Multifamily Residential New Construction characteristics and practices study

Market Research Report

PREPARED BY

RLW Analytics

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MULTIFAMILY RESIDENTIAL NEW CONSTRUCTION CHARACTERISTICS AND PRACTICES STUDY

Final Report

June 14, 2007

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Executive Summary

Introduction

This document is the multifamily final report for the Residential New Construction Baseline Study. The study was sponsored by the Northwest Energy Efficiency Alliance. The study was conducted by RLW and Ecos Consulting. This is the second multifamily residential new construction study conducted by the Northwest Energy Efficiency Alliance (herein referred to as "NEEA"). The previous study was published in 2001.

This report characterizes multifamily residential new construction using a representative sample of buildings constructed in 2004 and 2005. The single-family new construction results are available in a separate report. The results of this study are expected to serve as a basis for planning, forecasting, and program development initiatives by various entities in the region.

Objectives of the Project

There are three primary objectives of this study:

> **Objective 1:** Develop a representative sample of newly constructed multifamily buildings in the states of Montana, Idaho, Washington and Oregon. Conduct on-site surveys to gather detailed characteristics on construction materials, appliances, equipment, and lighting. The lighting, appliance, and equipment data are available online by means of a searchable database.
>
> **Objective 2:** Analyze the saturation of high efficiency technologies in the new construction market place for multifamily residences.
>
> **Objective 3:** Analyze the energy use of the multifamily dwellings. The analysis will be supported by utility billing data collected for each sample point. This analysis will be performed later in 2007 and will be available on the NEEA website.

Approach

A sample of 200 residential multifamily dwelling units at 100 complexes was selected to represent new construction practices in the Pacific Northwest. The sample was proportionally allocated by 2004 Census multifamily new home permits by county within each of the four states. For the 2006 study, NEEA decided to look more comprehensively at appliances and lighting using onsite audits of *occupied* residences to gather information about the dwelling. In order to obtain an accurate picture of appliance and lighting saturation, the homes needed to be fully occupied, which made it more difficult to obtain other characteristics such as accurate envelope data. The sample sites were recruited from a variety of sources such as FW Dodge, and internet apartment listing sites such as Apartments.com, Loopnet.com. Each potential dwelling was qualified during the recruitment process to ensure that the complex was constructed in 2004-05.

By comparison, the 2001 study focused on 49 complexes with almost 4,800 homes that were in the permitting stage, and not fully occupied, which limits the comparisons between the studies. The 2001 study data were gathered from building plans and builder interviews with limited audits. The 2001 residential new construction study was prepared by Ecotope and was called: "Baseline Characteristics of the Multi-Family

Sector: Oregon and Washington." The 2001 report is used as a basis for comparison for this report where the different methodologies for data collection allow a comparison. The 2001 study focused on envelope characteristics, as well as heating, cooling, and water heating equipment, with a limited amount of appliance efficiency or lighting data gathered. Additionally, the 2001 report only reported on Oregon and Washington, and this report contains information on Oregon, Washington, Idaho, and Montana.

Customers were recruited to participate in the study by mail, and each participant was paid $25 for agreeing to allow an on-site surveyor to visit their home to gather the required information. The on-site survey was implemented using handheld personal digital assistants (PDA) and an application for collecting the specified information. A total of 200 multifamily on-site surveys were completed between February and June 2006.

While on-site, the surveyors collected data on the major appliances in the home: Refrigerator-Freezers, Dishwashers, Clothes Washers, Clothes Dryers, Water Heaters, Heating Equipment, Spa/Pool Equipment, and Cooling Equipment. Data on thermostats, large appliances, and consumer electronics were also gathered. The surveyors collected lamp, fixture and wattage data for each lighting fixture within the home, as well as the front porch fixture. The surveyors also collected data on attic, floor and wall area, insulation R-values, wall construction, and window type, as well as demographic data. The surveyors also collected information on the complex common area, such as the number of washers and dryers, pools and spas, lighting, and number of units.

The data underwent quality control measures and model numbers were matched to databases of appliance efficiencies. RLW used data sources from the California Energy Commission (CEC), the Air-Conditioning and Refrigeration Institute (ARI), Association of Home Appliance Manufacturers (AHAM), and more. Once the model numbers were linked, the corresponding efficiency was assigned to the matched appliance.

The appliance and equipment efficiency findings presented in this report do not account for degradation. Most appliances (if not all) have been shown to degrade over time, the result of which can affect performance and energy efficiency. The efficiency information presented in this report is based on manufacturer compliance testing of new products to federal appliance and equipment standards. Therefore, efficiency data presented in this report may not be representative of operating efficiencies since efficiency values are based on manufacturer tested performance. However, since these are new homes, degradation is not as likely to have as much impact on the efficiencies.

The analysis for lighting and appliances is summarized in this report at the regional level. Each site was given its appropriate case weight to project to the population or various subsections of the population. The report contains numerous data queries, which for the most part are summarized by efficiency, size, and capacity bins. The data and analysis queries developed for this project can be accessed by any user. The Pacific Northwest Residential Efficiency Saturation Tool (PNWRES^{EST}) allows users to explore this residential sector data in a myriad of ways that go well beyond what is presented in this "regional" report. The tool can be accessed at www.pnwresest.com.

Key Findings

In this section we summarize some of the more interesting findings occurring at the regional level. Findings are grouped by appliance and equipment type, lighting, and

building characteristics. Readers can find additional information and details in the sections of the report that pertain to the topic of discussion in this section.

Lighting

The data collection parameters included a collection of fixture type, number of lamps, lamp technology type, and lamp wattage (when accessible). All of the indoor lighting data were characterized by room type.

The average multi-family home has 19 fixtures and 31 lamps. The most common fixture type by a large margin is ceiling mounted fixtures, with an average of 7.3 fixtures per home or 39% of all fixtures. Wall mounted fixtures and recessed cans each account for approximately 16% of all fixtures or 3 fixtures per home of each type.

Nearly 40% of all homes surveyed contain at least one compact fluorescent lamp (CFL). Nearly 10% of all lamps are compact fluorescent and over 5% of all fixtures contain a CFL. The most common CFL type, the spring lamp, is on average 17 watts. Table lamps and floor lamps are most likely to contain compact fluorescent lamps. Bedrooms have a higher tendency than most rooms to have CFLs with 16% to 19% of bedrooms having CFLs. CFLs in front porch fixtures are relatively common, with 22% of the homes with porch fixtures using CFLs.

General Characteristics

Approximately 44% of the multifamily residences surveyed are apartments with three stories or greater. The second most commonly visited type of residences were one to two story apartments constituting nearly 34% of the sample. Forty-eight percent of the residences had a floor area between 1,000 to 1,599 SQFT. The proportion of sampled residences with 1 or 2 occupants is the same at 31%.

The average floor area for homes in 2004 (2006 study) was 1,071, compared to 1,000 for homes constructed in 1998 (2001 study). Recall that the 2006 study includes Idaho, Oregon, Montana, and Washington, and the 2001 study includes Oregon and Washington. However, since Oregon and Washington constitute the majority of the sampled units in the 2006 study (81%), the majority of units from both the studies are from Oregon and Washington.

Refrigerators

Data were gathered for primary, secondary, and tertiary refrigerators. The proportion of homes with a second refrigerator, which tend to be older and less efficient than primary refrigerators, is 2.3%, and none of the homes surveyed had three refrigerators.

The average manufacturer reported size for primary refrigerators is 18.7 cubic feet, compared to the average single-family refrigerator size of 23.7 cubic feet. Refrigerators are the biggest energy consumer of household appliances. Efficiency is measured as unit energy consumption (UEC), which is the electrical consumption per unit per year reported as kWh/yr. The average overall nameplate UEC for primary refrigerators found in this study was 493 kWh/yr.

The majority of the primary refrigerators are top mounted refrigerators, or freezer on top, accounting for approximately 71% of all the primary refrigerators. Top mounted refrigerators without ice dispensers are the most efficient units with the lowest nameplate UEC at 462 kWh/yr. Side-by-side refrigerators account for nearly 22% of the

primary refrigerators. All of the primary refrigerators surveyed were less than 6 years old.

Water Heaters

Data were gathered on many water heater characteristics, including system type, size, age, efficiency, fuel type, output, and insulation. The most common system type of all water heaters are electric storage (62%), while 32% are gas storage, and 6% are central systems. The average age of all water heaters for which an age was obtained is 1.4 years old. The average energy factor (EF) for the popular 50 gallon gas fired water heater is 0.59, which is slightly above the 0.53 EF from the National Appliance Energy Conservation Act Standards (NAECA), implemented in 2004. The average EF for electric water heaters is 0.89, which is consistent if not slightly better than the current federal standard for 50 gallon systems of 0.90. The large majority of all water heaters are unwrapped (98%). This high percentage of unwrapped water heaters is not surprising as the water heaters are fairly new.

Clothes Washers

Approximately 85% of all multifamily homes have a clothes washing machine. Out of all the washers in the data, 61% were top-loading standard washing machines, 26% were stacked washing machines, and 12% were horizontal axis machines.

The efficiency measurement for clothes washers is the Modified Energy Factor (MEF), which is a measure of the energy used during the washing process that includes the machine energy, the water heating energy, and the drying energy. The higher the MEF, the more efficient the washer. The minimum ENERGY STAR qualifying MEF is 1.42 for all clothes washers manufactured prior to 2007. The average MEF for the washers in this study is 1.64. All washers exceed the minimum federal requirements, and all horizontal axis washers exceed ENERGY STAR requirements.

Clothes Dryers

Eighty-four percent of all multifamily homes have a clothes dryer. The overwhelming majority of homes (99%) use electric dryers, while only 1% use gas dryers. ENERGY STAR does not label dryers because many use a similar amount of energy. To reduce the amount of energy used it is recommended to use a moisture sensor detector on the dryer. The presence of a moisture sensor detects the amount of moisture in the load of laundry, and terminates the cycle prematurely if the moisture content reaches a certain moisture threshold. This feature is present in approximately 38% of dryers.

Dishwashers

Approximately 96% of all multifamily homes have a dishwasher. The average EF for all dishwashers that were matched is 0.52, is this greater than the federal standard of 0.46, but falls short of the minimum ENERGY STAR qualification of 0.58 which is 25% higher than the federal standard. All of the dishwashers with energy factors are within the range of 0.46 to 0.58. A potential bias is introduced with the low model number to efficiency match rates since the appliance efficiency databases are only updated periodically and therefore the models in the databases are more likely to be the older models, since the newer models might not have been added yet. This would lead to a potential downward bias in efficiency levels.

Cooling Equipment

From our analysis of the surveyed residences, approximately 41% of homes in the region have a cooling system, of which 56% are central systems and 44% are space units. The cooling equipment saturation in Oregon is 43% and in Washington is 24%. In the 2001 study, Oregon had an average cooling equipment saturation of about 18% and Washington had a penetration of 5%. Note however, that the 2006 penetration estimates include space AC systems, while the 2001 study only included central systems, since space systems are added to homes after they are occupied.

All central air conditioning systems were found to be between 2 and 5 tons. The greatest amount of combined central system air conditioners are in the 10 to 10.99 SEER range accounting for 86.3% of central systems.

Heating Equipment

The study results show that all multifamily homes have at least one heating system, and 43% of homes have more than one system. The most common primary heating system was found to be wall units, totaling 37% followed by baseboard heating at 23%. Space units used as the primary heating system were more common than central units.

In 2001, the Oregon market was found to have a low saturation of gas heating and the Washington market had a significantly higher saturation of gas heated units. When comparing 2006 to 2001 findings, the gas heating saturation looks to have increased in Oregon, going from 6% to 16%, however the error bound is 9% in 2006. The gas heating saturation appears to have decreased in Washington, from 54.5% to 26%, but the 2006 sample in Oregon and Washington does include some town/row houses, which are more likely to contain gas heating.

Among all the system types found, the majority used electricity (68%). The average Annual Fuel Utilization Efficiency (AFUE) for gas forced air heating systems is 84.

Windows

The saturation of metal frame windows is 5%, while the remainder of homes have double pane, non-metal windows. The finding that window frame types are largely non-metal is similar to the 2001 study findings. Field surveyors carried low-emissivity (low-e) detectors for determining the presence of low-e coatings. Overall, 64% of homes have low-e windows.

Study Limitations

The AC SEER value was obtained from efficiency databases based on the *condensing* unit model number. The databases that were used in the matching process use an average SEER value of common condenser/evaporator combinations, and therefore provide a relatively accurate representation of the efficiency of the systems observed.

Lamp wattage was difficult to collect in some circumstances. Approximately 6% of surveyed fixtures were inaccessible due to height, delicate fixture enclosures, or homeowner preference. RLW calculated the missing wattages based on average value in other homes with the same fixture type in the same room type.

The databases used for appliance matching are a study limitation. For example, dryer efficiencies were very difficult to match due to the lack of a comprehensive dryer efficiency database. The CEC has recently begun to compile a list of dryer efficiencies,

but only 12% of the 762 dryers (in SF and MF homes) that we collected model numbers for were in the database. More discussion on the model number matching is in the Introduction.

None of the appliance efficiency databases (i.e., CEC, AHAM, ARI) used for efficiency matching account for efficiency degradation over time. Appliance efficiencies are based on the manufacturer test data at the time of manufacture.

The 2001 study was used for comparison purposes where applicable; mainly in the building heat loss performance section. Though it is the most appropriate report for comparison, the two studies are dissimilar enough that a comparison of many tables is not possible, and the comparisons presented should be used with an understanding of the differences between the studies.

The 2001 study focused on the envelope characteristics, as well as heating, cooling, and water heating equipment, obtained from the builders and plans while the current study looks more comprehensively at appliances and lighting using on-site audits of *occupied* residences to gather information about the building. *The current study did not collect any information on code values or other compliance information from the building department*. Since the homes were completely finished and occupied, in many instances, the surveyors had to make assumptions about the insulation. In the previous study, the insulation and code values were on the plans that the contractors obtained. *This is a trade off in the type of data collected that was made during study planning and the envelope results and code values should be interpreted accordingly.*

Therefore, the tables in the insulation and building heat loss performance sections of this report contain RLW's best estimates of the insulation levels in homes. If the study's primary goal were to obtain envelope characteristics, then the study would have been performed on unoccupied, non-finished homes. RLW would also have attempted to obtain the plans for each home. However, obtaining the plans was never a part of this study since the envelope characteristics were not the main focus of the report.

The home characteristics that were comparable between the 2001 and the 2006 study were the heating, cooling, and water heating equipment, and envelope characteristics. RLW compared the differences in the 2001 and 2006 findings for heating fuel types, heating efficiencies, cooling saturation level, water heater fuel type, overall heat loss, U-value of envelope components, window frame, and wall framing types. These comparisons are found in the Multifamily Appliances and Building Characteristics chapter of this report in the relevant equipment or envelope characteristic section.

Introduction

This document is the final report for the Multifamily Residential New Construction Baseline Study. The study was sponsored by the Northwest Energy Efficiency Alliance. The study was conducted by RLW and Ecos Consulting. This is the second multifamily residential new construction study in a series of similar studies conducted by the Northwest Energy Efficiency Alliance (herein referred to as "NEEA").

This report characterizes multifamily residential new construction using a representative sample of buildings constructed in 2004 and 2005. The results of this study are expected to serve as a basis for planning, forecasting, and program development initiatives by various entities in the region.

Objectives of the Project

There are three primary objectives of this study:

> **Objective 1:** Develop a representative sample of newly constructed multifamily buildings in the states of Montana, Idaho, Washington and Oregon. Conduct on-site surveys to gather detailed characteristics on construction materials, appliances, equipment, and lighting. The lighting, appliance, and equipment data are available online by means of a searchable database.
>
> **Objective 2:** Analyze the saturation of high efficiency technologies in the new construction market place for multifamily residences.
>
> **Objective 3:** Analyze the energy use of the multifamily dwellings. The analysis will be supported by utility billing data collected for each sample point. This analysis will be performed later in 2007 and will be available on the NEEA website.

Approach

An evenly distributed sample of residential dwelling units was selected to represent new construction practices in the Pacific Northwest. The sample was proportionally allocated by 2004 Census new home permits by county within each of the four states. These customers were recruited from a variety of sources including FW Dodge, and internet apartment listing sites such as Apartments.com, Loopnet.com. Each potential dwelling was qualified during the recruitment process to ensure that the complex was constructed in 2004-05.

Customers were recruited to participate in the study by mail, and each participant was paid $25 for agreeing to allow an on-site surveyor to visit their home to gather the required information. The on-site survey was implemented using IPAQ hand held personal digital assistants (PDA) and a specially designed application for collecting the specified information. This approach provided fast and cost effective on-site data collection. A total of 200 multifamily on-site surveys were completed between February and June 2006.

While on-site, the surveyors collected data on the major appliances and lighting systems in the home. The surveyors collected nameplate data for the following appliances and equipment:

- Refrigerator-Freezer
- Dishwashers
- Clothes Washers and Dryers
- Water Heaters
- Heating Equipment
- Cooling Equipment
- Pool and Spa Equipment
- Large appliances
- Plug Loads
- Thermostats
- Envelope

For lighting, the surveyors collected lamp, fixture and wattage data for each lighting fixture within the home, as well as the front porch fixture. The on-site surveyors also collected data on attic, floor and wall area, insulation R-values, wall construction, and window type. The survey also included a brief set of demographic and socioeconomic questions. The surveyors also collected information on the complex common area, such as the number of washers and dryers, pools and spas, lighting, and number of units.

As the data were collected, the surveyors uploaded the site data from the PDA units to RLW's SQL database. The data underwent quality control measures and model numbers were matched to databases of appliance efficiencies. RLW used databases from the previous study, in addition to new data sources, including CEC, ARI, AHAM, and more. Once the model numbers were linked, the corresponding efficiency was assigned to the matched appliance. Matching rates varied greatly by appliance type and age. In most cases this was due to the comprehensiveness of the efficiency databases that were available for each appliance.

Table 1 presents each appliance for which we collected data in 2005-06 in multifamily homes for primary equipment. The tables contain the following data in the column order as listed below:

- Name of appliance,
- Number of each appliance found during all on-site visits,
- Number of model numbers found for each appliance,
- Percentage of model numbers that surveyors were **able** to identify on-site,
- Number of model numbers matched to efficiency database(s),
- Percentage of model numbers matched among **all** appliances recorded,
- Percentage of model numbers matched among appliances with model numbers.

For example, we recorded the presence of 200 primary refrigerators. During the on-site surveys, the surveyors were able to locate model numbers for 197 of those refrigerators, or 99% of all refrigerators.

When the data were aggregated at RLW's offices and linked to the refrigerator efficiency databases, only 168 of the 197 (85%) refrigerators with model numbers were matched. Another way to look at the match rate is to consider the percentage of the *total* number of primary refrigerators (200) that were successfully matched (168), which for refrigerators was 84%. This statistic combines the success rate of the matching with the success of the auditors in collecting model numbers. A high match rate among the units with model numbers collected is less meaningful if the auditors were only able to collect data on a handful of units.

Appliance/ Equipment	Total Number in Database (A)	Model Numbers Found (B)	% of Appliances with Model Number (B/A)	Model Numbers Matched (C)	% of All Appliances Matched (C/A)	% of Appliances with Model Numbers Matched (C/B)
Cooling	87	52	60%	32	37%	**62%**
Refrigerator	200	197	99%	168	84%	**85%**
Water Heat	200	171	86%	89	45%	**52%**
Washer	168	151	90%	31	18%	**21%**
Dishwasher	191	186	97%	103	54%	**55%**
Dryer	166	166	100%	42	25%	**25%**
Heating System Fuel	**Total Systems**	**Model Numbers Known**	**% of Systems with Model Number**	**Total Matched and Known Efficiency**	**% of All Appliances Matched**	**% of Systems with Model Numbers Matched**
Electric	138	71	51%	71	51%	**100%**
Gas	62	50	81%	32	52%	**64%**
Total Heating	200	121	61%	103	52%	**85%**

Table 1: Model Number Match Rates by Appliance

Based upon our experience from previous studies, we anticipated in the design stages of this project that the match rates would approximate what are shown in the table above. We knew that matching model numbers to appliance databases would be a long process. One of the problems is that wildcards (*, /, #, etc.) are often included in the model number. The wildcards add to the complexity of the query designs and decrease match rates. The "layered" queries that we built searched several databases for matching model numbers. Once the automated process was complete, a manual process of looking up the unmatched appliances was undertaken.

Efficiency databases were exhausted using the above protocols for matching appliances. RLW is confident that the great majority of model numbers found on-site were matched if they appeared in any of the efficiency databases. The problem with the low matching rates lies in the efficiency databases themselves. Simply put, much of the equipment found in the field is not documented in publicly or privately available efficiency databases. Furthermore, the private data such as the refrigerator-freezer data that were purchased from AHAM were not in the best condition, and somewhat partial in content.

A potential bias is introduced with low match rates since the databases are only updated periodically – annually in most cases – and therefore the models in the databases are

more likely to be the older models, since the newer models might not have been added yet.

The analyses of lighting and appliances summarized in this report are at the regional level. Each site was given its appropriate sampling weight to project to the population or various subsections of the population. Analysis queries were written in MS Access and processed using RLW's Model Based Statistical Sampling (MBSS) software. The report contains numerous data queries, which for the most part are summarized by age bins, efficiency bins, size bins and capacity bins.

The data and analysis queries developed for this project can be accessed by any user wishing to do so. As a product of this study, RLW developed a Web-based analytical tool that gives users the ability to "slice and dice" the data. The Pacific Northwest Residential Efficiency Saturation Tool (PNWRES^{EST}) allows users to explore this residential sector data in a myriad of ways that go well beyond what is presented in this "regional" report. The tool can be accessed at www.pnwresest.com.

Study Limitations

For the most part, all of the data the study aimed to collect through the on-site surveys were easily obtained. It should be noted that the SEER value was obtained from the various efficiency databases based on the model number of the condensing unit. The evaporator coil has an impact on the overall SEER of the system, but gathering information on the evaporator coil involves additional effort on the part of both the surveyor and especially the analyst, as there is no available database that caters to the large scale matching of condenser and evaporator units. However, the databases that were used in the matching process use an average SEER value of common condenser/evaporator combinations, and therefore provide a relatively accurate representation of the efficiency of the cooling systems observed.

Wattage was difficult to collect in some circumstances. Although surveyors were trained to remove luminaire covers if easily reachable and removable, approximately 6% of surveyed fixtures were inaccessible due to height, delicate fixture enclosures, or homeowner preference. For these lamps with unknown wattages, RLW calculated the missing wattages based on average value in other homes with the same fixture type in the same room type.

Field personnel also reported pool and spa information for pumps and heaters to be difficult to access and difficult to locate nameplate data. Compounded by the low overall saturation of homes with pools, limited information was obtained for these particular data points.

Comprehensiveness is a limitation with regard to the databases used for appliance matching. For example, field staff were able to obtain 186 of 191 dishwasher model numbers, yet through the matching process RLW was only able to match 55%, or 103 models, to databases. Dryer efficiencies were very difficult to match due to the lack of a comprehensive dryer efficiency database. The CEC has recently begun to compile a list of dryer efficiencies for newer models, but only 25% of the 166 dryers that we collected model numbers for were in the database. More detailed findings are presented on the model number matching process in Table 1. As mentioned previously, a potential bias is introduced with low match rates since the databases are only updated periodically – annually in most cases – and therefore the models in the databases are more likely to

be the older models, since the newer models might not have been added yet. This bias would potentially lead to more of the older models being matched to efficiency information, resulting in lower average reported efficiencies if the older models are less efficient than the unmatched models.

None of the appliance efficiency databases (i.e., CEC, AHAM, ARI) used for efficiency matching account for efficiency degradation over time. Appliance efficiencies are based on the manufacturer test data at the time of manufacture. However, over time appliances and equipment do degrade due to various factors that can affect operational performance. Considering this, the efficiencies of matched appliances, particularly of older appliances, are more than likely less efficient than what has been reported here since no attempt has been made to adjust for efficiency degradation. Degradation is less of a factor for cooling, water heating, dishwashers, and other systems installed during home construction for new residences. However, this does factor into efficiencies of appliances such as refrigerators and washers, which are oftentimes brought from previous residences.

The "Baseline Characteristics of the Multi-Family Sector: Oregon and Washington" study prepared by Ecotope in December 2001 was used for comparison purposes where applicable; mainly in the building heat loss performance section. Though it is the most appropriate report for comparison, the two studies are dissimilar enough that a comparison of many tables is not possible, and the comparisons presented should be used with an understanding of the differences between the studies.

The 2001 study presents data that was gathered from building plans and builder interviews, while the current study used on-site audits of *occupied* residences to gather as much information about the building and appliance characteristics *as possible*. The RLW surveyors faced many obstacles when trying to determine insulation levels for each assembly since the homes were completely finished and occupied. In many instances, the surveyors had to make assumptions about the levels of insulation, whereas in the previous study, the insulation and code values were on the plans that the contractors obtained.

The 2001 study focused on the envelope characteristics, as well as heating, cooling, and water heating equipment, with a limited amount of appliance efficiency or lighting data presented. The RLW study aimed to be more comprehensive with regards to appliances and lighting. To obtain an accurate picture of appliance and lighting saturation, the homes needed to be fully occupied, which made it more difficult to obtain accurate envelope data.

For example, the size of wall cavities is fairly easy to observe, but physically observing the insulation to determine the R-value of the insulation inside the cavity is not easily done in such a manner that the homeowner and budget constraints are satisfied. This is also the case with vaulted ceilings and floor insulation.

Information collected in the RLW study such as dishwasher, clothes washers and dryers, consumer electronics, lighting, functional testing, and other large appliances have no comparison, as these were not included in the 2001 report.

Therefore, these tables in the insulation and building heat loss performance sections of this report contain RLW's best estimates of the insulation levels in homes, however it must be acknowledged that if the study's primary goal were to obtain envelope

characteristics, then the study would have been performed on unoccupied, non-finished homes. RLW would also have attempted to obtain the plans for each home. However, obtaining the plans was never a part of this study since the envelope characteristics were not the main focus of the report.

The multifamily recruiting proved to be particularly challenging due to the lack of a complete, accurate listing of all new multifamily complexes in the region. RLW recruiters had to identify multifamily complexes through internet searches, word of mouth, property management offices, etc. These recruiting challenges forced RLW to sample multifamily complexes less randomly than preferred, and also to sample from different counties and size bins when complexes could not be identified for targeted strata. As a result, smaller complexes are under sampled since these were much more difficult to identify than large complexes.

Finally, the 2001 study had the primary goal of developing balanced sample frames across each state in order to develop a representative random sample of the two states (OR and WA). This strategy allowed for a comparison between the states and provided a higher level of precision for each state. The primary goal of the current study is to provide the best representation of the four-state *region as a whole.* To achieve this goal, a proportional allocation of the sample across the region was selected and comparisons across the states are less precise.

Sample Design

This section discusses the multifamily sample design. The 2004 Census multifamily housing permit counts by county were used to allocate the multifamily sample. The unit sample was designed at the region level in order to achieve an error bound of +/-10% at the 90% level of confidence.

RLW and NEEA contracted to complete 200 multifamily unit audits at 100 complexes. RLW calculated the allocation of the sample by state as shown below. Washington has over 55% of the permitted multifamily units, followed by Oregon with 27%, Idaho with 12% and Montana with 6%.

State	Total MF Units Permitted	Proportion of MF Units Permitted	Total MF Building Sample
Idaho	2,835	11.5%	24
Montana	1,550	6.3%	12
Oregon	6,599	26.8%	54
Washington	13,600	55.3%	110
Total	**24,584**	**100.0%**	**200**

Table 2: Original Planned Sample by State

A second layer of stratification was included to attempt to differentiate the smaller and larger multifamily complexes:

1. Sites with 2-4 housing units per building (groups 2-unit and 3-4 unit buildings)
2. Sites with 5 or more housing units per building

The table below shows the total quantity of multifamily units permitted in each state by building size category. Also included is the proportion of the total number of multifamily units permitted that each state-size category represents. Finally, the sample size for each state -size category is presented. The sample was designed at the county level using the same unit information.

State	Units Permitted		Proportion		Sample Points	
	2-4 Units per Building	5+ Units per Building	2-4 Units per Building	5+ Units per Building	2-4 Units per Building	5+ Units per Building
Idaho	1,969	866	8.0%	3.5%	16	7
Montana	696	854	2.8%	3.5%	6	7
Oregon	1,924	4,675	7.8%	19.0%	16	38
Washington	3,009	10,591	12.2%	43.1%	24	86
Total	**7,598**	**16,986**	**30.9%**	**69.1%**	**62**	**138**

Once we had the state distribution, we classified the county list into two types of counties:

1. Counties with at least 1.0% of the total MF units permitted in the region
2. Counties with less than 1.0% of the total MF units permits (Rural)

RLW planned to sample homes in each of the group 1 counties. All counties in the rural category were grouped together and at least one rural county from each state was selected for sampling. The number of sample sites allocated to the rural groups was in proportion to the sum of the units in each of the counties in these groups.

Table 3 shows the final sample by state. The final sample sizes are very close to the planned sample.

State	Permitted Units	Planned Sample	Actual Sample
ID	2,835	24	28
MT	1,845	12	10
OR	6,599	54	54
WA	13,600	110	108
Region	24,879	200	200

Table 3: Final Sample by State

Table 4 shows the final sample along with the case weight associated with each unit in each county. In some cases we had to revise the sampling plan due to difficulty in scheduling appointments in some county and complex size categories. The smaller units were *much* more difficult to recruit since they are not listed in advertisements and are not managed by property managers, making them difficult to locate.

The final case weights were calculated by county. Where there were no small units surveyed, the larger units were weighted to represent all units in the county. An alternate weighting strategy of aggregating the small and large complexes by state and weighting to the size groups within each state was considered, however due to the small number of smaller complexes that were surveyed, it was determined that the more appropriate weighting scheme was at the county level. Therefore we do acknowledge that due to difficulties in recruiting, there is a larger proportion of large size complexes in the sample than are represented in the population and the case weights adjust for this wherever possible.

State	County	Units Permitted			Planned Sample		Actual Sample		Case Weights	
		2-4 units	5+ units	All units	2-4 units	5+ units	2-4 units	5+ units	2-4 units	5+ units
		Small N	Large N	Total N	Small n	Large n	Small n	Large n	Small wt	Large wt
Idaho	Ada	552	32	584	4	-	-	5	-	117
	Canyon	420	48	468	4	-	-	5	-	94
	Bonneville	293	6	299	2	-	3	-	100	-
	Madison	197	157	354	2	2	-	4	-	89
	Kootenai	146	129	275	2	2	-	4	-	69
	Rural	361	494	855	2	4	3	4	120	124
	TOTAL	*1,969*	*866*	*2,835*	*16*	*8*	*6*	*22*		
Montana	Gallatin	425	332	757	2	2	-	5	-	151
	Flathead	133	162	295	2	-	-	-	-	-
	Yellowstone	115	315	430	-	2	-	2	-	215
	Rural	157	207	364	2	2	-	3	-	121
	TOTAL	*829*	*1,016*	*1,845*	*6*	*6*	-	*10*		
Oregon	Multnomah	364	1,911	2,275	4	16	-	19	-	120
	Deschutes	354	342	696	2	2	2	2	177	171
	Jackson	252	56	308	2	-	-	6	-	51
	Lane	160	240	400	2	2	-	1	-	400
	Josephine	125	-	125	2	-	-	5	-	25
	Marion	113	390	503	-	4	-	3	-	168
	Washington	113	1,279	1,392	-	10	-	8	-	174
	Rural	443	457	900	4	4	-	8	-	113
	TOTAL	*1,924*	*4,675*	*6,599*	*16*	*38*	*2*	*52*		
Washington	King	607	4,391	4,998	4	36	5	30	121	146
	Snohomish	531	712	1,243	4	6	1	12	531	59
	Pierce	420	1,140	1,560	4	10	2	9	210	127
	Benton	239	84	323	2	-	-	4	-	81
	Spokane	219	1,593	1,812	2	12	3	10	73	159
	Whatcom	174	667	841	2	6	-	9	-	93
	Clark	56	523	579	-	4	-	5	-	116
	Franklin	2	722	724	-	6	-	6	-	121
	Whitman	6	213	219	-	2	-	2	-	110
	Rural	755	546	1,301	6	4	-	10	-	130
	TOTAL	*3,009*	*10,591*	*13,600*	*24*	*86*	*11*	*97*		

Table 4: Final Sample and Case Weights by County

Data Collection

RLW performed the multifamily on-site surveys during the months of February through June 2006. Figure 1 shows the number of completed units by month.

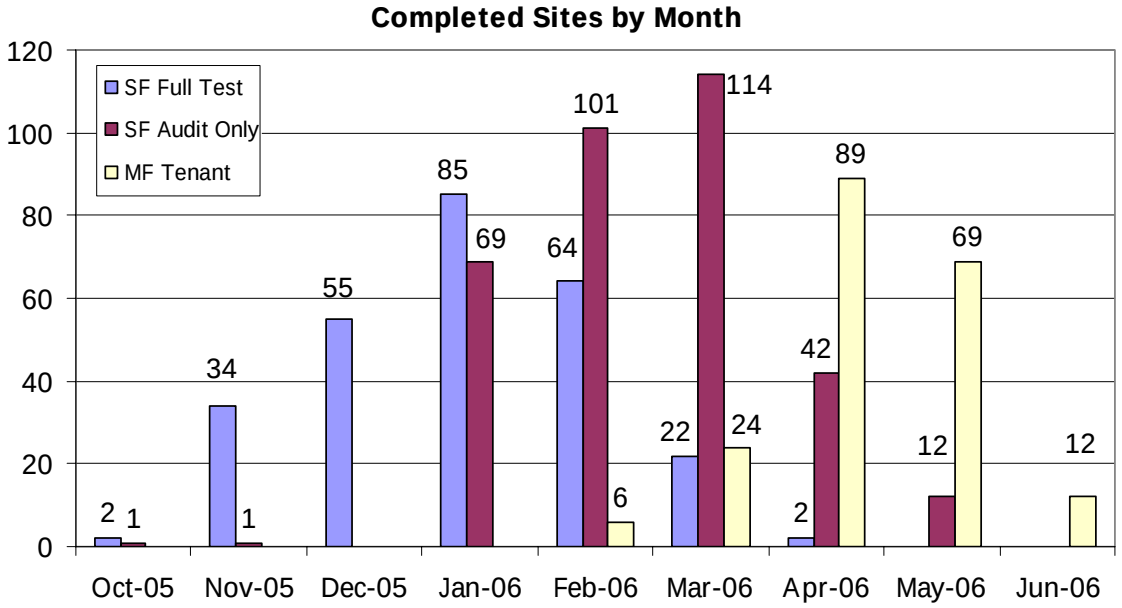

Figure 1: On-sites by Month of Completion

Recruiting

RLW recruiters began the recruiting process by obtaining the final count of sites that needed to be recruited within each county from the sample design. They were also provided the prioritized list of addresses to recruit for the sample by the analysis team. With this list they performed the following tasks:

- Performed reverse address search to obtain occupant name and phone numbers,
- Sent a letter to each residence,
- Fielded any incoming phone calls regarding the study and recruited residents into the study,
- Called residents that did not respond to initial letter (for those where RLW found phone numbers),
- Scheduled appointments,
- Coordinated appointments with auditors,
- Entered data into recruiting database.

These tasks are described below.

Instruments

RLW developed all recruiting instruments that were used in the project. Two main recruitment instruments were used in this study:

- the study introduction and recruitment letter, and
- the telephone recruitment instrument.

Customer Names and Phone Numbers

RLW obtained contact names and numbers for sampled customers from other data sources since the F.W. Dodge data being used for the sample design did not include phone numbers, only addresses. In order for RLW to send letters and telephone each of the sampled residences, we searched for the current occupant's phone number using reverse address lookup using sites such as: www.reverseaddress.com, www.superpages.com and www.switchboard.com. Although, these sites can be helpful, they are not updated frequently enough to have a large percentage of phone numbers for new construction. If we could not identify a customer's name for an address, we sent the letter to 'Current Resident'. Customer letters were mailed and telephone recruiting began shortly thereafter, once we had exhausted all of our sources for phone number lookups.

Customer Letter

The study introduction letter informed residents that they had been randomly selected to participate in a study, why the study was being conducted, how they could participate, and what was involved if they chose to participate. The content of the letter was carefully crafted to clearly convey the purpose of the study and why it was important that they participate with the ultimate goal of improving participation rates, thereby reducing non-response bias. We provided a toll free number to call if the resident had further questions, or if they were interested in participating. We also included a postage paid postcard that they returned to RLW to express their interest in participating.

Multifamily Recruiting Challenges

Only a handful of multifamily contacts responded to the study introduction letter. This is due to the fact that there are multiple decision makers at each complex, and the letters did not reach each party. Therefore, the multifamily recruitment shifted to predominately cold calling. This presented *many* challenges. In conjunction with the initial mailing of the recruiting letter, RLW obtained contact numbers for sampled customers using other data sources. After exhausting all of the phone numbers generated from all of the addresses we had in the sample frame, RLW needed to find other more creative ways to find newly constructed apartments.

RLW identified new apartments by searching through multiple online apartment finder websites such as www.apartments.com, www.rent.com, and www.apartmentguide.com. However, these websites do not list the year built, therefore, if the apartment did not state that it was new construction, RLW spent a considerable amount of time contacting complexes to ultimately find that they were ineligible to participate.

In addition to apartment finder websites, RLW used many other websites to find newly constructed apartments, including the apartment section of www.craigslist.com, as well as www.loopnet.com and www.zillow.com (two real estate sites where the user is able to search for multifamily residences by year constructed).

Once eligible apartments were found, the property managers were called and informed of the study. It was very challenging to recruit the property managers. First of all, it was difficult to simply get the property manager on the phone. Furthermore, a vast majority were too busy dealing with their tenants to be persuaded into participating in an energy study. Unless the manager also lived at the apartment (and was eligible for

two $25 money orders), a $25 money order was not enough of an incentive to participate. In addition, most property managers responded by saying they needed to check with their management company. Nearly all of these came back as refusals since their management company was too busy and skeptical. The strategy shifted to using the internet to find management companies to contact them directly, stressing the importance of the study, describing the process involved, and assuring that little was required of anyone on-site other than allowing us access and answering a limited number of questions. This also presented a challenge, as it was unknown whether they managed any new apartments until the call was made, and unfortunately, most did not.

Once the property managers expressed interest, there were several recurring problems that caused them to drop-out. For instance, many would agree and then find it was too difficult to find tenants who were interested (despite the emails and flyers RLW sent them to share with tenants). In addition, there is a high turn-over rate with property managers and some no longer worked at the apartment once the day of the survey arrived (even if the survey was scheduled just days prior).

All of these recruiting challenges forced RLW to sample less randomly than preferred, and also to sample from different counties and size bins when complexes could not be identified for each stratum. Smaller complexes are under sampled since these were much more difficult to identify than large complexes.

Recruiting and Participant Survey Data Entry and Tracking

A Microsoft Access database was designed to contain all data collected over the phone during the recruiting and participant survey process. Call dispositions and survey data were entered daily into a set of forms designed specifically for this study. Random data entry checks served as a quality control mechanism for maintaining consistent, error free data entry. Moreover, data entry forms were designed such that only valid parameters could be entered into the database in an effort to disallow data entry error.

Using the database, the recruiter maintained sample disposition information and produced regular status reports comparing the current sample to the sample design. Finally the recruiters worked with the on-site surveyors to resolve any unanticipated problems.

On-site Surveys

Surveyor Training

RLW conducted a one-day training session for each auditor before on-site work began. In addition, each surveyor received a Training Material packet for reference in the field. The information packet and training session covered the following topics:

- The purpose of the project,
- The procedure for verifying the site visit with the homeowner,
- The importance of being on time and courteous,
- The protocols for dealing with unanticipated problems,
- The procedure during the survey,
- The best methods of collecting and recording the information,
- How to operate and collect the data using the hand-held,
- The procedure for transferring on-site data to master database, and

- Any other relevant topics.

Ecos Consulting completed the bulk of the on-site surveys in Oregon, and a portion of the on-sites in Washington. Roger Jorstad Construction completed the majority of the on-sites in Idaho. Employees of Tacoma Power performed site visits and additional testing for sites within Tacoma Power territory. RLW Analytics field staff surveyed the remainder of the sites and performed a large number of the functional tests. Approximately 20 surveyors completed the on-site surveys over the course of the study.

Four training sessions were held, one in Portland for the Ecos surveyors, one in Tacoma for Tacoma Power employees, another in Sonoma for the RLW surveyors, and one in Idaho for Roger Jorstad.

Quality Control

Senior level staff at both RLW and Ecos were available to auditors on a daily basis to answer questions and maintain quality control. Senior staff reviewed random samples of uploaded survey data, held conference calls with all surveyors to discuss unforeseen issues that arose, and provided guidance and training on project efficiency. The field supervisors reported to the RLW Project Manager regularly so that all parties were familiar with current findings and activities.

Fieldwork

The trained auditors conducted the on-site audits according to the schedule set by the recruiter. The PDA application was designed to automatically sync with the recruiting database and download all appointments for the auditor. The daily downloads provided the auditor with every piece of information they needed to conduct the on-site, including special notes provided by the recruiter, directions, and of course customer name, address, and appointment information.

Each on-site visit consisted of two elements: the customer interview and the walk-through inventory. First, the auditor conducted the interview with the occupants to address demographic and behavioral factors. Next, the auditor conducted the walk-through audit of the home and recorded the lighting and appliance data into the hand-held.

All Data Collected

1. Envelope
    a. Windows
        i. Number of panes
        ii. Frame type
        iii. Low-E (RLW uses low-e detectors on all sites)
        iv. Window area
    b. Walls
        i. Framing type
        ii. Insulation R-value
        iii. Wall area
    c. Roof/attic
        i. Insulation R-value
        ii. Radiant barrier

        iii. Attic/vaulted area
    d. Basement
        i. Basement wall R-value
        ii. Basement wall area
        iii. Finished/Unfinished
        iv. Conditioned/Unconditioned
    e. Thermostat(s)
        i. Type
        ii. Temperature set-points
2. Detailed data on heating and cooling systems, primary, secondary, tertiary, etc.
    a. Central or Space
    b. System type (e.g., heat pump, electric resistance, forced-air, etc.)
    c. Fuel
    d. Make and model number
    e. Capacity
    f. Manufactured date
    g. Owner reported age
    h. Usage
3. Detailed data on refrigerator, primary, secondary, tertiary, etc.
    a. System type (e.g., standard, side by side, bottom freezer, etc.)
    b. Make and model number
    c. Options (ice maker, water, combo, none)
    d. Size
    e. Manufactured date
    f. Owner reported age
    g. Usage (other than primary)
4. Water heater
    a. System type (e.g., storage, tankless, heat pump, etc.)
    b. Fuel (gas, electric, solar assisted)
    c. Make and model number
    d. Size (gallons)
    e. Capacity (input BTU-h or kW)
    f. Manufactured date
    g. Owner reported age
    h. Energy Factor (if possible)
5. Dishwasher
    a. Make and model number
    b. Capacity
    c. Manufactured date
    d. Owner reported age
6. Clothes Washer
    a. System type (e.g., h-axis, standard)

   b. Make and model number
   c. Manufactured date
   d. Owner reported age
   e. Energy Factor (if possible)
   f. Usage
7. Clothes Dryer
   a. Make and model number
   b. Fuel type
   c. Usage
   d. Manufactured date
   e. Owner reported age
8. Lighting
   a. Fixture type by room (e.g., ceiling mounted, wall mounted, recessed can, etc.)
   b. Number of lamps per fixture
   c. Lamp technology type by fixture
   d. Lamp wattage
   e. Control type (e.g., switch, dimmer, occupancy sensor, etc.)
9. Pool and spa
   a. Fuel type
10. Other appliances (e.g., TV, microwave, computer, consumer electronics, etc.)
   a. Quantity
11. Multifamily complex common area
   a. Lighting inventory
   b. Pools and spas
   c. Water heaters
   d. Cooling and heating systems
   e. Washers and dryers
   f. General characteristics (e.g., square footage, number of units, etc.)

Appliances

Data were collected for heating systems, cooling systems, washing machines, clothes dryers, dishwashers, pools and spas, refrigerator/freezers, and water heaters. Data were also collected on plug loads, other large end uses, and thermostats.

- The residents were asked for the age of each appliance. If the resident did not know the age of the appliance, the surveyor would estimate the age or the appliance whenever possible.
- The classification of each appliance by type was observed from visual inspections of the appliances and recorded. Appliance types that were noted include; standard or horizontal axis washers, side-by-side, freezer on bottom, freezer on top or other refrigerator types, among others.
- Fuel types, such as electricity, natural gas or propane for heating systems, clothes dryers and water heaters were noted from visual inspection.

- The manufacturer, model number and size were taken from nameplate data when observable. If possible, sizes of some appliances were estimated in the case of missing, or unreadable data tags.
- Residents were asked to estimate the percentage of time in use for refrigerators and freezers to establish seasonal usage.
- Various features relating to energy efficiency were noted such as the existence of a through the door water dispenser for refrigerator-freezers or insulation levels for water heaters.

Lighting

Every lighting fixture in each residence was inventoried by fixture type, number of lamps, lamp type, and lamp wattage. Fixture control type was also noted for all fixtures in this study.

Insulation

The insulation levels of the floor, walls and attic were obtained by visual inspection if possible. Efforts were made to estimate the insulation levels through discussions with the residents and based on educated judgment (i.e. wall construction 2x4, 2x6, etc.) when no visual observations were possible.

Windows

The surveyor recorded the predominant window frame construction, wood, metal or vinyl, found in the home was noted, as was the number of panes found of the predominant window type. Low-e detectors were used to determine whether the window had a low-e glazing.

Final Databases

The data collected during the on-site visits are contained in three final databases. One database contains all appliance and envelope information for multifamily dwellings; another contains all the multifamily dwelling lighting information. The final database contains the multifamily common area data.

These databases are in MS Access format. In addition to the surveyor information collected on site, the appliance database contains all information linked from the efficiency databases that pertains to the appliance models in the sample, and contains the efficiency categories that were created in order to analyze the data.

The appendix contains a description of the databases as well as a complete description of each table and query.

Merging of Saturation and Efficiency Information

The surveyors were able to observe make and model number on-site, but in most cases, not energy efficiency. The RLW team used all available resources to match the model numbers collected on-site with a reliable source of efficiency ratings and/or Unit Energy Consumption (UEC). Sources that were used included:

- 2005 California Energy Commission Database of Energy Efficient Appliances,
- 2004 Federal Trade Commission (FTC) databases,
- 2003 AHAM Refrigeration database,
- 2003 Carriers Electronic Blue Book of Heating and Cooling Equipment, and

- 2000 ARI HVAC database.

RLW matched the on-site information by model number with standard efficiency ratings for each end-use. For example, in the case of residential cooling, the energy efficiency rating is provided in SEER, or Seasonal Energy Efficiency Ratio units. End-uses that do not have an associated standard efficiency rating (e.g., refrigerators) are characterized in terms of nameplate annual unit energy consumption or UEC.

The difficulty in matching model numbers should not be underestimated by anyone wishing to conduct this type of study in the future. RLW invested a lot of time manually linking sites, as a result of model number wildcards and irregular alphanumeric characters such as dashes, hyphens, slashes, stars, and other text. These characters made automated matching difficult and resulted in a more rigorous model number matching effort.

Database Summarization Tool (PNWRES^{EST})

The project will deliver a tool that can be used by program designers, managers, evaluators, and other parties for understanding efficiency and saturation characteristics of Pacific Northwest residences. RLW will use a web-based application that allows multiple users to apply stratified ratio estimation methods to the study data. The application was originally designed for the California Lighting and Appliance Saturation Study and has the ability to:

- Calculate ratio estimates, (e.g., of the saturation level of a set of appliances), classified by any available categorical variable such as age of home, residence type, or state.
- Calculate the underlying sample sizes
- Calculate the appropriate model-based error bounds
- Calculate proportions (e.g., proportion of all cooling units that are space vs. central)

The resulting tables can be easily exported to Excel and displayed graphically. The software provided is fully documented in the Appendix, and a help file is available within the software if the user encounters any problems.

The following is a list of some examples of the types of weighted statistics that can be obtained from the database:

- Average Efficiency of primary HVAC and other equipment
- Percentage of Homes with two or three refrigerators
- Average Energy Usage or Wattage of Equipment

This type of information can be developed for all sites, or for various classifications of residences. Using the standard queries that we provide in the database, the sites can be classified by any combination of the following variables:

- State
- Type of Residence
- Size of Household (Total People or Total Adults)
- Square Footage
- Household Income
- Year Built

- Rent or Own

Few of the results provided in this report are grouped by the aforementioned demographic data. The intent of the study was to collect the data, build a database of information, and provide the interested parties with a tool that could be used to analyze the data. Given this, only top-level analyses were conducted for reporting purposes. However, where the data were thought to differ drastically by the demographics of the household, the data were grouped by the appropriate characteristic.

PNWRES^{EST} Interface

By providing a web-based analysis tool, users have the power to explore the information based on specific needs. This section discusses the technical specifications of PNWRES^{EST}, the Pacific Northwest Residential Efficiency Saturation Tool, to be located at www.pnwresest.com. Once at the site, users can gain access to the full report and user help screens for understanding how to use PNWRES^{EST}.

Users are required to register, for free, in order to access the tool. Registration is an automated process whereby once the user provides their pertinent contact information and valid email address, a unique 8 character password is generated and automatically sent to the user via email. PNWRES^{EST} is a direct port of RLW's MBSS software application. Originally developed in Fortran, MBSS was later reprogrammed in Microsoft Visual Basic in order to support a 32 Bit operating system environment. For the web based tool, all the proprietary algorithms, code and queries were rewritten in CFScript (ColdFusions server-side implementation of Java style classes). This allows the tool to not only process requests more efficiently, but to also be scalable across multiple servers and operating systems.

Multifamily Demographics

A list of demographic data was developed by the study team to be collected by the field surveyors. The following demographic data was collected:

- Type of residence
- Number of residents by age
- Primary language of residents
- Total annual income for the home
- Year residence was built
- Total heated floor space of the home
- Whether the residence is rented or owner occupied
- If rented, the party responsible for the utility bills, (owner or renter)

The remainder of this section contains tables that summarize the demographic characteristics of the sample. The demographic results have not been weighted to reflect the population.

Table 5 shows the percentage of homes by type of residence. Approximately 44% of all the multifamily residences are apartment with 3-stories or greater. The second most commonly visited type of residences were 1-2 story apartments with nearly 34% of the sample.

Type of Residence	% of Homes
Apartment (1 to 2 stories)	33.5%
Apartment (3 or more stories)	43.7%
Townhouse/Rowhouse	22.8%

Table 5: Percentage of Homes by Type of Residence

Table 6 shows the percentage of homes by number of people occupying the home. The largest percentage of homes, or 31.2%, is the same for 1 or 2 occupants. However, it was also common to visit homes with 3 or 4 occupants.

Total Number of People	% of Homes
1	31.2%
2	31.2%
3	10.4%
4	17.1%
5	5.6%
6	0.5%
7	1.5%
8	0.5%
Vacant	1.8%

Table 6: Percentage of Homes by Number of People[1]

Table 7 shows the percentage of homes by number of adults occupying the home. Over half of all homes, or 51.1%, have 2 adults present.

Total Adults in Home	% of Homes
1	41.2%
2	51.1%
3	5.4%
4	0.5%
Vacant	1.8%

Table 7: Percentage of Homes by Number of Adults

Table 8 shows the percentage of homes by total household income. The largest percentage of residents has an annual income between $25,000 and $50,000, totaling 32.8% of the sample.

[1] A few homes were found to be vacant after the surveyor went to the site.

Total Household Income	% of Homes
<$25,000	23.4%
$25,000-$50,000	32.8%
$50,001-$75,000	9.0%
$75,001-$100,000	4.5%
>$100,000	4.7%
Refused	23.8%
Vacant	1.8%

Table 8: Percentage of Homes by Total Household Income

Table 9 shows the percentage of homes by age of home. As can be seen from the table, most homes were built in either 2005 or 2006.

Year Home Built	% of Homes
2003	1.8%
2004	11.4%
2005	60.4%
2006	26.4%

Table 9: Percentage of Homes by Age Range of Home

Table 10 shows the percentage of homes by the total heated floorspace of the homes. There were few homes with less than 600 square feet. Most homes had between 600 and 1,599 square feet of heated floor space. Less than 5% had an area greater than 1,600.

Total Heated Floorspace	% of Homes
Less Than 600 sq.ft.	7.8%
600 to 999 sq.ft.	38.9%
1,000 to 1,599 sq.ft.	48.4%
1,600 to 1,999 sq.ft.	2.5%
3,000 or more sq.ft.	2.4%

Table 10: Percentage of Homes by Total Heated Floor Space

Table 11 shows a slight trend of larger units built across Oregon and Washington. The percentage of units with less than 1,000 square feet of heated floor area is greater in 2001 than 2006. Although larger units require more energy to heat and light, the overall building energy use decreased as a result of higher code requirements, as code changes occurred between the two studies.

Unit Area (ft^2)	2001 Study		2006 Study			
	Oregon	Washington	Idaho	Montana	Oregon	Washington
< 800	28.7%	25.9%	9.7%	29.3%	26.7%	22.0%
800 – 1000	34.0%	27.5%	49.1%	25.4%	26.5%	18.1%
1,000 – 1400	34.6%	42.5%	33.4%	17.6%	43.2%	44.4%
> 1,400	2.7%	4.1%	7.8%	27.7%	3.6%	15.5%

Table 11: Comparison of Home Heated Floor Area - Percentages

Table 12 shows the average unit size for the two studies by state. The average unit size is lower in Oregon and higher in Washington when comparing 2001 to 2006.

Unit Size (ft^2)	2001 Study	2006 Study
Idaho		1,055
Montana		1,576
Oregon	1,002	956
Washington	1,004	1,074
Overall		1,071

Table 12: Comparison of Home Heated Floor Area - Averages

Table 13 shows the percentage of homes by type of ownership. Twenty percent of homes were occupied by owners. Renters constituted nearly 80% of the sample.

Rent or Own	% of Homes
Own	20.2%
Rent	79.8%

Table 13: Percentage of Homes by Ownership Type

Table 14 breaks down homes by the two most common heating and cooling fuel types: gas and electricity and by whether the landlord or the occupant pays for each fuel type. Electricity is almost always paid by the occupant of the house. An increased number of homes have gas costs paid by someone other than the occupant, at about 10%.

Fuel	Landlord		Occupant		Don't Know	
	%	EB	%	EB	%	EB
Electricity Costs	6.9%	2.9%	93.1%	2.9%	-	-
Gas Costs	10.2%	4.1%	88.2%	4.4%	1.6%	1.9%

Table 14: Who Pays for Electric and Gas among All Residences

Multifamily Lighting

This section of the report presents findings from the multifamily lighting analysis. Recall that every lighting fixture in each residence was inventoried by room, fixture type, fixture control type, number of lamps, lamp type, and lamp wattage. A total of 200 residences are included in the lighting analysis. This chapter of the report is broken up into the following three subsections that present the analyses shown below:

- Lighting Overview (by home)
    - number of fixtures and lamps per home,
    - average number of lamps per fixture,
    - percentage of homes having a certain fixture or lamp type[2],
    - prevalence of compact fluorescent lamps,
    - lamp wattage, and
    - fixture control types
- Specific Fixture Overviews (by home)
    - summary of recessed cans, torchieres, and ceiling fans
    - these fixtures were selected for further analysis because efficient lighting technologies are currently being developed for these fixture types
- Room Lighting Analysis (by room)
    - percentage of rooms with fixture types and lamp types

Throughout the lighting analysis, the room type "other" is given as a category of room. The Other room type is includes attics, bars, exercise rooms, music rooms, sewing rooms, as well as pool houses.

Lighting Overview

Table 15 presents the average number of fixtures and lamps per home by type of residence. Overall, homes have approximately 19 fixtures and 31 lamps on average.

Type of Residence	Fixtures		Lamps		Sample Size
	Average #	EB	Average #	EB	
Overall	18.74	1.40	31.34	1.91	200
Apartment (1-2 stories)	19.34	2.98	31.44	4.23	69
Apartment (3 stories)	15.93	1.45	27.95	1.94	93
Townhouse/Rowhouse	23.28	2.55	37.70	3.31	38

Table 15: Average Number of Fixtures/Lamps by Type of Residence

Table 16 displays the average number of fixtures per home by fixture type. The most common fixture types by a large margin are ceiling mounted fixtures, wall mount

[2] For a complete list and definition of lamp and fixture types refer to the Appendix.

fixtures and recessed cans, with homes having an average of 7.33 ceiling mounted fixtures, 3.03 wall mount fixtures, and 2.92 recessed cans. Also, homes have on average 1.61 table lamps. 'Other' fixtures are fixtures that could not be observed or were of a custom nature that could not be categorized into the more common fixture types.

Fixture Type	Average # of Fixtures (n=200)	EB
All Fixture Types	18.74	1.40
Architectually Integrated	0.31	0.21
Ceiling Fan	0.27	0.10
Ceiling Fixtures	7.33	0.46
Chandelier Hanging	0.66	0.10
Floor Lamp	0.58	0.12
Garage Door Opener	0.13	0.04
Other	0.10	0.06
Recessed Can	2.92	0.81
Recessed Lighting-Other	0.88	0.12
Table lamps	1.61	0.23
Torchiere	0.19	0.07
Track Lighting	0.25	0.12
Under Counter	0.48	0.09
Wall Mount	3.03	0.27

Table 16: Average Number of Fixtures by Fixture Type

Table 17 presents the percentage of all fixtures that are of a certain type. Over 39% of all fixtures are ceiling mounted fixtures, while about 16% of all fixtures are wall mounts. Additionally, recessed cans account for over 15% of all fixtures, while table lamps are nearly 9% of all fixtures.

Fixture Type	Percent of Total Fixtures (n=200)	EB
All Fixture Types	**100.0%**	
Architectually Integrated	1.7%	1.1%
Ceiling Fan	1.5%	0.5%
Ceiling Fixtures	39.1%	2.8%
Chandelier Hanging	3.5%	0.5%
Floor Lamp	3.1%	0.6%
Garage Door Opener	0.7%	0.2%
Other	0.6%	0.3%
Recessed Can	15.6%	3.5%
Recessed Lighting Other	4.7%	0.7%
Table Lamps	8.6%	1.1%
Torchiere	1.0%	0.3%
Track Lighting	1.3%	0.6%
Under Counter	2.6%	0.4%
Wall mount	16.1%	1.2%

Table 17: Percentage Fixture Types

Table 18 displays the percentage of homes having each fixture type. All 200 multifamily homes (100%) have a ceiling mounted fixture. Approximately 96% of homes have a wall mounted fixture, while 66% of homes have table lamps, and almost 51% have a chandelier/hanging fixture. Architecturally integrated and "other" fixtures are the least common with 7.7% and 5.6% respectively.

Fixture Type	Percent of Homes (n=200)	EB
Architectually Integrated	7.7%	4.0%
Ceiling Fan	17.6%	4.6%
Ceiling Fixtures	100.0%	-
Chandelier Hanging	50.6%	6.3%
Floor Lamp	36.2%	5.9%
Garage Door Opener	12.8%	3.9%
Other	5.6%	3.4%
Recessed Can	35.6%	6.1%
Recessed Lighting Other	52.4%	6.3%
Table Lamps	66.0%	6.1%
Torchiere	15.3%	5.4%
Track Lighting	10.3%	3.7%
Under Counter	38.3%	6.2%
Wall Mount	95.8%	3.2%

Table 18: Percentage of Homes with Fixture Types

Table 19 shows the distribution of the number of fixtures per home. Over half of homes have a total of 11-20 fixtures. Approximately 21% of homes have more than 1-10 fixtures present. Less than 5% of homes have more than 41 fixtures.

Number of Fixtures	Percent of Homes (n=200)	EB
1 to 10	21.2%	5.1%
11 to 20	50.7%	6.3%
21 to 30	16.0%	4.5%
31 to 40	8.0%	4.2%
41 to 50	3.0%	2.1%
>50	1.1%	1.5%

Table 19: Distribution of Number of Fixtures per Home

Table 20 presents the distribution of the number of fixtures per home by residence type.

Type of Residence	1 - 10 Fixtures		11 - 20 Fixtures		21 - 30 Fixtures		31 - 40 Fixtures		41 - 50 Fixtures		> 50 Fixtures		Sample Size
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	
Overall	21.2%	5.1%	50.7%	6.3%	16.0%	4.5%	8.0%	4.2%	3.0%	2.1%	1.1%	1.5%	200
Apartment (1-2 stories)	15.2%	8.0%	53.7%	10.7%	18.9%	8.0%	5.8%	4.4%	3.7%	4.6%	2.6%	4.2%	69
Apartment (3 stories)	27.0%	8.0%	57.6%	8.8%	9.5%	5.3%	3.4%	2.8%	1.9%	2.4%	0.6%	0.9%	93
Townhouse/Rowhouse	19.0%	11.1%	33.0%	13.0%	24.1%	12.1%	20.0%	14.8%	3.9%	4.6%	-	-	38

Table 20: Distribution of Number of Fixtures per Home by Residence Type

Table 21 displays the percentage of fixtures containing a CFL by fixture type. Over 5% of fixtures contain a compact fluorescent lamp. Table lamps and floor lamps are most likely to contain CFLs, with almost 13% of each table lamp and floor lamp having such a lamp. Approximately 11% of ceiling fans have a CFL installed.

Fixture Type	Percent Fixtures with CFL	EB	Sample Size (# Homes)
Overall	5.5%	1.6%	200
Architectually Integrated	-	-	12
Ceiling Fan	11.0%	10.4%	37
Chandelier Hanging	1.5%	1.7%	103
Ceiling Fixtures	6.7%	2.8%	200
Floor Lamp	12.6%	5.4%	73
Garage Door Opener	3.8%	6.1%	28
Other	-	-	11
Recessed Can	0.9%	1.0%	72
Recessed Lighting-Other	0.5%	0.9%	104
Table Lamps	12.5%	3.5%	139
Torchiere	7.9%	9.0%	26
Track Lighting	8.5%	12.5%	21
Under Counter	1.2%	1.5%	79
Wall Mount	4.7%	2.0%	194

Table 21: Fixtures Containing Compact Fluorescent Lamps

Table 22 shows the average number of lamps per fixture by fixture type. Wall mounted fixtures contain more lamps (2.45 lamps) than any other fixture type. Ceiling fans

contain 2.45 lamps on average. Architecturally integrated and recessed can contain the fewest number of lamps, with each of these fixtures containing one lamp on average.

Fixture Type	Lamps per Fixture		
	Average	EB	Sample Size (# Homes)
Architectually Integrated	1.00	0.00	12
Ceiling Fan	2.45	0.31	37
Ceiling Fixtures	1.77	0.05	200
Chandelier Hanging	1.95	0.23	103
Floor Lamp	1.39	0.13	73
Garage Door Opener	1.32	0.15	28
Recessed Can	1.00	0.00	72
Recessed Lighting-Other	1.09	0.04	104
Table Lamps	1.09	0.04	139
Torchiere	1.20	0.16	26
Track Lighting	2.93	0.40	21
Under Counter	1.21	0.08	79
Wall Mount	2.51	0.15	194

Table 22: Average Number of Lamps per Fixture

Table 23 presents the average number of lamps per home by general lamp type. Overall, homes have 31.34 lamps on average. Incandescent lamps are the most prevalent throughout the Pacific Northwest, with an average home having 24.10 incandescent lamps.

Lamp Type	Average # of Lamps (n = 200)
All Lamp Types	31.34
Compact Fluorescent Total	2.96
Fluorescent Total	1.91
Halogen Total	2.36
Incandescent Total	24.10

Table 23: Average Number of Lamps by Lamp Type

Table 24 shows the percentage of all lamps by general lamp type. Over 76% of all lamps are incandescent lamps.

Lamp Type	Percent of Total Lamps (n=200)
Compact Fluorescent Total	9.5%
Fluorescent Total	6.1%
Halogen Total	7.5%
Incandescent Total	76.9%

Table 24: Percentage Lamp Types

Table 25 shows the percentage of homes where a particular lamp type is present. Nearly all homes are equipped with at least one incandescent lamp, while almost two-thirds have at least one fluorescent lamp. Over 57% contains halogen lamps. Nearly 40% of all homes contain at least one CFL.

Lamp Type	Percent of Homes (n=200)	EB
Compact Fluorescent Total	39.6%	6.0%
Fluorescent Total	65.1%	5.8%
Halogen Total	57.1%	6.2%
Incandescent Total	99.4%	1.1%

Table 25: Percentages of Homes with Lamp Types

Location of CFLs – Bedrooms have a higher tendency than most rooms to have CFLs with 16% to 19% of the first two bedrooms having CFLs. CFLs in porch fixtures were relatively common, with 22.1% of homes with porch fixtures using CFLs.

Room	%	EB	Sample Size
Basement	18.8%	30.7%	3
Bathroom-1	9.9%	4.9%	117
Bathroom-2	-	-	24
Bathroom-3	-	-	2
Bathroom-Master	7.2%	3.0%	200
Bedroom-1	16.5%	5.8%	127
Bedroom-2	19.0%	8.0%	63
Bedroom-3	36.6%	24.1%	11
Bedroom-4	54.8%	57.4%	2
Bedroom-Master	16.7%	4.5%	200
Breakfast Nook	16.8%	11.1%	38
Closet	14.1%	6.3%	100
Dining Room	6.8%	4.2%	92
Family Room	13.8%	13.6%	16
Garage	6.1%	5.8%	36
Hall	15.9%	4.7%	183
Kitchen	4.3%	2.3%	197
Laundry Room	5.1%	4.1%	72
Living Room	23.4%	5.6%	169
Office	17.8%	11.7%	34
Other	17.2%	13.8%	15
Porch	22.1%	6.8%	104
Rec Room	39.0%	48.4%	3

Table 26: Percent of Rooms with CFL

Table 27 displays the distribution of the number of lamps per home. Over 55% of homes have 21 to 40 lamps. Furthermore, almost 24% of homes contain 1 to 20 lamps. Less than 3% of homes have greater than 61 lamps.

Number of Lamps	Percentage of Homes (n =200)	EB
1 to 20	23.9%	5.2%
21 to 40	55.8%	6.3%
41 to 60	18.0%	5.2%
61 to 80	0.9%	1.4%
81 to 100	1.5%	1.6%

Table 27: Distribution of Number of Lamps per Home

Table 28 presents the distribution of the number of lamps per home by residence type. Approximately half of each residence type has 21 to 40 lamps. About 25% of apartments (1-2 stories), 32% of apartments (3 stories) and only 5.3% of townhouses/rowhouses contain 1 to 20 lamps. Only about 12% of apartments (1-2 stories) and 11% of apartments (3 stories) contain 41 to 60 lamps, compared to more than 40% of townhouses/rowhouses.

Type of Residence	1 to 20 Lamps		21 to 40 Lamps		41 to 60 Lamps		61 to 80 Lamps		81 to 100 Lamps		Sample Size
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	
Overall	23.9%	5.2%	55.8%	6.3%	18.0%	5.2%	0.9%	1.4%	1.5%	1.6%	200
Apartment (1-2 stories)	25.6%	9.2%	56.8%	10.6%	12.4%	6.3%	2.6%	4.2%	2.6%	4.2%	69
Apartment (3 stories)	32.2%	8.4%	56.5%	8.8%	10.7%	5.3%	-	-	0.6%	0.9%	93
Townhouse/Rowhouse	5.3%	6.5%	52.7%	15.0%	40.2%	15.2%	-	-	1.8%	2.9%	38

Table 28: Distribution of Number of Lamps per Home by Residence Type

As one would expect, the average number of screw-based fixtures is far greater than that of pin-based fixtures. Lamps with a screw-base accounted for approximately 88.3% of all lamps found at the average house as seen in Table 29 and Table 30 below. The majority of the pin-based fixtures are MR-16 and quartz tube halogen fixture types, not commonly pin-based CFLs.

n= 200	Average Number of Lamps per Home	EB
Screw Base	27.66	2.00
Pin Base	3.68	0.79

Table 29: Average Number of Lamps per Home by Base Type

n= 200	Percentage of Base Type	EB
Screw Base	88.3%	2.5%
Pin Base	11.7%	2.5%

Table 30: Percentage of Lamps by Base Type

Table 31 displays the percentage of fixtures with screw-based lamps in which CFLs are installed. Recall that the percentage of all fixtures containing CFLs is 5.5%, but when only screw-based fixtures are examined, 5.9% of those fixtures have CFLs installed. The increased saturation is a result of having removed the pin-based CFL fixtures from the analysis.

Percent of CFL from all Screw Based Lamps	EB	Sample Size
5.9%	2.0%	200

Table 31: Percentage of Screw-Based Fixtures Containing CFLs

Specific Fixture Overviews

This section presents in-depth overviews for recessed cans, ceiling fans, and torchieres. These fixture types were selected for further analysis because efficient lighting technologies are currently being developed for these fixture types. For each of these fixture types, the distribution of the number of fixtures as well as the percentage of homes containing these fixtures is presented.

Recessed Cans

About 25% of homes have at least one recessed can. Recessed cans account for approximately 16% of all fixtures, and on average, homes contain 2.92 recessed cans. Less than 1% of all recessed cans contain a CFL.

Table 32 presents the distribution of the number of recessed cans per home. Approximately 64% of homes have no recessed cans present. About 15% have 1-4 recessed cans, while almost 3% of homes have greater than 21 recessed cans.

Number of Recessed Cans	Percentage of Homes (n = 200)	EB
0	64.4%	6.1%
1-4	14.9%	4.2%
5-7	6.3%	3.0%
8-10	4.6%	2.6%
11-20	6.8%	4.2%
> 21	2.9%	2.0%

Table 32: Number of Recessed Cans per Home

Table 33 shows the percentage of homes with recessed cans by room type. The most common location for recessed cans is in the recreation room; with more than 61% of homes having recessed cans in the recreation room. The kitchen is also very common with nearly 30% of kitchens containing recessed cans. Around 15% of homes contain recessed cans in the office, family room, and hallway.

Room	Percentage of Homes	EB	Sample Size
Basement	-	-	3
Bathroom-1	6.1%	3.8%	117
Bathroom-2	6.2%	7.2%	24
Bathroom-3	-	-	2
Bathroom-Master	9.6%	3.6%	200
Bedroom-1	1.6%	1.6%	127
Bedroom-2	-	-	63
Bedroom-3	-	-	11
Bedroom-4	-	-	2
Bedroom-Master	6.0%	4.0%	200
Breakfast Nook	5.5%	4.7%	38
Closet	-	-	100
Dining Room	6.1%	4.1%	92
Family Room	15.7%	13.5%	16
Garage	-	-	36
Hall	15.8%	5.3%	183
Kitchen	29.3%	6.0%	197
Laundry Room	0.6%	1.0%	72
Living Room	13.7%	5.7%	169
Office	16.7%	12.0%	34
Other	9.8%	15.0%	15
Porch	13.7%	7.6%	104
Rec Room	61.0%	48.4%	3
Whole House	35.6%	6.1%	200

Table 33: Percentage of Homes with Recessed Cans by Room Type

Table 34 displays the average number of recessed cans per home in homes that have at least one recessed can. The average number of recessed cans per home is 8.2.

Average Number of Recessed Cans	EB	Sample Size
8.22	1.63	72

Table 34: Average Number of Recessed Cans in Homes with Recessed Cans

The overwhelming majority (97%) of recessed can fixtures use screw-based lamps.

Ceiling Fans

Data were only collected and analyzed for ceiling fans that are designed to contain lamps. Almost 20% of homes have at least one ceiling fan. Ceiling fans account for 1.5% of all fixtures, and on average, homes contain 0.27 ceiling fans. About 11% of all ceiling fans contain a CFL.

Table 35 displays the distribution of the number of ceiling fans per home. More than 82% of homes do not have any ceiling fans, and about 13% of homes have only one ceiling fan.

Number of Ceiling Fans	Percent of Homes (n = 200)	EB
0	82.4%	4.6%
1	12.6%	3.9%
2	1.7%	1.7%
3	2.3%	1.6%
4	-	-
5+	0.9%	1.4%

Table 35: Number of Ceiling Fans per Home

Table 36 presents the percentage of homes with ceiling fans by room type. The most common rooms for a ceiling fan are the basement and breakfast nook, with nearly 19% of basements and 17.5% of breakfast nooks containing a ceiling fan. The living room and office are also common, with about 10% of living rooms and 12% of offices containing a ceiling fan.

Room	Percentage of Homes	EB	Sample Size
Basement	18.8%	30.7%	3
Bathroom-1	-	-	117
Bathroom-2	-	-	24
Bathroom-3	-	-	2
Bathroom-Master	1.4%	1.6%	200
Bedroom-1	2.4%	2.0%	127
Bedroom-2	4.7%	4.9%	63
Bedroom-3	5.8%	9.4%	11
Bedroom-4	-	-	2
Bedroom-Master	5.6%	2.8%	200
Breakfast Nook	17.5%	11.7%	38
Closet	-	-	100
Dining Room	3.5%	3.6%	92
Family Room	3.9%	6.5%	16
Garage	-	-	36
Hall	0.7%	1.1%	183
Kitchen	-	-	197
Laundry Room	-	-	72
Living Room	10.4%	3.7%	169
Office	12.2%	11.1%	34
Other	-	-	15
Porch	-	-	104
Rec Room	-	-	3
Whole House	17.6%	4.6%	200

Table 36: Percentage of Homes with Ceiling Fans by Room Type

Table 37 shows the distribution of the number of lamps per ceiling fan. About 31% of ceiling fans contain one lamp, while about 28% contain three lamps.

Number of Lamps	Percent of Fans (n = 37 Homes)	EB
1	30.8%	12.2%
2	17.3%	12.1%
3	27.7%	12.0%
4	24.2%	10.6%

Table 37 : Distribution of Number of Lamps per Ceiling Fan

Table 38 displays the percentage of ceiling fans equipped with each lamp type. About 80% of ceiling fans have standard incandescent lamps installed, and another 8.5% of ceiling fans are equipped with incandescent decorative bulbs. Compact fluorescent lamps were found in 11% of fans equipped with lamps.

Lamp Type	Percent of Ceiling Fans (n =37)	EB
Compact Fluorescent Spring	6.0%	7.0%
Compact Fluorescent Mini	5.0%	8.0%
Compact Fluorescent Total	**11.0%**	**10.4%**
Incandescent Standard	80.4%	10.7%
Incandescent Unknown	8.5%	5.9%
Incandescent Total	**89.0%**	**10.4%**

Table 38: Ceiling Fan Lamp Types

Homes that contain ceiling fans contain an average of 1.56 ceiling fans and all (100%) of those fans contain screw-based lamps.

Average Number of Fans	EB	Sample Size
1.56	0.34	37

Table 39: Average Number of Ceiling Fans in Homes with Ceiling Fans

Table 40 shows the percentage of ceiling fans with screw-based sockets that contain compact fluorescent lamps. Approximately 11% of those fixtures contain CFLs.

Percent of CFL	EB	Sample Size
11.0%	10.4%	37

Table 40: Percentage of CFLs in Screw-Based Ceiling Fan Fixtures

Torchieres

About 15% of homes have at least one torchiere. Torchieres account for approximately 1.0% of all fixtures, with an average of 0.19 torchieres per home. About 8% of all torchieres contain a CFL.

Table 41 shows the distribution of the number of torchieres per home. Approximately 11% of homes have one torchiere.

Number of Torchieres	Percent of Homes (n = 200)	EB
0	84.7%	5.4%
1	11.4%	5.1%
2	3.9%	2.3%

Table 41: Number of Torchieres per Home

Table 42 displays the percentage of homes with at least one torchiere by room type. Over 12% of homes have a torchiere in the family room. Nearly 9% of homes have a torchiere in the living room. No homes have a torchiere in the bathrooms, breakfast nook, closet, kitchen, garage, or porch.

Room	Percentage of Homes	EB	Sample Size
Basement	2.8%	4.6%	35
Bathroom-1	-	-	569
Bathroom-2	-	-	355
Bathroom-3	-	-	88
Bathroom-4	-	-	1
Bathroom-Master	-	-	604
Bedroom-1	2.3%	1.2%	554
Bedroom-2	1.4%	0.8%	473
Bedroom-3	1.4%	1.4%	208
Bedroom-4	0.8%	1.3%	50
Bedroom-Master	2.3%	1.1%	604
Breakfast Nook	-	-	194
Closet	-	-	510
Dining Room	0.3%	0.5%	479
Family Room	12.6%	4.7%	278
Garage	-	-	543
Hall	0.5%	0.5%	598
Kitchen	-	-	598
Laundry Room	0.1%	0.2%	546
Living Room	8.7%	2.3%	512
Office	3.4%	1.7%	328
Other	0.9%	1.5%	180
Porch	-	-	527
Rec Room	0.7%	1.2%	141
Whole House	18.2%	3.2%	604

Table 42: Percentage of Homes with Torchieres by Room Type

Table 43 displays the percentage of torchieres equipped with each lamp type. More than half of torchieres have incandescent lamps installed, and another almost 30% of torchieres are equipped with halogen lamps. Additionally, the percentage of torchieres with compact fluorescent bulbs is nearly 8%.

Lamp Type	Percent of Torchieres (n =26)	EB
Compact Fluorescent Spring	6.6%	8.8%
Compact Fluorescent Unknown	1.3%	2.1%
Compact Fluorescent Total	**7.9%**	**9.0%**
Fluorescent Circline	11.3%	16.9%
Fluorescent Total	**11.3%**	**16.9%**
Halogen Quartz Tube	19.4%	13.5%
Halogen Unknown	10.1%	9.9%
Halogen Total	**29.5%**	**15.9%**
Incandescent Globe	3.1%	5.1%
Incandescent Standard	48.2%	18.8%
Incandescent Total	**51.3%**	**18.8%**

Table 43: Torchiere Lamp Types

Fixture Control Types

Table 44 shows the percentage of homes that have a given lamp type and lamp control type among all lamps. About 78% of homes are using an incandescent lamp controlled manually. Additionally, approximately 9% are compact fluorescents also controlled manually. Less than 3% of switches were not controlled manually.

Lamp Type	Percent of Lamps by Control Type (n=200)											
	Manual		Dimmer		Motion Detector		Motion Detector with		Photocell		Timer	
	Percentage	EB	Percentage	EB	Percentage	EB	Percentage	EB	Percentage	EB	Percentage	EB
Compact Fluorescent	9.38%	2.66%	-	-		-	-	-	0.07%	0.07%	-	-
Fluorescent Other	0.65%	0.30%	0.07%	0.11%	-	-	-	-	-	-	-	-
Fluorescent T12	1.86%	0.47%	-	-	-	-	-	-	-	-	-	-
Fluorescent T8	3.52%	0.71%	-	-	-	-	-	-	-	-	-	-
Halogen	4.43%	1.36%	1.01%	0.58%	-	-	-	-	-	-	-	-
Incandescent	77.65%	3.51%	1.07%	0.58%	-	-	0.05%	0.08%	0.06%	0.04%	0.18%	0.09%

Table 44: Percent of Lamps by Control Types

Lamp Wattage

Table 45 shows average lamp wattage for each lamp type observed in this study. The highest average wattages were halogen tube lamps, halogen unknown lamps and halogen heat lamps. The most common lamp, the standard incandescent, has an average wattage of nearly 63. The most common CFL, the spring lamp, had an average wattage of 17.

Average Lamp Wattage By Lamp Type		
Lamp Type	**Average Wattage**	**EB**
Compact Fluorescent A Style	15.83	1.49
Compact Fluorescent Capsule	13.31	1.46
Compact Fluorescent Circline	18.00	-
Compact Fluorescent Decorative	11.43	1.69
Compact Fluorescent Flood	15.74	1.29
Compact Fluorescent Globe	10.02	1.34
Compact Fluorescent Spring	17.14	2.04
Compact Fluorescent Tubular	16.45	3.42
Compact Fluorescent Unknown	17.71	7.64
Compact Fluorescent Mini	15.97	2.87
Compact Fluorescent Pin Base	14.69	0.97
Fluorescent T12	42.59	2.73
Fluorescent T4	16.00	-
Fluorescent T5	13.81	8.52
Fluorescent T8	30.62	1.49
Fluorescent Circline	49.05	9.70
Fluorescent Tube Unknown	31.29	6.13
MR-16 Pin Based Halogen	44.54	7.94
Halogen Other	49.97	10.77
Halogen Parabolic Reflector	63.35	5.31
Halogen Quartz Tube	155.75	46.33
Halogen Unknown	163.84	85.70
Heat Lamp	211.10	13.02
Decorative Incandescent	49.66	4.07
Incandescent Flood	65.68	0.65
Incandescent Globe	51.81	1.78
Incandescent Mini	28.53	4.58
Incandescent Other	35.14	7.56
Incandescent Standard	62.89	0.77
Incandescent Unknown	52.88	4.90

Table 45: Average Lamp Wattage by Lamp Type

Table 46 presents the average wattage per fixture, inclusive of all lamp technology types found in the fixtures, and number of lamps found in the fixture. Lamps classified as 'Other' were found to have the highest overall wattage (180), followed by torchieres (178), and recessed lighting-other (170). Torchieres typically have a single lamp, most commonly halogen quartz tube, which can have wattages as high as 500 watts. Under counter fixture types have the lowest wattage, with an average of 43 watts. These fixtures are more commonly located in kitchens and are usually equipped with fluorescent tubes.

Fixture Type	Average Fixture Wattage	EB	Sample Size
Under Counter	42.8	4.8	79
Architectually Integrated	47.2	6.6	12
Table lamps	54.9	3.3	139
Recessed Can	65.0	1.6	72
Garage Door Opener	84.3	11.0	28
Floor Lamp	88.9	11.6	73
Ceiling Fixtures	93.6	4.2	200
Chandelier Hanging	117.4	13.6	103
Wall Mount	130.9	9.1	194
Ceiling Fan	133.2	18.6	37
Track Lighting	162.4	41.5	21
Recessed Lighting-Other	170.0	15.7	104
Torchiere	177.5	51.3	26
Other	179.8	44.1	11

Table 46: Average Fixture Wattage

Table 47 looks at the average wattage by room type, when considering all fixtures and lamps within the specific room. These numbers vary dramatically when considering size of home, type of home, and income. The recreation room and basement top the list in terms of highest overall wattage by room type. However, due to the small sample size (3) for these rooms, it is more telling to look at the bathrooms, hall and kitchen. Amongst rooms with sufficient sample sizes, master bathroom, bathroom 1 and bathroom 2 have the highest wattage ranging from 236-346. The hallway and kitchen have the next highest wattage of 253 and 237, respectively.

Room	Watts	EB	Sample Size
Bedroom-4	75.6	46.5	2
Porch	78.0	8.5	104
Laundry Room	91.2	8.5	72
Bedroom-3	91.4	21.7	11
Closet	93.7	10.7	100
Bathroom-3	94.7	33.9	2
Other	100.6	22.0	15
Bedroom-2	128.1	14.8	63
Dining Room	132.6	15.5	92
Bedroom-1	137.2	10.4	127
Bedroom-Master	162.8	13.8	200
Breakfast Nook	175.4	32.3	38
Family Room	188.2	59.9	16
Office	198.2	34.6	34
Living Room	220.2	23.7	169
Garage	228.6	26.9	36
Kitchen	237.1	16.9	197
Hall	253.3	26.7	183
Bathroom-1	263.3	26.7	117
Bathroom-Master	332.3	20.5	200
Bathroom-2	346.4	77.0	24
Basement	359.9	456.2	3
Rec Room	476.4	111.2	3
Whole House	1815.5	125.5	200

Table 47: Average Wattage by Room Type

Table 48 displays the average lighting power density (LPD) for multifamily homes. While multifamily is slightly lower than single-family LPDs, the same factors apply. These factors include the prevalence of incandescent lamps (over 75% saturation), and unlike commercial buildings, much of the residential lighting is not in use for a significant portion of the day.

Type of Residence	House LPD		Hardwired LPD	
	W/ft^2	EB	W/ft^2	EB
Overall	1.69	0.08	1.50	0.07
APRT 1-2-S	1.62	0.13	1.37	0.11
APRT 3+S	1.72	0.10	1.54	0.10
Town/Row	1.76	0.16	1.61	0.17

Table 48: Lighting Power Density for Whole House and Hardwired Fixtures

Multifamily Appliances and Building Characteristics

Refrigerator Freezers

The following section describes the refrigerator/freezers found at the surveyed households. In total, 200 households were surveyed. All 200 homes surveyed for this study have at least one refrigerator, 2.3% of all homes have a second. The following table summarizes second refrigerators by the residence types where they were found.

Type of Residence	Secondary Refrigerator				Sample Size
	Full or Compact		Full Only		
	%	EB	%	EB	
Overall	2.3%	2.0%	2.3%	2.0%	200
Apartment (1 to 2 stories)	4.8%	4.9%	4.8%	4.9%	69
Apartment (3 or more stories)	-	-	-	-	93
Townhouse/Rowhouse	3.1%	5.0%	3.1%	5.0%	38

Table 49: Percentage of Homes with Second Refrigerator by Type of Residence

Due to the small number of homes with a second refrigerator, the following summary information is only based upon the primary refrigerators.

The primary refrigerators are summarized by type, size, age, energy consumption, ENERGY STAR qualifications, and nameplate unit energy consumption (UEC) relative to standards. Because the amount of data for each of the aforementioned characteristics differs, the number of sites in each of the analyses will differ. The data used in the refrigerator analyses are described below.

- Type-The type of each refrigerator was obtained from the site visit.
- Size-The size of the refrigerators, in cubic feet, was first obtained from the efficiency databases (CEC and AHAM) if the model number successfully matched a model in the database. In the event that the models were not matched, the data on the size collected on-site were used.
- Age-The age of the freezer was also obtained from the efficiency databases if a match was made, otherwise the age from the on site visit was used in the analysis.
- Usage (nameplate UEC)-The usage data was obtained exclusively from the efficiency databases.
- ENERGY STAR Qualification- To qualify for 2001 ENERGY STAR standards, the annual energy consumption of a refrigerator must be at least 10% less than 2001 Federal Appliance Standards for annual energy consumption. To qualify for 2004 ENERGY STAR standards, the annual energy consumption of a refrigerator must be at least 15% less than 2001 Federal Appliance Standards for annual energy consumption.

Primary Refrigerators

All homes that were visited over the course of this study have a primary refrigerator. The classification of the refrigerators is by size, configuration and existence of a through the door ice dispenser. Full size refrigerators are categorized as either single or double door. The double door refrigerators are further classified by freezer position: either bottom mounted, top mount, or side-by-side. In the case of the side by side and top mount, a further division is the existence of a through the door ice and water dispenser. The following figure shows the percentage breakdown of primary refrigerators by type. The majority of the primary refrigerators found are Top mounted (Standard, in the figure below), accounting for approximately 71% of all the primary refrigerators. Side-by-side refrigerators account for nearly 22% of the primary refrigerators.

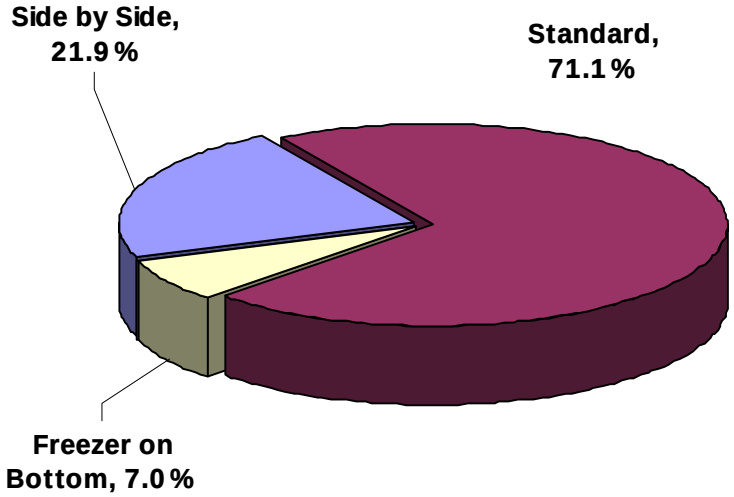

Figure 2: Percentage of Homes with Primary Refrigerator/Freezer by Type

The following abbreviations (common for refrigerators) are used throughout this section to describe the various types of refrigerator and defrost types as found:

- **BF** = Bottom Mounted Freezer (All Automatic)
- **SI =** Side-by-Side with Ice Dispenser (All Automatic)
- **SS** = Side by Side without Ice Dispenser (All Automatic)
- **TF** = Top Mounted Freezer without Ice Dispenser (Partial and Automatic Defrost)
- **SD=** Single Door
- **CO=** Compact Size
- **TI** = Top Mounted Freezer w/Ice Dispenser

Size

The sizes of refrigerators were obtained from manufacturer data if the unit is matched, or else from survey data if not matched. The following summary of the sizes of the refrigerators summarizes both the matched and unmatched units, or the manufacturer reported and surveyor estimated sizes. The manufacturer reported average overall size is not significantly different from the estimated overall sizes.

The sample size that is used in the following table that summarizes the average size of the refrigerators is 168. This is the number of full size refrigerators, 8 cubic feet or greater, for which we obtained size data from the efficiency databases. The average manufacturer reported size for all refrigerators obtained from the efficiency databases is 18.7 cubic feet.

Refrigerator Type	Manufacturer Reported Size	EB	Sample Size
All Types	18.7	0.4	168
Freezer On Bottom	19.9	0.9	8
Side By Side	19.1	0.7	7
Side By Side w/Ice Dispenser	23.8	0.6	27
Top Mounted Freezer	17.5	0.3	125
Top Mounted Freezer w/Ice Dispenser	25.4	0.0	1

Table 50: Average Estimated Size by Refrigerator Type

The following table shows the distribution of the sizes of the refrigerators including matched and unmatched units. The largest percentage of the refrigerators, or 52.8%, is within the size range 15.00 to 18.99 cubic feet. Top mounted refrigerators without ice makers are the only type of refrigerators surveyed that have sizes less than 15.00 cubic feet of volume.

Size Range (CuFt)	Refrigerator Type											
	All Types (n=200)		Freezer on Bottom (n=12)		Side By Side (n=7)		Side By Side w/Ice Dispenser (n=34)		Top Mounted Freezer (n=146)		Top Mounted Freezer w/ Ice Dispenser (n=1)	
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
11.00 to 14.99	7.2%	3.1%	-	-	-	-	-	-	10.2%	4.3%	-	-
15.00 to 18.99	52.8%	6.3%	17.0%	18.0%	34.0%	30.9%	2.8%	4.6%	70.0%	6.6%	-	-
19.00 to 21.99	25.4%	5.7%	54.2%	24.0%	66.0%	30.9%	24.5%	13.7%	19.7%	5.8%	-	-
> 22.00	14.6%	4.8%	28.9%	21.3%	-	-	72.7%	14.1%	-	-	100.0%	-

Table 51: Percentage of All Refrigerators by Type within Size Ranges- Estimated Sizes

Age

During the on-site survey, surveyors examined the refrigerator nameplate for a manufactured date and residents were asked for the approximate age of their refrigerators. If the resident was unable to provide an age, or the nameplate didn't provide a manufactured date, the surveyor estimated the age of the refrigerators whenever possible. The nameplate manufactured date, resident reported age, and surveyor estimated ages were used for refrigerators when no age data from the matching process were available for the following estimated age analysis.

All of the refrigerators surveyed were found to be less than 6 years old. As this is new construction, it is safe to assume that the vast majority of the apartments were furnished with refrigerators, and that the apartment complexes purchased new equipment with which to furnish the apartments. The other condos/townhomes surveyed were also found to have new equipment.

Energy Consumption

The average annual nameplate unit energy consumption (UEC) for refrigerator/freezers was obtained from the model number matches to manufacturer data. A sample of 168 nameplate UECs were obtained for the analysis below. Table 52 shows the average nameplate UEC by type of refrigerator and size range.

The average overall nameplate UEC for all types of refrigerators is 493.2 with an error bound of 10.3. The most efficient units are refrigerators with a top mounted freezer without ice dispenser, which have the lowest nameplate UEC at 462.4. The next most efficient are refrigerators with bottom mounted freezers, which have an average nameplate UEC at 493.3. The tables in the next section of the report that summarize the nameplate UECs relative to standards help to put these numbers into perspective.

Ref Type	Size Range (CuFt)	Average UEC	EB	Sample Size
All Types	Overall	493.2	10.3	168
	11.00-14.99	428.5	18.9	11
	15.00-18.99	467.0	6.5	97
	19.00-21.99	505.2	25.2	36
	>22.00	619.0	20.5	24
BF	Overall	493.3	9.1	8
	15.00-18.99	485.5	15.6	2
	19.00-21.99	493.3	11.5	5
	>22.00	509.0	0.0	1
SS	Overall	563.6	53.9	7
	15.00-18.99	519.2	63.2	3
	19.00-21.99	586.5	60.9	4
SI	Overall	617.1	31.3	27
	15.00-18.99	602.0	0.0	1
	19.00-21.99	581.1	146.4	4
	>22.00	626.1	19.6	22
TF	Overall	462.4	5.6	125
	11.00-14.99	428.5	18.9	11
	15.00-18.99	463.0	5.7	91
	19.00-21.99	475.0	13.9	23
TI	Overall	617.0	0.0	1
	>22.00	617.0	0.0	1

Table 52: Average Nameplate UEC by Type of Refrigerator

The bin distribution of UEC of all successfully matched full size primary refrigerators is shown below in Table 53 grouped by size and type. The nameplate UEC range that makes up the largest percentage of all refrigerators is the range between 350 to 549.9 kWh/year, which covers 82.5% of all types of refrigerators.

Ref Type	Unit Energy Consumption Ranges (kWh/Year)			
	Size Range (CuFt)	350 to 549.9	550 to 749.9	750 to 949.9
All Types	Overall	82.5%	17.0%	0.5%
	11.00-14.99	100.0%	-	-
	15.00-18.99	95.8%	4.2%	-
	19.00-21.99	83.6%	14.4%	2.0%
	>22.00	12.1%	87.9%	-
BF	Overall	100.0%	-	-
	15.00-18.99	100.0%	-	-
	19.00-21.99	100.0%	-	-
	>22.00	100.0%	-	-
SS	Overall	36.7%	63.3%	-
	15.00-18.99	70.0%	30.0%	-
	19.00-21.99	19.5%	80.5%	-
SI	Overall	15.5%	81.1%	3.4%
	15.00-18.99	-	100.0%	-
	19.00-21.99	56.4%	24.4%	19.2%
	>22.00	7.0%	93.0%	-
TF	Overall	98.4%	1.6%	-
	11.00-14.99	100.0%	-	-
	15.00-18.99	97.8%	2.2%	-
	19.00-21.99	100.0%	-	-
TI	Overall	-	100.0%	-
	>22.00	-	100.0%	-

Table 53: Percentage of Primary Refrigerators by Nameplate UEC Ranges and Type within Size Ranges

Additionally, the above groupings of full size primary refrigerators are compared with the 2001 Federal Appliance Standards for annual energy consumption.

Percentage Above/Below 2001 Federal Appliance Standards

The average percentage above or below the 2001 standards for each unit is calculated as follows:

$$\%\ \text{Relative to Std} = \frac{\text{2001 Standard (KWh/Yr)} - \text{UEC (KWh/Yr)}}{\text{2001 Standard (KWh/Yr)}}$$

For example, suppose the nameplate annual energy consumption for a refrigerator is 550 KWh/Yr. The 2001 standard consumption for this unit is 500 kWh/Yr. The percentage better or worse than 2001 standards is calculated as follows:

$$\frac{500 - 550}{500} = \frac{-50}{500} = -10\%$$

Thus, the annual energy consumption for this unit is 10% worse than 2001 standards.

Table 54 shows the average percentage above or below the 2001 standard that refrigerators are broken down by type and size. The average percentage above

standards for all types of refrigerators is 5.8%. We find that refrigerators with bottom mounted freezers and ice makers, and those with side-by-side with ice dispensers perform best in comparison to the standards among all refrigerators by averaging 13.7% and 10.4% above standards respectively.

Ref Type	Size Range (CuFt)	Average UEC Relative to 2001 Std	EB	Sample Size
All Types	Overall	5.8%	1.4%	163
	11.00-14.99	7.0%	3.9%	11
	15.00-18.99	4.1%	1.5%	94
	19.00-21.99	6.7%	3.9%	34
	>22.00	9.7%	3.2%	24
BF	Overall	13.7%	1.6%	6
	15.00-18.99	12.7%	2.8%	2
	19.00-21.99	15.3%	0.3%	3
	>22.00	10.1%	0.0%	1
SS	Overall	8.2%	8.7%	7
	15.00-18.99	14.7%	9.9%	3
	19.00-21.99	4.9%	10.3%	4
SI	Overall	10.4%	4.5%	27
	15.00-18.99	9.2%	0.0%	1
	19.00-21.99	11.9%	21.2%	4
	>22.00	10.2%	3.3%	22
TF	Overall	3.8%	1.2%	122
	11.00-14.99	7.0%	3.9%	11
	15.00-18.99	3.2%	1.5%	88
	19.00-21.99	4.4%	2.1%	23
TI	Overall	-5.3%	0.0%	1
	>22.00	-5.3%	0.0%	1

Table 54: Percentage Above/Below 2001 Federal Appliance Standards by Type of Refrigerator

The distribution of the percentages better or worse than 2001 standards for all refrigerators that were successfully matched by size range and type is presented in Table 55.

As can be seen in the table, many refrigerators are better than 2001 energy standards for annual energy consumption.

Percentage Comparison to 2001 Federal Appliance Standards						
Ref Type	Size Range (CuFt)	Better		Worse		Sample Size
		10% to 35%	0% to 9%	- 0.01% to -24.9%	- 25% to -49.9%	
All Types	Overall	34.4%	53.1%	10.8%	1.7%	163
	11.00-14.99	44.6%	44.2%	11.3%	-	11
	15.00-18.99	23.2%	69.0%	5.7%	2.1%	94
	19.00-21.99	38.6%	39.7%	19.6%	2.1%	34
	>22.00	70.4%	13.7%	15.9%	-	24
BF	Overall	100.0%	-	-	-	6
	15.00-18.99	100.0%	-	-	-	2
	19.00-21.99	100.0%	-	-	-	3
	>22.00	100.0%	-	-	-	1
SS	Overall	36.7%	-	63.3%	-	7
	15.00-18.99	70.0%	-	30.0%	-	3
	19.00-21.99	19.5%	-	80.5%	-	4
SI	Overall	70.1%	15.9%	10.5%	3.4%	27
	15.00-18.99	-	100.0%	-	-	1
	19.00-21.99	80.8%	-	-	19.2%	4
	>22.00	71.4%	15.1%	13.5%	-	22
TF	Overall	23.1%	68.5%	6.8%	1.6%	122
	11.00-14.99	44.6%	44.2%	11.3%	-	11
	15.00-18.99	19.5%	73.2%	5.0%	2.3%	88
	19.00-21.99	25.7%	63.1%	11.2%	-	23
TI	Overall	-	-	100.0%	-	1
	>22.00	-	-	100.0%	-	1

Table 55: Percentage of Refrigerators with a Nameplate UEC Better or Worse than 2001 Standards by Percentage Bins and Type within Size Ranges

ENERGY STAR Qualified

To qualify for 2001 ENERGY STAR standards, the annual energy consumption of a refrigerator must be at least 10% less than 2001 Federal Appliance Standards for annual energy consumption. To qualify for 2004 ENERGY STAR standards, the annual energy consumption of a refrigerator must be at least 15% less than 2001 Federal Appliance Standards for annual energy consumption. The following analysis is based on a sample of 163 primary refrigerators for which we have obtained nameplate UEC data.

The distribution of Primary Refrigerator/Freezers that meet ENERGY STAR qualifications grouped by size and type is shown below. These data are not shown by defrost type since the refrigerator data only contained automatic models that met the size requirements of the program. As can be seen in Table 56, the percentage of all refrigerators that meet 2001 ENERGY STAR qualifications is 34.4 % with a 6.5% error bound. The percentage of all refrigerators that meet 2004 ENERGY STAR qualifications is 18.7 % with a 5.3% error bound.

Ref Type	Size Range (CuFt)	2004 Energy Star		2001 Energy Star		Sample Size
		Percentage	EB	Percentage	EB	
All Types	Overall	18.7%	5.3%	34.4%	6.5%	163
	11.00-14.99	26.8%	25.2%	44.6%	25.9%	11
	15.00-18.99	6.9%	4.9%	23.2%	8.0%	94
	19.00-21.99	23.4%	12.2%	38.6%	14.5%	34
	>22.00	57.2%	17.2%	70.4%	15.7%	24
BF	Overall	46.4%	33.6%	100.0%	-	6
	15.00-18.99	50.0%	58.0%	100.0%	-	2
	19.00-21.99	57.7%	49.0%	100.0%	-	3
	>22.00	-	-	100.0%	-	1
SS	Overall	36.7%	32.4%	36.7%	32.4%	7
	15.00-18.99	70.0%	42.2%	70.0%	42.2%	3
	19.00-21.99	19.5%	31.7%	19.5%	31.7%	4
SI	Overall	59.4%	16.0%	70.1%	14.8%	27
	15.00-18.99	-	-	-	-	1
	19.00-21.99	56.4%	40.4%	80.8%	29.3%	4
	>22.00	63.2%	17.5%	71.4%	16.4%	22
TF	Overall	7.5%	4.5%	23.1%	6.9%	122
	11.00-14.99	26.8%	25.2%	44.6%	25.9%	11
	15.00-18.99	3.4%	3.9%	19.5%	7.9%	88
	19.00-21.99	12.9%	11.5%	25.7%	15.0%	23
TI	Overall	-	-	-	-	1
	>22.00	-	-	-	-	1

Table 56: Percentage of ENERGY STAR Qualified Primary Refrigerators by Type and Size Range

Water Heaters

The following section summarizes the data on the water heaters that were collected during the on-site visits. As can be seen in Figure 3, the large majority of water heaters are storage type water heaters. Approximately 62% of all water heaters are electric storage, and about 32% are gas storage.

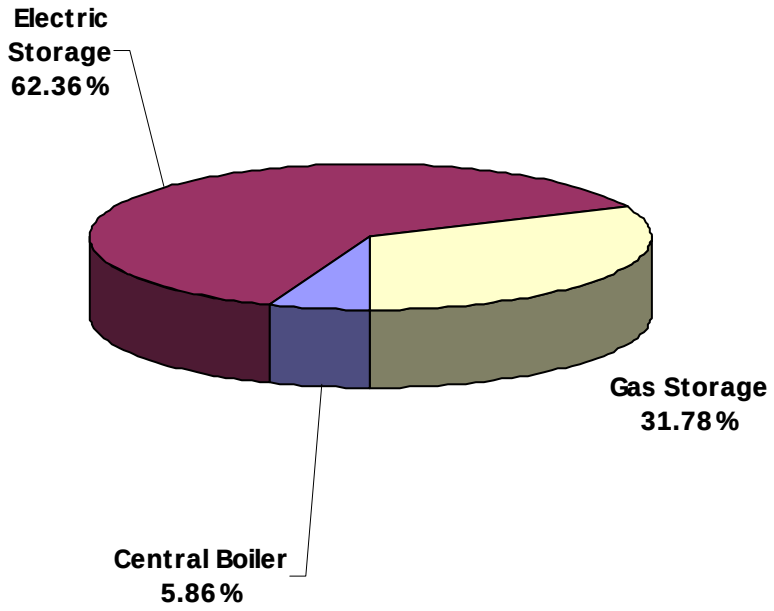

Figure 3: Water Heaters by Type

Fuel Type

Figure 4 shows the breakdown of water heaters by fuel type. The large majority of water heaters are electric, totaling over 62% of all water heaters found. About 38% of the water heaters are gas, either natural gas or propane. The water heater fuel type often corresponds with the heating fuel type. Note that over 80% of single-family homes have water heaters fueled by gas.

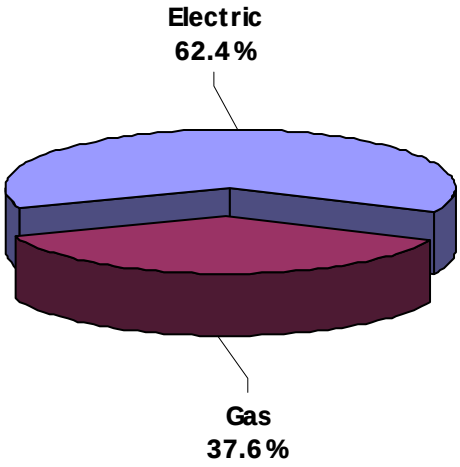

Figure 4: Water Heaters by Fuel Type

Table 57 shows the breakdown of water heaters by fuel type for the 2001 and the 2006 studies. The percentage of electric water heaters has decreased since 2001.

	2006		2001	
	Electric	Gas	Electric	Gas
Idaho	25%	75%	-	-
Montana	8%	92%	-	-
Oregon	81%	19%	71%	29%
Washington	68%	32%	42%	58%

Table 57: Percent of Water Heaters by Fuel Type – 2006 vs. 2001

Table 58 shows the average size of the water heaters, overall and for each of the fuel types. The average sizes of the units were obtained from two sources, the first being from the manufacturer if the model number matched a model in the efficiency databases, the second being from the site visit if the model was not matched. The surveyor attempted to obtain the capacity of the water heater from the nameplate information; if no nameplate capacity data were available, the surveyor made an estimate wherever possible.

Fuel	Average Size (Gallons)	EB	Sample Size
All Types	56.0	5.8	186
Electric	50.2	0.3	127
Gas	67.6	17.3	59

Table 58: Average Size of Water Heaters by Fuel Type

Table 59 shows the percentage of water heaters in each size range within each fuel type. The sample sizes used to calculate the percentages in each fuel type are also presented in the table below. Notice that the distribution of water heater capacities differs for electric and gas units. A heavy majority of both gas and electric units are in the 50 to 59 gallon range. Additionally, approximately 28% of gas units are in the 40-49 gallon range.

Size (Gallons)	Fuel Type					
	All Types (n=186)		Electric (n=127)		Gas (n=59)	
	%	EB	%	EB	%	EB
Gallons 40 to 49	10.4%	4.7%	1.5%	1.8%	28.4%	11.8%
Gallons 50 to 59	82.4%	5.4%	95.8%	3.0%	55.4%	12.0%
Gallons 60 to 69	3.1%	2.2%	2.7%	2.5%	3.9%	4.5%
Gallons 70 to 79	0.3%	0.5%	-	-	1.0%	1.6%
Gallons Greater Than 90	3.7%	2.5%	-	-	11.3%	7.2%

Table 59: Percentage of Water Heaters by Size Range and Fuel Type

Table 60 shows the percentage of total water heaters by fuel type within the size ranges. These percentages were calculated as a proportion relative to the entire set of water heaters, regardless of fuel type. This summary table better displays the actual percentage of the population of water heaters in each size range. The previous table shows that the 50 to 59 gallon size range accounts for 96% of all electric water heaters and Table 60 shows that the same size electric heaters constitute 58.6% of the entire

population. However, the same table also shows the market dominance of 50 to 59 gallon water heaters which account for over 75% of all water heaters.

(n=200)	Fuel Type			
	Electric		Gas	
Size (Gallons)	%	EB	%	EB
40 to 49 Gallons	0.9%	1.1%	8.6%	4.2%
50 to 59 Gallons	58.6%	6.2%	16.8%	4.6%
60 to 69 Gallons	1.6%	1.5%	1.2%	1.4%
70 to 79 Gallons	-	-	0.3%	0.5%
> 100 Gallons	-	-	3.4%	2.3%
Unknown	1.2%	1.3%	7.2%	3.3%

Table 60: Percentage of Water Heaters within each Size Range Among all Water Heaters

Energy Factor

Energy factor for water heaters is a measure of efficiency expressed as the ratio defined below, where a higher energy factor equates to a more efficient water heater:

$$\frac{\text{heater supplied energy content of the delivered hot water}}{\text{energy consumed by the water heater}}$$

The average energy factor for the popular 50 gallon gas fired water heater is 0.59, which is slightly above the 0.53 from the National Appliance Energy Conservation Act Standards (NAECA), implemented in 2004.

Energy Factor Comparison			
Size	Fuel Type	Energy Factor Standard	Average Energy Factor
50 Gallons	Gas	0.53	0.59
50 Gallons	Electric	0.90	0.89

Table 61: Energy Factor Comparison

Table 62 shows the average energy factor by fuel type within each size range. The energy factor was obtained from the efficiency databases, thus only the models that matched were included in the following summary table. The average energy factor from matched electric units is 0.89 while the average energy factor for all gas units is 0.59.

Size (Gallons)	Fuel Type					
	Electric			Natural Gas		
	Average Energy Factor	EB	Sample Size	Average Energy Factor	EB	Sample Size
All Sizes	0.89	0.01	50	0.59	0.01	36
40 to 49	-	-	-	0.59	0.00	12
50 to 59	0.89	0.01	48	0.59	0.01	22
60 to 69	0.88	0.00	2	0.55	0.00	2

Table 62: Average Energy Factor by Fuel Type in Size Ranges

Table 63 shows the percentage of water heaters within each fuel type and size range that fall into each of the energy factor ranges[3]. Energy factors of gas water heaters are distributed throughout the range from 0.52 to 0.67, while all electric water heaters fall within the range from 0.84 to 0.95. It is difficult to make any comprehensive comparisons between these data and the 2004 federal standard due to the standard being a function of water heater volume, but a table containing the federal standard is in the Appendix so that comparisons can be made as desired.

Fuel Type	Size Range (Gallons)	Energy Factor														Sample Size
		0.52 to 0.559	EB	0.56 to 0.599	EB	0.60 to 0.639	EB	0.64 to 0.679	EB	0.84 to 0.879	EB	0.88 to 0.919	EB	0.92 to 0.959	EB	
Electric	All Sizes	-	-	-	-	-	-	-	-	25.5%	10.0%	57.4%	11.9%	17.0%	9.5%	53
	50 to 59	-	-	-	-	-	-	-	-	26.7%	10.4%	55.4%	12.2%	17.8%	9.9%	51
	60 to 69	-	-	-	-	-	-	-	-	-	-	100.0%	-	-	-	2
Gas	All Sizes	13.6%	9.7%	60.5%	13.8%	12.4%	8.8%	13.4%	9.4%	-	-	-	-	-	-	36
	40 to 49	-	-	78.8%	18.9%	15.0%	16.9%	6.2%	10.0%	-	-	-	-	-	-	12
	50 to 59	10.4%	10.1%	59.2%	17.5%	12.6%	11.3%	17.8%	13.4%	-	-	-	-	-	-	22
	60 to 69	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	2

Table 63: Percentage of Water Heaters in Energy Factor Ranges by Fuel Type and Size

Table 64 shows the percentage of all water heaters broken down by whether the tank was wrapped with insulation or unwrapped by size. Approximately 97.8% of the water heaters were unwrapped.

Fuel Type	Size Range (Gallons)	Tank Wrapped		Tank Not Wrapped		Sample Size
		%	EB	%	EB	
All Types	Overall	2.2%	2.0%	97.8%	2.0%	200
	40 to 49	-	-	100.0%	-	19
	50 to 59	1.2%	1.9%	98.8%	1.9%	155
	60 to 69	-	-	100.0%	-	5
	70 to 79	-	-	100.0%	-	1
	> 100	-	-	100.0%	-	6
	Unknown	15.4%	16.3%	84.6%	16.3%	14

Table 64: Percentage of Water Heaters that were Wrapped and Unwrapped

Table 65 and Table 66 compare the percentage of water heater system types in 2006 and 2001, respectively. Overall, the percentage of units in Oregon found to be supplied

[3] The sample sizes in this table are slightly higher than the previous table since the average energy factor factored in the number of people per home, which was not available for all homes.

by individual storage tank units increased, while the opposite is true in Washington. The results for Idaho and Montana can be seen below as well.

Tank Type	Idaho			Montana			Oregon			Washington		
	Electric	Gas	Total	Electric	Gas	Total	Electric	Gas	Total	Electric	Gas	Total
Individual Unit	100%	100%	100%	100%	83.0%	84.3%	100%	100%	100%	100%	72.9%	91.2%
Central	0%	0%	0%	0%	17.0%	15.7%	0%	0%	0%	0%	27.1%	8.8%

Table 65: Water Heater Tank Type by Fuel Type, 2006 Study

Tank Type	Oregon			Washington		
	Electric	Gas	Total	Electric	Gas	Total
Individual Unit	100.0%	32.0%	80.2%	100.0%	94.7%	96.9%
Central	0.0%	68.0%	19.8%	0.0%	5.3%	3.1%

Table 66: Water Heater Tank Type by Fuel Type, 2001 Study

Clothes Washers

This section describes the clothes washer data. The model numbers collected on the washers were linked with the CEC database in order to obtain the energy factor. There were no manufacture date data available, thus all the age data presented in this section are customer reported dates from the on site survey.

Approximately 84.6% of all homes have a clothes washing machine.

Type of Residence	%	EB	Sample Size
Overall	84.6%	4.7%	200
Apartment (1 to 2 stories)	79.2%	9.7%	69
Apartment (3 or more stories)	87.3%	5.8%	93
Townhouse/Rowhouse	87.0%	9.1%	38

Table 67: Percentage of Homes with Clothes Washers by Type of Residence

Table 68 shows the distribution of the 168 clothes washers found on site, presented by type of washer and type of residence. Approximately 61% of all washers found were standard washing machines. The largest percentage of homes with standard washers occurred in apartments (1 to 2 stories) with nearly 77%.

Type of Residence	Horizontal Axis		Standard		Stacked		Sample Size
	%	EB	%	EB	%	EB	
Overall	12.7%	4.3%	61.1%	6.5%	26.2%	5.9%	168
Apartment (1 to 2 stories)	6.7%	5.7%	76.5%	9.9%	16.8%	8.8%	56
Apartment (3 or more stories)	14.0%	6.6%	54.5%	9.5%	31.5%	9.0%	79
Townhouse/Rowhouse	18.3%	10.9%	52.9%	15.8%	28.8%	13.3%	33

Table 68: Distribution of Clothes Washers by Type of Washer and by Type of Residence

The sample size of washers with age information was 162 washers. Again, the data on the year of manufacture of the washing machine is the year that the customer reported. The washing machine was excluded from this part of the analysis if the customer was not aware of the age of the machine. As can be seen from the table below, most of the

washers (94.7%) in the data were manufactured between 2000 and 2006. Among the remaining washers, approximately 3% were manufactured between 1995 and 1999. The presence of older appliances shows that a small part of the multifamily segment has used equipment.

Manufacture Date Range	% (n=162)	EB
2000-2006	94.7%	2.9%
1995-1999	3.0%	2.1%
1990-1994	1.7%	1.8%
1985-1989	0.6%	1.0%
1980-1984	-	-
1979 and older	-	-

Table 69: Distribution of Manufactured Date of Clothes Washers

In 2004, federal standards switched from rating clothes washer efficiencies from Energy Factor (EF) units to Modified Energy Factor (MEF) units. The change was made due to differences in the amount of water extracted from the clothing between different models. The MEF accounts for these differences, which have an impact on the energy consumption of the clothes dryer.

Modified Energy Factor for clothes washers is a ratio of cubic feet per kWh per cycle. The current federal efficiency standards for clothes washers, effective in 2004, set a minimum energy factor of 1.04. The minimum ENERGY STAR qualifying MEF is 1.42 for all clothes washers. The average MEF of each of the types of clothes washers, based upon the sample of clothes washers that were successfully linked with the efficiency database, meets the 2004 minimum standard energy factor. Additionally, it is apparent that horizontal axis washers and stacked horizontal axis washers, easily achieved ENERGY STAR qualifying levels on average, perform significantly better than standard units.

Type of Washer	2004 MEF Minimum Standard	Energy Star Qualifying MEF	Average Modified Energy Factor	EB	Sample Size
H-Axis	1.04	1.42	1.73	0.10	15
Stacked H-Axis	1.04	1.42	1.68	0.11	10
Standard	1.04	1.42	1.37	0.13	6

Table 70: Average Modified Energy Factor and Comparative Standards

The following table summarizes the modified energy factor distribution relative to efficiency standards. It shows that all washers exceed the minimum federal requirements, and 100% of H-axis and Stacked H-axis washers exceed ENERGY STAR minimum requirements. Surprisingly, even 54.9% of Standard washers exceed the ENERGY STAR minimum requirement. Overall, about 89% of all washers meet or exceed the ENERGY STAR threshold.

Type of Washer	Modified Energy Factor				Sample Size
	< 1.04	1.04 to 1.42	1.43 to 1.8	> 1.8	
All Washers	-	10.9%	77.3%	11.8%	31
H-Axis	-	0.0%	83.6%	16.4%	15
Stacked H-Axis	-	0.0%	85.5%	14.5%	10
Standard	-	45.1%	54.9%	0.0%	6

Table 71: Modified Energy Factor Distribution Relative to Standards

Clothes Dryers

The following section describes the clothes dryers found during the on site surveys. Data on clothes dryers were very limited in the CEC database. This section contains information on the percentage of homes with dryers, the breakdown of the fuel types, age of the dryers obtained by the surveyors during the site visits, and presence of a moisture sensor.

Table 72 shows the breakdown of the percentage of homes with dryers by residence type. The error bound and sample size for each type of residence is also displayed in the table.

Type of Residence	Percentage with Dryer	EB	Sample Size
Overall	84.0%	4.7%	200
Apartment (1 to 2 stories)	76.7%	9.9%	69
Apartment (3 or more stories)	86.3%	6.0%	93
Townhouse/Rowhouse	90.1%	7.9%	38

Table 72: Percentage of Homes with Dryers by Type of Residence

Figure 5 shows the breakdown of fuel types among all dryers found during the on site visits. A total of 166 homes in the sample have dryers. The overwhelming majority of homes used electric dryers, while 1% used gas dryers.

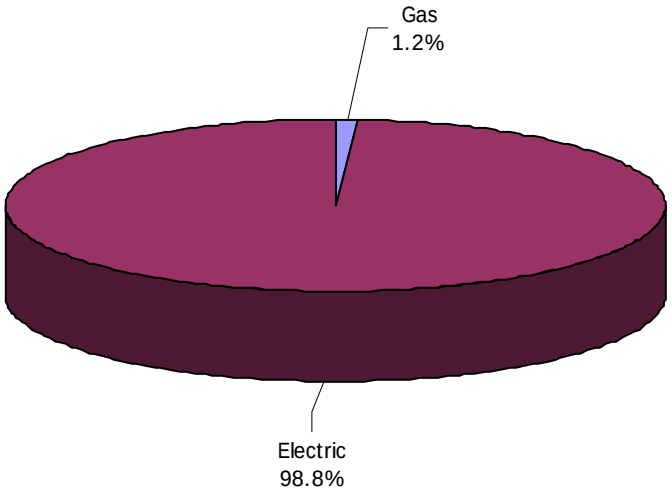

Figure 5: Percentage of Dryers by Fuel Type

The data on the age of the dryers were obtained from either the owner of the house or the surveyor estimation of the age. A total of 157 dryers in the sample have an estimated age. Table 73 shows the distribution of the estimated manufacture date for the dryers. The largest percentage (96.1%) of dryers is between 0 to 6 years old. As with the clothes washer results, a small percentage of multifamily homes contain used clothes dryers as well.

Manufacture Date Range	Percentage (n=157)	EB
2000-2006	96.1%	2.3%
1995-1999	1.8%	1.6%
1990-1994	1.4%	1.4%
1985-1989	0.0%	0.0%
1980-1984	0.6%	1.0%
1979 and older	0.0%	0.0%

Table 73: Distribution of Estimated Manufacture Date of Dryers

A moisture sensor detects the amount of moisture in the load of laundry, and terminates the cycle prematurely if the moisture content reaches a certain moisture threshold. Machines with this option save energy and wear, as it prevents over-drying. Table 74 illustrates that the feature is present in over one-third of the dryers found.

(n=166)	Presence of Moisture Sensor	
	Percentage	EB
Yes	37.5%	6.7%
No	62.5%	6.7%

Table 74: Dryers with Moisture Sensors

Dishwashers

The following section summarizes the 191 dishwashers found during the site visit. The data were merged with the CEC database to obtain the energy factor for the model. This section contains information on the percentage of homes with dishwashers, the age of the dishwasher obtained by the surveyor during the site visit, and the energy factor from the CEC database.

Table 75 shows the percentage of homes with dishwashers by type of home. Approximately 95.5% of all homes have a dishwasher.

Type of Residence	Percentage with Dishwashers	EB	Sample Size
Overall	95.5%	2.7%	200
Apartment (1 to 2 stories)	95.9%	3.8%	69
Apartment (3 or more stories)	96.8%	3.1%	93
Townhouse/Rowhouse	92.5%	8.3%	38

Table 75: Percentage of Homes with Dishwasher by Type of Residence

Based on the subset of 191 dishwashers for which age information was found, 94.4% of the dishwashers were built in 2004-2006.

Manufacture Date Range	Percentage (n=191)	EB
2004-2006	94.4%	2.4%
2001-2003	5.6%	2.4%
1998-2000	0.0%	0.0%

Table 76: Distribution of Manufacture Date of Dishwashers

Energy factor for dishwashers is defined as loads per kWh. The average energy factor for all dishwashers that were matched to the CEC database is 0.517. Table 77 displays the average energy factor compared to the current federal minimum standard, enacted in 1994.

Dishwasher Energy Factor (n=101)		
Current Federal Standards	Minimum Energy Star Qualification	Average Energy Factor
0.46	0.58	0.517

Table 77: Comparison of Energy Factor with Federal Standards

All of the dishwashers with energy factors were within the range of 0.460 to 0.579. This energy factor range includes dishwashers that meet 1994 standards, but were below the current ENERGY STAR minimum energy factor of 0.58. A potential bias is introduced with the low model number to dishwasher efficiency match rate (54%) since the appliance efficiency databases are only updated periodically and therefore the models in

the databases are more likely to be the older models, since the newer models might not have been added yet. This would lead to a potential downward bias in efficiency levels.

Cooling Equipment

This section presents the summary analysis of the data on primary cooling equipment found at the 40.7% of sites that had air conditioning. The air conditioner model numbers were linked with efficiency databases from the ARI, CEC, Carrier Bluebook, and FTC in order to obtain manufacture date, capacity, seasonal energy efficiency ratio (SEER), and energy efficiency ratio (EER).

The primary cooling equipment identified during this study was of five distinct types

- Packaged System Air Conditioning - These units have the air-conditioning cycle components, the condenser, compressor, evaporator (cooling) coil and air handler fan, combined into one piece of equipment or "package". The equipment can be mounted on the roof or the side of a residence depending on the duct location.
- Split System Air Conditioning - These units are the typical residential air-conditioner with a "split" between an indoor and outdoor piece of equipment. These pieces include a remote condenser and compressor located outside the home and commonly referred to as the outdoor or condensing unit. The indoor unit is typically in the same location as the furnace and houses the evaporator coil and air handler fan.
- Split System Heat Pumps - These units are similar to Split System A/Cs, but are configured to operate in both a normal and reverse refrigeration cycle. This allows the heat pump to provide cool air in the summer and warm air in the winter.
- Packaged Terminal Air Conditioning (PTAC) - These systems are commonly referred to as window units, room A/Cs, or wall units. They are package units because they have all components located in the same piece of equipment, but have a lower range of available cooling capacity. This category includes packaged terminal heat pumps.
- Portable- Stand Alone Units - These systems are sometimes called spot coolers and are similar to PTACs, but they are not mounted in a fixed location.

The distribution of these cooling equipment types is shown below in Table 78. Of all the homes in the study, 23% have central cooling, and 18% have space cooling systems.

System Type (n=200)		% of Primary Cooling Types	EB
None		59.3%	4.0%
Central	Central Chiller	1.8%	1.7%
	Heat Pump	2.9%	1.7%
	Packaged System A/C	5.2%	1.8%
	Split System A/C	12.8%	2.6%
Space	Portable- Stand Alone	8.8%	6.1%
	PTAC	6.9%	3.6%
	PTHP	2.2%	1.6%

Table 78: Distribution of Cooling System Types

In the 2001 study, Oregon had an average cooling equipment saturation of about 18% and Washington had a penetration of 5%. Table 79 presents the 2006 study results. The penetration of AC systems has increased in both states. Note that these penetration estimates include space AC systems, while the 2001 study only included central systems, since space systems are most often added after homes are occupied.

State	Have AC	EB	n
Idaho	91.3%	8.0%	28
Montana	80.5%	20.5%	10
Oregon	43.4%	12.1%	54
Washingon	24.3%	7.1%	108

Table 79: Presence of AC System – 2006

The analysis of cooling equipment is presented in this section. We will include heat pumps in this analysis and consider heat pumps the same as air conditioners, as the cooling portion of a heat pump is very similar in terms of energy use to a standard A/C.

From our analysis of the surveyed residences, 59.3% with a 4.0% error bound of homes have no cooling equipment in place. The remaining homes have one or more cooling equipments present. Of the homes that have primary cooling equipment, the distribution of central systems versus space cooling units is shown below.

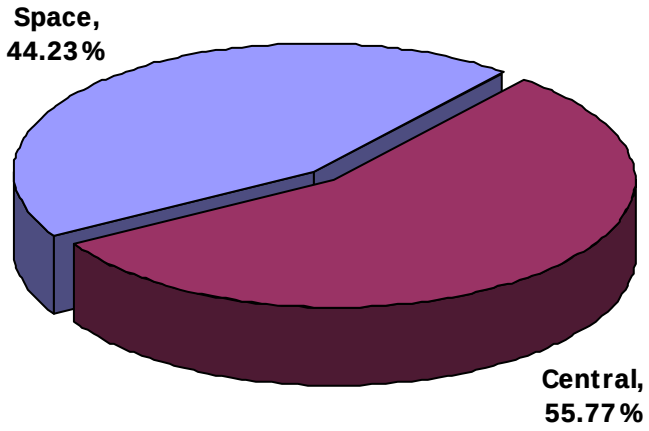

Figure 6: Distribution of Primary Cooling Systems

Cooling equipment was classified into seven types; chiller, heat pump, packaged system A/C, and Split System AC, all classified as central systems, and PTAC, PTHP, and portable considered space units. The data show that the majority of systems are split A/C which corresponds to common building practices. The second most predominant systems were Portable.

Equipment Type	Central (n=48)		Space (n=39)	
	% of System Class	EB	% of System Class	EB
Split System A/C	56.4%	12.2%		
Packaged System AC	22.9%	10.3%		
Heat Pump	12.6%	7.4%		
Chiller	8.1%	7.3%		
PTAC			38.5%	13.8%
Portable			49.0%	14.3%
PTHP			12.5%	8.7%

Table 80: Breakdown of Classes of Primary Cooling Systems by Equipment Type

Table 81 below shows the average estimated age of the primary system found at a residence. The estimated ages were obtained from a combination of dates that were gathered from the manufacturer nameplate and the surveyor estimates during the on site visit. The sample size of 87 (summing central and space units) represents all sites that were found with some type of cooling equipment and age estimate. The average central air conditioning system type is 1.4 years old. The average space air conditioning system is 1.4 years old also.

Air Conditioning System Type		Primary Cooling System Estimated Age	EB	Sample Size
Central	All Types	1.43	0.17	48
	Central Chiller	1.00	-	3
	Heat Pump	2.13	0.58	8
	Packaged System A/C	1.57	0.25	11
	Split System A/C	1.29	0.22	26
Space	All Types	1.42	0.20	39
	Portable- Stand Alone	1.33	0.35	16
	PTAC	1.43	0.23	17
	PTHP	1.71	0.37	6

Table 81: Average Age of Primary Cooling Equipment

Table 82 shows the percentage distribution for each type of cooling system by age or year manufactured. Most (85%) of the primary central and space type air conditioners were manufactured in 2004 or 2005.

Age	Central										Space							
	All Types		Central Chiller		Heat Pump		Packaged System		Split System A/C		All Types		Portable- Stand		PTAC		PTHP	
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
2006	1.7%	2.7%	-	-	-	-	-	-	3.0%	4.8%	7.6%	8.4%	15.5%	16.3%	-	-	-	-
2005	66.5%	11.3%	100.0%	-	32.4%	30.7%	43.3%	25.3%	78.6%	13.2%	46.6%	14.3%	43%	21.1%	56.7%	22.5%	28.8%	37.4%
2004	18.6%	9.3%	-	-	22.0%	20.6%	56.7%	25.3%	5.1%	8.1%	42.5%	14.1%	34.5%	19.9%	43.3%	22.5%	71.2%	37.4%
2003	13.3%	7.8%	-	-	45.7%	31.2%	-	-	13.4%	10.4%	3.3%	5.3%	6.8%	10.7%	-	-	-	-

Table 82: Age Range Distribution of Cooling System by Types

Table 83 below shows bin distributions of capacities for cooling system types. The capacities were obtained from a combination of manufacturer information and the surveyor estimates during the on site visit. The sample size of 52 represents all cooling equipment for which capacity data was obtained. All central air conditioning capacities were found to be between 2.0 and 5.0 tons. The largest percentage bin of combined central air conditioning types is 28.7% found in the 2 to 2.49 ton range. Seventy-four percent of the 15 window/wall units (PTAC) fall in the under 1 ton range.

Ton Range	Central										Space							
	All Central (n=37)		Central Chiller (n=3)		Heat Pump (n=3)		Packaged System A/C (n=7)		Split System A/C (n=24)		All Space (n=15)		Portable- Stand Alone (n=2)		PTAC (n=7)		PTHP (n=6)	
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
<1.0	-	-	-	-	-	-	-	-	-	-	74.1%	21.1%	100.0%	-	100.0%	-	43.3%	36.8%
1.0-1.49	-	-	-	-	-	-	-	-	-	-	13.2%	19.6%	-	-	-	-	28.8%	37.4%
1.5-1.99	20.8%	11.1%	-	-	-	-	-	-	31.1%	15.7%	12.7%	12.0%	-	-	-	-	27.9%	26.9%
2.0-2.49	28.7%	12.1%	-	-	100.0%	-	15.6%	23.4%	33.1%	15.7%	-	-	-	-	-	-	-	-
2.5-2.99	19.5%	11.0%	-	-	-	-	45.9%	32.2%	16.3%	12.4%	-	-	-	-	-	-	-	-
3.0-3.49	7.0%	7.9%	-	-	-	-	21.9%	30.5%	4.3%	6.9%	-	-	-	-	-	-	-	-
3.5-3.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4.0-4.49	11.9%	11.1%	-	-	-	-	9.2%	14.8%	15.2%	15.6%	-	-	-	-	-	-	-	-
4.5-4.99	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
>5.0	10.7%	9.5%	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 83: Size Distribution of Cooling Systems by Type

Table 84 shows the percentage of cooling systems by type and capacity within age ranges. For example, from the table we can identify that 66.5% of all types of central cooling units were built in 2005.

Central Air Conditioning System Type	Ton Range	Age 2006		Age 2005		Age 2004		Age 2003		Sample Size
		%	EB	%	EB	%	EB	%	EB	
All Types	All Ranges	1.7%	2.7%	66.5%	11.3%	18.6%	9.3%	13.3%	7.8%	48
	1.5 to 1.99	-	-	55.3%	29.9%	18.1%	26.0%	26.6%	26.3%	8
	2.0 to 2.49	7.7%	12.2%	64.2%	21.6%	12.7%	11.9%	15.4%	16.5%	13
	2.5 to 2.9	-	-	70.8%	28.3%	29.2%	28.3%	-	-	7
	3.0 to 3.5	-	-	100.0%	-	-	-	-	-	2
	4.0 to 4.49	-	-	100.0%	-	-	-	-	-	3
	4.5 to 5	-	-	100.0%	-	-	-	-	-	1
	> 5	-	-	100.0%	-	-	-	-	-	3
	Unknown	-	-	40.5%	25.3%	35.8%	23.9%	23.7%	20.4%	11
Central Chiller	All Ranges	-	-	100.0%	-	-	-	-	-	3
	> 5	-	-	100.0%	-	-	-	-	-	3
Heat Pump	All Ranges	-	-	32.4%	30.7%	22.0%	20.6%	45.7%	31.2%	8
	2.0 to 2.49	-	-	-	-	100.0%	-	-	-	3
	Unknown	-	-	41.5%	37.4%	-	-	58.5%	37.4%	5
Packaged System A/C	All Ranges	-	-	43.3%	25.3%	56.7%	25.3%	-	-	11
	2.0 to 2.49	-	-	100.0%	-	-	-	-	-	1
	2.5 to 2.9	-	-	33.9%	45.0%	66.1%	45.0%	-	-	3
	3.0 to 3.49	-	-	100.0%	-	-	-	-	-	1
	4.0 to 4.49	-	-	100.0%	-	-	-	-	-	1
	4.5 to 5	-	-	100.0%	-	-	-	-	-	1
	Unknown	-	-	-	-	100.0%	-	-	-	4
Split System A/C	All Ranges	3.0%	4.8%	78.6%	13.2%	5.1%	8.1%	13.4%	10.4%	26
	1.5 to 1.99	-	-	55.3%	29.9%	18.1%	26.0%	26.6%	26.3%	8
	2.0 to 2.49	10.0%	15.6%	70.0%	24.5%	-	-	20.0%	21.1%	9
	2.5 to 2.9	-	-	100.0%	-	-	-	-	-	4
	3.0 to 3.49	-	-	100.0%	-	-	-	-	-	1
	4.0 to 4.49	-	-	100.0%	-	-	-	-	-	2
	Unknown	-	-	100.0%	-	-	-	-	-	2

Table 84: Size Distributions by Age Range for Central System Types

Seasonal energy efficiency ratio (SEER) is a measure of air conditioning efficiency given in kBtu of cooling delivered per kWh of electrical energy consumed. The SEER data for this analysis were obtained strictly from the manufacturer data of matched model numbers. The sample of size of 34 represents all of the cooling systems that were successfully matched with manufacturer data. Since the sample size with SEER data is very small, the results may be biased and should be used as suggestive rather than definitive.

The distribution of SEER range by cooling system type is shown below in Table 85. The greatest amount of combined central system air conditioners are in the 10 to 10.99 SEER range accounting for 86.3% of central systems with a 9.7% error bound. As these homes were permitted before 2006, the 10 to 10.99 SEER range met the national standard of that time, though it should be noted that the current national standard has increased to 13 SEER. The ENERGY STAR threshold has increased to 14 SEER.

Efficiency Range	All Central Types (n=34)		Heat Pump (n=4)		Packaged System A/C (n=6)		Split System A/C (n=24)	
	%	EB	%	EB	%	EB	%	EB
14 or Higher SEER	-	-	-	-	-	-	-	-
13 - 13.99 SEER	-	-	-	-	-	-	-	-
12 - 12.99 SEER	4.2%	4.9%	-	-	9.6%	15.5%	3.5%	5.7%
11 - 11.99 SEER	3.2%	5.2%	-	-	-	-	4.3%	6.9%
10 - 10.99 SEER	86.3%	9.7%	30.0%	34.3%	90.4%	15.5%	92.2%	8.8%
9 to 9.99 SEER	6.3%	7.1%	70.0%	34.3%	-	-	-	-

Table 85: Distribution of Cooling Systems by SEER/EER ranges and Cooling System Type

The distribution of average SEER values across the system capacity ranges is shown below. The average SEER for capacity range can be observed in this table. For central units in the range of 2.0 to 2.49 tons, the most saturated capacity range, the average system efficiency is 10.1 with an error bound of 0.1. The most efficient units are central units in the 4.5 to 5 range with an efficiency of 12.0.

System Type	Ton Range	Average Efficiency	EB	Sample Size
All Central	1.5 to 1.99	10.1	0.1	8
	2.0 to 2.49	10.1	0.1	12
	2.5 to 2.9	10.4	0.4	7
	3.0 to 3.49	11.0	0.0	1
	4.0 to 4.49	10.3	0.2	3
	4.5 to 5	12.0	-	1
	Unknown	9.4	0.0	2
Heat Pump	2.0 to 2.49	10.0	-	2
	Unknown	9.4	0.0	2
Packaged System A/C	2.0 to 2.49	10.3	0.0	1
	2.5 to 2.9	10.2	0.0	3
	4.0 to 4.49	10.0	-	1
	4.5 to 5	12.0	-	1
Split System A/C	1.5 to 1.99	10.1	0.1	8
	2.0 to 2.49	10.1	0.1	9
	2.5 to 2.9	10.5	0.6	4
	3.0 to 3.49	11.0	0.0	1
	4.0 to 4.49	10.3	0.2	2

Table 86: Cooling Systems by Type, Tonnage Range, and Average Efficiency

As mentioned above, the current minimum efficiency standard for split-system air conditioners, packaged air conditioners, and heat pumps is a SEER of 13.0. The minimum qualifying ENERGY STAR SEER is 14.0 for split-system and packaged air conditioners and heat pumps. Table 87 shows the average SEER compared with current and previous standards. The average SEER for packaged systems and split system types listed below exceed the previous federal standard (which was current when the homes were permitted), but fall short of the 2006 standard and ENERGY STAR

minimum. The average SEER of 9.58 for heat pumps falls slightly short of the 9.7 previous minimum federal standard.

SEER					
Type of System	**Previous Minimum Federal Standard**	**2006 Minimum Federal Standard**	**Minimum Energy Star Standard**	**Average SEER**	**Sample Size**
Heat Pump	9.7	13	14	9.58	4
Packaged System A/C	9.7	13	14	10.34	6
Split System A/C	10	13	14	10.24	24

Table 87: Average SEER Standard Comparison

Heating Equipment

This section presents the summary analysis of the primary heating systems found during the site visits. The heating systems were linked with efficiency databases from the CEC and the Carrier Bluebook in order to obtain manufacture date, input, output, capacity, and annual fuel utilization efficiency (AFUE, expressed as a percentage). The efficiency of gas units is shown in AFUE, and no distribution of electric unit efficiencies is given due to the fact that all electric units are assumed to be 100% efficient. Heat pumps are included in the next several tables due to the fact that the heat pump may be the only heating system at the home. They are excluded from the efficiency tables due to low efficiency matching rates.

Table 88 shows the percentage of homes that have one or more heating system. Most homes (57%) have one heating system. For the homes with more than one heating system, the surveyor determined which system was primary and noted it accordingly.

Number of Heating Systems	% of Homes (n=200)	EB
1	57.2%	6.3%
2	16.5%	5.1%
3	7.8%	3.7%
4	4.6%	2.5%
5 or more	13.9%	4.1%

Table 88: Percentage of Homes with Heating System

Table 89 shows the primary heating system type among all houses with heating system types. The majority of all primary heating systems were found to be wall units, totaling 37% of the population of primary heating systems. Space units used as the primary heating system were more common than central units.

	System Type (n=200)	% of Primary Heating Types	EB
Central	Forced Air Furnace	20.2%	5.4%
	Heat pump w/Electric Supp	2.8%	1.9%
	Heat pump w/out Elec Supp	0.9%	0.7%
	Hydronic System	12.9%	4.0%
Space	Baseboards	23.1%	5.2%
	Fireplace	3.1%	2.1%
	Wall Unit	37.0%	6.1%

Table 89: Percentage of Primary Heating Types by Type of System

Table 90 shows the percentage of heating systems by fuel type and system type. These fuel types were taken from the surveyor information. Among all the system types found, the vast majority used electricity. Approximately one-third of all primary heating systems consumed gas. Among all forced air furnaces, 95.3% consumed natural gas.

	System Type	Fuel Type				Sample Size
		Gas		Electricity		
		%	EB	%	EB	
	All Types	32.3%	6.0%	67.7%	6.0%	200
Central	All Central	83.5%	7.0%	16.5%	7.0%	74
	Forced Air Furnace	95.3%	5.4%	4.7%	5.4%	38
	Heat pump w/Electric Supp	-	-	100.0%	-	6
	Heat pump w/no Supp	-	-	100.0%	-	4
	Hydronic System	88.9%	9.9%	11.1%	9.9%	26
Space	All Space	2.5%	2.4%	97.5%	2.4%	126
	Baseboards	-	-	100.0%	-	48
	Fireplace	50.4%	33.8%	49.6%	33.8%	6
	Wall Unit	-	-	100.0%	-	72

Table 90: Percentage of Heating Systems by Fuel Type within Type of Heating System

Table 91 shows the percentage of heating systems by fuel type by state and size of unit. The percentage of units with gas heat was lowest in Oregon and Washington; the sample in those states includes more large units, which are more likely to contain gas heating. All of the residences in the Montana sample were gas heated.

State	Fuel Type	SqFt Bins				Overall
		<800	800 - 1000	1000 - 1400	>1400	
ID	Electricity	-	57%	21%	-	35%
	Gas	100%	43%	79%	100%	65%
	n	3	14	9	2	28
MT	Electricity	-	-	-	-	-
	Gas	100%	100%	100%	100%	100%
	n	3	3	2	2	10
OR	Electricity	100%	100%	72%	-	84%
	Gas	-	-	28%	100%	16%
	n	13	16	23	2	54
WA	Electricity	75%	88%	83%	33%	74%
	Gas	25%	12%	17%	67%	26%
	n	22	18	51	17	108
Overall	Electricity	73%	78%	72%	23%	68%
	Gas	27%	22%	28%	77%	32%
	n	41	51	85	23	200

Table 91: Percentage of Heating Systems by Fuel Type by State - 2006

Table 92 shows the percentage of floor area by fuel type by state from the 2001 study. In 2001, the Oregon market was found to have a low saturation of gas heating as shown below. The Washington market had a significantly higher saturation of gas heated units. When comparing 2006 to 2001 findings, the gas heating saturation looks to have increased in Oregon, going from 6% to 16%, however the error bound is 9% in 2006. The gas heating saturation appears to have decreased in Washington, from 54.5% to 26%.

Area (ft^2)	Percent of Units			
	Oregon		Washington	
	Electric	Gas	Electric	Gas
<800	100.0	0.0	100.0	0.0
800 – 1,000	100.0	0.0	66.9	33.1
1,000 – 1,400	89.5	10.5	2.8	97.1
>1,400	0.0	100.0	0.0	100.0
All Units	93.6	6.3	45.5	54.5

Table 92: Percentage of Floor Area by Fuel Type by State - 2001

Table 93 shows the average estimated age of each type of heating system, and the percentage of each type of heating systems in various manufacture date ranges. As explained previously, the estimated ages were obtained from a combination of the dates that were obtained from the manufacturer information and the surveyor estimates during the on site visit. On average, all types were 1.47 years old.

System Type		Manufactured Date and Estimated Manufactured Date Ranges														Sample Size
		Avg Mfr Age	Ave Mfr EB	2006		2005		2004		2003		2002		2001		
				%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
All Types		1.47	0.09	3.6%	2.3%	54.1%	6.2%	35.2%	5.9%	6.2%	2.6%	0.2%	0.4%	0.6%	1.0%	200
Central	All Central	1.50	0.15	4.9%	3.9%	50.2%	10.6%	34.8%	9.9%	10.1%	5.6%	-	-	-	-	74
	Forced Air Furnace	1.50	0.20	6.4%	6.0%	47.0%	15.5%	36.9%	14.4%	9.7%	7.1%	-	-	-	-	38
	Heat pump w/Electric Supplement	1.92	0.62	-	-	42.2%	34.8%	23.3%	25.4%	34.5%	32.5%	-	-	-	-	6
	Heat pump w/no Supplemental Heat	1.96	0.60	-	-	27.8%	37.8%	48.1%	40.7%	24.1%	34.4%	-	-	-	-	4
	Hydronic System	1.38	0.21	3.8%	6.2%	58.5%	16.4%	33.1%	15.8%	4.6%	7.4%	-	-	-	-	26
Space	All Space	1.45	0.11	2.9%	2.7%	56.3%	7.6%	35.5%	7.3%	4.0%	2.4%	0.4%	0.6%	0.9%	1.5%	126
	Baseboards	1.52	0.20	-	-	60.9%	12.2%	32.4%	11.8%	3.1%	3.0%	1.0%	1.7%	2.6%	4.2%	48
	Fireplace	1.29	0.29	-	-	71.3%	29.3%	28.7%	29.3%	-	-	-	-	-	-	6
	Wall Unit	1.43	0.13	5.0%	10.2%	52.2%	10.2%	38.0%	9.8%	4.8%	3.6%	-	-	-	-	72

Table 93: Average Estimated Age and Percentage of Heating System by Type within Age Ranges

Table 94 shows the percentage of all furnaces by fuel type and capacity range. The capacity of the furnaces was obtained from manufacturer information if the model number linked to one of the databases. The on site estimation of the capacity of the furnaces was used if the model number did not link with the database. More than one-fifth of all units were electric units between 1 and 2.99 kW. The second largest percentage of furnaces was gas units between 55 and 69.99 kBtu.

	Capacity Ranges (n = 200)	% of Furnaces with Capacity	EB
Gas (kBtuh)	24 to 39.99	0.6%	0.7%
	40 to 54.99	6.0%	4.0%
	55 to 69.99	6.2%	2.9%
	70 to 84.99	1.1%	1.1%
	85 to 99.99	0.3%	0.5%
	100 to 114.99	1.7%	2.0%
	115 to 129.99	0.0%	0.0%
Electric (kW)	1 to 2.99	21.8%	5.2%
	3 to 4.99	3.0%	2.2%
	5 to 6.99	1.3%	1.5%
	7 to 8.99	2.1%	1.8%
	9 or Greater	4.2%	2.3%

Table 94: Percentage of All Furnaces with Capacity by Fuel Type within Capacity Ranges

Table 95 shows the average AFUE by system type. Only the units that matched with one of the efficiency databases were included in the analysis below. The average AFUE for central systems is 82.00.

System Type	All Types	Central		
		All Central	Forced Air Furnace	Hydronic System
Average AFUE	82.00	82.00	83.94	82.00
Error Bound	0.0	0.0	1.9	0.0
Sample Size	33	31	29	2

Table 95: Average AFUE by System Type

Table 96 shows the percentage of heating systems with an AFUE by type and AFUE range. The large majority of the forced air furnaces have an AFUE between 78 and 84.99.

AFUE Range	Central					
	All Central (n=33)		Forced Air Furnace (n=31)		Hydronic System (n=2)	
	%	EB	%	EB	%	EB
Below 78	-	-	-	-	-	-
78 - 84.99	68.3%	13.7%	71.2%	14.0%	100.0%	0.0%
85 - 89.99	-	-	-	-	-	-
90 - 96	25.5%	12.5%	28.8%	14.0%	0.0%	0.0%

Table 96: Percentage of Heating Systems by Type within AFUE Ranges

Table 97 shows the overall average AFUE for gas fired forced air furnaces compared with standards. On average, the forced air furnaces meet 1994 minimum standards, but fall short of ENERGY STAR qualifying standards.

Annual Fuel Utilization Efficiency			
Type	Minimum Federal Standard	Minimum Energy Star Standard	Average AFUE
Gas Fired Forced Air Furnace	78	90	83.94

Table 97: Average AFUE Standard Comparison

Table 98 shows the distribution of gas forced air furnace AFUE. None of the furnaces fall below the current federal minimum standard of 78 AFUE.

AFUE Range				
Type	72 to 77.99	78 to 84.99	90 to 96	Sample Size
Gas Forced Air Furnace	-	71.2%	28.8%	31

Table 98: AFUE Bin Distribution

Table 99 and Table 100 show the heating fuel type by state and unit floor area for the 2006 and the 2001 studies. There is noticeable consistency between the two studies in Oregon, where units less than 1,000 square feet of floor area are heated by electric heat. Between the two studies, the percentage of units heated by electric decreased slightly for units between 1,000 and 1,400 square feet. Every home larger than 1,400 square feet in both studies was heated primarily using natural gas as the fuel.

Washington is a different case. While the 2001 study indicated similar trends for heating fuels in both Oregon and Washington (the larger the unit, the more likely it would be heated with natural gas), the RLW study showed this trend in a less absolute way. The 2001 results indicate all units less than 800 square feet were electrically

heated, while the 2006 report suggests that natural gas heating has penetrated that market slightly at approximately 25% of the units of that size.

The 2006 study shows the vast majority of units between 800 and 1400 square feet are heated primarily by electricity, and while the 2001 study shows all larger units (>1,400 square feet) are heated with natural gas, the 2006 study indicates that roughly two-thirds of the units are heated with natural gas and the remaining percentage is heated with electricity.

The results for Idaho and Montana can also be seen in Table 99, though the statistics do not have a comparison in the 2001 study and no sample sizes are presented.

2006 Study								
Unit Area (ft2)	Percent of Units							
	Idaho (n=28)		Montana (n=10)		Oregon (n=54)		Washington (n=108)	
	Electric	Gas	Electric	Gas	Electric	Gas	Electric	Gas
<800	0.0%	100.0%	0.0%	100.0%	100.0%	0.0%	75.1%	24.9%
800 – 1,000	56.7%	43.3%	0.0%	100.0%	100.0%	0.0%	87.6%	12.4%
1,000 – 1,400	21.1%	78.9%	0.0%	100.0%	71.7%	28.3%	83.0%	17.0%
>1,400	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	32.6%	67.4%
All Units	34.9%	65.1%	0.0%	100.0%	84.2%	15.8%	74.3%	25.7%

Table 99: Heating Fuel Type by Unit Floor Area, 2006 Study

Unit Area (ft2)	Percent of Units			
	Oregon		Washington	
	Electric	Gas	Electric	Gas
<800	100.0%	0.0%	100.0%	0.0%
800 – 1,000	100.0%	0.0%	66.9%	33.1%
1,000 – 1,400	89.5%	10.5%	2.8%	97.1%
>1,400	0.0%	100.0%	0.0%	100.0%
All Units	93.6%	6.3%	45.5%	54.5%

Table 100: Heating Fuel Type by Unit Floor Area, 2001 Study

Thermostats

Table 101 shows the percentage of homes by the type of thermostat within each home. The large majority of homes (71%) have mechanical thermostats.

Type	% of Homes (n=195)	Error Bound
Mechanical Thermostat	71.3%	6.2%
Digital Thermostat	27.4%	6.1%
Hybrid Thermostat	1.2%	1.4%

Table 101: Percent of Homes by Type of Thermostat

Pool and Spa

As would be expected in a multifamily setting, there were no pools associated with the tenant spaces. Pools that are part of a common area are addressed in the common area chapter. The only spa found during the course of the multifamily study was in a high-end, luxury apartment.

Consumer Electronics

RLW surveyors were asked to record the number of plug loads in each residence by type. The table below shows the average number of each plug load found in each surveyed home. There are on average 1.9 televisions per home, compared to only 1.1 computers per home.

Consumer Appliances	Average Number (n=199)	EB
Television	1.9	0.1
Video Cassette Recorder	1.6	0.1
Camera Charger	0.6	0.1
Computers	1.1	0.1
Gaming Console	0.5	0.1
Fax Machine	0.2	0.1
Printer	0.8	0.1
Personal Digital Assistant	0.2	0.1
MP3 Player	0.6	0.1
Cell Phone Charger	1.3	0.1
Aquariums	0.5	0.1
Answering Machine	0.4	0.1
Stereos	0.9	0.1
Cordless Phone	1.1	0.1

Table 102: Average Number of Each Plug Load

Large Appliances

Information on other major end uses in the home was gathered. Table 103 presents the percentage of homes that had each of the large appliances surveyed.

Large Appliances	% of Homes (n=200)	EB
Has Attic Fan	5.4%	2.7%
Has Well	0.4%	0.6%
Has Driveway Coil	-	-
Has Crank Case Heater	1.2%	1.4%
Has Photovoltaic System	0.2%	0.4%
Has Welding Equipment	-	-
Has Shop Equipment	1.1%	1.3%
Has Air Cleaner	3.3%	2.2%

Table 103: Percent of Homes with Large Appliances

Building Envelope Components

The following section discuses the findings for building envelope components as observed by the survey. Comparisons to the 2001 study are made where available, while a more detailed comparison of building code standards and compliance for envelope components is presented in the following section titled Building Heat Loss Performance.

Windows

The following section describes the window types at the residences. Information on the type of window frame and the number of panes in each window was recorded during the site visit. If the customer reported that there were multiple types of frames or panes in their home, the predominant window type was observed and recorded. A low-e detector was used on-site to determine the presence of a low-emissivity coating applied by the manufacturer.

Figure 7 shows the breakdown of window frame types among all homes. The majority of window frame types found in homes are non-metal, constituting more than 95% of the glass area in homes.

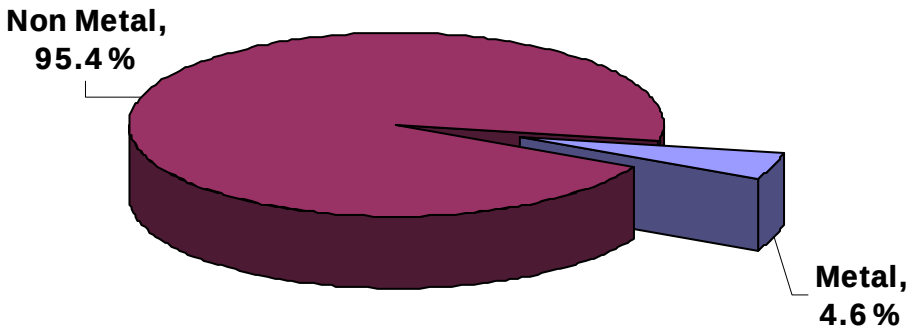

Figure 7: Percentage of Glass Area by Window Frame Type

Table 104 shows the breakdown of homes by window frame type and type of panes by type of residence. Nearly 95% of all the homes have non-metal framed, double paned windows. On an average, approximately 5% of all homes have metal framed, double paned windows. Less than 1% of the homes in the analysis have metal or non-metal single paned windows.

Type of Residence	Window and Pane Type						
	Metal Double		Non Metal Single		Non Metal Double		Sample
	%	EB	%	EB	%	EB	Size
Overall	5.0%	2.7%	0.3%	0.5%	94.7%	2.7%	200
Apartment (1 to 2 stories)	5.0%	4.7%	0.9%	1.4%	94.2%	4.9%	69
Apartment (3 or more stories)	6.8%	4.8%	-	-	93.2%	4.8%	93
Townhouse/Rowhouse	1.6%	2.6%	-	-	98.4%	2.6%	38

Table 104: Percentage of Homes by Frame Type and Panes Type by Type of Residence

Table 105 shows the percentage of homes by glazing characteristics and type of residence. Low-e glazing constitutes 63.7% of the overall window glazing. Non Low-e Glazing constitutes the remaining 36.3% of all homes.

Type of Residence	Window Glazing Characteristics				
	Low E Glazing		Not Low E Glazing		Sample Size
	%	EB	%	EB	
Overall	63.7%	6.1%	36.3%	6.1%	200
Apartment (1 to 2 stories)	47.4%	10.7%	52.6%	10.7%	69
Apartment (3 or more stories)	78.1%	7.4%	21.9%	7.4%	93
Townhouse/Rowhouse	60.2%	14.1%	39.8%	14.1%	38

Table 105: Percentage of Homes by Presence of Low-E Coating

Table 106 presents window performance data, which is characterized by the average total window U-value and a total window area (expressed as a percent of total floor area). Table 106 summarizes window performance as observed during the on-site visits in the 2006 study, while Table 107 displays the results of the 2001 study. The average glazing as a percentage of floor area is very similar between the two studies. The state codes identified and changes to the codes since the 2001 study are discussed in more detail in the Building Heat Loss Performance section.

The results from the comparison of the sampled window U-values to the code U-values should be interpreted with the following two limitations:

1. True window performance data were not collected, only frame type, number of panes and the presence of low-e coatings. RLW then had to estimate actual window u-values using the collected data. In the multifamily market, developers are possibly more likely to buy the cheapest components possible to comply with the building code. Window manufacturers can achieve U-0.40 and meet the Oregon code requirement with a number of techniques that are not visible in the type of inspections done in our survey; so it is possible that the reported U-values are too high.
2. In Oregon, code requirements are different for residential buildings over three stories or in mixed-use commercial buildings; they fall under the commercial building code which has U-values of only 0.50; not the 0.40. So the comparison in Oregon code of U-0.40 is not truly correct. In this study, 43.7% of the study buildings had 3 or more stories; calling into question the appropriate comparison code value for Oregon.

State	Sample		Code	
	U-Value	% of Floor Area	U-Value	% of Floor Area
ID	0.456	10.9%	0.463	8% to 30% glazing to wall area ratio
MT	0.350	8.1%	0.350	
OR	0.442	12.9%	0.400	NA
WA	0.384	13.2%	0.400	15%, opt II
Overall	0.162		0.404	NA

Table 106: Window Performance, 2006 Study

State	Sample	
	U-Value	% of Floor Area
OR	0.410	12.1%
WA	0.430	13.4%

Table 107: Window Performance, 2001 Study

Table 108 shows the percentage of sites within each U-value bin. The majority of the sites have windows with U-values less than 0.4. None of the sites in the sample had an average U-value less than 0.35.

Since the on-site inspectors did not collect actual window performance labels from the occupied homes, it was not possible to determine if the windows used Argon gas to obtain a U-value rating. This missing piece of information could help to explain part of the apparent non-compliance.

State	U-Value > 0.4		U-Value <= 0.4	
	%	EB	%	EB
ID	67%	15%	33%	15%
MT	0%	0%	100%	0%
OR	58%	13%	42%	13%
WA	22%	8%	78%	8%
Overall	37%	7%	63%	7%

Table 108: U-Value Bins, 2006 Study

Wall Construction

Figure 8 shows the breakdown of all homes by wall construction type. The large majority of homes were constructed using 2 x 6s, totaling nearly 82% of all homes.

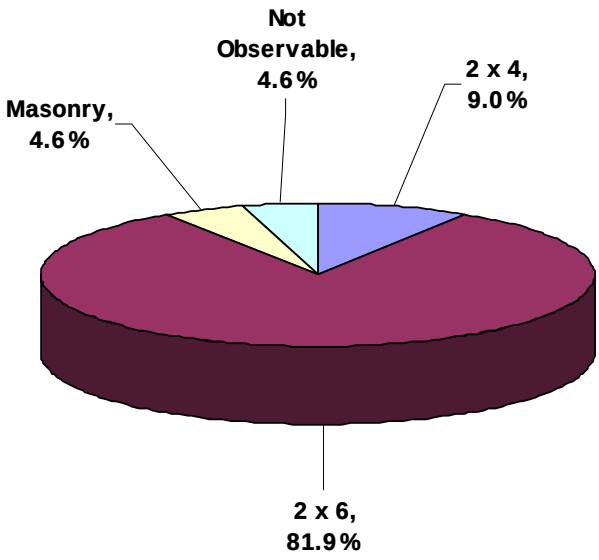

Figure 8: Percentage of Homes by Wall Construction Type

Insulation

The following section describes the insulation in walls, floors, and attics. Along with insulation level, the surface area of each insulated component was measured at each site. The insulation in raised floors and attics was often directly observable in occupied homes, while wall and slab edge insulation typically were not observable. Unobservable insulation levels were determined based on framing size and any documentation available on-site. In the absence of any data the code values for the site location were assigned to these building envelope components. These data were collected with some additional difficulty during the site visits. Difficulty arose when the attic was inaccessible due to the fact that access was blocked by furniture; the homeowner denied the surveyor access, etc. When the attic was accessible and there was batt insulation, in some cases the R-value was not observable, then the surveyor estimated the thickness of the insulation, which was then converted into R-value.

Attic

The average R-value among all homes with an estimated or verified R-value for attic insulation is 27.8 with an error bound of 2.2. Table 109 shows the average R-value and the percentage of homes with R-values in ranges by age of residence. The largest percent of homes are in the range between R-38 to R-41.99, totaling 62.8% of the homes with an R-value.

In the event that the surveyor was only able to record the inches of the batt insulation, the CEC residential Title-24 manual was referenced in order to translate the inches into R-value. In the event that the surveyor was only able to record the inches of the blown in insulation, the number of inches was multiplied by 3.5 to arrive at the R-value. The overall attic R-value was calculated as the sum of the R-values for blown-in and batt insulation.

Type of Residence	Average R Value	Average R Value Error Bounds	Adiabatic		R11 to R18.99		R19 to R21.99		R30 to R37.99		R38 to R41.99		Sample Size
			%	EB	%	EB	%	EB	%	EB	%	EB	
Overall	27.8	2.2	21.2%	5.7%	1.7%	1.5%	4.7%	2.7%	9.5%	3.8%	62.8%	6.6%	170
Apartment (1 to 2 stories)	29.6	3.9	18.2%	10.4%	-	-	3.3%	3.7%	10.7%	6.6%	67.9%	11.4%	58
Apartment (3 or more stories)	23.7	3.2	30.5%	8.7%	3.7%	3.2%	5.8%	4.6%	7.9%	4.7%	52.2%	9.3%	85
Townhouse/Rowhouse	34.8	2.5	3.7%	5.9%	-	-	4.4%	5.1%	11.7%	10.7%	80.2%	12.8%	27

Table 109: Average R-value and Percentage of Homes with Attic R-values within R-value Bins

Walls

The percentage of insulated homes with different insulation levels are presented in the table below. Among those homes where it was possible to observe the percentage of the walls that were insulated, the percentage of homes with R21 is 45.2%.

Construction Type	Insulation Level												Sample Size
	None		R 11		R 13		R 15		R 19		R 21		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
All Types	7.3%	3.9%	-	-	7.0%	3.4%	2.8%	2.6%	37.7%	7.0%	45.2%	7.2%	141
2 X 4	-	-	-	-	92.8%	11.4%	-	-	7.2%	11.4%	-	-	12
2 X 6	2.6%	2.4%	-	-	-	-	3.3%	3.0%	41.3%	7.7%	52.8%	7.9%	121
Masonry	73.9%	25.9%	-	-	-	-	-	-	26.1%	25.9%	-	-	8

Table 110: Percentage of Homes by Wall Construction Type by Insulation Level

Floor

The following table displays the percentage of homes for which an R-value was obtained for the floor insulation. Over 27% of all homes are slab on grade.

Floor R-Value (n=200)	ID	MT	OR	WA	Overall
R13	9%	16%	0%	1%	3%
R19	8%	49%	22%	2%	11%
R21	8%	0%	0%	2%	2%
R25	0%	0%	4%	1%	2%
R30	0%	0%	45%	10%	17%
Adiabatic	16%	0%	0%	28%	17%
Slab	55%	36%	19%	24%	27%
Unknown	3%	0%	10%	32%	21%
n	28	10	54	108	200

Table 111: Percentage of Homes with Floor R-values

Table 112 shows the percentage of homes with basements. Less than 4% of multifamily homes are above basements.

Basement (n=200)	Percentage	EB
None	96.8%	2.4%
Finished, Conditioned	1.4%	1.6%
Unfinished, Conditioned	1.3%	1.6%
Unfinished, Unconditioned	0.6%	1.0%

Table 112: Percent of Homes with Basement Type

Insulation Performance

This section presents an analysis that compares the current assembly U-values to those found in the 2001 baseline study. The 2001 study focused on the envelope characteristics, as well as heating, cooling, and water heating equipment obtained from building plans, with a limited amount of appliance efficiency or lighting data presented. For the 2006 study NEEA decided to look more comprehensively at appliances and lighting. To obtain an accurate picture of appliance and lighting saturation, the homes needed to be audited after they were fully occupied, which made it more difficult to obtain accurate envelope data.

In some instances, the surveyors had to make assumptions about the levels of insulation, whereas in the previous study, the insulation and code values were on the plans that the contractors obtained.

Therefore, these tables contain RLW's best estimates of the insulation levels in homes, however it must be acknowledged that if the study's primary goal were to obtain the most accurate envelope characteristics information available, then the study would have been performed on unoccupied, non-finished homes.

Assembly U-Values

The on-site surveyors collected data on frame types and insulation levels of individual building components during the site visits. These components were examined independently and the U-values for each assembly are presented below. Because of the variations in code, code enforcement, building standards, and market conditions, the states vary on many components associated with energy efficiency. For all states, RLW compared building component heat loss performance to the energy code reference prescriptive compliance path, or base path, associated with each home's location.

Building component insulation levels were collected on-site in terms of R-value. In order to compute heat loss rates. RLW used the R-value to U-value conversions found in Chapter 10 of the 2004 Washington State Energy Code. There is wide variation of assembly U-values with the same cavity insulation level (R-value). RLW chose the representative assemblies based on the table of R-value and U-value in the Washington State Energy Code, which specifies both U-value and R-value for most building components.

Table 113 summarizes the U-values associated with the opaque components of the residential buildings in 2006. Average U-Values exceeded code in walls. Floor U-values surpassed the minimum code for Oregon, ceiling U-values were above code for both states, while window U-values were better than code in Washington. Table 114 shows the results from the 2001 study.

There has been a lot of discussion regarding some increases in code. We utilized the most current energy codes for each state. Below is some discussion about the code values that are presented.

Compliance method:

Because RLW did not obtain building plans for the homes, we were not aware which compliance method was used for the home. Prescriptive or whole building alternates to the prescriptive approach. The handful of high rise units were excluded from this analysis, thus the single-family code was used. Under a non-prescriptive run, builders can trade off envelope efficiency for increased heating, cooling, or water heating efficiency. In addition, plan details of the construction assemblies used at each site such as stud spacing, additional rigid insulation, and alternative building materials have an impact on U-value assignments.

The prescriptive code varies by state depending on glazing % of floor area, climate zone, wall construction type, and occupancy type. Without knowing the exact code that was used to gain compliance for the residence, the code values presented in this report are best approximations of the actual code values.

Floor:

The sample and code values presented in Table 113 are for raised floors only.

Ceiling:

The 2001 study reported a ceiling code U-value of 0.026 for every state. Since 2001 the code for ceiling insulation has increased in all four states.

The 2004 Washington State Energy Code (WSEC) calls for a U-value of 0.031 for dropped ceilings and 0.034 for vaulted ceilings for the entire state under the prescriptive requirements.

The 2005 Oregon Residential Energy Code calls for a U-value of 0.031 under Path 1 of the prescriptive code.

The 2003 International Energy Conservation Code used for Montana requires a U-value of 0.026 representing a “nominal” insulation value of R-49 or R-38 with a standard framed ceiling of R-38 with advanced framing.

State Code References:

State	Code Used	Notes
Idaho	2003 International Energy Conservation Code (IECC), no state amendments	In 2003, Idaho began using IECC as their building code. Prior to that, Idaho used the Idaho Building Code Act that was not strictly enforced (used for the 2001)
Montana	2003 IECC	Montana amendments
Oregon	March 2005 Oregon Residential Energy Code, Table N1104.1(1) Base Path 1 (The code U-values have been at or very close to the current values since 1992)	The residential energy code provides a Base Path (Path 1) for code compliance that is used for the majority of new construction. All new buildings are required to be built in compliance with the Base Path or one of the nine other "Prescriptive Paths." Paths 2-8 provide design flexibility and are generally energy-equivalent to the Base Path. Path 9 allows for log home construction. Path 10 allows for 2x4 exterior wall
Washington	2004 Washington State Energy Code Second Edition, and the Energy Code Builder's Field Guide	The current edition of the WSEC was adopted effective July 1, 2004.

As mentioned previously in the window U-value section, the results from the comparison of the sampled window U-values to the code U-values should be interpreted with the following two limitations:

1. True window performance data were not collected, only frame type, number of panes and the presence of low-e coatings. RLW then had to estimate actual window u-values using the collected data. In the multifamily market, developers are possibly more likely to buy the cheapest components possible to comply with the building code. Window manufacturers can achieve U-0.40 and meet the Oregon code requirement with a number of techniques that are not visible in the type of inspections done in our survey; so it is possible that the reported U-values are too high.
2. In Oregon, code requirements are different for residential buildings over three stories or in mixed-use commercial buildings; they fall under the commercial building code which has U-values of only 0.50; not the 0.40. So the comparison in Oregon code of U-0.40 is not truly correct. In this study, 43.7% of the study buildings had 3 or more stories; calling into question the appropriate comparison code value for Oregon.

All homes in the study were permitted in 2004 or later. Recall that the actual compliance documentation was not reviewed for these homes. Specific permit dates for each home were not available. The codes referenced are the most recent revisions and most likely code applicable to all sites in each state.

State	Wall		Floor		Ceiling		Window		Sample Size
	Sample	Code	Sample	Code	Sample	Code	Sample	Code	
OR	0.061	0.060	0.032	0.034	0.032	0.031	0.442	0.400	44
WA	0.068	0.058	0.030	0.029	0.030	0.031	0.384	0.400	81

Table 113: U-Value Comparison of Components (Btu/hr-F-ft2) 2006 Study

State	Wall	Floor	Ceiling	Window
	Sample	Sample	Sample	Sample
OR	0.059	0.069	0.032	0.410
WA	0.064	0.046	0.033	0.430

Table 114: U-Value Comparison of Components (Btu/hr-F-ft2) 2001 Study

State	Wall		Floor		Ceiling		Window		Sample Size
	Sample	Code	Sample	Code	Sample	Code	Sample	Code	
OR	0.001	0.000	0.001	0.000	0.001	0.000	0.027	0.000	44
WA	0.013	0.001	0.001	0.000	0.001	0.000	0.014	0.000	81

Table 115: Error Bounds of U-Values (2006 Study)

Building heat Loss Performance

Overall building heat loss rates were developed from the building characteristics data and assembly areas, and were normalized by conditioned floor area of the home. Code heat loss rates were developed by applying the most recent versions of the residential code values to the sample homes. Each state's residential building code was used to determine each home's compliance or non-compliance. The overall heat loss rates were calculated using Washington State Energy Code, Chapter 5, Equation 3, which can be found in Appendix A. The basic formula is shown below:

$$UA_{total} = \sum_{n=1}^{x} U_n A_n$$

Where U is the U-value for each independent component and A is the associated area. X is the number of opaque and glazed building components including windows, floors, ceilings, walls, doors and slab. The measured component areas were used for both the code UA and site UA, so that the only variable was the component U value.[4]

It should be noted here that energy code compliance is demonstrated at the building level for multifamily units. Thus a particular unit in our sample may or may not "comply" based on the prescriptive code compliance base path for that location while the entire building meets code requirements.

The overall heat loss rates reported in the previous study included heat loss due to air infiltration. This factor in the 2001 study was assigned based on the *Super Good Cents Heat Loss Reference*[5]. Since our study included performance testing, the heat loss due

[4] For slab-on-grade and below grade slabs the measured perimeter and appropriate F-factor were used following the WSEC method

[5] Davis, B. ; Baylon, D. ; Kennedy, M. **Super good cents heat loss reference.** Research Org: Ecotope, Inc., Seattle, WA (USA); Sponsoring Org: DOE;USDOE, Washington, DC (USA); 1991 Feb 01

to measured air infiltration was added to the overall heat loss for each site. The atmospheric conditions, heat capacity-density product of dry air, were based on the Conservation and Renewable Residential Specifications from the Bonneville Power Authority (October 1, 2002). This document assigns a heat capacity-density product to the three heating zones of the Regional Technical Forum because the average elevation above sea level varies across the Northwest affecting the density of dry air. Heat loss due to infiltration is calculated using the following equation:

$$UA_{\text{inf } il} = ACH * V * HCP$$

Where ACH is the measured infiltration rate, V is the measured conditioned volume, and HCP is the heat capacity-density product for the appropriate elevation.

Similar to the previous section, results are presented as comparisons between this study and the 2001 study. The average overall building heat loss rates and the code reference can be seen in the following two tables. The differences in methodologies between the two studies are most apparent in this comparison. RLW did not obtain building plans for the homes, and therefore was unaware which compliance method was used for the home. As mentioned previously, RLW did not always have access to accurate construction R-values onsite in completed homes compared to the details available on plans in terms of cavity and framing characteristics for envelope assemblies. This fundamental difference in data collection methodology may lead to larger or smaller than actual discrepancies between the two studies.

The decrease in overall heat loss rates per square foot is likely due to a number of factors, the most significant of which is the improved window U-values. Another factor is the heat loss due to infiltration. Measured infiltration in these homes was fairly low resulting in a low UA_{infil}. Another possible contributor to the lower normalized heat loss rate is the high percentage of multi-story buildings in the sample. In the current study, just under two-thirds of the homes are multiple-story dwellings. The distribution of multi-story dwellings is not presented in the 2001 report. A multi-story home has less heat loss surface per square foot of floor area than a single-story home.

RLW has not included a % pass rate for this study since we did not collect building plans for each site and therefore do not know the exact pass fail rate for the homes.

State	Overall Heat Loss		Sample Size
	Buildings	Code	
OR	0.188	0.162	49
WA	0.142	0.131	82
Overall	0.175	0.157	169

Table 116: Overall Heat Loss Rates (by State), 2006 Study

State	Sample UA/sf	Code UA/sf
OR	0.164	0.168
WA	0.183	0.200

Table 117: Overall Heat Loss Rates (by State), 2001 Study

Multifamily Common Area

The multifamily common area data analysis is summarized in this chapter. One hundred complexes were surveyed for this study. Forty-one complexes in the sample do not have any common space, leaving 59 complexes that are analyzed in this chapter. Many of the following analyses are based upon different sample sizes since some data points were not applicable to all buildings. There are some very large error bounds around these results due to the small sample sizes and the results should be used accordingly.

General Characteristics

The majority of the buildings in the study were permitted in 2004. This was extended by a year in some areas that had not seen much or any recent multifamily construction. The average age of all the buildings is 1.7 years.

Of the surveyed sites, only four had a predominant[6] construction type of masonry, only 5 had steel construction, and the remaining 91 had wood frame construction. A combination of lack of access to the attic space, and a lack of knowledge by the occupants and on-site managers led to a small amount of insulation information. Of the areas with common space, attic insulation values were found for only nine sites. Two sites have R-30 insulation, one has R-28, two have R-19, one has R-13, and three have no attic insulation at all.

As seen in Table 118, the most common window and frame combination is double-pane glass in a vinyl frame at 96% of all window/frame combinations. This large share of the market is attributable to the ability of double-pane vinyl windows to meet code requirements while being the least expensive window available. Wood framed windows account for only 3% of the area. This is a reflection of the custom home builders that were part of the sample.

Predominant Window/Frame Type	% of SF n=59	EB
Single Wood	0.5%	0.8%
Double Metal	0.3%	0.4%
Double Wood	2.9%	3.8%
Double Vinyl	96.3%	4.0%

Table 118: Predominant Window and Frame Types

Table 119 shows the average window to wall ratio for all buildings. The minimum for each orientation is zero and the maximum is 76%.

[6] A very small number of sites have multiple construction types. For the sake of analysis, we selected the construction type that accounted for the largest percentage of the total square footage.

Orientation	Window to Wall Ratio n=100	EB
North	17.2%	1.7%
Northeast	15.0%	4.5%
East	13.9%	2.1%
Southeast	20.7%	4.4%
South	16.3%	1.7%
Southwest	17.6%	6.8%
West	14.6%	2.2%
Northwest	19.8%	3.3%

Table 119: Average Window to Wall Ratio

Heating and Cooling

All of the common area in 50 of the complexes is heated. The different system types can be seen in Table 120. Heat pumps are the most common and heat 37% of the common area.

Heating System Type	% of SF n=50	EB
Forced Air Furnace	23.4%	14.0%
Baseboard	9.3%	7.3%
Wall	9.0%	6.4%
Hydronic	4.7%	6.4%
Boiler	15.9%	19.1%
Heat Pump	37.0%	18.0%
Window Unit	0.7%	1.1%

Table 120: Heating System Type

Table 121 shows the percentage of fuel types. Nearly 57% of all sites use electricity as the main method of heating the common area spaces.

Fuel Type	Percentage n=50	EB
Gas	40.1%	14.5%
Electric	56.8%	14.4%
Propane	1.0%	1.6%
Other	2.7%	3.5%

Table 121: Heating Fuel Types

Thirty-seven sites have common areas that are air conditioned. Of these sites over 70% use split systems, nearly 20% use room, or wall/window air conditioners. Very few sites use packaged a/c like those commonly found in commercial buildings.

Washers and Dryers

Of the 100 sites visited, only 20 were found to have washers. The same 20 complexes were found to have dryers. Table 122 shows the percentage of dryers by fuel type. The majority of dryers are gas at 58.3% of all dryers.

Dryer Fuel Type	Percentage n=20	EB
Gas	58.3%	21.0%
Electric	41.7%	21.0%

Table 122: Percentage of Dryers by Fuel Type

Water Heaters

Forty-three of the apartment complexes have water heaters specifically for the common area. As illustrated in Table 123, over 43% of the area is served by electric water heaters.

Water Heater Type	% of SF n=43	EB
Gas	36.9%	18.2%
Electric	43.9%	20.0%
Unknown	3.4%	4.6%
Other	15.7%	21.3%

Table 123: Water Heater Fuel Types

Pools and Spas

Of all the apartment complexes visited, only 10 sites have pools and seven complexes have a spa. With such small quantities of pools and spas surveyed, the data are only briefly summarized here.

All but one of the pools are located outdoors and heated with natural gas. Only one pool was found to be heated during the winter months and only two of the pools had a cover.

The seven spas in the sample are heated with gas throughout the year. All but one spa are located outdoors and do have a cover in place.

Indoor Lighting

The indoor lighting data were collected by space type. The majority of common area space in multifamily complexes is comprised of hallways as seen in Table 124. The second largest space is activity spaces, totaling 13% of the common area. None of the remaining spaces constitute more than 10% of the common space in the complexes. The 'Other' category consists of bathrooms, storage rooms, trash rooms, etc.

Space Type (n=59)	Percent of Common Area	EB
Hallway	34%	9%
Other	20%	7%
Activity	13%	4%
Lobby	10%	4%
Rec Room	8%	3%
Office	8%	3%
Laundry	8%	4%
Building Services	0.5%	0.5%

Table 124: Percentage of Space Types

As seen in Table 125 there is a large range from the lowest to the highest LPD for each space type. There are also very large error bounds around these results due to the small sample sizes for each space.

Space Type	Average LPD	EB	Minimum	Maximum	Sample Size
Activity	0.72	0.20	0.10	4.97	23
Building Srvcs	0.89	0.45	0.29	2.42	5
Hallway	0.22	0.12	0.04	6.32	35
Laundry	0.54	0.18	0.24	3.00	19
Lobby	1.19	0.17	0.27	4.20	25
Office	1.08	0.27	0.20	3.17	30
Other	0.19	0.10	0.06	1.61	20
Rec Room	1.29	0.34	0.21	5.37	25

Table 125: Average, Min, and Max of Lighting Power Density

There are three predominant types of lighting technology found in multifamily common areas: CFL, linear fluorescent, and incandescent. The average wattage for a CFL fixture is 15 watts, see Table 126. For a linear fluorescent fixture the average is 39 watts for a T-12 lamp and 32 watts for a T-8 lamp. Standard incandescent fixtures average 58 watts per lamp, and incandescent halogen lamps average 57 watts.

Lamp Type	Average Watts	EB	Sample Size
Compact Fluorescent	14.7	0.99	35
Fluorescent T12	39.3	3.13	14
Fluorescent T8	32.1	0.65	30
Incandescent Halogen	56.6	4.68	18
Incandescent Standard	58.5	2.75	37

Table 126: Average Wattage by Technology

Table 127 shows the breakdown of lamps by lamp type. Fluorescent T-8 lamps are the most common lamps, followed by standard incandescent lamps, and then compact fluorescent lamps.

Lamp Type (n=58)	% of Lamps	EB
Compact Fluorescent	20%	10%
Fluorescent T12	14%	10%
Fluorescent T5	0%	0%
Fluorescent T8	38%	17%
Fluorescent U-Tube	1%	2%
Incandescent Halogen	5%	3%
Incandescent Standard	21%	6%

Table 127: Percentage of Lamps by Lamp Type

This concludes the Multifamily Residential New Construction Baseline Study Report. A final study appendix is also available that contains more detailed information on how the data analyses were performed and describes the final study datasets.

MULTIFAMILY RESIDENTIAL NEW CONSTRUCTION CHARACTERISTICS AND PRACTICES STUDY

Appendix

March 21, 2007

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Table of Contents

Multifamily Lighting Data Tables and Queries

LIGHTING TABLE DEFINITIONS

All - Fixtures Table

The All - Fixtures Table contains the number of fixture types per room type in each home.

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Room	Room type	
Number of Fixtures	Total fixtures in house	
Archit_Integrated	Number of architecturally integrated fixtures	
Ceiling Fan	Number of ceiling fan fixtures	
Ceiling Fixtures	Number of ceiling fixtures	
Chandelier Hanging	Number of hanging chandelier	
Floor Lamp	Number of floor lamps	
Garage Door Opener	Number of garage door openers	
Other	Number of other fixtures	
Recessed can	Number of recessed can fixtures	
Recessed lighting Other	Number of recessed lighting other fixtures	
Table lamps	Number of table lamps	
Torchiere	Number of torchieres	
Track lighting	Number of track lighting fixtures	
Under Counter	Number of under counter fixtures	
Wall mount	Number of wall mount fixtures	

All - Lamps Table

The All – Lamps Table contains the number of lamp types per room type in each home.

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Room	Room type	
Total Lamps	Total number of lamps in the house	
CF-I-A	Number of A-type compact fluorescent lamps with an integrated ballast	
CF-I-CAP	Number of capsule compact fluorescent lamps with an integrated ballast	
CF-I-CIRC	Number of circline-type compact fluorescent lamps with an integrated ballast	
CF-I-DEC	Number of decorative-type compact fluorescent lamps with an integrated ballast	

CF-I-FLOOD	Number of flood-type compact fluorescent lamps with an integrated ballast	
CF-I-GLO	Number of globe-type compact fluorescent lamps with an integrated ballast	
CF-I-SPRN	Number of spring-type compact fluorescent lamps with an integrated ballast	
CF-I-TUBE	Number of tube-type compact fluorescent lamps with an integrated ballast	
CF-I-UNK	Number of unknown type compact fluorescent lamps with an integrated ballast	
CF-MINI	Number of miniature compact fluorescent lamps	
CF-PIN-BASE	Number of pin based compact fluorescent lamps with an integrated ballast	
F-12	Number of F-12 fluorescent lamps	
F-4	Number of F-4 fluorescent lamps	
F-5	Number of F-5 fluorescent lamps	
F-8	Number of F-8 fluorescent lamps	
F-CIR	Number of circline fluorescent lamps	
F-OTH	Number of other fluorescent lamps	
F-TUBE-UNK	Number of unknown fluorescent lamps	
HAL-MR	Number of halogen MR lamps	
HAL-OTH	Number of other halogen lamps	
HAL-PAR	Number of halogen PAR lamps	
HAL-QTZTUB	Number of halogen quartz tube lamps	
HAL-UNK	Number of unknown halogen lamps	
HEAT LAMP	Number of heat lamps	
I-DEC	Number of incandescent decorative lamps	
I-FLOOD	Number of incandescent flood lamps	
I-GLO	Number of incandescent globe lamps	
I-MINI	Number of incandescent mini lamps	
I-OTH	Number of other incandescent lamps	
I-STD	Number of incandescent standard A-type lamps	
I-UNK	Number of unknown incandescent lamps	

Control and Wattage ALL Table

The Control and Wattage ALL table contains the inventory of fixture type and quantity, lamp type, wattage, and quantity, and control type in each room of the home.

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Room	Room type	
FixType	Type of light fixture	
FixQTY	Number of each fixture	
LampType	Lamp technology installed in fixture	
LampQTY	Number of lamps per fixture	
LampWATTS	Wattage of lamps in fixture	
Total Lamp Qty	Number of similar lamps in similar fixtures	
LControl	Switch, timer, dimmer, motion, photo	
Fixture Number	Unique number identifier generated for fixture	

Fan Lamp Types Table

The Fan Lamp Types table provides the total number of ceiling fans as well as the number of ceiling fans in the home containing each lamp type.

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Number of Fans	Number of Ceiling Fans in the Home	
CF CFU	Number of Ceiling Fans Containing a Compact Fluorescent Unknown Lamp	
CF CI	Number of Ceiling Fans Containing a Compact Fluorescent Integral Lamp	
CF CO	Number of Ceiling Fans Containing a Compact Fluorescent Other Lamp	
CF DK	Number of Ceiling Fans Containing an Unknown Lamp	
CF FC	Number of Ceiling Fans Containing a Fluorescent Circline Lamp	
CF HO	Number of Ceiling Fans Containing a Halogen Other Lamp	
CF IA	Number of Ceiling Fans Containing a Standard Incandescent Lamp	
CF ID	Number of Ceiling Fans Containing an Incandescent Decorative Lamp	
CF IG	Number of Ceiling Fans Containing an Incandescent Globe Lamp	
CF IO	Number of Ceiling Fans Containing an Incandescent Other Lamp	
CF IR	Number of Ceiling Fans Containing an Incandescent Reflector Lamp	
CF IU	Number of Ceiling Fans Containing an Incandescent Unknown Lamp	

General Information Table

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Type of Residence	Single Family Home, Apartment, etc.	
Total People	Total Number of Residents at Site	
Total Adults	Total Number of Adults at Site	18 and Over
People Under 1 year	Total Number of People Under 1 Year at Site	
People 2 to 5 years	Total Number of People between 2 to 5 years at site	
People 6 to 18 years	Total Number of People between 6 to 18 years at site	
People 18 to 29 years	Total Number of People between 18 to 29 years at site	
People 30 to 49 years	Total Number of People between 30 to 49 years at site	
People 50 to 64 years	Total Number of People between 50 to 64 years at site	
People 65 or more years	Total Number of People over 65 years at site	
Income	Annual Household Income Range	Resident Supplied
Total Heated Sqft	Square Footage Range of Residence	
Age Range	Age Range of Residence	
Rent or Own	Ownership Status of Residence	
Who Pays Electric? (Occ or Landlord)	Responsibility for Electric Bill	
Who Pays Gas?	Responsibility for Gas Bill	
Total Heated Floorspace	Square Footage of Heated Floorspace of Residence	

Rooms – Fixtures Table

The Rooms - Fixtures table provides, for each room type including the whole house, the total number of fixtures as well as indicator variables indicating whether the site had a particular fixture type and lamp type combination.

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Room	Room Type	
Number of Fixtures	Total Number of Fixtures	
Archit_ Integrated	Count of Architecturally Integrated Fixtures	
Ceiling Fan	Count of Ceiling Fan Fixtures	
Ceiling fixtures	Count of Ceiling Mounted Fixtures	
Chandelier Hanging	Count of Chandelier/Hanging Fixtures	
Floor Lamp	Count of Floor Lamps	
Garage Door Opener	Count of garage door openers	

Other	Count of other fixtures	
Recessed can	Count of recessed can fixtures	
Recessed lighting Other	Count of recessed lighting other fixtures	
Table lamps	Count of table lamps	
Torchiere	Count of torchieres	
Track lighting	Count of track lighting fixtures	
Under Counter	Count of under counter fixtures	
Wall mount	Count of wall mount fixtures	

Rooms – Lamps Table

The ROOMS - FIXTURES - LAMP SUMMARIES table provides, for each room type including the whole house, the total number of fixtures as well as indicator variables indicating whether the site had a particular fixture type and lamp type combination. Here, the lamp types have been categorized by lamp technology.

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
ROOM	Room Type	
Total Lamps	Total Number of Lamps	
CF-I-A	Number of A-type compact fluorescent lamps with an integrated ballast	
CF-I-CAP	Number of capsule compact fluorescent lamps with an integrated ballast	
CF-I-CIRC	Number of circline-type compact fluorescent lamps with an integrated ballast	
CF-I-DEC	Number of decorative-type compact fluorescent lamps with an integrated ballast	
CF-I-FLOOD	Number of flood-type compact fluorescent lamps with an integrated ballast	
CF-I-GLO	Number of globe-type compact fluorescent lamps with an integrated ballast	
CF-I-SPRN	Number of spring-type compact fluorescent lamps with an integrated ballast	
CF-I-TUBE	Number of tube-type compact fluorescent lamps with an integrated ballast	
CF-I-UNK	Number of unknown type compact fluorescent lamps with an integrated ballast	
CF-MINI	Number of miniature compact fluorescent lamps	
CF-PIN-BASE	Number of pin based compact	

	fluorescent lamps with an integrated ballast	
F-12	Number of F-12 fluorescent lamps	
F-4	Number of F-4 fluorescent lamps	
F-5	Number of F-5 fluorescent lamps	
F-8	Number of F-8 fluorescent lamps	
F-CIR	Number of circline fluorescent lamps	
F-OTH	Number of other fluorescent lamps	
F-TUBE-UNK	Number of unknown fluorescent lamps	
HAL-MR	Number of halogen MR lamps	
HAL-OTH	Number of other halogen lamps	
HAL-PAR	Number of halogen PAR lamps	
HAL-QTZTUB	Number of halogen quartz tube lamps	
HAL-UNK	Number of unknown halogen lamps	
HEAT LAMP	Number of heat lamps	
I-DEC	Number of incandescent decorative lamps	
I-FLOOD	Number of incandescent flood lamps	
I-GLO	Number of incandescent globe lamps	
I-MINI	Number of incandescent mini lamps	
I-OTH	Number of other incandescent lamps	
I-STD	Number of incandescent standard A-type lamps	
I-UNK	Number of unknown incandescent lamps	

Torchiere Lamp Types Table

The Torchiere Lamp Types table provides the total number of torchieres as well as the number of torchieres in the home containing each lamp type.

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Number of Torchieres	Number of Torchieres in the Home	
TO CFU	Number of Torchieres Containing a Compact Fluorescent Unknown Lamp	
TO CI	Number of Torchieres Containing a Compact Fluorescent Integral Lamp	
TO CO	Number of Torchieres Containing a Compact Fluorescent Other Lamp	
TO FC	Number of Torchieres Containing a Fluorescent Circline Lamp	
TO HO	Number of Torchieres Containing a Halogen Other Lamp	
TO HT	Number of Torchieres Containing a Halogen Tubular Lamp	
TO IA	Number of Torchieres Containing a Standard Incandescent Lamp	

TO ID	Number of Torchieres Containing an Incandescent Decorative Lamp	
TO IR	Number of Torchieres Containing an Incandescent Reflector Lamp	

CATEGORY QUERIES

Categories – Gen

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
State	State where Residence is Located
Stratum	Stratification Variable

Categories – Rooms

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
State	State where Residence is Located
Stratum	Stratification Variable
Room	Room Type (required for all queries in this category)

ANALYSIS QUERIES

Gen - Average Lamps Per Fixture – SBA

Basis	Special Basis Query: SB - Rooms - Average Lamps Per Fixture
Description	Returns the average number of lamps in each fixture type

Gen - Average Num CF in Homes with CF

Basis	One for all homes with at least one CFL
Description	Returns the average number of CFLs in Homes that have at least one CFL

Gen - Average Number of Fixtures by Type

Basis	One for all homes
Description	Returns the average number of fixtures per home

Gen - Average Number of Lamps by Base Type

Basis	One for all rooms
Description	Returns the average number of lamps per home by base type (screw-base or pin-base)

Gen - Average Number of Lamps by Type

Basis	One for all lamp types
Description	Returns the average number of lamps for each technology type

Gen - Ceiling Fan Base Type

Basis	The number of ceiling fan fixtures in the home
Description	Returns the percentage of pin and screw based ceiling fan fixtures

Gen – HasCFan

Basis	One for all homes
Description	Returns the percentage of homes with at least ceiling fan fixture

Gen - Have Torchiere

Basis	One for all homes
Description	Returns the percentage of homes with at least one torchiere fixture

Gen - Lamp ABB Presence WH

Basis	One for all homes
Description	Returns the percentage of homes with at least one incandescent, fluorescent, compact fluorescent, or halogen lamp.

Gen - LPD by Wiring Status

Basis	The home floor area in square feet
Description	Returns the average wattage per square foot for the homes

Gen – Number of Fixture Bins

Basis	One for all homes
Description	Returns the number of fixtures in a home by bins (1-10,..., 41-50, More than 50)

Gen – Number of Lamps Bins

Basis	One for all homes
Description	Returns the number of fixtures in a home by bins (1-20,..., 81-100, More than 100)

Gen - Percent CFL by Base Type

Basis	The number of lamps in screw-based sockets
Description	Returns the percentage of lamps in screw-based sockets that are CFL

Gen – Percent Lamp Type by Technology

Basis	One for all homes
Description	Returns the percentage of homes that have CFL, fluorescent, incandescent, or halogen lamps

Gen - Percent of Ceiling Fans with Bulb Count

Basis	Number of fans per home
Description	Returns the percentage of homes with 1-8 lamps per ceiling fan fixture (in one lamp increments)

Gen - Percent of Ceiling Fans with Lamp Types

Basis	Number of fans per home
Description	Returns the percentage of different lamp types contained within ceiling fan fixtures

Gen - Percent of Fixtures by Type

Basis	Total fixtures per home
Description	Returns the percentage composition of fixtures type for the whole house

Gen - Percent of Fixtures with CFL – SBA

Basis	Special Basis Query: SB - Percent of Fixtures with CFL
Description	Returns the percentage of fixtures that contain a compact fluorescent lamp

Gen - Percent of Homes with CFL Quantity

Basis	One for all sites
Description	Returns the percentage of homes containing 0-Greater than 15 compact fluorescent lamps (in one CFL increments)

Gen- Percent of Lamps by Base Type

Basis	Sub – Percent of Lamps by Base Type
Description	Returns the percentage of all lamps that are pin-based or screw-based

Gen - Percent of Torchieres with Lamp Types

Basis	Number of Torchieres per Home
Description	Returns the percentage of different lamp types contain in Torchiere fixtures

Gen – Presence of Fixture Type WH

Basis	One for each home
Description	Returns which fixture types are present in each home

Gen - Presence of Lamp Type by Technology

Basis	One for each home
Description	Returns which lamp types are present in each home

Gen - Presence of Lamp Type in Home

Basis	One for all homes
Description	Returns the percentage of homes that have specific lamp types

Gen – Recessed can overview

Basis	One if recessed can is present; 0 if not present
Description	Returns the average number of pin vs. screw based recessed can fixtures

Gen – Recessed Can Overview2

Basis	Rooms – Recessed Can Overview 2
Description	Returns the percent of recessed can fixtures with screw based CFLs

Gen – Recessed Can Overview3

Basis	Rooms – Recessed Can Overview 3
Description	Returns the percentage of pin based and screw based CFLs in recessed can fixtures

Gen – Specific Fixture Overview WH

Basis	Total fixtures per home
Description	Returns the percentage composition of fixtures type for the whole house

Rooms - Average Fixture Wattage – SBA

Basis	Special Basis Query: SB - Rooms - Average Fixture Wattage
Description	Returns the average wattage for each fixture per room and whole house

Rooms - Average Lamp Wattage – SBA

Basis	Special Basis Query: SB - Rooms - Average Lamp Wattage
Description	Returns the average wattage for each lamp type per room and whole house

Rooms - Average LampABB Wattage – SBA

Basis	One for all rooms
Description	Returns the average lamp wattage for CFL, fluorescent, incandescent and halogen lamps

Rooms - Average Number of Lamps by Base Type

Basis	One for all rooms
Description	Returns the average number of lamps per home by base type (screw-base or pin-base)

Rooms – Ceiling Fan Overview

Basis	One if ceiling fan is present; 0 if not present
Description	Returns the average number of pin vs. screw based ceiling fan fixtures

Rooms – Ceiling Fan Overview2

Basis	Count of ceiling fans with screw type bases
Description	Returns the percentage of ceiling fans with screw type bases that have CFLs

Rooms – Ceiling Fan Overview3

Basis	Count of all ceiling fans
Description	Returns the percentage of pin vs. screw based ceiling fan fixtures

Rooms - Lamp and Fixture Combo Presence

Basis	One for all rooms
Description	Returns the percentage of rooms that contain fixture types and fixture/generic lamp combinations

Rooms - LampABB by FIX TYP

Basis	Number of fixtures per room and whole house
Description	Returns the percentage of fixture/generic lamp combinations per room and whole house

Rooms - LampABB Presence

Basis	One for all rooms and whole house
Description	Returns the percentage of rooms and homes that contain generic lamp types (CFL, T12, T8, and Other Tube Fluorescent, Incandescent, Halogen, and High Intensity Discharge)

Rooms - Percent Generic Lamp Types Large

Basis	The total number of lamps per room and whole house
Description	Returns the percentage of lamps that are compact fluorescent, tube fluorescent, halogen, incandescent, or high intensity discharge

Rooms - Percent of Lamps by Control

Basis	Total number of lamps per home
Description	Returns the percentage of lighting control types for each room and the whole house

Rooms - Percent of Lamps by Control and Lamp Type

Basis	Total number of lamps home
Description	Returns the percentage of generic lamp types (CFL, T12, T8, and Other Tube Fluorescent, Incandescent, Halogen, and High Intensity Discharge) by control type for each room and the whole house

Rooms - Presence of Fixture Type

Basis	One for all homes
Description	Returns the percentage of homes with the different fixture types

Rooms - Presence of Generic Lamp Types

Basis	One for all homes
Description	Returns the percentage of homes with the given lamp types

Rooms - Presence of Lamp Type

Basis	One for all homes
Description	Returns the percentage of homes with the different lamp types

Rooms – Recessed Can Overview

Basis	One for all recessed can fixtures
Description	Returns average number of recessed can fixtures with pin base or screw base

Rooms – Recessed Can Overview2

Basis	Count of all recessed cans with screw bases
Description	Returns the percentage of recessed cans with screw based CFLs

Rooms – Recessed Can Overview3

Basis	Count of all recessed cans
Description	Returns the percentage of recessed cans with pin based vs. screw based CFLs

Rooms - Room Wattage

Basis	One for all rooms and homes
Description	Returns the average wattage for each room and whole house, as well as the relative proportion of the total wattage contributed by standard screw-base lamps (excluding CFLs), CFL, and non-standard base lamps

Rooms - Specific Fixture Overview

Basis	One for all homes
Description	Returns the percentage of homes containing ceiling fans, recessed cans, and torchiere, and (if present in the home) percentage of homes with those fixtures in bins

Multifamily Appliance Data Queries

APPLIANCE TABLE DEFINITIONS

All Refrigerators Table

Field Heading	Value	Comments
RLWID	RLW Site Identification Number	
FridgeType	Standard, side by side, freezer on bottom, single door	
YearsOld	Age of refrigerator in years	
Options	Icemaker, water and ice service in door, none	
SizeRange	Small, medium, large, very large	
MFG	Name of manufacturer	
ModelNo	Model number	
MFGdate	Date of manufacture	
UsageR	Primary or secondary and percentage of year in use (0-25%,...,75-100%)	
AEC	Model number parsed for matching	
MModel	Model number parsed for matching	
Match	Matching model number found in efficiency database?	
Notes		

Clothes Dryer Table

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Dryer Number	1=primary, 2=secondary	Code for primary, secondary dryer
Age of Machine	Resident reported age from on-site	
Fuel Type	Natural Gas. Propane, or Electric	
Usage	Infrequent use, most loads, all loads	
Manufacturer	Manufacturer from on-site	
Model Number	Model number from on-site	
Model_Clean	Model with nonalphanumerics removed	Not Used
Moisture Sensor	Does the unit have moisture sensing	

Cooling System Table

SiteID	RLW Site Identification Number	
Cooling Unit #	Cooling system ID number	Cooling unit#_1 =

		Primary
System Type	System type (e.g.. split system, win/wall, package, etc.)	
Space or Central	Space or Central System Classification	
Age of System	Customer reported age of system in years old, from on-site	
Manufacturer	Manufacturer of system, from on-site	
Model Number	Model number of system from on-site	
Tons Estimate	Estimated tonnage of cooling system	
Manufacture Date	Date of manufacture from efficiency database	
Cooling System	Y if present, N if not present	
SysCap	Capacity of cooling system	
EER	Matched Efficiency	
SEER	Matched Efficiency	

Dishwasher Table

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Dishwasher Number	Code for primary or secondary dishwasher	
Age of Dishwasher (in years old)	Age from model number match	
Manufacturer	Manufacturer from on-site	
Manufacturer Date	Date of manufacture	
Model Number	Model number from onsite	
Model_Clean	Model Number with non alphanumerics removed	
Energy Factor	Energy Factor	[load/kWh]-from database
Source	CEC_ckwa if matched,	CEC_ckwa was only database used

Envelope Table

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Wall Construction Type	Exterior wall construction type	
Wall Insulation R-Value	R-Value of Walls	
Attic R-Value	Batt Insulation (R-Value)	
Floor Insulation (R-Value)	Floor Insulation (R-Value)	
Frame Type	Predominant Window Frame Type	
Number of Panes	Average Number of Panes per Window	
LowE	Low-e coating on windows	
Storm	Storm windows	

CrawlVenting	Is the crawl space vented	
Basement	Does the home have a basement	

General Information Table

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Type of Residence	Single Family Home, Apartment, etc.	
Total People	Total Number of Residents at Site	
Total Adults	Total Number of Adults at Site	18 and Over
People	Total Number of Residents at Site	Converted from text to number
Adults	Total Number of Adults at Site	Converted from text to number
People Under 1 year	Total Number of People Under 1 Year at Site	
People 2 to 5 years	Total Number of People between 2 to 5 years at site	
People 6 to 18 years	Total Number of People between 6 to 18 years at site	
People 18 to 29 years	Total Number of People between 18 to 29 years at site	
People 30 to 49 years	Total Number of People between 30 to 49 years at site	
People 50 to 64 years	Total Number of People between 50 to 64 years at site	
People 65 or more years	Total Number of People over 65 years at site	
Income	Annual Household Income Range	Resident Supplied
Total Heated Sqft	Square Footage Range of Residence	
Age Range	Age Range of Residence	
Rent or Own	Ownership Status of Residence	
Who Pays Electric? (Occ or Landlord)	Responsibility for Electric Bill	
Who Pays Gas?	Responsibility for Gas Bill	
Total Heated Floorspace	Square Footage of Heated Floorspace of Residence	

Heating System

SiteID	RLW Site Identification Number	
Furnace #	Furnace ID number	Furnace#_1 = Primary
Space or Central	Space or Central System Type	
Fuel Type	Fuel type of system (i.e. electric, gas wood, etc.)	
System Type	System type (i.e. forced air furnace, baseboard, wall, etc.)	

Age of System	Customer reported age of system in years old.	From on-site
Manufacturer	On-site name of furnace manufacturer	From nameplate
Model Number	On-site model number	From nameplate
Model_Clean	Model number with all alphanumeric symbols removed	
Input	CEC_cent input capacity (kBtuh)	
Output	CEC_cent output capacity (kBtuh)	
HP_HSPF	Efficiency of heat pump	
HP_Output	Output of heat pump	
afue1	Annual Fuel Utilization Efficiency for unit if matched	
Manufacture Date	Date of manufacture	

Pool

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Heated	Is pool heated	
FuelTyp	Fuel type for heater	

Washing Machine Table

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Washing Machine #		
Type of Washer	Standard or Horizontal Axis	
Age of Machine (in years old)	Age from model number match	
Age of Machine	Resident reported age	
Manufacturer	Manufacturer from on-site	
Model Number	Model Number as recorded from On-site	
Model_Clean	Model Number with non alphanumerics removed	Used for model number to database matching
Type	Numeric Code for Washer Type	
Energy Factor	Energy Factor [cubic feet/kWh]	
Water Factor	Gallon capacity over cubic feet	Not Used
Moisture Content	Remaining water content from CEC_ckwa.dbf database	Not Used
Source	Database from which washer data was extracted	
Age estimate	Resident reported age from on-site	

Spa

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
FuelTyp	Fuel type for heater	

Water Heater Table

Field Heading	Value	Comments
SiteID	RLW Site Identification Number	
Water Heater #	1=primary, 2=secondary	
Fuel Type	Gas or Electric	From on-site
Fuel Type_On Site	Gas, Heat Pump, No Heat Pump	To determine if Electric water heater users have heat pump or not
on-site energy factor	Energy Factor from nameplate	
Size (Gallons)	Storage capacity in Gallons	From on-site
Heater Type	Storage or Instantaneous	
Internal Tank Insulation (R-Value)	R-Value of Internal Tank insulation from on-site	
External Tank Wrap?	Yes -external tank wrap, No wrap	
Age (in years old)	Estimated Age of Water heater in years old	Resident reported
If Electric-KW	Capacity in kW if Electric	
If Gas-kBtuh	Capacity in kBtuh if gas	
Manufacturer	Manufacturer fro on-site	
Model Number	Model number from on-site	
Model_Clean	Model number with non-alphanumerics removed	Used for database matching
Fuel	Electric, Gas	Gas is natural gas or propane
Gallons	Storage capacity in gallons from database match	
Gallons Estimate	Storage capacity in gallons from on-site	
Instant	Yes = Instantaneous , No = storage	Only one instantaneous heater found
Input	Input Capacity Btu or kW from database match	
Efficiency	Efficiency of water heater from database match	No cycling, and transmission losses considered
Annual Energy Consumption	Annual Energy consumption from database matching	Btu for Gas, kWh for electric
Energy Factor	Energy Factor from database matching	Energy Factor for water heater is unitless, (water heater delivered energy/energy consumed)
Source	CEC_gwh for matched gas heaters,	

	CEC_ewh for matched electric water heaters	
Age Estimate	Estimated Manufacture Date from on-site	(2000-Age in years old)

CATEGORY QUERIES

Categories-Cooling

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People in Home	Total Number of Residents at Site
Total Adults in Home	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Central or Space	Space Units Serve a Single Area; Central Units Serve the Whole Home
Type of System	Split System AC, Wall/Window Unit, etc.
Cooling Tons	Capacity of System in Half Ton Bins (i.e. 0.5-0.99 tons, 1-1.49 tons, …, greater than 5 tons)
System Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Dishwasher

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People in Home	Total Number of Residents at Site
Total Adults in Home	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
System Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Dryer

Site ID	RLW Site Identification Number

Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
System Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Envelope

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Wall Construction Type	2 x 4, 2 x 6, Masonry, etc.
Basement Type	Finished, unfinished, conditioned, unconditioned

Categories—Gen

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter

State	State where home is located
Stratum	Stratification variable

Categories-Heating

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Fuel	Electric, Gas, Pellet, Propane, Wood
Central or Space	Space Units Serve a Single Area; Central Units Serve the Whole Home
Type	Forced Air Furnace, Floor, Wall Unit w/Fan, etc.
System Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Pool

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Fuel	Electricity, Gas, Propane, Solar

Categories-Pri Refrigerator

SiteID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site

Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Refrigerator Type	Freezer On Bottom, Built-In, Side-By-Side, Top Mounted Freezer, etc
Refrigerator Size	<=10, 11-14, 15-18, 19-22, and >22
Refrigerator Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Pri Refrigerator EFF

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Refrigerator Type	Freezer On Bottom, Built-In, Side-By-Side, Top Mounted Freezer, etc
Refrigerator Size	<=10, 11-14, 15-18, 19-22, and >22
Refrigerator Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Sec Refrigerator

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located

Stratum	Stratification variable
Refrigerator Type	Freezer On Bottom, Built-In, Side-By-Side, Top Mounted Freezer, etc
Refrigerator Size	<=10, 11-14, 15-18, 19-22, and >22
Refrigerator Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Sec Refrigerator EFF

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Refrigerator Type	Freezer On Bottom, Built-In, Side-By-Side, Top Mounted Freezer, etc
Refrigerator Size	<=10, 11-14, 15-18, 19-22, and >22
Refrigerator Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

Categories-Spa

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable

Categories-Washer

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site

Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
System Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Type of Washer	Standard, Horizontal Axis, or Stacked

Categories-Water Heater

Site ID	RLW Site Identification Number
Weight	Case weight
Type of Residence	Single Family Home, Apartment, etc.
Total People	Total Number of Residents at Site
Total Adults	Total Number of Adults at Site
Income	Annual Household Income Range
Year Occupied	Year Occupied
Total Heated Floorspace	Square Footage Range of Residence
Rent or Own	Ownership Status of Residence
Who Pays Electric	Owner or renter
Who Pays Gas	Owner or renter
State	State where home is located
Stratum	Stratification variable
Fuel	Electric, Gas, or Propane
Size	Tank Size (in Ten Gallon bins)
Unit Type	Storage or Instantaneous
System Age	Age of System (in Five Year Bins- 1990-1994, 1995-1999, etc)

ANALYSIS QUERIES

Cooling Efficiency Average

Basis	One for all homes where a SEER value was obtained
Description	Returns the average SEER value

Cooling Efficiency Bins

Basis	One for all homes where a SEER value was obtained
Description	Returns the average SEER value as well as percentage of units contained within SEER bins (8-8.99, 9-9.99, etc.)

Cooling Efficiency Relative to Standards

Basis	One for all homes with central systems where SEER value was obtained
Description	Returns the average SEER value as well as percentage of units contained within SEER bins (bins based on the federal efficiency standards)

Cooling Estimated Age Avg and Bins

Basis	One for all homes where the age of the cooling system was obtained
Description	Returns the average age as well as the percentage of units by year (2006, 2005, etc.)

Cooling Primary System Type

Basis	One for all homes where the system type is known (excluding whole house fans)
Description	Returns the percentage of homes with system types, including heat pump, split AC, packaged AC, window unit, and portable

Cooling Proportions

Basis	One for all homes
Description	Returns the proportion of homes which fall into the user selected group by variable

Cooling Space or Central

Basis	One for all homes where the system is known to be either a space or central system
Description	Returns the percentage of homes that are cooled by a space or central air conditioning unit

Cooling System Saturation

Basis	One for all homes with cooling
Description	Returns the percentage of homes with cooling

Cooling Ton Bins

Basis	One for all homes where the capacity of the unit is known
Description	Returns the percentage of units contained with ½ ton bins (i.e. 0.5-0.99 tons, 1-1.49 tons, ..., greater than 5 tons)

Dishwasher Age Avg and Bins

Basis	One for all homes in which the dishwasher age is known
Description	Returns the average age as well as the percentage of units in three year bins (2006-2004, 2003-2001, etc.)

Dishwasher Average Energy Factor

Basis	One for all homes in which the dishwasher energy factor is known
Description	Returns the average energy factor

Dishwasher Energy Factor Bins

Basis	One for all homes in which the dishwasher energy factor is known
Description	Returns the percentage of dishwashers in energy factor bins (0.275 to 0.459,

	0.460 to 0.579, 0.580 to 0.775)

Dishwasher Homes with Dishwasher

Basis	One for all homes
Description	Returns the percentage of homes that contain a dishwasher

Dryer EFF Average Energy Factor

Basis	One for all dryers where energy factor was determined
Description	Returns the average energy factor

Dryer Estimated Age Avg and Bins

Basis	One for all homes in which the dryer age is known
Description	Returns the average age as well as the percentage of units in five year bins (1990-1994, 1995-1999, etc.)

Dryer Fuel Type

Basis	One for all homes that have a clothes dryer
Description	Returns the percentage of clothes dryers by fuel type (Electric, Gas, Propane)

Dryer Has Moisture Sensor

Basis	One for all dryers
Description	Returns the percentage dryers which had a moisture sensor

Dryer Homes with Dryers

Basis	One for all homes
Description	Returns the percentage of homes that contain a clothes dryer

Envelope Attic Insulation R-Value Bins

Basis	One for all homes where the attic r-value is known
Description	Returns the average attic r-value as well as the percentage of homes with attic r-values in bins

Envelope Floor Insulation R-Value

Basis	One for all homes where the floor r-value is known, and is not adiabatic or slab-on-grade
Description	Returns the percentage of homes in specific r-values

Envelope proportions of basement type

Basis	One for all homes
Description	Returns the proportion of homes with basements

Envelope Wall Construction Type

Basis	One for all homes
Description	Returns the percentage of homes whose wall construction is 2x4, 2x6, Masonry, or Unknown

Envelope Wall Insulation R-Value

Basis	One for all homes where the wall r-value is known
Description	Returns the percentage of homes in specific r-values

Envelope Window Frame by Pct of Win Area

Basis	The total window square footage, unless unknown
Description	Returns the percentage of all window area by frame type

Envelope Window Frame Type

Basis	One for all homes where the frame type is known
Description	Returns the percentage of homes with specified frame types (Metal, Non-metal)

Envelope Window Frame Type by Num Panes

Basis	One for all homes where the frame type is known
Description	Returns the percentage of homes with specified frame types and number of panes (Metal, Non-metal, and Single or Double-paned)

Envelope Window LowE

Basis	One for all homes where the frame type is known
Description	Returns the percentage of homes with specified glass types (Clear or Low-E)

Envelope Window Pct LowE

Basis	The total window area unless the frame type is unknown
Description	Returns the percentage of homes with specified glass types (Clear or Low-E)

Envelope Window to Floor Percent

Basis	The total conditioned floor area
Description	Returns the ratio of window to floor area

Gen Average Floor Area

Basis	One for all homes
Description	Returns the average floor area

Gen Consumer Electronics

Basis	One for all homes where the number of consumer electronics is known
Description	Returns the average number of consumer electronics in the home

Gen Demographic Proportions

Basis	One for all homes
Description	Returns the proportion of homes which fall into the user selected group by variable

Gen Large Appliances

Basis	One for all homes
Description	Returns the percentage of homes with specified large appliances

Gen Pays Electric Bill-Non Owners

Basis	One for all homes

Description	Returns the percentage of homes by electricity bill payer (Landlord, Occupant, or Unknown)

Gen Pays Gas Bill-Non Owners

Basis	One for all homes
Description	Returns the percentage of homes by gas bill payer (Landlord, Occupant, or Unknown)

Gen Thermostat Types

Basis	One for all homes where the thermostat type is known
Description	Returns the percentage of homes by type of thermostat (Mechanical, Digital, Hybrid)

Heating AFUE Bins

Basis	One for all homes where the heating system's efficiency is known (excludes heat pumps)
Description	Returns the percentage of heating systems that fall into specified bins

Heating Average AFUE

Basis	One for all homes where the heating system's efficiency is known (excludes heat pumps)
Description	Returns the average AFUE

Heating Capacity Bins

Basis	One for all homes whose heating system's capacity is known (excludes heat pumps)
Description	Returns the percentage of heating systems that fall into specified bins

Heating Estimated Age Bins

Basis	One for all homes in which the heating system age is known
Description	Returns the average age as well as the percentage of units by year

Heating Fuel Types

Basis	One for all homes where there is a heating system
Description	Returns the percentage of homes with the specified fuel types

Heating HeatPump HSPF Output Averages

Basis	One for all homes where there is a heat pump with a known HSPF and output capacity
Description	Returns the average HSPF and output capacity

Heating HeatPump HSPF Output Bins

Basis	One for all homes where there is a heat pump with a known HSPF and output capacity
Description	Returns the percentage of heat pumps that fall within HSPF and capacity bins

Heating Number of Heating Systems

Basis	One for all homes
Description	Returns the percentage of homes with 0 – 5 heating systems

Heating Primary System Type

Basis	One for all homes with heating systems where the fuel type is known
Description	Returns the percentage of homes with specified primary system types

Heating Proportions

Basis	One for all homes
Description	Returns the proportion of homes which fall into the user selected group by variable

Pool Fuel Types

Basis	One for all homes that have a pool
Description	Returns the percentage of fuel types of pools as well as percentage of pools that we not heated

Pool Saturation

Basis	One for all homes that have a pool
Description	Returns the percentage homes with pools

Pri Refrigerator AEC Bins

Basis	One for all primary refrigerators which had an annual energy consumption match from the appliance efficiency databases
Description	Returns the percentage of primary refrigerators that fall into specified bins of annual energy consumption

Pri Refrigerator Avg Energy Consumption

Basis	One for all primary refrigerators which had an annual energy consumption match from the appliance efficiency databases
Description	Returns the average annual energy consumption of primary refrigerators

Pri Refrigerator Consumption to Natl Stnd

Basis	One for all primary refrigerators which had all the necessary information with which to calculate the federal energy use standard
Description	Returns the average percentage of energy use for the primary refrigerator compared to the federal standard

Pri Refrigerator Consumption to Natl Stnd Bins

Basis	One for all primary refrigerators which had all the necessary information with which to calculate the federal energy use standard
Description	Returns the average percentage of energy use for the primary refrigerator compared to the federal standard, as well as the percentage of refrigerators that fall into specified bins

Pri Refrigerator Energy Star

Basis	One for all primary refrigerators which had all the necessary information with

	which to calculate the federal energy use standard
Description	Returns the percentage of refrigerators that meet the ENERGY STAR qualifications as of 2001 and 2004

Pri Refrigerator Estimated Manufacture Date

Basis	One for all homes in which the refrigerator estimated or manufactured age is known
Description	Returns the average age as well as the percentage of units in five year bins (1990-1994, 1995-1999, etc.)

Pri Refrigerator Homes with 2 or 3 Refrigerators

Basis	One for all homes
Description	Returns the percentage of homes with two or three refrigerators, either full-sized or compact

Pri Refrigerator Types

Basis	One for all homes
Description	Returns the percentage of refrigerators that fall into the specified refrigerator types

Pri Refrigerator Volume

Basis	One for all primary refrigerators which had a volume matched from the appliance efficiency databases
Description	Returns the average volume in cubic feet for primary refrigerators

Pri Refrigerator Volume Bins

Basis	One for all primary refrigerators where the range of volume is known
Description	Returns the percentage of primary refrigerators that fall into specified volume ranges

Sec Refrigerator Estimated Manufacture Date

Basis	One for all homes in which the refrigerator estimated or manufactured age is known
Description	Returns the average age as well as the percentage of units in five year bins (1990-1994, 1995-1999, etc.)

Sec Refrigerator Types

Basis	One for all homes with a secondary refrigerator
Description	Returns the percentage of refrigerators that fall into the specified refrigerator types

Sec Refrigerator Volume

Basis	One for all secondary refrigerators which had a volume matched from the appliance efficiency databases
Description	Returns the average volume in cubic feet for secondary refrigerators

Sec Refrigerator Volume Bins

Basis	One for all secondary refrigerators where the range of volume is known
Description	Returns the percentage of secondary refrigerators that fall into specified volume ranges

Spa Fuel Type

Basis	One for all homes with a spa
Description	Returns the percentage of homes with spas with respect to heating fuel type

Spa Saturation

Basis	One for all homes with a spa
Description	Returns the percentage of homes with a spa

Washer Age Avg and Bins

Basis	One for all homes in which the washing machine age is known
Description	Returns the average age as well as the percentage of units in five year bins (1990-1994, 1995-1999, etc.)

Washer Average Energy Factor

Basis	One for all homes with clothes washers where the energy factor is known
Description	Returns the average energy factor

Washer Average Modified Energy Factor

Basis	One for all homes with clothes washers where the energy factor is known
Description	Returns the percentage of clothes washers that fall into specified energy factor bins

Washer MEF Bins

Basis	One for all homes with clothes washers where the modified energy factor is known
Description	Returns the average modified energy factor

Washer Type of Washer

Basis	One for all homes with a clothes washer
Description	Returns the percentage of clothes washers that are horizontal axis, stacked, or standard axis

Water Heater Average Energy Factor

Basis	One for all homes where the water heater energy factor is known
Description	Returns the average energy factor

Water Heater Energy Factor Bins

Basis	One for all homes where the water heater energy factor is known
Description	Returns the percentage of water heaters with energy factors that fall into specified bins

Water Heater Estimated Average Age and Bins

Basis	One for all homes in which the water heater age is known
Description	Returns the average age as well as the percentage of units in three year bins (2006-2004, 2003-2001, etc.)

Water Heater Fuel Type

Basis	One for all water heaters with known fuel types
Description	Returns the percentage of water heaters that are heated by electricity, natural gas, propane, and solar

Water Heater Proportions

Basis	One for all homes
Description	Returns the proportion of homes which fall into the user selected group by variable

Water Heater Size Avg and Bins

Basis	One for all water heaters that have a known tank capacity
Description	Returns the average water heater tank capacity, as well as the percentage of tanks that fall into specified bins

Water Heater System Type

Basis	One for all water heaters
Description	Returns the percentage of water heaters that were either storage or central units

Water Heater Tank Wrap

Basis	One for all water heaters
Description	Returns the percentage of water heaters that were either covered or not covered by an external insulating blanket, and those where the blanket status was unknown

WindowArea by frame type

Basis	N/A
Description	Returns the window square footage for each frame type

Multifamily Room Lighting Analysis

This section contains lighting results by room type. For each room type, the percentage of homes with a given fixture type and lamp type are shown.

Kitchen

Table 1 presents the percentage of homes with a given fixture type and lamp type in the kitchen along with the associated error bound. The most predominant fixture and lamp type combination are ceiling mounted fixtures, recessed cans, and under counter fixtures with incandescent lamps, as well as ceiling mounted fixtures with fluorescent T8.

Fixture Type (n=197)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	4.3%	2.3%	26.5%	5.4%	21.0%	5.1%	4.6%	2.8%	11.7%	3.8%	79.6%	4.9%
Architectually Integrated	1.0%	1.1%	-	-	-	-	-	-	-	-	0.5%	0.8%	0.5%	0.8%
Ceiling Fixtures	71.7%	6.0%	2.3%	1.6%	25.3%	5.3%	20.7%	5.1%	4.1%	2.7%	1.7%	1.6%	28.7%	5.5%
Chandelier Hanging	10.0%	3.6%	-	-	-	-	-	-	-	-	2.4%	1.7%	7.8%	3.3%
Other	0.1%	0.2%	-	-	-	-	-	-	-	-	-	-	0.1%	0.2%
Recessed Can	29.3%	6.0%	0.4%	0.6%	-	-	-	-	-	-	4.3%	2.3%	24.6%	5.8%
Recessed Lighting-Other	14.4%	4.2%	0.5%	0.8%	-	-	-	-	-	-	-	-	14.0%	4.2%
Table lamps	0.5%	0.8%	-	-	-	-	-	-	-	-	-	-	0.5%	0.8%
Track Lighting	7.6%	3.2%	0.7%	1.2%	-	-	-	-	-	-	2.8%	1.9%	4.1%	2.4%
Under Counter	38.6%	6.3%	0.6%	0.7%	1.2%	1.4%	-	-	0.5%	0.6%	2.2%	1.6%	34.4%	6.2%
Wall Mount	0.2%	0.4%	-	-	-	-	0.2%	0.4%	-	-	-	-	-	-

Table 1: Percentage of Homes with Fixture Type and Lamp Type in Kitchen

Bedrooms

Table 2, Table 3, Table 4, Table 5, and Table 6 present the percentage of homes with a given fixture type and lamp type in the bedrooms, as well as the error bounds associated with these estimates. The most predominant fixture and lamp type combinations are ceiling mounted fixtures and table lamps with incandescent lamps, as well as ceiling mounted fixtures containing compact fluorescent lamps.

Fixture Type (n=200)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	16.7%	4.5%	-	-	-	-	-	-	5.1%	2.4%	91.8%	3.4%
Architectually Integrated	0.9%	1.4%	-	-	-	-	-	-	-	-	-	-	0.9%	1.4%
Ceiling Fan	5.6%	2.8%	0.9%	1.1%	-	-	-	-	-	-	-	-	4.6%	2.7%
Ceiling Fixtures	79.7%	5.6%	11.7%	4.0%	-	-	-	-	-	-	0.8%	0.9%	67.6%	6.2%
Chandelier Hanging	0.8%	1.0%	-	-	-	-	-	-	-	-	-	-	0.8%	1.0%
Floor Lamp	9.9%	3.6%	1.1%	1.3%	-	-	-	-	-	-	2.1%	1.7%	7.2%	3.1%
Recessed Can	6.0%	4.0%	-	-	-	-	-	-	-	-	1.2%	1.2%	4.8%	3.9%
Table lamps	41.4%	6.1%	4.1%	2.2%	-	-	-	-	-	-	1.0%	1.0%	38.3%	6.1%
Torchiere	1.2%	1.4%	-	-	-	-	-	-	-	-	-	-	1.2%	1.4%
Wall Mount	3.6%	2.2%	-	-	-	-	-	-	-	-	-	-	3.6%	2.2%

Table 2: Percentage of Homes with Fixture Type and Lamp Type in Master Bedroom

Fixture Type (n=127)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	16.5%	5.8%	-	-	-	-	-	-	6.3%	3.4%	86.6%	5.4%
Ceiling Fan	2.4%	2.0%	0.7%	1.2%	-	-	-	-	-	-	-	-	1.7%	1.6%
Ceiling Fixtures	91.2%	4.2%	14.8%	5.6%	-	-	-	-	-	-	-	-	77.0%	6.5%
Floor Lamp	3.4%	2.8%	-	-	-	-	-	-	-	-	0.8%	1.3%	2.6%	2.5%
Recessed Can	1.6%	1.6%	-	-	-	-	-	-	-	-	0.4%	0.6%	1.3%	1.5%
Table lamps	29.3%	6.9%	1.0%	1.6%	-	-	-	-	-	-	4.6%	3.1%	25.6%	6.6%
Torchiere	0.4%	0.6%	-	-	-	-	-	-	-	-	-	-	0.4%	0.6%
Track Lighting	2.7%	2.7%	-	-	-	-	-	-	-	-	0.5%	0.8%	2.2%	2.6%

Table 3: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 1

Fixture Type (n=63)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	19.0%	8.0%	-	-	-	-	-	-	3.2%	3.7%	85.3%	7.4%
Ceiling Fan	4.7%	4.9%	-	-	-	-	-	-	-	-	-	-	4.7%	4.9%
Ceiling Fixtures	92.9%	5.5%	16.7%	7.7%	-	-	-	-	-	-	-	-	76.2%	8.9%
Floor Lamp	3.7%	3.6%	0.7%	1.2%	-	-	-	-	-	-	1.4%	2.3%	1.6%	2.6%
Other	0.6%	1.0%	-	-	-	-	-	-	-	-	-	-	0.6%	1.0%
Table lamps	22.9%	9.2%	1.5%	2.4%	-	-	-	-	-	-	1.8%	3.0%	19.5%	8.7%

Table 4: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 2

Fixture Type (n=11)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	36.6%	24.1%	-	-	-	-	-	-	-	-	74.0%	21.4%
Ceiling Fan	5.8%	9.4%	-	-	-	-	-	-	-	-	-	-	5.8%	9.4%
Ceiling Fixtures	94.2%	9.4%	36.6%	24.1%	-	-	-	-	-	-	-	-	57.6%	24.6%
Table lamps	19.3%	20.1%	-	-	-	-	-	-	-	-	-	-	19.3%	20.1%

Table 5: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 3

Fixture Type (n=2)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	54.8%	57.4%	-	-	-	-	-	-	-	-	45.2%	57.4%
Ceiling Fixtures	100.0%	-	54.8%	57.4%	-	-	-	-	-	-	-	-	45.2%	57.4%

Table 6: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 4

Living Room

Table 7 presents the percentage of homes with a given fixture type and lamp type in the living room, along with the error bounds associated with these estimates. The most commonly found fixture and lamp type combinations are ceiling mounted fixtures, floor lamps, recessed can and table lamps with incandescent lamps, as well as table lamps with compact fluorescent lamps.

Fixture Type (n=169)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	23.4%	5.6%	-	-	-	-	2.6%	4.2%	17.7%	5.1%	87.6%	4.2%
Architectually Integrated	2.0%	2.0%	-	-	-	-	-	-	-	-	1.3%	1.8%	1.7%	2.0%
Ceiling Fan	10.4%	3.7%	0.6%	1.0%	-	-	-	-	-	-	-	-	9.8%	3.6%
Ceiling Fixtures	38.9%	6.7%	4.5%	2.6%	-	-	-	-	-	-	1.6%	1.6%	32.8%	6.5%
Chandelier Hanging	5.1%	2.8%	-	-	-	-	-	-	-	-	-	-	5.1%	2.8%
Floor Lamp	29.1%	6.1%	4.8%	2.8%	-	-	-	-	-	-	2.1%	1.7%	24.3%	5.7%
Other	0.1%	0.2%	-	-	-	-	-	-	-	-	-	-	0.1%	0.2%
Recessed Can	13.7%	5.7%	-	-	-	-	-	-	-	-	1.5%	1.5%	12.2%	5.6%
Table lamps	41.4%	6.7%	12.2%	4.2%	-	-	-	-	-	-	4.3%	2.9%	30.5%	6.1%
Torchiere	16.6%	6.1%	1.2%	1.2%	-	-	-	-	2.6%	4.2%	4.4%	2.6%	8.6%	4.4%
Track Lighting	5.4%	2.9%	-	-	-	-	-	-	-	-	2.4%	1.9%	3.0%	2.3%
Wall Mount	4.6%	2.8%	2.1%	2.0%	-	-	-	-	-	-	0.8%	1.3%	1.6%	1.6%

Table 7: Percentage of Homes with Fixture Type and Lamp Type in Living Room

Bathrooms

Table 8, Table 9, Table 10, and Table 11 present the percentage of homes with a given fixture type and lamp type in bathrooms and the error bounds associated with these estimates. The most commonly found fixture and lamp type combinations are ceiling mounted fixtures, recessed lighting-other, and wall mounted fixtures with incandescent lamps.

Fixture Type (n=200)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	7.2%	3.0%	8.9%	3.8%	0.3%	0.3%	0.6%	1.0%	7.1%	3.2%	91.5%	3.4%
Ceiling Fan	1.4%	1.6%	0.7%	1.1%	-	-	-	-	-	-	-	-	0.7%	1.1%
Ceiling Fixtures	26.0%	5.4%	5.1%	2.6%	-	-	-	-	-	-	1.1%	1.3%	19.8%	4.9%
Chandelier Hanging	0.3%	0.5%	-	-	-	-	-	-	-	-	-	-	0.3%	0.5%
Other	4.9%	3.3%	-	-	-	-	-	-	-	-	-	-	4.9%	3.3%
Recessed Can	9.6%	3.6%	0.2%	0.4%	-	-	-	-	-	-	0.7%	0.9%	8.9%	3.5%
Recessed Lighting-Other	41.8%	6.2%	-	-	-	-	-	-	-	-	0.6%	1.0%	41.2%	6.2%
Table lamps	1.7%	1.6%	-	-	-	-	-	-	-	-	0.6%	1.0%	1.1%	1.3%
Track Lighting	0.6%	1.0%	-	-	-	-	-	-	-	-	0.6%	1.0%	-	-
Wall Mount	93.4%	3.7%	3.1%	1.8%	8.9%	3.8%	0.3%	0.3%	0.6%	1.0%	4.4%	2.5%	77.2%	5.5%

Table 8: Percentage of Homes with Fixture Type and Lamp Type in Master Bathroom

Fixture Type (n=117)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	9.9%	4.9%	7.2%	4.3%	-	-	-	-	4.3%	3.2%	89.3%	5.1%
Ceiling Fixtures	13.5%	5.4%	4.2%	3.1%	-	-	-	-	-	-	-	-	9.3%	4.6%
Other	6.1%	3.8%	-	-	-	-	-	-	-	-	-	-	6.1%	3.8%
Recessed Can	6.1%	3.8%	-	-	-	-	-	-	-	-	0.4%	0.7%	5.7%	3.7%
Recessed Lighting-Other	33.8%	7.7%	-	-	-	-	-	-	-	-	-	-	33.8%	7.7%
Table lamps	0.4%	0.7%	0.4%	0.7%	-	-	-	-	-	-	-	-	-	-
Track Lighting	1.0%	1.7%	-	-	-	-	-	-	-	-	1.0%	1.7%	-	-
Wall Mount	90.7%	4.7%	8.1%	4.5%	7.2%	4.3%	-	-	-	-	2.9%	2.7%	72.9%	7.3%

Table 9: Percentage of Homes with Fixture Type and Lamp Type in Bathroom 1

Fixture Type (n=24)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	-	-	-	-	-	-	-	-	3.5%	5.7%	100.0%	-
Ceiling Fixtures	2.7%	4.4%	-	-	-	-	-	-	-	-	-	-	2.7%	4.4%
Other	10.2%	11.3%	-	-	-	-	-	-	-	-	-	-	10.2%	11.3%
Recessed Can	6.2%	7.2%	-	-	-	-	-	-	-	-	-	-	6.2%	7.2%
Recessed Lighting-Other	47.6%	19.9%	-	-	-	-	-	-	-	-	-	-	47.6%	19.9%
Wall Mount	85.6%	12.8%	-	-	-	-	-	-	-	-	3.5%	5.7%	82.1%	13.8%

Table 10: Percentage of Homes with Fixture Type and Lamp Type in Bathroom 2

Fixture Type (n=2)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	-	-	-	-	-	-	-	-	-	-	100.0%	-
Ceiling Fixtures	42.1%	56.5%	-	-	-	-	-	-	-	-	-	-	42.1%	56.5%
Wall Mount	57.9%	56.5%	-	-	-	-	-	-	-	-	-	-	57.9%	56.5%

Table 11: Percentage of Homes with Fixture Type and Lamp Type in Bathroom 3

Halls

Table 12 presents the percentage of homes with a given fixture type and lamp type in hallways and the error bounds associated with these estimates. The most commonly found fixture and lamp type combinations are ceiling mounted fixtures, recessed cans and wall mounted fixtures with incandescent lamps. Ceiling mounted fixtures with compact fluorescent lamps were the next most common fixture-lamp combination.

Fixture Type (n=183)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	15.9%	4.7%	-	-	0.4%	0.7%	-	-	5.6%	2.9%	86.6%	4.4%
Architectually Integrated	2.5%	2.4%	-	-	-	-	-	-	-	-	-	-	2.5%	2.4%
Ceiling Fan	0.7%	1.1%	-	-	-	-	-	-	-	-	-	-	0.7%	1.1%
Ceiling Fixtures	88.0%	4.0%	15.1%	4.6%	-	-	0.4%	0.7%	-	-	0.9%	1.2%	74.6%	5.6%
Chandelier Hanging	2.4%	2.1%	-	-	-	-	-	-	-	-	-	-	2.4%	2.1%
Recessed Can	15.8%	5.3%	-	-	-	-	-	-	-	-	4.3%	2.5%	12.8%	5.0%
Table lamps	1.2%	1.3%	-	-	-	-	-	-	-	-	-	-	1.2%	1.3%
Track Lighting	1.0%	1.2%	-	-	-	-	-	-	-	-	1.0%	1.2%	-	-
Wall Mount	22.6%	6.0%	2.7%	2.4%	-	-	-	-	-	-	0.3%	0.4%	19.6%	5.8%

Table 12: Percentage of Homes with Fixture Type and Lamp Type in Hallway

Dining Room

Table 13 presents the percentage of homes with a given fixture type and lamp type in dining rooms as well as the error bounds associated with these estimates. The most commonly found fixture and lamp type combinations are ceiling mounted fixtures and chandelier/hanging fixtures with incandescent bulbs.

Fixture Type (n=92)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	6.8%	4.2%	-	-	-	-	-	-	2.0%	1.9%	92.0%	4.4%
Architectually Integrated	0.5%	0.8%	-	-	-	-	-	-	-	-	0.5%	0.8%	-	-
Ceiling Fan	3.5%	3.6%	1.0%	1.6%	-	-	-	-	-	-	-	-	2.6%	3.2%
Ceiling Fixtures	24.8%	7.7%	3.8%	3.2%	-	-	-	-	-	-	-	-	21.0%	7.3%
Chandelier Hanging	64.7%	8.6%	2.1%	2.4%	-	-	-	-	-	-	0.5%	0.8%	62.1%	8.8%
Floor Lamp	2.5%	2.9%	-	-	-	-	-	-	-	-	-	-	2.5%	2.9%
Recessed Can	6.1%	4.1%	-	-	-	-	-	-	-	-	0.5%	0.8%	5.5%	4.0%
Table lamps	2.8%	2.8%	-	-	-	-	-	-	-	-	0.9%	1.4%	1.9%	2.4%
Track Lighting	1.7%	2.1%	-	-	-	-	-	-	-	-	0.6%	1.0%	1.1%	1.8%

Table 13: Percentage of Homes with Fixture Type and Lamp Type in Dining Room

Breakfast Nook

Table 14 presents the percentage of homes with a given fixture type and lamp type in breakfast nooks along with the error bounds associated with these estimates. Similar to dining rooms, the most commonly found fixture and lamp type combinations are ceiling mounted fixtures and chandelier/hanging fixtures with incandescent bulbs, along with ceiling fans and incandescent

bulbs. Ceiling mounted fixtures with compact fluorescent lamps were the next most common fixture-lamp combination.

Fixture Type (n=38)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	16.8%	11.1%	-	-	-	-	-	-	7.8%	7.5%	78.6%	12.0%
Ceiling Fan	17.5%	11.7%	-	-	-	-	-	-	-	-	-	-	17.5%	11.7%
Ceiling Fixtures	37.1%	13.5%	9.8%	8.7%	-	-	-	-	-	-	-	-	27.3%	12.2%
Chandelier Hanging	38.1%	13.8%	7.1%	7.9%	-	-	-	-	-	-	6.5%	7.3%	27.7%	12.5%
Recessed Can	5.5%	4.7%	-	-	-	-	-	-	-	-	-	-	5.5%	4.7%
Table lamps	2.1%	3.4%	-	-	-	-	-	-	-	-	-	-	2.1%	3.4%
Torchiere	3.3%	5.2%	-	-	-	-	-	-	-	-	-	-	3.3%	5.2%
Track Lighting	4.1%	5.0%	-	-	-	-	-	-	-	-	1.3%	2.2%	2.8%	4.6%
Wall Mount	6.5%	7.3%	6.5%	7.3%	-	-	-	-	-	-	-	-	-	-

Table 14: Percentage of Homes with Fixture Type and Lamp Type in Breakfast Nook

Home Office

Table 15 presents the percentage of homes with a given fixture type and lamp type in home offices and the error bounds associated with these estimates. The most commonly found fixture and lamp type combinations are ceiling mounted fixtures, recessed can, floor lamps, and table lamps with incandescent bulbs.

Fixture Type (n=34)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	17.8%	11.7%	-	-	-	-	-	-	18.7%	11.0%	95.5%	5.6%
Ceiling Fan	12.2%	11.1%	-	-	-	-	-	-	-	-	-	-	12.2%	11.1%
Ceiling Fixtures	64.4%	15.1%	5.3%	6.2%	-	-	-	-	-	-	3.5%	5.7%	57.7%	15.9%
Chandelier Hanging	2.1%	3.4%	-	-	-	-	-	-	-	-	-	-	2.1%	3.4%
Floor Lamp	21.3%	12.2%	3.2%	5.2%	-	-	-	-	-	-	1.3%	2.2%	16.8%	11.2%
Recessed Can	16.7%	12.0%	-	-	-	-	-	-	-	-	4.5%	5.6%	15.4%	11.9%
Table lamps	42.7%	15.6%	9.3%	9.2%	-	-	-	-	-	-	7.9%	6.9%	28.9%	13.2%
Track Lighting	2.7%	4.4%	-	-	-	-	-	-	-	-	2.7%	4.4%	-	-
Wall Mount	11.5%	9.4%	-	-	-	-	-	-	-	-	3.5%	5.7%	8.0%	7.7%

Table 15: Percentage of Homes with Fixture Type and Lamp Type in Home Office

Laundry Room

Table 16 presents the percentage of homes with a given fixture type and lamp type in laundry rooms along with the error bounds associated with these estimates. The most predominant fixture and lamp type combinations are ceiling mounted fixtures with incandescent. Recessed lighting-other with incandescent bulbs and ceiling mounted fixtures with compact fluorescent lamps were the next most common fixture-lamp combinations.

Fixture Type (n=72)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	5.1%	4.1%	6.1%	4.6%	1.5%	2.4%	-	-	0.7%	1.1%	87.3%	6.4%
Ceiling Fixtures	83.9%	7.3%	5.1%	4.1%	-	-	-	-	-	-	-	-	78.7%	8.1%
Recessed Can	0.6%	1.0%	-	-	-	-	-	-	-	-	-	-	0.6%	1.0%
Recessed Lighting-Other	7.9%	5.6%	-	-	-	-	-	-	-	-	-	-	7.9%	5.6%
Under Counter	0.7%	1.1%	-	-	-	-	-	-	-	-	0.7%	1.1%	-	-
Wall Mount	8.7%	5.4%	-	-	6.1%	4.6%	1.5%	2.4%	-	-	-	-	1.1%	1.8%

Table 16: Percentage of Homes with Fixture Type and Lamp Type in Laundry Room

Closets

Table 17 presents the percentage of homes with a given fixture type and lamp type in closets and the error bounds associated with these estimates. The most commonly found fixture and lamp type combinations are ceiling mounted fixtures with incandescent bulbs and ceiling mounted fixtures with CFLs.

Fixture Type (n=100)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	14.1%	6.3%	9.5%	5.2%	8.6%	5.1%	9.1%	5.1%	-	-	68.0%	8.4%
Ceiling Fixtures	85.0%	6.1%	13.1%	6.1%	4.5%	4.0%	2.8%	3.2%	2.6%	3.1%	-	-	65.3%	8.6%
Wall Mount	23.0%	7.3%	1.0%	1.6%	4.9%	3.6%	5.7%	4.1%	6.4%	4.2%	-	-	5.0%	3.3%

Table 17: Percentage of Homes with Fixture Type and Lamp Type in Closets

Garage

Table 18 presents the percentage of homes with a given fixture type and lamp type in garages along with the error bounds associated with these estimates. The most predominant fixture and lamp type combinations are ceiling mounted fixtures and garage door opener with incandescent lamps.

Fixture Type (n=36)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	6.1%	5.8%	8.3%	7.6%	2.6%	4.2%	2.8%	4.5%	1.3%	2.1%	94.4%	6.4%
Ceiling Fixtures	97.5%	4.0%	6.1%	5.8%	8.3%	7.6%	2.6%	4.2%	2.8%	4.5%	1.3%	2.1%	80.6%	10.8%
Garage Door Opener	67.6%	17.0%	2.6%	4.2%	-	-	-	-	-	-	-	-	65.0%	16.9%
Wall Mount	6.9%	6.4%	-	-	-	-	-	-	-	-	-	-	6.9%	6.4%

Table 18: Percentage of Homes with Fixture Type and Lamp Type in Garage

All Other Rooms

Table 19 presents the percentage of homes with a given fixture type and lamp type in all rooms other than the types previously mentioned as well as the error bounds associated with these estimates. The Other room type includes attics, bars, exercise rooms, music rooms, sewing rooms, as well as pool houses. The most predominant fixture and lamp type combinations are ceiling mounted fixtures and wall mounted fixtures with incandescent lamps, along with ceiling mounted fixtures with CFLs.

Fixture Type (n=15)	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB	% of Homes	EB
Overall	-	-	17.2%	13.8%	-	-	-	-	-	-	-	-	87.6%	11.6%
Ceiling Fixtures	62.8%	21.9%	17.2%	13.8%	-	-	-	-	-	-	-	-	45.6%	22.7%
Floor Lamp	4.8%	7.7%	4.8%	7.7%	-	-	-	-	-	-	-	-	-	-
Recessed Can	9.8%	15.0%	-	-	-	-	-	-	-	-	-	-	9.8%	15.0%
Wall Mount	41.9%	22.2%	-	-	-	-	-	-	-	-	-	-	41.9%	22.2%

Table 19: Percentage of Homes with Fixture Type and Lamp Type in Other Room Type

Porch Lighting

Table 20 presents the percentage of homes utilizing each lamp type for the porch light. Approximately 77% of all homes are using a standard incandescent lamp for the porch light. More than 22% of homes are using a compact fluorescent lamp.

Lamp Type	Percentage of Homes (n=104)	EB
Compact Fluorescent A Style	5.5%	3.7%
Compact Fluorescent Capsule	0.2%	0.3%
Compact Fluorescent Flood	0.9%	1.5%
Compact Fluorescent Tubular	1.9%	2.1%
Compact Fluorescent Mini	1.7%	2.0%
Compact Fluorescent Pin Base	11.9%	5.3%
Compact Fluorescent Total	**22.1%**	**6.8%**
Halogen Parabolic Reflector	2.4%	2.3%
Halogen Total	**2.4%**	**2.3%**
Decorative Incandescent	0.5%	0.9%
Incandescent Flood	11.1%	7.4%
Incandescent Globe	1.2%	1.9%
Incandescent Standard	63.7%	8.8%
Incandescent Unknown	3.0%	2.8%
Incandescent Total	**77.2%**	**6.9%**

Table 20: Percentage of Homes Having Lamp Type as Porch Light