2005 California Statewide Residential Lighting and Appliance Efficiency Saturation Study

Final Report

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Lastly, this section would not be complete without acknowledging the thousand plus residential customers that took time from their busy schedules to coordinate with RLW and ASW field personnel to allow us into their homes. Without the willingness of these generous Californians none of this would have been possible.

Matt Brost

RLW Project Manager

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Executive Summary

Introduction

The 2005 California Statewide Lighting and Appliance Efficiency Saturation Study (CLASS) is a follow-on study to the 2000 Statewide Lighting and Appliance Efficiency Saturation Study. Each of these studies were paid for by Public Purpose funds for the purpose of understanding current levels of appliance and lighting saturation and efficiencies in the existing residential sector.

Subsequent to the 1999-2000 study, a tremendous amount of Public Purpose funds were invested in energy conservation programs that served customers of the four California investor owned utilities. These Public Purpose dollars were invested in a multitude of ways, all with the goal of achieving lasting energy savings in California's energy markets. The overarching goals of the 2004-05 update study was to provide revised baselines of saturation and efficiency characteristics for use in understanding future energy savings potential and past accomplishments in the residential sector.

The four primary objectives of this study were:

> **Objective 1:** Complete 850 onsite surveys of single-family, multi-family and modular homes in the service territories of the four California Investor Owned Utilities (IOUs).
>
> **Objective 2:** Develop a database of residential building characteristics, lighting and appliance saturations and efficiencies, expanded to represent the population of IOU customers.
>
> **Objective 3:** Develop a web-based tool to provide utility staff and other parties the ability to conduct "what-if" scenario analyses on the data collected.
>
> **Objective 4:** Conduct trend and comparison analyses of saturations and efficiencies between the two California Statewide Lighting and Appliance Saturation and Efficiency Studies, in addition to a comparison of results between the Residential Market Share Tracking Study and the 2003 RASS Study.

Approach

An evenly distributed sample of residential accounts was selected for each utility for each residential rate class offered by the four participating IOUs. Customers were recruited to participate in the study by phone, and each participant was paid $25.00 for agreeing to allow an onsite surveyor to visit their home to gather the required information. The onsite 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 850 on-site surveys were completed between November 2004 and May 2005.

While on-site, the surveyors collected data on the major appliances and lighting systems in the home. The surveyors collected nameplate data for eight major appliances: Refrigerator-Freezers, Self-standing Freezers, Dishwashers, Clothes Washers, Clothes Dryers, Water Heaters, Heating Equipment, Spa/Pool Equipment and Cooling Equipment. 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 insulation R-values, wall construction, and window type.

The survey also included a brief set of demographic and socioeconomic questions, in addition to a few questions regarding recent or planned remodeling of the home.

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 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. Matching rates varied greatly by appliance type and age. Table 3 and Table 4 in the following section provide an analysis of the overall match rates for each appliance for the 2005 and 2000 CLASS.

It is important to understand that 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 (e.g., SEER, UEC, EF, etc.) presented in this report is based on results from manufacturer compliance testing of new products to federal appliance and equipment standards. Therefore, efficiency data presented in this report is likely conservative since efficiency values are based on manufacturer tested performance.

The analysis for lighting and appliances is summarized in this report at the statewide level. Each site was given its appropriate case 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, unit energy consumption (UEC) bins, efficiency, 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 from the 2000 and 2005 studies. The California Residential Efficiency Saturation Tool (CALRES^{EST}) allows users to explore this residential sector data in a myriad of ways that go well beyond what is presented in this "statewide" report. The tool can be accessed at www.calresest.com.

Key Findings

In this section we summarize some of the more interesting findings occurring at the statewide 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.

Following this chapter is a comparison of the 2005 CLASS results to the 2003 Residential Appliance Saturation Study (RASS) and the most recent Residential Market Share Tracking (RMST) study. Overall, results from these studies seem to validate the majority of the 2005 CLASS study findings. In addition, the following chapter provides a comparison of the 2005 CLASS results to the 2000 CLASS results. Additionally, some of the interior lighting results are also compared with 2005 Residential CFL metering Study. Some very interesting trends that have occurred over the past 5 years are highlighted in that section.

Lighting

Data were gathered on all fixtures in the home and for the porch light. No other exterior lighting data were collected. The data collection parameters included collection of fixture type, number of lamps, lamp technology type and lamp wattage (if accessible). All of the indoor lighting data were characterized by room type. The 2005 study included wattage data collection, whereas the 2000 study did not. All in all, 90% of wattage data were obtained.

Number of fixtures and lamps - The 2005 study shows an overall increase in the number of fixtures and lamps per home. Up from 20 fixtures and 34 lamps in 2000, current estimates show that, on average, homes now have 23 fixtures and 41 lamps.

Fixtures with a compact fluorescent (CFL) – On average, 11% of all fixtures have at least one CFL; this is up from less than 1% in 2000. Although ceiling mounted fixtures are the most common fixture type, floor and table lamps are most likely to contain a CFL.

Saturation of CFLs – The percentage of CFLs among all lamps has increased since the previous finding less than 1% of lamps were CFL; the current findings reveal this number has increased to nearly 9%. Of the numerous types of CFLs, spring lamp styles are the most common. In terms of homes with CFLs, 57% of all homes have one or more CFLs installed, as compared to the 2003 Residential Appliance Saturation Study (RASS) which found that 51% of all homes contained at least one CFL and compared to the 2000 CLASS study which found that 12% of all homes contained at least one CFL.

Location of CFLs – The most common room type to have a CFL are living rooms and bedrooms. About 24% of living rooms and 20% of master bedrooms and bedrooms contain a CFL. Dining rooms are least likely to contain a CFL, perhaps due to the higher preponderance of fixtures (e.g., chandelier, dimmer controls) that do not easily accommodate CFLs. Table 1 summarizes the proportion of rooms with at least one CFL.

Room Type	Percent with CFL
Living Room	24%
Master Bedroom	20%
Bedroom Average	19%
Home Office	18%
Bathroom Average	16%
Kitchen	15%
Master Bath	15%
Other	14%
Hallways	11%
Laundry	11%
Garage	11%
Breakfast Nook	10%
Closets	10%
Dining Room	8%

Table 1: Percent of Rooms with CFL

According to the CFL Metering Study (KEMA, 2005), CFLs located in kitchens, living rooms, outside, and in garages are used the most, while those in laundry rooms, bathrooms, and hallways are being used the least. KEMA found that living rooms have

the second highest hours of use of any room in the house (second to the Kitchen), which is also the room most likely (24% of homes) to contain a CFL.

Average Lamp Wattages – The average wattage for incandescent A-type lamps is 64 watts, while the average wattage for spring type CFLs is 18 watts. The CFL Metering Study (KEMA, 2005) found that more than 90 percent of CFLs installed in residences are in the 13-to-26-Watt range and have screw-in bases and integrated ballasts, they also found that the *most common* wattage range is 13-17 watts, similar to RLW's finding of 18 watts.

Refrigerators

Data were gathered for primary, secondary, and tertiary refrigerators. Since the last study, the number of homes with secondary refrigerators has slightly increased, up 5% from the previous finding of 14%. Only 1% of homes have a third refrigerator.

Primary Refrigerator Age – Previously, the 2000 CLASS study found that 34% of all refrigerators were reported to be 16-30 years old; in the 2005 study we found a tremendous reduction in primary refrigerators of this age, new findings suggest that only 5% are 16-30 years old. This is likely due in part to the aggressive refrigerator recycling and rebate campaigns offered by the IOUs. Based on manufacturer data obtained through the model number matching process, the overall (groups all types of refrigerators) average age of refrigerators is 6.6 years. This compares closely to the self-reported age data, which estimates the overall average age to be 7.4 years old. Previously, the average age of primary refrigerators was estimated to be 9 years old.

Primary Refrigerator Nameplate Unit Energy Consumption (UEC) – The overall average nameplate UEC for primary refrigerators is 721. This estimate is down from a nameplate UEC of 913 in 2000. This equates to a 21% efficiency improvement. These encouraging results are likely due to new federal energy standards and utility rebate and recycling programs.

ENERGY STAR Qualified – Overall, 7% of all primary refrigerators qualify with the 2004 ENERGY STAR standards, while 23% of all refrigerators meet or exceed the 2001 ENERGY STAR standards. In 2000, only 1% of refrigerators met the 2001 ENERGY STAR standards. These findings suggest a significant boost in the adoption rate of ENERGY STAR refrigerator products by consumers. This is likely due, in part, to ENERGY STAR promotional campaigns and incentive programs aimed at achieving a greater market share of ENERGY STAR qualifying products.

Age and Efficiency of Secondary Refrigerators – In 2000 the average age of secondary refrigerators was 13 years, the current estimate is nine years old. In terms of nameplate UEC, the 2000 study estimated that secondary refrigerators use 1,034 kWh/yr, the 2005 findings estimated secondary refrigerators use about 731 kWh/yr, a 29% reduction in annual energy consumption. On average, secondary refrigerators are 3 cubic feet smaller than primary refrigerators (22 vs. 19).

Self Standing Freezers

Nearly 19% of homes have a self-standing freezer for food storage. This finding is up 2% from the previous study. Upright freezers constitute the majority of freezer types (65%); chest style freezers make up the rest. Freezers have on average 13 cubic feet of storage space, and upright freezers tend to have twice the storage space when compared to chest type freezers.

Freezers do appear to be consuming less energy when compared to the previous study findings. Currently, 16% of freezers use 10% or less energy than the 2001 federal freezer standards, compared to 2000 when 9% of freezers consumed 10% or less energy than the 1993 federal standards. This is likely directly correlated to the finding that the overall average age of freezers has decreased from 14 years to 12 years.

Clothes Washers

The amount of homes with a clothes washer remains virtually unchanged, up 3% from 2000, it is now estimated that 82% of all homes have a clothes washer. Washers are least common in apartment buildings, where about 35% of individual dwelling units have a washing machine.

Clothes Washer Type – Nine percent of all machines are horizontal-axis, the remaining 91% are of the standard type. The low saturation of horizontal-axis washing machines suggests that these types of machines continue to be unaffordable for the majority of Californians.

Clothes Washer Age – Fifty-six percent of washing machines are less than five years old, while 80% are less than ten years old. The average washing machine age is 6.7 years old, as compared to 2000 when the average age was estimated to be 7.4 years.

Clothes Washer Efficiency – 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. The efficiency databases used for this study to determine model efficiency only had MEF for a very limited number of horizontal-axis washing machines, therefore we continue to present efficiency in terms of EF.

The average EF for standard washing machines is 1.22, closely related to the 2000 finding of 1.26. Horizontal-axis units have an average EF of 4.13, an improvement over the 2000 findings of 3.95.

Clothes Dryers

Overall, 80% of homes have a clothes dryer. As one would expect, this saturation estimate closely compares to the saturation of washing machines. Clothes dryer fuel saturation remains virtually unchanged from the previous study; findings indicate that 57% are gas, 41% are electric and less than 2% are propane. The average age of clothes dryers is 7.6 years old, compared to 2000 when the average age was 8.4 years. Dryer efficiencies were not summarized since dryer efficiency databases continue to be scarce and incomplete.

Water Heaters

Data were gathered on many water heater characteristics, including system type, size, age, efficiency, fuel type, output, and insulation. The following summarizes some of the key findings related to water heating equipment.

Water Heater System type – The most common system types are gas storage systems. This finding remains unchanged from the previous study. However, a slight emergence of instantaneous natural gas systems was identified, 1.4% of homes have one of these systems, whereas previously this system type had virtually no market share.

Water Heater Efficiency – The average energy factor (EF) for 40 gallon gas water heaters (the most common type) is 0.58, compared to the previous finding of 0.57. This compares closely to the current federal standard for 40 gallon systems of 0.58. The average EF for electric water heaters remains unchanged from the previous study at 0.89.

Water Heater Age – The average age of water heaters has dropped somewhat, from 9 years old five years ago to 7 years old currently. This finding explains the slight increase in efficiency, since newer systems are generally more energy efficient than older systems.

Cooling Systems

As in the previous study, the 2005 results confirm that about half (53% in 2005, 52% in 2000) of all homes have some type of cooling system. The majority of cooling systems are central systems, 86%, up 8% from five years ago, which found that 78% of all cooling systems to be central. As a result, the saturation of space systems has dropped, moving from 22% five years ago to the current estimate of 14%.

Cooling System Type – The data reveal an increase in the most common system type, split-system central air-conditioners. Currently this system type represents 62% of all central cooling systems, up from 54% five years ago. Package unit air-conditioners comprise 30% of central systems, with the remainder made up by evaporative systems.

Cooling System Age – The average age of central air-conditioners has been slightly reduced, going from 12.2 years to 10.8. A similar trend has occurred with space air-conditioners. The average age of these systems in 2000 was 13.1 years, down to the current estimate of 11.9. However, when considering all cooling system types, the findings reveal that 40% of all cooling systems are less than five years old, while 25% are more than 15 years old.

Cooling System Size – The most common central air-conditioner size is the 4-ton category, 23%, and the next most common size is the 3 ton category. About 60% of all central air-conditioners fall within the 3-4.5 ton capacity range. This is up about 10% from the previous study, suggesting primary systems are getting larger, perhaps due to the growing size of new homes.

Cooling System Efficiency – Of the 257 central systems surveyed, 164 units were matched to an efficiency database for determining the SEER. The findings show that 5% of all units are SEER 13 or greater. The majority of units, 40%, fell within the 10-10.99 SEER range, while 7% of all units were found to have a SEER rating of 8 or less. Five years ago, only 2% were 13 SEER or greater, 30% of central air-conditioners fell within the 10-10.99 SEER range, and 3.4% were less SEER 8 or less. These results suggest that central air-conditioner efficiency has only slightly increased in the last five years.

Heating Systems

The study results show that 84% of homes have one heating system, 13% have two systems, and 3% have 3 systems or more. These findings are extremely similar to the previous CLASS findings.

Primary Heating System Type – The most common heating system type are central system forced air furnaces (63%), followed by wall unit space systems (13%). These results are very similar to the 2000 study which found 66% and 16% saturation for these system types, respectively. Heat pump systems comprise 5% of all system types.

Primary Heating System Fuel – The primary heating fuel is natural gas (79%), followed by electric systems (11%). About 2% of primary heating systems are wood and pellet stoves, and another 3% are propane. These findings are strikingly similar to the 2000 findings and the 2003 RASS.

Primary Heating System Age – Overall, heating systems are about 17 years old. Central systems are on average younger than space systems, 14 and 27 years old respectively.

Primary Heating System Efficiency – The average Annual Fuel Utilization Efficiency (AFUE) for gas central heating systems is 80.6, compared to 72.2 for space systems. Ninety percent of all central systems fall with 78-85 AFUE, and 75% of all space systems are between 66 and 72 AFUE.

Dishwashers

Just less than 70% of homes have a dishwasher, which is a close comparison to the 2000 study which found that just more than 70% of homes had a dishwasher.

Dishwasher Age – The average age of dishwashers has decreased over time, down from 9 years, the average age of dishwashers is now estimated to be 7 years old.

Dishwasher Efficiency – The current average EF for dishwashers is 0.495, greater than the current federal energy standard (.46), but less than the minimum ENERGY STAR qualification (0.58), which is set 25% higher than the federal standard. Current overall efficiency is slightly greater than what was found in 2000 (0.48).

Building Envelope

The saturation of metal frame windows has decreased significantly since 2000, down from 75% to 62%. At the same time the saturation of wood and vinyl has dramatically increased. 2005 CLASS results show saturation of vinyl windows at 25% and wood at 12%, a combined total of 37%, up from a combined total of 21% five years ago. This may be due to low interest rates during this period of time that afforded many Californians' the ability to refinance mortgages and invest in high capital home improvement projects, such as window retrofits.

Overall, the most common window type is single pane metal frame windows, with a saturation of 43%. The second most common type of window type is dual pane wood or vinyl. Apartment buildings have the highest potential for having single pane aluminum glazing and single family two and three story homes are most likely to have double pane vinyl/wood glazing products.

Field surveyors carried Low-E detectors for determining the presence of Low-E coatings. Overall, 10% of homes are thought to have Low-E coatings. Interestingly, homes built between 1951 and 1955 have the highest saturation, 19%, followed closely by homes built between 2001-2005 (17%). Older homes with Low E are due to window retrofits, while new homes are increasingly using Low-E as standard practice. Low-E data was not gathered in 2000, therefore comparisons are not possible.

Limitations

For the most part, all of the data the study hoped to collect through the on-site surveys was easily obtained. However, in situations where heating and cooling systems were on the roof of the customer's residence, we were not able to collect model number data. This is fairly common in the Central Valley. These units are commonly package air

conditioners, package heat pumps and evaporative cooling systems. Moreover, this style of construction is more characteristic of older homes, which are more likely to have older less efficient units. Since we can only project SEER for units where nameplate data was collected, this particular limitation is likely biasing the baseline efficiency findings (Table 3 summarizes these findings).

It should be noted that the SEER value was matched into 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.

Water heater blankets are fairly common and in many circumstances covered the nameplate data. Blankets were not completely removed to collect this information, only slightly moved if easily replaceable. In many cases, homes that comply with earthquake safety codes (e.g., metal strapping intended to hold water heaters in place in the event of an earthquake) have hardware in place that obstruct the nameplate or prevent the blanket from being removed for nameplate identification.

Wattage was also difficult to collect in many circumstances. Surveyors were trained to remove luminaire covers if easily reachable and removable. Yet surprisingly, overall, the surveyors were able to obtain wattages for 90% of all fixtures. For the lighting wattage analysis RLW calculated missing wattages based on other homes with the same fixture type in the same room type. About 2-3% of all lamps found were 3-way, with many variations on wattage. These fixtures were dropped from the analysis due to the difficulty of assigning a reasonable wattage constant.

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.

Further information was reported back by field surveyors regarding the difficulty of obtaining model number information for window/wall air-conditioners. These systems often require removal of face plates, which are often delicate, challenging to remove, and at times even more difficult to replace once removed. Surveyors were asked not to remove or tamper with equipment if they were not comfortable doing so. Other access issues were also problematic, such as location of the nameplate with respect to the mounting of the unit in the wall.

Limitations continue to be a problem with regard to the databases used for appliance matching. For example, field staff were able to obtain 559 of 583 dishwasher model numbers, yet through the matching process RLW was only able to match 25%, or 148 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 3% of the 644 dryers that we collected model numbers for were in the database. More detailed findings are presented on the model number matching process in Table 3.

Finally, 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.

Trends and Comparisons

In this section we take a look at trends that have become evident since completing the previous CLASS study in 2000; comparisons are made using findings from the two related studies. The three sources that were used to make comparisons include:

- California Residential Efficiency Market Share Tracking HVAC 2003 (RMST). Conducted by Itron for Southern California Edison. Published June 23, 2004.
- California Residential Efficiency Market Share Tracking Lamp Report 2004. Conducted by Itron for Southern California Edison. Published June 15, 2005.
- Residential Appliance Saturation Study (RASS) – Conducted by KEMA-Xenergy for the California Energy Commission. Published June 2004. Report #400-04-009

Sample

A comparison of the CLASS sample to the RASS and 2000 Census finds a slight over sampling of single family attached dwellings. The CLASS study sample included 65% single family dwellings. Both RASS and the 2000 Census show single family detached dwellings represent 58% of all California residences. The CLASS sample included 24% apartment and condo residences, while the other studies place this number at around 31%. Based on this comparison, it appears that we have under sampled multifamily dwellings. However, the CLASS study did not include master metered apartment buildings, whereas the Census and RASS did, this alone may explain most of the sample deviation related to home type. For both mobile homes and townhouses/row houses, the CLASS sample is very similar to both the RASS and the 2000 Census.

The CLASS sample is over represented by those who own as opposed to rent. Nearly 70% of the CLASS participants own their homes, versus the RASS and Census which estimates 60% of Californian's own their homes. However, homeownership is based on the 2000 Census and this number may have changed since the Census data were last collected. Considering the ultra-low mortgage rates and first time homebuyer loan programs offered during 2000-2005 it is likely that the Census data are outdated.

Number of occupants is another point of comparison, and a comparison shows the CLASS sample to be in good agreement with both the RASS and the 2000 Census. Very little variation can be found between the various occupant groupings, for example, 19% of CLASS participants are single occupants, 33% are dual occupants, 16% have three and four occupants and 8% have five, compared to 23%, 29%, 16%, 15% and 8% as reported by the 2000 Census, respectively.

There is also fairly good agreement amongst the various income categories. All categories are fairly well balanced with the exception of the category of less than $25,000 household income; here it appears as though the sample may have come up short. However, there were a large number of participants that either did not know their household income, or declined to answer this question. Without knowing the income range for 20% of the sample, it is difficult to say whether or not there is significant income bias. Table 2 summarizes the CLASS sample against the 2000 Census for income range. The final column in the table shows the breakdown of the CLASS sample for sites where income was known. This column is presented because it is likely that the Census utilized a similar method to exclude unknown incomes. The percentages in the

final column more closely approximate the Census data, however the lowest income category is still under represented in the CLASS sample.

Total Household Income	2005 CLASS	2000 Census	2005 CLASS Exc. Missing
< $25,000	12%	26%	15%
$25,001-$50,000	21%	27%	27%
$50,001-$75,000	17%	18%	21%
$75,001-	13%	11%	17%
>$100,000	16%	18%	20%
Unknown	5%		
Refused	16%		

Table 2: Comparison of CLASS Sample to 2000 Census by Income Category

Lighting

In the past five years we have seen a tremendous growth in the saturation of compact fluorescent lighting. Previously less than one percent of all residential lamps were CFL; currently this estimate is closer to 10%. Sales data reported in the California Residential Market Share Tracking Lamp Report 2004 support this finding. According to recent findings, the share of medium screw-based compact fluorescent lamp sales has shown strong growth in the last five years, peaking in 2001 at 8.7% market share, then averaging approximately 5% in following years. Previous sales numbers were much lower, demonstrating a less than 1% market share for CFLs. The sharp increase in CFL sales over the last 4 years seems to be directly tied to the increased saturation of CFLs in homes over the last 5 years found in this study.

Since the previous CLASS study in 2000, we have noted a sharp increase in the number of recessed can lighting fixtures. Often found in kitchens, hallways, and foyers, recessed cans often have higher wattage lamps (e.g., parabolic spot, halogen) that can easily be retrofitted with parabolic CFLs. In 2000 we found that 12% of all lighting fixtures were recessed cans. The 2005 estimates place this number closer to 18% of all fixtures, a 6% increase. Other increases in total fixture share include ‘recessed lighting other’ and ‘table lamps’, both increasing by about 3%. Figure 1 summarizes the 2005 and the 2000 statewide fixture shares for all home types.

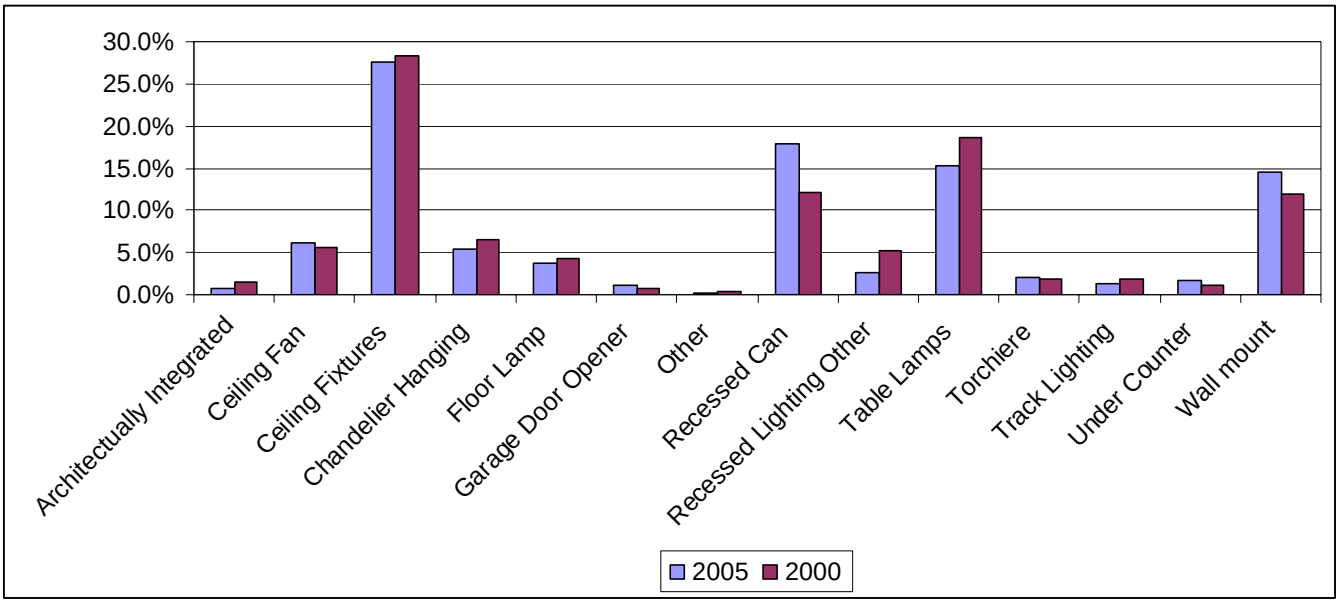


Figure 1: 2005 and 2000 Statewide Fixture Distribution

Refrigerators

As we compare findings from the previous study, there are some very notable trends occurring. To begin with, the results of the two CLASS studies demonstrate ever increasing efficiencies among primary and secondary refrigerators. Furthermore, the average age of both primary and secondary units has also dropped. This decrease in average unit energy consumption does not appear to be a function of smaller overall sized refrigerators. In fact, to the contrary, the average size of refrigerators seems to have increased in the last five years, moving from 20 cubic feet to 21 cubic feet.

We find similar findings when directly comparing the CLASS results to the RASS study. The RASS conditional demand analysis (CDA) results estimate primary refrigerator energy use to be 788 kWh/year. This is very comparable to the 2005 CLASS results which estimates primary refrigerator nameplate annual energy consumption to be 721 kWh/year.

When looking at UEC estimates for secondary refrigerators we find significant differences between the CLASS and the RASS. RASS reports secondary refrigerators use 1,021 kWh/year, while the CLASS findings suggest this number to be closer to 740 kWh/yr. Although the nameplate UEC for secondary units is similar to the nameplate UEC for primary units (720 vs. 740), it is important to note that secondary units were found to be smaller in size on average (18 vs. 21 cubic feet).

While similar, it should be noted that the RASS disaggregated refrigerator use from the total home electric usage, while the CLASS data is based on initial energy use based on manufacturer test conditions, so there may be a larger difference between the two results than appears.

Finally, the RASS findings indicate that 12% of households replaced major kitchen appliances during “the previous year”, most likely in the 2003 time period. If this estimate were extrapolated to the five year period between the last CLASS study and this study,

results would show a significant proportion of Californians having replaced major kitchen appliances. These findings further support the positive trends we are seeing in California in regards to refrigerator age and efficiency.

Heating and Air Conditioning

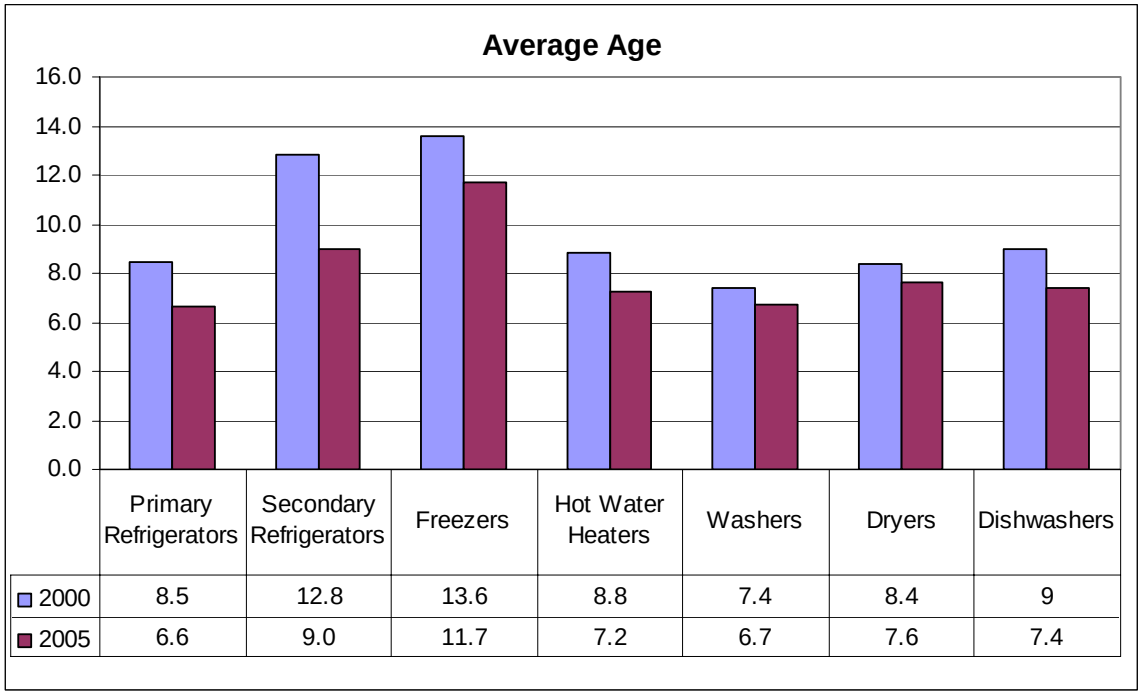
One of the trends we see with air-conditioning is an increase in the saturation of central systems, and a decrease in room/space conditioning systems. The RASS study findings are similar; they also report room and evaporative type systems going out of favor and central air-conditioning systems becoming more popular.

Though somewhat difficult to directly compare, there is general agreement between the RASS findings and the CLASS findings regarding the age of cooling equipment. The RASS findings suggest that 32% of air-conditioners are 15 years or older, while the CLASS findings estimate that 26% of all cooling systems are 15 years or older.

In terms of heating fuel type, the CLASS study is in agreement with the RASS study. The CLASS results and the RASS results estimate 80% of heating systems use natural gas, while only 11% utilize electricity as the primary heating fuel. Single family detached homes are much more likely to be heated using natural gas, while apartments are more likely to be heated by electric systems.

Appliance and Equipment Age and Efficiency Trends

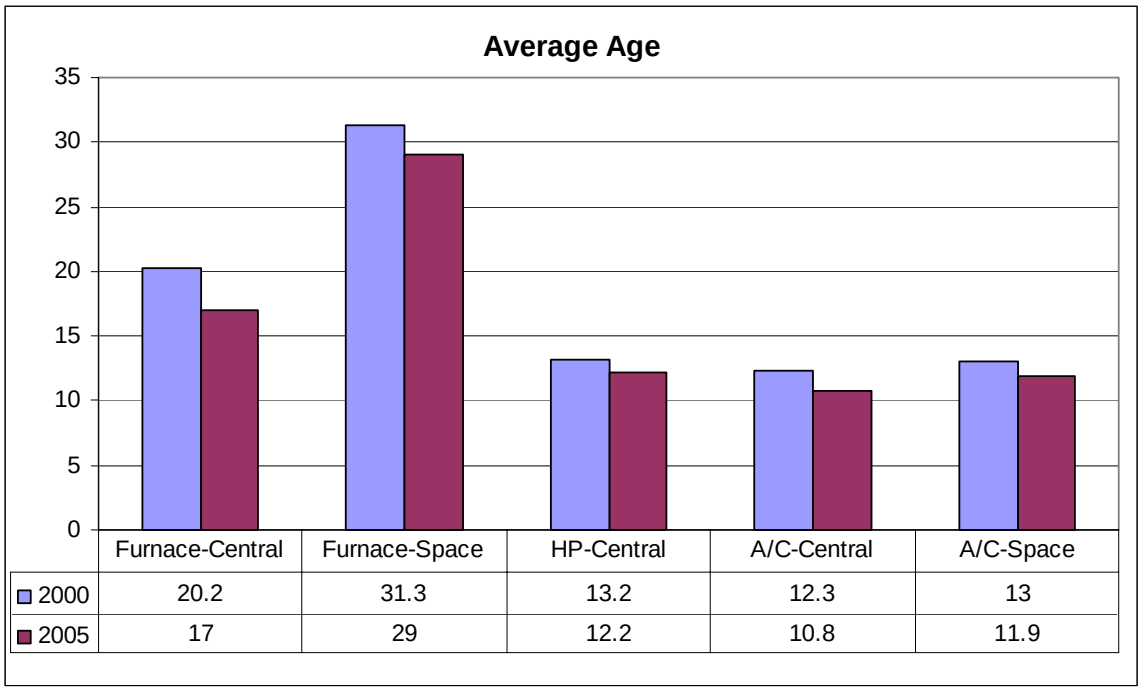
There certainly is a notable trend occurring regarding the average age and efficiency of appliances and equipment. Figure 2 is an illustration of the average age of major appliances based on the 2000 and 2005 study findings. The results demonstrate a steady, across the board reduction in the average age of appliances. For example, 2005 findings reveal that, currently, secondary refrigerators are nearly the same age as primary refrigerators were five years ago.



	Primary Refrigerators	Secondary Refrigerators	Freezers	Hot Water Heaters	Washers	Dryers	Dishwashers
2000	8.5	12.8	13.6	8.8	7.4	8.4	9
2005	6.6	9.0	11.7	7.2	6.7	7.6	7.4

Figure 2: Average Age Comparison for Major Appliances

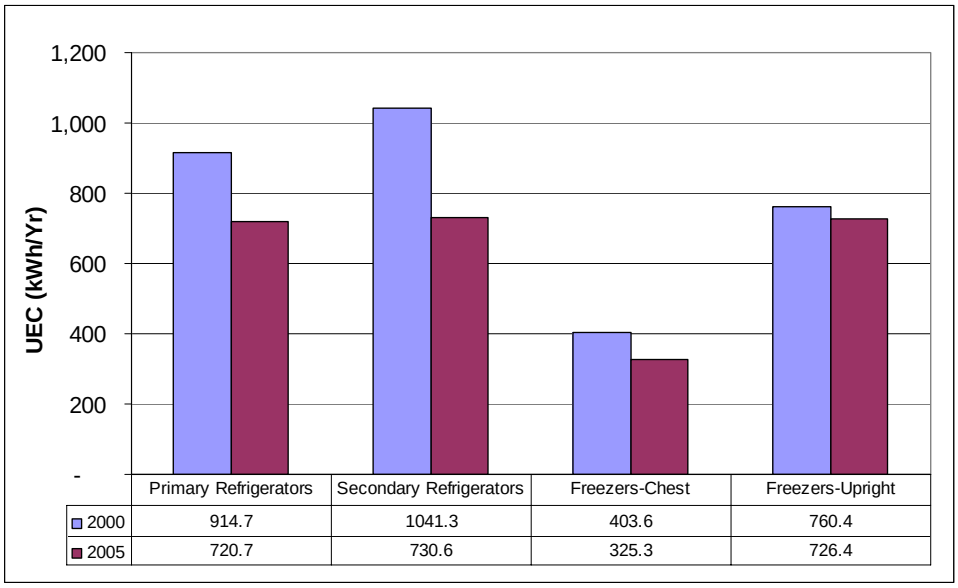
Figure 3 is an illustration of the average age of HVAC systems based on the 2000 and 2005 study findings. The results again demonstrate a steady, across the board reduction in the average age of HVAC systems.



	Furnace-Central	Furnace-Space	HP-Central	A/C-Central	A/C-Space
2000	20.2	31.3	13.2	12.3	13
2005	17	29	12.2	10.8	11.9

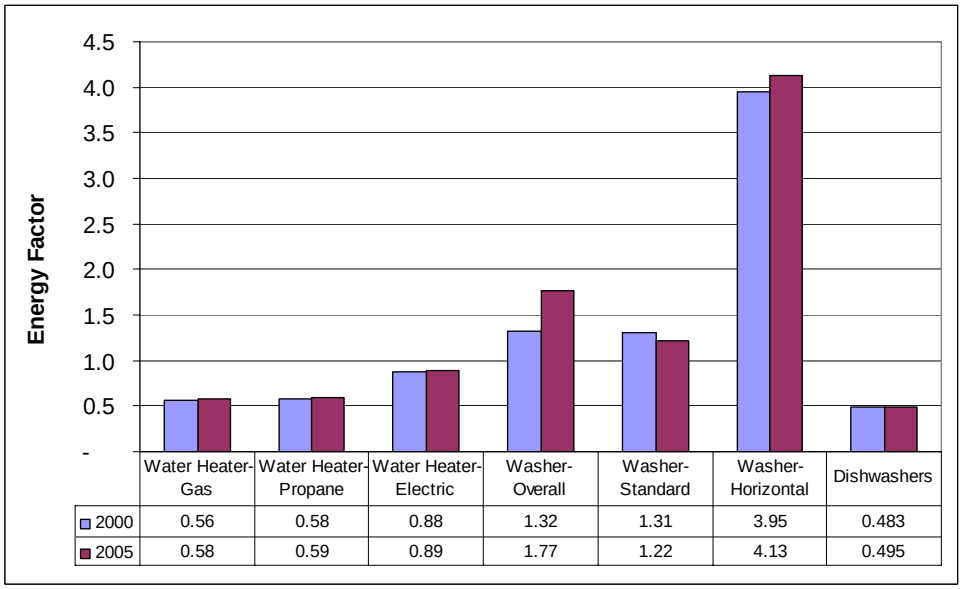
Figure 3: Statewide Comparison of HVAC Average Age 2000-2005

As one might expect, with a decrease in the average age of appliances, the base efficiency has also improved. The following figures demonstrate the efficiency improvements that have been made in the last five years, beginning with refrigerators and freezers that are rated using labeled energy consumption, then appliances that are rated using energy factor (EF), then heating equipment that is AFUE rated and finally cooling equipment that is rated using SEER.



	Primary Refrigerators	Secondary Refrigerators	Freezers-Chest	Freezers-Upright
2000	914.7	1041.3	403.6	760.4
2005	720.7	730.6	325.3	726.4

Figure 4: Statewide Comparison of Primary and Secondary Refrigerator Efficiency 2000-2005



	Water Heater-Gas	Water Heater-Propane	Water Heater-Electric	Washer-Overall	Washer-Standard	Washer-Horizontal	Dishwashers
2000	0.56	0.58	0.88	1.32	1.31	3.95	0.483
2005	0.58	0.59	0.89	1.77	1.22	4.13	0.495

Figure 5: Statewide Comparison of Efficiency for Energy Factor Rated Appliances 2000-2005

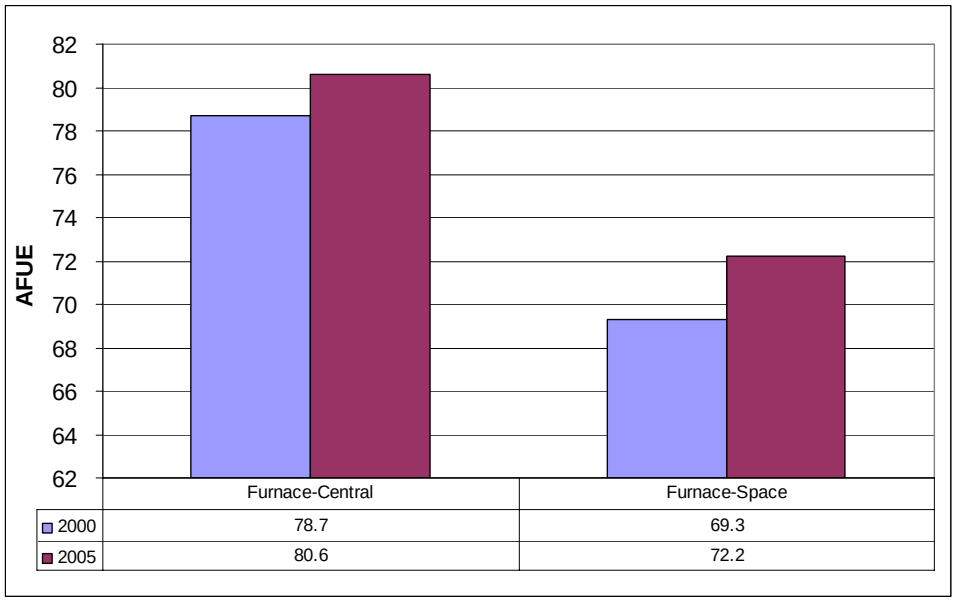


Figure 6: Statewide Comparison of Efficiency for AFUE Rated Heating Equipment 2000-2005

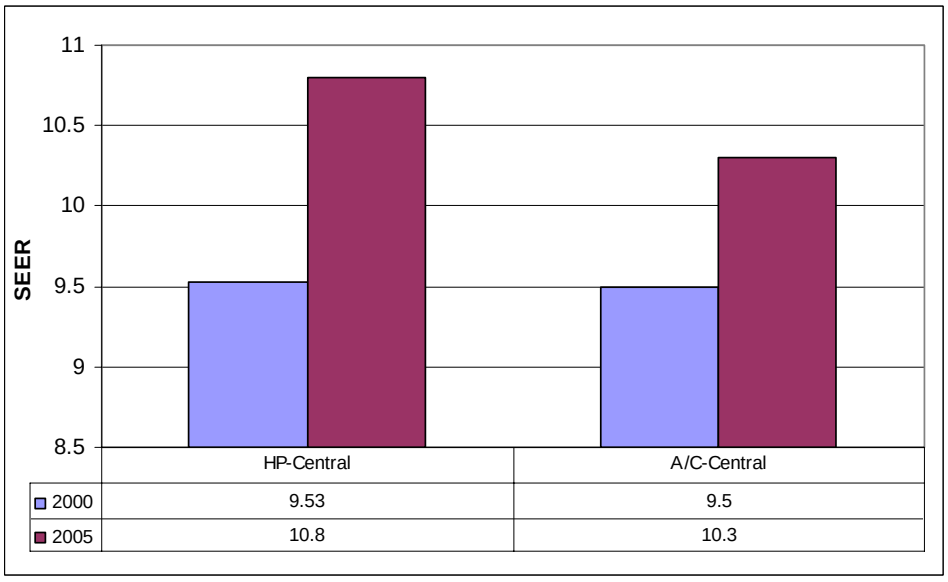


Figure 7: Statewide Comparison of Efficiency for SEER Rated Central Cooling Equipment 2000-2005

Attributing these findings is difficult and somewhat subjective. Part of the explanation for this trend is in the huge quantities of new homes being built each year in California[1] (e.g., 200,000 homes in 2004). However, it is not reasonable to think that such large

[1]California Building Industry Association. "California Builders Remain on Target to Build 210,000 Units in 2005". June 1, 2005. http://www.cbia.org/index.cfm?pageid=1167

improvements in the age and efficiency stock of appliances and equipment is due exclusively to the increasing contribution of new construction.

We believe that there are at least two other relevant drivers. During the period of 2000-2005, interest rates reached an all time low; during the same period, property values in California ascended at unprecedented rates. These two forces afforded many Californians the opportunity to refinance and borrow against their property in order to make upgrades and improvements. Within our own survey sample, customers were asked if they had remodeled in the last 10 years and 26% of customers indicated that they had. Of those stating they had remodeled, 50% reported having replaced kitchen appliances, another 50% reported hard wired lighting remodels, and 17% reported having completed a full remodel of the home[2].

Secondly, during 2000 and 2001 California experienced blackouts and deregulation, which in turn created an energy efficiency resurgence, perhaps unsurpassed by any other prior event or period. Through programs like the 20/20 program, CPUC mandated energy efficiency programs, and marketing, education and information programs like Flex Your Power and ENERGY STAR, Californians were the target of many mass market energy efficiency programs that sought to change behavior and purchasing habits. As time passes, it may be necessary to remind customers about the 2001 energy crisis that prompted many new efficiency programs, so that conservation remains relevant in the minds of the customers and they opt to replace older, less efficient equipment with newer, more efficient equipment.

The CLASS study did not explore attribution, therefore these are merely educated guesses, and certainly more forces may be at work. Regardless of the cause, it certainly appears as though Californians are on the right track to creating a more energy conscious state.

[2] Multiple responses were allowed, therefore results do not sum to 100%.

Introduction

This is the final report for the 2005 California Statewide Residential Lighting and Appliance Efficiency Saturation Study. RLW Analytics, Inc., The Benningfield Group and ASW Engineering conducted the study on behalf of the four investor owned utilities, including San Diego Gas and Electric, Southern California Gas Company, Southern California Edison and Pacific Gas and Electric. San Diego Gas and Electric Company managed the study. The key project stakeholders consisted of one member from the Natural Resources Defense Council (NRDC) and one member from each of the investor owned utilities. In addition to IOU participation, the Sacramento Municipal Utility District also participated in this study. SMUD results are presented in a separate report.

The 2005 California Statewide Lighting and Appliance Efficiency Saturation Study (CLASS) is a follow-on study to the 2000 Statewide Lighting and Appliance Efficiency Saturation Study. Each of these studies were paid for by Public Purpose funds for the purpose of understanding current levels of equipment and lighting saturation and efficiencies in the existing residential sector.

Subsequent to the 1999-2000 study, a tremendous amount of Public Purpose funds were invested in energy conservation programs that serve customers of the investor owned utilities. These Public Purpose dollars were invested in a multitude of ways, all with the goal of achieving lasting energy savings in California's energy markets. The overarching goal of the 2004-05 update study was to provide revised baselines of saturation and efficiency characteristics for use in understanding future energy savings potential and past accomplishments in the residential sector.

The four primary objectives of this study were:

> **Objective 1:** Complete 850 onsite surveys of single-family, multi-family and modular homes in the service territories of the Investor Owned Utilities.
>
> **Objective 2:** Develop a database of residential building characteristics, lighting and appliance saturations and efficiencies, expanded to represent the population of IOU customers.
>
> **Objective 3:** Develop a web-based tool to provide utility staff and other parties the ability to conduct "what-if" scenario analyses on the data collected.
>
> **Objective 4:** Conduct trend and comparison analyses of saturations and efficiencies between the two California Statewide Residential Lighting and Appliance Saturation and Efficiency Studies, in addition to a comparison of results between the Residential Market Share Tracking Study and the 2004 RASS Study.

Approach

An evenly distributed sample of residential accounts was selected for each utility for each residential rate class offered by the four participating IOUs. Customers were recruited to participate in the study by phone, and each participant was paid $25.00 for agreeing to allow an onsite surveyor to visit their home to gather the required information. The onsite 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 850 on-site surveys were completed between January and May 2005.

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:

- Refrigerator-Freezer
- Self-standing Freezers
- Dishwashers
- Clothes Washers
- Clothes Dryers
- Water Heaters
- Heating Equipment
- Cooling Equipment
- Pool and Spa Equipment (heater and pump)

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 insulation R-values, wall construction, and window type.

The survey also included a brief set of demographic and socioeconomic questions, in addition to a few questions regarding recent or planned remodeling of the home.

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 3 presents each appliance for which we collected data in 2004-05 and Table 4 presents similar data from 1999-2000. The tables contain the following data in the same column order as listed below:

1. Name of appliance,
2. Number of each appliance found during all on-site visits,
3. Number of model numbers found for each appliance,
4. Number of model numbers matched to efficiency database(s),
5. Percentage of matched model numbers among appliances with model numbers,
6. Percentage of model numbers that surveyors were **unable** to identify on-site,
7. Percentage of matched model numbers among **all** appliances recorded.

For example, in the 2005 study, we recorded the presence 848 refrigerators. During the on-site surveys, the surveyors were able to locate model numbers for 773 of those refrigerators. Seventy-five of the 848 (9%) refrigerators had either an unreadable or a missing nameplate.

When the data were aggregated at RLW's offices and linked to the refrigerator efficiency databases, only 530 of the 773 (69%) refrigerators with model numbers were matched. Another way to look at the match rate is to consider the percentage of the *total* number of refrigerators (848) that were successfully matched (530), which for refrigerators was 63%. 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.

Some comparisons of the match rate between the 2005 and the 2000 study are presented after Table 4.

2005	Total Number in Database (A)	Model Numbers Found (B)	Model Numbers Matched (C)	% Model Numbers Matched (C/B)	% Model Numbers Not Found (1-(B/A))	% of Total Matched (C/A)
Primary Refrigerators	848	773	530	69%	9%	63%
Secondary Refrigerators	160	119	70	59%	26%	44%
Cooling Overall	490	266	167	63%	46%	34%
Cooling Packaged	99	47	34	72%	53%	34%
Cooling Split	230	188	118	63%	18%	51%
Cooling Win/Wall	65	15	6	40%	77%	9%
Clothes Dryer	680	644	21	3%	5%	3%
Heat Pump	27	13	10	77%	52%	37%
Heating	809	400	233	58%	51%	29%
Primary Freezer	164	109	51	47%	34%	31%
Dishwasher	583	559	148	26%	4%	25%
Washing Machine	696	602	106	18%	14%	15%
Water Heater	848	564	276	49%	33%	33%

Table 3: 2005 Model Number Match Rates by Appliance

2000	Total Number in Database (A)	Model Numbers Found (B)	Model Numbers Matched (C)	% Model Numbers Matched (C/B)	% Model Numbers Not Found (1-(B/A))	% of Total Matched (C/A)
Refrigerators	1444	1260	865	69%	13%	60%
Cooling Overall	733	460	300	65%	37%	41%
Cooling Evap	49	13	0	0%	73%	0%
Cooling Packaged	117	48	26	54%	59%	22%
Cooling Split Sys	400	328	268	82%	18%	67%
Cooling Win Wall	167	71	6	8%	57%	4%
Furnace	1275	791	339	43%	38%	27%
Heat Pumps	83	60	30	50%	28%	36%
Freezers	214	165	51	31%	23%	24%
Dishwashers	871	849	286	34%	3%	33%
Washing Machines	965	865	156	18%	10%	16%
Hot Water Heaters	1074	822	439	53%	23%	41%

Table 4: 2000 Model Number Match Rates by Appliance

Figure 8 shows the percentage of the *total* number of each appliance that was successfully matched by study year (the last column in tables above). There is no obvious trend that one study had a higher matching success rate than the other. Rather, we can see that the success rate across years varies by appliance. For example, refrigerators and freezers were matched at a higher rate in 2005 than in 2000. However dishwashers and water heaters were matched at a higher rate in 2000. Similar variances can be seen in Figure 9, the match rates for HVAC systems.

Refrigerators consistently had the highest match rates while room air-conditioners had the lowest.

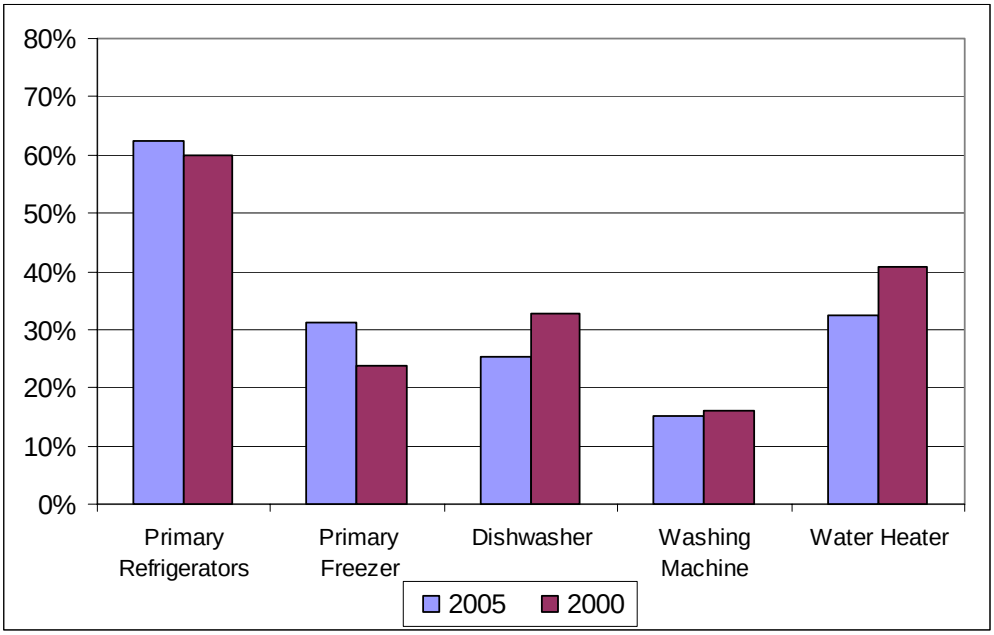


Figure 8: Percentage of All Appliance Models Matched

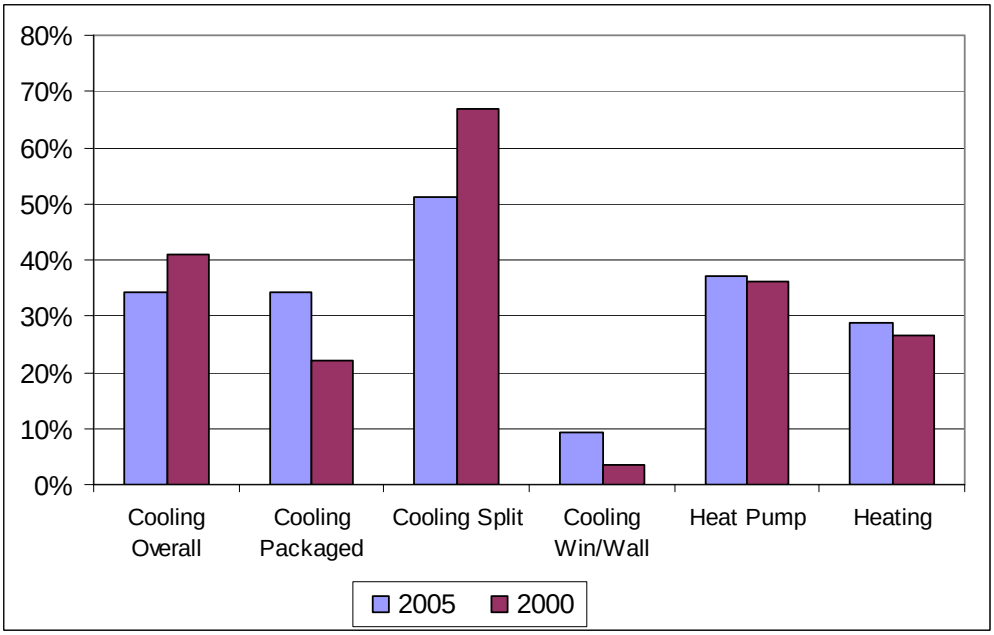


Figure 9: Percentage of All HVAC Models Matched

Based upon our experience with the previous study, we anticipated in the design stages of the project that the match rates would approximate what are shown in the tables and graphs 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 state of California 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.

Previously there was no database available for matching dryers. After 2000, the CEC has compiled a list of dryers. We were only able to match 3% of the dryer model number using this database. We also purchased the AHAM room air-conditioner database for this project. Our hypothesis was that if we utilized this database for matching, we could increase the room air-conditioner match rate from the 8% that we matched in 2000. That did turn out to be true since we were able to match 40% of room air-conditioners in 2005. However, there were only 6 units for which we had model numbers.

The analysis for lighting and appliances is summarized in this report at the statewide 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 from the 2000 and 2005 studies. The California Residential Efficiency Saturation Tool (CALRES^{EST}) allows users to explore this residential sector data in a myriad of ways that go well beyond what is presented in this "statewide" report. The tool can be accessed at www.calresest.com.

Sample Design

Sampling Plan

Table 5 below documents our planned sample design. The table shows the residential rate classes served by SCE, SDG&E, PG&E, and SMUD together with the number of accounts in each class (population size).

For SCE, SDG&E, and PG&E, we allocated the sample in each rate class by the proportion of the number of accounts in each rate class. The sample size for each stratum is given by the following formula:

$$\text{Rate Class Sample Size} = \left(\frac{\text{Rate Class Population}}{\text{Total Population}} \right) \text{ x } \text{Desired Sample Size}$$

We added the constraint that the sample should include at least one site from every rate class. The initial calculations produced 20 rate classes with less than one sample point. So, we adjusted the formula accordingly, i.e., we reduced the desired sample size from 850 to 830. This procedure allowed us to manually allocate at least one sample point for the 20 rate classes that would not have been represented by proportional allocation. This procedure also prevented us from exceeding the desired sample size of 850.

For example, SCE has 921,494 customers on its Domestic CARE rate. Overall, SCE, SDG&E and PG&E have 9,190,693 customers. So, the proportion of customers on SCE's D-CARE rate is 10% (921,494 / 9,190,063). This proportion multiplied by 830 yielded a sample size of 83 for SCE's Domestic CARE rate.

SMUD joined the project after the sample design was completed for the three IOUs; therefore their sample design was completed independently. For SMUD, the sample sizes were proportionally allocated among the Standard Residential rates and EAPR (low income) rates. Rate class sample sizes were calculated using the same method above. The desired sample size for SMUD was 225.

Utility	Stratum	Population	Sample
SCE	D-APS	75,399	7
SCE	D-CARE	921,494	83
SCE	D-CARE-APS	9,946	1
SCE	DE	10,581	1
SCE	DE-APS	1,550	1
SCE	DOMESTIC	2,879,065	259
SCE	D-S	6,304	1
SCE	TOU-D-1	360	1
SCE	TOU-D-2	3,144	1
SCE	**SUB TOTAL**	**3,907,843**	**355**
SDG&E	DR	921,350	84
SDG&E	DRLI	164,631	16
SDG&E	**SUB TOTAL**	**1,085,981**	**100**
PG&E	E1	3,340,434	302
PG&E	E1L	692,810	62
PG&E	E1S	207	1
PG&E	E1SL	56	1
PG&E	E1T	323	1
PG&E	E1TL	842	1
PG&E	E2A	54	1
PG&E	E2AL	12	1
PG&E	E2B	58	1
PG&E	E2BL	6	1
PG&E	E3A	199	1
PG&E	E3AL	59	1
PG&E	E3B	166	1
PG&E	E3BL	64	1
PG&E	E7	78,977	7
PG&E	E7A	58	1
PG&E	E7AL	3	1
PG&E	E7L	4,669	1
PG&E	E8	70,210	6
PG&E	E8L	7,523	1
PG&E	E9A	138	1
PG&E	E9AL	1	1
PG&E	**SUB TOTAL**	**4,196,869**	**395**
SMUD	Std-SF-Gas	289,625	100
SMUD	Std-SF-Elec	57,746	20
SMUD	Std-MF-Gas	62,396	21
SMUD	Std-MF-Elec	58,202	20
SMUD	EAPR-SF-Gas	17,143	30
SMUD	EAPR-SF-Elec	3,619	6
SMUD	EAPR-MF-Gas	8,894	16
SMUD	EAPR-MF-Elec	6,678	12
SMUD	**SUB TOTAL**	**504,303**	**225**
TOTAL	**TOTAL**	**9,694,996**	**1,075**

Table 5: Planned Sample Size by Utility

Final Sample

Table 6 shows the final sample along with the weight associated with each rate class. For most strata, the final sample size is identical to the original sample design. In some cases, we had to revise the sampling plan slightly. For example, there was only one customer in PG&E's E9AL rate class. RLW recruiters were not able to reach this customer, so a sample point was added to PG&E's E8 rate class to make up the difference.

Note that the weights for SMUD strata tend to be quite a bit smaller than the weights for the other three utilities. This reflects the fact that the SMUD population was more heavily sampled than the other three utilities. The sampling plan and sample weights allows for each of the utilities to conduct statistically representative analyses for the population of customers at the utility level.

Utility	Stratum	Population	Planned Sample	Actual Sample (Appliance)	Actual Sample (Lighting)	Appliance Weight	Lighting Weight
SCE	D-APS	75,399	7	7	7	10,771.3	10,771.3
SCE	D-CARE	921,494	83	83	83	11,102.3	11,102.3
SCE	D-CARE-APS	9,946	1	1	1	9,946.0	9,946.0
SCE	DE	10,581	1	1	1	10,581.0	10,581.0
SCE	DE-APS	1,550	1	1	1	1,550.0	1,550.0
SCE	DOMESTIC	2,879,065	259	258	257	11,159.2	11,202.6
SCE	D-S	6,304	1	1	1	6,304.0	6,304.0
SCE	TOU-D-1	360	1	1	1	360.0	360.0
SCE	TOU-D-2	3,144	1	1	1	3,144.0	3,144.0
SCE	**SUB TOTAL**	**3,907,843**	**355**	**354**	**353**		
SDG&E	DR	921,350	84	83	83	11,100.6	11,100.6
SDG&E	DRLI	164,631	16	16	16	10,289.4	10,289.4
SDG&E	**SUB TOTAL**	**1,085,981**	**100**	**99**	**99**		
PG&E	E1	3,340,434	302	302	302	11,061.0	11,061.0
PG&E	E1L	692,810	62	62	62	11,174.4	11,174.4
PG&E	E1S	207	1	1	1	207.0	207.0
PG&E	E1SL	56	1	1	1	56.0	56.0
PG&E	E1T	323	1	1	1	323.0	323.0
PG&E	E1TL	842	1	0	0		
PG&E	E2A	54	1	1	1	54.0	54.0
PG&E	E2AL	12	1	1	1	12.0	12.0
PG&E	E2B	58	1	1	1	58.0	58.0
PG&E	E2BL	6	1	1	1	6.0	6.0
PG&E	E3A	199	1	1	1	199.0	199.0
PG&E	E3AL	59	1	1	1	59.0	59.0
PG&E	E3B	166	1	1	1	166.0	166.0
PG&E	E3BL	64	1	1	1	64.0	64.0
PG&E	E7	78,977	7	8	8	9,872.1	9,872.1
PG&E	E7A	58	1	1	1	58.0	58.0
PG&E	E7AL	3	1	1	1	3.0	3.0
PG&E	E7L	4,669	1	1	1	4,669.0	4,669.0
PG&E	E8	70,210	6	7	7	10,030.0	10,030.0
PG&E	E8L	7,523	1	1	1	7,523.0	7,523.0
PG&E	E9A	138	1	1	1	138.0	138.0
PG&E	E9AL	1	1	0	0		
PG&E	**SUB TOTAL**	**4,196,869**	**395**	**395**	**395**		
SMUD	Std-SF-Gas	289,625	100	100	100	2,896.3	2,896.3
SMUD	Std-SF-Elec	57,746	20	20	19	2,887.3	3,039.3
SMUD	Std-MF-Gas	62,396	21	19	19	3,284.0	3,284.0
SMUD	Std-MF-Elec	58,202	20	20	20	2,910.1	2,910.1
SMUD	EAPR-SF-Gas	17,143	30	30	30	571.4	571.4
SMUD	EAPR-SF-Elec	3,619	6	6	6	603.2	603.2
SMUD	EAPR-MF-Gas	8,894	16	18	18	494.1	494.1
SMUD	EAPR-MF-Elec	6,678	12	12	12	556.5	556.5
SMUD	**SUB TOTAL**	**504,303**	**225**	**225**	**224**		
TOTAL	**TOTAL**	**9,694,996**	**1,075**	**1,073**	**1,071**		

Table 6: Final Sample

Figure 10 through Figure 13 detail the site locations of the statewide sample as well as the three utilities' final samples. Each tack represents an address where a house was surveyed.

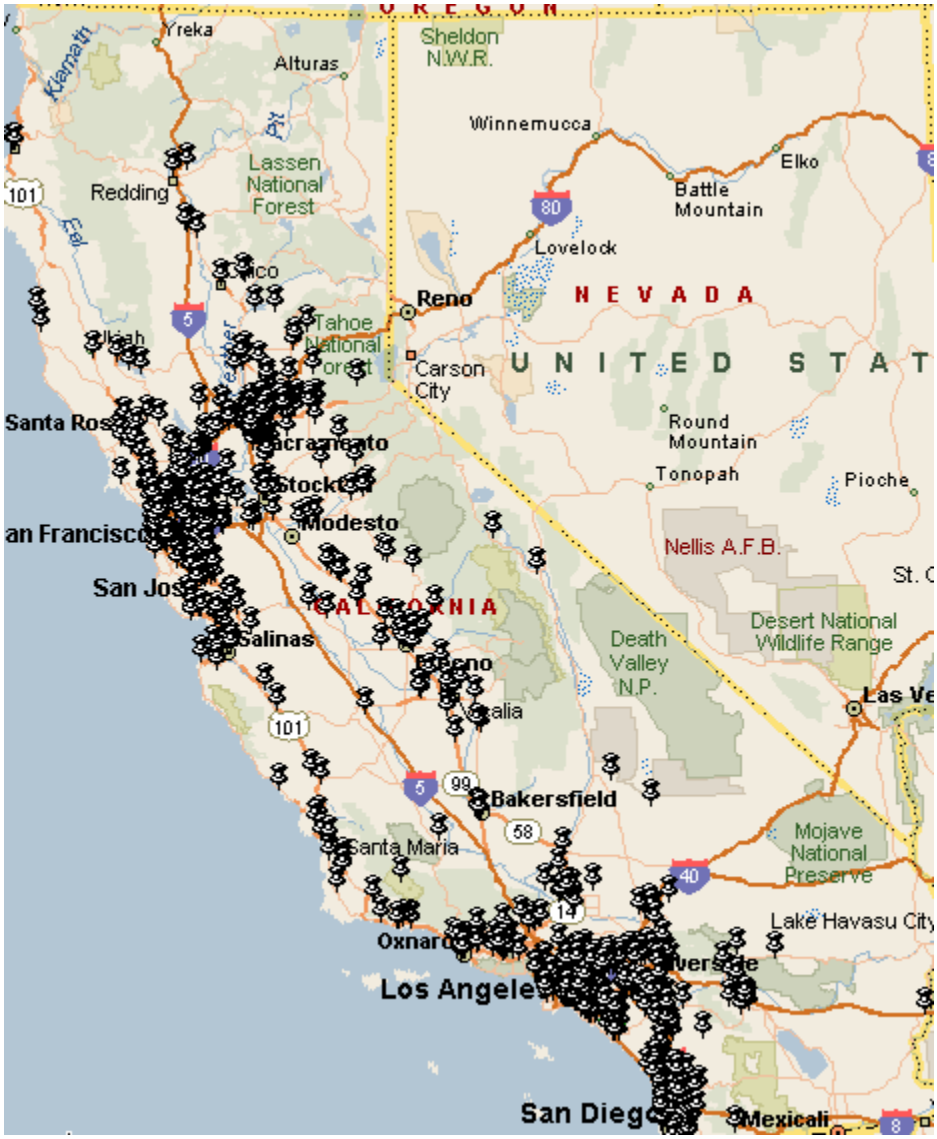


Figure 10: Statewide Final Sample Location

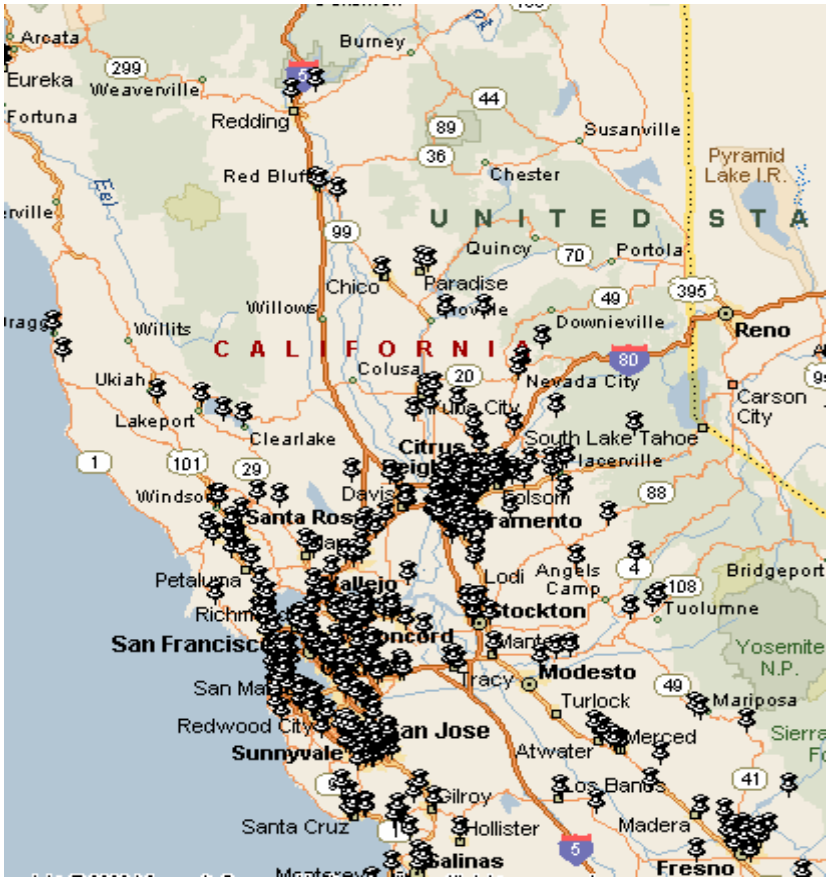


Figure 11: PG&E Final Sample Location

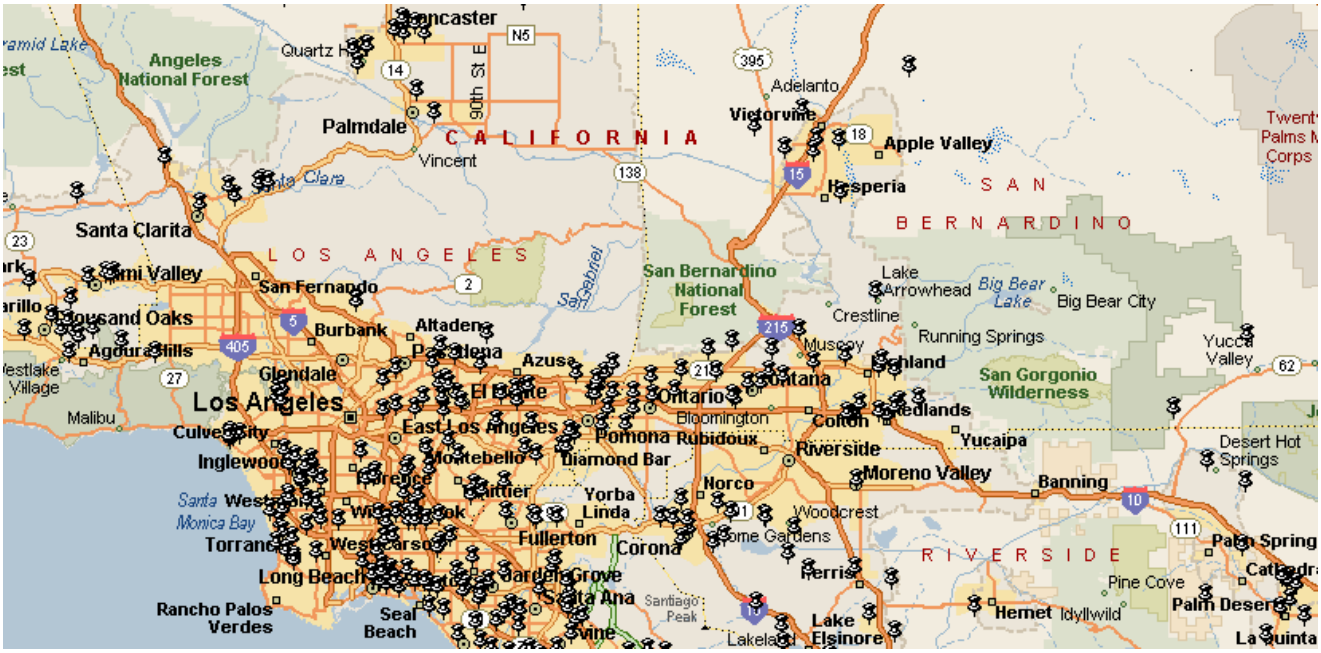


Figure 12: SCE Final Sample Location

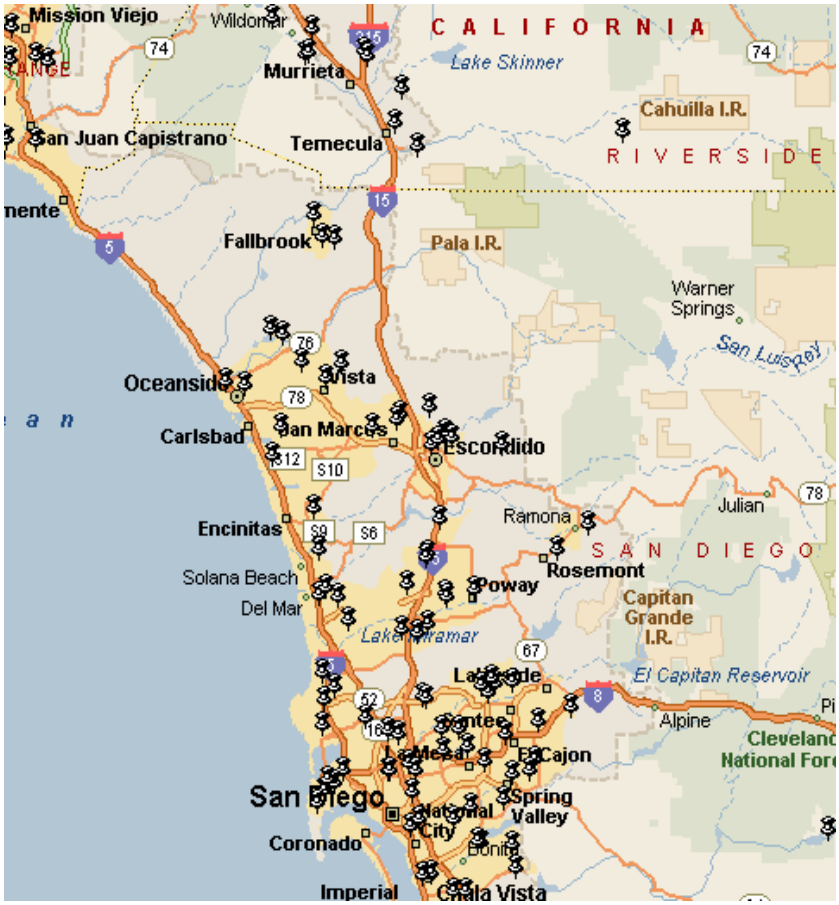


Figure 13: SDG&E Final Sample Location

Data Collection

Overview

The data collection component of the study was highly resource intensive, taking about seven months to complete. As Figure 14 indicates, only a few pilot sites were completed in the months of November, December and January due to the holiday season. After the 25 pilot sites were completed, the survey instrument was reviewed for completeness and modified to reflect unanticipated field observations. The bulk of the onsite work was completed between mid-January and April; fewer than 20 visits were scheduled in May.

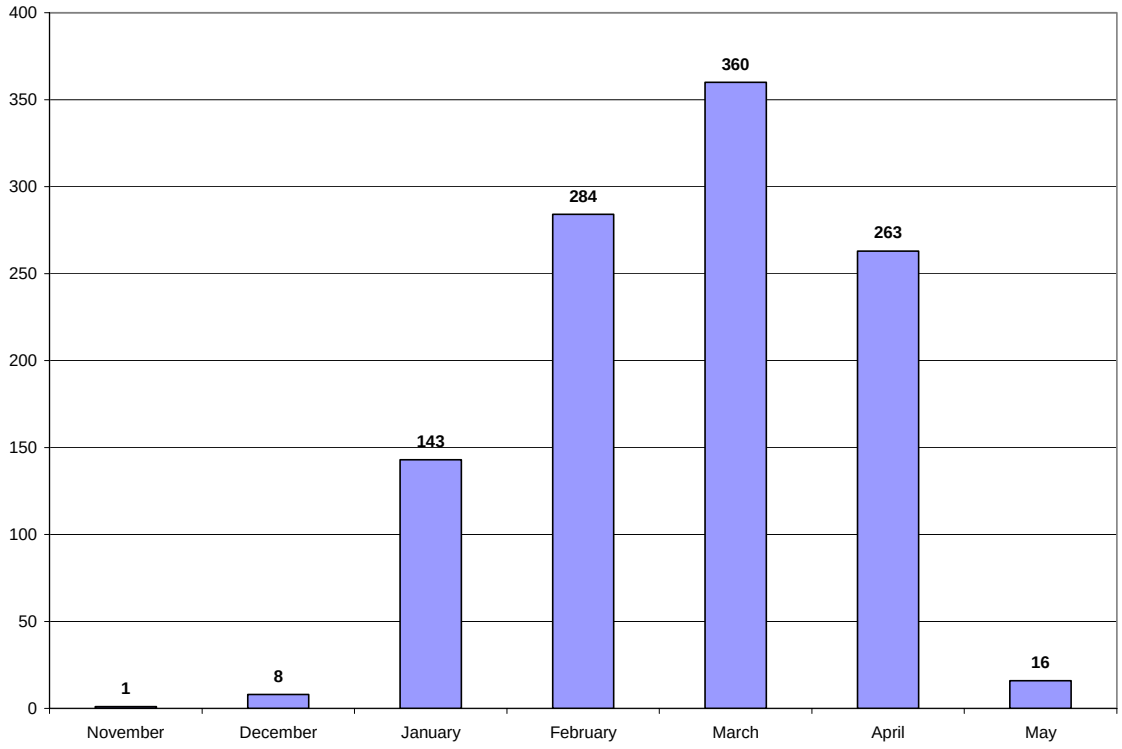


Figure 14: On-sites by Month of Completion

ASW Engineering completed the on-site surveys in the territories of San Diego Gas and Electric, Southern California Edison, and a small portion of the southern most regions of PG&E service territory. The Benningfield Group completed surveys of SMUD service territory; while RLW Analytics field staff surveyed sites in PG&E and a small portion of the northern-most regions of SCE service territory. Approximately 18 surveyors completed the 1,075 required on-site surveys.

Each surveyor participated in a one-day training session. The training was focused on demographic, lighting, and appliance data to be collected while in the field. Additionally, the surveyors were trained to use the palm-top computers, data uploading and downloading and Internet access. Three training sessions were held, one in Anaheim for the ASW surveyors, another in Sonoma for the RLW surveyors, and one in Sacramento for the Benningfield Group surveyors.

Recruiting

RLW and ASW recruited customers based on their geographic location. In general, RLW recruited in the northern part of California, ASW the southern region, and the Benningfield Group concentrated on the Sacramento area. A $25 incentive was offered to customers that agreed to participate in the study. The recruiters scheduled appointments between the hours of 8AM to 8PM Monday-Friday and occasionally on Saturday. The recruiting manager dispatched the information electronically to the field surveyors at the end of each day. In all, 1075 sites were recruited to participate in the study; Table 7 shows the number of sites recruited and surveyed per utility service territory.

Service Territory	Number of Sites Recruited
PG&E	395
SCE	355
SDG&E	100
SMUD	225

Table 7: Number of Sites Recruited by Service Territory

Before they were contacted by the recruiters over the phone, each customer selected for the study received a letter from their utility provider. The letter described the purpose of the research and gave them the option to call RLW, ASW or their utility provider to voice their interest or lack of interest in the study. Customer letters were instrumental to the success of the study and improved the overall completion rate from the previous study.

Generally, the recruiters make up to seven attempts to reach the customer by phone. However, the program managers and RLW recruiters agreed that the sixth and seventh calls rarely resulted in success. Therefore, the recruiters attempted to contact each customer a maximum of five times. If unsuccessful after the fifth call, the customer was replaced with a back-up customer and the site was designated 'unable to contact'.

When customers missed appointments or refused the on-site, the recruiters attempted to reschedule the audit. Eight customers were deemed 'No Shows' and were not rescheduled before the study concluded. Sites were also rescheduled if end use data was missing for sites believed to be completed. The customers were cooperative in scheduling revisits when this occurred.

Table 8 summarizes the disposition codes and final outcomes for customers that the recruiters attempted to contact during the study. Call dispositions such as 'Left Message', 'Busy' and 'No Answer' were changed to 'Unable to Contact' after five calls were placed to the customer.

About one-quarter of all customers contacted refused to participate in the study. The greatest percentage of refusals came from SDG&E customers. The Statewide refusal rate includes:

- 13 customers who first agreed to participate, and then refused the auditor entry into their home to complete the survey.
- 2 customers who only allowed a partial audit of their home.

RLW recruiters expanded the call disposition outcomes from the previous study with the intent of having a more accurate characterization; outcomes 11-18 are new to the study.

		PG&E		SCE		SDG&E		SMUD		Statewide	
	Call Outcome	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
1	Appointment Completed	395	34.8%	355	21.7%	100	27.2%	225	31.9%	1075	28.0%
2	Left Message	3	0.3%	51	3.1%	-	-	13	1.8%	67	1.7%
3	Callback	-	-	32	2.0%	-	-	4	0.6%	36	0.9%
4	Busy	-	-	-	-	-	-	-	-	-	-
5	No Answer	1	0.1%	18	1.1%	-	-	2	0.3%	21	0.5%
6	Refusal	244	21.5%	411	25.1%	110	29.9%	169	24.0%	934	24.3%
7	Wrong Number	69	6.1%	143	8.7%	24	6.5%	86	12.2%	322	8.4%
8	No phone number/cannot locate #	33	2.9%	57	3.5%	5	1.4%	22	3.1%	117	3.0%
9	Disconnected	100	8.8%	123	7.5%	23	6.3%	44	6.2%	290	7.5%
10	Communication Barrier	13	1.1%	33	2.0%	3	0.8%	13	1.8%	62	1.6%
11	Vacant	20	1.8%	24	1.5%	6	1.6%	12	1.7%	62	1.6%
12	Customer recently passed away.	2	0.2%	8	0.5%	2	0.5%	3	0.4%	15	0.4%
13	Reschedule	-	-	1	0.1%	0	0.0%	5	0.7%	6	0.2%
14	Not Qualified	74	6.5%	18	1.1%	7	1.9%	14	2.0%	113	2.9%
15	Stratum Filled	10	0.9%	13	0.8%	16	4.3%	13	1.8%	52	1.4%
16	Tenant Occupied	1	0.1%	6	0.4%	-	-	-	-	7	0.2%
17	Termination	7	0.6%	34	2.1%	10	2.7%	7	1.0%	58	1.5%
18	Unable to Contact	164	14.4%	308	18.8%	62	16.8%	73	10.4%	607	15.8%
	Total	1136		1635		368		705		3844	

Table 8: Recruiting Final Outcome by Service Territory

SDG&E had the highest refusal rate of the utilities (nearly 30%). Almost 20% of SCE customers were designated 'Unable to Contact'. SMUD had the highest percentage of customers with wrong numbers (12.2%).

Unlike the previous study, PG&E had the highest completion rate at 34.8%; previously PG&E had a significantly lower completion rate at 19.1%. This can most likely be explained by the fact that customers were receptive to the letter and that RLW recruiters have had extensive experience with utility sponsored studies. Once the PG&E and SMUD customers were successfully recruited, the RLW recruiters assisted ASW with meeting the sample requirements for SCE and SDG&E.

SCE customers were the most challenging to recruit as indicated by the high proportion of 'Refusal' and 'Unable to Contact' final outcomes. SCE also had the lowest success rate of all four utilities (21.7%). One reason for the difficulty may be attributed to the fact that many SCE customers reside in Los Angeles County; the recruiters noted that many LA County customers refused to participate, claiming they were "too busy" or "didn't have time".

On-Site Survey Data

The study team developed a list of data and data attributes to be collected during the on-site surveys. A palm top computer was given to each surveyor loaded with the software developed specifically for this project. The software consisted of a series of screens to be filled during the course of the site visit.

The following data were collected at all sites by the field surveyors. For further detail refer to the on-site survey instrument in the appendix,

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
- Has the home been remodeled in last 10 years, if so what was the nature of the remodel (i.e. appliances, hard-wired lights, cosmetic, which rooms)
- Are there plans to remodel in the future
- 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. These results have not been weighted to reflect the population.

Table 9 shows the percentage of homes by type of residence. Over 45% of all the residences are single family, unattached, 1-story dwellings. The second most commonly visited type of residence was single family, unattached, 2 story housing, totaling 19.7% of the sample.

Type of Residence	Percent of Homes
Apt/Condo (1 or 2 stories)	19.1%
Apt/Condo (3 or more stories)	5.3%
Mobile Home - Double Wide	2.4%
Mobile Home - Single Wide	0.4%
Modular/Prefabricated	0.5%
Other	0.6%
Single Family Unattached (1 story)	45.4%
Single Family Unattached (2 stories)	19.7%
Single Family Unattached (3 or more stories)	0.9%
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	5.8%

Table 9: Percentage of Homes by Type of Residence

Table 10 shows the percentage of homes by number of people occupying the home. The largest percentage of homes, or 32.7%, has 2 occupants. However, it was also common to visit homes with 1, 3, or 4 occupants. The average number of people per home is 2.8 people.

Total Number of People	Percent of Homes
1	18.5%
2	32.7%
3	16.0%
4	16.4%
5	7.7%
6	3.9%
7	1.1%
8	1.0%
9	0.2%
11	0.1%
13	0.1%
Refused	1.8%
Vacant	0.3%

Table 10: Percentage of Homes by Number of People[3]

Table 11 shows the percentage of homes by number of adults occupying the home. Not surprisingly, over half of homes, or 57.7%, have 2 adults present. The average number of adults per home is 2.0.

Total Adults in Home	Percent of Homes
1	22.9%
2	57.7%
3	10.2%
4	4.4%
5	2.0%
6	0.2%
7	0.1%
8	0.1%
9	0.1%
Refused	1.8%
Vacant	0.3%

Table 11: Percentage of Homes by Number of Adults

Table 12 shows the percentage of homes by primary language. Not surprisingly, English was the primary language spoken at over 83% of the homes. Spanish was the second most common language, with over 10% of all respondents speaking Spanish as their primary language.

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

Primary Language	Percent of Homes
Chinese	2.1%
English	83.4%
French	0.4%
Indian	0.8%
Other	2.5%
Russian	0.2%
Spanish	10.6%

Table 12: Percentage of Homes by Primary Language

Table 13 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 21.5% of the sample.

Total Household Income	Percent of Homes
< $25,000	12.0%
$25,001-$50,000	21.5%
$50,001-$75,000	16.9%
$75,001-$100,000	13.3%
>$100,000	15.7%
Unknown	5.1%
Refused	15.6%

Table 13: Percentage of Homes by Total Household Income

Table 14 shows the percentage of homes by age of home. The age of homes was fairly evenly distributed among the age ranges, with homes built in the 'before 1950' group being more common in the sample.

Home Age Range	Percent of Homes
1950 or Earlier	15.0%
1951-1955	6.3%
1956-1960	6.1%
1961-1965	7.5%
1966-1970	6.1%
1971-1975	7.7%
1976-1980	8.0%
1981-1985	6.4%
1986-1990	7.3%
1991-1995	4.8%
1996-2000	5.5%
2001-2005	6.4%
Unknown	12.9%

Table 14: Percentage of Homes by Age Range of Home

Table 15 shows the percentage of homes by the total heated floorspace of the homes. Almost one-third of the homes surveyed were between 1,000 to 1,599 SQFT.

Total Heated Floorspace	Percent of Homes
Fewer than 600 sq.ft.	5.2%
600 to 999 sq.ft.	17.0%
1,000 to 1,599 sq.ft.	31.8%
1,600 to 1,999 sq.ft.	19.0%
2,000 to 2,399 sq.ft.	11.2%
2,400 to 2,999 sq.ft.	7.2%
3,000 or more sq.ft.	4.8%
Unknown	3.8%

Table 15: Percentage of Homes by Total Heated Floor Space

Table 16 shows the percentage of homes by whether the home was remodeled in the last 10 years. The overwhelming majority of residences have not been remodeled, totaling 68.3% of the homes.

Remodeled in Last 10 Years	% of Homes
No	68.3%
Yes	26.4%
Don't Know	5.3%

Table 16: Percentage of Homes that were Remodeled in Last 10 Years

Table 17 shows the percentage of homes by type of remodel among those homes that were remodeled in the last 10 years. Over 80% of homes were remodeled cosmetically, while 16.5% were completely remodeled. In the table below, "Cosmetic" stands for "Cosmetic/Other" types of remodels.

Type of Remodel	% of Homes that were Remodeled
Kitchen Appliance	51.7%
Hardwired Lighting	53.8%
Cosmetic	81.9%
Remodeled All	16.5%

Table 17: Percentage of Homes that were Remodeled by Type of Remodel

Table 18 shows the percentage of residents that plan to remodel in the next 2 years. Interestingly, over three-quarters of the residents replied that they have no plans to remodel.

Plan to Remodel in Next 2 Years	% of Homes
No	76%
Yes	11%
Unknown	13%

Table 18: Percentage of Residents that Plan to Remodel in Next 2 Years

Table 19 shows the percentage of homes by type of ownership. Nearly 70% of homes were occupied by owners. Renters constituted roughly 30% of the sample.

Rent or Own	Percent of Homes
Own	69.9%
Rent	29.7%
Unknown	0.4%

Table 19: Percentage of Homes by Ownership Type

Table 20 shows the percentage of homes that are occupied and have gas or electric by who pays for each fuel type. Only a small fraction of homes have electricity paid by someone other than the occupant, at less than 1%.

	Landlord		Owner		Renter		Refused	
	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound
Electricity Costs	0.2%	0.3%	71.8%	2.5%	27.8%	2.5%	0.1%	0.2%
Gas Costs	1.2%	0.6%	72.1%	2.5%	26.5%	2.5%	0.2%	0.3%

Table 20: Who Pays for Electric and Gas Among All Residences

Appliances

Data were collected for heating systems, cooling systems, washing machines, clothes dryers, dishwashers, pools and spas, refrigerator/freezers, self-standing freezers and water heaters. No data were collected on stoves or small appliances.

- 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, washing machines 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 appliance 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, as opposed to just for the porch fixtures in the previous 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, home age, 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.

Database

Overview

The data collected during the 1,075 on-site visits are contained in two final databases. One database contains all appliance and envelope information, and the other contains all the lighting information. These two 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 data on each appliance in the appliance database are located in separate tables. Queries have been set up that allow the user to analyze some key questions for each appliance. The same is true of the lighting database. All of the summary tables in this report have been obtained from queries performed on the two project databases.

The following is a list of the steps that were taken to ready the databases for delivery:

- Consolidation of Surveyor Information
- Cleaning of Surveyor Information
- Merge of Weights
- Acquisition of Efficiency Databases to Link with Surveyor Data
- Creation of Efficiency Categories
- Creation of Analysis Queries
- Efficiency Weighting Adjustments for Unmatched Appliances
- Development of Database Summarization Tool

This section contains a description of the databases and the steps taken to prepare the databases for analysis and delivery, however for a complete description of each table and query see the appendix to this report.

Consolidation of Surveyor Information

During the site visit, the surveyors entered all information directly into a palmtop computer as the survey was completed. The hand-held application was designed to automatically download all on-site data to an SQL database that is hosted at RLW's Sonoma office. Downloaded data were stored in the SQL database which was structured in the same way as the 1999-00 databases, which allowed RLW to reuse many analysis queries that were developed for the previous study. As the data were consolidated, an automated QC process in addition to a manual QC process was performed.

Merge of Weights

Once the sites were merged and cleaned in the central database, the sample design case weights for the analysis were merged into the database in the 'General Information' table. Each site in a given stratum was given a corresponding case weight that we define to be the number of sites in the population that the site is thought to represent. The following formula defines the stratum weight to be the ratio of the number of sites in the population in that stratum to the number of sites in the sample in that stratum.

$$w_h = N_h / n_h \text{ , where h is the stratum number}$$

These weights were used to expand the sample to the population. Once the weights were merged, all the lighting data were pasted into a separate database so the databases were more manageable.

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.

We 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.

Creation of Efficiency Categories

Efficiency categories from the 2000 Study were altered for each appliance type depending on the distribution of the efficiencies. Size and age categories were also altered for each appliance. The size ranges were determined by the distribution of the sizes of each appliance. The age ranges for each appliance were broken into 5 year increments, starting with 2005-2000, then 1995-1999, and so on until the last category of 1979 and older. The efficiency, size and age categories were linked to the surveyor information using logic statements built into the analysis queries.

Creation of Analysis Queries

Analysis queries for each appliance were created in MS Access in order to answer some key questions on market saturation. These queries were designed to analyze each appliance by age, type, size, and any other energy consumption or efficiency variable. Analysis queries were also established for the lighting database. These analysis queries were designed specifically for the Model Bases Statistical Sampling (MBSS) program to analyze the data using ratio estimation techniques. More information on the format of each query is provided in the appendix.

Efficiency Weighting Adjustments for Unmatched Appliances

RLW performed a weighting adjustment to the appliance efficiency data in order to remove the upward bias in average efficiencies that resulted from the model number matching. Appliances manufactured more recently were easier to find matches for than older units. Therefore larger amounts of efficiency data were obtained for newer and potentially more efficient appliances. We have good reason to believe that these uneven match rates produced more efficient overall baseline appliance efficiencies than is actually the case.

Due to the low match rates for the older appliances, the older models were under-represented in the average efficiency calculations relative to their representation in the overall appliance stock. The weighting adjustment serves to increase the weight for each of the matched appliances relative to the number of unmatched appliances in each age range. This adjustment will give the older appliances the appropriate amount of influence on the average efficiencies, and ensures that the matched appliances within each age range have the same proportional representation as the total number of appliances within that age range with and without efficiency.

To improve the findings of this 2005 study, and to improve the 2000 study results, we calculated new weights for the appliance efficiency data in order to account for the uneven match rates we encountered. Applying these weighting adjustments to both the 2005 and 2000 study data produces an "apples to apples" comparison.

Below are the steps that were taken to calculate the weight adjustments:

1. Count the total number of appliance by age bins for each appliance (**A**)
2. Count the number of matched appliances by age bins for each appliance (**B**)
3. Divide the total number of appliances by the number of matched appliances by age bin (**A/B**)
4. Multiply the appliance weight by the case weight to project the appliance efficiency to the population (upward adjustment of weight to reflect appliances that were unmatched in each age range)

A weighting adjustment was not applied to any matched appliance with unknown age since we could not be certain that they were representative of all the unmatched, unknown age appliances.

Table 21 shows an example of the difference between the percent of cooling units **matched** compared to the **total** (matched and unmatched) percentage of cooling units by age range. Nearly 42% of the units that were **matched** were between 0 and 5 years old, while only 25% of **all** cooling units were in this age range.

Without adjusting the case weights to reflect the match rates by age, the efficiency information would be more heavily influenced by the newer and more efficient cooling systems.

Age	Total Number of Units (A)	Number of Matched Units (B)	Weight Adjustment (A/B)	Age Distribution of All Units (n=490)	Age Distribution of Matched Units (n=170)
2000-2005	121	71	1.70	24.7%	41.8%
1995-1999	48	29	1.66	9.8%	17.1%
1990-1994	46	13	3.54	9.4%	7.6%
1985-1989	34	12	2.83	6.9%	7.1%
1980-1984	21	4	5.25	4.3%	2.4%
1979 and Older	24	4	6.00	4.9%	2.4%
Unknown	196	37	1.00	40.0%	21.8%
Total	**490**	**170**	-	**100%**	**100%**

Table 21: Percentage of Matched Cooling Systems and All Cooling Systems by Estimated or Manufacturer Reported Date

The weight adjustment factors are shown in the table above in the column labeled 'Weight Adjustment' which is calculated as the total number of units divided by the total matched units in the same age range. This weight equates to the number of unmatched appliances in each age range that each matched appliance represents. Once these weight adjustment factors are calculated, they are multiplied by the case weights of each of the matched appliances in the corresponding age group.

The existing case weights that are used for the majority of the saturation calculations were determined by the original sample design. Each site in a rate class is assigned a case weight that represents the number of accounts that the sample point represents in the population. Another way to think about the case weight is at the appliance level. If a site has a cooling unit, the cooling unit represents the same number of cooling units in the population that the site represents.

By multiplying the case weight by the weight adjustment factor for the efficiency calculations, the matched appliance is representing the total number of appliances that it represents in the population **and** representing the unmatched units that were previously being dropped from the analysis.

For example, consider a site with a case weight of 1,000 that has a cooling unit manufactured in 2002 that was successfully matched to an efficiency database (making up one of the 71 units in Column B). This site's new weight would be calculated as follows:

1. *Weight Adjustment Factor = Total Number of Units / Number of Matched Units*

   (121 / 71 = 1.7: This matched appliance represents 1.7 unmatched appliances between 0 and 5 years old)

Next the adjustment factor is applied to the case weight

2. *New case weight = Original Case Weight * Adjustment Factor*

   *(1,000 * 1.7 = 1,704: This appliance now represents 1,704 cooling units in the population)*

Alternatively, a site with a case weight of 1,000 with a cooling unit manufactured in 1982 that was successfully matched to an efficiency database (making up one of the 4 units in Column B) has a very different new case weight:

3. *Weight Adjustment Factor = Total Number of Units / Number of Matched Units*

   (24 /4 = 6: This matched appliance represents 6 unmatched appliances between 20 and 25 years old)

4. *New case weight = Original Case Weight * Adjustment Factor*

   *(1,000 * 6 = 6,000: This appliance now represents 6,000 cooling units in the population)*

As shown, appliances in the age groups that were matched with less frequency were applied larger adjustment factors to represent the larger quantities of unmatched units for the average efficiency calculations.

Development of Database Summarization Tool (CALRES^{EST})

The project was designed to deliver a tool that can be used by program designers, managers, evaluators, and other parties for understanding efficiency and saturation characteristics of California residences. This task was performed in conjunction with the data collection tasks. As the data were being collected for the study, the Benningfield Group developed a web-based application that would allow multiple users to apply stratified ratio estimation methods to the study data. The application tailored for this project 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 utility service territory.
- Calculate the underlying sample sizes
- Calculate the appropriate model-based error bounds
- Calculate proportions (i.e., proportion of all cooling units that are space vs. central)

This program can be used to create one-way, two-way or multi-way tables categorizing the market share of specified appliances and measures by any specified dimensions from both the 1999-00 Study data, and the 2004-05 Study data, allowing other parties the ability to produce their own “what-if” trend analyses. 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:

- Level of Efficiency (by End Use)
- Utility Service Territory
- CEC Climate Zone
- Type of Residence
- Size of Household (Total People or Total Adults)
- Square Footage
- Household Income
- Primary Language
- Age of Home
- Rent or Own
- Remodeled in Last 10 years
- Stratum

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 utilities with a tool by which they could analyze the data. Given this, only top-level analysis was conducted for reporting purposes. However, where the data was thought to differ drastically by the demographics of the household, the data was grouped by the appropriate characteristic.

CALRES^{EST} *Interface*

Given the immense amount of data collected on-site, the endless number of ways to slice-and-dice the data, and the wide variation in needs of program managers and designers, a web based application was developed to give access to the data to any number of potential users. By providing a web-based analysis tool, users have the power to explore the information based on specific needs. Moreover, all of the 2000 data also resides on the web site, allowing users to understand baseline conditions from five years ago, and trends that have take place by comparing to the 2005 findings. This section discusses the technical specifications of CALRES^{EST}, the California Residential Efficiency Saturation Tool, located at www.calresest.com. Once on the site users can gain access to the full reports from 2000 and 2005, SMUD reports and data, and user help screens for understanding how to use CALRES^{EST} .

CALRES^{EST} was developed using Macromedia ColdFusion MX, a tag-based server-scripting language for rapid web development, for the user interface and Microsoft Access and SQL for the database storage/engine. 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, ColdFusion generates a unique 8 character password and automatically sends it to the user via email.

CALRES^{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 OS's (Windows, Linux, Unix, etc) if load balancing, increased bandwidth, and/or increased demand are desired.

CalResEst.com resides on a standalone hardened Dell Enterprise class server, with a Microsoft Server 2003 SP1 operating system (OS). The server's OS, applications, and data reside on redundant hard drives configured in a RAID (Redundant Array of Independent Disks*)* 10 array. The server has dual 1.5 GHz CPU's, with 2GB's of RAM (Random Access Memory). In addition, the server has dual redundant power supply units which are connected to an enterprise class UPS (uninterruptible power supply) unit. These all reside in Sonoma, California in a physically secured server room. Internet access is provided via a full T-1 line, with a Service Level Agreement of 99.99% uptime guarantee. In the event there is a service outage, a separate business class broadband connection will automatically act as a failover, as well as provide some load balancing.

The web pages are being served via Microsoft IIS (Internet Information Services) 6.0. The ColdFusion server-side engine resides on the same machine and is tuned for optimum performance. Website Security is provided in several ways. First, a kernel level Intrusion Detection System disables the ability to have the server become compromised via "buffer overflow" style attacks. Last, the server resides behind a Firewall appliance providing SPI packet inspection that detects and blocks DoS (Denial of Service) and other malicious attacks.

Lighting

This section of this chapter presents findings from the lighting analysis. Recall that every lighting fixture in each residence was inventoried by fixture type, fixture control type, number of lamps, lamp type, and lamp wattage. A total of 847 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[4],
    - 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, basements, exercise rooms, music rooms, sewing rooms, as well as pool houses.

Lighting Overview

Table 22 presents the average number of fixtures and lamps per home by type of residence. Overall, homes have approximately 23 fixtures and 41 lamps on average (up from 20 fixtures and 34 lamps in the last study). As might be expected, apartments and duplexes/triplexes/quadplexes have significantly fewer fixtures and lamps on average than do single family, unattached residences.

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

Type of Residence	Fixtures		Lamps		
	Average #	Error Bound	Average #	Error Bound	Sample Size
Overall	23.48	0.94	40.62	1.56	847
Apt/Condo (1 or 2 stories)	11.84	0.90	18.85	1.40	159
Apt/Condo (3 or more stories)	12.86	1.67	21.69	3.16	46
Mobile Home - Double Wide	19.71	3.55	34.09	6.83	21
Mobile Home - Single Wide	16.28	9.02	39.23	24.32	3
Modular/Prefabricated	15.99	1.84	23.76	3.56	4
Other	28.86	13.14	43.09	22.32	6
Single Family Unattached (1 story)	24.33	1.40	41.86	2.09	383
Single Family Unattached (2 stories)	36.24	2.15	65.67	3.57	168
Single Family Unattached (3 or more stories)	46.21	2.14	76.98	4.36	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	19.92	2.42	32.72	4.34	48

Table 22: Average Number of Fixtures/Lamps by Type of Residence

Table 23 displays the average number of fixtures per home by fixture type. **The most common fixture types are ceiling mount and recessed cans, with homes having an average of 4.2 recessed cans, an average which has nearly doubled from the previous study's average of 2.4 recessed cans.** Also, homes have on average, 3.6 table lamps and 3.4 wall mount fixtures. Table 23 also tells us that each home averages over one ceiling fan with lights.

Fixture Type	2005		2000	
	Average # of Fixtures (n=847)	Error Bound	Average # of Fixtures (n = 1255)	Error Bound
All Fixture Types	**23.48**	**0.94**	**19.72**	**0.69**
Architectually Integrated	0.17	0.08	0.31	0.08
Ceiling Fan	1.43	0.10	1.11	0.08
Ceiling Fixtures	6.50	0.27	5.57	0.20
Chandelier Hanging	1.26	0.09	1.30	0.08
Floor Lamp	0.86	0.07	0.83	0.06
Garage Door Opener	0.26	0.03	0.15	0.02
Other	0.03	0.01	0.06	0.02
Recessed Can	4.18	0.57	2.37	0.36
Recessed Lighting-Other	0.61	0.12	1.02	0.12
Table lamps	3.57	0.19	3.69	0.15
Torchiere	0.47	0.05	0.36	0.04
Track Lighting	0.31	0.07	0.38	0.07
Under Counter	0.41	0.06	0.24	0.04
Wall Mount	3.42	0.15	2.33	0.11

Table 23: Average Number of Fixtures by Fixture Type

Table 24 presents the percentage of all fixtures that are of a certain type. Nearly 30% of all fixtures are ceiling mounts, while almost 20% are recessed cans. Additionally, wall mounted fixtures and table lamps each have about a 15% share in the number of fixtures. Comparing the 2005 data to the 2000 data, recessed cans now account for 6% more of the total fixtures than previously. Wall mount fixtures also account for a larger share now than in 2000, with a 3% increase in fixture share.

Fixture Type	2005		2000	
	Percent of Total Fixtures (n=847)	Error Bound	Percent of Total Fixtures (n = 1255)	Error Bound
All Fixture Types	**100%**		**100%**	
Architectually Integrated	0.7%	0.3%	1.6%	0.4%
Ceiling Fan	6.1%	0.5%	5.6%	0.4%
Ceiling Fixtures	27.7%	1.2%	28.2%	1.0%
Chandelier Hanging	5.4%	0.3%	6.6%	0.4%
Floor Lamp	3.6%	0.3%	4.2%	0.3%
Garage Door Opener	1.1%	0.1%	0.8%	0.1%
Other	0.1%	0.1%	0.3%	0.1%
Recessed Can	17.8%	1.9%	12.0%	1.5%
Recessed Lighting Other	2.6%	0.5%	5.2%	0.6%
Table Lamps	15.2%	0.7%	18.7%	0.7%
Torchiere	2.0%	0.2%	1.8%	0.2%
Track Lighting	1.3%	0.3%	1.9%	0.4%
Under Counter	1.7%	0.2%	1.2%	0.2%
Wall mount	14.6%	0.6%	11.8%	0.5%

Table 24: Percentage Fixture Types

Table 25 displays the percentage of homes having each fixture type. Approximately 56% of homes have a ceiling fan, compared to only 49% in 2000. About 42% of homes have recessed cans, up from 33% in 2000. Ninety-five percent of homes have wall mount fixtures, up from 85% in 2000. Almost 99% of all homes are equipped with a ceiling mounted fixture, while over 83% of homes have a table lamp.

Fixture Type	2005		2000	
	Percent of Home (n=847)	Error Bound	Percent of Homes (n = 1255)	Error Bound
Architectually Integrated	5.1%	1.2%	11.4%	1.6%
Ceiling Fan	56.0%	2.8%	49.4%	2.5%
Chandelier Hanging	61.4%	2.8%	59.8%	2.5%
Ceiling Fixtures	98.7%	0.7%	97.1%	0.8%
Floor Lamp	47.2%	2.9%	48.2%	2.5%
Garage Door Opener	21.7%	2.4%	14.3%	1.7%
Other	2.3%	0.9%	2.9%	0.8%
Recessed Can	41.6%	2.8%	32.8%	2.4%
Recessed Lighting Other	18.4%	2.2%	31.9%	2.3%
Table Lamps	83.4%	2.1%	86.8%	1.7%
Torchiere	28.6%	2.6%	21.7%	2.1%
Track Lighting	12.6%	1.9%	12.3%	1.6%
Under Counter	23.0%	2.4%	12.2%	1.6%
Wall Mount	95.2%	1.2%	85.2%	1.8%

Table 25: Percentage of Homes with Fixture Types

Table 26 shows the distribution of the number of fixtures per home. About one-third of homes have a total of 11 to 20 fixtures. Approximately 5.4% of homes have more than

50 fixtures present. The percentage of homes with more than 40 fixtures has jumped from 6% to nearly 12% over the past five years.

Number of Fixtures	2005		2000	
	Percent of Homes (n=847)	Error Bound	Percent of Homes (n = 1255)	Error Bound
1 to 10	18.6%	2.2%	22.7%	2.1%
11 to 20	33.6%	2.7%	42.7%	2.5%
21 to 30	23.0%	2.4%	19.9%	2.0%
31 to 40	13.1%	1.9%	8.6%	1.4%
41 to 50	6.4%	1.4%	3.0%	0.8%
>50	5.4%	1.3%	3.1%	0.9%

Table 26: Distribution of Number of Fixtures per Home

Table 27 presents the distribution of the number of fixtures per home by residence type. As might be expected, apartments, mobile homes, and duplexes/triplexes/quadplexes have significantly fewer fixtures on average than do single family, unattached residences.

Type of Residence	1 - 10 Fixtures		11 - 20 Fixtures		21 - 30 Fixtures		31 - 40 Fixtures		41 - 50 Fixtures		> 50 Fixtures		
	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	Sample Size
Overall	18.6%	2.2%	33.6%	2.7%	23.0%	2.4%	13.1%	1.9%	6.4%	1.4%	5.4%	1.3%	847
Apt/Condo (1 or 2 stories)	53.8%	6.5%	38.7%	6.4%	5.0%	2.9%	1.8%	1.7%	-	-	0.6%	1.0%	159
Apt/Condo (3 or more stories)	47.5%	12.4%	38.8%	12.1%	9.2%	7.2%	4.6%	5.2%	-	-	-	-	46
Mobile Home - Double Wide	19.9%	14.7%	45.3%	18.3%	24.7%	15.8%	5.0%	8.1%	5.0%	8.1%	-	-	21
Mobile Home - Single Wide	33.6%	44.9%	-	-	66.4%	44.9%	-	-	-	-	-	-	3
Modular/Prefabricated	-	-	100.0%	-	-	-	-	-	-	-	-	-	4
Other	-	-	40.0%	36.0%	19.8%	29.2%	20.1%	29.5%	-	-	20.1%	29.5%	6
Single Family Unattached (1 story)	9.0%	2.4%	38.6%	4.1%	30.0%	3.9%	12.5%	2.8%	5.8%	2.0%	4.2%	1.7%	383
Single Family Unattached (2 stories)	-	-	12.9%	4.3%	28.4%	5.8%	29.6%	5.9%	14.0%	4.4%	15.1%	4.6%	168
Single Family Unattached (3 or more stories)	0.1%	0.1%	-	-	-	-	-	-	72.4%	27.1%	27.5%	27.1%	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	19.2%	9.5%	40.5%	11.8%	23.2%	10.1%	12.7%	8.0%	4.2%	4.8%	0.1%	0.1%	48

Table 27: Distribution of Number of Fixtures per Home by Residence Type

Table 28 displays the percentage of fixtures containing a compact fluorescent lamp by fixture type. **Over 10% of fixtures contain a compact fluorescent lamp, which is up tenfold from the previous CLASS report.** Floor lamps are most likely to contain a compact fluorescent lamp, with about 16% of all floor lamps having such a lamp. Approximately 15% of table lamps have a compact fluorescent lamp installed, and about 9.5% of all torchieres have CFLs, up from 1.5% in 2000.

Fixture Type	2005			2000		
	Percent Fixtures with CFL	Error Bound	Sample Size (# Homes)	Percent Fixtures with CFL	Error Bound	Sample Size (# Homes)
Overall	10.6%	1.1%	847	0.8%	0.1%	1,255
Architectually Integrated	2.1%	2.2%	47	0.6%	0.7%	132
Ceiling Fan	12.1%	2.6%	476	0.7%	0.4%	644
Chandelier Hanging	5.7%	1.4%	522	0.4%	0.3%	728
Ceiling Fixtures	10.3%	1.3%	836	1.0%	0.2%	1,211
Floor Lamp	16.3%	2.7%	400	1.0%	0.5%	586
Garage Door Opener	2.8%	1.9%	185	0.0%	0.0%	174
Other	4.0%	6.5%	19	0.0%	0.0%	41
Recessed Can	10.3%	2.8%	353	0.4%	0.2%	380
Recessed Lighting-Other	3.9%	2.8%	156	1.1%	0.6%	398
Table Lamps	14.9%	2.0%	709	1.2%	0.3%	1,085
Torchiere	9.5%	3.0%	242	1.5%	1.0%	298
Track Lighting	4.7%	2.8%	107	0.3%	0.4%	146
Under Counter	3.6%	1.8%	196	0.0%	0.0%	149
Wall Mount	11.0%	1.4%	806	0.6%	0.2%	1,083

Table 28: Fixtures Containing Compact Fluorescent Lamps

Table 29 shows the average number of lamps per fixture by fixture type. Chandeliers/Hanging fixtures contain more lamps (3.96 lamps) than any other fixture type. Ceiling fans contain 2.72 lamps on average. Recessed cans, table lamps, and torchieres contain the fewest number of lamps, with each of these fixtures containing approximately one lamp on average.

Fixture Type	Lamps per Fixture		
	Average	Error Bound	Sample Size (# Homes)
Architectually Integrated	1.26	0.15	47
Ceiling Fan	2.72	0.08	476
Chandelier Hanging	3.96	0.21	522
Ceiling Fixtures	1.60	0.03	836
Floor Lamp	1.50	0.07	400
Garage Door Opener	1.44	0.13	185
Other	1.24	0.21	19
Recessed Can	1.02	0.01	353
Recessed Lighting-Other	1.52	0.12	156
Table Lamps	1.13	0.02	709
Torchiere	1.12	0.04	242
Track Lighting	2.18	0.29	107
Under Counter	1.18	0.06	196
Wall Mount	2.50	0.10	806

Table 29: Average Number of Lamps per Fixture

Table 30 presents the average number of lamps per home by general lamp type. Overall, homes have 40.62 lamps on average, an increase of almost seven lamps per home from 2000. Incandescent lamps are the most prevalent throughout California, with an average home having 30.71 incandescent lamps. Once again, the number of CFLs has jumped from 0.32 lamps in 2000 to 3.51 lamps per home in 2005.

Lamp Type	2005 Average # of Lamps (n = 847)	2000 Average # of Lamps (n = 1255)
All Lamp Types	40.62	33.82
Compact Fluorescent Total	3.51	0.32
Fluorescent Total	4.75	5.20
Halogen Total	1.65	0.93
Incandescent Total	30.71	27.33

Table 30: Average Number of Lamps by Lamp Type

Table 31 shows the percentage of all lamps by general lamp type. Almost 76% of all lamps are incandescent lamps, a decrease from 81% in 2000. Over 11% of lamps are fluorescent, and 4% are halogen. **Compact fluorescent lamps have seen a large increase from around 1% from the previous study to nearly 9% presently.** Halogen lamps have also grown in popularity. This trend is likely due to the emergence of MR-16 style lamps which are being specified more often in new construction and remodels.

Lamp Type	2005 Percent of Total Lamps (n=847)	2000 Percent of Total Lamps (n = 1255)
Compact Fluorescent Total	8.6%	0.95%
Fluorescent Total	11.7%	15.4%
Halogen Total	4.1%	2.8%
Incandescent Total	75.6%	80.8%

Table 31: Percentage Lamp Types

Table 32 shows the percentage of homes where a particular lamp type is present. Virtually all homes are equipped with at least one incandescent lamp, while over two-thirds have at least one fluorescent (non T-8) lamp**. Over 56% of all homes contain at least one type of compact fluorescent lamp. This is a huge jump from the previous study, in which it was determined that only 12% of homes contained at least one compact fluorescent.** About one-third of homes have at least one halogen lamp present.

Lamp Type	2005 Percent of Homes (n=847)	2000 Percent of Homes (n = 1255)
Compact Fluorescent Total	56.9%	12.4%
Fluorescent (Non-T8) Total	69.2%	70.4%
Halogen Total	31.3%	32.2%
Incandescent Total	99.2%	99.9%

Table 32: Percentages of Homes with Lamp Types

Table 33 displays the distribution of the number of lamps per home. Nearly 30% of homes have more than 50 lamps. This finding combined with findings about the number of fixtures per home suggests that most homes are equipped with fixtures containing

more than one lamp. Also, in comparison to the 2000 CLASS, the percentage of homes with more than 50 lamps has increased by 10%.

Number of Lamps	2005		2000	
	Percentage of Homes (n = 847)	Error Bound	Percentage of Homes (n = 1255)	Error Bound
1 to 10	6.5%	1.4%	8.6%	1.4%
11 to 20	18.1%	2.2%	23.7%	2.1%
21 to 30	17.5%	2.2%	23.2%	2.1%
31 to 40	15.7%	2.1%	15.9%	1.8%
41 to 50	14.3%	2.0%	11.1%	1.6%
>50	27.9%	2.6%	17.5%	1.9%

Table 33: Distribution of Number of Lamps per Home

Table 34 presents the distribution of the number of lamps per home by residence type. As might be expected, apartments, mobile homes, and duplexes/triplexes/quadplexes have significantly fewer fixtures and lamps on average than do single family, unattached residences. Also, single family, unattached residences that are two or more stories contain significantly more lamps than single family, unattached residences that are one story.

Type of Residence	1 to 10 Lamps		11 to 20 Lamps		21 to 30 Lamps		31 to 40 Lamps		41 to 50 Lamps		>50 Lamps		
	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	Sample Size
Overall	6.5%	1.4%	18.1%	2.2%	17.5%	2.2%	15.7%	2.1%	14.3%	2.0%	27.9%	2.6%	847
Apt/Condo (1 or 2 stories)	21.5%	5.4%	43.1%	6.5%	22.2%	5.4%	7.6%	3.5%	3.8%	2.5%	1.8%	1.7%	159
Apt/Condo (3 or more stories)	15.8%	9.0%	40.7%	12.2%	25.1%	10.8%	11.5%	7.9%	2.3%	3.7%	4.6%	5.2%	46
Mobile Home - Double Wide	-	-	24.9%	15.9%	25.2%	16.0%	29.9%	16.8%	5.0%	8.1%	14.9%	13.1%	21
Mobile Home - Single Wide	33.6%	44.9%	-	-	-	-	-	-	33.2%	44.6%	33.3%	44.7%	3
Modular/Prefabricated	-	-	25.1%	35.7%	49.9%	41.1%	25.1%	35.7%	-	-	-	-	4
Other	-	-	19.8%	29.2%	20.1%	29.5%	19.8%	29.2%	20.1%	29.5%	20.1%	29.5%	6
Single Family Unattached (1 story)	2.4%	1.3%	12.5%	2.8%	18.9%	3.3%	20.5%	3.4%	20.2%	3.4%	25.5%	3.7%	383
Single Family Unattached (2 stories)	-	-	0.6%	1.0%	3.1%	2.2%	11.7%	4.1%	17.8%	4.9%	66.9%	6.0%	168
Single Family Unattached (3 or more stories)	-	-	0.1%	0.1%	-	-	-	-	-	-	99.9%	0.1%	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	6.4%	5.9%	19.2%	9.5%	32.0%	11.2%	19.0%	9.4%	6.3%	5.8%	17.1%	9.0%	48

Table 34: 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 35 of the average 41, or 85%, lamps found at the average house as seen in Table 35 and Table 36 below. The majority of the pin-based fixtures are MR-16 and quartz tube halogen fixture types, not commonly pin-based CFLs.

n=847	Average Number of Lamps per Home	Error Bound
Screw Base	34.6	1.3
Pin Base	6.0	0.5

Table 35: Average Number of Lamps per Home by Base Type

n=847	Percent of Base Type	Error Bound
Screw Base	85.2%	1.0%
Pin Base	14.8%	1.0%

Table 36: Percentage of Lamps by Base Type

Table 37 displays the percentage of fixtures with screw-based lamps in which are CFLs installed. As recalled from Table 28, the percentage of all fixtures containing CFLs is 10.6%, but when only screw-based fixtures are examined, 9.7% of those fixtures have CFLs installed. The decreased saturation is a result of having removed the significant number of pin-based CFL fixtures from the analysis.

Percent of CFL from all Screw Based Lamps	Error Bound	Sample Size
9.7%	1.0%	847

Table 37: 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 one-third of homes have at least one recessed can. Recessed cans account for approximately 18% of all fixtures, and on average, homes contain 4.18 recessed cans. About 10% of all recessed cans contain a compact fluorescent lamp.

Table 38 presents the distribution of the number of recessed cans per home. Approximately 58% of homes have no recessed cans present. About 16% have a total of 1 – 4 cans, and another 5 percent have more than ten cans. The percentage of homes with more than 10 cans has increased from 6.8% in 2000 to 12.6% in 2005.

Number of Recessed Cans	2005		2000	
	Percentage of Homes (n = 847)	Error Bound	Percentage of Homes (n = 1255)	Error Bound
0	58.4%	2.8%	67.5%	2.4%
1-4	16.1%	2.1%	17.9%	1.9%
5-7	7.6%	1.5%	5.3%	1.1%
8-10	5.1%	1.2%	2.7%	0.8%
11-20	7.9%	1.5%	5.0%	1.1%
> 21	4.7%	1.2%	1.8%	0.7%

Table 38: Number of Recessed Cans per Home

Table 39 shows the percentage of homes with recessed cans by room type. One-fifth of homes have recessed cans in the kitchen, halls, or master bathroom.

Room	Percentage of Homes	Error Bound	Sample Size
Bathroom - 1	6.6%	1.5%	725
Bathroom - 2	10.7%	3.1%	270
Bathroom - 3	21.2%	10.3%	43
Master Bathroom	19.5%	2.7%	589
Bedroom - 1	2.2%	0.9%	736
Bedroom - 2	1.5%	0.9%	475
Bedroom - 3	1.3%	1.4%	166
Bedroom - 4	7.2%	8.0%	29
Master Bedroom	6.1%	1.6%	649
Breakfast Nook	11.7%	4.4%	150
Closet	7.9%	2.6%	298
Dining Room	7.2%	1.8%	581
Family Room	14.7%	3.1%	362
Garage	0.5%	0.5%	440
Hall	23.7%	2.6%	744
Kitchen	25.7%	2.5%	834
Laundry Rm	8.4%	2.5%	331
Living Room	9.6%	1.9%	672
Office	8.2%	2.8%	274
Other	8.9%	4.6%	104
Porch	7.1%	1.8%	578
Recreation Room	18.2%	7.7%	72
Whole House	41.6%	2.8%	847

Table 39: Percentage of Homes with Recessed Cans by Room Type

Table 40 displays the percentage of homes with recessed cans by age of the home. Homes built after 1986 are more likely to contain recessed cans than are homes built prior to 1986. About 60% of homes built in 1990 or later have recessed cans, while approximately one-third of homes built earlier have cans.

Age of Home	Percentage of Homes	Error Bound	Sample Size
1950 or Earlier	33.8%	7.0%	127
1951-1955	40.2%	11.1%	53
1956-1960	45.1%	11.5%	52
1961-1965	30.8%	9.6%	64
1966-1970	35.3%	11.0%	52
1971-1975	35.9%	9.9%	65
1976-1980	39.7%	9.8%	68
1981-1985	38.1%	11.3%	53
1986-1990	70.5%	9.6%	62
1991-1995	66.8%	12.4%	41
1996-2000	83.0%	9.0%	47
2001-2005	64.1%	10.8%	54
Unknown	10.3%	4.8%	109

Table 40: Percentage of Homes with Recessed Cans by Age of Home

Table 41 presents the average number of recessed cans per home by age of home. Homes built in 1986 or later contain significantly more recessed cans on average than

do homes built prior to 1986, suggesting a trend in residential new construction towards an increased number of recessed cans.

Age of Home	Number of Recessed Cans	Error Bound	Sample Size
1950 or Earlier	3.54	2.36	127
1951-1955	2.66	1.12	53
1956-1960	3.39	1.31	52
1961-1965	2.40	1.28	64
1966-1970	2.83	1.67	52
1971-1975	2.65	1.25	65
1976-1980	2.60	0.90	68
1981-1985	4.77	2.19	53
1986-1990	7.00	2.35	62
1991-1995	7.41	2.45	41
1996-2000	11.60	2.95	47
2001-2005	10.08	2.99	54
Unknown	0.37	0.22	109

Table 41: Number of Recessed Cans per Home by Age of Home

Table 42 displays the average number of recessed cans per home in homes that have at least one recessed can. When compared with Table 23, the average number of recessed cans per home increases greatly, from 4.18 to 10.0.

Average Number of Recessed Cans	Error Bound	Sample Size
10.0	1.2	353

Table 42: Average Number of Recessed Cans in Homes with Recessed Cans

As can be seen below in Table 43, the overwhelming majority of recessed can fixtures use screw-based lamps. This accounts for nearly 91% of all recessed can fixtures, while pin-based lamps make up the remaining 9%. The majority of the 9% pin-based are MR-16 halogen recessed fixtures.

n=353	Percent	Error Bound
Screw Base	90.8%	6.2%
Pin Base	9.2%	6.2%

Table 43: Percentage of Lamp Base Type for Recessed Can Fixtures

CFLs are installed in slightly greater than 10% of screw-based recessed can fixtures. Table 44 displays the associated error bound and sample size.

Percent of CFL	Error Bound	Sample Size
10.4%	3.0%	341

Table 44: Percentage of CFLs in Screw-Based Recessed Can Fixtures

Ceiling Fans

Data were only collected and analyzed for ceiling fans that are designed to contain lamps. Over half of homes have at least one ceiling fan. Ceiling fans account for approximately 6% of all fixtures, and on average, homes contain 1.43 ceiling fans. About 12.1% of all ceiling fans contain a compact fluorescent lamp.

Table 45 displays the distribution of the number of ceiling fans per home. Less than half of homes do not have any ceiling fans, and about one-fifth of homes have only one ceiling fan. Almost 8% of homes have five or more ceiling fans.

Number of Ceiling Fans	2005		2000	
	Percent of Homes (n = 847)	Error Bound	Percent of Homes (n = 1255)	Error Bound
0	44.0%	2.8%	50.8%	2.5%
1	21.8%	2.4%	23.5%	2.1%
2	10.3%	1.7%	9.1%	1.4%
3	9.1%	1.6%	6.8%	1.3%
4	7.1%	1.5%	4.9%	1.1%
5+	7.7%	1.5%	5.2%	1.1%

Table 45: Number of Ceiling Fans per Home

Table 46 presents the percentage of homes with ceiling fans by room type. About 25% of homes have a ceiling fan in the bedroom, breakfast nook, dining room, family room, or recreation room.

Room	Percentage of Homes	Error Bound	Sample Size
Bathroom - 1	0.7%	0.5%	725
Bathroom - 2	1.5%	1.3%	270
Bathroom - 3	4.8%	5.5%	43
Master Bathroom	2.6%	1.1%	589
Bedroom - 1	21.9%	2.5%	736
Bedroom - 2	27.4%	3.4%	475
Bedroom - 3	31.8%	6.0%	166
Bedroom - 4	13.9%	10.7%	29
Master Bedroom	33.7%	3.1%	649
Breakfast Nook	29.5%	6.2%	150
Closet	0.7%	0.8%	298
Dining Room	23.6%	2.9%	581
Family Room	29.3%	4.0%	362
Garage	0.7%	0.7%	440
Hall	1.7%	0.8%	744
Kitchen	7.9%	1.6%	834
Laundry Room	0.3%	0.5%	331
Living Room	13.3%	2.2%	672
Office	19.0%	3.9%	274
Other	9.9%	4.9%	104
Porch	0.7%	0.6%	578
Recreation Room	25.1%	8.7%	72
Whole House	56.0%	2.8%	847

Table 46: Percentage of Homes with Ceiling Fans by Room Type

Table 47 shows the distribution of the number of lamps per ceiling fan. About 30% of ceiling fans contain one lamp, and about 40% of ceiling fans contain four or more lamps.

Number of Lamps	Percent of Fans (n = 476 Homes)	Error Bound
1	31%	3%
2	8%	2%
3	24%	3%
4	35%	3%
5+	3%	1%

Table 47 : Distribution of Number of Lamps per Ceiling Fan

Table 48 displays the percentage of ceiling fans equipped with each lamp type. Over three-fifths of ceiling fans have standard incandescent lamps installed, and another 17% of ceiling fans are equipped with incandescent decorative bulbs. Compact fluorescent lamps were found in 12.1% of fans equipped with lamps, a huge increase over the 1.1% found in the previous report. This may be a result of ENERGY STAR qualifying ceiling fans making their way into the residential market.

Lamp Type	Percent of Ceiling Fans (n = 476 Homes)	Error Bound
Compact Fluorescent A Style	0.4%	0.5%
Compact Fluorescent Capsule	0.1%	0.1%
Compact Fluorescent Circline	0.1%	0.1%
Compact Fluorescent Decorative	0.1%	0.1%
Compact Fluorescent Spring	10.3%	2.5%
Compact Fluorescent Tubular	1.1%	0.6%
Compact Fluorescent Pin Base	0.1%	0.1%
Compact Fluorescent Total	**12.1%**	
Fluorescent Circline	0.1%	0.1%
Fluorescent Total	**0.1%**	
MR-16 Pin Based Halogen	0.1%	0.1%
Halogen Other	0.3%	0.3%
Halogen Parabolic Reflector	0.2%	0.2%
Halogen Quartz Tube	0.1%	0.1%
Halogen Total	**0.6%**	
Decorative Incandescent	17.2%	2.6%
Incandescent Flood	0.9%	0.4%
Incandescent Globe	5.4%	1.6%
Incandescent Mini	1.0%	0.6%
Incandescent Other	0.3%	0.3%
Incandescent Reflector	1.1%	0.9%
Incandescent Standard	60.6%	3.5%
Incandescent Unknown	0.7%	0.5%
Incandescent Total	**87.2%**	

Table 48: Ceiling Fan Lamp Types

Homes that contain ceiling fans contain an average of 2.6 ceiling fans and all but 0.3% of those fans contain screw-based lamps.

Average Number of Fans	Error Bound	Sample Size
2.6	0.1	476

Table 49: Average Number of Ceiling Fans in Homes with Ceiling Fans

n=476	Percent of Base Type	Error Bound
Screw Base	99.7%	0.3%
Pin Base	0.3%	0.3%

Table 50: Percentage of Lamp Base Types for Ceiling Fan Fixtures

Table 51 shows the percentage of ceiling fans with screw-based sockets that contain compact fluorescent lamps. Approximately 12% of those fixtures contain CFLs.

Percent of CFL	Error Bound	Sample Size
12.1%	2.6%	476

Table 51: Percentage of CFLs in Screw-Based Ceiling Fan Fixtures

Torchieres

About 29% of homes have at least one torchiere, which is up from 21% in 2000. Torchieres account for approximately 2.0% of all fixtures, with an average of 0.47 torchieres per home. About 9.5% of all torchieres contain a compact fluorescent lamp.

Table 52 shows the distribution of the number of torchieres per home. Approximately 17% of homes have one torchieres, an increase of 3.7% from 2000.

Number of Torchieres	2005		2000	
	Percent of Homes (n = 847)	Error Bound	% of Homes (n = 1255)	Error Bound
0	71.4%	2.6%	78.6%	2.1%
1	16.8%	2.1%	13.1%	1.7%
2	7.8%	1.5%	5.1%	1.1%
3	2.5%	0.9%	2.4%	0.8%
4	0.6%	0.4%	0.8%	0.4%
5+	1.0%	0.6%	0.3%	0.3%

Table 52: Number of Torchieres per Home

Table 53 displays the percentage of homes with at least one torchiere by room type. Over 15% of homes have a torchiere in the living room. Over 10% of homes have a torchiere in the family room or home office. No homes have a torchiere in the garage, closet, or porch.

Room	Percent of Homes	Error Bound	Sample Size
Bathroom - 1	0.3%	0.3%	725
Bathroom - 2	0.4%	0.6%	270
Bathroom - 3	-	-	43
Master Bathroom	0.2%	0.3%	589
Bedroom - 1	7.3%	1.6%	736
Bedroom - 2	8.4%	2.1%	475
Bedroom - 3	5.2%	2.9%	166
Bedroom - 4	-	-	29
Master Bedroom	6.6%	1.6%	649
Breakfast Nook	0.7%	1.1%	150
Closet	-	-	298
Dining Room	1.9%	0.9%	581
Family Room	13.1%	3.0%	362
Garage	-	-	440
Hall	0.1%	0.2%	744
Kitchen	0.1%	0.2%	834
Laundry Room	0.3%	0.5%	331
Living Room	15.5%	2.3%	672
Office	11.0%	3.1%	274
Other	3.9%	3.2%	104
Porch	-	-	578
Recreation Room	5.9%	4.7%	72
Whole House	28.6%	2.6%	847

Table 53: Percentage of Homes with Torchieres by Room Type

Table 54 displays the percentage of torchieres equipped with each lamp type. About half of torchieres have incandescent lamps installed, and another 40% of torchieres are equipped with halogen tube lamps. Additionally, the percentage of torchieres with compact fluorescent bulbs increased from 1.5% in 2000 to 9.5% in 2005.

Lamp Type	Percent of Torchieres (n = 242)	Error Bound
Compact Fluorescent Circline	2.6%	1.6%
Compact Fluorescent Spring	6.0%	2.5%
Compact Fluorescent Tubular	0.8%	0.9%
Compact Fluorescent Pin Base	0.3%	0.4%
Compact Fluorescent Total	**9.5%**	
Fluorescent Circline	0.8%	0.7%
Fluorescent Total	**0.8%**	
Halogen Other	0.3%	0.4%
Halogen Parabolic Reflector	0.5%	0.8%
Halogen Quartz Tube	40.6%	5.6%
Halogen Unknown	0.5%	0.6%
Halogen Total	**41.9%**	
Decorative Incandescent	0.5%	0.8%
Incandescent Flood	0.8%	0.9%
Incandescent Globe	0.5%	0.6%
Incandescent Standard	45.8%	5.4%
Incandescent Unknown	0.3%	0.4%
Incandescent Total	**47.8%**	

Table 54: Torchiere Lamp Types

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. A more comprehensive analysis is provided for the kitchen light that is used most often.

Kitchen

Table 55 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 combinations are ceiling mounts with T12 fluorescent lamps, ceiling mounts with incandescent lamps, and recessed cans with incandescent lamps. Under-the-counter fixtures with incandescent lamps had the next highest saturation, and this finding deserves an explanation. It turns out that this result is due to a training issue. RLW staff was trained to gather data on the range/stove light, whereas ASW staff was not trained to collect range/stove light information.

Another interesting finding is the percentage of kitchens with recessed can lighting; saturation has gone up from 9.4% to 25.7% in the last 5 years, more than likely a result of kitchen remodeling activities. Four percent of these fixtures were equipped with CFLs.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 834)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			14.5%	2.0%	1.8%	0.8%	44.6%	2.9%	7.6%	1.5%	5.9%	1.3%	67.8%	2.7%
Architectually Integrated	0.9%	0.5%	-	-	-	-	0.4%	0.3%	0.1%	0.2%	0.4%	0.3%	0.1%	0.2%
Ceiling Fan	7.9%	1.6%	1.4%	0.7%	-	-	-	-	-	-	0.1%	0.2%	6.6%	1.4%
Ceiling Fixtures	69.0%	2.7%	7.7%	1.5%	1.2%	0.6%	34.9%	2.7%	1.8%	0.8%	0.5%	0.4%	30.9%	2.7%
Chandelier Hanging	8.0%	1.6%	0.7%	0.5%	-	-	0.5%	0.4%	-	-	0.6%	0.4%	6.1%	1.4%
Floor Lamp	0.4%	0.3%	-	-	-	-	-	-	-	-	-	-	0.4%	0.3%
Other	0.5%	0.4%	-	-	-	-	0.2%	0.3%	0.1%	0.2%	-	-	0.1%	0.2%
Recessed Can	25.7%	2.5%	3.9%	1.1%	-	-	0.1%	0.2%	-	-	2.6%	0.9%	21.4%	2.4%
Recessed Lighting-Other	10.0%	1.7%	0.1%	0.2%	0.2%	0.3%	7.7%	1.5%	-	-	0.1%	0.2%	2.6%	0.9%
Table lamps	0.8%	0.5%	0.1%	0.2%	-	-	-	-	-	-	0.1%	0.2%	0.6%	0.4%
Torchiere	0.1%	0.2%	-	-	-	-	-	-	-	-	0.1%	0.2%	-	-
Track Lighting	2.8%	1.0%	0.1%	0.2%	-	-	-	-	-	-	1.0%	0.6%	1.7%	0.7%
Under Counter	22.0%	2.4%	1.1%	0.6%	0.3%	0.3%	1.1%	0.6%	5.5%	1.3%	1.7%	0.7%	15.2%	2.1%
Wall Mount	3.9%	1.1%	0.7%	0.5%	-	-	0.6%	0.4%	0.1%	0.2%	-	-	2.7%	0.9%

Table 55: Percentage of Homes with Fixture Type and Lamp Type in Kitchen

Bedrooms

Table 56, Table 57, Table 58, Table 59, and Table 60 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 fans, ceiling mounts, table lamps with incandescent lamps, as well as table lamps containing compact fluorescent lamps.

Fixture Type	Lamp Type											
	Overall		Compact Fluorescent		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 649)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			19.5%	2.6%	0.8%	0.6%	0.5%	1.7%	7.2%	1.7%	88.7%	2.1%
Architectually Integrated	0.6%	0.5%	-	-	-	-	-	-	0.3%	0.4%	0.3%	0.4%
Ceiling Fan	33.7%	3.1%	4.0%	1.3%	-	-	-	-	-	-	29.9%	3.0%
Ceiling Fixtures	23.1%	2.7%	3.6%	1.2%	-	-	-	-	0.6%	0.5%	19.3%	2.6%
Chandelier Hanging	3.9%	1.3%	0.3%	0.4%	-	-	-	-	-	-	3.6%	1.2%
Floor Lamp	10.8%	2.0%	2.2%	0.9%	-	-	0.3%	0.4%	0.9%	0.6%	7.5%	1.7%
Recessed Can	6.1%	1.6%	0.2%	0.3%	-	-	-	-	0.5%	0.4%	5.4%	1.5%
Recessed Lighting-Other	1.1%	0.7%	0.2%	0.3%	0.3%	0.4%	-	-	-	-	0.6%	0.5%
Table lamps	63.0%	3.1%	10.2%	2.0%	-	-	0.2%	0.3%	0.9%	0.6%	53.9%	3.2%
Torchiere	6.6%	1.6%	0.6%	0.5%	-	-	-	-	3.6%	1.2%	2.7%	1.1%
Track Lighting	1.5%	0.8%	-	-	-	-	-	-	0.3%	0.3%	1.2%	0.7%
Wall Mount	8.5%	1.8%	1.1%	0.7%	0.5%	0.4%	-	-	0.8%	0.6%	6.3%	1.6%

Table 56: Percentage of Homes with Fixture Type and Lamp Type in Master Bedroom

Fixture Type	Lamp Type											
	Overall		Compact Fluorescent		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 736)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			14.7%	2.2%	1.4%	0.7%	0.8%	0.6%	5.4%	1.4%	87.0%	2.1%
Architectually Integrated	0.1%	0.2%	-	-	-	-	-	-	-	-	0.1%	0.2%
Ceiling Fan	21.9%	2.5%	2.9%	1.0%	-	-	-	-	-	-	18.9%	2.4%
Ceiling Fixtures	33.4%	2.9%	4.4%	1.3%	0.7%	0.5%	0.3%	0.3%	0.4%	0.4%	27.5%	2.7%
Chandelier Hanging	3.9%	1.2%	0.3%	0.3%	0.1%	0.2%	-	-	-	-	3.5%	1.1%
Floor Lamp	9.5%	1.8%	1.1%	0.6%	-	-	0.1%	0.2%	0.4%	0.4%	8.2%	1.7%
Other	0.1%	0.2%	-	-	-	-	-	-	-	-	0.1%	0.2%
Recessed Can	2.2%	0.9%	0.3%	0.3%	-	-	-	-	0.3%	0.3%	1.7%	0.8%
Recessed Lighting-Other	0.4%	0.4%	-	-	-	-	-	-	-	-	0.4%	0.4%
Table lamps	45.5%	3.0%	6.0%	1.5%	-	-	0.1%	0.2%	1.0%	0.6%	39.5%	3.0%
Torchiere	7.3%	1.6%	0.4%	0.4%	-	-	0.1%	0.2%	3.2%	1.1%	3.9%	1.2%
Track Lighting	1.0%	0.6%	-	-	-	-	-	-	0.3%	0.3%	0.7%	0.5%
Under Counter	0.1%	0.2%	-	-	-	-	0.1%	0.2%	-	-	-	-
Wall Mount	5.5%	1.4%	0.4%	0.4%	0.6%	0.5%	-	-	-	-	5.0%	1.3%

Table 57: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 1

Fixture Type	Lamp Type											
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 475)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			16.8%	2.9%	0.2%	0.4%	1.7%	1.0%	0.9%	0.7%	4.8%	1.6%	83.7%	2.8%
Architectually Integrated	0.4%	0.5%	-	-	-	-	-	-	-	-	0.2%	0.4%	0.2%	0.4%
Ceiling Fan	27.4%	3.4%	3.5%	1.4%	-	-	-	-	0.2%	0.4%	0.5%	0.5%	23.2%	3.2%
Ceiling Fixtures	33.2%	3.6%	6.5%	1.9%	-	-	0.6%	0.6%	0.2%	0.4%	0.2%	0.4%	26.1%	3.3%
Chandelier Hanging	3.2%	1.3%	0.9%	0.7%	-	-	0.2%	0.3%	-	-	-	-	2.1%	1.1%
Floor Lamp	8.2%	2.1%	0.8%	0.7%	-	-	-	-	0.2%	0.4%	0.4%	0.5%	6.7%	1.9%
Other	0.4%	0.5%	-	-	-	-	-	-	-	-	-	-	0.4%	0.5%
Recessed Can	1.5%	0.9%	-	-	-	-	-	-	-	-	0.2%	0.4%	1.3%	0.9%
Recessed Lighting-Other	0.2%	0.4%	-	-	-	-	-	-	-	-	-	-	0.2%	0.4%
Table lamps	41.0%	3.8%	6.0%	1.8%	-	-	-	-	-	-	0.4%	0.5%	35.6%	3.7%
Torchiere	8.4%	2.1%	0.2%	0.4%	-	-	-	-	0.2%	0.4%	2.8%	1.3%	5.2%	1.7%
Track Lighting	0.4%	0.5%	-	-	-	-	-	-	-	-	-	-	0.4%	0.5%
Under Counter	0.2%	0.4%	-	-	-	-	0.2%	0.4%	-	-	-	-	-	-
Wall Mount	5.0%	1.7%	0.2%	0.4%	0.2%	0.4%	0.7%	0.6%	-	-	0.2%	0.4%	3.7%	1.4%

Table 58: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 2

Fixture Type	Lamp Type											
	Overall		Compact Fluorescent		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 166)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			17.8%	5.0%	0.6%	1.0%	0.6%	1.0%	4.4%	2.7%	84.2%	4.7%
Architectually Integrated	0.001%	0.001%	-	-	-	-	-	-	-	-	0.001%	0.001%
Ceiling Fan	31.8%	6.0%	4.4%	2.7%	-	-	-	-	-	-	27.4%	5.8%
Ceiling Fixtures	34.4%	6.2%	5.2%	2.9%	0.6%	1.0%	-	-	0.6%	1.0%	27.9%	5.8%
Chandelier Hanging	5.5%	2.9%	0.6%	1.0%	-	-	-	-	-	-	4.9%	2.8%
Floor Lamp	6.9%	3.3%	0.6%	1.0%	-	-	0.6%	1.0%	1.3%	1.5%	4.3%	2.6%
Recessed Can	1.3%	1.4%	-	-	-	-	-	-	-	-	1.3%	1.4%
Recessed Lighting-Other	0.6%	1.0%	-	-	-	-	-	-	-	-	0.6%	1.0%
Table lamps	32.8%	6.1%	6.3%	3.2%	-	-	-	-	0.6%	1.0%	27.1%	5.8%
Torchiere	5.2%	2.9%	1.3%	1.4%	-	-	-	-	1.3%	1.4%	2.7%	2.1%
Track Lighting	1.9%	1.8%	-	-	-	-	-	-	0.6%	1.0%	1.3%	1.5%
Wall Mount	5.1%	2.9%	0.6%	1.0%	-	-	-	-	-	-	4.4%	2.7%

Table 59: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 3

Fixture Type	Lamp Type									
	Overall		Compact Fluorescent		Fluorescent T12		Halogen		Incandescent	
(n = 29)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			25.1%	13.5%	3.6%	5.8%	7.2%	8.1%	82.0%	12.0%
Ceiling Fan	13.9%	10.7%	-	-	-	-	-	-	13.9%	10.7%
Ceiling Fixtures	43.0%	15.4%	14.4%	10.9%	3.6%	5.8%	-	-	25.0%	13.5%
Chandelier Hanging	7.2%	8.0%	3.6%	5.8%	-	-	-	-	7.2%	8.0%
Floor Lamp	10.8%	9.7%	3.6%	5.8%	-	-	3.6%	5.8%	7.2%	8.1%
Recessed Can	7.2%	8.0%	-	-	-	-	3.6%	5.8%	3.6%	5.8%
Table lamps	32.2%	14.5%	3.6%	5.8%	-	-	-	-	28.7%	14.1%
Torchiere	0.004%	0.006%	-	-	-	-	0.004%	0.006%	-	-
Track Lighting	7.2%	8.1%	-	-	-	-	-	-	7.2%	8.1%

Table 60: Percentage of Homes with Fixture Type and Lamp Type in Bedroom 4

Living Room

Table 61 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 fans, floor lamps, and table lamps with incandescent lamps, as well as table lamps with compact fluorescent lamps. The most notable change in the past five years is the percentage of homes having compact fluorescent bulbs in their living room, which has gone from nearly 4% in 2000 to nearly 24% in 2005.

Fixture Type	Lamp Type											
	Overall		Compact Fluorescent		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 672)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			23.8%	2.7%	1.4%	0.7%	0.9%	0.6%	12.9%	2.1%	86.4%	2.2%
Architectually Integrated	0.8%	0.6%	-	-	-	-	0.2%	0.2%	0.5%	0.4%	0.2%	0.2%
Ceiling Fan	13.3%	2.2%	2.0%	0.9%	-	-	-	-	0.2%	0.3%	11.3%	2.0%
Ceiling Fixtures	12.7%	2.1%	2.3%	1.0%	0.5%	0.4%	0.2%	0.3%	0.6%	0.5%	9.6%	1.9%
Chandelier Hanging	10.8%	2.0%	1.0%	0.6%	-	-	-	-	0.2%	0.2%	9.8%	1.9%
Floor Lamp	35.1%	3.1%	7.3%	1.7%	-	-	0.2%	0.3%	2.9%	1.1%	27.3%	2.9%
Other	0.6%	0.5%	-	-	0.2%	0.3%	-	-	-	-	0.5%	0.4%
Recessed Can	9.6%	1.9%	1.1%	0.7%	-	-	-	-	1.7%	0.8%	7.4%	1.7%
Recessed Lighting-Other	0.6%	0.5%	-	-	0.2%	0.3%	-	-	-	-	0.5%	0.4%
Table lamps	60.3%	3.1%	11.8%	2.1%	-	-	-	-	0.8%	0.6%	51.8%	3.2%
Torchiere	15.5%	2.3%	1.5%	0.8%	-	-	0.2%	0.3%	6.1%	1.5%	7.8%	1.7%
Track Lighting	4.1%	1.3%	0.6%	0.5%	-	-	-	-	1.2%	0.7%	2.4%	1.0%
Wall Mount	7.2%	1.7%	0.2%	0.3%	0.8%	0.6%	0.3%	0.4%	0.2%	0.2%	5.8%	1.5%

Table 61: Percentage of Homes with Fixture Type and Lamp Type in Living Room

Bathrooms

Table 62, Table 63, Table 64, and Table 65 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 mounts, wall mounts, and recessed cans with incandescent lamps, as well as ceiling mounts with compact fluorescent lamps.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 589)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			15.4%	2.5%	0.9%	0.6%	10.4%	2.1%	3.9%	1.3%	3.3%	1.2%	91.0%	2.0%
Architectually Integrated	0.2%	0.3%	-	-	-	-	-	-	0.2%	0.3%	-	-	-	-
Ceiling Fan	2.6%	1.1%	0.5%	0.5%	-	-	-	-	-	-	-	-	2.1%	1.0%
Ceiling Fixtures	48.3%	3.4%	8.2%	1.9%	0.2%	0.3%	6.6%	1.7%	2.8%	1.1%	0.2%	0.3%	35.6%	3.3%
Chandelier Hanging	2.0%	0.9%	0.7%	0.6%	-	-	-	-	-	-	-	-	1.2%	0.7%
Floor Lamp	0.5%	0.5%	-	-	-	-	0.2%	0.3%	-	-	-	-	0.3%	0.4%
Other	0.2%	0.3%	-	-	-	-	-	-	0.2%	0.3%	-	-	-	-
Recessed Can	19.5%	2.7%	3.1%	1.2%	-	-	-	-	-	-	0.9%	0.6%	17.5%	2.6%
Recessed Lighting-Other	5.2%	1.5%	0.5%	0.5%	-	-	1.9%	0.9%	0.2%	0.3%	-	-	2.9%	1.2%
Table lamps	2.6%	1.1%	0.5%	0.5%	-	-	-	-	-	-	-	-	2.3%	1.0%
Torchiere	0.2%	0.3%	-	-	-	-	-	-	-	-	0.2%	0.3%	-	-
Track Lighting	0.7%	0.6%	0.002%	0.004%	-	-	-	-	-	-	0.3%	0.4%	0.3%	0.4%
Under Counter	0.3%	0.4%	-	-	-	-	-	-	0.2%	0.3%	-	-	0.2%	0.3%
Wall Mount	73.7%	3.0%	4.8%	1.5%	0.7%	0.6%	1.7%	0.9%	0.5%	0.5%	1.7%	0.9%	65.0%	3.3%

Table 62: Percentage of Homes with Fixture Type and Lamp Type in Master Bathroom

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 725)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			13.6%	2.1%	0.4%	0.4%	8.0%	1.7%	3.1%	1.1%	1.4%	0.7%	87.3%	2.1%
Architectually Integrated	0.1%	0.2%	-	-	-	-	-	-	-	-	-	-	0.1%	0.2%
Ceiling Fan	0.7%	0.5%	-	-	-	-	-	-	-	-	-	-	0.7%	0.5%
Ceiling Fixtures	33.2%	2.9%	4.8%	1.3%	-	-	4.4%	1.3%	2.5%	1.0%	0.1%	0.2%	22.4%	2.6%
Chandelier Hanging	1.7%	0.8%	0.1%	0.2%	-	-	0.1%	0.2%	-	-	-	-	1.4%	0.7%
Recessed Can	6.6%	1.5%	1.7%	0.8%	-	-	-	-	-	-	0.4%	0.4%	5.1%	1.4%
Recessed Lighting-Other	4.2%	1.2%	0.7%	0.5%	-	-	1.4%	0.7%	-	-	-	-	2.3%	0.9%
Table lamps	0.8%	0.6%	-	-	-	-	-	-	-	-	-	-	0.8%	0.6%
Torchiere	0.3%	0.3%	0.1%	0.2%	-	-	-	-	-	-	0.1%	0.2%	-	-
Track Lighting	0.6%	0.5%	0.1%	0.2%	-	-	-	-	-	-	0.3%	0.3%	0.1%	0.2%
Under Counter	0.3%	0.3%	-	-	-	-	0.1%	0.2%	0.1%	0.2%	-	-	-	-
Wall Mount	80.6%	2.4%	7.4%	1.6%	0.4%	0.4%	2.0%	0.9%	0.4%	0.4%	0.4%	0.4%	71.1%	2.8%

Table 63: Percentage of Homes with Fixture Type and Lamp Type in Bathroom 1

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 270)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			15.3%	3.6%	0.4%	0.6%	8.0%	2.7%	2.3%	1.5%	1.5%	1.2%	87.3%	3.4%
Architectually Integrated	0.4%	0.6%	-	-	-	-	0.4%	0.6%	-	-	-	-	-	-
Ceiling Fan	1.5%	1.3%	-	-	-	-	-	-	-	-	-	-	1.5%	1.3%
Ceiling Fixtures	30.6%	4.7%	5.7%	2.4%	-	-	2.7%	1.6%	2.3%	1.5%	-	-	20.3%	4.1%
Chandelier Hanging	1.9%	1.4%	-	-	-	-	0.4%	0.6%	-	-	-	-	1.5%	1.2%
Recessed Can	10.7%	3.1%	1.9%	1.4%	-	-	-	-	-	-	0.4%	0.6%	8.7%	2.9%
Recessed Lighting-Other	6.8%	2.5%	0.8%	0.9%	-	-	2.7%	1.6%	-	-	0.3%	0.6%	3.0%	1.7%
Table lamps	1.1%	1.1%	-	-	-	-	-	-	-	-	-	-	1.1%	1.1%
Torchiere	0.4%	0.6%	-	-	-	-	-	-	-	-	0.4%	0.6%	-	-
Wall Mount	77.7%	4.2%	7.7%	2.7%	0.4%	0.6%	2.2%	1.5%	-	-	0.4%	0.6%	67.7%	4.7%

Table 64: Percentage of Homes with Fixture Type and Lamp Type in Bathroom 2

Fixture Type	Lamp Type											
	Overall		Compact Fluorescent		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 43)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			17.8%	5.0%	0.6%	1.0%	0.6%	1.0%	4.4%	2.7%	84.2%	4.7%
Ceiling Fan	4.8%	5.5%	-	-	-	-	-	-	-	-	4.8%	5.5%
Ceiling Fixtures	33.5%	12.0%	4.8%	5.4%	4.8%	5.4%	4.8%	5.4%	-	-	21.6%	10.5%
Chandelier Hanging	4.8%	5.4%	-	-	-	-	-	-	-	-	4.8%	5.4%
Recessed Can	21.2%	10.3%	4.8%	5.4%	-	-	-	-	4.5%	5.1%	16.7%	9.5%
Recessed Lighting-Other	7.2%	6.6%	2.4%	3.9%	4.8%	5.5%	-	-	-	-	-	-
Table lamps	4.8%	5.4%	-	-	-	-	-	-	-	-	4.8%	5.4%
Wall Mount	57.1%	12.6%	2.4%	3.9%	2.4%	3.9%	-	-	-	-	52.3%	12.7%

Table 65: Percentage of Homes with Fixture Type and Lamp Type in Bathroom 3

Halls

Table 66 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 mounts, wall mounts, recessed cans, and chandelier/hanging fixtures with incandescent lamps. Ceiling mounts with compact fluorescent lamps were the next most common fixture-lamp combination.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 331)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			10.7%	2.8%	2.2%	1.3%	18.2%	3.5%	3.4%	1.7%	2.2%	1.3%	65.3%	4.4%
Ceiling Fan	0.3%	0.5%	-	-	-	-	-	-	-	-	-	-	0.3%	0.5%
Ceiling Fixtures	82.6%	3.5%	8.5%	2.5%	1.6%	1.1%	16.7%	3.4%	3.1%	1.6%	0.3%	0.5%	52.8%	4.6%
Chandelier Hanging	1.5%	1.1%	-	-	0.3%	0.5%	0.6%	0.7%	-	-	-	-	0.6%	0.7%
Floor Lamp	0.6%	0.7%	-	-	-	-	-	-	-	-	0.3%	0.5%	-	-
Other	0.3%	0.5%	-	-	-	-	-	-	-	-	-	-	0.3%	0.5%
Recessed Can	8.4%	2.5%	1.6%	1.1%	-	-	-	-	-	-	1.2%	1.0%	5.9%	2.2%
Recessed Lighting-Other	3.1%	1.6%	-	-	-	-	0.9%	0.9%	-	-	-	-	2.2%	1.3%
Table Lamps	0.3%	0.5%											0.3%	0.5%
Torchiere	0.3%	0.5%	-	-	-	-	-	-	-	-	0.3%	0.5%	-	-
Under Counter	0.6%	0.7%	-	-	0.3%	0.5%	-	-	0.3%	0.5%	-	-	-	-
Wall Mount	4.3%	1.9%	0.9%	0.9%	-	-	-	-	-	-	-	-	3.4%	1.7%

Table 66: Percentage of Homes with Fixture Type and Lamp Type in Hallway

Dining Room

Table 67 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 fans, ceiling mounts, chandelier/hanging fixtures and table lamps with incandescent bulbs. The percent of compact fluorescents in dining rooms has increased tenfold over the past five years, going from 0.8% to 8.1%.

Fixture Type	Lamp Type											
	Overall		Compact Fluorescent		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 581)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			8.1%	1.9%	1.4%	0.8%	0.4%	0.4%	6.1%	1.6%	90.7%	2.0%
Architectually Integrated	2.6%	1.1%	0.4%	0.4%	0.2%	0.3%	0.4%	0.4%	0.7%	0.6%	1.2%	0.8%
Ceiling Fan	23.6%	2.9%	2.7%	1.1%	-	-	-	-	0.2%	0.3%	20.9%	2.8%
Ceiling Fixtures	15.9%	2.5%	1.6%	0.9%	0.9%	0.6%	-	-	0.5%	0.5%	12.9%	2.3%
Chandelier Hanging	57.6%	3.4%	1.9%	1.0%	0.2%	0.3%	-	-	1.6%	0.9%	54.3%	3.4%
Floor Lamp	2.5%	1.1%	0.4%	0.4%	-	-	-	-	0.5%	0.5%	1.6%	0.9%
Recessed Can	7.2%	1.8%	0.4%	0.4%	-	-	-	-	0.7%	0.6%	6.3%	1.7%
Recessed Lighting-Other	0.4%	0.4%	-	-	-	-	-	-	0.4%	0.4%	-	-
Table lamps	4.6%	1.4%	0.9%	0.6%	-	-	-	-	-	-	3.8%	1.3%
Torchiere	1.9%	0.9%	0.2%	0.3%	-	-	-	-	1.1%	0.7%	0.7%	0.6%
Track Lighting	1.0%	0.7%	-	-	-	-	-	-	0.7%	0.5%	0.4%	0.4%
Under Counter	0.2%	0.3%	-	-	-	-	-	-	-	-	0.2%	0.3%
Wall Mount	2.1%	1.0%	-	-	0.2%	0.3%	-	-	-	-	1.9%	0.9%

Table 67: Percentage of Homes with Fixture Type and Lamp Type in Dining Room

Breakfast Nook

Table 68 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 fans, ceiling mounts, and chandeliers with incandescent bulbs.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 150)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			9.7%	4.0%	0.7%	1.1%	1.3%	1.5%	0.7%	1.1%	2.1%	2.0%	90.5%	4.0%
Architectually Integrated	0.7%	1.1%	-	-	-	-	-	-	-	-	0.7%	1.1%	-	-
Ceiling Fan	29.5%	6.2%	4.1%	2.7%	-	-	-	-	-	-	-	-	26.1%	6.0%
Ceiling Fixtures	14.6%	4.8%	0.9%	1.2%	0.7%	1.1%	1.3%	1.5%	-	-	-	-	11.7%	4.4%
Chandelier Hanging	43.0%	6.8%	1.4%	1.6%	-	-	-	-	-	-	0.7%	1.1%	40.9%	6.7%
Floor Lamp	1.4%	1.6%	0.7%	1.1%	-	-	-	-	-	-	-	-	0.7%	1.1%
Other	0.7%	1.1%	-	-	-	-	-	-	-	-	-	-	0.7%	1.1%
Recessed Can	11.7%	4.4%	1.4%	1.6%	-	-	-	-	-	-	-	-	11.0%	4.3%
Table lamps	2.0%	1.9%	1.3%	1.5%	-	-	-	-	-	-	-	-	0.7%	1.1%
Torchiere	0.7%	1.1%	-	-	-	-	-	-	-	-	0.7%	1.1%	-	-
Track Lighting	0.7%	1.1%	-	-	-	-	-	-	-	-	-	-	0.7%	1.1%
Under Counter	0.7%	1.1%	-	-	-	-	-	-	0.7%	1.1%	-	-	-	-
Wall Mount	0.9%	1.2%	0.2%	0.3%	-	-	-	-	-	-	-	-	0.7%	1.1%

Table 68: Percentage of Homes with Fixture Type and Lamp Type in Breakfast Nook

Home Office

Table 69 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 fans, ceiling mount, floor lamps, and table lamps with incandescent bulbs. A table lamp with compact fluorescent lamps is the most common fixture lamp combination accounts for nearly 10% of the fixture-lamp combinations.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 274)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			18.1%	3.9%	0.4%	0.6%	6.4%	2.5%	3.0%	1.7%	16.5%	3.7%	83.0%	3.8%
Architectually Integrated	1.1%	1.0%	-	-	-	-	-	-	-	-	0.7%	0.8%	0.4%	0.6%
Ceiling Fan	19.0%	3.9%	2.6%	1.6%	-	-	-	-	-	-	-	-	16.8%	3.8%
Ceiling Fixtures	28.7%	4.5%	2.0%	1.4%	-	-	4.9%	2.2%	-	-	0.4%	0.6%	21.8%	4.1%
Chandelier Hanging	8.3%	2.8%	-	-	-	-	-	-	0.4%	0.6%	0.4%	0.6%	7.5%	2.7%
Floor Lamp	16.5%	3.7%	3.3%	1.8%	-	-	-	-	-	-	0.7%	0.9%	13.2%	3.4%
Other	1.1%	1.1%	0.4%	0.6%	-	-	-	-	0.4%	0.6%	-	-	0.4%	0.6%
Recessed Can	8.2%	2.8%	0.8%	0.9%	-	-	-	-	-	-	1.1%	1.0%	6.4%	2.5%
Recessed Lighting-Other	0.7%	0.8%	-	-	-	-	0.4%	0.6%	-	-	-	-	0.3%	0.6%
Table lamps	48.0%	5.0%	9.4%	2.9%	-	-	0.4%	0.6%	0.7%	0.9%	7.5%	2.7%	34.1%	4.8%
Torchiere	11.0%	3.1%	1.6%	1.2%	-	-	-	-	-	-	5.6%	2.3%	3.8%	1.9%
Track Lighting	5.9%	2.4%	0.4%	0.6%	-	-	-	-	-	-	1.1%	1.1%	4.8%	2.1%
Under Counter	2.6%	1.6%	-	-	0.4%	0.6%	0.8%	0.9%	1.5%	1.2%	-	-	-	-
Wall Mount	5.0%	2.2%	1.2%	1.1%	-	-	-	-	-	-	0.4%	0.6%	3.8%	1.9%

Table 69: Percentage of Homes with Fixture Type and Lamp Type in Home Office

Laundry Room

Table 70 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 mounts with fluorescent tube lamps other than T8s, ceiling mounts with incandescent lamps, as well as ceiling mounts with compact fluorescent lamps.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 330)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			10.7%	2.8%	2.2%	1.3%	18.3%	3.5%	3.4%	1.7%	2.2%	1.3%	65.2%	4.4%
Ceiling Fan	0.3%	0.5%	-	-	-	-	-	-	-	-	-	-	0.3%	0.5%
Ceiling Fixtures	82.9%	3.5%	8.5%	2.6%	1.6%	1.1%	16.7%	3.4%	3.1%	1.6%	0.3%	0.5%	53.0%	4.6%
Chandelier Hanging	1.6%	1.1%	-	-	0.3%	0.5%	0.6%	0.7%	-	-	-	-	0.6%	0.7%
Floor Lamp	0.3%	0.5%	-	-	-	-	-	-	-	-	0.3%	0.5%	-	-
Other	0.3%	0.5%	-	-	-	-	-	-	-	-	-	-	0.3%	0.5%
Recessed Can	8.4%	2.5%	1.6%	1.1%	-	-	-	-	-	-	1.2%	1.0%	5.9%	2.2%
Recessed Lighting-Other	3.1%	1.6%	-	-	-	-	0.9%	0.9%	-	-	-	-	2.2%	1.3%
Torchiere	0.3%	0.5%	-	-	-	-	-	-	-	-	0.3%	0.5%	-	-
Under Counter	0.6%	0.7%	-	-	0.3%	0.5%	-	-	0.3%	0.5%	-	-	-	-
Wall Mount	4.3%	1.9%	0.9%	0.9%	-	-	-	-	-	-	-	-	3.4%	1.7%

Table 70: Percentage of Homes with Fixture Type and Lamp Type in Laundry Room

Closets

Table 71 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 mounts and wall mounts with incandescent bulbs.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 298)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			10.4%	2.9%	0.3%	0.6%	4.1%	1.9%	1.7%	1.3%	1.7%	1.3%	87.6%	3.2%
Ceiling Fan	0.7%	0.8%	-	-	-	-	-	-	-	-	-	-	0.7%	0.8%
Ceiling Fixtures	81.1%	3.8%	8.8%	2.7%	0.3%	0.6%	2.4%	1.5%	1.4%	1.1%	0.7%	0.8%	70.7%	4.4%
Chandelier Hanging	0.7%	0.8%	-	-	-	-	-	-	-	-	-	-	0.7%	0.8%
Recessed Can	7.9%	2.6%	0.3%	0.5%	-	-	-	-	-	-	0.7%	0.8%	7.2%	2.5%
Recessed Lighting-Other	0.4%	0.6%	-	-	-	-	-	-	-	-	-	-	0.4%	0.6%
Track Lighting	0.7%	0.8%	-	-	-	-	-	-	-	-	0.3%	0.6%	0.3%	0.6%
Wall Mount	14.0%	3.3%	1.7%	1.2%	-	-	1.7%	1.2%	0.3%	0.6%	-	-	11.3%	3.1%

Table 71: Percentage of Homes with Fixture Type and Lamp Type in Closets

Garage

Table 72 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 mounts with T12 fluorescent lamps as well as ceiling mounts, wall mounts, and garage door openers with incandescent lamps.

Fixture Type	Lamp Type													
	Overall		Compact Fluorescent		Fluorescent T8		Fluorescent T12		Fluorescent-Other Tube		Halogen		Incandescent	
(n = 440)	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound	% of Homes	Error Bound
Overall			11.1%	2.5%	2.6%	1.3%	57.4%	3.9%	1.2%	0.9%	0.7%	0.6%	66.9%	3.7%
Ceiling Fan	0.7%	0.7%	-	-	-	-	-	-	-	-	-	-	0.7%	0.7%
Ceiling Fixtures	75.6%	3.4%	6.0%	1.9%	2.3%	1.2%	49.2%	4.0%	0.7%	0.7%	0.5%	0.5%	28.5%	3.6%
Chandelier Hanging	8.1%	2.2%	0.5%	0.5%	-	-	7.2%	2.0%	-	-	-	-	0.5%	0.5%
Floor Lamp	0.2%	0.4%	-	-	-	-	-	-	-	-	-	-	0.2%	0.4%
Garage Door Opener	41.5%	3.9%	1.4%	0.9%	-	-	-	-	-	-	-	-	40.1%	3.9%
Recessed Can	0.5%	0.5%	-	-	-	-	-	-	-	-	-	-	0.5%	0.5%
Recessed Lighting-Other	0.2%	0.4%	-	-	-	-	0.2%	0.4%	-	-	-	-	-	-
Table lamps	0.2%	0.4%	-	-	-	-	-	-	-	-	-	-	0.2%	0.4%
Track Lighting	0.7%	0.7%	-	-	-	-	-	-	-	-	-	-	0.7%	0.7%
Under Counter	0.9%	0.8%	0.2%	0.4%	-	-	0.5%	0.5%	0.2%	0.4%	-	-	-	-
Wall Mount	21.1%	3.2%	4.4%	1.6%	0.2%	0.4%	0.7%	0.7%	0.2%	0.4%	0.2%	0.3%	15.5%	2.9%

Table 72: Percentage of Homes with Fixture Type and Lamp Type in Garage

All Other Rooms

Table 73 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, basements, exercise rooms, music rooms, sewing rooms, as well as pool houses. The most predominant fixture and lamp type combinations are ceiling mounts, chandelier or hanging fixtures, and wall mounts with incandescent lamps.

	Lamp Type													
Fixture Type	**Overall**		**Compact Fluorescent**		**Fluorescent T8**		**Fluorescent T12**		**Fluorescent-Other Tube**		**Halogen**		**Incandescent**	
(n = 104)	**% of Homes**	**Error Bound**	**% of Homes**	**Error Bound**	**% of Homes**	**Error Bound**	**% of Homes**	**Error Bound**	**% of Homes**	**Error Bound**	**% of Homes**	**Error Bound**	**% of Homes**	**Error Bound**
Overall			13.8%	5.6%	1.0%	1.6%	12.8%	5.4%	3.9%	3.2%	7.9%	4.4%	86.2%	5.6%
Ceiling Fan	9.9%	4.9%	-	-			-	-	-	-	-	-	9.9%	4.9%
Ceiling Fixtures	49.7%	8.1%	5.9%	3.8%	1.0%	1.6%	8.8%	4.6%	2.0%	2.3%	1.0%	1.6%	36.9%	7.9%
Chandelier Hanging	11.8%	5.3%	-	-			2.0%	2.3%	-	-	-	-	10.8%	5.1%
Floor Lamp	6.9%	4.1%	1.0%	1.6%			-	-	-	-	1.0%	1.6%	4.9%	3.5%
Other	1.0%	1.6%	-	-			-	-	-	-	-	-	1.0%	1.6%
Recessed Can	8.9%	4.6%	2.0%	2.3%			-	-	-	-	1.0%	1.6%	6.9%	4.1%
Recessed Lighting-Other	4.9%	3.5%	-	-			2.0%	2.3%	-	-	-	-	3.0%	2.8%
Table lamps	12.8%	5.5%	4.0%	3.2%			-	-	-	-	-	-	9.9%	4.9%
Torchiere	3.9%	3.2%	-	-			-	-	-	-	3.9%	3.2%	-	-
Track Lighting	3.9%	3.2%	-	-			-	-	-	-	1.0%	1.6%	3.0%	2.8%
Wall Mount	17.7%	6.2%	2.0%	2.3%			-	-	2.0%	2.3%	2.0%	2.3%	13.8%	5.6%

Table 73: Percentage of Homes with Fixture Type and Lamp Type in Other Room Type

Porch Lighting

Table 74 presents the percentage of homes utilizing each lamp type for the porch light. Approximately 80% of all homes are using a standard incandescent lamp for the porch light. Nearly 15% of homes are using a compact fluorescent lamp. In the past five years, the percentage of homes using either compact fluorescent or halogen lightning for their porches has increased greatly. The percentage for compact fluorescents has gone from 6% to 14.5%, and the percentage for halogens has increased from 0.8% to 5.6%.

Lamp Type	Percentage of Homes (n = 578)	Error Bound
Compact Fluorescent A Style	0.6%	0.6%
Compact Fluorescent Capsule	0.1%	0.2%
Compact Fluorescent Decorative	0.2%	0.4%
Compact Fluorescent Flood	0.3%	0.4%
Compact Fluorescent Globe	0.7%	0.8%
Compact Fluorescent Reflector	0.2%	0.4%
Compact Fluorescent Spring	8.8%	1.9%
Compact Fluorescent Tubular	1.6%	0.8%
Compact Fluorescent Unknown	0.3%	0.4%
Compact Fluorescent Mini	0.1%	0.2%
Compact Fluorescent Pin Base	1.4%	0.7%
Compact Fluorescent Total	**14.5%**	
MR-16 Pin Based Halogen	0.9%	0.9%
Halogen Other	0.1%	0.2%
Halogen Parabolic Reflector	3.5%	1.6%
Halogen Quartz Tube	0.5%	0.5%
Halogen Unknown	0.6%	0.7%
Halogen Total	**5.6%**	
Decorative Incandescent	15.6%	3.5%
Incandescent Flood	11.5%	4.0%
Incandescent Globe	0.7%	0.5%
Incandescent Mini	0.1%	0.2%
Incandescent Other	0.4%	0.5%
Incandescent Standard	51.1%	4.2%
Incandescent Unknown	0.3%	0.4%
Incandescent Total	**79.8%**	
Metal Halide	0.1%	0.2%

Table 74: Percentage of Homes Having Lamp Type as Porch Light

Fixture Control Types

Table 75 shows the percentage of homes have a given lamp type and lamp control type among all lamps. About 70% of homes are using a standard incandescent lamp controlled manually. Only approximately 6% were incandescent lamps in dimmer controlled switches, while 1% were halogen lamps in a dimmer controlled switch.

	Percent of Lamps by Control Type (n=847)											
	Manual		Dimmer		Motion Detector		Motion Detector with Photocell		Photocell		Timer	
Lamp Type	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound
Compact Fluorescent	8.4%	0.87%	0.11%	0.09%	0.06%	0.03%	-	-	0.03%	0.02%	0.02%	0.01%
Fluorescent Other	0.9%	0.17%	0.02%	0.03%	<0.01%	0.005%	-	-	-	-	-	-
Fluorescent F12	10.3%	0.67%	-	-	0.03%	0.03%	-	-	-	-	-	-
Fluorescent F8	0.4%	0.15%	-	-	-	-	0.02%	0.04%	-	-	-	-
Halogen	2.6%	0.79%	1.13%	0.30%	0.05%	0.03%	0.01%	0.02%	<0.01%	0.005%	<0.01%	0.00%
Incandescent	69.2%	1.35%	5.82%	0.77%	0.53%	0.18%	0.11%	0.09%	0.08%	0.04%	0.10%	0.09%
Other	-	-	-	-	-	-	-	-	<0.01%	0.005%	-	-

Table 75: Percent of Lamps by Control Types

Lamp Wattage

Table 76 shows average lamp wattage for each lamp type observed in this study. The highest average wattages were halogen tube lamps and heat lamps. The most common lamp, the standard incandescent, has an average wattage of 64. The most common compact fluorescent lamp, the spring lamp, had an average wattage of 18.

Average Lamp Wattage By Lamp Type	
Lamp Type	**Average Wattage**
CF I A	15.8
CF I CAP	19.9
CF I CIRC	24.9
CF I DEC	17.4
CF I FLOOD	18.3
CF I GLO	16.4
CF I REF	12.0
CF I SPRN	18.2
CF I TUBE	17.0
CF I UNK	18.1
CF MINI	9.0
CF PIN BASE	18.1
F 12	40.0
F 4	16.7
F 5	18.6
F 8	47.2
F CIR	27.0
F OTH	28.2
F TUBE UNK	26.4
HAL MR	39.5
HAL OTH	68.3
HAL PAR	69.5
HAL QTZTUB	213.4
HAL UNK	53.4
HEAT LAMP	192.6
I DEC	34.0
I FLOOD	69.4
I GLO	41.9
I MINI	31.7
I OTH	41.6
I REF	56.0
I STD	64.2
I UNK	68.2
MH 100	100.0

Table 76: Average Lamp Wattage by Lamp Type

Table 77 presents the average wattage per fixture, inclusive of all lamp technology types found in the fixtures, and number of lamps found in the fixture. Torchieres were found to have the highest overall wattage (165), followed by chandeliers (150), and ceiling fans (126). Both chandeliers and ceiling fans commonly have multiple lamps per fixture, explaining the high wattage for these fixtures. Torchieres on the other hand typically have a single lamp, most commonly halogen quartz, which go as high as 500 watts per lamp. Under counter fixture types have the lowest wattage, with a statewide average of

42 watts. These fixtures are more commonly located in kitchens and are usually equipped with fluorescent tubes. Architecturally integrated fixtures have the second lowest average wattage. These fixtures represent a number of lamp types, but are most commonly fluorescent tubes.

Fixture Type	Average Fixture Wattage	Error Bound	Sample Size
Under Counter	42.1	8.7	341
Architectually Integrated	43.9	25.8	92
Other	50.8	30.9	37
Recessed Can	62.7	11.4	555
Table lamps	66.7	5.1	831
Recessed Lighting-Other	69.9	18.2	283
Garage Door Opener	77.8	16.0	325
Ceiling Fixtures	80.2	4.8	846
Floor Lamp	90.3	11.3	617
Track Lighting	117.6	34.1	198
Wall Mount	118.6	7.8	846
Ceiling Fan	125.8	13.5	680
Chandelier Hanging	149.9	15.6	722
Torchiere	165.1	30.6	409

Table 77: Average Fixture Wattage

Table 78 looks at the average wattage by room type, when considering all fixtures and lamp within the specific room. The table presents findings as the statewide level. These numbers do vary dramatically when considering size of home, type of home, and income. Master Bathrooms top the list in terms of highest overall wattage by room type, more than likely a result of multiple fixtures with one often being the vanity with multiple lamps. Other rooms are second on the list, these rooms group together non-typical room types such as weight rooms, libraries, attics, basements and dens. Living rooms, family rooms, kitchens and garages top out the top five high wattage rooms. Conversely, on the low end of wattages are laundry rooms, porches and closets. These rooms commonly have a single fixture and a single lamp.

Room	Watts	Error Bound	Sample Size
Laundry Rm	82.4	4.6	331
Porch	96.3	11.2	578
Closet	113.3	7.9	298
Bedroom - 2	133.7	7.3	475
Bedroom - 3	141.5	12.0	166
Bedroom - 1	142.1	6.2	736
Breakfast Nook	152.1	13.7	150
Bedroom - 4	168.8	54.3	29
Bathroom - 1	184.1	7.7	725
Bathroom - 2	192.6	13.4	270
Office	197.5	17.3	274
Hall	206.4	12.2	744
Bedroom - Master	207.3	9.5	649
Dining Rm	215.1	10.8	581
Bathroom - 3	228.3	39.8	43
Rec Rm	228.9	52.6	72
Garage	232.2	16.1	440
Kitchen	245.2	11.5	834
Family Room	252.6	16.1	362
Living Rm	253.5	14.2	672
Other	267.6	49.9	104
Bathroom - Master	274.4	14.2	589

Table 78: Average Wattage by Room Type

Energy and Demand Potential

Although not a goal of this study, or something that can be done with the CLASS analysis tool developed for this study, we thought it would be interesting to investigate the potential energy savings that could result from CFL retrofits of standard screw based non-CFL lamps. This analysis is possible since this is one of the first studies that conducted a thorough inspection of lamp wattages, by room type and technology type.

We decided that for this report a utility level analysis would make the most sense, although a similar approach could be taken to understand lighting savings potential at many other levels, such as climate zone, house type, fixture type, room type, etc. Based on our survey efforts we have determined the average total household lighting wattage ranges from 2,494 watts per home in SDG&E's territory to 1,749 watts per home in SCE's territory. Next, we calculated the wattage that does not have energy savings potential, namely fixtures that are already CFL and other non-screw type sockets (e.g., tube fluorescent, halogen quartz, etc.). These unchangeable, or already retrofitted wattages, were then removed from the total wattage to determine the average retrofit potential for medium screw based sockets. These values can be found in the final column of Table 79.

Utility	Average Household Wattage	Non Changeable Lighting Wattage	CFL Wattage	Potential Retrofit Wattage
PG&E	2,306	388	72	1,846
SCE	1,749	216	55	1,477
SDG&E	2,494	456	59	1,978

Table 79: Household Wattage by Electric IOU

Using these values RLW computed potential energy savings using the following simplified approach. First, the total household demand for changeable sockets was multiplied by the total population of customers for each utility, yielding the total demand of changeable lighting (column 2). A CFL reduction factor was then used to determine the potential reduction in megawatts by multiplying the factor by the total demand represented by changeable sockets. The CFL reduction factor (column 3) was calculated by taking the difference between baseline wattage values (CFL and non-CFL medium screw lamps) gathered through this study. Next, we used the 2004 CFL Metering Study (Kema, 2004) findings to apply hours of use to the total potential demand, yielding the maximum potential energy savings in GWh/yr (column 7). Finally, we assumed a feasible adoption rate of 10% could be achieved, yielding the final values of achievable potential.

Amazingly, the amount of achievable energy savings ranges from 450 GWh/yr for PG&E to 137 GWh for SDG&E. In total, assuming a 10% adoption rate, California could save more than 882 GWh of energy through CFL mass market programs.

Utility	Total Population	Demand from Retrofitable Lamps (MW)	CFL Wattage Reduction Factor	Potential Reduction (MW)	Hours per year used	Maximum Potential Energy Saved (GWh/yr)	Feasible Adoption Rate	Achievable Potential Energy Saved (GWh/yr)
PG&E	4,196,869	7,748.11	0.69	5,361	840	4,500	0.1	450
SCE	3,907,843	5,773.24	0.67	3,852	767	2,953	0.1	295
SDG&E	1,085,981	2,148.34	0.65	1,395	986	1,374	0.1	137

Table 80: Maximum and Achievable Energy Savings Potential from CFL Retrofits

Appliances

Refrigerator Freezers

The following section describes the refrigerator/freezers found at the surveyed households. In total, 850 households were surveyed, however, due to palmtop computer malfunction appliance information for two sites was lost and the refrigerator analysis is inclusive of 848 households. All 848 homes surveyed for this study have at least one refrigerator, 18.9% of all homes have a second, and only 1.1% of all homes have a third refrigerator. Compared to the previous CLASS study this is an increase in secondary and third refrigerator saturation of 4.5% and 0.4%, respectively. For this analysis any refrigerator with a capacity under 8 cubic feet is considered a "compact" refrigerator, while any refrigerator with a capacity of 8 cubic feet and above is referred to as "full-size". The following table summarizes second and third refrigerators by the residence types where they were found. As expected, it is more common to find second and third refrigerators in single family dwellings than apartments.

Type of Residence	Secondary Refrigerator				Third Refrigerator				Sample Size
	Full or Compact		Full Only		Full or Compact		Full Only		
	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound	
Overall	18.9%	2.2%	15.3%	2.0%	1.1%	0.6%	0.4%	0.3%	848
Apt/Condo (1 or 2 stories)	3.2%	2.3%	2.5%	2.1%	0.0%	0.0%	0.0%	0.0%	159
Apt/Condo (3 or more stories)	2.1%	3.5%	2.1%	3.5%	0.0%	0.0%	0.0%	0.0%	46
Mobile Home - Double Wide	14.7%	12.9%	9.9%	10.9%	4.9%	7.8%	0.0%	0.0%	21
Mobile Home - Single Wide	33.2%	44.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3
Modular/Prefabricated	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4
Other	20.0%	29.5%	20.0%	29.5%	0.0%	0.0%	0.0%	0.0%	6
Single Family Unattached (1 story)	24.1%	3.6%	19.8%	3.4%	1.3%	1.0%	0.3%	0.4%	383
Single Family Unattached (2 stories)	30.4%	5.9%	24.9%	5.5%	1.2%	1.4%	0.6%	1.0%	168
Single Family Unattached (3 or more stories)	45.0%	29.8%	17.6%	21.6%	17.6%	21.6%	17.6%	21.6%	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	4.2%	4.7%	4.2%	4.7%	0.0%	0.0%	0.0%	0.0%	49

Table 81: Percentage of Homes with Second or Third Refrigerator by Type of Residence

Due to the small number of homes with third refrigerators, the following summary information is only based upon the primary and secondary refrigerators. This refrigerator/freezer section of the report first summarizes the analysis conducted on the primary refrigerators, and then summarizes the secondary refrigerators.

The primary and secondary refrigerators are summarized by type, size, age, energy consumption, ENERGY STAR qualifications, and nameplate 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-The unit was marked as ENERGY STAR qualified if its nameplate UEC was calculated as 10% above standard for 2001 standards, and 15% above standard for 2004 standards.

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 the top-mounted freezer type, accounting for almost 52% of all the primary refrigerators.

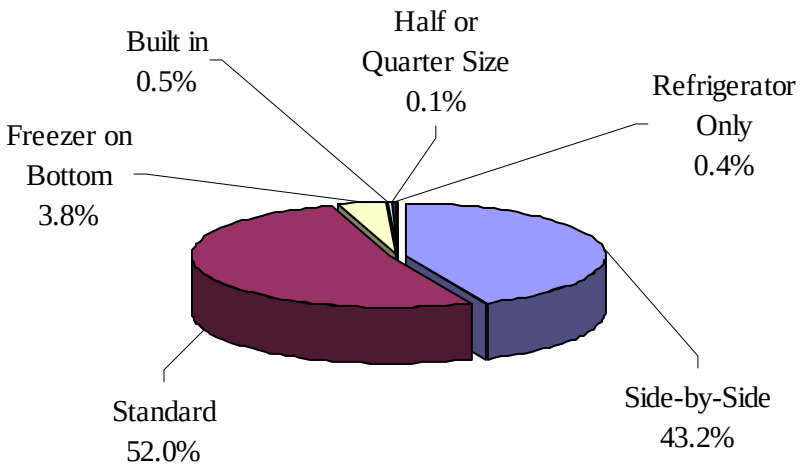


Figure 15: Percentage of Homes with Primary Refrigerator/Freezer by Type

Side-by-side type refrigerators account for over 43% of the primary refrigerators. Compared to the previous study, standard type units have lost market share, while side-by-side units have gained market share. The results reveal a near 10% increase for side-by-side units, and an 8% reduction for standard refrigerators.

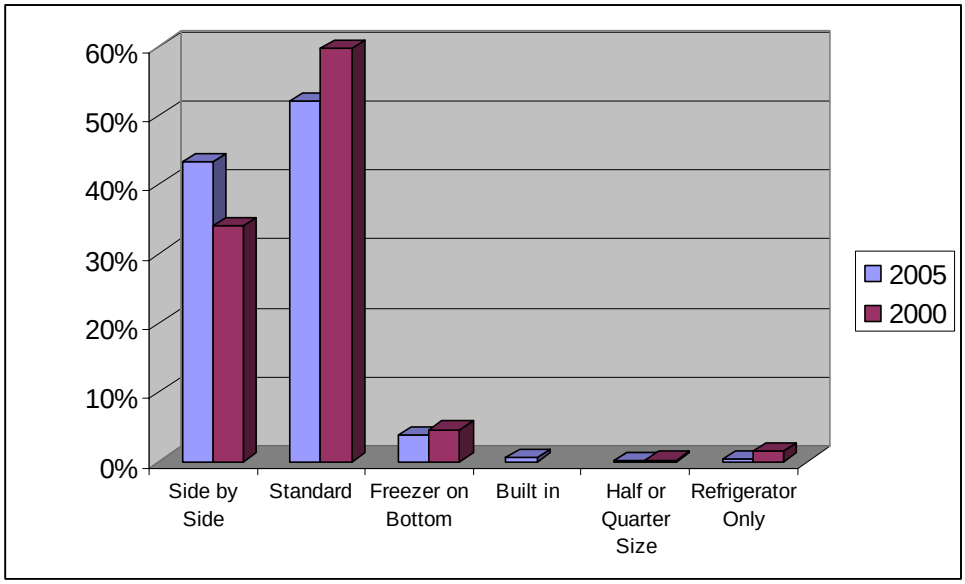


Figure 16: Market Share Comparison of Primary Refrigerator Type 2000 to 2005

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)
- **TI =** Top Mounted Freezer with Ice Dispenser (All Automatic)

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 528. 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 21.0 cubic feet.

Refrigerator Type	Manufacturer Reported Size	Error Bound	Sample Size
All Types	21.0	0.3	528
BF	21.1	0.8	20
SI	24.5	0.2	203
SS	22.9	0.8	27
TF	18.2	0.3	272
TI	19.0	1.5	6

Table 82: 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 37.6%, is within the size range between 19.00 to 21.99 cubic feet. Top mounted refrigerators without ice makers are the only type of refrigerators surveyed that have sizes less than 15.00 cubic.

Size Range (CuFt)	Refrigerator Type											
	All Types (n=835)		BF (n=33)		SI (n=311)		SS (n=56)		TF (n=419)		TI (n=16)	
	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound
11.00 to 14.99	7.2%	1.5%	-	-	-	-	-	-	14.4%	2.8%	-	-
15.00 to 18.99	27.7%	2.6%	9.4%	8.5%	4.6%	2.0%	7.5%	5.9%	49.0%	4.1%	24.6%	17.6%
19.00 to 21.99	37.6%	2.8%	69.3%	13.3%	36.6%	4.5%	55.5%	11.1%	33.0%	3.8%	50.2%	20.6%
> 22.00	27.4%	2.6%	21.3%	11.8%	58.8%	4.6%	37.0%	10.8%	3.6%	1.5%	25.1%	17.9%

Table 83: 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 manufacturers was available for the following estimated age analysis.

The bias in this data results from a customer or surveyor reported age, which will inherently have some amount of incorrect information. However, it is our judgment that the latter of the two, the estimated ages, will be more accurate because there is much less bias towards newer refrigerators and the total number of respondents is higher (532 vs. 743). However, in order to give the reader an idea of the ages of the matched refrigerators that are used in the UEC, ENERGY STAR, and Standards Comparison analyses, the average manufacturer reported ages are also presented in this section.

Table 84 summarizes the data that resulted from the matches of the refrigerator/freezer model numbers collected from on-sites with manufacturer data to obtain an approximate manufacture date. The ages of 532 primary refrigerator/freezers were obtained in this manner. Based on this sample, the overall average age of these refrigerators is 6.6

years with an error bound of 0.3 years. The average life expectancy for refrigerators is 14 years. The previous CLASS study reported the average age of primary refrigerator/freezer age was 8.5 years with an error bound of 0.4 years. The manufacture dates range for 2000 through 2005 accounts for more than half of all primary refrigerators. It is interesting to note that the overall saturation of primary refrigerators in each age range steadily decreases as the age range decreases. The previous CLASS study reported 34.8% of primary refrigerators were in the 1975-1989 age range, whereas this study is reporting that 4.9% of primary refrigerators are in the 1975-1989 age range. This is a strong indication that older refrigerators have been removed from the market since the previous CLASS study was conducted.

				Manufactured Date Ranges						
Ref Type	**Size Range (CuFt)**	**Avg Mfg Age**	**Ave Mfg Age EB**	**2000 - 2005**	**1995 - 1999**	**1990 - 1994**	**1985 - 1989**	**1980 - 1984**	**1979 and Older**	**Sample Size**
All Types	Overall	6.6	0.3	50.6%	33.6%	11.9%	3.3%	1.2%	0.4%	532
	11.00-14.99	8.5	1.3	31.5%	42.1%	15.8%	7.9%	2.6%	0.0%	39
	15.00-18.99	7.1	0.6	44.7%	35.6%	14.6%	3.8%	0.6%	0.6%	160
	19.00-21.99	6.8	0.6	49.0%	33.2%	13.4%	2.7%	1.6%	0.5%	191
	>22.00	5.2	0.5	64.9%	30.0%	5.8%	1.5%	0.7%	0.0%	140
	Unknown	9.1	8.7	52.7%	0.0%	0.0%	47.3%	0.0%	0.0%	2
BF	Overall	4.8	1.6	78.1%	10.7%	5.6%	5.6%	0.0%	0.0%	18
	11.00-14.99	-	-	-	-	-	-	-	-	0
	15.00-18.99	2.0	0.0	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	19.00-21.99	4.4	1.3	77.5%	14.7%	7.7%	0.0%	0.0%	0.0%	13
	>22.00	6.8	5.4	74.5%	0.0%	0.0%	25.5%	0.0%	0.0%	4
	Unknown	-	-	-	-	-	-	-	-	0
SI	Overall	5.5	0.5	61.9%	27.8%	8.8%	0.5%	0.5%	0.5%	198
	11.00-14.99	-	-	-	-	-	-	-	-	0
	15.00-18.99	5.1	1.4	72.8%	18.2%	9.1%	0.0%	0.0%	0.0%	11
	19.00-21.99	6.5	0.9	48.3%	36.1%	14.1%	0.0%	0.0%	1.4%	73
	>22.00	4.9	0.6	69.3%	23.5%	5.4%	0.9%	0.9%	0.0%	114
	Unknown	-	-	-	-	-	-	-	-	0
SS	Overall	7.0	1.4	45.8%	33.3%	20.9%	0.0%	0.0%	0.0%	25
	11.00-14.99	-	-	-	-	-	-	-	-	0
	15.00-18.99	7.5	5.2	50.2%	0.0%	49.8%	0.0%	0.0%	0.0%	2
	19.00-21.99	6.4	2.4	59.9%	20.0%	20.1%	0.0%	0.0%	0.0%	11
	>22.00	7.3	1.7	33.4%	49.9%	16.7%	0.0%	0.0%	0.0%	12
	Unknown	-	-	-	-	-	-	-	-	0
TF	Overall	7.5	0.5	41.0%	37.8%	13.6%	5.4%	1.8%	0.4%	284
	11.00-14.99	8.5	1.3	31.5%	42.1%	15.8%	7.9%	2.6%	0.0%	39
	15.00-18.99	7.3	0.7	41.8%	38.0%	14.4%	4.3%	0.7%	0.7%	142
	19.00-21.99	7.5	0.9	43.7%	34.0%	13.4%	5.6%	3.3%	0.0%	91
	>22.00	6.3	1.5	40.1%	59.9%	0.0%	0.0%	0.0%	0.0%	10
	Unknown	9.1	8.7	52.7%	0.0%	0.0%	47.3%	0.0%	0.0%	2
TI	Overall	6.9	2.7	42.3%	43.3%	14.4%	0.0%	0.0%	0.0%	7
	11.00-14.99	-	-	-	-	-	-	-	-	0
	15.00-18.99	7.8	3.9	49.0%	25.6%	25.4%	0.0%	0.0%	0.0%	4
	19.00-21.99	5.7	3.2	33.5%	66.5%	0.0%	0.0%	0.0%	0.0%	3
	>22.00	-	-	-	-	-	-	-	-	0
	Unknown	-	-	-	-	-	-	-	-	0

Table 84: Average Age and Percentage of Refrigerator Manufacturer Reported Ages within Size Ranges

The sample size of 743 primary refrigerator ages represents all full size primary refrigerator ages obtained in this study. The average manufacturer and surveyor reported age and error bound along with the distribution of manufacturing date range by type and size range are presented in the following table. The average age of the refrigerators is 7.4 years with an error bound of 0.3 years.

Manufactured Date and Estimated Mfr Date Ranges										
Ref Type	**Size Range (CuFt)**	**Average Est Age**	**Average Est Age EB**	**2000 - 2005**	**1995 - 1999**	**1990 - 1994**	**1985 - 1989**	**1980 - 1984**	**1979 and Older**	**Sample Size**
All Types	Overall	7.4	0.3	47.2%	31.5%	13.5%	4.5%	2.1%	1.2%	743
	11.00-14.99	10.4	1.7	29.1%	35.4%	14.6%	12.5%	6.2%	2.1%	50
	15.00-18.99	8.0	0.7	40.8%	36.6%	14.1%	4.0%	2.5%	2.0%	203
	19.00-21.99	7.4	0.5	46.5%	31.1%	15.3%	4.8%	1.5%	0.8%	276
	>22.00	6.0	0.5	58.7%	26.8%	10.6%	1.9%	1.5%	0.5%	210
	Unknown	16.2	7.5	25.7%	0.0%	0.0%	48.6%	0.0%	25.7%	4
BF	Overall	6.7	2.0	67.9%	15.9%	3.2%	6.5%	3.3%	3.2%	32
	15.00-18.99	12.3	11.9	66.7%	0.0%	0.0%	0.0%	0.0%	33.3%	3
	19.00-21.99	5.4	1.3	68.8%	22.2%	4.5%	4.5%	0.0%	0.0%	23
	>22.00	8.6	5.7	65.5%	0.0%	0.0%	17.2%	17.3%	0.0%	6
SI	Overall	5.9	0.4	58.0%	29.6%	9.8%	1.4%	0.7%	0.4%	282
	15.00-18.99	5.5	1.4	64.3%	28.6%	7.1%	0.0%	0.0%	0.0%	14
	19.00-21.99	6.6	0.8	50.0%	34.8%	13.2%	1.0%	0.0%	1.0%	102
	>22.00	5.6	0.5	62.4%	26.6%	8.0%	1.9%	1.2%	0.0%	166
SS	Overall	10.1	1.6	33.4%	20.9%	31.2%	8.3%	0.0%	6.3%	50
	15.00-18.99	11.7	6.6	33.4%	0.0%	33.1%	33.5%	0.0%	0.0%	4
	19.00-21.99	9.4	2.3	41.6%	16.7%	25.1%	12.4%	0.0%	4.2%	25
	>22.00	9.8	2.1	25.1%	30.1%	39.8%	0.0%	0.0%	5.0%	20
	Unknown	26.0	0.0	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	1
TF	Overall	8.3	0.5	38.4%	36.1%	15.2%	6.2%	3.1%	1.1%	363
	11.00-14.99	10.4	1.7	29.1%	35.4%	14.6%	12.5%	6.2%	2.1%	50
	15.00-18.99	8.1	0.7	38.4%	38.8%	14.3%	4.0%	2.8%	1.7%	178
	19.00-21.99	8.1	0.8	40.5%	32.0%	18.0%	6.9%	2.6%	0.0%	119
	>22.00	6.1	1.6	50.1%	42.8%	7.1%	0.0%	0.0%	0.0%	14
	Unknown	9.1	8.7	52.7%	0.0%	0.0%	47.3%	0.0%	0.0%	2
TI	Overall	7.3	2.6	56.1%	25.1%	6.3%	6.2%	6.2%	0.0%	16
	15.00-18.99	7.8	3.9	49.0%	25.6%	25.4%	0.0%	0.0%	0.0%	4
	19.00-21.99	7.4	4.0	43.0%	42.8%	0.0%	0.0%	14.2%	0.0%	7
	>22.00	3.5	1.4	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4
	Unknown	20.0	0.0	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	1

Table 85: Average Age and Percentage of Refrigerator Manufacturer Reported Ages and On Site Estimated Ages within Size Ranges

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 522 nameplate UECs were obtained for the analysis below. Table 86 shows the average nameplate UEC by type of refrigerator and size range.

The average overall nameplate UEC for all types of refrigerators is 720.7 with an error bound of 27.8. This is a significant improvement over the findings of the 2000 CLASS report, in which it was found that the average nameplate UEC was 913.3 with an error bound of 19.8. The most efficient units on average are refrigerators with bottom mounted freezers, which have the lowest nameplate UEC at 562.2, followed by top

mounted refrigerators without an ice dispenser that have an average nameplate UEC of 591.5. 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	Error Bound	Sample Size
All Types	Overall	720.7	27.8	522
	11.00-14.99	622.3	72.0	36
	15.00-18.99	650.1	48.3	149
	19.00-21.99	728.2	45.6	194
	>22.00	813.0	57.7	142
	Unknown	514.0	0.0	1
BF	Overall	562.2	44.7	20
	15.00-18.99	499.0	0.0	1
	19.00-21.99	536.1	17.0	16
	>22.00	668.1	128.1	3
SI	Overall	824.2	49.7	197
	15.00-18.99	791.2	75.7	10
	19.00-21.99	835.1	80.9	70
	>22.00	821.0	67.9	117
SS	Overall	806.5	77.3	27
	15.00-18.99	659.0	0.0	1
	19.00-21.99	702.6	63.1	14
	>22.00	921.3	105.3	12
TF	Overall	655.9	37.1	272
	11.00-14.99	622.3	72.0	36
	15.00-18.99	642.0	53.8	133
	19.00-21.99	692.7	69.3	92
	>22.00	630.7	74.3	10
	Unknown	514.0	0.0	1
TI	Overall	591.5	110.6	6
	15.00-18.99	601.7	129.3	4
	19.00-21.99	569.9	204.6	2

Table 86: Average Nameplate UEC by Type of Refrigerator

The bin distribution of unit energy consumption of all successfully matched full size primary refrigerators is shown below in Table 87 grouped by size and type. The nameplate UEC range that makes up the largest percentage of all refrigerators is the range between 550 to 749.9 kWh/year, which covers 47.3% of all types of refrigerators.

Unit Energy Consumption Ranges (kWh/Year)										
Ref Type	**Size Range (CuFt)**	**350 to 549.9**	**550 to 749.9**	**750 to 949.9**	**950 to 1149.9**	**1150 to 1349.9**	**1350 to 1549.9**	**1550 to 1749.9**	**1750 to 1949.9**	**1950 to 2150**
All Types	Overall	23.3%	47.3%	14.3%	8.0%	3.9%	1.5%	0.5%	0.8%	0.5%
	11.00-14.99	34.0%	48.7%	11.1%	6.3%	-	-	-	-	-
	15.00-18.99	37.4%	46.8%	6.4%	3.3%	4.4%	-	1.7%	-	-
	19.00-21.99	24.2%	45.4%	17.3%	4.9%	4.2%	2.8%	-	-	1.3%
	>22.00	3.8%	50.3%	19.6%	17.6%	4.1%	1.7%	-	3.0%	-
BF	Overall	60.2%	28.7%	11.1%	-	-	-	-	-	-
	15.00-18.99	100.0%	-	-	-	-	-	-	-	-
	19.00-21.99	61.1%	38.9%	-	-	-	-	-	-	-
	>22.00	47.4%	-	52.6%	-	-	-	-	-	-
SI	Overall	0.6%	54.1%	20.4%	16.5%	3.2%	1.8%	-	2.2%	1.3%
	15.00-18.99	-	52.6%	21.3%	26.1%	-	-	-	-	-
	19.00-21.99	1.6%	47.8%	31.9%	8.9%	4.2%	1.7%	-	-	3.9%
	>22.00	-	8.4%	57.1%	14.7%	19.8%	-	-	-	-
SS	Overall	8.1%	31.4%	39.7%	11.2%	9.6%	-	-	-	-
	15.00-18.99	-	100.0%	-	-	-	-	-	-	-
	19.00-21.99	16.9%	48.8%	25.5%	8.7%	-	-	-	-	-
	>22.00	-	8.4%	57.1%	14.7%	19.8%	-	-	-	-
TF	Overall	37.0%	46.1%	7.7%	2.6%	4.3%	1.5%	0.9%	-	-
	11.00-14.99	34.0%	48.7%	11.1%	6.3%	-	-	-	-	-
	15.00-18.99	39.6%	46.8%	5.0%	1.8%	4.9%	-	1.9%	-	-
	19.00-21.99	34.0%	45.2%	8.4%	2.5%	5.5%	4.4%	-	-	-
	>22.00	35.4%	38.3%	26.3%	-	-	-	-	-	-
TI	Overall	53.8%	18.9%	27.4%	-	-	-	-	-	-
	15.00-18.99	52.0%	27.8%	20.2%	-	-	-	-	-	-
	19.00-21.99	57.5%	-	42.5%	-	-	-	-	-	-

Table 87: 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 88 shows the average percentage above or below the 2001 standard that refrigerators are broken down by type and size. The average percentage below

standards for all types of refrigerators is 19.5%. We find that refrigerators with top mounted freezers and ice makers, and those with bottom mounted freezers perform best in comparison to the standards among all refrigerators by averaging 3.2% and 2.3% above standards respectively. However, no conclusions will be drawn since their sample sizes were very small.

Ref Type	Size Range (CuFt)	Average UEC Relative to 2001 Std	Error Bound	Sample Size
All Types	Overall	-19.5%	3.8%	438
	11.00-14.99	-42.4%	16.3%	32
	15.00-18.99	-19.9%	3.6%	119
	19.00-21.99	-22.1%	7.8%	164
	>22.00	-12.2%	5.4%	122
	Unknown	1.1%	0.0%	1
BF	Overall	2.3%	7.6%	20
	15.00-18.99	10.3%	0.0%	1
	19.00-21.99	6.5%	2.7%	16
	>22.00	-14.0%	23.4%	3
SI	Overall	-14.0%	6.1%	165
	15.00-18.99	-9.6%	11.5%	7
	19.00-21.99	-24.5%	14.5%	57
	>22.00	-8.6%	5.5%	101
SS	Overall	-23.9%	12.7%	25
	15.00-18.99	0.4%	0.0%	1
	19.00-21.99	-8.9%	10.2%	14
	>22.00	-43.9%	17.6%	10
TF	Overall	-27.9%	5.3%	223
	11.00-14.99	-42.4%	16.3%	32
	15.00-18.99	-22.5%	3.7%	107
	19.00-21.99	-30.4%	11.4%	75
	>22.00	-17.1%	14.9%	8
	Unknown	1.1%	0.0%	1
TI	Overall	3.2%	19.3%	5
	15.00-18.99	3.3%	23.5%	3
	19.00-21.99	3.2%	33.0%	2

Table 88: 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 89.

As can be seen in the table about 41.3% of all refrigerators are better than 2001 energy standards for annual energy consumption. Nearly half of refrigerators (49.6%) have a nameplate UEC of 0.01% to 49.9% worse than 2001 Federal appliance standards for annual energy consumption.

Percentage Comparison to 2001 Federal Appliance Standards												
Ref Type	Size Range (CuFt)	Better		Worse								Sample Size
		35% to 10%	0% to 9%	- 0.01% to -24.9%	- 25% to -49.9%	- 50% to -74.9%	- 75% to -99.9%	- 100% to -124.9%	- 125% to -149.9%	- 150% to -174.9%	- 175% to -199.9%	
All Types	Overall	22.9%	18.4%	18.4%	31.2%	2.7%	2.7%	2.1%	1.0%	-	0.6%	438
	11.00-14.99	4.8%	11.8%	11.9%	48.9%	3.3%	7.0%	12.4%	-	-	-	32
	15.00-18.99	11.0%	24.7%	21.3%	39.9%	0.7%	2.5%	-	-	-	-	119
	19.00-21.99	22.9%	17.3%	21.2%	26.4%	4.6%	2.5%	0.7%	2.7%	-	1.6%	164
	>22.00	39.4%	14.9%	14.2%	24.4%	2.0%	2.1%	2.9%	-	-	-	122
	Unknown	-	100.0%	-	-	-	-	-	-	-	-	1
BF	Overall	55.2%	16.5%	17.2%	11.1%	-	-	-	-	-	-	20
	15.00-18.99	100.0%	-	-	-	-	-	-	-	-	-	1
	19.00-21.99	54.3%	22.3%	23.4%	-	-	-	-	-	-	-	16
	>22.00	47.4%	-	-	52.6%	-	-	-	-	-	-	3
SI	Overall	37.0%	15.3%	18.0%	22.3%	1.7%	1.8%	2.2%	-	-	1.6%	165
	15.00-18.99	30.7%	-	46.4%	22.9%	-	-	-	-	-	-	7
	19.00-21.99	24.9%	13.6%	24.0%	25.4%	2.1%	5.2%	-	-	-	4.8%	57
	>22.00	44.1%	17.3%	12.7%	20.6%	1.7%	-	3.6%	-	-	-	101
SS	Overall	8.8%	24.2%	31.1%	17.7%	7.8%	10.4%	-	-	-	-	25
	15.00-18.99	-	100.0%	-	-	-	-	-	-	-	-	1
	19.00-21.99	16.9%	38.2%	29.8%	6.3%	8.7%	-	-	-	-	-	14
	>22.00	-	-	35.7%	32.9%	7.5%	23.9%	-	-	-	-	10
TF	Overall	10.0%	20.6%	17.8%	41.0%	3.2%	2.9%	2.5%	2.0%	-	-	223
	11.00-14.99	4.8%	11.8%	11.9%	48.9%	3.3%	7.0%	12.4%	-	-	-	32
	15.00-18.99	7.0%	26.6%	20.6%	42.3%	0.8%	2.8%	-	-	-	-	107
	19.00-21.99	14.7%	15.8%	17.8%	36.0%	6.9%	1.5%	1.5%	5.8%	-	-	75
	>22.00	29.8%	14.9%	11.0%	44.3%	-	-	-	-	-	-	8
	Unknown	-	100.0%	-	-	-	-	-	-	-	-	1
TI	Overall	66.3%	-	-	33.7%	-	-	-	-	-	-	5
	15.00-18.99	72.0%	-	-	28.0%	-	-	-	-	-	-	3
	19.00-21.99	57.5%	-	-	42.5%	-	-	-	-	-	-	2

Table 89: 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 2004 Federal Appliance Standards for annual energy consumption. The following analysis is based on a sample of 438 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 90, the percentage of all refrigerators that meet 2001 ENERGY STAR qualifications is 22.9 % with a 3.5% error bound. The percentage of all refrigerators that meet 2004 ENERGY STAR qualifications is 6.9 % with a 2.1% error bound.

Ref Type	Size Range (CuFt)	2004 Energy Star		2001 Energy Star		Sample Size
		Percentage	Error Bound	Percentage	Error Bound	
All Types	Overall	6.9%	2.1%	22.9%	3.5%	438
	11.00-14.99	1.7%	2.8%	4.8%	5.8%	32
	15.00-18.99	2.4%	2.3%	11.0%	5.0%	119
	19.00-21.99	8.2%	3.8%	22.9%	5.8%	164
	>22.00	10.9%	4.9%	39.4%	7.6%	122
	Unknown	-	-	-	-	1
BF	Overall	15.0%	13.3%	55.2%	19.5%	20
	15.00-18.99	-	-	100.0%	-	1
	19.00-21.99	20.4%	17.2%	54.3%	20.8%	16
	>22.00	-	-	47.4%	50.2%	3
SI	Overall	10.3%	4.1%	37.0%	6.5%	165
	15.00-18.99	-	-	30.7%	29.3%	7
	19.00-21.99	8.1%	6.4%	24.9%	10.0%	57
	>22.00	12.3%	5.7%	44.1%	8.4%	101
SS	Overall	8.8%	9.8%	8.8%	9.8%	25
	15.00-18.99	-	-	-	-	1
	19.00-21.99	16.9%	17.8%	16.9%	17.8%	14
	>22.00	-	-	-	-	10
TF	Overall	2.0%	1.5%	10.0%	3.5%	223
	11.00-14.99	1.7%	2.8%	4.8%	5.8%	32
	15.00-18.99	0.6%	0.9%	7.0%	4.3%	107
	19.00-21.99	2.9%	3.4%	14.7%	7.2%	75
	>22.00	15.0%	22.4%	29.8%	28.2%	8
	Unknown	-	-	-	-	1
TI	Overall	66.3%	33.6%	66.3%	33.6%	5
	15.00-18.99	72.0%	40.6%	72.0%	40.6%	3
	19.00-21.99	57.5%	56.8%	57.5%	56.8%	2

Table 90: Percentage of ENERGY STAR Qualified Primary Refrigerators by Type and Size Range

Secondary Refrigerators

Of the 18.9% of homes with second refrigerator/freezers, the majority (58.7%) have top mount freezers (TF) as their secondary refrigerator type, while 17.7% of homes have side-by-side refrigerators, and 14.6% have half-size or quarter-size models with capacities fewer than 8 cubic feet. A complete breakdown of secondary refrigerator/freezer by type is shown below.

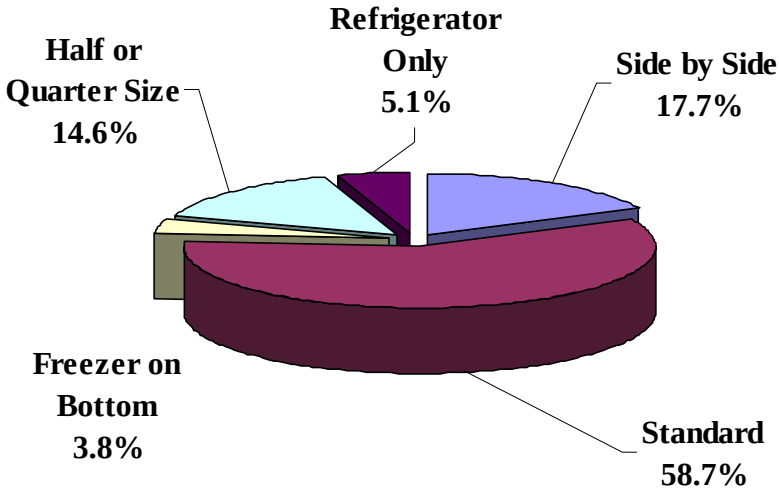


Figure 17: Secondary Refrigerators by Type

Size

The sample size that is used in the following analysis of the secondary refrigerators by size of the unit is 70. Size data for secondary refrigerators was obtained from the manufacturer data and the surveyor estimate.

Table 91 shows the average estimated size of the refrigerators by type. The average of all types of refrigerators is 17.8 cubic feet with an error bound of 1.3 cubic feet. The side-by-side refrigerators with ice dispensers are 24.8 cubic feet on average, the largest of all the types.

Refrigerator Type	Ave Est Size (CuFt)	Error Bound	Sample Size
All Types	17.8	1.3	70
BF	15.8	8.1	3
CO	3.1	0.7	6
SD	4.2	0.2	2
SI	24.8	1.2	10
SS	21.7	1.8	4
TF	18.7	0.6	45

Table 91: Average Estimated Size of Secondary Refrigerators by Type

The following table shows the distribution of the sizes of the refrigerators. The largest percentage of the secondary refrigerators surveyed (33.1%) fall in the size range of 19.00 to 21.99 cubic feet

Size Range (CuFt)	All Types (n=160)		Bottom Freezer (BF) (n=6)		Compact (CO) (n=23)		Single Door (SD) (n=8)		Side by Side with Ice Maker (SI) (n=17)		Side by Side No Ice Maker (SS) (n=12)		Top Freezer No Ice Maker (TF) (n=94)	
	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound	%	Error Bound
< 10.99	20.4%	5.3%	16.7%	25.0%	95.6%	7.0%	74.9%	25.2%	-	-	-	-	3.3%	3.1%
11.00 to 14.99	12.0%	4.3%	-	-	4.4%	7.0%	12.5%	19.2%	6.3%	10.1%	8.4%	13.2%	16.1%	6.3%
15.00 to 18.99	31.4%	6.1%	16.7%	25.0%	-	-	-	-	6.3%	10.1%	16.9%	17.9%	49.0%	8.6%
19.00 to 21.99	33.1%	6.2%	66.7%	31.6%	-	-	12.6%	19.4%	68.3%	19.2%	66.4%	22.5%	30.5%	7.9%
> 22.00	3.2%	2.3%	-	-	-	-	-	-	19.1%	16.3%	8.4%	13.2%	1.1%	1.8%

Table 92: Estimated Size Distribution of Secondary Refrigerators by Type

Age

Similar to the primary refrigerator, this analysis attempts to match the refrigerator/freezer model numbers collected from on-sites with manufacturer data to obtain an approximate manufacture date. The ages of 64 secondary refrigerator/freezers were obtained in this manner. Based on this sample, the overall average age of secondary refrigerators is 9.0 years with an error bound of 1.1 years. This is considerably older than the average age of primary refrigerators, which is 6.6 years. The manufacture date range of 2000 through 2005 has the largest percentage, accounting for 32.3% of all secondary refrigerators.

Manufacturer Reported Age Ranges										
Ref Type	**Size Range (CuFt)**	**Ave Mfg Age**	**Ave Mfg Age EB**	**2000 - 2005**	**1995 - 1999**	**1990 - 1994**	**1985 - 1989**	**1980 - 1984**	**1979 and Older**	**Sample Size**
All Types	Overall	9.0	1.08	32.3%	27.6%	25.9%	14.2%	-	-	64
	<=10.99	6.4	3.56	42.9%	42.8%	-	14.3%	-	-	7
	11.00-14.99	9.7	3.10	33.3%	16.6%	33.3%	16.8%	-	-	6
	15.00-18.99	8.4	1.72	41.6%	25.0%	20.9%	12.5%	-	-	25
	19.00-21.99	10.1	1.49	17.5%	31.0%	39.4%	12.2%	-	-	24
	>22.00	9.5	9.89	50.0%	-	-	50.0%	-	-	2
BF	Overall	5.5	2.91	50.0%	50.0%	-	-	-	-	2
	<=10.99	8.0	-	-	100.0%	-	-	-	-	1
	19.00-21.99	3.0	-	100.0%	-	-	-	-	-	1
CO	Overall	7.2	4.59	40.0%	40.0%	-	20.0%	-	-	5
	<=10.99	7.2	4.59	40.0%	40.0%	-	20.0%	-	-	5
SD	Overall	1.0	-	100.0%	-	-	-	-	-	1
	<=10.99	1.0	-	100.0%	-	-	-	-	-	1
SI	Overall	9.4	2.49	12.6%	49.4%	25.3%	12.6%	-	-	8
	11.00-14.99	10.0	-	-	100.0%	-	-	-	-	1
	19.00-21.99	10.7	2.19	-	49.2%	33.9%	16.9%	-	-	6
	>22.00	1.0	-	100.0%	-	-	-	-	-	1
SS	Overall	10.1	5.37	34.4%	-	34.5%	31.2%	-	-	3
	19.00-21.99	10.1	5.37	34.4%	-	34.5%	31.2%	-	-	3
TF	Overall	9.3	1.26	32.5%	23.6%	30.2%	13.7%	-	-	45
	11.00-14.99	9.6	3.71	40.0%	-	39.9%	20.1%	-	-	5
	15.00-18.99	8.4	1.72	41.6%	25.0%	20.9%	12.5%	-	-	25
	19.00-21.99	10.3	1.89	15.3%	32.0%	45.9%	6.8%	-	-	14
	>22.00	18.0	-	-	-	-	100.0%	-	-	1

Table 93: Average Age and Percentage of Refrigerator Manufacturer Reported Ages within Size Ranges

During the on-site visit residents were asked for the approximate age of their refrigerators. If the resident was unable to provide an age, surveyors estimated the age of the refrigerators whenever possible. These estimated ages were used for refrigerators when no age data from manufacturers was available for the following analysis. The sample size of 127 secondary refrigerator ages represents all full size secondary refrigerator age data obtained in this study. The average age and error bound along with the distribution of manufacturing date range by type and size range are presented in the following table. The average age of the refrigerators is 10.8 years with an error bound of 1.3 years.

Similar to the primary refrigerator age estimates, both of the secondary refrigerator manufactured and estimated ages have some bias. These biases are explained in the primary refrigerator section. It is likely that less bias exists in the estimated age analysis, though we thought it important to report both.

Manufactured Date and Estimated Mfr Date Ranges										
Ref Type	**Size Range (CuFt)**	**Avg Est Age**	**Avg Est Age EB**	**2000 - 2005**	**1995 - 1999**	**1990 - 1994**	**1985 - 1989**	**1980 - 1984**	**1979 and Older**	**Sample Size**
All Types	Overall	10.8	1.35	33.2%	21.9%	26.8%	10.2%	1.6%	6.4%	127
	<=10.99	5.0	1.86	72.7%	13.6%	4.5%	9.1%	-	-	22
	11.00-14.99	13.4	4.05	33.8%	13.5%	20.3%	12.8%	-	19.6%	15
	15.00-18.99	12.3	2.89	31.8%	22.8%	27.2%	6.8%	2.3%	9.1%	45
	19.00-21.99	11.4	1.46	12.9%	31.0%	38.8%	12.1%	2.6%	2.6%	41
	>22.00	11.5	5.26	24.9%	-	50.2%	24.9%	-	-	4
BF	Overall	14.0	11.05	25.0%	50.0%	-	-	-	25.0%	4
	<=10.99	8.0	-	-	100.0%	-	-	-	-	1
	15.00-18.99	37.0	-	-	-	-	-	-	100.0%	1
	19.00-21.99	5.5	2.91	50.0%	50.0%	-	-	-	-	2
CO	Overall	6.1	2.68	64.3%	14.3%	7.1%	14.3%	-	-	14
	<=10.99	6.2	2.88	61.6%	15.4%	7.7%	15.4%	-	-	13
	11.00-14.99	5.0	-	100.0%	-	-	-	-	-	1
SD	Overall	3.5	2.19	83.3%	16.7%	-	-	-	-	6
	<=10.99	2.2	1.18	100.0%	-	-	-	-	-	5
	11.00-14.99	10.0	-	-	100.0%	-	-	-	-	1
SI	Overall	11.1	2.15	14.4%	28.2%	43.7%	13.7%	-	-	15
	11.00-14.99	10.0	-	-	100.0%	-	-	-	-	1
	15.00-18.99	15.0	-	-	-	100.0%	-	-	-	1
	>22.00	9.4	5.70	33.1%	-	66.9%	-	-	-	3
	19.00-21.99	11.4	2.58	11.3%	32.8%	34.3%	21.5%	-	-	10
SS	Overall	10.7	2.64	25.2%	25.4%	38.0%	11.4%	-	-	8
	11.00-14.99	5.0	-	100.0%	-	-	-	-	-	1
	15.00-18.99	12.5	2.91	-	50.0%	50.0%	-	-	-	2
	19.00-21.99	11.1	3.51	20.3%	20.5%	40.8%	18.4%	-	-	5
TF	Overall	12.0	1.85	28.3%	20.7%	29.6%	10.0%	2.6%	8.9%	80
	<=10.99	3.0	1.55	100.0%	-	-	-	-	-	3
	11.00-14.99	15.6	5.09	27.8%	-	27.8%	17.6%	-	26.8%	11
	15.00-18.99	11.6	3.00	35.0%	22.5%	24.9%	7.5%	2.5%	7.5%	41
	19.00-21.99	12.0	2.01	8.7%	30.9%	43.5%	8.2%	4.4%	4.4%	24
	>22.00	18.0	-	-	-	-	100.0%	-	-	1

Table 94: Average Age and Percentage of Secondary Refrigerator Manufacturer Reported Ages and On Site Estimated Ages by Size Range and Type

Energy Consumption

The average annual nameplate unit energy consumption (UEC) data for refrigerator/freezers is obtained from the model number matches to manufacturer data. A sample of 69 nameplate UECs were obtained for the analysis below. The bin distribution and the average of nameplate annual energy consumption based upon the sample of all successfully matched secondary refrigerators is shown below grouped by type and size.

The average overall nameplate UEC is 730.6 kWh/year with an error bound of 115.1 kWh/year. The largest percentage of refrigerators (31.8%) is within the range from 550 to 749.9 kWh/year.

		Unit Energy Consumption Ranges										
Ref Type	**Size Range (CuFt)**	**Average UEC**	**Average UEC EB**	**150 - 349.9**	**350 - 549.9**	**550 - 749.9**	**750 - 949.9**	**950 - 1149.9**	**1150 - 1349.9**	**1350 - 1549.9**	**1550 - 1750**	**Sample Size**
All Types	Overall	730.6	115.1	15.5%	20.1%	31.8%	11.2%	3.9%	11.4%	5.7%	0.4%	69
	<=10.99	324.9	5.9	100.0%	-	-	-	-	-	-	-	9
	11.00-14.99	585.0	71.6	-	25.2%	74.8%	-	-	-	-	-	5
	15.00-18.99	701.0	179.1	-	44.0%	37.3%	2.6%	-	16.1%	-	-	24
	19.00-21.99	871.0	151.2	-	8.5%	36.2%	26.6%	11.2%	-	16.2%	1.2%	28
	>22.00	1133.7	271.1	-	-	18.5%	11.2%	-	70.3%	-	-	3
BF	Overall	479.6	103.8	29.9%	40.2%	29.9%	-	-	-	-	-	3
	<=10.99	311.0	-	100.0%	-	-	-	-	-	-	-	1
	19.00-21.99	551.6	42.1	-	57.3%	42.7%	-	-	-	-	-	2
CO	Overall	324.1	6.4	-	-	-	-	-	-	-	-	6
	<=10.99	324.1	6.4	100.0%	-	-	-	-	-	-	-	6
SD	Overall	333.0	14.0	100.0%	-	-	-	-	-	-	-	2
	<=10.99	333.0	14.0	100.0%	-	-	-	-	-	-	-	2
SI	Overall	1022.0	248.2	-	-	17.2%	31.2%	14.0%	-	37.5%	-	10
	11.00-14.99	658.0	-	-	-	100.0%	-	-	-	-	-	1
	19.00-21.99	1124.2	236.3	-	-	-	32.9%	18.3%	-	48.9%	-	7
	>22.00	696.2	113.3	-	-	62.2%	37.8%	-	-	-	-	2
SS	Overall	823.3	231.7	-	-	73.2%	13.5%	-	-	-	13.3%	4
	19.00-21.99	823.3	231.7	-	-	73.2%	13.5%	-	-	-	13.3%	4
TF	Overall	762.6	128.6	-	29.3%	40.5%	9.4%	2.8%	17.9%	-	-	44
	11.00-14.99	568.1	80.0	-	31.0%	69.0%	-	-	-	-	-	4
	15.00-18.99	701.0	179.1	-	44.0%	37.3%	2.6%	-	16.1%	-	-	24
	19.00-21.99	759.8	98.5	-	8.5%	52.4%	28.9%	10.2%	-	-	-	15
	>22.00	1318.5	-	-	-	-	-	-	100.0%	-	-	1

Table 95: Percentage of Refrigerators by Nameplate UEC Ranges and Type within Size Ranges

Percentage Above/Below 2001 Federal Appliance Standards

Additionally, the above groupings of secondary refrigerators are compared with the 2001 Federal Appliance Standards for nameplate annual energy consumption, calculated the same as described in the primary refrigerator section.

Table 96 shows that on average, the secondary refrigerators are 31.7% less efficient than standard. This is significantly worse than the primary refrigerators that are 19.5% less efficient than standard.

Ref Type	Size Range (CuFt)	Average UEC Relative to 2001 Std	Error Bound	Sample Size
All Types	Overall	-31.7%	16.6%	45
	<=10.99	1.9%	6.2%	5
	11.00-14.99	-17.4%	18.7%	5
	15.00-18.99	-19.5%	10.5%	16
	19.00-21.99	-55.6%	24.3%	17
	>22.00	4.1%	16.0%	2
CO	Overall	6.2%	0.0%	4
	<=10.99	6.2%	0.0%	4
SD	Overall	-12.1%	0.0%	1
	<=10.99	-12.1%	0.0%	1
SI	Overall	-42.3%	36.8%	9
	11.00-14.99	11.1%	0.0%	1
	19.00-21.99	-58.8%	33.9%	6
	>22.00	4.1%	16.0%	2
SS	Overall	-98.7%	87.9%	2
	19.00-21.99	-98.7%	87.9%	2
TF	Overall	-26.3%	8.6%	29
	11.00-14.99	-28.5%	17.2%	4
	15.00-18.99	-19.5%	10.5%	16
	19.00-21.99	-42.6%	15.4%	9

Table 96: Percentage Comparison to 2001 Federal Appliance Standards By Type of Refrigerator

The distribution of the percentages below the 2001 standards for all full size secondary refrigerators that were successfully matched by size range and type is presented in the table below.

More than 31% of all secondary refrigerators met or exceeded the 2001 standard, while the majority (approximately 50%) have a nameplate UEC of 0.01% to 49.9% worse than 2001 Federal Appliance standards for annual energy consumption. This is a significant increase over the 2000 CLASS study, in which it was found that no secondary refrigerators met the 2001 standard, and less than half of them were within the range of 0.01% to 49.9% worse.

Ref Type	Size Range (Cu Ft)	Percent Better then 2001 Standards		Percentage Worse than 2001 Standards								Sample Size
		10 to 35%	0 to 9.9%	-0.01% to 24.9%	-25% to 49.9%	- 50% to 74.9%	- 75% to 99.9%	-100% to 124.9%	-125% to 149.9%	-150% to 174.9%	-175% to 199.9%	
All Types	Overall	7.9%	25.2%	22.7%	27.2%	1.7%	12.6%	1.7%	-	-	0.8%	45
	<=10.00	-	73.4%	26.6%	-	-	-	-	-	-	-	5
	11.00-14.99	18.8%	25.2%	-	56.0%	-	-	-	-	-	-	5
	15.00-18.00	7.7%	38.5%	10.4%	38.8%	-	4.7%	-	-	-	-	16
	19.00-21.99	-	-	39.7%	17.8%	4.9%	30.4%	4.8%	-	-	2.3%	17
	>22.00	62.2%	-	37.8%	-	-	-	-	-	-	-	2
CO	Overall	-	100.0%	-	-	-	-	-	-	-	-	4
	<=10.00	-	100.0%	-	-	-	-	-	-	-	-	4
SD	Overall	-	-	100.0%	-	-	-	-	-	-	-	1
	<=10.00	-	-	100.0%	-	-	-	-	-	-	-	1
SI	Overall	18.4%	-	33.5%	7.9%	-	40.2%	-	-	-	-	9
	11.00-14.99	100.0%	-	-	-	-	-	-	-	-	-	1
	19.00-21.99	-	-	36.0%	10.5%	-	53.5%	-	-	-	-	6
	>22.00	62.2%	-	37.8%	-	-	-	-	-	-	-	2
SS	Overall	-	-	50.2%	-	-	-	-	-	-	49.8%	2
	19.00-21.99	-	-	50.2%	-	-	-	-	-	-	49.8%	2
TF	Overall	4.7%	28.6%	16.4%	41.6%	2.9%	2.9%	2.9%	-	-	-	29
	11.00-14.99	-	31.0%	-	69.0%	-	-	-	-	-	-	4
	15.00-18.00	7.7%	38.5%	10.4%	38.8%	-	4.7%	-	-	-	-	16
	19.00-21.99	-	-	43.9%	30.9%	12.7%	-	12.5%	-	-	-	9

Table 97: Percentage range of Secondary 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 nameplate annual energy unit consumption of a refrigerator must be at least 10% less than 2001 Federal Appliance Standards for nameplate annual energy consumption. To qualify for 2004 ENERGY STAR standards, the nameplate annual energy consumption of a refrigerator must be at least 15% less than 2001 Federal Appliance Standards for nameplate annual energy consumption. The following analysis is based on a sample of 45 secondary refrigerators for which we have obtained nameplate UEC data.

The distribution of secondary refrigerator/freezers that meet ENERGY STAR qualifications grouped by size and type is shown below. As can be seen in the table the percentage of all secondary refrigerators that meet 2001 ENERGY STAR qualifications is 7.9% with a 7.3% error bound. Additionally, the percentage of secondary refrigerators meeting the 2004 ENERGY STAR qualifications is 5.7% with an error bound of 6.5%.

Ref Type	Size Range (CuFt)	2004 Energy Star Qualified		2001 Energy Star Qualified		Sample Size
		Percentage	Error Bound	Percentage	Error Bound	
All Types	Overall	5.7%	6.5%	7.9%	7.3%	45
	<=10.00	-	-	-	-	5
	11.00-14.99	-	-	18.8%	28.2%	5
	15.00-18.00	7.7%	12.0%	7.7%	12.0%	16
	19.00-21.99	-	-	-	-	17
	>22.00	62.2%	54.7%	62.2%	54.7%	2
CO	Overall	-	-	-	-	4
	<=10.00	-	-	-	-	4
SD	Overall	-	-	-	-	1
	<=10.00	-	-	-	-	1
SI	Overall	10.6%	17.4%	18.4%	22.1%	9
	11.00-14.99	-	-	100.0%	-	1
	19.00-21.99	-	-	-	-	6
	>22.00	62.2%	54.7%	62.2%	54.7%	2
SS	Overall	-	-	-	-	2
	19.00-21.99	-	-	-	-	2
TF	Overall	4.7%	7.6%	4.7%	7.6%	29
	11.00-14.99	-	-	-	-	4
	15.00-18.00	7.7%	12.0%	7.7%	12.0%	16
	19.00-21.99	-	-	-	-	9

Table 98: Percentage of 2001 and 2004 ENERGY STAR Qualified Secondary Refrigerators by Type and Size Range

Self-standing Freezers

The following section describes the self-standing freezers. Over 18% of all homes have one self-standing freezer and approximately 0.5% of all homes have a second self-standing freezer. Since the number of homes with more that one freezer is statistically insignificant, the following summary will be based strictly upon primary freezers.

This section summarizes the freezers by type, size, age, and usage. The type of the freezers was obtained from the site visit. The size of the freezers was first obtained from the efficiency databases (CEC and AHAM) if the model number successfully matched a model in the database. For the models that were not matched, the information on the size collected on site by the surveyor was used. 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 age analysis. The usage data were obtained exclusively from the efficiency databases. Due to the fact that some ages and sizes were not obtained during the on site visit, the number of sites in each of the following analyses will differ.

The following figure shows the percentage breakdown of primary freezers by freezer type. The majority of the primary freezers found were the upright type, totaling over 65.3% of all the primary freezers. Chest type freezers accounted for the remaining 34.7% of the primary freezers.

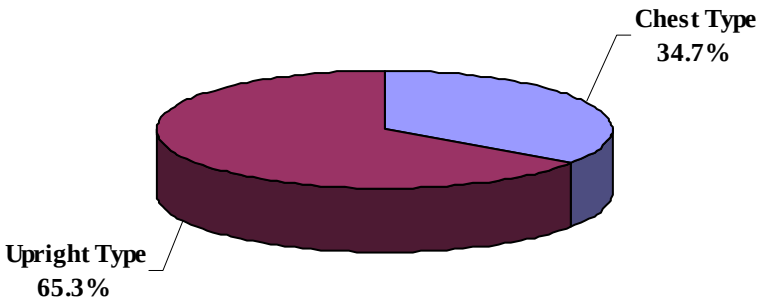


Figure 18: Percentage of Freezer Types among All Primary Freezers

Size

Table 99 shows the average size of the chest and upright freezers. The average size of both types of freezers combined is also shown. The error bound and sample sizes for the freezers used in this analysis are also presented in the following table. The average size of chest units is found to be approximately 8.2 cubic feet smaller than the average size of the upright units. The number of chest units in the sample is less than half that of upright units.

	Average Size (CuFt)	Error Bound	Sample Size
All	13.0	1.3	51
Chest	7.2	1.2	15
Upright	15.4	1.2	36

Table 99: Average Size of Primary Freezers by Type

Table 100 shows the distribution of the size of the primary freezers by type of freezer. The largest percentage of chest freezers is in the size range under 11.00 cubic feet, totaling 47% of the chest freezers. The largest percentage of upright freezers is in the size range between 19 and 21.9 cubic feet, containing over one-third of all the upright freezers.

Size Range (CuFt)	All Stand Alone Freezers (n=160)		Chest (n=54)		Upright (n=106)	
	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound
< 11.00	19.8%	5.3%	47.0%	11.5%	6.0%	3.9%
11.00-14.00	28.9%	6.0%	29.3%	10.5%	28.8%	7.4%
15.00-18.00	21.1%	5.4%	17.8%	8.7%	22.7%	6.8%
19.00-21.99	25.7%	5.8%	2.0%	3.2%	37.7%	7.9%
> 22.00	4.5%	2.8%	3.9%	4.5%	4.9%	3.5%

Table 100: Distribution of Size of Primary Freezers and Type

Annual Energy Consumption

Table 101 shows the distribution of the freezer nameplate UECs by type. The majority of self standing freezers of both types use less than 625 kWh per year. The sample sizes for the analyses by nameplate UEC are smaller than those for the size analyses due to the fact that we were only able to match a small percentage of the units with the efficiency databases that contained the nameplate UEC.

	Chest and Upright (n=51)		Chest (n=15)		Upright (n=36)	
Annual Usage Range (kWh/Yr)	**Percentage**	**Error Bound**	**Percentage**	**Error Bound**	**Percentage**	**Error Bound**
225 to 424.9	27.0%	10.2%	74.4%	27.2%	11.3%	8.2%
425 to 624.9	33.0%	12.4%	25.6%	27.2%	35.4%	14.1%
625 to 824.99	18.3%	9.9%	-	-	24.4%	12.7%
825 to 1024.99	10.0%	9.4%	-	-	13.3%	12.3%
1025 to 1225	11.7%	8.9%	-	-	15.5%	11.6%

Table 101: Distribution of Nameplate Annual Usage of Primary Freezers by Type

Table 102 shows the nameplate average annual usage of the primary freezers by type. The average annual usage of upright freezers is significantly higher than that of chest freezers. This result is not a surprise due to the fact that upright freezers were found to be larger and older than chest freezers on average.

Federal efficiency standards for residential freezers were increased in 2001. The standard is a maximum UEC equation as a function of capacity and type. Since the minimum standard UEC is a function of capacity, the 2001 standards presented for comparison are based upon the capacities of the sample. The average nameplate UECs for both chest and upright freezers are above the federal maximum, and therefore on average are *less* efficient than current standards.

Freezer Type	Sample Size	Manufacturer Data		2001 Standard	
		UEC (kWh/yr)	**Error Bound**	**UEC (kWh/yr)**	**Error Bound**
Chest and Upright	51	626.5	71.8	468.4	38.5
Chest	15	325.3	65.9	250.7	31.9
Upright	36	726.4	74.1	540.6	33.2

Table 102: Nameplate Average Annual Usage of Primary Freezers by Type

Table 103 compares the nameplate UEC from the efficiency databases to the calculated current federal maximum UEC for each model. The 8.7% of freezers that are over 100% worse than the 2001 standard consume more than twice the electricity than the maximum allowed for a freezer manufactured today, and only 15.8% of freezers meet the 2001 minimum standards. Interestingly, in the 2000 CLASS study it was found that no freezers would meet the 2001 standards, so the 15.8% shows a significant increase in efficiency.

Comparison to 2001 Standards	(n=51)	
	Percentage	Error Bound
0.0% to 9.9% Better	15.8%	7.6%
10.0 to 24.9% Worse	46.3%	12.7%
25.0 to 49.9% Worse	9.9%	8.8%
50.0 to 74.9% Worse	15.0%	11.7%
75.0 to 99.9% Worse	2.9%	4.7%
100.0 to 124.9% Worse	-	-
125.0 to 149.9% Worse	8.7%	7.9%

Table 103: Comparison of Primary Freezers to Federal Standards

Age

Table 104 shows the average age of the primary freezers by type. The average age of chest type freezers is on average lower than that of upright freezers.

Freezer Type	Estimated and Manufacturer Reported Average Age	Error Bound	Sample Size
All	11.7	1.6	127
Chest	9.4	2.7	43
Upright	12.8	2.0	84

Table 104: Average Manufacture Date of Primary Freezers by Type

Table 105 shows the distribution of the age of the primary freezers within 5 year age ranges. The largest percentage of all the primary freezers was in the manufacture range from 2000 to 2005.

Estimated and Manufacturer Reported Age	All (n=127)		Chest (n=43)		Upright (n=84)	
	%	Error Bound	%	Error Bound	%	Error Bound
2000-2005	39.1%	7.3%	52.2%	12.9%	32.4%	8.6%
1995-1999	18.1%	5.7%	15.4%	9.3%	19.5%	7.2%
1990-1994	17.2%	5.6%	15.0%	9.3%	18.3%	7.1%
1985-1989	9.2%	4.3%	10.0%	7.8%	8.8%	5.2%
1980-1984	4.9%	3.2%	2.5%	4.0%	6.1%	4.4%
1979 and Older	11.6%	4.8%	5.0%	5.6%	14.9%	6.5%

Table 105: Distribution of Manufacture Date of Primary Freezers by Type

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 19, the heavy majority of water heaters currently in homes are storage type water heaters, but there has been an increase in the number of instantaneous water heaters over the past five years. In the 2000 CLASS report, only one instantaneous water heater was found, whereas in this current study approximately 1.4% of homes had instantaneous water heating.

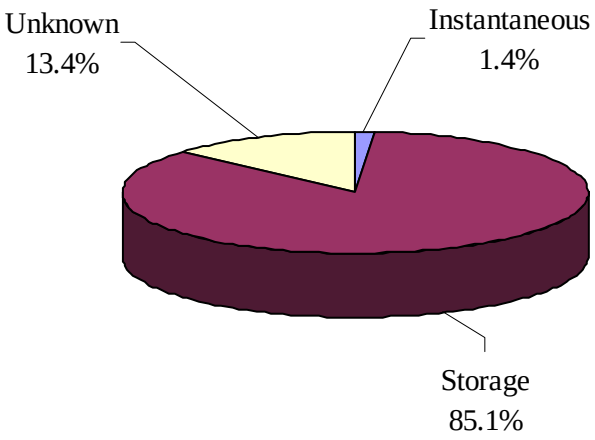


Figure 19: Water Heaters by Type

Fuel Type

Figure 20 shows the breakdown of water heaters by fuel type. The large majority of water heaters are gas, either natural gas or propane, totaling over 80% of all water heaters found. About 5% of the water heaters are electric, while fuel type is not known for 14%. Previous CLASS results from 2000 found about 90% of water heaters were gas and about 10% of water heaters were electric.

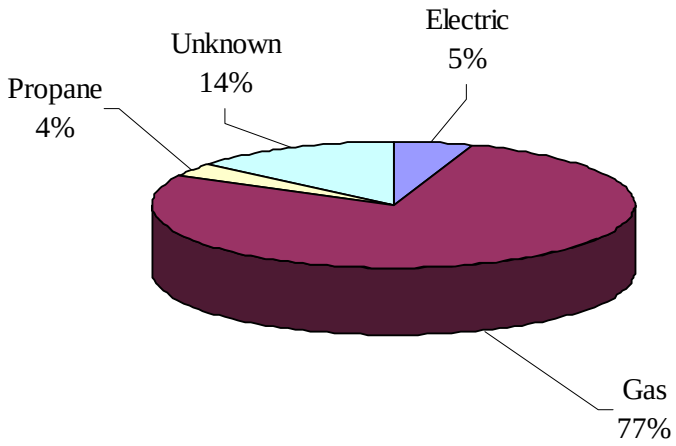


Figure 20: Water Heaters by Fuel Type

Table 106 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)	Error Bound	Sample Size
All Types	42.5	0.7	650
Electric	45.8	5.9	40
Gas	42.3	0.7	577
Propane	41.3	3.1	25
Solar/Electric	55.0	0.0	1
Solar/Gas	45.0	5.8	2
Unknown	54.0	17.2	5

Table 106: Average Size of Water Heaters by Fuel Type

Table 107 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 slightly for electric and gas units. A heavy majority of gas units are in the 40 to 49 gallon range, whereas with the electric units there is a wide distribution of capacities from 30 to 59 gallons. However, the majority of all the water heaters combined by fuel type are still in the size range from 40 to 49 gallons.

	Fuel Type													
	Overall (n=650)		Electric (n=40)		Gas (n=577)		Propane (n=25)		Solar/Electric (n=1)		Solar/Gas (n=2)		Unknown (n=5)	
Size (Gallons)	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
Less Than 30	1.7%	0.7%	5.4%	6.1%	1.6%	0.7%	-	-	-	-	-	-	-	-
30 to 39	14.1%	2.3%	22.3%	11.1%	13.5%	2.4%	20.3%	13.3%	-	-	-	-	-	-
40 to 49	52.9%	3.2%	29.9%	12.4%	54.3%	3.4%	56.4%	16.3%	-	-	50.1%	58.2%	59.9%	36.1%
50 to 59	27.8%	2.9%	31.9%	12.5%	27.8%	3.1%	19.3%	12.8%	100.0%	-	49.9%	58.2%	20.0%	29.4%
60 to 69	0.5%	0.4%	2.4%	4.0%	0.4%	0.4%	-	-	-	-	-	-	-	-
70 to 79	1.9%	0.9%	-	-	1.9%	0.9%	4.1%	6.5%	-	-	-	-	-	-
80 to 89	0.6%	0.5%	5.4%	6.1%	0.3%	0.4%	-	-	-	-	-	-	-	-
Greater Than 89	0.6%	0.5%	2.7%	4.4%	0.3%	0.4%	-	-	-	-	-	-	20.0%	29.5%

Table 107: Percentage of Water Heaters by Size Range and Fuel Type

Table 108 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 40 to 49 gallon size range accounts for 29.9% of all electric water heaters and Table 108 shows that the same size electric heaters constitute only 1.3% of the entire population. This emphasizes the market dominance of the 40-gallon gas fired water heater that accounts for 37.5% of all water heaters.

(n=848)	Fuel Type											
	Electric		Natural Gas		Propane		Solar/Electric		Solar/Gas		Unknown	
Size (Gallons)	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
Tankless	-	-	0.7%	0.5%	-	-	-	-	-	-	-	-
20 to 29	0.2%	0.3%	0.4%	0.3%	-	-	-	-	-	-	-	-
30 to 39	1.0%	0.6%	9.3%	1.7%	0.6%	0.4%	-	-	-	-	-	-
40 to 49	1.3%	0.7%	37.5%	2.8%	1.7%	0.7%	-	-	0.1%	0.2%	0.4%	0.3%
50 to 59	1.4%	0.7%	19.2%	2.2%	0.6%	0.4%	0.1%	0.2%	0.1%	0.2%	0.1%	0.2%
60 to 69	0.1%	0.2%	0.2%	0.3%	-	-	-	-	-	-	-	-
70 to 79	0.0%	0.0%	1.3%	0.6%	0.1%	0.2%	-	-	-	-	-	-
80 to 89	0.2%	0.3%	0.2%	0.3%	-	-	-	-	-	-	-	-
>100	0.1%	0.2%	0.2%	0.3%	-	-	-	-	-	-	0.1%	0.2%
Unknown	0.7%	0.5%	7.8%	1.5%	0.7%	0.5%	-	-	-	-	13.2%	1.9%

Table 108: Percentage of Water Heaters within each Size Range Among all Water Heaters

Age

Table 109 shows the average age of water heaters by fuel type in each of the size ranges. The ages of the water heaters were obtained during the site visit only. No age information was available in the efficiency databases. The average age of all water heaters for which an age obtained is 7.2 years old. The ages of the electric and gas water heaters are not significantly different.

Size (Gallons)	Fuel Type											
	All Types			Electric			Natural Gas			Propane		
	Average Age	Error Bound	Sample Size	Average Age	Error Bound	Sample Size	Average Age	Error Bound	Sample Size	Average Age	Error Bound	Sample Size
All Sizes	7.2	0.5	476	6.5	2.0	21	7.2	0.5	417	7.2	1.6	29
Tankless	2.0	0.9	5	-	-	-	2.0	0.9	5	-	-	-
20 to 29	11.5	7.6	2	-	-	-	11.5	7.6	2	-	-	-
30 to 39	8.7	1.6	55	3.7	2.4	7	9.8	1.9	43	5.6	2.0	5
40 to 49	7.2	0.7	224	5.0	1.2	2	7.1	0.7	207	6.8	2.2	12
50 to 59	6.9	0.9	134	9.0	3.3	10	6.8	0.9	119	6.8	3.1	4
60 to 69	5.0	0.0	1	-	-	-	5.0	0.0	1	-	-	-
70 to 79	6.8	3.1	12	-	-	-	5.6	2.7	11	20.0	0.0	1
80 to 89	9.5	5.2	2	-	-	-	9.5	5.2	2	-	-	-
>100	-	-	-	-	-		-	-	-	7.3	4.1	7
Size Unknown	7.1	1.7	41	5.5	4.1	2	7.6	2.3	27	-	-	-

Table 109: Average Age of Water Heaters by Fuel Type within Size Ranges

Table 110 shows the percentage of water heaters within each fuel type and size range that fall into each of the manufacture date ranges. The first row of data, representing all water heaters, shows the largest percentage was manufactured in the last 6 years, totaling over 52% of all the units.

All size/fuel categories with a substantial sample show a similar distribution of age ranges. The largest percentage of water heaters is found in the most recent age range and the percentage decreases with each successive older age range ending with a few percent in the 1979 and older category.

Fuel Type	Size Range (Gallons)	Estimated Manufacture Date						Sample Size
		2000-2005	1995-1999	1990-1994	1985-1989	1980-1984	1979 and Older	
All Types	All Sizes	52.3%	23.8%	14.2%	6.9%	1.7%	1.1%	476
	Tankless	100.0%	-	-	-	-	-	5
	20 to 29	50.0%	-	-	50.0%	-	-	2
	30 to 39	41.4%	24.6%	24.5%	3.8%	3.8%	1.9%	55
	40 to 49	51.3%	24.4%	14.8%	7.7%	1.4%	0.5%	224
	50 to 59	55.1%	24.2%	10.8%	7.0%	0.7%	2.3%	134
	60 to 69	100.0%	-	-	-	-	-	1
	70 to 79	50.4%	32.7%	-	16.9%	-	-	12
	80 to 89	50.0%	-	50.0%	-	-	-	2
	Size Unknown	56.9%	21.4%	13.6%	2.7%	5.4%	-	41
Electric	All Sizes	52.1%	26.9%	15.6%	5.3%	-	-	21
	30 to 39	65.9%	33.8%	0.3%	-	-	-	7
	40 to 49	50.0%	50.0%	-	-	-	-	2
	50 to 59	43.7%	11.8%	33.2%	11.4%	-	-	10
	Size Unknown	50.2%	49.8%	-	-	-	-	2
Natural Gas	All Sizes	52.2%	23.6%	14.7%	6.4%	1.9%	1.2%	417
	Tankless	100.0%	-	-	-	-	-	5
	20 to 29	50.0%	-	-	50.0%	-	-	2
	30 to 39	35.7%	21.5%	30.8%	4.8%	4.8%	2.4%	43
	40 to 49	51.7%	24.5%	15.1%	6.8%	1.5%	0.5%	207
	50 to 59	55.8%	25.3%	8.7%	6.9%	0.8%	2.5%	119
	60 to 69	100.0%	-	-	-	-	-	1
	70 to 79	55.0%	35.7%	-	9.2%	-	-	11
	80 to 89	50.0%	-	50.0%	-	-	-	2
	Size Unknown	54.4%	16.3%	21.0%	0.0%	8.3%	0.0%	27
Propane	All Sizes	57.0%	21.5%	10.7%	10.8%	-	-	29
	30 to 39	59.9%	40.1%	-	-	-	-	5
	40 to 49	58.3%	16.7%	16.7%	8.3%	-	-	12
	50 to 59	48.7%	25.7%	25.7%	-	-	-	4
	70 to 79	-	-	-	100.0%	-	-	1
	Size Unknown	66.7%	16.6%	0.1%	16.6%	-	-	7

Table 110: Percentage of Water Heaters in Purchase Date Ranges by Fuel Type

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:

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

The average energy factor for the popular 40 gallon gas fired water heater is 0.58, which is slightly below the average of 0.59 from the National Appliance Energy Conservation Act Standards (NAECA), implemented in 2004. The average energy factor for electric models of the two most popular sizes (40 and 50 gallon) is also slightly below standard.

Energy Factor Comparison			
Size	**Fuel Type**	**Energy Factor Standard**	**Average Energy Factor**
40 Gallons	Gas	0.59	0.58
40 Gallons	Propane	0.59	0.59
40 Gallons	Electric	0.92	0.89
50 Gallons	Electric	0.90	0.89

Table 111: Energy Factor Comparison

Table 112 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 gas units is 0.58 while the average energy factor for all electric units is 0.89.

Size (Gallons)	Fuel Type								
	Gas			Electric			Propane		
	Average Energy Factor	**Error Bound**	**Sample Size**	**Average Energy Factor**	**Error Bound**	**Sample Size**	**Average Energy Factor**	**Error Bound**	**Sample Size**
Overall	0.58	0.00	314	0.89	0.01	11	0.59	0.01	10
Tankless	0.76	0.06	5	-	-	-	-	-	-
30 to 39	0.58	0.00	40	0.89	0.00	3	0.58	0.01	3
40 to 49	0.58	0.00	180	0.89	0.01	4	0.60	0.02	6
50 to 59	0.57	0.01	80	0.89	0.02	4	0.60	0.00	1
60 to 69	0.57	0.00	1	-	-	-	-	-	-
70 to 79	0.49	0.01	6	-	-	-	-	-	-
80 to 89	0.53	0.00	1	-	-	-	-	-	-
Size Unknown	0.58	0.00	1	-	-	-	-	-	-

Table 112: Average Energy Factor by Fuel Type in Size Ranges

Table 113 shows the percentage of water heaters within each fuel type and size range that fall into each of the energy factor ranges. Energy factors of gas water heaters seem to be well distributed throughout the range from 0.52 to 0.64, while the majority of electric water heaters fall within the range from 0.88 to 0.92. 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																		
		0.48 to 0.519	Error Bound	0.52 to 0.559	Error Bound	0.56 to 0.599	Error Bound	0.60 to 0.639	Error Bound	0.64 to 0.679	Error Bound	0.68 to 0.719	Error Bound	0.84 to 0.879	Error Bound	0.88 to 0.919	Error Bound	0.92 to 0.959	Error Bound	Sample Size
Electric	All Sizes	-	-	-	-	-	-	-	-	-	-	-	-	25.3%	24.9%	62.1%	26.9%	12.6%	19.1%	11
	30 to 39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0%	-	-	-	3
	40 to 49	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100.0%	-	-	-	4
	50 to 59	-	-	-	-	-	-	-	-	-	-	-	-	56.2%	41.5%	15.9%	25.4%	27.9%	38.6%	4
Gas	All Sizes	1.8%	1.3%	25.3%	4.4%	40.1%	5.0%	26.8%	4.3%	4.4%	2.0%	0.9%	0.9%	0.7%	0.9%	-	-	-	-	314
	Tankless	-	-	-	-	-	-	-	-	-	-	55.7%	37.6%	44.3%	37.6%	-	-	-	-	5
	30 to 39	-	-	-	-	91.3%	7.3%	8.7%	7.3%	-	-	-	-	-	-	-	-	-	-	40
	40 to 49	-	-	19.1%	5.3%	45.2%	6.6%	28.7%	5.8%	7.1%	3.3%	-	-	-	-	-	-	-	-	180
	50 to 59	-	-	54.3%	10.2%	7.1%	7.3%	37.1%	9.5%	1.5%	2.4%	-	-	-	-	-	-	-	-	80
	60 to 69	-	-	-	-	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	70 to 79	87.0%	20.3%	13.0%	20.3%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6
	80 to 89	-	-	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
	Unknown	-	-	-	-	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Propane	All Sizes	-	-	-	-	49.7%	26.4%	50.3%	26.4%	-	-	-	-	-	-	-	-	-	-	10
	30 to 39	-	-	-	-	100.0%	-	-	-	-	-	-	-	-	-	-	-	-	-	3
	40 to 49	-	-	-	-	29.7%	30.8%	70.3%	30.8%	-	-	-	-	-	-	-	-	-	-	6
	50 to 59	-	-	-	-	-	-	100.0%	-	-	-	-	-	-	-	-	-	-	-	1

Table 113: Percentage of Water Heaters in Energy Factor Ranges by Fuel Type and Size

Table 114 shows the percentage of all water heaters broken down by whether the tank was wrapped with insulation or unwrapped. The unknown category contains tanks that were unobservable. Over two-thirds of the observed water heaters were unwrapped.

Fuel Type	Size Range (Gallons)	Tank Wrapped		Tank Not Wrapped		Unknown		Sample Size
		Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound	
All Types	Overall	16.0%	2.1%	68.0%	2.7%	16.0%	2.1%	848
	Tankless	-	-	66.7%	31.7%	33.3%	31.7%	6
	20 to 29	39.9%	36.0%	40.1%	36.1%	20.0%	29.4%	5
	30 to 39	6.7%	4.3%	91.2%	4.9%	2.1%	2.4%	93
	40 to 49	14.7%	3.2%	83.3%	3.3%	2.1%	1.3%	342
	50 to 59	14.4%	4.3%	83.4%	4.6%	2.2%	1.8%	184
	60 to 69	34.3%	45.4%	65.7%	45.4%	-	-	3
	70 to 79	-	-	100.0%	-	-	-	12
	80 to 89	-	-	100.0%	-	-	-	4
	>100	24.9%	35.6%	75.1%	35.6%	0.0%	0.0%	4
	Size Unknown	25.1%	5.2%	12.3%	3.9%	62.6%	5.8%	195

Table 114: Percentage of Water Heaters that were Wrapped and Unwrapped

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 was no manufacture date data, thus all the age data presented in this section are customer reported dates from the on site survey.

Approximately 82.1% of all homes have a clothes washing machine. All modular homes in our sample were found to have a washer, thus the weighted percentage of modular homes with washers is also 100%. A large majority of single family homes have a washer in the house, with three or more story houses all having washers. The

percentage of apartments with washers is significantly lower than that of single family homes because it is common to have a central laundry facility in apartment complexes.

Type of Residence	Percentage	Error Bound	Sample Size
Overall	82.1%	2.2%	848
Apt/Condo (1 or 2 stories)	39.2%	6.4%	159
Apt/Condo (3 or more stories)	36.3%	11.9%	46
Mobile Home - Double Wide	95.0%	8.1%	21
Mobile Home - Single Wide	100.0%	0.0%	3
Modular/Prefabricated	100.0%	0.0%	4
Other	80.1%	29.3%	6
Single Family Unattached (1 story)	96.6%	1.5%	383
Single Family Unattached (2 stories)	97.6%	1.9%	168
Single Family Unattached (3 or more stories)	100.0%	0.0%	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	87.5%	7.9%	49

Table 115: Percentage of Homes with Clothes Washers by Type of Residence

Table 116 shows the distribution of the 696 clothes washers found on site, presented by type of washer and type of residence. Nearly 9% of all washers found were horizontal-axis washing machines; this is up from 2% in the previous study. The largest percentage of homes with horizontal-axis washers occurred in single family three or more story houses. Approximately 54.8% of all homes of that type with washers have horizontal-axis washers, though it should be noted that the sample size is too small to represent all homes with three or more floors. The second largest percentage was 11.9% and was found in the 2 story houses. Interestingly, the third largest percentage of households with horizontal-axis washers occurred in 1 to 2 story apartments, totaling 8% of all washers found at that type of residence. This could be due to space constraints in apartments.

Type of Residence	Horizontal Axis		Standard		Stacked		Sample Size
	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound	
Overall	8.8%	1.8%	88.6%	2.0%	2.6%	1.0%	696
Apt/Condo (1 or 2 stories)	8.0%	5.6%	82.3%	8.0%	9.7%	6.2%	62
Apt/Condo (3 or more stories)	6.3%	10.0%	75.2%	17.7%	18.5%	15.9%	16
Mobile Home - Double Wide	-	-	89.4%	11.6%	10.6%	11.6%	20
Mobile Home - Single Wide	-	-	100.0%	0.0%	-	-	3
Modular/Prefabricated	-	-	100.0%	0.0%	-	-	4
Other	-	-	100.0%	0.0%	-	-	5
Single Family Unattached (1 story)	7.7%	2.3%	90.7%	2.5%	1.7%	1.1%	370
Single Family Unattached (2 stories)	11.9%	4.2%	88.1%	4.2%	-	-	164
Single Family Unattached (3 or more stories)	54.8%	29.8%	45.2%	29.8%	-	-	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	7.1%	6.5%	90.5%	7.4%	2.4%	3.9%	43

Table 116: Distribution of Clothes Washers by Type of Washer and by Type of Residence

The sample size of washers with ages was 562 washers. Again, the age data reported is the number of years old the customer reported for the washing machine. The washing machine was excluded from this part of the analysis if the customer was not aware of the age of the machine. The average overall self-reported age of clothes washers is 6.7

years old. This compares to the previous study findings which found the average age to be 7.4 years old.

Manufactured Date Range	Percentage (n=562)	Error Bound
2000-2005	55.8%	3.5%
1995-1999	25.4%	3.1%
1990-1994	11.2%	2.2%
1985-1989	5.5%	1.6%
1980-1984	1.6%	0.9%
1979 and Older	0.5%	0.5%

Table 117: 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. The efficiency databases used for this study to determine model efficiency only had MEF for a very limited number of horizontal-axis washing machines, therefore we continue to present efficiency in terms of EF.

Energy factor for clothes washers is defined in cubic feet per kWh per cycle. The current federal efficiency standards for standard top-loading clothes washers, effective in 1994, set a minimum energy factor of 1.18. The minimum ENERGY STAR qualifying energy factor is 2.5 for all clothes washers. The average energy factor 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 1994 minimum standard energy factor. Additionally, it seems apparent that horizontal axis washers, which easily achieved ENERGY STAR qualifying levels on average, perform significantly better than standard or stacked units.

Type of Washer	1994 EF Minimum Standard	Energy Star Qualifying EF	Average Energy Factor	Error Bound	Sample Size
Standard	1.18	2.5	1.22	0.03	82
H-Axis	-	2.5	4.13	0.27	18
Stacked Washer & Dryer	-	2.5	1.44	0.36	6

Table 118: Average Energy Factor and Comparative Standards

The following table summarizes the energy factor distribution relative to efficiency standards. It shows that all of the horizontal axis washers far exceed the minimum federal requirements, and 96.8% exceed ENERGY STAR minimum requirements. Around 7% of the standard units failed to achieve the minimum federal requirements and none exceed ENERGY STAR minimum requirements. All in all, only 6.6% of total washers failed to meet the minimum federal requirements.

Type of Washer	Energy Factor		
	Less Than 1.18	1.18 to 2.49	Greater Than 2.5
All Washers	6.6%	75.5%	17.9%
H-Axis	-	3.2%	96.8%
Stacked Washer & Dryer	23.8%	76.2%	-
Standard	6.8%	93.2%	-

Table 119: 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 not available in the CEC database. Thus, we were unable to merge in efficiency data or manufacturer dates. This section contains information on the percentage of homes with dryers, the breakdown of the fuel types, and the age of the dryers obtained by the surveyors during the site visits.

Approximately 80% of all sites that were visited have a dryer. Table 120 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. Not surprisingly, the percentage of sites with dryers in apartments is significantly lower than the percentage of single family homes with dryers, due to the presence of common laundry facilities.

Type of Residence	Percentage with Dryers	Error Bound	Sample Size
Overall	80.1%	2.3%	848
Apt/Condo (1 or 2 stories)	37.3%	6.3%	159
Apt/Condo (3 or more stories)	34.1%	11.8%	46
Mobile Home - Double Wide	95.0%	8.1%	21
Mobile Home - Single Wide	100.0%	0.0%	3
Modular/Prefabricated	100.0%	0.0%	4
Other	60.1%	36.0%	6
Single Family Unattached (1 story)	94.2%	2.0%	383
Single Family Unattached (2 stories)	96.9%	2.2%	168
Single Family Unattached (3 or more stories)	100.0%	0.0%	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	85.4%	8.4%	49

Table 120: Percentage of Homes with Dryers by Type of Residence

Figure 21 shows the breakdown of fuel types among all dryers found during the on site visits. A total of 679 homes in the sample have dryers. The majority of homes used gas dryers, while a large percentage also used electric dryers.

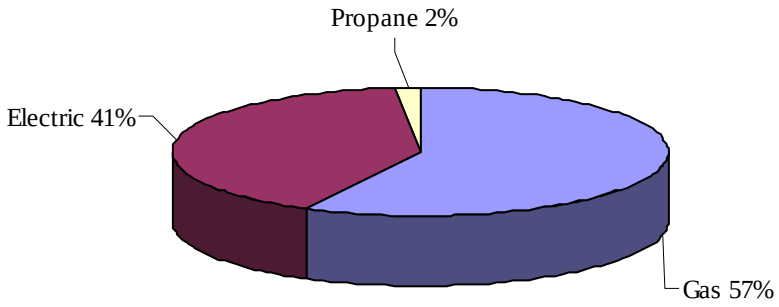


Figure 21: Percentage of Dryers by Fuel Type

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 549 dryers in the sample have an estimated age. The average weighted age of the dryers is 7.6 years old, compared to the 2000 finding of 8.4. Table 121 shows the distribution of the estimated manufacture date for the dryers. The largest percentage of dryers is between 0 to 5 years old. However, nearly 30% of all dryers are between 6 and 10 years old.

Manufacture Date Ranges	Percentage (n=549)	Error Bound
2000-2004	39.0%	3.5%
1995-1999	28.8%	3.2%
1990-1994	15.7%	2.6%
1985-1989	9.5%	2.1%
1980-1984	4.3%	1.4%
1979 and Older	2.6%	1.1%

Table 121: Distribution of Estimated Manufacture Date of Dryers

Dishwashers

The following section summarizes the 583 dishwashers found during the site visit. The data were merged with 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 122 shows the percentage of homes with dishwashers by type of home. Approximately 68.8% of all homes have a dishwasher, which is similar to the 70% of homes determined in the previous CLASS study. The table shows that dishwashers are more concentrated in single family homes and mobile homes.

Type of Residence	Percentage with Dishwashers	Error Bound	Sample Size
Overall	68.8%	2.6%	848
Apt/Condo (1 or 2 stories)	48.1%	6.5%	159
Apt/Condo (3 or more stories)	72.7%	11.0%	46
Mobile Home - Double Wide	85.1%	13.1%	21
Mobile Home - Single Wide	100.0%	0.0%	3
Modular/Prefabricated	25.1%	35.7%	4
Other	20.0%	29.5%	6
Single Family Unattached (1 story)	68.7%	3.9%	383
Single Family Unattached (2 stories)	90.2%	3.8%	168
Single Family Unattached (3 or more stories)	99.9%	0.1%	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	56.2%	11.8%	49

Table 122: Percentage of Homes with Dishwasher by Type of Residence

Based on the subset of 411 dishwashers for which age information was found, the average age of dishwashers is 7.4 years old. The 2000 CLASS study found that dishwashers were 9 years old on average. Table 123 shows that the majority of dishwashers (55.7%) were reported to have been manufactured between 2000 and 2005, and more than 75% of dishwashers were manufactured in the last 10 years. This is up from the 65% of dishwashers that were 10 years old or newer from the 2000 study.

Manufacture Date Range	Percentage (n=411)	Error Bound
2000-2005	55.7%	4.1%
1995-1999	20.9%	3.3%
1990-1994	12.8%	2.7%
1985-1989	5.2%	1.8%
1980-1984	2.5%	1.3%
1979 and Older	3.0%	1.4%

Table 123: 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 0.495, which has improved upon the average EF of 0.48 from five years ago. Table 124 displays the average energy factor compared to the current federal minimum standard, enacted in 1994.

Dishwasher Energy Factor		
Current Federal Standards	Minimum Energy Star Qualification	Average Energy Factor
0.460	0.580	0.495

Table 124: Comparison of Energy Factor with Federal Standards

The distribution of dishwasher energy factors is found in Table 125. The highest percentage of dishwashers with energy factors falls within the range of 0.460 to 0.579, containing over 75% of the dishwashers. This energy factor range encompasses all dishwashers that met 1994 standards but were below the current ENERGY STAR

minimum. The range of 0.580 to 0.775 accounts for all dishwashers that met or exceeded the ENERGY STAR minimum qualifying energy factor of 0.58. The total percentage of dishwashers meeting 1994 federal standards is 88.9%. In comparing this year's result with those of five years ago, we find that the number of units meeting the federal standard has decreased slightly from 82% to 75.6%, but the number of units meeting ENERGY STAR qualification, which has increased from and energy factor of 0.52 to 0.58, has increased by 2%. The sample size for the distribution of the energy factors is 149, which is the total number of dishwashers that we were able to match with the CEC database.

Energy Factor	Percentage (n=149)	Error Bound
0.275 to 0.459	11.1%	4.9%
0.460 to 0.579	75.6%	7.3%
0.580 to 0.775	13.3%	6.3%

Table 125: Distribution of Energy Factor of Dishwashers

Cooling Equipment

This section presents the summary analysis of the data on primary cooling equipment found at the 453 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).

Cooling Equipment

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

- Packaged System Air Conditioning units
- Split System Air Conditioning units
- Packaged Air to Air Heat Pumps
- Split System Air to Air Heat Pumps
- Evaporative Systems
- Window/Wall Room Air Conditioning units

The distribution of these cooling equipment types is shown below in Table 126.

	System Type (n=453)	% of Primary Cooling Types	Error Bound
Central	Packaged System AC	21.7%	3.2%
	Split System A/C	50.9%	3.9%
	Split Heat Pump	2.1%	1.1%
	Packaged Heat Pump	3.9%	1.5%
	Evaporative System	7.0%	2.0%
Space	Window Unit	14.4%	2.7%

Table 126: Distribution of Cooling System Types in Residences with Cooling Equipment

The analysis of cooling equipment is presented in this section and will consider heat pumps the same as air conditioners. This is because 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, 51.6% with a 2.5% error bound of homes have some type of cooling equipment in place, including non-mechanical systems such as evaporative coolers. Of the homes that have primary cooling equipment, the distribution of central systems versus space cooling units is shown below.

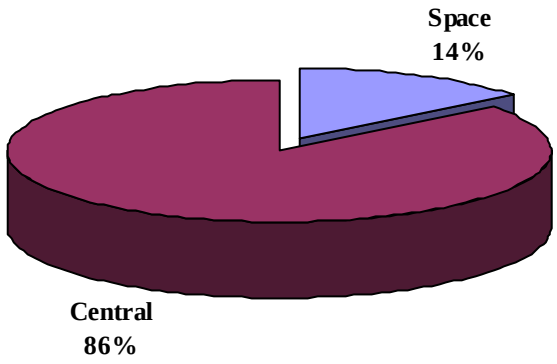


Figure 22-The Distribution of Primary Cooling Systems

Cooling equipment was classified into six types; evaporative systems, all of which were central systems, split system A/C, split heat pump, packaged system A/C, and packaged heat pump, all classified as central systems, and window/wall units, 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 packaged A/C units.

Equipment Type	Central (n=388)		Space (n=65)	
	Percentage of System Class	Error Bound	Percentage of System Class	Error Bound
Evaporative System	8.2%	2.3%	0.0%	0.0%
Split System A/C	59.5%	4.1%	0.0%	0.0%
Split Heat Pump	2.4%	1.3%	0.0%	0.0%
Packaged System AC	25.4%	3.7%	0.0%	0.0%
Packaged Heat Pump	4.5%	1.8%	0.0%	0.0%
Window Unit	0.0%	0.0%	100.0%	0.0%

Table 127: Breakdown of Classes of Primary Cooling Systems by Equipment Type

Table 128 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 287 (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 10.8 years old, down from 12.2 in the previous study.

The average space air conditioning system is 11.9 years old, down slightly from five years ago which estimated the average age to be 13 years old.

Air Conditioning System Type		Primary Cooling System Estimated Age	Error Bounds	Sample Size
Central	All Types	10.8	0.9	257
	Evaporative System	18.0	6.2	14
	Packaged System A/C	9.8	2.1	47
	Packaged System HP	12.7	6.8	8
	Split System A/C	10.3	1.0	184
	Split System HP	12.9	6.9	4
Space	All Types	11.9	4.0	30
	Window/Wall	11.9	4.0	30

Table 128 Average Age of Primary Cooling Equipment

Table 129 shows the percentage distribution for each type of cooling system by age range. Over half of all primary central and space type air conditioners have been manufactured in the past 10 years.

Age Range	Central												Space			
	All Types (n=257)		Evaporative System (n=14)		Packaged System A/C (n=347)		Packaged System HP (n=8)		Split System A/C (n=184)		Split System HP (n=4)		All Types (n=30)		Window/Wall (n=30)	
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
2000 - 2005	39.5%	5.1%	23.1%	19.2%	42.4%	12.1%	50.0%	29.1%	39.6%	6.0%	30.6%	41.3%	55.1%	15.2%	55.1%	15.2%
1995 - 1999	18.2%	4.0%	23.1%	19.2%	17.9%	9.4%	-	-	19.0%	4.8%	-	-	6.9%	7.7%	6.9%	7.7%
1990 - 1994	16.6%	3.9%	7.7%	12.2%	20.1%	9.8%	-	-	16.8%	4.6%	30.4%	41.1%	6.9%	7.7%	6.9%	7.7%
1985 - 1989	11.3%	3.3%	7.7%	12.2%	11.2%	7.7%	-	-	12.2%	4.0%	8.6%	15.0%	6.9%	7.8%	6.9%	7.8%
1980 - 1984	7.2%	2.7%	-	-	4.3%	4.9%	37.5%	28.2%	6.7%	3.1%	30.4%	41.1%	6.9%	7.8%	6.9%	7.8%
1979 and older	7.2%	2.7%	38.4%	22.2%	4.2%	4.8%	12.5%	19.2%	5.6%	2.8%	-	-	17.3%	11.6%	17.3%	11.6%

Table 129: Age Range Distribution of Cooling System by Types

Table 130 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 239 represents all cooling equipment for which capacity data was obtained. Nearly all capacities were found to be between 0.5 and 5.0 tons. The largest percentage bin of combined central air conditioning types is 23.4% found in the 4 to 4.49 ton range. The largest percentage bin of space air conditioning type window/wall units is 41.7% and falls in the 0.5 to 0.99 ton range.

Ton Range	Central Type										Space Type	
	All HP and A/C Types (n=227)		Packaged System A/C (n=44)		Packaged System HP (n=4)		Split System A/C (n=173)		Split System HP (n=6)		Window / Wall (n=12)	
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
0.5-0.99	0.5%	0.7%	-	-	-	-	-	-	16.6%	25.0%	41.7%	23.4%
1.0-1.49	0.9%	1.0%	-	-	25.1%	35.7%	-	-	16.7%	25.1%	33.3%	22.4%
1.5-1.99	0.9%	1.0%	2.3%	3.8%	-	-	0.6%	1.0%	-	-	24.9%	20.5%
2.0-2.49	9.4%	3.2%	4.7%	5.3%	25.1%	35.7%	10.0%	3.8%	16.6%	24.9%	-	-
2.5-2.99	6.8%	2.8%	9.3%	7.3%	-	-	6.5%	3.1%	-	-	-	-
3.0-3.49	22.5%	4.6%	25.5%	10.9%	-	-	23.1%	5.3%	-	-	-	-
3.5-3.99	13.5%	3.8%	11.5%	7.9%	-	-	14.2%	4.4%	16.7%	25.1%	-	-
4.0-4.49	23.4%	4.7%	28.1%	11.2%	25.1%	35.7%	23.0%	5.3%	-	-	-	-
4.5-5.00	21.6%	4.5%	16.3%	9.3%	24.8%	35.5%	22.5%	5.3%	33.3%	31.6%	-	-
>5.01	0.5%	0.7%	2.3%	3.8%	-	-	-	-	-	-	-	-

Table 130: Size Distribution of Cooling Systems by Type

Table 131: Size Distributions by Age Range for Central System Types shows the percentage of cooling systems by type and capacity within age ranges. For example, from the table we can identify that 46.9% of all types of central cooling units in the range of 4.0 to 4.49 tons were built between 2000 and 2005. This is also useful in identifying which size units tend to be older. The table shows the highest concentration of central units with a known tonnage built in 1979 or earlier, at 11.2%, is for the units in the 2.5 to 2.99 ton range.

Central Air Conditioning System Type	Ton Range	Age Range												Sample Size
		2000 to 2005		1995 to 1999		1990 to 1994		1985 to 1989		1980 to 1984		1979 and older		
		%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
All Types	All Ranges	39.5%	5.1%	18.2%	4.0%	16.6%	3.9%	11.3%	3.3%	7.2%	2.7%	7.2%	2.7%	257
	1.0 to 1.49	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	1.5 to 1.99	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	2.0 to 2.49	23.2%	19.3%	38.8%	22.3%	7.7%	12.2%	14.7%	15.9%	7.8%	12.3%	7.8%	12.3%	13
	2.5 to 2.99	55.5%	27.3%	22.2%	22.8%	11.1%	17.2%	0.0%	0.0%	0.0%	0.0%	11.2%	17.3%	9
	3.0 to 3.49	48.7%	13.2%	15.4%	9.5%	12.9%	8.8%	15.4%	9.5%	5.1%	5.8%	2.6%	4.2%	39
	3.5 to 3.99	58.6%	16.5%	16.7%	12.6%	8.3%	9.3%	12.6%	11.2%	3.8%	6.1%	0.0%	0.0%	26
	4.0 to 4.49	46.9%	12.2%	24.4%	10.5%	15.6%	8.9%	4.2%	4.8%	4.5%	5.1%	4.4%	5.1%	46
	4.5 to 5.00	42.6%	12.5%	19.1%	10.0%	33.5%	11.8%	2.4%	3.9%	2.4%	3.9%	0.0%	0.0%	44
	Unknown	22.8%	8.0%	12.2%	6.3%	14.9%	6.8%	18.0%	7.3%	14.7%	6.7%	17.4%	7.2%	78
Evaporative System	Not Applicable	23.1%	19.2%	23.1%	19.2%	7.7%	12.2%	7.7%	12.2%	0.0%	0.0%	38.4%	22.2%	14
Packaged System A/C	All Ranges	42.4%	12.1%	17.9%	9.4%	20.1%	9.8%	11.2%	7.7%	4.3%	4.9%	4.2%	4.8%	47
	2.0 to 2.49	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	2.5 to 2.99	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	3.0 to 3.49	57.0%	30.8%	14.4%	21.8%	28.6%	28.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7
	3.5 to 3.99	69.0%	43.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	31.0%	43.1%	0.0%	0.0%	3
	4.0 to 4.49	29.6%	27.4%	56.3%	30.2%	14.1%	21.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8
	4.5 to 5.00	59.9%	36.1%	20.1%	29.5%	20.0%	29.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5
	Unknown	33.2%	16.9%	9.6%	10.6%	24.0%	15.4%	19.3%	14.2%	4.8%	7.7%	9.1%	10.1%	22
Packaged System HP	All Ranges	50.0%	29.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	37.5%	28.2%	12.5%	19.2%	8
	1.0 to 1.49	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	2.0 to 2.49	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	1
	4.0 to 4.49	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	4.5 to 5.00	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	1
	Unknown	50.0%	41.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	25.1%	35.7%	25.0%	35.6%	4
Split System A/C	All Ranges	39.6%	6.0%	19.0%	4.8%	16.8%	4.6%	12.2%	4.0%	6.7%	3.1%	5.6%	2.8%	184
	1.5 to 1.99	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	2.0 to 2.49	27.5%	22.2%	45.9%	24.7%	9.2%	14.4%	8.2%	12.9%	0.0%	0.0%	9.2%	14.4%	11
	2.5 to 2.99	49.9%	29.1%	25.0%	25.2%	12.5%	19.2%	0.0%	0.0%	0.0%	0.0%	12.6%	19.3%	8
	3.0 to 3.49	46.8%	14.5%	15.6%	10.6%	9.4%	8.5%	18.7%	11.3%	6.2%	7.0%	3.1%	5.1%	32
	3.5 to 3.99	55.0%	18.3%	20.0%	14.7%	10.0%	11.0%	15.0%	13.1%	0.0%	0.0%	0.0%	0.0%	22
	4.0 to 4.49	48.8%	13.5%	18.9%	10.6%	16.3%	10.0%	5.1%	5.8%	5.5%	6.2%	5.4%	6.1%	37
	4.5 to 5.00	42.6%	13.7%	20.0%	11.1%	34.5%	13.0%	2.9%	4.7%	0.0%	0.0%	0.0%	0.0%	37
	Unknown	14.1%	9.6%	11.5%	8.9%	14.3%	9.8%	23.1%	11.7%	22.6%	11.6%	14.4%	9.8%	36
Split System HP	All Ranges	30.6%	41.3%	0.0%	0.0%	30.4%	41.1%	8.6%	15.0%	30.4%	41.1%	0.0%	0.0%	4
	3.5 to 3.99	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	4.5 to 5.00	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
	Unknown	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	22.1%	40.1%	77.9%	40.1%	0.0%	0.0%	2

Table 131: Size Distributions by Age Range for Central System Types

Table 132: Size Distributions by Age Range for Space System Types shows the percentage of space cooling systems by type and capacity within age ranges. From the table, we can see that 55.1% of all window/wall units were manufactured between 2000 and 2005.

Space Air Conditioning System Type	Cooling Tons	Age Range												Sample Size
		2000 to 2005		1995 to 1999		1990 to 1994		1985 to 1989		1980 to 1984		1979 and older		
		%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Window/Wall Air Conditioner	All Ranges	55.1%	15.2%	6.9%	7.7%	6.9%	7.7%	6.9%	7.8%	6.9%	7.8%	17.3%	11.6%	30
	0.5 to 0.99	40.0%	36.0%	20.1%	29.5%	19.9%	29.3%	0.0%	0.0%	20.1%	29.5%	0.0%	0.0%	5
	1.0 to 1.49	33.1%	44.6%	0.0%	0.0%	0.0%	0.0%	33.4%	44.8%	0.0%	0.0%	33.4%	44.8%	3
	1.5 to 1.99	0.0%	0.0%	0.0%	0.0%	50.0%	58.2%	0.0%	0.0%	0.0%	0.0%	50.0%	58.2%	2
	Unknown	68.4%	17.6%	5.2%	8.4%	0.0%	0.0%	5.3%	8.5%	5.3%	8.5%	15.8%	13.8%	20

Table 132: Size Distributions by Age Range for Space 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 170, (164 central and 6 space units) represents all of the cooling systems that were successfully matched with manufacturer data.

The distribution of SEER range by cooling system type is shown below in Table 133. The greatest amount of combined central system air conditioners are in the 10 to 10.99 SEER range accounting for 41.2% of central systems with a 7.1% error bound. Similarly 81.9% of the window/wall units are in the 10 to 10.99 EER range.

Efficiency Range	Central										Space	
	All Central Types (n=164)		Packaged System A/C (n=35)		Packaged System HP (n=4)		Split System A/C (n=119)		Split System HP (n=6)		Window/Wall (n=6)	
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
13 or Higher SEER	7.4%	3.2%	6.3%	7.2%	-	-	8.2%	3.8%	-	-	-	-
12 - 12.99 SEER	14.8%	4.5%	24.7%	12.7%	17.8%	29.4%	13.1%	4.9%	-	-	-	-
11 - 11.99 SEER	8.0%	3.6%	10.1%	8.3%	-	-	7.8%	4.3%	12.1%	19.9%	-	-
10 - 10.99 SEER	41.2%	7.1%	34.3%	14.8%	17.6%	29.2%	44.2%	8.3%	24.1%	28.1%	-	-
9 - 9.99 SEER	14.4%	6.2%	7.1%	8.9%	-	-	15.3%	7.4%	51.9%	40.0%	-	-
8 - 8.99 SEER	6.3%	3.3%	5.6%	5.3%	10.3%	18.3%	6.1%	3.9%	12.0%	19.7%	-	-
Less Than 8 SEER	7.7%	5.5%	11.8%	15.0%	54.3%	47.4%	5.3%	5.5%	-	-	-	-
10 - 10.99 EER	-	-	-	-	-	-	-	-	-		81.9%	26.8%
9 - 9.99 EER	-	-	-	-	-	-	-	-	-		18.1%	26.8%

Table 133: 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 in Table 134: Cooling Systems by Type, Tonnage Range, and Average . The average SEER for capacity range can be observed in this table. For split system units in the range of 3.0 to 3.49 tons, the most saturated capacity range, the average system efficiency is 10.1 with an error bound of 0.7. The most efficient units are packaged central units in the 3.5 to 3.99 range with an efficiency of 13.5.

System Type	Ton Range	Average Efficiency	Error Bounds	Sample Size
Central All Types (SEER)	0.5 to 0.99	10.0	0.0	1
	1.0 to 1.49	10.0	0.0	1
	1.5 to 1.99	10.0	0.0	1
	2.0 to 2.49	10.0	0.3	13
	2.5 to 2.99	10.1	0.7	12
	3.0 to 3.49	10.3	0.6	35
	3.5 to 3.99	10.5	0.8	17
	4.0 to 4.49	10.6	0.5	39
	4.5 to 5.00	10.7	0.7	31
	Unknown	9.2	1.1	14
Central Packaged System Air Conditioning (SEER)	1.5 to 1.99	10.0	0.0	1
	2.0 to 2.49	9.3	0.4	2
	2.5 to 2.99	9.6	0.6	4
	3.0 to 3.49	10.8	0.6	6
	3.5 to 3.99	13.5	1.7	2
	4.0 to 4.49	10.9	0.7	11
	4.5 to 5.00	11.6	0.6	4
	Unknown	7.9	2.0	5
Central Packaged System Heat Pump (SEER)	4.0 to 4.49	12.0	0.0	1
	4.5 to 5.00	7.5	0.0	1
	Unknown	9.3	1.1	2
Central Split System Air Conditioning (SEER)	2.0 to 2.49	10.2	0.2	10
	2.5 to 2.99	10.2	0.9	8
	3.0 to 3.49	10.2	0.7	29
	3.5 to 3.99	10.1	0.7	15
	4.0 to 4.49	10.5	0.6	27
	4.5 to 5.00	11.0	0.6	24
	Unknown	10.1	1.0	6
Central Split System Heat Pump (SEER)	0.5 to 0.99	10.0	0.0	1
	1.0 to 1.49	10.0	0.0	1
	2.0 to 2.49	8.6	0.0	1
	4.5 to 5.00	9.6	1.0	2
	Unknown	9.0	0.0	1
Space Window/Wall Air Conditioning (EER)	0.5 to 0.99	9.9	0.1	2
	1.0 to 1.49	9.8	0.0	2
	Unknown	9.4	0.5	2

Table 134: Cooling Systems by Type, Tonnage Range, and Average Efficiency

The current minimum efficiency standard for split-system air conditioners is a SEER of 10.0, while the federal minimum efficiency standard for packaged air conditioners is a SEER of 9.7 (both effective 1995). The minimum qualifying ENERGY STAR SEER is 13.0 for split-system air conditioners and heat pumps, and 12.0 for packaged system air conditioners and heat pumps. Table 135 shows the average SEER compared with current standards. The close correlation in average efficiencies relative to standards reflects the fact that the 74% of the units surveyed were installed after 1990. It should be noted that in 2006 the Federal standards will increase the minimum SEER to 13. At

those standards only 7.4% with an error bound of 3.2% of the unit surveyed would comply.

SEER				
Type of System	**Minimum Federal Standard**	**Minimum Energy Star Standard**	**Average SEER**	**Sample Size**
Packaged System A/C	9.7	12	10.3	35
Packaged System Heat Pump	9.7	12	8.8	4
Split System A/C	10	13	10.4	119
Split System Heat Pump	10	13	9.5	6

Table 135: 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.

Heating Equipment

Table 136 shows the percentage of homes that have one or more heating system. A very large percentage of the homes have one heating system, totaling 84.2% of the homes. The percentage of homes is smaller with each additional 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=848)	Error Bound
0	0.1%	0.2%
1	84.2%	2.1%
2	12.6%	1.9%
3	2.0%	0.8%
4	0.8%	0.5%
5	0.1%	0.2%

Table 136: Percentage of Homes with Heating System

Table 137 shows the primary heating system type among all houses with heating system types. The majority of all primary heating systems were found to be forced air furnaces, totaling just under two-thirds of the population of primary heating systems. Space units used as the primary heating system were far less common than central units.

	System Type (n=848)	% of Primary Heating Types	Error Bound
N/A	Not Observable	3.5%	1.1%
	No Heat	0.1%	0.2%
Central	Common - Shared Heating	0.5%	0.4%
	Forced Air Furnace	62.8%	2.8%
	Heat Pump w/Elec Supp	2.4%	0.9%
	Heat Pump w/out Elec Supp	2.2%	0.8%
	Hydronic System	0.6%	0.4%
Space	Baseboards	1.2%	0.6%
	Ceiling Cable	1.8%	0.8%
	Fireplace	1.0%	0.6%
	Floor	4.3%	1.2%
	Pellet Stove	0.5%	0.4%
	Portable	0.7%	0.5%
	Wall Unit w/Fan	3.8%	1.1%
	Wall Unit w/out Fan	13.1%	1.9%
	Window Unit Resistance	0.2%	0.3%
	Woodstove	1.2%	0.6%

Table 137: Percentage of Primary Heating Types by Type of System

Table 138 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 consumed natural gas. Only 11.3% of all primary heating systems consumed electricity. Interestingly, among all forced air furnaces, 94.1% consumed natural gas.

	System Type	Fuel Type												Sample Size
		Gas		Electricity		Pellets		Propane		Wood		Unknown		
		%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
	All Types	79.0%	2.3%	11.3%	1.8%	0.5%	0.4%	2.9%	0.9%	1.8%	0.8%	4.5%	1.2%	847
Central	All Central	87.7%	2.3%	8.4%	1.9%	0.0%	0.0%	2.8%	1.1%	0.0%	0.0%	1.1%	0.7%	574
	Forced Air Furnace	94.1%	1.7%	1.7%	0.9%	-	-	3.0%	1.2%	-	-	1.2%	0.8%	530
	Heat Pump w/Elec Supp	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	20
	Heat Pump w/out Elec Supp	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19
	Hydronic System	100.0%	0.0%	-	-	-	-	-	-	-	-	-	-	5
	Common - Shared Heating	49.9%	41.1%	-	-	-	-	-	-	-	-	50.1%	41.1%	5
Space	All Space	68.2%	5.0%	20.2%	4.3%	1.7%	1.4%	3.4%	2.0%	6.4%	2.6%	-	-	239
	Baseboards	-	-	100.0%	0.0%	-	-	-	-	-	-	-	-	10
	Ceiling Cable	-	-	100.0%	0.0%	-	-	-	-	-	-	-	-	16
	Fireplace	-	-	-	-	-	-	25.3%	25.4%	74.7%	25.4%	-	-	8
	Floor	89.1%	8.5%	5.6%	6.3%	-	-	5.3%	6.0%	-	-	-	-	37
	Pellet Stove	-	-	-	-	100.0%	0.0%	-	-	-	-	-	-	4
	Portable	-	-	100.0%	0.0%	-	-	-	-	-	-	-	-	6
	Wall Unit w/Fan	62.7%	14.1%	31.0%	13.4%	-	-	6.4%	7.2%	-	-	-	-	32
	Wall Unit w/out Fan	97.2%	2.6%	1.8%	2.1%	-	-	0.9%	1.5%	-	-	-	-	114
	Window Unit Resistance	-	-	100.0%	0.0%	-	-	-	-	-	-	-	-	2
	Woodstove	-	-	-	-	-	-	10.0%	15.6%	90.0%	15.6%	-	-	10

Table 138: Percentage of Heating Systems by Fuel Type within Type of Heating System

Table 139 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, forced air furnaces were 13.5 years old.

Manufactured Date and Estimated Manufactured Date Ranges															
System Type		Avg Mfr Age	Avg Mfr Age EB	2000 to 2005		1995 to 1999		1990 to 1994		1985 to 1989		1980 to 1984		1979 and older		Sample Size
				%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
All Types		16.7	1.1	30.5%	3.5%	15.5%	2.7%	10.4%	2.3%	12.4%	2.5%	5.8%	1.8%	25.5%	3.3%	483
Central	All Central	13.5	1.0	34.9%	4.1%	16.7%	3.2%	12.2%	2.8%	13.6%	3.0%	6.2%	2.1%	16.5%	3.2%	367
	Forced Air Furnace	13.5	1.1	35.0%	4.3%	16.7%	3.4%	12.8%	3.0%	13.1%	3.0%	5.7%	2.1%	16.8%	3.4%	342
	Heat Pump w/Elec Supp	12.2	4.5	27.5%	22.2%	27.5%	22.2%	8.3%	13.1%	18.4%	19.3%	9.1%	14.3%	9.2%	14.4%	11
	Heat Pump w/out Elec Supp	14.4	7.5	43.1%	26.5%	10.7%	16.7%	-	-	13.9%	17.4%	10.8%	16.8%	21.5%	22.1%	10
	Hydronic System	16.5	7.6	25.1%	35.7%	-	-	-	-	50.0%	41.1%	25.0%	35.6%	-	-	4
Space	All Space	27.2	2.8	16.2%	5.8%	11.7%	5.0%	4.6%	3.3%	8.2%	4.3%	4.6%	3.3%	54.7%	7.8%	116
	Baseboards	5.3	2.0	66.7%	44.8%	33.3%	44.8%	-	-	-	-	-	-	-	-	3
	Ceiling Cable	31.1	3.1	-	-	-	-	-	-	11.2%	17.4%	-	-	88.8%	17.4%	10
	Fireplace	1.0	0.0	100.0%	0.0%	-	-	-	-	-	-	-	-	-	-	2
	Floor	38.6	7.0	-	-	14.8%	13.0%	5.3%	8.5%	5.3%	8.6%	-	-	74.6%	16.3%	20
	Pellet Stove	6.3	2.8	75.0%	35.6%	-	-	25.0%	35.6%	-	-	-	-	-	-	4
	Portable	2.5	0.6	100.0%	0.0%	-	-	-	-	-	-	-	-	-	-	2
	Wall Unit w/Fan	21.6	6.1	7.6%	12.1%	23.2%	19.3%	-	-	30.7%	21.0%	15.4%	16.5%	23.1%	19.2%	13
	Wall Unit w/out Fan	30.7	3.7	9.6%	6.7%	9.8%	6.9%	5.9%	5.4%	2.0%	3.2%	5.9%	5.4%	66.8%	10.8%	55
	Woodstove	12.8	7.2	42.9%	30.8%	14.3%	21.7%	-	-	28.5%	28.1%	-	-	14.3%	21.7%	7

Table 139: Average Estimated Age and Percentage of Heating System by Type within Age Ranges

Table 140 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. Over one-quarter of all units were gas units between 55 to 69.99 kBtu. The second largest percentage of furnaces was gas units between 70 and 84.99 kBtu.

	Capacity Ranges (n=251)	% of Furnaces with Capacity	Error Bound
Gas (kBtuh)	10 to 24.99	10.9%	3.3%
	25 to 39.99	12.6%	3.5%
	40 to 54.99	11.4%	3.3%
	55 to 69.99	28.4%	4.7%
	70 to 84.99	17.4%	4.0%
	85 to 99.99	7.6%	2.8%
	100 to 114.99	5.9%	2.4%
	115 to 129.99	1.0%	1.0%
Electric (kW)	1 to 2.99	0.8%	0.9%
	3 to 4.99	1.2%	1.2%
	5 to 6.99	1.6%	1.3%
	7 to 8.99	0.4%	0.7%
	9 or Greater	0.8%	0.9%

Table 140: Percentage of All Furnaces with Capacity by Fuel Type within Capacity Ranges

Table 141 shows the average AFUE by system type. Only the units that matched with one of the efficiency databases were included in the analysis below. As one would expect, the average AFUE for central systems is significantly higher than the AFUE for all space heat systems at 80.6 and 72.2, respectively.

System Type	All Types	Central			Space			
		All Central	Forced Air Furnace	Hydronic System	All Space	Floor	Wall Unit w/Fan	Wall Unit w/out Fan
Average AFUE	79.3	80.6	80.6	80.0	72.2	69.7	73.6	72.0
Error Bound	0.6	0.4	0.5	0.0	1.2	0.6	1.6	1.7
Sample Size	246	204	203	1	42	5	9	28

Table 141: Average AFUE by System Type

Table 142 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						Space							
	All Central (n=204)		Forced Air Furnace (n=203)		Hydronic System (n=1)		All Space (n=42)		Floor (n=5)		Wall Unit w/Fan (n=9)		Wall Unit w/out Fan (n=28)	
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB
66 - 71.99	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	62.9%	14.7%	100.0%	0.0%	28.6%	29.1%	72.0%	16.1%
72 - 77.99	6.3%	3.4%	6.3%	3.4%	0.0%	0.0%	31.2%	14.3%	0.0%	0.0%	63.7%	30.2%	21.9%	14.3%
78 - 84.99	87.2%	4.4%	87.1%	4.5%	100.0%	0.0%	2.1%	3.5%	0.0%	0.0%	7.7%	12.7%	0.0%	0.0%
85 - 89.99	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%	6.0%	0.0%	0.0%	0.0%	0.0%	6.1%	9.6%
90 - 96	6.5%	3.2%	6.6%	3.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 142: Percentage of Heating Systems by Type within AFUE Ranges

Table 143 shows the overall average AFUE for gas fired forced air furnaces compared with standards. On average, the forced air furnaces meet 1992 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	80.6

Table 143: Average AFUE Standard Comparison

Table 144 shows the distribution of gas forced air furnace AFUE. The grayed cells represent AFUE values that fall below current minimum efficiency standards. 6.3% of gas forced air furnaces fall below the current federal minimum standard of 78 AFUE effective 1993.

AFUE Range				
Type	72 to 77.99	78 to 84.99	90 to 96	Sample Size
Gas Forced Air Furnace	6.3%	87.1%	6.6%	203

Table 144: AFUE Bin Distribution

Window and Wall Constructions

Overview

The following section describes the window and wall construction 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. Data was also collected on the type of wall construction.

Windows

Figure 23 shows the breakdown of window frame types among all homes. The majority of window frame types found in homes is metal, constituting more than 60% of the homes.

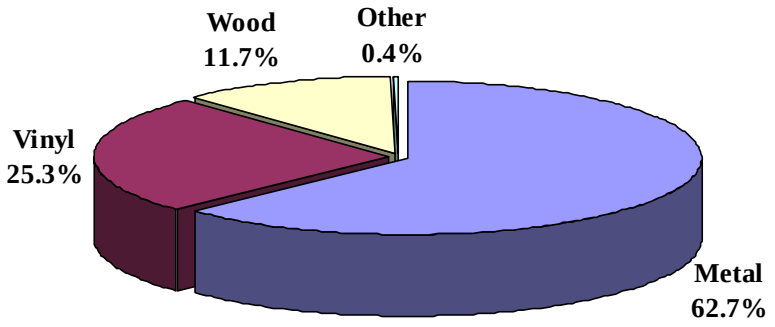


Figure 23: Percentage of Homes by Window Frame Type

Table 145 shows the breakdown of homes by window frame type and type of panes by type of residence. More than half of all the homes have metal framed, single paned windows. Interestingly, a large majority of the "modular/prefabricated" homes have metal framed, double paned windows. Nearly 75% of 1-2 story apartment buildings have metal framed, single paned windows. This may present an excellent opportunity for energy efficiency in the multifamily retrofit market.

Type of Residence	Window and Pane Type												Sample Size
	Metal Single		Metal Double		Wood or Vinyl Single		Wood or Vinyl Double		Other Single		Other Double		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Overall	43.4%	2.8%	19.3%	2.2%	10.8%	1.8%	26.1%	2.5%	0.2%	0.3%	0.1%	0.2%	848
Apt/Condo (1 or 2 stories)	73.4%	5.8%	13.3%	4.5%	6.3%	3.2%	6.3%	3.2%	-	-	0.6%	1.0%	159
Apt/Condo (3 or more stories)	54.3%	12.4%	18.3%	9.6%	9.1%	7.2%	16.0%	9.1%	2.3%	3.7%	-	-	46
Mobile Home - Double Wide	80.0%	14.7%	10.1%	11.1%	-	-	9.9%	10.9%	-	-	-	-	21
Mobile Home - Single Wide	33.5%	44.9%	33.2%	44.7%	-	-	33.3%	44.8%	-	-	-	-	3
Modular/Prefabricated	-	-	49.9%	41.1%	-	-	50.1%	41.1%	-	-	-	-	4
Other	40.1%	36.1%	20.1%	29.5%	19.9%	29.3%	19.9%	29.3%	-	-	-	-	6
Single Family Unattached (1 story)	35.3%	4.0%	19.3%	3.3%	14.6%	3.0%	30.5%	3.9%	0.3%	0.4%	-	-	383
Single Family Unattached (2 stories)	27.5%	5.7%	25.5%	5.6%	8.6%	3.6%	38.4%	6.2%	-	-	-	-	168
Single Family Unattached (3 or more stories)	0.1%	0.1%	3.9%	6.6%	41.1%	29.7%	54.9%	29.8%	-	-	-	-	9
Townhouse/Rowhouse/Duplex/Triplex/Quadplex	47.9%	11.9%	20.8%	9.6%	6.2%	5.7%	25.1%	10.3%	-	-	-	-	49

Table 145: Percentage of Homes by Frame Type and Panes Type by Type of Residence

Table 146 shows the percentage of homes by frame and pane type by age of residence. Not surprisingly, a larger percentage of newer homes have double paned windows than the older homes. For example, 62% of homes built between the years 2000-2005 have wood or vinyl framed double paned windows, while only 8% of homes built in the years 1981-1985 have the same type of windows.

Age of Residence	Window and Pane Type												Sample Size
	Metal Single		Metal Double		Wood or Vinyl Single		Wood or Vinyl Double		Other Single		Other Double		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Overall	43.4%	2.8%	19.3%	2.2%	10.8%	1.8%	26.1%	2.5%	0.2%	0.3%	0.1%	0.2%	848
1950 or Earlier	27.4%	6.6%	7.3%	3.8%	40.3%	7.2%	24.2%	6.3%	0.8%	1.3%	0.0%	0.0%	127
1951-1955	34.1%	10.7%	14.7%	7.9%	19.1%	8.9%	32.2%	10.6%	0.0%	0.0%	0.0%	0.0%	53
1956-1960	33.4%	10.9%	19.5%	9.1%	15.6%	8.4%	31.5%	10.7%	0.0%	0.0%	0.0%	0.0%	52
1961-1965	53.9%	10.4%	15.6%	7.5%	8.1%	5.7%	22.4%	8.7%	0.0%	0.0%	0.0%	0.0%	64
1966-1970	53.0%	11.5%	13.7%	7.9%	5.8%	5.3%	27.5%	10.3%	0.0%	0.0%	0.0%	0.0%	52
1971-1975	71.9%	9.2%	7.8%	5.5%	4.7%	4.4%	15.5%	7.4%	0.0%	0.0%	0.0%	0.0%	65
1976-1980	63.2%	9.6%	13.2%	6.7%	3.0%	3.4%	20.6%	8.1%	0.0%	0.0%	0.0%	0.0%	68
1981-1985	53.8%	11.5%	34.5%	10.9%	4.0%	4.5%	7.8%	6.1%	0.0%	0.0%	0.0%	0.0%	54
1986-1990	41.0%	10.3%	34.7%	10.0%	3.2%	3.6%	21.2%	8.6%	0.0%	0.0%	0.0%	0.0%	62
1991-1995	20.4%	10.6%	51.4%	13.2%	0.0%	0.0%	28.3%	11.9%	0.0%	0.0%	0.0%	0.0%	41
1996-2000	8.5%	6.7%	34.0%	11.4%	2.1%	3.4%	55.3%	11.9%	0.0%	0.0%	0.0%	0.0%	47
2001-2005	9.5%	6.6%	28.4%	10.2%	0.0%	0.0%	62.2%	11.0%	0.0%	0.0%	0.0%	0.0%	54
Unknown	68.1%	7.4%	12.2%	5.2%	3.7%	3.0%	14.1%	5.5%	0.9%	1.5%	0.9%	1.5%	109

Table 146: Percentage of Homes by Frame Type and Panes Type by Age of Residence

Table 134 shows the percentage of homes by glazing characteristics and age of residence. Low-e glazing constitutes less than 10% of the overall window glazing. The residences built between 1951 and 1955 had the highest percentage of low e glazing, 19%. This is probably due to renovation activity in older homes that included window upgrades.

Age of Residence	Window Glazing Characteristics						Sample Size
	Low E Glazing		Clear Glazing		Unknown Glazing		
	Percentage	Error Bound	Percentage	Error Bound	Percentage	Error Bound	
Overall	9.8%	1.7%	86.8%	1.9%	3.4%	1.0%	848
1950 or Earlier	4.1%	2.9%	93.5%	3.6%	2.4%	2.3%	127
1951-1955	19.1%	8.9%	80.9%	8.9%	0.0%	0.0%	53
1956-1960	15.8%	8.4%	82.2%	8.8%	2.0%	3.2%	52
1961-1965	13.0%	7.0%	85.4%	7.4%	1.6%	2.6%	64
1966-1970	13.8%	7.9%	86.2%	7.9%	0.0%	0.0%	52
1971-1975	3.1%	3.6%	95.3%	4.4%	1.6%	2.6%	65
1976-1980	16.2%	7.4%	82.3%	7.6%	1.5%	2.4%	68
1981-1985	4.0%	4.5%	94.0%	5.5%	2.0%	3.2%	54
1986-1990	6.4%	5.1%	90.3%	6.2%	3.2%	3.7%	62
1991-1995	12.9%	8.8%	69.2%	12.2%	18.0%	10.1%	41
1996-2000	12.8%	8.0%	72.3%	10.7%	14.9%	8.6%	47
2001-2005	17.0%	8.5%	75.4%	9.7%	7.6%	6.0%	54
Unknown	3.8%	3.0%	96.2%	3.0%	0.0%	0.0%	109

Table 147: Percentage of Homes by Glazing Type and Age Range

Walls

Figure 24 shows the breakdown of all homes by wall construction type. The large majority of homes were constructed using 2 x 4s, totaling over 85% of all homes.

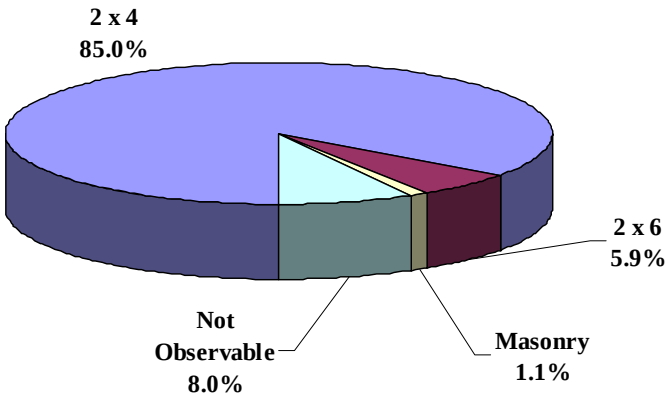


Figure 24: Percentage of Homes by Wall Construction Type

Insulation

The following section describes the insulation in walls, floors, and attics. This data was collected with some difficulty during the site visits. Difficulty arose when the attic was inaccessible due to the fact that it was located in another apartment unit, blocked by furniture, 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 18.2 with an error bound of 0.8. Table 148 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-19 to R-21.99, totaling 39.5% of the homes with an R-Value. Approximately 14% of the homes have no attic insulation.

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.

Residence Age Range	Average R-Value	Average R-Value Error Bounds	No Insulation		< R-11		R-11 to R-18.99		R-19 to R-21.99		R-22 to R-29.99		R-30 to R-37.99		> R-37.99		Sample Size
			%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Overall	18.2	0.8	14.1%	2.5%	4.6%	1.5%	17.6%	2.8%	39.5%	3.5%	6.6%	1.8%	13.0%	2.4%	4.6%	1.5%	530
1950 or Earlier	15.0	2.4	30.2%	8.1%	10.5%	5.4%	14.0%	6.2%	19.7%	7.0%	3.5%	3.3%	17.5%	6.7%	4.7%	3.7%	86
1951-1955	14.6	2.4	21.4%	10.4%	4.8%	5.4%	23.7%	10.8%	38.2%	12.3%	4.8%	5.4%	7.2%	6.6%	0.0%	0.0%	42
1956-1960	16.6	2.9	14.0%	8.8%	7.2%	6.6%	33.5%	12.0%	33.3%	12.0%	0.0%	0.0%	4.8%	5.4%	7.2%	6.6%	43
1961-1965	17.0	2.6	16.9%	9.6%	2.4%	3.9%	25.8%	11.0%	33.5%	12.0%	9.4%	7.4%	7.2%	6.6%	4.8%	5.4%	44
1966-1970	16.3	2.5	13.6%	10.4%	0.0%	0.0%	31.0%	14.1%	34.5%	14.5%	13.8%	10.6%	7.0%	7.8%	0.0%	0.0%	30
1971-1975	17.6	2.2	5.3%	6.0%	10.4%	8.1%	26.2%	11.7%	37.0%	12.9%	10.5%	8.2%	7.9%	7.2%	2.6%	4.3%	39
1976-1980	18.7	1.8	4.9%	5.6%	4.7%	5.4%	12.3%	8.5%	63.5%	12.4%	4.9%	5.6%	7.2%	6.6%	2.5%	4.0%	41
1981-1985	18.4	2.3	3.4%	5.4%	6.7%	7.5%	23.3%	12.7%	46.6%	15.0%	10.0%	9.0%	6.7%	7.5%	3.3%	5.4%	33
1986-1990	19.5	1.6	5.0%	5.7%	0.0%	0.0%	7.5%	6.9%	70.2%	11.8%	2.5%	4.1%	14.7%	9.1%	0.0%	0.0%	41
1991-1995	22.7	2.7	3.6%	5.8%	0.0%	0.0%	10.8%	9.6%	46.3%	15.5%	10.7%	9.6%	21.5%	12.8%	7.1%	8.0%	30
1996-2000	25.3	2.5	2.7%	4.4%	0.0%	0.0%	2.7%	4.4%	40.7%	13.3%	18.9%	10.6%	27.0%	12.0%	8.1%	7.4%	37
2001-2005	28.5	3.0	0.0%	0.0%	0.0%	0.0%	5.6%	6.3%	41.8%	13.5%	2.8%	4.5%	30.5%	12.6%	19.4%	10.8%	37
Unknown	9.5	3.2	45.8%	16.1%	3.9%	6.2%	15.4%	11.7%	31.0%	15.0%	0.0%	0.0%	3.9%	6.2%	0.0%	0.0%	27

Table 148: Average R-Value and Percentage of Homes with Attic R-Values within R-Value Bins

Walls

Among those homes where it was possible to observe the percentage of the walls that were insulated, the percentage of homes that have no exterior wall insulation is 21.8%, while the percentage of homes in which all the exterior walls are insulated totals 36.5% of the homes.

Construction Type	Percentage of Walls Insulated												Sample Size
	0%		25%		50%		75%		100%		Unknown		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
All Types	21.8%	2.4%	2.3%	0.9%	3.0%	1.0%	1.2%	0.6%	36.5%	2.7%	35.2%	2.7%	848
2x4	22.4%	2.6%	2.6%	1.0%	3.6%	1.1%	1.4%	0.7%	37.1%	3.0%	33.0%	2.9%	721
2x6	20.6%	9.5%	2.0%	3.3%	-	-	-	-	71.5%	10.6%	5.9%	5.5%	51
Masonry	66.7%	25.8%	-	-	-	-	-	-	11.1%	17.2%	22.2%	22.7%	10
Not Observable	9.4%	6.6%	-	-	-	-	-	-	-	-	90.6%	6.6%	53
Other	14.6%	15.8%	-	-	-	-	-	-	38.6%	22.2%	46.8%	22.8%	13

Table 149: Percentage of Homes by Wall Construction Type by Percentage of Walls Insulated

Table 150 shows the percentage of homes with any amount of wall insulation by type of residence, regardless of the R-value that was obtained during the site visit. Over two-thirds of the homes have some type of wall insulation.

Type of Residence	Percentage of Homes	Error Bound	Sample Size
Overall	66.4%	3.3%	554
Apt/Condo (1 or 2 stories)	49.2%	10.4%	64
Apt/Condo (3 or more stories)	42.0%	18.6%	19
Mobile Home - Double Wide	100.0%	0.0%	6
Mobile Home - Single Wide	100.0%	0.0%	2
Modular/Prefabricated	100.0%	0.0%	3
Other	66.4%	44.8%	4
Single Family Unattached - 1 story	63.1%	4.7%	288
Single Family Unattached - 2 story	84.0%	5.4%	129
Single Family Unattached - > 3 stories	38.9%	42.0%	5
Townhouse/Rowhouse/Duplex/Quadplex or Triplex	66.5%	13.5%	34

Table 150: Percentage of Homes with Wall Insulation by Type of Residence

Floor

The following table displays the percentage of homes for which an R-Value was obtained for the floor insulation. Over 38% are slab on grade. Among the other homes, almost 89% have no insulation.

Floor R-Value (n=373)	Percentage	Error Bound
< R-11	1.6%	1.1%
Floor R-11	1.6%	1.1%
Floor R-13	3.5%	1.6%
Floor R-19	3.8%	1.6%
No Insulation	89.4%	2.6%

Table 151: Percentage of Homes with Floor R-Values within R-Value Sizes

Pool and Spa

The following section describes the pools and spas found at the residences. Information on the fuel type, pump horsepower, and pump efficiency were recorded during the site visit. However, surveyors found this data very difficult to access and record given time limitations and access issues. Of course, the overall lack of data is compounded by a low overall saturation of homes with pools and spas. This report will focus on fuel type for both pools and spas, and pump horsepower for pools. Due to a small sample size and difficulty in matching with databases, the pump efficiency data is not presented in this report.

Pool

Approximately 7% of sites visited had a below ground swimming pool of some sort. The following figure shows the percentage of these residences broken down by heating fuel type. It can be seen that the predominant fuel type is natural gas, which is used to heat approximately one-third of the total pools. However, the majority of pools (54%) are not heated.

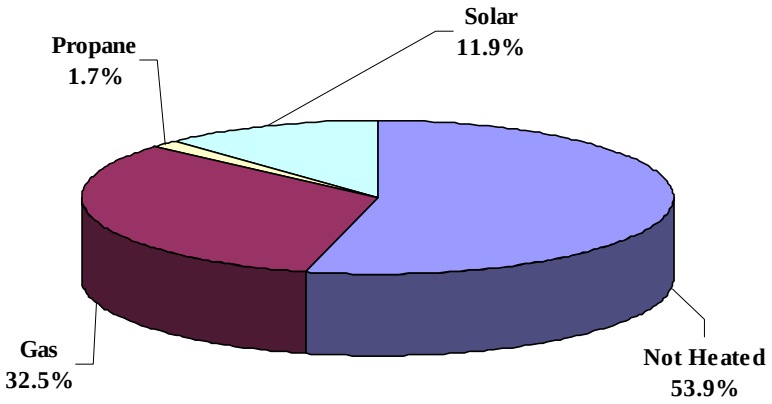


Figure 25: Percentage of Residences with Pool by Fuel Type

Table 152 shows the percentage of pumps by horsepower. The predominant pump horsepower is one, with 36% of the total pumps being rated at this value. Table 153 gives the average value of pool pump horsepower.

Pump Horsepower	Percentage (n=44)	Error Bound
0.25	2%	4%
0.5	14%	9%
1	36%	12%
1.5	19%	10%
2	26%	11%
3	2%	4%

Table 152: Percentage of Pool Pumps by Pump Horsepower

	Average (n=44)	Error Bound
Pool Pump HP	1.36	0.14

Table 153: Average Pool Pump Horsepower

Spa

Six percent of homes in the IOU service territories have a spa. There is a fairly even split between spas that are heated with electricity and natural gas. Table 154 outlines the percentage of various fuel types for sites that had spas.

Spa Fuel Type	Percentage (n=55)	Error Bound
Gas	41.3%	11.1%
Electric	47.5%	11.3%
Propane	11.2%	7.1%

Table 154: Percentage of Spas by Fuel Type