communicate programs and information to low income customers. • **Group Energy Audits.** Complement existing individual energy audits with group information sessions (together with mobile efficiency demonstration center to allow for real-time feedback and evaluation).
REGULATORY	» *Advocate for regulatory change to improve mechanical system and appliance performance* • **Landlord Licensing.** Advocate modifications to landlord licensing process through adoption of appropriate incentives and regulations that address energy efficiency in rental homes. • **Landlord Maintenance.** Advocate requirement that all landlords perform mechanical system and appliance service/repairs at regular intervals (e.g., every 5 years or every 3rd tenant turnover). • **Energy Efficiency Enforcement During Property Transactions.** Advocate requirement that all existing home sales include mechanical system and appliance service/repairs in closing and/or home inspection process, prior to completion of the sale. • **Improve Minimum Housing Code.** Adopt an advocacy role in the formation and revision of the minimum housing codes to support the implementation of sound building science, increase the market penetration of best practices, and remove the restrictions on local governments who choose to make their codes more restrictive than state standards from an efficiency standpoint.
GOALS	» *Existing programs and long-term goals: continue to improve DSM efforts, change behavior, drive market efficiency transformation* • **Continuous Review.** Continue to review effects of existing DSM programs around the country and apply lessons learned to GRU programs. • **Information Sharing.** Continue to encourage sharing of information between utilities to increase effectiveness of DSM throughout the utility industry at the state and national level.

12.2: Incentives

Incentives are an important means by which utilities can influence energy efficiency among customers. However, incentives do not always cover the whole cost of an energy efficiency upgrade or repair and can be beyond the means of some low income customers. To address this utility incentives aimed at low income customers should cover a substantial portion of the incremental cost and target items that are of the greatest impact to energy use. With that in mind the following recommendations are for incentive programs:

Adding Insulation:
Insulation slows the amount of heat that flows in and out of a home, and reduces the amount of energy necessary for the heating and cooling systems to maintain a comfortable temperature. Adding additional insulation in an attic and/or under raised flooring when existing levels are inadequate can reduce heat transfer and help lower energy bills.

Inadequate insulation is prevalent among the homes surveyed (89%). This can be addressed in any incentive program meant to resolve the energy needs of low income customers. Adding insulation is a relatively cheap energy efficiency measure in most applications. In homes with flat ceilings that have attic access, insulation can be blown in on top of existing insulation to increase the R-Value.

GRU rolled out an added insulation rebate in December 2006 that provides a $0.125 per square foot rebate for installing an additional R-19 in the attic or R-11 under the floor. This rebate amount is almost half the cost of self installation of the measure.

In order for this program to reach low income households, a grass roots campaign encouraging community groups or churches to coordinate a volunteer effort may be appropriate. GRU could provide training to these groups to help others to install the insulation.

Address the Whole House:
One of the objectives of the DEED Study was to determine the major reasons why GRU residential low income customers, have higher energy intensity compared to others. This was to be accomplished by evaluating low and relatively high energy users in Gainesville. Comparison of these results and Btu intensities suggested a "two pronged effort" that included weatherization and repair programs, combined with aggressive education and outreach programs.

GRU will implement a Low Income Whole-house Improvement Pilot Program as a result of the results of this research. The program will target 40 low income households to make energy efficient improvements to help lower their energy use. The following measures, up to $2750, will be included in the program based on the recommendations of the DEED Study:

- Seal penetrations in exterior walls, floors and along ceiling to prevent air infiltration
- Provide weather-stripping and caulking along exterior doors and windows
- Raise attic insulation and access cover insulation levels to a minimum of R-30
- Increase raised floor insulation level to R-11
- Replace poor performing windows and exterior doors with more efficient models (as needed)
- Seal and repair ducts
- Service and/or repair central air conditioning systems
- Replace old inefficient refrigerator and/or room air conditioner (as necessary)

GRU will work with other housing agencies that assist low income households to determine eligibility. Participants in the program will be required to attend an Energy

Efficiency Workshop that will provide information on how to operate, understand and maintain their home systems, and discuss energy and equipment problems and solutions.

HVAC and Mechanical Maintenance:

Forty-two percent of homes exhibited signs of poor maintenance of their HVAC systems. Elements identified included missing or dirty air filters, uninsulated refrigerant lines, dirty or blocked evaporator coils, and dirty or blocked condenser units.

GRU currently offers a rebate of $55 for HVAC Maintenance. This rebate is enough to offset three quarters of the cost required to address these common problems. Low income customers are not taking advantage of this program. Benefits of regular maintenance may not be understood and require further incentives and marketing. GRU will evaluate this program to determine the best course of action to increase the participation of low income customers. A campaign to promote this service, along with an educational component of how to maintain the system afterwards, may have a beneficial impact to these customers.

Repair/Replace Ductwork:

GRU developed a Duct Leak Repair Pilot Program September 2005 to determine the cost effectiveness of duct system repair and the energy savings resulting from a more efficient air distribution system. This program determined that there is a high frequency of duct leakage occurring in Gainesville homes that is not necessarily correlated to the age. Leaky ducts allow expensive conditioned air to escape into attics causing a significant increase in air conditioning energy use. The pilot also provided GRU with the average savings ($9.68/month) for sealing duct systems.

The DEED Study substantiated these findings and noted that improperly sealed ductwork or air handler closets will cause inefficiencies in HVAC systems. When conditioned air is not distributed properly, return air is not preconditioned and the structure becomes negatively pressurized resulting in outside air infiltration. Duct leakage was present in 39% of surveyed homes.

The findings from GRU's Duct Leak Pilot Program resulted in the development of a Duct Leak Repair Rebate. Up to $200 is offered to the customer for having their duct systems thoroughly inspected and repaired. This includes the air handler and all duct work. Based on the additional findings of the DEED Study, this rebate will be modified, effective January 2007, to reward the customer up to $375. This rebate will be evaluated to determine the best way to make sure that it is applicable to low income customers.

Ductless mini-split Air Conditioner

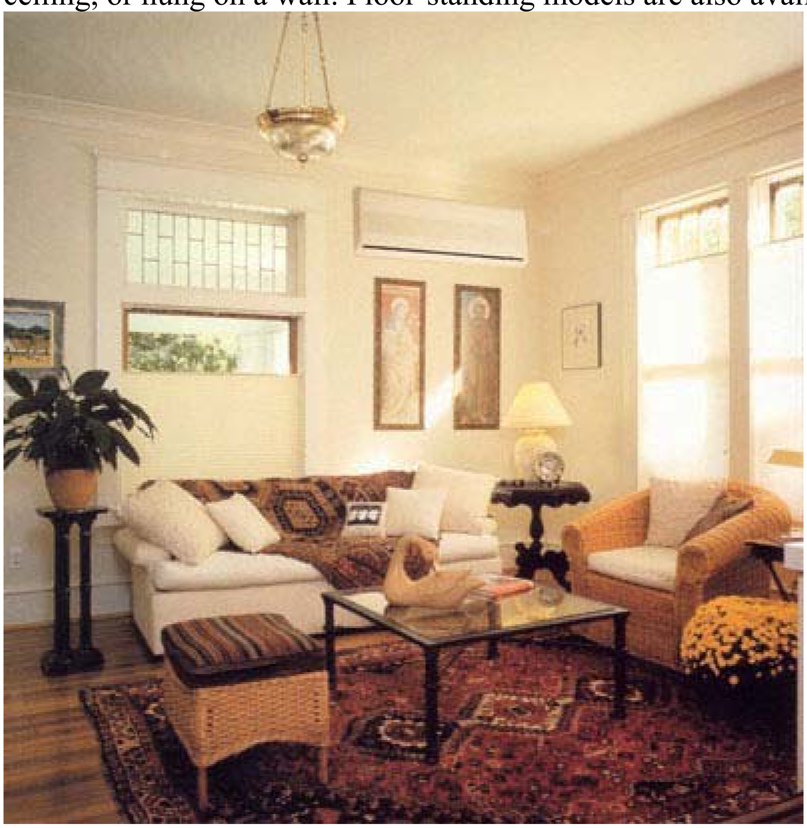
A rebate program to encourage the use of ductless mini-split air conditioners would be appropriate for retrofit applications in houses with "non-ducted" heating systems, such as hydronic (hot water), radiant panels, and space heaters (wood, kerosene, propane). Ductless systems are beneficial for room additions, where extending or installing distribution ductwork is infeasible. A ductless system could also be a viable alternative when replacing a ducted unit when ductwork needs extensive repair or replacement.

Central systems typically have an evaporator unit installed in an interior closet, garage, or attic. This unit supplies conditioned air to individual rooms through branched ductwork. The ductless systems utilizes an outside condenser unit connected to one or more evaporator units located throughout the house. The evaporator units blow air across the coils and directly cool the rooms they are located in eliminating the need for an air distribution system.

Advantages
Advantages of ductless systems are size and flexibility for zoning or heating and cooling individual rooms. One outdoor unit may support up to four indoor units. Individual zones can be controlled by a thermostat.

Ductless systems do not have the energy losses associated with the ductwork of central forced air systems. Duct losses can account for more than 30% of energy consumption for space conditioning, particularly if the ducts are in an unconditioned space. Ductless systems also help to improve indoor air quality by avoiding dust buildup and mold growth typically seen within ducted systems.

In comparison to other options, ductless systems can offer more flexibility in interior design. The indoor air handlers can be suspended from a ceiling, mounted flush into a drop ceiling, or hung on a wall. Floor-standing models are also available.



Disadvantages
The primary disadvantage of ductless systems is cost. Systems cost approximately $1,500–$2,000 per ton (12,000 Btu per hour) of cooling capacity. This is at least 30% more than central systems (not including ductwork) and about double the cost of a comparable sized window unit.

Provide Better Controls:
Eighty percent of surveyed homes had a non programmable thermostat. Proper use of a programmable thermostat helps to improve the efficiency of an HVAC system. Programmable thermostats can be used to automatically set back or turn of the system while the occupants are away during the day or at night while they are asleep.

GRU intends to incorporate this technology by offering free installation of programmable thermostats in conjunction with a direct load control program. This program will be initiated in October 2007. During program development GRU will evaluate potential to address low income customers.

Coupons or Buy Downs:
Point of sale buy downs or coupons are an effective way to reach customers who are unable to invest in energy efficiency. These programs work well with CFLs, weather-stripping or on a larger scale, Energy Star appliances.

GRU will work with large retailers and manufactures to create buy downs or coupon programs that address these items. One program that GRU currently offers is the room A/C rebate of $150. This rebate covers a large percentage of the cost of replacing an inefficient room A/C unit with a high efficiency unit. The program requires a customer to purchase the unit and be reimbursed. A point of sale rebate would help decrease any cash flow problems this creates for customers.

Customized Residential Rebate:
Utility companies could eliminate existing rebates and incentive programs focused on specific actions and technologies and replace them with rebates and incentives based on actual energy use reduction. Each home would have a five or seven year floating average of energy consumption. Household categories could be established based on square footages or some other differentiator. Contests could be conducted annually to provide rebates to the top 0.1% (or some other amount) of households in each category who displayed the greatest percentage of energy use reduction as compared to their seven year floating average.

Rewarding customers through overall efficiency instead of specific technologies or other expensive upgrades, allows the customer to determine what process is most suitable to their budget and personal behavior. GRU will implement a pilot program to offer customized residential rebates. The program will offer the opportunity for 10 to 20 households to compete to save the most energy over the course of one year. At the end of the year, each household will be paid an incentive based on their savings and GRU will evaluate the program for full implementation.

Customers will apply for the pilot and 10 to 20 households will be randomly selected. Each applicant will need a minimum number of years of history (to be determined) and must agree to live in the home for a time after the rebate has been issued (to be determined).

Low Interest Loans:
Low income customers typically do not have enough savings to cover major equipment replacements or repairs, even after rebates are applied. Banks are not always willing to offer small enough loans to cover these replacements or repairs. Low value loans could

help low income customers purchase energy efficiency upgrades, and allow repayment with the utility bill savings. GRU plans to implement a low interest loan program in January 2007.

12.3: Education

It is clear from the feedback that customers surveyed are concerned about the cost of energy. When questioned 98 percent of customers were either very, or somewhat concerned with energy costs indicating that there is potential for education to influence customers.

The survey has several examples of the disconnect between perceptions about energy usage and actual understanding. When asked, 75 percent of respondents had ideas about the factors affecting energy usage. Forty three percent of those responses identified air conditioning and cooling systems as impacting energy usage. Over 20 percent of respondents thought that appliances had the largest impact on household energy use. Although awareness of HVAC system costs as a component of energy use was high, almost 90 percent of respondents have inadequate attic insulation, 59 percent have uninsulated walls, 42 percent have dirty air filters and 39 percent of ducts have leaks. Another important finding of the survey was that 87 percent of respondents were not aware of programs to help lower their energy costs.

Almost half of the respondents claim to have made changes to their home or modified energy consumption within the last year. However, the difference in energy use per square foot was not significantly different between those that had and those who had not made changes. This indicates that the types of changes made may not have been effective. Education on the most energy intensive uses and the most effective ways to modify energy use is an area with potential for this group of customers.

Educational opportunities include:

- **Provision of Usage Information.** Determine what information is helpful to customers in making energy efficiency decisions. As a first step explore providing more detailed usage history on customers' bills. As a long term goal developing a web-based GIS tool which can benchmark individual performance against larger geographical areas.

- **Mobilization of Education.** Design and deploy a mobile efficiency demonstration center that can travel to local events, churches, community centers, and other major gathering places to bring educational materials, coupons, and other useful items to customers.

- **Energy Use Goal Setting.** Provide customers with optimal energy-efficiency targets for their homes by detailing power and water use expectations for homes that perform well to allow customers to gauge their use and modify their own performance expectations.

- **Evaluation of Current Education.** Evaluate existing educational materials to ensure that they are meaningful and useful for the target population. Focus groups and other forms of market research will be needed before conclusions are reached.

- **Provisions of Checklists.** Make maintenance checklists available to customers through webpage, bill inserts, and stand alone direct mail pieces.

- **Management of Communications Channels.** Determine if all appropriate communications channels are being utilized effectively to communicate programs and information to low income customers.

- **Group Energy Audits.** Complement existing individual energy audits with group information sessions (together with mobile efficiency demonstration center to allow for real-time feedback and evaluation).

12.4: Regulatory

As a municipal utility GRU has the traditional options of influence on legislative matters through professional organizations and associations with peer utilities. An additional approach includes regulatory aspects and the use of home rule powers to influence energy efficiency. The City of Gainesville has the ability to use home rule power to protect the health safety and welfare of citizens. That would be limited to the jurisdiction of the City of Gainesville. The involvement of Alachua County would be necessary to reach the entire GRU service area.

GRU has been directed by the City Commission to investigate ways to assist low income and rental customers. The City of Gainesville Community Development Committee is considering a variety of alternatives to utilize municipal home rule posers to assist with the regulatory arena of energy conservation. The Committee has directed staff to investigate ways to encourage efficient dwelling units through utility service provision, and city and state codes. The 2007 City of Gainesville Legislative platform includes a proposal for amendments to the State Building Code.

GRU has worked with the Alachua County and Gainesville Housing Authorities to implement energy efficiency requirements for Section 8 landlords. The Alachua County Housing Authority has committed to retrofitting public housing units to maximize energy efficiency standards. The City of Gainesville has committed to using these standards for all housing programs that receive local, State or Federal funds.

- **Landlord Licensing.** Advocate modifications to the landlord licensing process through adoption of appropriate incentives and regulations that address energy efficiency in rental homes.

- **Landlord Maintenance.** Advocate requirement that all landlords perform mechanical system and appliance service/repairs at regular intervals (e.g., every 5 years or every 3rd tenant turnover).

- **Energy Efficiency Enforcement During Property Transactions.** Advocate requirement that all existing home sales include mechanical system and appliance service/repairs in closing and/or home inspection process, prior to completion of the sale.

- **Improve Minimum Housing Code.** Adopt an advocacy role in the formation and revision of the minimum housing codes to support the implementation of sound building science, increase the market penetration of best practices, and remove the restrictions on local governments who choose to make their codes more restrictive than state standards from an efficiency standpoint

12.5: Goals

All programs need goals to pursue and periodic reviews to ensure that they reach their targets. Targets should be long range, achievable and broad enough to expand and refine in the future.

- **Continuous Review.** Continue to review effects of existing DSM programs around the country and apply lessons learned to GRU programs.

- **Information Sharing.** Continue to encourage sharing of information between utilities to increase effectiveness of DSM throughout the utility industry at the state and national level.

Resources

A Consumer's Guide to Energy Efficiency and Renewable Energy: Your Home (U.S. Department of Energy)
http://www.eere.energy.gov/consumer/your_home/

American Council for an Energy-Efficient Economy – ACEEE Spotlights the Nation's Top Low Income Energy Efficiency Programs: Needed Relief from Katrina's Energy Aftershocks
http://www.aceee.org/press/u053pr.htm

Australian Institute for Social Research – An Evaluation of the Energy Efficiency Program for Low Income Households
http://www.sustainable.energy.sa.gov.au/pdfserve/programs/households/eeplih_eval_report.pdf

ENERGY STAR®
http://www.energystar.gov/

ExpectMore.Gov – Detailed Information on the Low Income Home Energy Assistance Program Assessment
http://www.whitehouse.gov/OMB/expectmore/detail.10001059.2005.html

Building America Program (U.S. Department of Energy)
http://www.eere.energy.gov/buildings/building_america/

Building America Best Practices Series: Volume 1 – Builders and Buyers Handbook for Improving New Home Efficiency, Comfort, and Durability in the Hot and Humid Climate (U.S. Department of Energy)
http://www.eere.energy.gov/buildings/building_america/hot_humid_best_practices.html

Program for Resource Efficient Communities: Build Green and Profit – A Building Science Based Continuing Education Series (University of Florida)
http://www.energy.ufl.edu

Toronto Environmental Alliance (TEA) – A Low Income Energy Efficiency Program: Mapping the Sector and Program Design Principles
http://www.conservationbureau.on.ca/Storage/13/1834_Low_Income_Energy_Efficiency_Program.pdf

U.S. DOE Energy Citations Database – Weatherization Works: Final Report of the National Weatherization Evaluation
http://www.osti.gov/energycitations/product.biblio.jsp?osti_id=814412
(or)
http://www.ornl.gov/~webworks/cppr/y2001/rpt/109939.pdf

U.S. DOE Office of Energy Efficiency and Renewable Energy – Weatherization Assistance Program: Reducing the Energy Burden on Needy Families
http://www.eere.energy.gov/weatherization/reducing.html

U.S. DOE Office of Energy Efficiency and Renewable Energy – Weatherization Assistance Program: DOE Fact Sheets for Renters and Homeowners
http://www.eere.energy.gov/weatherization/doe_fact.html

U.S. Department of Health & Human Services – Low Income Home Energy Assistance Program (LIHEAP)
http://www.acf.hhs.gov/programs/liheap/

U.S. DOE Office of Energy Efficiency and Renewable Energy – State Energy Alternatives: Low Income Programs
http://www.eere.energy.gov/states/alternatives/low_income_prog.cfm

13. Future Plans

GRU plans to use information from this study to develop and offer three new programs:
1. Low Income Whole House Improvement Program
2. Energy Star Certification of Affordable Housing Construction Program
3. Low interest Energy Efficiency Loan Program

A DEED research project done by Municipal Electric Utilities of Wisconsin developed a booklet on how to implement a Public Benefits Fund (ID# G168). Once GRU determines what programs to implement, GRU may use the Wisconsin model to help develop a Public Benefits Fund to help pay for these conservation programs.

14. Equipment

GRU conservation analysts used the following equipment to gather survey data: Energy Survey Action Checklist (Attachment C), Appliance Questionnaire (Attachment D), flashlight and temperature gauges for air conditioning systems, water heaters and refrigerators.

15. Budget

GRU	Budget	Spent
Duct Leak Pilot (final summary forthcoming)	$ 42,423	$ 42,423
Invitation Letter development, supplies, printing, and postage	$ 500	$ 287
Purchase of Compact Fluorescent Lamps 200 6-packs	In-Kind	$ 1,994
Audits Completed	$ 14,598	$ 10,821
Customer Credit for Survey Participation	In-Kind	$ 1,780
UF PREC (In-Kind Services)		
Invitation Letter Development, Ongoing Professional Analysis, Review, and Confirmation	$ 26,539	$ 9,952
UF PREC Contract Services (Reduced to $50,000)		
Phase 1 of SubContractor's Contract 100% complete (Invoiced 6/7)	$ 12,500	$ 12,500
Phase 2 of Sub Contractor's Contract 100% complete (Invoiced 9/13)	$ 12,500	$ 12,500
Phase 3 of Sub Contractor's Contract	$ 12,500	
Phase 4 of SubContractor's Contract	$ 12,500	
Total actuals as of 9/13/2006	$ 134,060	$ 90,190

16. Additional Notes

Mr. Nick Taylor, a University of Florida Master's student in the M.E. Rinker School of Building Construction and primary DEED investigator for PREC, will continue to analyze and interpret these data for his thesis research and will share additional results and recommendations with GRU. Mr. Taylor expects to complete his thesis work by early Spring 2007.

17. References

Baxter, Lester W. "Federal Options for Low Income Electricity Policy." 11 (1998): 72-80.

Berg, Sanford V. "The Customer Bill as an Index of Utility Performance." The Electricity Journal 8 (1995): 54-59.

Brown, M., L. Berry, and L. Kinney. "Weatherization Works: Final Report of the National Weatherization Evaluation." ORNL/CON-395. http://www.ornl.gov/~webworks/cppr/y2001/rpt/109939.pdf Oak Ridge, TN: Oak Ridge National Laboratory. (1994)

Colton, Roger D. "Energy Consumption and Expenditures by Low Income Customers." The Electricity Journal 15 (2002): 70-75. "Energy Wise." Keys Energy Services. 5 Oct. 2006.

Davidson, K and L. Wilson. "An Evaluation of the Energy Efficiency Program for Low Income Households."

http://www.sustainable.energy.sa.gov.au/pdfserve/programs/households/eeplih_eval_report.pdf The University of Adelaide, Australia. Australian Institute for Social Research. (2006)

Flanigan, Ted, and June Weintraub. "The Most Successful DSM Programs in North America." The Electricity Journal 6 (1993): 53-65.

Gehring, Kay L. "Can Yesterday's Demand Side Management Lessons Become Tomorrow's Market Solutions?" The Electricity Journal 15 (2002): 63-69.

Grosskopf, K. R., and Charles J. Kibert. "Economic Incentive Framework for Sustainable Energy Use in US Residential Construction." Construction Management and Economics (2006).

Halvorsem, Robert. "Demand for Electric Energy in the United States." Southern Economic Journal (1976).

HUD (U.S. Department of Housing and Urban Development). State of the Cities Data System. Comprehensive Housing Affordability Strategy. (2000). http://socds.huduser.org

Kushler, M., D. York, and P. Witte. "Meeting Essential Needs: The Results of a National Search for Exemplary Utility-Funded Low Income Energy Efficiency Programs." http://aceee.org/pubs/u053.pdf Washington, DC: American Council for an Energy-Efficient Economy. (2005)

McPherson, E G. "Evaluating the Cost Effectiveness of Shade Trees for Demand-Side Management." The Electricity Journal 6 (1993): 57-65.

National Energy Assistance Survey Report. National Energy Assistance Directors' Association. (2004) http://www.neada.org/comm/surveys/NEADA_Survey_2004.pdf

Olatubi, Williams O., and Yan Zhang. "A Dynamic Estimation of Total Energy Demand for the Southern States." The Review of Regional Studies 33 (2003): 206-228.

Power, Meg. "Low Income Consumers' Energy Bills and Their Impact in 2006." Economic Opportunity Studies. (2005).

"Residential Energy Consumption Survey." Energy Information Administration. 12 Sept. 2006 http://www.eia.doe.gov/emeu/recs/

U.S. Department of Energy (US DOE) Office of Energy Efficiency and Renewable Energy. "State Energy Alternatives: Low Income Programs." http://www.eere.energy.gov/states/alternatives/low_income_prog.cfm. (2006)

Wikler, Gregory A. "Policy Options for Energy Efficiency Initiatives." The Electricity Journal 13 (2000): 61-68.

Attachment A-1: Recruitment Mailing Cover Letter

February 6, 2006

Dear Family Bill-Payer:

As fuel prices continue to rise, families throughout Gainesville are looking for ways to reduce home energy expenses. GRU and the City of Gainesville are developing ways to help you save energy, but we need your help. We hope you will be part of a study that will help you and other customers save energy and money. Your home has been selected to represent at least 50 others in your neighborhood, so your participation is important.

Please fill out the short form included with this letter and mail it back to GRU in the enclosed postage-paid envelope by February 24, 2006. Your responses will tell us if you and your home meet the needs of the study. If you qualify, we will contact you at the telephone number you provide to schedule an in-home energy assessment. During our visit, we will 1) perform a detailed energy survey at no charge to you, and 2) with your help, complete an in-depth questionnaire about your energy usage and pertinent features of your home such as appliances, number of rooms, windows, and insulation levels.

If you are selected and agree to participate, we will thank you by installing three energy saving compact fluorescent light bulbs in your home for *free!* These light bulbs will help reduce your home's energy use and save you money.

We hope you will take this chance to conserve energy, save on your monthly energy bill, and improve the environment. Fill out the short form and drop it in the mail today! If you have questions about the enclosed form or the energy survey itself, please contact Amy Carpus in GRU's Conservation Services Department at (352) 393-1450.

Thank you for your participation!

Sincerely,

Pegeen Hanrahan
Mayor, City of Gainesville

RJL:CEP
Enclosure

Attachment A-2: Recruitment Mailing Survey Form

Energy Survey Form

Family Bill-Payer: Please take a minute to complete this survey form and mail it back to GRU in the enclosed postage-paid envelope by February 24, 2006. If you qualify, we will contact you at the telephone number you provide to schedule an in-home energy assessment.

Name: **Phone Number: ( )**

Best time to reach you by phone: □ Morning □ Afternoon □ Evening

1. How concerned are you about energy costs in your home?

□ Not Concerned at All □ Somewhat Concerned □ Very Concerned

2. Including yourself, how many people live in your home?

□ 1 □ 2 □ 3 □ 4 □ 5+

3. How long have you and your family been living in this home?

□ Less than 1 year □ 1-2 years □ 2-4 years □ 4-6 years □ More than 6 years

4. What was your combined household's 2005 income before taxes? (See Box 1 on your W-2 forms)

□ Under $18,750 □ $18,751 to $30,000 □ $30,001 to $34,300 □ $34,301 to $38,600 □ $38,601 to $42,900

□ $42,901 to $46,300 □ $46,301 to $49,750 □ $49,751 to $53,150 □ $53,151 to $56,600 □ over $56,601

Thank you for your participation! Source Code: 1001

Attachment B: In-Home Verbally-Administered Energy Survey

DEED HOME ENERGY SURVEY

Section 1: INFORMATION ABOUT YOUR HOME

We would like to begin by asking some information about the home in which you now live.

Q1. When did you move into this home?

1 Less than 1 year ago — Date given: ______________________
2 1 year to less than 2 years ago
3 2 years to less than 3 years ago
4 3 years to less than 5 years ago
5 5 years to less than 10 years ago
6 10 years ago or longer

Q2. How many months per year do you live in this home?

1 Less than 3 months
2 3 months to just under 6 months
3 6 months to just under 9 months
4 9 months to 12 months

Q3. Do you expect to move from this home in the next 12 months?

1 Yes ➔ Explanation, if offered:
2 No
3 Uncertain

Q4. Do you own your home?

1 Yes, I own (or am buying) my home
2 No, I'm renting/leasing my home
3 Other:

Q5. When was your home built?

1 Less than 5 years ago — Year if known: ______________________
2 5 years to just under 10 years ago
3 10 years to just under 20 years ago
4 20 years ago or more
5 Don't know

Q6. What direction does the longest side of your home face?

1 West (or East)
2 Southeast (or Northwest)
3 Southwest (or Northeast)
4 South (or North)

Q7. Which best describes the foundation of your home?

1 Slab on grade
2 Raised wood floors ➔ **Insulated?** ___Yes ___No ___Uncertain
3 Other:

Q8. What is the major wall type of your home?

1 Concrete block
2 Brick
3 Wood frame
4 Other:

Q9. What is the shape of your home's roof?

1 Flat
2 Shed
3 Gabled
4 Hipped
5 Other:

Q10. Does your home have an attic?

1 Yes ➔ **Insulated?** ___Yes ___No ___Uncertain
2 No

Q11. What is your home's roofing material?

1 Asphalt shingles
2 Wooden shakes
3 Tile (clay or concrete)
4 Metal
5 Other:

Q12. What is the color of your home's roofing material?

1 White or silver
2 Light grey or tan
3 Red or orange
4 Dark brown or dark grey
5 Black
6 Other:

Q13. What is the total square footage of your home, including bathrooms and hallways? (Do not include garages, outside patios or porches)

GRU Records / Appraiser Value:«Merge Record #»

1 Less than 500
2 500-999
3 1000-1499
4 1500-1999
5 2000-2499
6 2500-2999
7 3000-3999
8 4000 or more
9 Don't Know

Specific #, if offered: ___________ ft^2

Q14. Describe your home's exterior doors.

	Description	**Total #**	**# Weather-stripped**
1	Wood		
2	Metal Insulated		
3	Glass		
4	Other:		

Q15. Describe your home's windows.

	Description	Total #	# Weather-stripped	# Double-paned	Frame Material (majority)	Window Covering (majority)
1	Single Hung				Wood / Vinyl / Metal / Other:	None / Drapes / Blinds / Other:
2	Double Hung				Wood / Vinyl / Metal / Other:	None / Drapes / Blinds / Other:
3	Casement				Wood / Vinyl / Metal / Other:	None / Drapes / Blinds / Other:
4	Jalousie				Wood / Vinyl / Metal / Other:	None / Drapes / Blinds / Other:
5	Awning				Wood / Vinyl / Metal / Other:	None / Drapes / Blinds / Other:
6	Sliding				Wood / Vinyl / Metal / Other:	None / Drapes / Blinds / Other:
7	Other:				Wood / Vinyl / Metal / Other:	None / Drapes / Blinds / Other:

Q16. What type of floor coverings does your home have? (Circle all that apply and indicate percentage covering)

	Description	Percent Covering			
1	Hardwood	25%	50%	75%	100%
2	Carpet or Area Rugs	25%	50%	75%	100%
3	Tile (Ceramic)	25%	50%	75%	100%
4	Vinyl or Linoleum	25%	50%	75%	100%
5	Other:	25%	50%	75%	100%

Q17. During a typical summer day, to what extent do trees help shade your house in the morning? *(around 8AM)*

1 Almost totally shade the house
2 Partially shade the house
3 No shading of the house

Q18. During a typical summer day, to what extent do trees help shade your house in the late afternoon? *(around 4PM)*

1 Almost totally shade the house
2 Partially shade the house
3 No shading of the house

Section 2: KEEPING YOUR HOME COMFORTABLE

The next step is intended to gather some information about how you keep your home warm in the winter and cool in the summer.

Q19. What are the main types of heating systems that you use?

Primary

1 Electric resistance
2 Natural gas furnace
3 Liquid propane gas furnace
4 Heat pump ➔ __ Central __ Non-central
5 Portable electric heater
6 Kerosene space heater
7 Wood stove / fireplace
8 Natural gas logs
9 None
10 Other:

Secondary

1 Electric resistance
2 Natural gas furnace
3 Liquid propane gas furnace
4 Heat pump ➔ __ Central __ Non-central
5 Portable electric heater
6 Kerosene space heater
7 Wood stove / fireplace
8 Natural gas logs
9 None
10 Other:

Q20. What type of thermostat controls your main heating system?

1 Standard Thermostat
2 Programmable Electronic Thermostat
3 No Thermostat

Q21. At what temperature do you normally set your thermostat for winter heating?

________ºF

Q22. Do you change your thermostat setting or other heating control when you are away?

1 Yes ➔ **To what temperature is it changed?**
2 No ________ºF

Q23. Do you change your thermostat setting or other heating control when you are sleeping?

1 Yes ➔ **To what temperature is it changed?**
2 No ________ºF

Now we're going to ask about how you keep your home cool in the summer.

Q24. What are the main types of cooling systems that you use in your home?

Primary

1 Electric central air conditioner
2 Natural gas air conditioner
3 Window / wall / room air conditioner
4 Whole house fan
5 Ceiling fans
6 Floor / box fans
7 None
8 Other:

Secondary

1 Electric central air conditioner
2 Natural gas air conditioner
3 Window / wall / room air conditioner
4 Whole house fan
5 Ceiling fans
6 Floor / box fans
7 None
8 Other:

Q25. What type of thermostat is used to control your home's main air conditioning system?

1 Standard Thermostat
2 Programmable Thermostat
3 No Thermostat

Q26. At what temperature do you normally set your thermostat for summer cooling?

________ºF

Q27. Do you change your thermostat setting or other cooling control when you are away from home?

1 Yes ➔ **To what temperature is it changed?**

2 No ________ºF

Q28. Do you change your thermostat setting or other cooling control when you are sleeping?

1 Yes ➔ **To what temperature is it changed?**

2 No ________ºF

Q29. How often is the air conditioner filter changed?

1 Once a month
2 Once every 2-3 months
3 Once every 4-6 months
4 Once a year
5 Don't know

Q30. During what months of the year, if any, do you open windows on a regular basis for natural ventilation?

__ January	__ April	__ July	__ October
__ February	__ May	__ August	__ November
__ March	__ June	__ September	__ December

__ Never Open Windows

Section 3: APPLIANCES IN YOUR HOME

The next step is intended to gather some information about appliances and water use in your home. ***Use side notes to indicate if an appliance is Energy Star rated, is particularly out of date, or there are other factors that could be affecting its efficiency.***

Q31. What type of hot water heater do you have?

1 Gas
2 Electric
3 LP Gas
4 Other:

Q32. About how old is your main water heater?

1 Less than 2 years old
2 2 to just under 5 years old
3 5 to just under 10 years old
4 10 to just under 20 years old
5 20 years or older
6 Don't know

Specific age, if offered: ___________ years

Q33. In a typical *week (7 days)*, about how many baths and showers are taken in your home?

per day: ___________

1 7 or less
2 8 to 14
3 15 to 21
4 22 to 28
5 29 to 35
6 36 to 42
7 43 or more

Q34. About how long is a typical shower?

___________ minutes

Q35. Do you have a washing machine (or machines) in your home?

1 Yes
2 No ➔ **SKIP to Q39**

Q36. About how old is your main washer?

1 Less than 2 years old
2 2 to just under 5 years old
3 5 to just under 10 years old
4 10 to just under 20 years old
5 20 years or older
6 Don't know

Specific age, if offered: ___________ years

Q37. How many loads of clothes do you wash in a typical week (7 days)?

____

Q38. How often do you use hot water to wash your clothes?

1 Always
2 Frequently
3 Occasionally
4 Never

Q39. Do you have a clothes dryer (or dryers) in your home?

1 Yes
2 No ➔ **SKIP to Q42**

Q40. About how old is your main dryer?

1 Less than 2 years old
2 2 to just under 5 years old
3 5 to just under 10 years old
4 10 to just under 20 years old
5 20 years or older
6 Don't know

Q41. What type of energy does your dryer use?

1 Gas
2 Electric

Q42. How often do you hang your clothes to dry?

1 Always
2 Frequently
3 Occasionally
4 Never

Q43. What type of energy does your stove/oven use?

1 Gas
2 Electric
3 Other:

Q44. In a typical week, how many meals are prepared at home? (breakfast, lunch, and dinner each count as one meal)

1 5 or less
2 6 to 10
3 11 to 15
4 16 or more

Q45. How frequently do you use a microwave, toaster oven, or toaster?

1 Never
2 Once a week or less
3 About every other day
4 Once or twice a day
5 Several times a day

Section 4: LIGHTING IN YOUR HOME

Q46. During a typical day, how many hours do you use indoor lights in your home? (consider both morning and night hours)

1 less than two hours
2 2 to just under 4 hours
3 4 to just under 6 hours
4 6 to just under 8 hours
5 8 to just under 10 hours
6 10 to just under 12 hours
7 12 hours or more

Specific #, if offered: ___________ hours

Q47. When using your indoor lights, how many rooms usually have lights on?

1 One
2 Two
3 Three
4 Four
5 Five or More

Q48. What type of light bulbs do you use in your home? (include rough percentage)

	Type	Percent of Total			
1	Standard Incandescent	25%	50%	75%	100%
2	Fluorescent	25%	50%	75%	100%
3	Compact Fluorescent	25%	50%	75%	100%
4	Other:	25%	50%	75%	100%

Q49. Do you have exterior flood lights around your home?

1 Yes
2 No

Q50. How are your exterior lights controlled?

1 Indoor switch
2 Timer
3 Motion Sensor
4 Other:

Q51. How many hours per night are exterior lights typically on?

1 Less than 2 hours
2 2 to just under 4 hours
3 4 to just under 6 hours
4 6 to just under 8 hours
5 8 to just under 10 hours
6 10 to just under 12 hours
7 12 hours or more

Specific #, if offered: ___________ hours

Section 5: HOME ENTERTAINMENT

Now, think about some of the other energy users in your home, such as electronic equipment.

Q52. How many TVs are in your home?

1 One
2 Two
3 Three
4 Four
5 5 or more ➔ **Of all TVs, how many are large screens?** ________
6 None

Q53. About how many hours will at least one TV be on in a typical day?

1 None
2 Less than 2 hours
3 2 to just under 4 hours
4 4 to just under 6 hours
5 6 to just under 8 hours
6 8 hours or more

Specific #, if offered: ___________ hours

Q54. About how many hours per day is a video game system typically in use?

1 None
2 Less than 2 hours
3 2 to just under 4 hours
4 4 to just under 6 hours
5 6 to just under 8 hours
6 8 hours or more

Specific #, if offered: ___________ hours

Q55. About how many hours per day is a computer typically in use?

1 None
2 Less than 2 hours
3 2 to just under 4 hours
4 4 to just under 6 hours
5 6 to just under 8 hours
6 8 hours or more

Specific #, if offered: ___________ hours

Q56. How many hours per day is a CD player, radio, or other type of stereo system typically in use?

1 None
2 Less than 2 hours
3 2 to just under 4 hours
4 4 to just under 6 hours
5 6 to just under 8 hours
6 8 hours or more

Specific #, if offered: ___________ hours

Section 6: HOUSEHOLD DEMOGRAPHICS

Finally, we would like to ask a few questions about you and your family. Please remember that your information will be grouped together with other families' responses and will not be linked directly to your household. We will use the results of this survey to help you and your neighbors lessen the burden of monthly energy bills, so your continued input is important.

Q57. Including yourself, how many people live in your home (i.e., sleep here at least five nights a week)?

____

Q58. How many senior citizens (65 years or older) are in your household?

1 One
2 Two
3 Three
4 Four
5 Five or more
6 None

Q59. How many children (17 years or younger) are in your household?

1 One
2 Two
3 Three
4 Four
5 Five or more
6 None

Q60. Do any members of your household regularly work from home?

1 Yes → Occupation, if offered:
2 No

Q61. During a typical work week, is someone at home all day?

1 Yes
2 No

Q62. What was your household's total 2005 income before taxes? (See Box 1 on your W-2 forms)

1 $20,000 or less
2 $20,001 to $25,000
3 $25,001 to $30,000
4 $30,001 to $35,000
5 $35,001 to $40,000
6 $40,001 to $45,000
7 $45,001 to $50,000
8 $50,001 to $55,000
9 Over $55,000 Specific #, if offered: $____________

Q63. What things do *you* feel have the largest impact on your household's energy use?

Q64. How concerned are you about energy costs in your home?

1 Very concerned
2 Somewhat concerned
3 Not concerned

Q65. In the past year, have you or anyone else in your household made any changes – in either your home or your lifestyle – to make your home more energy efficient?

1 Yes ➔ Explain:
2 No

Q66. Are you aware of any programs that are available to help you lower your home energy bills?

1 Yes ➔ Explain:
2 No

Those are all of our questions, but before we wrap up, we would be happy to answer any questions you may have for us. [REMEMBER TO GIVE RESPONDENT 3 CFLs once they've completed the survey]
Thank you for your time and patience.

Attachment C: GRU Energy Survey Action Checklist

GRU More than Energy

GAINESVILLE REGIONAL UTILITIES
CONSERVATION SERVICES PHONE: 393-1460
ENERGY AND WATER ACTION SAVINGS PLAN

Name: ______________________ GRU # ____________ Home Phone ____________

Address: ______________________ Survey # ____________ Work Phone ____________

Meter Readings: Electric # ____________ Water # ____________ Gas # ____________

	Date	Days	Reading	kWh	kWh/Day	Reading	Gallons	Gallons/Day	Reading	Therms	Therms/Day
Today											
Previous											

I have checked the major areas that may cause high energy and water use. You can reasonably expect the following suggestions to save you money. Savings will be afffected by equipment type, efficiency and condition, operation patterns, and weather.

GRU Representative ______________________ Date/Time ______________________

☐ Since I did not find you at home, I looked around and made some general observations. Because the heating, cooling, water heating, and refrigeration equipment can dramatically affect your utility bill, you may want to call us for another appointment. As always, we are here to serve you.

HEATING, VENTILATION, AND COOLING

I checked:	**Findings:**	**Suggested Actions:**
☐ Refrigerant Line	☐ Large line needs insulation	☐ Install pipe insulation
☐ Condenser Coil (Outside a/c coil)	☐ Coils are damaged ☐ Coils are dirty ☐ Air flow restricted (See comments)	☐ Call HVAC contractor to repair ☐ Clean coils ☐ Remove air flow obstruction
☐ Filters	☐ Filter is dirty ☐ Filter is missing ☐ Air by-passing filter	☐ Clean and/or replace filter ☐ Install filter (Size: ____________) ☐ Install proper-sized filter or secure filter across opening
☐ Evaporator Coil (Air handler coil)	☐ Air handler coil is dirty ☐ Evidence suggests coil is dirty ☐ Temperature Drop = ________°F	☐ Call HVAC contractor to service unit(s) ☐ Ideal range is between 8-12°F
☐ Ducts	☐ Ducts have leaks ☐ Ducts need insulation	☐ Call HVAC contractor to seal leaks ☐ Insulate ducts (R-6)
☐ Air Handler/Furnace	☐ Air handler, support platform, air handler closet leaks ☐ Excessive rust found ☐ Yellow flame noted	☐ Consult HVAC contractor to seal air handler, support box or closet ☐ Have furnace serviced ☐ Replace with natural gas unit
☐ Attic Insulation	☐ Attic insulation is inadequate (Currently R-______)	☐ Upgrade ________ to at least R-____ ☐ Insulate attic access cover(s)

OTHER HEATING AND COOLING TIPS:

Current thermostat setting is: ______________________

☐ When cooling, set the thermostat no lower that 78°F when home, and turn up or off the system when gone.
☐ When heating set the thermostat no higher that 68°F when you are at home, and turn it off or back 10-15°F when gone (except with a heat pump where you leave the temperature constant) and set to 55°F at night.
☐ **Keep interior doors open, or at least cracked open one inch, for proper air circulation.**
☐ Use fans, but only when someone is in the room.
☐ Shade windows that get direct sunshine in the summer on the ☐**N** ☐**S** ☐**E** ☐**W**.
☐ Snuggly cover windows in winter.
☐ Weatherstrip and caulk around doors and windows.

Water Heating

I checked:	Findings:	Suggested Actions:
☐ Hot Water Temperature	☐ Now set at __________°F	☐ Reset to __________°F
☐ Water Heater	☐ Pipe feel test indicates leaks ☐ Pipes need insulation ☐ Pipes rusty, corroded, leaking ☐ Tank needs insulation	☐ Find and fix leaks ☐ Insulate Pipes ☐ Repair Pipes ☐ Insulate Tank
☐ Showerhead	☐ Energy and water waster	☐ Install showerhead that uses less thatn 3 gallons/minute

LEAKS NEEDING REPAIR

Kitchen/Laundry	Bathroom(s)	Outdoor Leaks	Concealed Leaks
☐ Kitchen sink faucet	☐ Toilet flapper	☐ Front yard faucet	☐ Behind wall(s)
☐ Kitchen sink shutoffs	☐ Toilet Ffloat control	☐ Back yard faucet	☐ Beneath dwelling
☐ Dishwasher	☐ Sink Faucet	☐ Side yard faucet	☐ Underground
☐ Laundry tub faucet	☐ Sink Faucet Shutoffs	☐ Irrigation system	
☐ Laundry tub shutoff	☐ Bathtub Faucet	☐ Pool/spa	
☐ Washing machine hose connections	☐ Shower	☐ Meter box ☐ Customer side ☐ GRU side	

COMMENTS:

____

____

____

____

____

____

____

____

____

____

ADDITIONAL ENERGY SAVING TIPS:

- ☐ Run irrigation system for an appropriate time each season, now set to: ________________________________ .
- ☐ Reduce pool pump run time to 4-8 hours/day in season, now running __________________________________ .
- ☐ Service refrigerator to increase efficiency, ____ .
- ☐ Keep fireplace damper(s) closed when not in use.
- ☐ Consider a high efficiency outdoor lighting system.

Customer provided with:			
	☐ The Energy Book	☐ Rate calculation fact sheets:	☐ Electric
	☐ Water Conservation		☐ Natural Gas
	☐ Xeriscaping information		☐ Water
	☐ Vendors list		☐ Wastewater
	☐ Lighting Guide	☐ Solar information	
	☐ Pool Operating Tips	☐ Heat Pump Operation Guide	

Results received by:____ **Date:** ________________________

Circle applicable categories for mainframe - Write details or comments below.

STRUC TYPE	SING	MULT	MOBI	BUSI			**COOKING**	NATG	PROP	STRI	PUMP		
OCCUPANCY	OWNE	RENT					**POOL HEAT**	NONE	NATG	PROP	STRI	PUMP	SOLA
CEILINGS	INSU	UNIN	BYPA	ATTI	ROOF		**SPA HEAT**	NONE	NATG	PROP	STRI	PUMP	SOLA WOOD
FLOORS	INSU	UNIN	SLAB	RAIS			**REFRIG**	REFR	FREE	HIGH			
WALLS	INSU	UNIN	BYPA	BLOC	WOOD		**OUTDR LT**	INCA	FLUO	HID	LOW	MEDI	HIGH
WINDOWS	GOOD	POOR	AWNI	JALO									
SHADE NEED	EAST	WEST	SOUT	NORT				**A/C REBATE**					
COOL DISTR	NONE	ATTI	INTE	LEAK				MAINT ______					
HEAT DISTR	NONE	ATTI	INTE	LEAK				SYST ______					
PRIME COOL	NATG	PROP	ELEC	PUMP	WALL	CENT		WIND ______					
PRIME HEAT	NATG	PROP	STRI	PUMP	FUEL	WOOD		RRC ______					
PORT HEAT	KERO	STRI	OTHE					HP ______					
WATER HEAT	NATG	PROP	STRI	PUMP	HRU	SOLA		HRU ______					

____

____

____

____

____

SERVICES PROVIDED:

Action check ______
Computer Audit ______
A/C Sizing ______
Landscape Survey ______

HOUSE PLAN REVIEW:
Addition ______
New Home ______
EPI Calculation ______
Florida Fix Eval ______
Solar Eval ______

CBIS ______
UEAS ______

INIT ______

REV ______

Attachment D: GRU Appliance Checklist

1. Which of these appliances or devices do you use in your home and how many do you have?

1	2	3	4 or more	
☐	☐	☐	☐	central air conditioner
☐	☐	☐	☐	window/wall/room air conditioner
☐	☐	☐	☐	central heater - electric
☐	☐	☐	☐	central heater - natural or LP (propane) gas
☐	☐	☐	☐	central heater - other (wood, oil, etc.)
☐	☐	☐	☐	water heater - electric
☐	☐	☐	☐	water heater - natural or LP (propane) gas
☐	☐	☐	☐	water heater - other (wood, oil, etc.)
☐	☐	☐	☐	clothes washer
☐	☐	☐	☐	clothes dryer - electric
☐	☐	☐	☐	clothes dryer - natural or LP (propane) gas
☐	☐	☐	☐	well pump
☐	☐	☐	☐	swimming pool pump
☐	☐	☐	☐	pool heater - electric
☐	☐	☐	☐	pool heater - natural or LP (propane) gas
☐	☐	☐	☐	pool heater - solar
☐	☐	☐	☐	hot tub heater - electric
☐	☐	☐	☐	hot tub heater - natural or LP (propane) gas
☐	☐	☐	☐	electric dishwasher
☐	☐	☐	☐	ceiling fans
☐	☐	☐	☐	attic/whole house fans
☐	☐	☐	☐	refrigerator/freezer combo
☐	☐	☐	☐	stand alone refrigerators
☐	☐	☐	☐	stand alone freezers
☐	☐	☐	☐	home theatre sound system
☐	☐	☐	☐	large screen television (>36 inches)
☐	☐	☐	☐	standard television (<36 inches)
☐	☐	☐	☐	DVD player or VCR
☐	☐	☐	☐	personal computers
☐	☐	☐	☐	exterior fixtures on dawn-to-dusk sensors
☐	☐	☐	☐	fixtures on motion detectors
☐	☐	☐	☐	low voltage landscape light system

2. Do you use any other equipment or large appliances that consume a significant amount of electricity or natural gas in your home?

☐ Yes ☐ No (Please describe equipment and fuel used)

3. Please indicate if you have added, replaced or removed any of the following appliances in the last 12 months. (Choose all that apply.)

	Added appliance/a new unit	Replaced an old unit	Removed and did not replace
Central Heating - electric	☐	☐	☐
Central heater - natural or LP (propane) gas	☐	☐	☐
Central heater - other (wood, oil, etc.)	☐	☐	☐
Central Cooling	☐	☐	☐
Room or window air conditioner	☐	☐	☐
Water heater - electric	☐	☐	☐
Water heater - natural or LP (propane) gas	☐	☐	☐
Water heater - solar	☐	☐	☐
Water heater - other (wood, oil, etc.)	☐	☐	☐
Dishwasher	☐	☐	☐
Clothes washer	☐	☐	☐
Clothes Dryer	☐	☐	☐
Pool Heater	☐	☐	☐
Pool Pump	☐	☐	☐
Hot tub	☐	☐	☐
Large screen television (>36 inches)	☐	☐	☐

☐ Have not added any of the above appliances.

☐ Have not removed any of the above appliances.

Attachment E: Descriptive Energy Use and Energy Intensity Data (from GRU customer records and Property Appraiser data)

Table E.1a: Summary Statistics for Total Energy Use and Energy Intensity (169 DEED Households)

	Min	Max	Mean	Standard Deviation
kWh Total (Average kWh/month)	14	4580	**1118**	767
kWh Intensity (Average kWh/month/1000ft^2)	15	2971	**878**	584
therm Total (Average therm/month, N=103)	0.8	86.2	**28.1**	16.9
therm Intensity (Average therm/month/1000ft^2, N=103)	0.7	66.2	**21.5**	14.2
Btu* Total (Average MMBtu/month)	0.05	15.57	**5.53**	2.72
Btu Intensity (Average MMBtu/month/1000ft^2)	0.05	10.95	**4.31**	2.00
Household Square Footage (conditioned area, ft^2)	672	3282	**1333**	450

*Btu conversion factors: (1kWh = 3412Btu), (1therm = 100,000Btu), (1MMBtu = 1millionBtu)

Table E.1b: Summary Statistics for Total Energy Use and Energy Intensity (362 SF Appliance Saturation Survey Households)

	Mean	Standard Deviation	Difference (DEED – SF)
kWh Total (Average kWh/month)	**1134**	580	-16
kWh Intensity (Average kWh/month/1000ft^2)	**680**	635	198
therm Total (Average therm/month)	**27**	17	1.1
therm Intensity (Average therm/month/1000ft)	**15**	10	6.5
Btu* Total (Average MMBtu/month)	**6**	3	-0.5
Btu Intensity (Average MMBtu/month/1000ft^2)	**3**	2	1.2
Household Square Footage (conditioned area, ft^2)	**1901**	776	-568

Table E.2: Summary Statistics for Total Energy Use and Energy Intensity in *Owner-Occupied* Households (N=137)

	Min	Max	Mean	Standard Deviation
kWh Total (Average kWh/month)	14	4308	**1069**	754
kWh Intensity (Average kWh/month/1000ft^2)	15	2971	**824**	575
therm Total (Average therm/month, N=86)	0.8	86.2	**27.5**	17.4
therm Intensity (Average therm/month/1000ft^2, N=86)	0.7	66.2	**21.1**	15.0
Btu* Total (Average MMBtu/month)	0.05	14.65	**5.33**	2.60
Btu Intensity (Average MMBtu/month/1000ft^2)	0.05	10.14	**4.12**	1.96
Household Square Footage (conditioned area, ft^2)	672	3282	**1348**	457

Table E.3: Summary Statistics for Total Energy Use and Energy Intensity in *Renter-Occupied* Households (N=32)

	Min	Max	Mean	Standard Deviation
kWh Total (Average kWh/month)	408	4580	**1329**	799
kWh Intensity (Average kWh/month/1000ft^2)	297	2210	**1109**	574
therm Total (Average therm/month, N=17)	7.6	68.4	**31.1**	14.3
therm Intensity (Average therm/month/1000ft^2, N=17)	3.7	40.7	**23.2**	9.4
Btu* Total (Average MMBtu/month)	2.91	15.69	**6.36**	3.08
Btu Intensity (Average MMBtu/month/1000ft^2)	2.13	10.95	**5.14**	1.98
Household Square Footage (conditioned area, ft^2)	672	2669	**1266**	420

Table E.4: Total Energy Use and Energy Intensity Means, Renter- vs. Owner-Occupied

	All	Owned	Rented	Difference (R-O)
kWh Total (Average kWh/month)	1118	1069	1329	**260**
kWh Intensity (Average kWh/month/1000ft^2)	878	824	1109	**285**
therm Total (Average therm/month, N=17)	28.1	27.5	31.1	**3.6**
therm Intensity (Average therm/month/1000ft^2, N=17)	21.5	21.1	23.2	**2.1**
Btu* Total (Average MMBtu/month)	5.53	5.33	6.36	**1.03**
Btu Intensity (Average MMBtu/month/1000ft^2)	4.20	4.12	5.14	**1.02**
Household Square Footage (conditioned area, ft^2)	1333	1348	1266	**-82**

Attachment F: In-Home DEED Energy Survey, Summary Descriptive Data and ANOVA test statistics.

Tables 1.1-3.15 and Tables 4.1-6.10 (Section F.1) correspond directly to questions from the verbally-administered survey (Attachment A) and show *respondent-reported* data. Tables 3.16a-3.16h (Section F.2) are presented at the end of the appliance data section of the verbally administered survey and correspond directly to data from the GRU appliance checklist (Attachment C), *as recorded by GRU's conservation analysts*. Tables 7.1-7.45 (Section F.3) correspond directly to data from the GRU Energy Action Survey Checklist (Attachment B), *also as recorded by GRU's conservation analysts*

Categorical energy intensity means are presented for ordinal variables and the mean for the independent variable category with the greatest magnitude of MMBtu intensity is highlighted in bold. One-way analysis of variance (ANOVA) tests across categorical energy intensity means were conducted for variables with at least 5% of responses in more than one category. Significance results, F-statistics, and degrees of freedom are presented for each of the tests conducted. Results significant at <.01 are flagged by ***, at <.05 by **, and at <.10 by *.

F.1: Verbally-Administered Energy Survey

Section 1: INFORMATION ABOUT YOUR HOME

Table 1.1: Respondent Tenure at Residence (Q1)

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 1 year	13	7.7	4.27
1-2 years	22	13.0	3.31
2-3 years	14	8.3	**4.76**
3-5 years	13	7.7	4.28
5-10 years	19	11.2	3.95
10 or more years	88	52.1	4.57
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .135 (F = 1.709, 5 df)

Table 1.2: Respondent Months per Year at Residence (Q2)

	N	**%**
Less than 3 months	3	1.8
3-6 months	0	0.0
6-9 months	2	1.2
9 months or more	164	97.0
Total	169	100.0
Non-respondents	0	0.0

Insufficient distribution across categories to report ANOVA

Table 1.3: Residency Status until Summer 2007 (Q3)

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
Expect to be at same residence	151	89.4	4.23
Expect to move to a new residence	12	7.1	4.97
Unsure about future residence	6	3.5	**5.05**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .301 (F = 1.208, 2 df)

Table 1.4: Owner vs. Renter Occupied Households (Q4)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Own	137	81.1	4.12
Rent	32	18.9	**5.14**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

***One-way ANOVA Sig = .009 (F = 6.986, 1 df)

Table 1.5: Home Age (Q5)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 5 years old	9	5.3	3.89
5-10 years old	5	3.0	3.74
10-20 years old	6	3.6	4.31
20 or more years old	128	75.7	4.32
Uncertain	21	12.4	**4.58**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .881 (F = .295, 4 df)

Table 1.6: Axis Orientation, Direction Longest Side of Home Faces (Q6)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
West (or East)	62	39.2	4.33
Southeast (or Northwest)	5	3.2	**5.10**
Southwest (or Northeast)	5	3.2	4.42
South (or North)	86	54.4	4.29
Total	158	100.0	4.34
Non-respondents	11	6.5	3.91

One-way ANOVA Sig = .870 (F = .311, 4 df)

Table 1.7a: Home Foundation Material (Q7)

	N	%
Slab on grade	119	71.3
Raised wood floors	46	27.5
Other	2	1.2
Total	167	100.0
Non-respondents	2	1.2

ANOVA: See Table 7.35, Floor Type

Table 1.7b: Insulation of Raised Wood Floors, N=46 (Q7)

	N	%
Yes	10	22.2
No	18	40.0
Uncertain	17	37.8
Total	45	100.0
Non-respondents	1	2.2

ANOVA: See Table 7.36, Floor Insulation

Table 1.8: Home Wall Material (Q8)

	N	%
Concrete block	107	63.3
Brick	9	5.3
Wood frame	48	28.4
Other	5	3.0
Total	169	100.0
Non-respondents	0	0.0

ANOVA: See Table 7.37, Wall Type

Table 1.9: Home Roof Shape (Q9)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Flat	6	3.6	4.71
Shed	3	1.8	**5.04**
Gabled	141	85.5	4.34
Hipped	14	8.5	3.65
Other	1	0.6	0.73
Total	165	100.0	4.29
Non-respondents	4	2.4	2.00

One-way ANOVA Sig = .299 (F = 1.228, 5 df)

Table 1.10a: Home Attic (Q10)

	N	%
Yes	150	90.9
No	15	9.1
Total	165	100.0
Non-respondents	4	2.4

ANOVA: See Table 7.33, Ceiling Type

Table 1.10b: Insulation of Attic, N=150 (Q10)

	N	%
Yes	113	77.4
No	11	7.5
Uncertain	22	15.1
Total	150	100.0
Non-respondents	4	2.7

ANOVA: See Table 7.34, Ceiling Insulation

Table 1.11: Home Roofing Material (Q11)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Asphalt shingles	140	83.8	**4.39**
Wooden shakes	0	0.0	-
Tile (clay or concrete)	1	0.6	4.20
Metal	12	7.2	4.08
Other	14	8.4	3.58
Total	167	100.0	4.30
Non-respondents	2	1.2	5.49

One-way ANOVA Sig = .578 (F = .723, 4 df)

Table 1.12: Home Roofing Color (Q12)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
White or silver	12	7.4	3.80
Light grey or tan	46	28.2	3.59
Red or orange	12	7.4	**5.37**
Dark brown or grey	56	34.4	4.69
Black	33	20.3	4.46
Other	4	2.5	2.99
Total	163	100.0	4.28
Non-respondents	6	3.6	5.25

**One-way ANOVA Sig = .015 (F = 2.735, 6 df)

Table 1.13: Home Square Footage (Q13)

	property appraiser data			**respondent reported**	
	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)	**N**	**%**
500-999 ft^2	30	17.8	**4.81**	20	11.9
1000-1499 ft^2	103	61.0	4.41	58	34.5
1500-1999 ft^2	22	13.0	3.73	17	10.1
2000-2499 ft^2	8	4.7	3.85	6	3.6
2500-2999 ft^2	3	1.8	3.70	3	1.8
3000-3999 ft^2	3	1.8	1.79	2	1.2
Don't Know	n/a	n/a	-	62	36.9
Total	169	100.0	4.31	168	100.0
Non-respondents	n/a	n/a	-	1	0.6

*One-way ANOVA Sig = .090 (F = 1.941, 5 df)

Table 1.14: Home Exterior Doors Material and Weatherstripping (Q14)

	N	**% of all doors**	**N**	**% weatherstripped**
All	500	100.0	334	67.8
Wood	299	59.8	178	59.5
Metal Insulated	109	21.8	92	84.4
Glass	89	17.8	63	70.8
Other	3	0.6	1	33.3
Non-respondents	0	0.0	0	0.0

ANOVA: See Table 7.22, Doors and/or Windows Need Weatherstripping

Table 1.15: Home Windows: Type, Weatherstripping, and Double Paned (Q15)

	N	**window type, % of all windows**	**N**	**% of window type weatherstripped**	**N**	**% of window type double paned**
All	2324	100.0	1303	56.1	268	11.5
Single Hung	1433	61.7	1023	71.4	215	15.0
Double Hung	205	8.8	21	10.2	4	2.0
Casement	96	4.1	21	21.9	6	6.3
Jalousie	46	2.0	0	0.0	0	0.0
Awning	334	14.4	149	44.6	6	1.8
Sliding	93	4.0	69	74.2	19	20.4
Other	117	5.0	20	17.1	18	15.4
Non-respondents	0	0.0	0	0.0	0	0.0

ANOVA: See Table 7.22, Doors and/or Windows Need Weatherstripping

Table 1.16: Home Floor Coverings (Q16)

	N	% of all homes
Hardwood	53	31.4
Carpet or Area Rugs	126	74.6
Tile (Ceramic)	66	39.1
Vinyl or Linoleum	97	57.4
Other	9	5.3
Non-respondents	0	0.0%

Multiple counts per respondent, no ANOVA

Table 1.17: Home Summer Shade from Trees (Q17 and Q18)

	morning (around 8AM)			afternoon (around 4PM)		
	N	%	Mean Energy Intensity (MMBtu/1000ft^2)	N	%	Mean Energy Intensity (MMBtu/1000ft^2)
Total	38	22.8	3.84	29	17.4	4.19
Partial	91	54.5	4.41	91	54.5	**4.39**
None	38	22.8	**4.48**	47	28.1	4.17
Total	167	100%	4.30	167	100%	4.29
NR	2	1.2	5.25	2	1.2	5.25

One-way ANOVA Sig = .385 (F = 1.020, 3 df) One-way ANOVA Sig = .823 (F = .303, 3 df)

Section 2: KEEPING YOUR HOME COMFORTABLE

Table 2.1: Primary and Secondary Heating Systems (Q19)

	primary N	primary %	secondary N	secondary %
Electric resistance	38	22.5	5	3.0
Natural gas furnace	61	36.1	2	1.2
Liquid propane gas furnace	4	2.4	0	0.0
Heat pump	46	27.2	0	0.0
Portable electric heater	4	2.4	16	9.5
Kerosene space heater	7	4.1	2	1.2
Wood stove or fireplace	2	1.2	4	2.4
Natural gas logs	1	0.6	0	0.0
None	1	0.6	136	81.0
Other	5	3.0	2	1.2
Total	169	100.00	167	100.0
Non-respondents	0	0.0	1	1.2

*ANOVA: See Table 7.43, Primary Heating System

Table 2.2: Thermostat for Main Heating System (Q20)

	N	%	Mean Energy Intensity (MMBtu/1000ft^2)
Standard Thermostat	112	66.3	4.35
Programmable Electronic Thermostat	35	20.7	**4.48**
No Thermostat	22	13.0	3.80
Total	169	100.0	4.31
Non-respondents	0	0.0	-

Insufficient data to estimate ANOVA

Table 2.3a: Thermostat Temperature Setting: Winter Heating, N=142 (Q21)

	normal setting, °F	**deviation from recommended 68°F**
Average	72	+4
Min	60	-8
Max	82	+14
Non-respondents	5 (3.4%)	

Table 2.3b: Deviation from Recommended Thermostat Temperature Setting: Winter Heating, N=142 (Q21)

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
10°-6° below 68 °F	4	2.8	3.75
5°-1° below 68 °F	6	4.2	4.39
0°-5° above 68 °F	81	57.0	4.46
6°-10° above 68 °F	36	25.4	4.18
11°-15° above 68 °F	15	10.6	**4.71**
Total	142	100.0	4.39
Non-respondents	27	16.0	3.88

One-way ANOVA Sig = .735 (F = .551, 5 df)

Table 2.4a: Change Heating Thermostat or Heating Control When Away or Sleeping (Q22 and Q23)

	while away			**while sleeping**		
	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)	**N**	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	96	62.3	4.22	71	46.1	4.20
No	58	37.7	**4.58**	83	52.9	**4.49**
Total	154	100.0	4.36	154	100.0	4.36
NR	15	8.9	3.84	15	8.9	3.84
	One-way ANOVA Sig = .350 (F = 1.056, 2 df)			One-way ANOVA Sig = .431 (F = .847, 2 df)		

Table 2.4b: Winter Thermostat Setting while Away or Sleeping (Q22 and Q23)

Away setting, °F	**N**	**%**	**sleep setting, °F**	**N**	**%**
Average 63°F	20	22.0	Average 67 °F	36	58.1
'Off'	71	78.0	'Off'	26	41.9
Total	91	100.0		62	100.0
Non-respondents	5	5.2		9	12.7

Table 2.5: Primary and Secondary Cooling Systems (Q24)

	primary N	primary %	secondary N	secondary %
Electric central air conditioner	123	72.8	3	1.8
Natural gas air conditioner	3	1.8	0	0.0
Window/wall/room air conditioner	32	18.9	9	5.3
Whole house fan	0	0.0	0	0.0
Ceiling fan(s)	7	4.1	76	45.0
Floor/box fan(s)	2	1.2	12	7.1
None	2	1.2	69	40.8
Other	0	0.0	0	0.0
Total	169	100.00	169	100.0
Non-respondents	0	0.0	0	0.0

ANOVA: See Table 7.42, Primary Cooling System

Table 2.6: Thermostat for Main Cooling System (Q25)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Standard Thermostat	105	62.1	4.27
Programmable Electronic Thermostat	34	20.1	4.13
No Thermostat	30	17.8	**4.64**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

Insufficient data to estimate ANOVA

Table 2.7a: Thermostat Temperature Setting: Summer Cooling, N=137 (Q26)

	normal setting, °F	deviation from recommended 78°F
Average	76	-2
Min	68	-10
Max	85	+7
Non-respondents	2 (1.4%)	

Table 2.7b: Deviation from Recommended Thermostat Temperature Setting: Summer Cooling, N=137 (Q26)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
6º-10º below 78 ºF	28	20.4	**4.39**
1º-5º below 78 ºF	78	56.9	4.35
0º-5º above 78 ºF	30	21.9	4.02
6º-10º above 78 ºF	1	0.7	3.06
Total	137	100.0	4.28
Non-respondents	32	18.9	4.44

One-way ANOVA Sig = .881 (F = .295, 4 df)

Table 2.8a: Change Cooling Thermostat or Cooling Control When Away or Sleeping (Q27 and Q28)

	while away			while sleeping		
	N	%	Mean Energy Intensity (MMBtu/1000ft^2)	N	%	Mean Energy Intensity (MMBtu/1000ft^2)
Yes	92	61.7	4.17	57	39.0	4.00
No	57	38.3	**4.60**	89	61.0	**4.49**
Total	149	100.0	4.33	136	100.0	4.30
NR	20	11.8	4.11	33	19.5	5.64

One-way ANOVA Sig = .404 (F = .911, 2 df) One-way ANOVA Sig = .471 (F = .845, 2 df)

Table 2.8b: Summer Thermostat Setting while Away or Sleeping (Q27 and Q28)

Away setting, °F	N	%	sleep setting, °F	N	%
Average 82°F	23	25.6	Average 78 °F	23	44.2
'Off'	67	74.4	'Off'	29	55.8
Total	90	100.0		52	100.0
Non-respondents	2	2.2		5	8.8

Table 2.9: Frequency of Changing Air Filter (Q29)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Once a month	51	34.0	4.46
Once every 2-3 months	52	34.7	4.34
Once every 4-6 months	20	13.3	3.60
Once a year	11	7.3	**4.87**
Don't know	16	10.7	4.38
Total	150	100.0	4.33
Non-respondents	19	11.2	4.16

One-way ANOVA Sig = .571 (F = .773, 5 df)

Table 2.10: Months per Year Opening Windows on Regular Basis (Q30)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Never open windows	58	34.9	4.42
1-3 months per year	21	12.7	3.92
4-6 months per year	51	30.7	**4.64**
7-9 months per year	16	9.6	3.57
10 or more months per year	20	12.0	4.11
Total	166	100.0	4.31
Non-respondents	3	1.8	4.53

One-way ANOVA Sig = .452 (F = .947, 5 df)

Section 3: APPLIANCES IN YOUR HOME

Table 3.1: Type of Hot Water Heater (Q31)

	N	%
Natural gas	92	54.8
Electric	73	43.5
Liquid propane gas	1	0.6
Other	2	1.2
Total	168	100.0
Non-respondents	1	0.6

ANOVA: See Table 7.44, Water Heating System

Table 3.2: Water Heater Age (Q32)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 2 years old	30	17.9	4.57
2-5 years old	29	17.3	4.24
6-10 years old	29	17.3	3.77
11-20 years old	29	17.3	3.78
21 years or older	17	10.1	**5.20**
Don't know	34	20.2	4.54
Total	168	100.0	4.31
Non-respondents	1	0.6	-

One-way ANOVA Sig = .128 (F = 1.741, 5 df)

Table 3.3: Total Number of Showers Taken per Week in Home (Q33)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
7 or fewer	35	20.8	3.60
8-14	50	29.8	4.07
15-21	28	16.7	4.30
22-28	22	13.1	**5.46**
29-35	18	10.7	4.63
36-42	4	2.4	5.26
43 or more	11	6.6	4.71
Total	168	100.0	4.32
Non-respondents	1	0.6	-

**One-way ANOVA Sig = .024 (F = 2.498, 6 df)

Table 3.4a: Typical Shower Length (Q34)

	time, minutes	**deviation from recommended 5 minutes or less**
Average	11	+6
Min	1	-4
Max	60	+55
Non-respondents	9 (5.3%)	

Table 3.4b: Typical Shower Length (Q34)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
0-5 minutes	37	23.3	4.16
6-10 minutes	70	44.0	4.19
11-15 minutes	39	24.5	**4.57**
16 minutes or longer	13	8.2	4.55
Total	159	100.0	4.31
Non-respondents	10	5.9	4.39

One-way ANOVA Sig = .861 (F = .325, 4 df)

Table 3.5: Home Washing Machine (Q35)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	156	92.3	4.30
No	13	7.7	**4.39**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .827 (F = .024, 1 df)

Table 3.6: Washing Machine Age, N=156 (Q36)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 2 years old	33	21.2	**4.79**
2-5 years old	44	28.2	4.54
6-10 years old	32	20.5	3.58
11-20 years old	26	16.7	4.11
21 years or older	4	2.6	4.64
Don't know	17	10.9	4.29
Total	156	100.0	4.30
Non-respondents	0	0.0	-

One-way ANOVA Sig = .307 (F = 1.203, 6 df)

Table 3.7a: Typical Number of Wash Loads per Week, N=156 (Q37)

Average	5
Min	0
Max	44
Non-respondents	12

Table 3.7b: Typical Number of Wash Loads per Week, N=156 (Q37)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 3	47	30.5	4.29
3-5	72	46.8	4.01
6-8	24	15.6	**4.98**
More than 8	11	7.1	4.43
Total	154	100.0	4.28
Non-respondents	2	1.3	-

One-way ANOVA Sig = .323 (F = 1.177, 4 df)

Table 3.8: Frequency of Hot Water Wash Loads, N=156 (Q38)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Always	13	8.4	**4.64**
Frequently	19	12.3	4.55
Occasionally	47	30.3	3.78
Never	76	49.0	4.50
Total	155	100.0	4.30
Non-respondents	1	0.6	-

One-way ANOVA Sig = .210 (F = 1.528, 3 df)

Table 3.9: Home Clothes Dryer (Q39)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	140	82.8	4.19
No	29	17.2	**4.91**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

*One-way ANOVA Sig = .077 (F = 3.158, 1 df)

Table 3.10: Clothes Dryer Age, N=140 (Q40)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 2 years old	21	15.2	**4.79**
2-5 years old	28	20.3	4.40
6-10 years old	43	31.2	3.80
11-20 years old	25	18.1	4.01
21 years or older	5	3.6	4.72
Don't know	16	11.6	3.93
Total	138	100.0	4.16
Non-respondents	2	1.4	-

One-way ANOVA Sig = .437 (F = .973, 5 df)

Table 3.11: Clothes Dryer Energy Type, N=140 (Q41)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Natural Gas	7	5.0	3.29
Electric	132	95.0	**4.24**
Total	139	100.0	4.19
Non-respondents	1	0.7	-

One-way ANOVA Sig = .122 (F = 2.133, 2 df)

Table 3.12: Frequency of Hanging Clothes to Dry (Q42)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Always	23	14.7	**4.61**
Frequently	15	9.6	4.44
Occasionally	22	14.1	3.81
Never	96	61.5	4.29
Total	156	100.0	4.28
Non-respondents	13	7.7	4.60

One-way ANOVA Sig = .694 (F = .557, 4 df)

Table 3.13: Stove or Oven Energy Type (Q43)

	N	%
Natural Gas	60	35.5
Electric	108	63.9
Other	1	0.6
Total	169	100.0
Non-respondents	0	0.0

ANOVA: See Table 7.45, Cooking Energy Type

Table 3.14: Total Number of Meals Prepared at Home in a Typical Week (Q44)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
5 or fewer	72	42.6	4.29
6-10	45	26.6	4.27
10-15	27	16.0	**4.72**
16 or more	25	14.8	3.98
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .608 (F = .611, 3 df)

Table 3.15: Frequency of Microwave Use (Q45)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Never	6	3.6	3.53
Once a week or less	11	6.5	3.47
About every other day	26	15.4	4.49
Once or twice a day	86	50.9	4.02
Several times a day	40	23.7	**5.15**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

**One-way ANOVA Sig = .017 (F = 3.119, 4 df)

F.2: GRU Appliance Checklist Data

Table 3.16: HVAC System Types and Appliances, Number of Households with One or More of Each System or Appliance

	N	**%** (of 169 households)
Central Air Conditioner	130	76.9
Window/Wall/Room Air Conditioner	49	29.0
Central Heater – *Electric*	79	46.8
Central Heater – *Liquid Propane or Natural Gas*	73	43.2
Central Heater – *Other**	6	3.6
Water Heater – *Electric*	73	43.2
Water Heater – *Natural Gas*	91	53.9
Clothes Washer	155	91.7
Clothes Dryer – *Electric*	134	79.3
Well Pump	6	3.6
Dish Washer – *Electric*	59	34.9
Ceiling Fan**	139	82.3
Attic Whole House Fan	9	5.3
Refrigerator/Freezer – *Combo*	161	95.3
Refrigerator – *Stand Alone*	8	4.7
Freezer – *Stand Alone*	59	34.9
Home Theater System	8	4.7
Television – *Large Screen*	45	26.6
Television – *Standard*	155	91.7
DVD/VHS Player	129	76.3
Personal Computer	98	58.0
Exterior Fixture – *Dusk to Dawn Sensor*	12	7.1
Exterior Fixture – *Motion Sensor*	42	24.9
Other Significant Energy Consuming Appliances	21	12.4

* 16 households surveyed (9%) have no central heating source.
** 5 households surveyed (3%) have ceiling fans as their *only* source of home cooling; all others have at least one central or window/wall/room AC unit.

Detail tables for appliance checklist data

Table 3.16a: Number of Window/Wall/Room AC Units per Household, N=49

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	28	57.1	**4.67**
Two	11	22.4	4.02
Three	8	16.3	3.56
Four	2	4.1	3.61
Total	49	100.0	4.30

One-way ANOVA Sig = .645 (F = .626, 4 df)

Table 3.16b: Number of Ceiling Fans per Household, N=139

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	20	14.4	4.49
Two	22	15.8	4.90
Three	20	14.4	**5.08**
Four	77	55.4	3.80
Total	139	100.0	4.26

**One-way ANOVA Sig = .031 (F = 2.732, 4 df)

Table 3.16c: Number of Combo Refrigerator/Freezers per Household, N=161

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	153	95.0	**4.29**
Two	8	5.0	3.61
Total	161	100.0	4.26

One-way ANOVA Sig = .172 (F = 1.777, 2 df)

(3 households surveyed do not have a refrigerator or freezer, 3 have a stand-alone freezer only, and 1 has a stand-alone refrigerator only.)

Table 3.16d: Number of Big Screen Televisions per Household, N=45

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	39	86.7	4.54
Two	4	8.9	3.37
Three	1	2.2	2.15
Four	1	2.2	**5.54**
Total	45	100.0	4.41

One-way ANOVA Sig = .564 (F = .743, 4 df)

Table 3.16e: Number of Standard Televisions per Household, N=155

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	45	29.0	3.92
Two	38	24.5	3.77
Three	34	21.9	**4.77**
Four	36	23.2	4.66
Five	2	1.3	3.84
Total	155	100.0	4.24

*One-way ANOVA Sig = .091 (F = 1.937, 5 df)

(9 households – 5% of those surveyed – do not have any TVs, standard or big screen)

Table 3.16f: Number of DVD/VCR Players per Household, N=129

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	69	53.5	4.01
Two	28	21.7	**4.97**
Three	15	11.6	4.96
Four	17	13.2	4.46
Total	129	100.0	4.39

One-way ANOVA Sig = .140 (F = 1.759, 4 df)

Table 3.16g: Number of Personal Computers per Household, N=98

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	72	73.5	3.88
Two	16	16.3	**5.62**
Three	6	6.1	3.87
Four	4	4.1	3.51
Total	98	100.0	4.15

**One-way ANOVA Sig = .017 (F = 3.113, 4 df)

Table 3.16h: Number of Exterior Motion Sensor Flood Lights per Household, N=42

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	23	54.8	3.95
Two	12	28.6	5.11
Three	4	9.5	**5.37**
Four	3	7.1	2.02
Total	42	100.0	4.28

*One-way ANOVA Sig = .100 (F = 1.979, 4 df)

Section 4: LIGHTING IN YOUR HOME *(verbally-administered survey data resumed)*

Table 4.1: Frequency of Indoor Light Use During a Typical 24-hour Period (Q46)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 2 hours	28	16.7	4.14
2 to just under 4 hours	37	22.0	4.67
4 to just under 6 hours	44	26.2	4.35
6 to just under 8 hours	21	12.5	3.56
8 to just under 10 hours	12	7.1	4.12
10 to just under 12 hours	3	1.8	3.22
12 hours or more	23	13.7	**4.68**
Total	168	100.0	4.30
Non-respondents	1	0.6	-

One-way ANOVA Sig = .410 (F = 1.027, 6 df)

Table 4.2: Number of Rooms Lit When Using Indoor Lights (Q47)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	66	39.3	4.02
Two	51	30.4	4.36
Three	36	21.4	4.63
Four	5	3.0	**5.00**
Five or More	10	6.0	4.31
Total	168	100.0	4.30
Non-respondents	1	0.6	-

One-way ANOVA Sig = .567 (F = .738, 4 df)

Table 4.3: Light Bulb Types Used in Home (Q48)

	N	% of all homes
Standard incandescent	163	97.6
Fluorescent	56	33.5
Compact Fluorescent	34	20.4
Other	1	0.6
Non-respondents	2	1.2

Multiple counts per respondent, no ANOVA

Table 4.4: Exterior Flood Lights (Q49)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	142	85.0	4.25
No	25	15.0	4.32
Total	167	100.0	4.26
Non-respondents	2	1.2	**8.09**

**One-way ANOVA Sig = .026 (F = 3.735, 2 df)

Table 4.5: Control of Exterior Lights (Q50)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Indoor switch	95	61.7	4.21
Timer	4	2.6	**5.25**
Motion sensor	52	33.8	4.43
Other	3	2.0	3.72
Total	154	100.0	4.30
Non-respondents	15	8.9	4.36

One-way ANOVA Sig = .822 (F = .382, 4 df)

Table 4.6: Frequency of Exterior Light Use During a Typical Night (Q51)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Less than 2 hours	101	64.7	4.16
2 to just under 4 hours	10	6.4	3.59
4 to just under 6 hours	3	1.9	**5.48**
6 to just under 8 hours	4	2.6	3.88
8 to just under 10 hours	12	7.7	4.60
10 to just under 12 hours	14	9.0	4.91
12 hours or more	12	7.7	4.94
Total	156	100.0	4.30
Non-respondents	13	7.7	-

One-way ANOVA Sig = .431 (F = .995, 6 df)

Section 5: HOME ENTERTAINMENT

Table 5.1a: Number of Televisions per Home (Q52)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Zero	3	1.8	**6.68**
One	35	20.8	3.88
Two	40	23.8	3.68
Three	38	22.6	4.86
Four	32	19.1	4.52
Five or More	20	11.9	4.64
Total	168	100.0	4.32
Non-respondents	1	0.6	-

**One-way ANOVA Sig = .017 (F = 2.863, 5 df)

Table 5.1b: Number of *Large Screen* Televisions per Home (Q52)

	N	%
Zero	125	74.0
One	38	22.5
Two	4	2.4
Three	2	1.2
Total	169	100.0
Non-respondents	0	0.0

ANOVA: See Table 3.16d, Number of Big Screen Televisions per Household

Table 5.2: Hours of Television Use in a Typical Day (Q53)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Zero	5	3.0	4.62
Less than 2 hours	20	11.8	3.03
2 to just under 4 hours	38	22.5	4.22
4 to just under 6 hours	23	13.6	3.73
6 to just under 8 hours	20	11.8	4.58
8 hours or more	63	37.3	**4.87**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

***One-way ANOVA Sig = .007 (F = 3.354, 5 df)

Table 5.3: Hours of Video Game System Use in a Typical Day (Q54)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Zero	129	76.3	4.20
Less than 2 hours	22	13.0	4.56
2 to just under 4 hours	10	5.9	4.09
4 to just under 6 hours	3	1.8	6.39
6 to just under 8 hours	2	1.2	2.74
8 hours or more	3	1.8	**6.88**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

*One-way ANOVA Sig = .065 (F = 2.128, 5 df)

Table 5.4: Hours of Computer Use in a Typical Day (Q55)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Zero	66	39.5	4.11
Less than 2 hours	40	24.0	4.50
2 to just under 4 hours	27	16.2	4.02
4 to just under 6 hours	9	5.4	4.60
6 to just under 8 hours	6	3.6	4.02
8 hours or more	19	11.4	**4.79**
Total	167	100.0	4.29
Non-respondents	2	1.2	-

One-way ANOVA Sig = .712 (F = .585, 5 df)

Table 5.5: Hours of CD Player, Radio, or Stereo System Use in a Typical Day (Q56)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Zero	78	46.2	**4.60**
Less than 2 hours	54	32.0	3.95
2 to just under 4 hours	20	11.8	4.11
4 to just under 6 hours	7	4.1	4.35
6 to just under 8 hours	2	1.2	3.76
8 hours or more	8	4.7	4.53
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .587 (F = .751, 5 df)

Section 6: HOUSEHOLD DEMOGRAPHICS

Table 6.1: Number of Occupants per Household (Q57)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
One	53	31.6	3.62
Two	47	28.0	4.32
Three	26	15.5	4.44
Four	20	11.9	**5.49**
Five or More	22	13.1	4.79
Total	168	100.0	4.32
Non-respondents	1	0.6	-

**One-way ANOVA Sig = .012 (F = 2.818, 6 df)

Table 6.2: Number of Senior Citizens per Household (Q58)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
None	96	56.8	4.35
One	57	33.7	4.13
Two	14	8.3	4.84
Three	1	0.6	**6.38**
Four	1	0.6	0.73
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .217 (F = 1.458, 4 df)

Table 6.3: Number of Children per Household (Q59)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
None	114	67.9	4.09
One	21	12.5	4.23
Two	13	7.7	5.28
Three	12	7.1	4.44
Four	4	2.4	**5.72**
Five or More	4	2.4	5.58
Total	168	100.0	4.30
Non-respondents	1	0.6	-

One-way ANOVA Sig = .149 (F = 1.654, 5 df)

Table 6.4: Occupant Regularly Works from Home (Q60)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	20	11.8	**4.73**
No	149	88.2	4.25
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .314 (F = 1.021, 1 df)

Table 6.5: Occupant at Home All Day During Typical Work Week (Q61)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	112	66.3	**4.43**
No	57	33.7	4.07
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .263 (F = 1.260, 1 df)

Table 6.6: Household 2005 Gross Income (Q62)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
$20,000 or less	80	54.4	4.25
$20,001-$25,000	22	15.0	3.62
$25,001-$30,000	18	12.2	4.29
$30,001-$35,000	10	6.8	4.35
$35,001-$40,000	8	5.4	4.68
Over $40,000	9	6.2	**4.87**
Total	147	100.0	4.17
Non-respondents	22	13.0	-

One-way ANOVA Sig = .672 (F = .722, 5 df)

Table 6.7: Factors Respondents Feel Have Largest Impact on Household Energy Use (Q63)

	N	**% of all respondents**
Air conditioning/cooling systems	73	43.2
Appliances	35	20.7
Heat/heating systems	27	16.0
Water heating	23	13.6
Lighting	16	9.5
Electronics	13	7.7
Other	17	10.0
Non-respondents	0	0.0

Multiple counts per respondent, no ANOVA

Table 6.8: Respondents' Concern about Household Energy Costs (Q64)

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
Very concerned	125	74.0	4.42
Somewhat concerned	40	23.7	3.86
Not concerned	4	2.4	**5.21**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .198 (F = 1.638, 2 df)

Table 6.9: Changes in Past Year to Make Home More Energy Efficient? (Q65)

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	77	45.6	4.30
No	92	54.4	**4.32**
Total	169	100.0	4.31
Non-respondents	0	0.0	-

One-way ANOVA Sig = .953 (F = .003, 1 df)

Table 6.10: Aware of Programs to Help Lower Home Energy Costs? (Q66)

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	22	13.1	3.96
No	146	86.9	**4.36**
Total	168	100.0	4.31
Non-respondents	1	0.6	3.89

One-way ANOVA Sig = .667 (F = .405, 2 df)

F.3: GRU Energy Action Survey Checklist Data

Section 1: HEATING, VENTILATION, AND COOLING

Table 7.1: Main Refrigerant Line Needs Insulation, N=130

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	36	27.7	**4.46**
No	94	72.3	4.27
Total	130	100.0	4.32

One-way ANOVA Sig = .611 (F = .260, 1 df)

Table 7.2: Condenser Coils Damaged, N=130

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	11	8.5	**5.40**
No	119	91.5	4.23
Total	130	100.0	4.33

*One-way ANOVA Sig = .062 (F = 3.536, 1 df)

Table 7.3: Condenser Coils Dirty, N=130

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	8	6.1	**4.43**
No	122	93.9	4.30
Total	130	100.0	4.31

One-way ANOVA Sig = .861 (F = .031, 1 df)

Table 7.4: Condenser Air Flow Restricted, N=130

	N	%
Yes	3	2.3
No	127	97.7
Total	130	100.0

Insufficient distribution across categories to report ANOVA

Table 7.5: Air Filter Dirty, N=130

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	54	41.5	4.27
No	76	58.5	**4.33**
Total	130	100.0	4.31

One-way ANOVA Sig = .877 (F = .024, 1 df)

Table 7.6: Air Filter Missing, N=130

	N	%
Yes	4	3.1
No	126	96.9
Total	130	100.0

Insufficient distribution across categories to report ANOVA

Table 7.7: Air By-passing Air Filter, N=130

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	7	5.4	**4.88**
No	123	94.6	4.25
Total	130	100.0	4.28

One-way ANOVA Sig = .218 (F = 1.527, 1 df)

Table 7.8: Air Handler Coil Dirty, N=130

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	22	16.9	**5.09**
No	108	83.1	4.19
Total	130	100.0	4.34

**One-way ANOVA Sig = .049 (F = 3.934, 1 df)

Table 7.9: Evidence Suggests Air Handler Coil Dirty, N=130

	N	%
Yes	4	3.1
No	126	96.9
Total	130	100.0

Insufficient distribution across categories to report ANOVA

Table 7.10: Inadequate Temperature Drop Across Air Handler Coil, N=130

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	20	15.4	**4.97**
No	110	84.6	4.22
Total	130	100.0	4.31

One-way ANOVA Sig = .118 (F = 2.469, 1 df)

Table 7.11: Ducts Have Leaks, N=152

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	59	38.8	**4.66**
No	93	61.2	4.12
Total	152	100.0	4.34

*One-way ANOVA Sig = .094 (F = 2.837, 1 df)

Table 7.12: Ducts Need Insulation, N=152

	N	%
Yes	6	3.9
No	146	96.1
Total	152	100.0

Insufficient distribution across categories to report ANOVA

Table 7.13: Air Handler, Support Platform, or Air Handler Closet Leaks, N=152

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	50	32.9	**4.54**
No	102	67.1	4.21
Total	152	100.0	4.32

One-way ANOVA Sig = .340 (F = .915, 1 df)

Table 7.14: Excessive Furnace Rust, N=152

	N	%
Yes	6	3.9
No	146	96.1
Total	152	100.0

Insufficient distribution across categories to report ANOVA

Table 7.15: Furnace Yellow Flame, N=73

	N	%
Yes	2	2.7
No	71	97.3
Total	73	100.0

Insufficient distribution across categories to report ANOVA

Table 7.16: Inadequate Attic Insulation, N=150 (Average R-value = 13)

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	133	88.7	**4.40**
No	17	11.3	4.00
Total	150	100.0	4.35

One-way ANOVA Sig = .233 (F = 1.433, 1 df)

Table 7.17: Attic Access Needs Insulation, N=150

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	46	30.7	**4.73**
No	104	69.3	4.15
Total	150	100.0	4.33

*One-way ANOVA Sig = .098 (F = 2.770, 1 df)

Table 7.18: Thermostat Set Too Low (Cooling), N=139

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	40	28.8	**4.70**
No	99	71.2	4.19
Total	139	100.0	4.34

One-way ANOVA Sig = .162 (F = 1.974, 1 df)

Table 7.19: Interior Doors Closed, N=169

	N	%
Yes	4	2.4
No	165	97.6
Total	169	100.0

Insufficient distribution across categories to report ANOVA

Table 7.20: Fans On in Unoccupied Rooms, N=139

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	39	28.1	4.14
No	100	71.9	**4.36**
Total	139	100.0	4.30

One-way ANOVA Sig = .541 (F = .376, 1 df)

Table 7.21: Windows Need Shade or Cover, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	33	19.5	**4.69**
No	136	80.5	4.22
Total	169	100.0	4.31

One-way ANOVA Sig = .227 (F = 1.473, 1 df)

Table 7.22: Doors and/or Windows Need Weatherstripping, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	76	45.0	**4.52**
No	93	55.0	4.14
Total	169	100.0	4.31

One-way ANOVA Sig = .218 (F = 1.529, 1 df)

Section 2: WATER HEATING

Table 7.23: Hot Water Temperature Set Too High, N=164

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	35	21.3	**5.14**
No	129	78.7	4.09
Total	164	100.0	4.31

***One-way ANOVA Sig = .005 (F = 8.025, 1 df)

Table 7.24: Water Heater Pipe Leaks, N=164

	N	%
Yes	0	0.0
No	164	100.0
Total	164	100.0

Insufficient distribution across categories to report ANOVA

Table 7.25: Water Heater Pipes Need Insulation, N=164

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	91	55.5	**4.40**
No	73	44.5	4.20
Total	164	100.0	4.31

One-way ANOVA Sig = .533 (F = .390, 1 df)

Table 7.26: Water Heater Pipes Rusty or Corroded, N=164

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	19	11.6	**4.81**
No	145	88.4	4.25
Total	164	100.0	4.31

One-way ANOVA Sig = .248 (F = 1.344, 1 df)

Table 7.27: Water Heater Tank Needs Insulation, N=164

	N	%
Yes	0	0.0
No	164	100.0
Total	164	100.0

Insufficient distribution across categories to report ANOVA

Section 3: OTHER POTENTIAL CONCERNS

Table 7.28: Inefficient Showerhead, N=169

	N	%
Yes	6	3.6
No	163	96.4
Total	169	100.0

Insufficient distribution across categories to report ANOVA

Table 7.29: Inefficient Refrigerator, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	103	61.0	**4.70**
No	66	39.0	3.70
Total	169	100.0	4.31

***One-way ANOVA Sig = .001 (F = 10.583, 1 df)

Table 7.30: Fireplace Damper Open When Not in Use, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Yes	10	5.9	3.62
No	159	94.1	**4.35**
Total	169	100.0	4.31

One-way ANOVA Sig = .261 (F = 1.270, 1 df)

Section 4: STRUCTURE AND SYSTEMS

Table 7.31: Structure Type Single Family Detached, N=169

	N	%
Yes	169	100.0
No	0	0.0
Total	169	100.0

Insufficient distribution across categories to report ANOVA

Table 7.32: Occupancy Status, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Own	138	81.7	4.10
Rent	31	18.3	**5.22**
Total	169	100.0	4.31

***One-way ANOVA Sig = .005 (F = 8.173, 1 df)

Table 7.33: Ceiling Type, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Attic	138	93.5	**4.37**
Roof	31	6.5	3.40
Total	169	100.0	4.31

One-way ANOVA Sig = .119 (F = 2.458, 1 df)

Table 7.34: Ceiling Insulation, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Insulated	152	89.9	4.24
Uninsulated	17	10.1	**4.89**
Total	169	100.0	4.31

One-way ANOVA Sig = .211 (F = 1.575, 1 df)

Table 7.35: Floor Type, N=168

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Slab on grade	116	69.0	4.18
Raised wood floors	52	31.0	**4.62**
Total	168	100.0	4.31

One-way ANOVA Sig = .343 (F = 1.076, 1 df)

Table 7.36: Floor Insulation, N=71

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Insulated	5	7.0	3.54
Uninsulated	66	93.0	**4.61**
Total	71	100.0	4.53

One-way ANOVA Sig = .238 (F = 1.449, 1 df)

Table 7.37: Wall Type, N=169

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Concrete block	111	65.7	4.22
Wood frame	58	34.3	**4.47**
Total	169	100.0	4.31

One-way ANOVA Sig = .443 (F = .590, 1 df)

Table 7.38: Wall Insulation, N=71

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Insulated	29	40.9	3.66
Uninsulated	42	59.1	**4.86**
Total	71	100.0	4.37

**One-way ANOVA Sig = .043 (F = 3.215, 2 df)

Table 7.39: Window Condition, N=166

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Good	106	63.9	4.07
Bad	60	36.1	**4.73**
Total	166	100.0	4.31

One-way ANOVA Sig = .123 (F = 2.119, 2 df)

Table 7.40: Cooling Distribution System, N=159

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
None	31	19.5	4.12
Attic	115	72.3	**4.34**
Interior	13	8.2	3.53
Total	159	100.0	4.23

*One-way ANOVA Sig = .096 (F = 2.146, 3 df)

Table 7.41: Heating Distribution System, N=163

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
None	20	12.3	3.87
Attic	129	79.1	**4.41**
Interior	14	8.6	3.49
Total	163	100.0	4.26

One-way ANOVA Sig = .130 (F = 1.911, 3 df)

Table 7.42: Primary Cooling System, N=165

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Propane	1	0.6	2.94
Electric	127	77.0	**4.46**
Pump	14	8.5	3.73
Wall unit	23	13.9	3.83
Total	165	100.0	4.30

One-way ANOVA Sig = .444 (F = 0.936, 4 df)

Table 7.43: Primary Heating System, N=164

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Natural gas	86	52.4	4.48
Propane	6	3.7	3.04
Strip	44	26.8	**4.65**
Pump	27	16.5	3.81
Fuel	1	0.6	1.45
Total	164	100.0	4.34

One-way ANOVA Sig = .078 (F = 2.022, 5 df)

Table 7.44: Water Heating System, N=166

	N	%	**Mean Energy Intensity** (MMBtu/1000ft^2)
Natural gas	84	50.6	**4.49**
Propane	3	1.8	3.31
Strip	77	46.4	4.21
Pump	1	0.6	3.52
Solar	1	0.6	2.02
Total	166	100.0	4.32

One-way ANOVA Sig = .667 (F = .643, 5 df)

Table 7.45: Cooking Energy Type, N=166

	N	**%**	**Mean Energy Intensity** (MMBtu/1000ft^2)
Natural gas	40	24.1	**4.34**
Electric strip	125	75.3	4.29
Pump	1	0.6	7.34
Total	166	100.0	4.32

One-way ANOVA Sig = .433 (F = .919, 3 df)