POST OCCUPANCY RESIDENTIAL SURVEY

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CALIFORNIA ENERGY COMMISSION

Pete Wilson, *Governor*

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CALIFORNIA ENERGY COMMISSION

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1.0 EXECUTIVE SUMMARY

In 1976, the California Legislature passed the Warren-Alquist Act. This Act created the California Energy Commission (Commission) and directed the Commission to develop energy efficiency standards (Standards) for new buildings. According to the Act, the Commission must demonstrate that the standards are cost effective with respect to historic practice. The Commission issued the first energy efficiency standards in 1978 and has revised and updated them regularly since that time.

This project involved the collection of data from 400 single-family detached homes constructed since July 1, 1989, distributed across all 16 California climate zones. The five primary purposes of this effort were to examine:

1. If, and how, the surveyed homes initially complied with Title 24 standards
2. If energy efficiency measures were removed after homeowner occupancy
3. If additional energy efficiency measures were installed after homeowner occupancy
4. Why energy efficiency or energy saving measures were removed or installed by homeowners
5. How the results of these 400 surveys compare with two previous Commission surveys

1.1 Sample Size And Weights

In previous projects, the distribution of the homes to be surveyed or monitored was based on issues other than building construction activity and climate zone distribution. For this project, great care was taken to provide a wide distribution of sample points across California. Areas of high building activity were given the highest emphasis, while inclusion of homes in the less active building construction or populous areas were also included. Each climate zone was required to be represented by a minimum of 15 homes. The final project sample size, precision levels, and weights are presented in Table 1-1.

Proportional allocation was used to determine the sample size for most strata with a minimum of 15 sample points imposed to ensure sufficient precision for the zones with the least construction activity. These results can be weighted by the ratio of climate zone to statewide building activity in order to achieve statistically valid results for estimates at the statewide level. The statewide estimate has a precision level of 95 percent confidence with a 5 percent margin of error.

Table 1-1 Final Project Sample Size, Distribution, And Weights

Climate Zone	Estimated Building Activity N_h	Sample n	Largest City in Climate Zone	Precision Level % Confidence/ % Margin of Error	Weight w
1	4,066	15	Eureka	80/17.5	271
2	19,637	15	Santa Rosa	80/17.5	1,309
3	24,552	18	Oakland	80/15	1,364
4	15,033	15	San Jose	80/17.5	1,002
5	6,049	15	San Luis Obispo	80/17.5	403
6	19,591	15	Long Beach	80/17.5	1,306
7	24,191	18	San Diego	80/15	1,344
8	23,708	18	Santa Ana	80/15	1,317
9	19,623	15	Los Angeles	80/17.5	1,308
10	69,813	52	San Bernardino	80/10	1,343
11	32,433	25	Roseville	80/12.75	1,297
12	105,139	99	Sacramento	95/10	1,062
13	59,045	35	Fresno	80/11	1,687
14	37,654	15	Hesperia	80/17.5	2,510
15	14,589	15	Palm Springs	80/17.5	973
16	12,765	15	South Lake Tahoe	80/17.5	851
Total For State	487,888	400		95/5	1,220

1.2 Collected Survey Data

The three areas of emphasis in the data collection phase of this project are:

1. The collection of basic homeowner occupancy and demographic data, as well as information on the age and quantity of energy using equipment

2. The collection of the necessary data for CALRES simulations during the on-site survey. During this portion of the data collection, all of the necessary information available on the physical characteristics of the home were collected. This included window areas, wall areas, ceiling and floor information, heating and cooling equipment, and hot water equipment information

3. The collection of data relating to changes the homeowner made to the house. This included the addition, removal, and replacement of energy efficiency measures or items which affected the energy use in the home.

This information was documented on survey forms designed for this project. A Microsoft FoxPro database was designed to match the on-site data collection forms. This database was used to document the findings at each of the homes surveyed and was a major deliverable for this project.

1.3 Non-Response Bias Survey

To assess the validity of the data collected for this project, 26 former non-respondent homes in Climate Zone 12 were recruited by the Commission. These 26 homes were part of the original sample, but chose not to participate in the on-site survey. The results of the data collection of these 26 homes were analyzed in conjunction with the other homes surveyed in Climate Zone 12. This analysis was designed to answer questions relating to possible non-response bias in the sampling and recruitment procedures for the project. The Commission became concerned that the homeowners participating in the survey might be homeowners who were more interested in energy efficiency. For this reason, Commission staff conducted the recruitment effort of homeowners previously recruited but who did not choose to participate in the survey. The analysis concluded that the non-response bias may make the standard budget estimates derived from the Post-Occupancy Residential Survey lower than the actual average of the population.

1.4 CALRES Simulations

The data residing in the project database was used to conduct two CALRES energy simulations for each home in the survey. The first simulation was for the pre-occupancy case. This simulation adjusted for the energy efficiency items the homeowner had added or removed since occupancy. The second simulation was for the post-occupancy case, which was the as-surveyed case. Energy efficiency items that were added or removed by the homeowner were included in this simulation case. Results of the CALRES model runs were tabulated and provided to the Commission, along with the CALRES input files (see Appendix C).

Since an updated version of the CALRES program was introduced during the time period from July, 1989 to the present to reflect changes in the Standards, the construction date of each home was used to determine which version of CALRES should be used for the analysis. Energy use for homes that were built prior to January, 1994 was simulated using CALRES Version 1.10 (or CALRES). There were 354 of these houses. Energy use for the remaining 46 houses, which were built after January 1994, was simulated using CALRES Version 1.31 (or CALRES2). A sixth month lag was used past the effective date of July 1993 for the change in the Standards. This lag was designed to capture homes that passed compliance using the pre-1993 Standards, but were built after the new Standards took effect. Since houses were randomly selected from those constructed between July 1989 and December 1994, the majority of the homes (89 percent) selected were built using the pre-1993 Standards.

1.5 Results And Conclusions

1.5.1 Title 24 Compliance

The CALRES Energy Simulation Program was used to determine compliance with the Title 24 energy standards. Based on these energy simulations, 38 percent of the homes complied with Title 24 before homeowner occupancy. Because the level of compliance varied greatly from climate zone to climate zone, the sample size per climate zone greatly determines this 38 percent compliance value. Climate Zone 7 had the highest level of compliance, 83 percent, but was represented by only 18 homes in the total sample of 400 homes. Conversely, Climate Zone 12 was represented by 99 homes, but had a low level compliance, 24 percent. For this reason, it is much more important to review the compliance levels at climate zone level. A breakdown of the compliance levels for each climate zone is presented in Table 1-2.

Table 1-2 Performance Compliance of As Built Audited Houses

Climate Zone	Comply	Don't Comply	Total	% Complying
1	0	15	15	0%
2	8	7	15	53%
3	4	14	18	22%
4	10	5	15	67%
5	1	14	15	7%
6	11	4	15	73%
7	15	3	18	83%
8	6	12	18	33%
9	7	8	15	47%
10	24	28	52	46%
11	13	12	25	52%
12	24	75	99	24%
13	14	21	35	40%
14	1	14	15	7%
15	3	12	15	20%
16	11	4	15	73%
Total	**152**	**248**	**400**	**38%**

In the CALRES simulations documented for the Post-Occupancy Residential Survey Project, the percentage of homes which complied with the Standards on a performance basis was significantly lower than 100 percent. There were several reasons for this. Most important, however, was the purpose of the simulations. When a home builder or designer is seeking compliance with the energy standards, every possible approach is examined and applied to help meet compliance with the Standards. If compliance with the Standards cannot be documented, the house cannot be built. Also, the compliance documentation can vary significantly from the house as it was finally built. Within this project, the Standards and CALRES simulations were applied dispassionately. All houses were modeled using the same approach to eliminate possible bias toward a climate zone, type of house, or other characteristics of the house. This provided for a more even handed approach to simulating these houses in comparison to the desire to have every home meet compliance with the Standards. Thus, no "fine-tuning" of the input data was utilized to increase the compliance rate.

1.5.2 Removal Of Energy Efficiency Measures

Based on the data collected from these 400 homes, there were no significant levels of energy efficiency measure removal in newly constructed homes in California. This included lighting measures, structure measures, window covering measures, landscaping measures, and water fixture measures. The removal of energy efficiency measures does not seem to be a major issue in energy performance of newly constructed homes in California.

1.5.3 Addition Or Replacement Of Energy Efficiency Measures

This survey project determined a significant amount of addition or replacement of energy efficient measures. Areas where considerable activity is taking place includes window coverings, shade trees, and faucets or showerhead replacement.

As would be expected, most homeowners do add window coverings (80 percent of the homeowners) and shade trees (at least 25 percent of the homeowners) to their homes after they move into the home. The data collected from this on-site survey reports that window coverings are added mainly for decorative reasons, to keep the house cool, and for privacy. Shade trees, on the other hand, are added to keep the house cool and for general landscaping reasons. Regardless of the reasons given by the homeowner, the end result is still higher energy efficiency.

This project uncovered a significant amount of replacement of showerheads and faucets (37 percent). In some cases, this replacement was due to a desire to change the showerhead or fixture type (18 percent), but there were homeowners that had replaced showerheads and faucets to decrease water flow (8 percent). These replacements would tend to decrease hot water use and overall water use, which increases two conservation opportunities.

1.5.4 Sources Of Information For Homeowner Removal Or Installation

In reviewing the sources of information relied upon by the homeowner in making energy decisions, past experience is always the main resource the homeowner relies upon. For certain measures, an interior decorator or a contractor may be consulted, but the primary source is always past experience. For equipment purchases, consumer guides were also mentioned quite frequently.

The reasons for making a change in a home were strongly based on past experience. Except in cases where equipment broke down and needed to be replaced, which was then reason for the action, past experience was nearly always the guide for an energy efficient action. This included everything from shade trees to window coverings to faucet replacement.

1.5.5 Previous Commission Surveys

A separate report was prepared comparing the data and results from the two reports generated for the "Residential Building Standards Monitoring Project," *Occupancy Patterns & Energy Consumption in New California Houses* and *Energy Characteristics, Code Compliance and Occupancy of California 1993 Title 24 Houses*, with the data and results from the "Post-Occupancy Residential Survey Project." Overall conclusions were drawn in three major areas. First, since these projects collected data on newly constructed homes over an eight-year period, conclusions could be made regarding the changes in building insulation levels and equipment efficiency over time. Second, levels of compliance with the Title 24 energy standards were compared and contrasted on a climate zone level. Finally, like data elements from the two reports and the current project were analyzed to determine if the homes surveyed in these projects showed enough similarity to provide credence to the results documented in the "Post-Occupancy Residential Survey Project" final report.

Since the data collected from these projects were collected on homes that were built at different points in time, the data should show improvements in energy efficiency and technology as newer homes are compared homes built under previous energy standards. This is expected because the Standards have become more stringent and the energy efficiency of equipment as improved. This assumption was verified by the data. The two data collection efforts which covered the same time period, Phase Three of the "Residential Building Standards Monitoring Project" and the "Post-Occupancy Residential Survey Project" had higher ceiling, wall, and floor insulation levels and more efficient window glazing than data collected on homes built from 1984 through 1988 (Phase One). Similarly, improvements in the efficiencies of HVAC equipment are shown through comparison of the three projects. There appeared to be little difference between the HVAC equipment in the "Post-Occupancy Residential Survey Project" and the houses that participated in the 1993 project (Phase Three). Differences do appear between the Phase One project houses. In the more recent projects, the cooling equipment

SEER and heating equipment AFUE appear to be higher, which is expected based on differences in year of construction for the houses. Historic comparisons on the efficiency of the hot water equipment were not made, since efficiencies in the Phase One data were collected using Recovery Efficiencies and the “Post-Occupancy Residential Survey Project” collected the efficiency data using Energy Factors.

Comparisons of compliance with energy codes were made using the CALRES simulation model. These comparisons were between simulations made on the houses surveyed in Phase Three of the “Residential Building Standards Monitoring Project” and the houses surveyed in the “Post-Occupancy Residential Survey Project”. While the levels of compliance were not identical between these two projects, the comparisons did show consistency by climate zone. Both projects showed the lowest levels of compliance occurred in Climate Zone 14 and the highest levels of compliance occurred in Climate Zone 10. These results may show a climate zone bias in the Standards or a need for a greater level of energy standard enforcement Climate Zones 12 and 14. A comparison of the average percentage margin of compliance between these two projects show the compliance margins were within four percentage points in Climate Zones 10, 12, and 13. This indicates that, on an average, the simulation results were comparable between the two projects. The lone exception is Climate Zone 14, which had similar results, but a greater magnitude of difference, which may be related to the small sample size for this climate zone in the “Post-Occupancy Residential Survey Project.”

Finally, comparisons were made on a wide range of data elements between the three on-site survey projects. While these data elements were not expected to show variance based on the year of construction, they do show an indication of the similarity in the type and characteristics of the houses surveyed in the three projects. In the area of building structure, there appeared to be little difference among the houses from the three projects in terms of number of floors, average floor area, or floor type, For home appliance information, comparisons between the projects were made by looking at the presence and, in some cases, fuel type of clothes washers and dryers, cooking equipment, freezers, and hot tub/spa. The only major differences between the three on-site surveys is that the presence of freezers was lower in the “Post-Occupancy Residential Survey Project” when compared to the Phase One data collection. Also, natural gas was used more commonly as the fuel for clothes drying and cooking with the “Post-Occupancy Residential Survey Project” than the two previous projects and the presence of hot tubs/spas appears to be lower in the current project compared to the 1990 project. These small differences are most likely based on the sample selection rather than any true differences in the homes surveyed for these projects. In general, the characteristics of the homes surveyed in these three on-site surveys are very similar and show no major differences.

2.0 BACKGROUND

In 1976, the California Legislature passed the Warren-Alquist Act. This Act created the California Energy Commission and directed the Commission to develop energy efficiency standards for new buildings. According to the Act, the Commission must demonstrate that the standards are cost effective with respect to historic practice. The Commission issued the first building energy efficiency standards (Title 24) in 1978 and has revised and updated them regularly since that time.

Since adoption of the initial set of standards in 1978, various entities have provided input and stated their concerns relating to the assumptions used to design the standards, the costs associated with the standards, and the energy savings attributable to the standards. In the fiscal year of 1995-96, the Energy Commission solicited proposals on several contracts designed to help evaluate:

- Whether the standards are based on realistic assumptions
- Whether the expected energy savings are being realized
- How selected elements of the program could be restructured to be more effective

In general, this project was designed to provide information to aid the Commission in these types of evaluation efforts. Specifically, this project also investigated actions a homeowner undertakes during occupancy of a newly constructed, single family residence and how those actions affect energy efficiency in the home.

2.1 Purpose

There were five basic areas investigated by this project:

1. *Compliance with Title 24 standards.* While past projects have evaluated compliance with the Title 24 standards based on compliance forms and on-site surveys, this project is the first project to use data collected directly from newly constructed homes in all 16 climate zones. This project seeks to answer the question of whether or not the as-built homes comply with the Title 24 standards.

2. *Removal of energy efficiency measures from the home.* This project was designed to investigate if homeowners remove various energy efficiency measures installed or placed in the home at the time of construction, and how this removal affects the energy efficiency of the home.

3. *Addition of energy efficiency measures in the home.* This project was also designed to investigate the addition of energy efficiency measures to the home during the first few years of occupancy. What energy efficiency measures are frequently added by a new homeowner? What is the effect of the these homeowner installed measures and how much do they improve the efficiency of the newly constructed home?

4. *Reasons for the removal or addition of energy efficiency measures.* In a more qualitative sense, this project was planned to collect decision-maker information from the homeowner. Why were energy efficiency measures installed or removed after moving into the home? Was it solely for energy efficiency reasons or was it for less technical reasons, such as aesthetics or comfort? Who helped the homeowner decide to remove or add an energy efficiency measure? This project hoped to show how and why these energy efficiency decisions were made.

5. *Comparison of survey data with information gathered from the 1990 and 1993 residential survey projects.* Each of the three projects included in this comparison provided different amounts and levels of detail in the data gathered. Nevertheless, one of the objectives of this project was to construct comparison matrices for all applicable and comparable aspects of information in the home between these three projects. These comparisons could then be used to observe trends in construction, occupancy, and energy usage in homes over the course of the past decade or so. A separate consultant report addresses this issue. This report is described more fully in Section 6.

2.2 Sample Size & Weights

The basic criteria for participation in this survey was that homes must be single-family detached homes constructed since July 1989 and occupied by the original owner of the home for at least one year.

To provide an estimate of the size of this population, NEOS obtained building permit data by county and by metropolitan area for the State of California from the California Construction Review, a monthly statistical service of the Construction Industry Research Board (CIRB). This periodical provides information on permits and valuation associated with residential and non-residential construction activity in California. The number of single-family residential permits by county for the period July, 1989 through February of 1995 is shown in Table 2-1.

As evident from these data, nearly half a million permits were issued during this period with a significant concentration of these permits located in five Southern California counties (Los Angeles, San Bernardino, Riverside, San Diego, and Orange) as well as Sacramento County in Northern California.

Table 2-1 Number Of Single-Family Building Permits By County
July 1989 Through February 1995

County	Permits	County	Permits	County	Permits
Alameda	11,083	Marin	1,689	San Mateo	3,207
Alpine	74	Mariposa	722	Santa Barbara	3,787
Amador	1,551	Mendocino	2,099	Santa Clara	10,346
Butte	5,008	Merced	6,474	Santa Cruz	2,029
Calaveras	2,696	Modoc	68	Shasta	6,763
Colusa	468	Mono	461	Sierra	103
Contra Costa	18,349	Monterey	5,208	Siskiyou	829
Del Norte	663	Napa	2,398	Solano	10,550
El Dorado	7,330	Nevada	4,707	Sonoma	12,197
Fresno	22,102	Orange	27,133	Stanislaus	12,991
Glenn	465	Placer	12,135	Sutter	3,351
Humboldt	2,778	Plumas	1,230	Tehama	1,370
Imperial	3,464	Riverside	52,374	Trinity	329
Inyo	261	Sacramento	32,784	Tulare	9,590
Kern	19,639	San Benito	1,777	Tuolomne	2,303
Kings	3,127	San Bernardino	40,226	Ventura	8,141
Lake	2,049	San Diego	30,570	Yolo	3,480
Lassen	546	San Francisco	683	Yuba	1,434
Los Angeles	45,488	San Joaquin	14,127		
Madera	5,150	San Luis Obispo	5,933	**Total For State**	487,888

Under direction from the Commission, NEOS used a proportional allocation sample selection technique, along with a minimum precision specification for those strata with fewer building permits. The minimum stratum sample size was 15. Use of this sample design, as opposed to a uniform sample allocation method, provides a higher level of precision for climate zones that have higher levels of building activity. The level of precision for the climate zones with less building activity is lower, but sufficient, using this sampling strategy. When the data are combined for statewide analyses, the estimates from each climate zone are weighted by their stratum weights, N_h/N, to reflect the distribution of building permits across the state. A copy of the Commission climate zone map is presented in Figure 2-1.

Figure 2-1
California Climate Zones

Using the CIRB building permit data by county, NEOS computed estimates of the building activity in each climate zone by first calculating the population change over the last five years for incorporated cities in each county, excluding the smallest cities only. Second, the ratios of each city's population change to each corresponding county's total population change were calculated. These ratios were multiplied by each corresponding county's total building activity to give the imputed building permit activity for each city. The city permit activity values were summed across all cities in each climate zone to give the estimated building activity for each climate zone. Table 2-2 provides these data and the estimates of sample size for each climate zone along with the associated precision level for the estimates for each stratum. The precision level for the sample as a whole is 95 percent with a 5 percent margin of error.

Table 2-2 Recommended Project Sample Size And Distribution

Climate Zone	Estimated Building Activity N_h	Sample n	Largest City in Climate Zone	Precision Level % Confidence/ % Margin of Error
1	4,066	15	Eureka	80/17.5
2	19,637	15	Santa Rosa	80/17.5
3	24,552	18	Oakland	80/15
4	15,033	15	San Jose	80/17.5
5	6,049	15	San Luis Obispo	80/17.5
6	19,591	15	Long Beach	80/17.5
7	24,191	18	San Diego	80/15
8	23,708	18	Santa Ana	80/15
9	19,623	15	Los Angeles	80/17.5
10	69,813	52	San Bernardino	80/10
11	32,433	25	Roseville	80/12.75
12	105,139	77	Sacramento	90/10
13	59,045	44	Fresno	80/10
14	37,654	28	Hesperia	80/12.75
15	14,589	15	Palm Springs	80/17.5
16	12,765	15	South Lake Tahoe	80/17.5
Total For State	487,888	400		95/5

Note that the finite population correction factor was not applied since the population in each stratum is sufficiently large in relation to the sample size calculation for an infinite population. In other words, there were enough homes built in each of the climate zones, so that a proper sample of homes could be selected. If too few homes were available, i.e. the population was too small, a correction factor would have to be applied to the sample size to statistically correct for this situation. The stratum populations were reduced by the fraction of resold homes, rental properties, and unoccupied homes; however, the smallest stratum population (in Climate Zone 1) still provided sufficient data to achieve the desired number of sample points for the project.

The percentage confidence is the probability that the home selected is representative of the new homes in a climate zone. If more homes were surveyed, there would be a stronger (or higher) confidence that the data collected is representative of all the new homes. The percentage margin of error is related to the level of significance and is basically the percentage chance that the home selected is not representative of the new homes. The more homes surveyed, the lower the percentage margin of error and the less likely the home is not representative of the new homes.

As the project neared completion, the Commission instructed NEOS to redirect survey activities to collect data for a separate non-response bias study. The Commission became concerned that the homeowners participating in the survey had a bias toward, or additional interest in, energy efficiency. Consequently, the Commission reduced the number of homes surveyed in climate zones 13 and 14 and increased the number of homes surveyed in climate zone 12. While this change reduced the precision confidence levels and increased the margins of error for climate zones 13 and 14, it did not impact the overall results from the project at the statewide level.

The additional 26 homes in climate zone 12 were homes which declined an initial invitation to take part in the survey. The recruitment procedures are explained in more detail later in Section 2.5. The final project sample size, distribution, and ensuing weights are shown in Table 2-3.

In summary, proportional allocation was used to determine the sample size for most strata with a minimum of 15 sample points imposed to ensure sufficient precision for the zones with the least construction activity. These results can be weighted by the ratio of climate zone to statewide building activity in order to achieve statistically valid results for estimates at the statewide level. The statewide estimate has a precision level of 95 percent confidence and a 5 percent margin of error.

Table 2-3 Final Project Sample Size, Distribution, And Weights

Climate Zone	Estimated Building Activity N_h	Sample *n*	Largest City in Climate Zone	Precision Level % Confidence/ % Margin of Error	Weight *w*
1	4,066	15	Eureka	80/17.5	271
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5	6,049	15	San Luis Obispo	80/17.5	403
6	19,591	15	Long Beach	80/17.5	1,306
7	24,191	18	San Diego	80/15	1,344
8	23,708	18	Santa Ana	80/15	1,317
9	19,623	15	Los Angeles	80/17.5	1,308
10	69,813	52	San Bernardino	80/10	1,343
11	32,433	25	Roseville	80/12.75	1,297
12	105,139	99	Sacramento	95/10	1,062
13	59,045	35	Fresno	80/11	1,687
14	37,654	15	Hesperia	80/17.5	2,510
15	14,589	15	Palm Springs	80/17.5	973
16	12,765	15	South Lake Tahoe	80/17.5	851
Total For State	487,888	400		95/5	1,220

2.3 Sample Source And Selection

After investigating numerous sources of information from which to obtain the sample population frame for the project, NEOS determined that the best source of data for sample selection was the DataQuick Property Database. This source provided a comprehensive and easily accessible source of data for choosing the sample. It was less costly and less problematic to use one internally-consistent source of data than it would have been to obtain and match data from different sources, such as the various building departments in the state.

The minimum variables required for sample selection included dwelling type, construction date, address, resale information, owner name, and telephone number. In general, the DataQuick Property Database contained these items as well as home improvement data, floor area, construction type, heating and air conditioning characteristics, and other data. This additional information in the

DataQuick Database was also valuable in gaining a preliminary understanding of the configuration of the home prior to the survey recruitment. A basic description of the DataQuick information is provided below.

2.3.1 DataQuick Property Database

As an information service company, DataQuick Property Database collects, organizes, updates and maintains a complete inventory of all tax parcels for each county in California (as well as other geographic areas in the country). This data is gathered from several sources:

- Public records available through county agencies, such as the Assessor's and Recorder's offices
- Data submitted by customers subscribing to DataQuick's On-Line Publication services
- Data collected by DataQuick's staff through field inspections and appraisals
- Information obtained from trade publications, newspapers and local information services

The DataQuick on-line real estate database contains detailed information on properties. Some of this information includes assessed values for buildings and land, home characteristics (number of bedrooms, bathrooms, construction type, etc.), location (address, Thomas Bros. map page, etc.), year built, last sale date, owner name, telephone number, home remodel information, and other data. While DataQuick strives to present consistent data from county to county and city to city, there are some counties and cities that do not document or report the date of construction for a home. Since these areas are minimal, the data provided were more than adequate to consider a home as a potential candidate for the survey phase of the project.

2.3.2 Sample Selection

As the first step in the sample selection process, NEOS staff screened records by:

- *House type* - only single-family detached dwelling units
- *Year of construction* - only after July 1, 1989
- *Resale information* - only original owners
- *City* - a subset of cities for each of the 16 climate zones

The data were further sampled by climate zone. Climate zones were identified in the database by county and city. However, since most of the climate zones overlap counties and vice versa, records were chosen by city location. The number sampled from each city in a climate zone was based on the estimated proportion of a given county's building activity that falls in that climate zone. To determine this number, first, a proportion of the sample for each climate zone was assigned to the counties in the climate zone depending on the county's total building activity. Second, the cities were sampled in order of relative population growth (from 1990 to 1995) until a sufficient sample size was obtained for the climate zone. Multiple cities were sampled in each climate zone unless the majority of population growth occurred in one city in the climate zone.

An important factor in determining the number of records that were sampled was the expected participation rate. The expected participation of home-owners in this study was low based on the results from other on-site studies of this nature. Even with added monetary and service incentives (offered in the past and during this project), most homeowners were not interested in participating. This may be due to the amount of time required from homeowners, lack of interest, fear of letting strangers into their homes, or other reasons. The participation rate for this survey was originally expected to be around 20 percent, but was dropped to 5 percent based on the results from the first homeowner recruitment effort. The actual response rate, however, varied greatly by location. Areas of higher building activity generally had a much higher response rate. Given this low expected participation rate, sample recruitment mailings were 10 to 20 times the number of responses needed in each climate zone to guarantee the required survey levels.

In areas where no year of construction information was available, a larger recruitment effort was necessary in order to capture the necessary sample size. In these instances, sales activity by location, the year of sale of the home, and other information were used as proxy indicators for year of construction. In addition, the recruitment letter for these areas emphasized the eligibility criteria for the survey, and verification of year of construction was also carried out during the scheduling phase of the survey. While this approach was somewhat problematic and time consuming, NEOS was successful in recruiting enough homes in each climate zone to match the desired sample size.

2.4 Data Acquisition

Once the sample was drawn from the DataQuick information, the data acquisition phase of the project was started. This phase included survey recruitment, development of a survey instrument, the training of surveyors, and the on-site data collection

2.4.1 Survey Recruitment

Once the project sample source was identified and a sample was selected, the next step of the process was the solicitation and recruitment of participants for the data collection. To accomplish this objective, NEOS recruited participants through a mail marketing effort. This approach entailed mailing a letter to each home selected in the sample with a business reply, postage-paid postcard enclosed.

The letter was addressed to the name of the occupant and briefly introduced the project. It explained the project's purpose and importance, indicated that their home was selected randomly from a list of eligible homes, and that only 400 homes were to be surveyed around the state. The letter explained the nature of the data collection effort and offered to provide a number of services and a monetary incentive in return for their participation. These services included a free air filter replacement, resetting and checking the programmable thermostat if necessary, checking the water heater temperature setting and repositioning if needed, as well as a visual inspection of the attic space and/or crawl space for insulation condition, duct sealing, and duct leakage.

The homeowner was assured that the data obtained from the survey were confidential and that all published results would never include any specific reference to names, addresses, or any other identifying information. In addition, homeowners were reassured that this project was purely research-oriented in nature. To reconfirm the eligibility criteria, the letter indicated that the homeowner must be the original occupant of the home and that the home must have been constructed after July of 1989. Finally, the letter indicated to the homeowner that surveys would be conducted on a first-come-first-served basis for the first eligible and valid respondents to the letter by area. Potential participants were asked to complete the enclosed postage-paid reply postcard and return it as soon as possible. Homeowners were informed that the selected participants would be contacted by telephone to arrange for scheduling of the actual survey by an energy survey professional. A copy of the recruitment letter is provided in Appendix A.

The return postcards included in each letter were professionally printed with a first-class postage-paid label and bar code. The postcards included spaces for the homeowner to write their name, address, telephone numbers, best times to contact, as well as basic information on the furnace filter size and type, if known. Homeowners were requested to locate and provide furnace filter information to the person who calls to arrange the survey if not readily available at the time. A copy of this post card is also provided in Appendix A.

Numerous mailings occurred during the course of the project in order to reduce delay from the time of receipt of postcards to actual contact and scheduling of surveys. Response rates obtained from each mailing were used to adjust the size of the next mailing as appropriate. More letters were sent, if necessary, to achieve the required number of sample homes.

Establishing the survey recruitment parameters in this way provided the advantages of pre-screening and self-recruiting, in contrast to the telephone "cold-call" approach. Although the response rate from a telephone solicitation may have been higher, not all potential participants had listed telephone numbers, and not all potential participants would be home (which can require multiple contacts). Conducting a mail solicitation, on the other hand, provided for much wider coverage and provided an

Table 2-4 Cities Surveyed
By Climate Zones

Climate Zone	City	County	# Of Homes Surveyed
1	Arcata	Humboldt	2
	Fortuna	Humboldt	13
2	San Rafael	Marin	15
3	El Sobrante	Contra Costa	4
	Fremont	Alameda	8
	Richmond	Contra Costa	6
4	Milpitas	Santa Clara	9
	Morgan Hill	Santa Clara	6
5	Arroyo Grande	San Luis Obispo	8
	Grover Beach	San Luis Obispo	1
	Santa Maria	Santa Barbara	6
6	Oxnard	Ventura	15
7	Oceanside	San Diego	18
8	Anaheim	Orange	8
	Anaheim Hills	Orange	3
	Mission Viejo	Orange	7
9	Burbank	Los Angeles	4
	Glendale	Los Angeles	11
10	Corona	Riverside	40
	Hemet	Riverside	12
11	Chico	Butte	12
	Rocklin	Placer	13
12	Antioch	Contra Costa	13
	Folsom	Sacramento	54
	Galt	Sacramento	22
	Turlock	Stanislaus	10
13	Bakersfield	Kern	21
	Clovis	Fresno	10
	Delano	Kern	4
14	Palmdale	Los Angeles	8
	Victorville	San Bernardino	7
15	Indio	Riverside	15
16	Susanville	Lassen	5
	Truckee	Nevada	10

initial contact with the homeowner. This process greatly facilitated the scheduling and conducting of the actual field work. NEOS gathered and processed all returned postcards and provided each field team with those postcards which were applicable to their area of coverage. The field staff were responsible for contacting and scheduling the appointments with each homeowner and conducting the data collection. The final number of homes surveyed by climate zone are presented in Table 2-4.

2.4.2 Survey Instrument

The survey instrument for this project needed to fulfill several criteria to ensure a successful data collection effort. These criteria were centered upon the need to collect post occupancy changes to the home, Title 24 compliance information, and CALRES input data.

In the development of the survey instrument for this project, multiple-choice, yes/no, or check-off type questions were used whenever possible. This survey question type was easy to use for the surveyor, homeowner, data entry personnel, and the analyst. Other benefits of this style of questions was to force the surveyors to describe building components using like terminology, and to ensure data were collected in a uniform and consistent fashion for all locations. Some questions and information that needed to be collected on-site were not amenable to the multiple-choice style format. In those cases, space was provided to document the appropriate information.

Although many of the questions in the survey instrument, such as information relating to modifications to the home, were direct responses from the homeowner, other information were collected by measurement or inspection. For some of these data elements, direct inspection was not always possible. In these cases, an estimate or assumption from the field surveyor was required. While direct measurement was preferable, an estimate made on-site by a qualified field surveyor was considered favorable to leaving blanks in the data or to an estimate made by an analyst, who had not seen the home. Blank or missing information still remained in the data, however, in cases where even estimates were not reasonable. For example, in several instances water heaters were wrapped with insulation blankets which obscured the nameplate data. In these cases, it was feasible to estimate the water heater tank storage capacity, but not the model number information.

The analysts using the database from this project have an interest in the quality of data collected. Did the surveyor estimate, assume, or actually measure the documented data? To aid the analysts in assessing the quality or source of the data, data elements that were more likely to be estimated, assumed, or measured had check-off boxes to document the source of the data. This information was also useful in determining default values for the CALRES simulations.

Another factor for consideration in the survey instrument was the design of the database management and processing system. The design of the survey instrument directly impacted the development of the data entry and verification procedures established for the project. Care was taken to ensure that a smooth transition could be made from one to the other. Also factored into this process was the data collection format employed on previous Commission projects. Since one of the aspects of this project involved comparison of the data with the results of previous surveys, consistency in the data collection format helped to facilitate such comparisons. The finalized data collection instrument is provided in Appendix B of this document.

2.4.3 Training Of Surveyors

The next step in initiating the data collection process was the development and implementation of a one-day training session for all field staff involved in the project. This training session was conducted in Sacramento and included surveyors from Block Energy Design, Occidental Analytical Group, and Valley Energy Consultants. Several aspects of training were included during this session including: interview techniques; a detailed item-by-item discussion of each question in the survey; hypothetical scenarios and data collection situations; an exchange of ideas and actual field experiences; as well as definition of the procedures and techniques required to provide the services included for each homeowner during the survey.

During the training session, NEOS issued project identification (ID) badges to all field staff included in the project. These ID badges included a picture of the surveyor, along with his or her name and the name and telephone number of the their respective organizations. These ID badges were presented to the homeowner upon arrival for verification purposes. When appointments were scheduled, homeowners were informed who the surveyor would be and that he or she would have a badge for identification purposes. This step greatly alleviated homeowner concerns of unauthorized access or home entry.

2.4.4 On-Site Data Collection

The on-site data collection can be separated into three segments:

1. An initial homeowner interview. This phase included the collection of basic homeowner occupancy and demographic data, as well as information on the age and quantity of various pieces of energy using equipment. Care was taken to structure these questions and their presentation to prevent biased responses.

2. Measurements and construction characteristics. During this portion of the data collection, the surveyor gathered all of the necessary information available on the physical characteristics of the home. This phase also included floor plan and basic elevation sketches of the home, as well as

photographs of the exterior of the home and any important equipment or unusual attributes of the interior or exterior. During this phase, the surveyor administered all of the homeowner services.

3. A final wrap-up interview or working session with the homeowner. During this portion, any follow-up questions which arose during the data collection and from observations made by the surveyor were asked of the homeowner. During this portion, the surveyor also answered any questions that the homeowner may have had regarding their energy use. The surveyor also reviewed a checklist of potential energy efficiency measures with the homeowner to provide feedback on the expected costs and benefits associated with measures considered applicable to the home in question. Each homeowner was provided with this checklist along with a copy of the Commission's Home Energy Manual.

The checklist of potential efficiency measures was developed by NEOS prior to the initiation of field work, and was discussed as part of the training session. The information contained in this checklist was based on previous work conducted by NEOS to develop an energy efficiency forecasting model for the Demand Analysis Office of the Commission. Part of the work associated with that effort involved the development of a cost-effective residential energy efficiency measure database by climate zone for California. The primary source of measure cost, measure life, and energy impact information for that effort was the Database for Energy Efficiency Resources (DEER) housed at the Commission and sponsored by the California Conservation Inventory Group.

For this project, NEOS used the DEER information, along with the results of its more recent energy efficiency model developments to establish the measure checklist, calculation procedures, and data used during the homeowner energy review. From the data and models available, NEOS constructed a simplified calculation method which utilizes the square footage of the home and a handful of other basic information to allow the surveyor to estimate the cost and energy savings potential for selected efficiency measures applicable to the home. The intent was to provide a system whereby the surveyor could quickly and efficiently carry out the energy efficiency analyses in the field. A copy of the energy efficiency measure checklist is also provided in Appendix B.

Upon completion of each survey, field representatives were responsible for checking to ensure that all necessary data were obtained prior to leaving the home. Completed survey data forms were mailed (along with film rolls and film logs) to NEOS for data verification and for entry in the project Database Management System (DBMS).

2.5 Non-Response Bias

After reviewing the results of the pilot phase study, the Energy Commission staff became concerned that the homeowners participating in the project might be homeowners who were more interested in energy efficiency. The Commission subsequently decided to explore whether the survey results were also representative of all homeowners eligible to participate in the project -- not just those homeowners who chose to participate in the project.

Non-response bias results from systematic differences between respondents and non-respondents and can bias estimates and distort inferences. Non-response bias was assessed by surveying some former non-respondents in the Folsom area and then evaluating whether there were significant differences in the CALRES model outputs between the Folsom area participants who responded to the initial solicitations by NEOS and the former non-respondents recruited by the Commission. The following three constraints shaped the non-response bias study methodology: no demographic data could be collected, the contract completion date could not be extended and no additional funds were available.

The Commission limited the scope of the study to the Folsom area (Climate zone 12). This limited scope improved the precision of the estimates in two ways. First, it reduced errors by controlling for differences between climate zones. Second, by eliminating the need to stratify, sample sizes were maximized thus decreasing sampling error. However, this approach has some limitations. Since the non-response bias study was limited to the Folsom area, the results cannot be generalized statewide. Also, there is the possibility that the energy efficiency decisions made by the participants in the non-response bias study might be significantly different than the decisions made by homeowners who refused to participate in the study.

NEOS' initial recruitment method resulted in only 7.5 percent of the solicited Folsom households agreeing to participate in the study. The Commission expected to increase the response rates by using an adaptation of Dillman's total design method (Dillman, 1978). The Commission's budget allowed for on-site surveys of up to 38 former non-respondents in Folsom. Assuming a 69 percent response rate, the Commission staff randomly selected 55 of Folsom's original non-respondent households for the non-response bias study. The Commission recruited by sending all 55 households a carefully worded letter, followed by a reminder post card a week later. Two weeks later, those homeowners who still did not indicate willingness to participate were sent another letter. Finally, the remaining reluctant households were phoned. Cumulative response rates for each of these recruitment waves were 21.1 percent, 41.1 percent, 61.8 percent and 74.6 percent, respectively. When the subcontractor called to schedule on-site surveys, some attrition occurred. Ultimately, 26 of the original non-respondents in the Folsom area agreed to have their homes surveyed, representing a 47.8 percent response rate.

The Commission staff assessed whether there was an indication of non-response bias by comparing the CALRES simulation results for the Folsom area respondents recruited by NEOS and the respondents recruited by the Commission staff. There were two analyses done on the CALRES simulation outputs: first, staff calculated and compared the kBtu/sq.ft./yr. standard budget for each group, and second, staff calculated and compared the difference between the kBtu/sq.ft./yr. value for each home as constructed and each home as currently configured.

The statistical test was constructed similarly for each of the two analyses. The null hypothesis was that the two groups of Folsom residents have the same mean kBtu/sq.ft./yr. The alternative hypothesis was that the groups have different means. If the test statistic using the t-test were to fall in the rejection region, the Commission staff would reject the null hypothesis and conclude in favor of the alternative hypothesis. This would provide evidence of non-response bias.

If the test statistic using the t-test were to fall in the acceptance region, the Commission staff would accept the null hypothesis and conclude that there is not statistical evidence of non-response bias. Therefore, even if the observed sample means are different, the difference is not statistically significant. In other words, if there is no statistical evidence of non-response bias, the results from the NEOS' post occupancy survey would most likely be representative of all homeowners eligible to participate in the project -- not just those who chose to participate in the project.

Significant differences were found between the two groups' standard budgets. First, the standard budget variances of the NEOS-recruited participants and the Commission-recruited participants were compared. The two groups had significantly different variances (F=.61), indicating different underlying distributions.

Second, the mean standard budgets were compared. The Commission-recruited homes' mean standard budget was larger than the mean standard budget in the group recruited by NEOS (47.93 kBtu/sq.ft./yr. versus 45.07 kBtu/sq.ft./yr.). At the 95 percent level of significance and using a one-tailed, unequal variance t-test, this difference was significant (T=1.69). This is evidence supporting the existence of non-response bias, or in other words, the standard budget estimates derived from NEOS' post-occupancy residential survey may be lower than the actual average of the population. The indication was not strong, however, because this difference was not significant for a two-tailed test at the 95 percent level of significance or for a one-tailed test at the 99 percent level of significance.

Next, for both the NEOS-recruited participants' homes and the Commission-recruited participants' homes, the Commission staff compared the mean difference between the kBtu/sq.ft./yr. value for homes as constructed and homes as currently configured. In this case, the sample variances were not significantly different (F=1.11). The sample means were then compared. The group of Commission-recruited participants reduced their energy use more than the NEOS-recruited participants (-1.90 kBtu/sq.ft./yr. vis-à-vis -1.52 kBtu/sq.ft./yr.). The difference between the two groups, however, was not statistically significant at the 95 percent level of significance (T=1.11). This means that, although the groups have different means, there is not statistical evidence at the 95 percent level of significance that homeowners in the NEOS-recruited group behaved differently after they moved into their homes compared to the Commission-recruited group.

The differences between the mean standard budgets of the groups recruited by NEOS and the Commission staff provide some evidence of non-response bias in the Folsom area. The fact that the

Commission-recruited group's mean standard budget was larger than NEOS-recruited group's mean standard budget is an indication that the Commission-recruited participants' homes are different than the NEOS-recruited participants' homes. Non-response bias may make the standard budget estimates derived from NEOS' post occupancy residential survey lower than the actual average of the population.

Based on comparing the mean difference between the kBtu/sq.ft./yr. value for homes as constructed and homes as currently configured, homeowners in the NEOS-recruited group did not behave differently after they moved into their homes compared to the Commission-recruited group. While the group recruited by the Commission staff reduced their energy use more than the group recruited by NEOS, the difference was not statistically significant.

2.6 Data Analysis

The final step of the project involved the analysis of the data obtained from the survey. Three distinct aspects of analysis were associated with this project: 1) conducting statistical tabulations and summaries of the data and information gathered from the survey 2) developing the CALRES building input data files and conducting CALRES runs for each house 3) comparing the data and the results obtained from this effort with similar analyses conducted for two previous Commission contracts. The efforts associated with the first two items shown above are contained in this report in the remaining sections. Comparison of the results with previous analyses is discussed and presented in a separate Consultant Report. A description of this Consultant Report is presented in Section 6.

3.0 SUMMARY AND ANALYSIS OF COLLECTED SURVEY DATA BY CLIMATE ZONE

During the data collection at the 400 homes, hundreds of pieces of data were collected. These data elements covered subjects relating to occupancy, operation and structure of the house and various pieces of equipment. This section will provide analysis on a statewide and climate zone level for numerous data elements considered important in the energy use of newly constructed homes.

The on-site surveyors, all with prior on-site survey experience and a working knowledge of the Standards, felt that in general the homes surveyed in each climate zone were representative of homes within that climate zone. In a few instances, insulation was missing or the home was larger than the standard tract house, but those instances were rare. Based on the surveyors' past experience, they felt the construction practices and building characteristics were typical of newly constructed homes in each particular area or climate zone.

The first subsection presents an overview of the rest of the subsections by present information defining an average home for every climate zone. This table defines structure, water heater, air-conditioning, furnace, kitchen, laundry and appliance information for each climate zone thereby presenting a "typical" home for each climate zone. The following subsections provide summaries of the analysis conducted on the characteristics of the home, the structure of the home, general equipment, kitchen equipment, laundry equipment, hot water equipment, pool and spa equipment, heating equipment information and cooling equipment.

3.1 Average Home Definition By Climate Zone

By analyzing the data collected from the 400 on-site surveys, an average or typical home can be defined for each climate zone. Tables 3-1 and 3-2 present average values by climate zone for house structure, water heaters, furnaces, air-conditioners, cooking equipment, refrigerators, freezers, washers, dryers and other appliances. The analyses undertaken to develop these numbers are given in greater detail in the following subsections.

3.2 Characteristics Of The Home

This subsection shows results of the analyses conducted on the data collected on the 400 homes in the 16 climate zones of California related to the characteristics of the home. These analyses include: the number of residents of each home; electric and gas utilities that serve each of the homes; other fuels used at each of the homes; type of homes surveyed; the number of bedrooms, bathrooms and other rooms; and the number of garage spaces in each of the homes.

Table 3-1 Structure, HVAC, Hot Water Equipment Information For The Average Home

	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
STRUCTURE																
Number Of Stories	1.4	2.0	1.8	2.0	1.5	1.8	1.6	2.0	2.0	1.7	1.3	1.5	1.3	1.4	1.0	1.6
Number Of Bedrooms	3.20	3.27	3.78	3.93	3.00	3.67	4.00	3.61	3.47	3.44	3.40	3.74	3.49	3.27	3.53	3.20
Number Of Bathroom	2.40	3.00	2.83	3.00	2.60	2.80	2.72	3.06	3.53	2.77	2.36	2.54	2.34	2.47	2.13	2.20
Number Of Garage Spaces	2.07	2.13	2.56	2.20	2.13	2.80	2.94	2.61	2.33	2.58	2.44	2.62	2.29	2.33	2.07	2.00
Number Of Fireplaces	0.47	1.20	1.78	1.40	1.40	1.27	1.39	1.50	1.27	1.06	0.88	1.28	0.94	1.00	0.87	0.13
Floor Area (sq. ft.)	1,753	2,188	2,543	2,149	2,082	2,220	2,323	2,255	2,419	2,030	1,875	2,116	2,019	1,737	1,525	1,815
Glazing % Of Floor Area	16.5%	16.5%	16.9%	19.6%	17.1%	16.0%	16.0%	18.3%	17.5%	16.6%	14.7%	17.3%	15.7%	19.4%	18.0%	15.2%
Glazing Type %																
Single	0.0%	0.0%	1.4%	0.0%	0.0%	37.4%	0.0%	27.7%	13.0%	4.8%	0.3%	0.6%	1.2%	0.0%	0.5%	0.1%
Double	100.0%	100.0%	98.6%	100.0%	99.9%	62.6%	100.0%	72.3%	87.0%	95.2%	99.7%	99.4%	98.8%	100.0%	99.5%	99.9%
Triple	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Roof R-Value	32.9	31.6	29.7	33.3	28.5	37.9	33.1	34.7	34.4	30.5	35.1	34.1	32.5	33.7	32.0	34.4
Wall R-Value	13.8	13.3	16.3	13.5	13.8	15.1	13.0	12.9	12.8	14.8	14.3	16.3	16.7	13.9	18.8	18.6
WATER HEATER																
Fuel Type	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Propane
Tank Volume	41.53	60.00	63.53	47.33	45.00	48.00	47.00	48.89	50.71	48.50	44.56	48.29	43.55	45.00	44.20	44.62
Energy Factor	0.61	0.54	0.55	0.59	0.59	0.59	0.57	0.57	0.59	0.60	0.59	0.58	0.60	0.59	0.61	0.58
FURNACE																
Fuel Type	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Gas	Propane
AFUE	80.90	78.73	79.18	77.67	78.33	79.646	77.27	76.00	81.08	79.75	78.85	78.00	79.14	81.71	80.07	84.78
AIR-CONDITIONING																
SEER	N/A	9.63	10.10	10.49	N/A	12.00	10.06	9.79	10.02	10.36	10.59	10.11	11.05	10.79	10.78	N/A

Table 3-2 Appliance Information For The Average Home

	CZ 1	CZ 2	CZ 3	CZ 4	CZ 5	CZ 6	CZ 7	CZ 8	CZ 9	CZ 10	CZ 11	CZ 12	CZ 13	CZ 14	CZ 15	CZ 16
KITCHEN																
Cooking Fuel Type																
Electricity	13%	20%	50%	13%	13%	7%	0%	0%	0%	0%	24%	29%	37%	7%	0%	80%
Natural Gas	87%	80%	50%	87%	87%	93%	100%	100%	100%	100%	76%	71%	63%	93%	100%	0%
Propane	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Oven Fuel Type																
Electricity	33%	53%	61%	60%	47%	67%	44%	39%	40%	37%	56%	73%	63%	7%	7%	73%
Natural Gas	67%	47%	39%	40%	53%	33%	56%	61%	60%	63%	44%	26%	37%	93%	93%	0%
Propane	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	27%
Refrigerator Type																
Top Freezer	47%	40%	33%	40%	27%	67%	28%	56%	33%	37%	44%	47%	54%	53%	60%	73%
Side-By-Side	40%	60%	67%	60%	73%	33%	72%	44%	67%	62%	48%	51%	46%	47%	40%	27%
Bottom Freezer	13%	0%	0%	0%	0%	0%	0%	0%	0%	2%	8%	2%	0%	0%	0%	0%
Upright Freezer																
Yes	53%	7%	6%	7%	20%	20%	17%	6%	7%	15%	16%	17%	14%	13%	0%	33%
No	47%	93%	94%	93%	80%	80%	83%	94%	93%	85%	84%	83%	86%	87%	100%	77%
Chest Freezer																
Yes	27%	7%	6%	13%	0%	20%	17%	0%	0%	12%	4%	6%	20%	20%	7%	20%
No	73%	93%	94%	87%	100%	80%	83%	100%	100%	88%	96%	94%	80%	80%	93%	80%
Number Of Microwaves	1.00	1.07	1.17	1.00	1.00	1.07	1.22	1.11	1.20	1.10	1.04	1.01	1.00	0.73	1.00	1.07
Number Of Dishwashers	1.00	1.00	0.94	1.00	1.07	0.93	1.00	1.00	1.00	1.00	0.96	0.99	0.97	1.00	1.00	1.00
Number Of Trash Compactors	0.13	0.53	0.33	0.07	0.40	0.93	0.06	0.17	0.33	0.06	0.20	0.17	0.09	0.07	0.07	0.07
LAUNDRY																
Dryer Fuel Type																
Electricity	67%	73%	83%	73%	20%	13%	17%	6%	13%	15%	71%	72%	40%	20%	36%	93%
Natural Gas	33%	27%	17%	27%	80%	87%	83%	94%	87%	85%	29%	28%	60%	80%	64%	0%
Propane	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%
APPLIANCES																
Number Of Televisions	2.47	3.13	2.83	2.67	3.13	2.60	3.39	2.44	2.80	2.71	2.32	2.44	2.74	2.33	2.80	2.53
Number Of VCRs	1.47	2.07	2.00	2.47	1.60	1.93	2.06	1.44	1.73	1.88	1.40	1.56	1.51	1.60	1.67	1.87
Number Of Computers	0.87	1.07	1.50	1.40	0.87	0.93	0.94	0.89	0.80	0.80	0.72	0.89	0.91	0.93	0.67	0.73
Number Of Printers	0.73	0.93	1.06	1.07	0.60	0.87	0.89	0.78	0.67	0.76	0.56	0.77	0.80	0.80	0.53	0.67
Number Of FAX Machines	0.13	0.47	0.44	0.33	0.13	0.07	0.28	0.11	0.33	0.20	0.08	0.20	0.14	0.13	0.27	0.07

3.2.1 Number Of Residents

Table 3-3 presents the average number of residents in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of residents in these newly constructed homes is just over three residents per home and this seems to be consistent across all of the climate zones.

Table 3-3 Average Number Of Residents Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	2.93	1.44	1	5	14
2	2.80	1.21	1	5	15
3	3.06	0.87	2	4	18
4	3.53	1.25	2	6	15
5	2.40	0.99	1	4	15
6	3.13	1.13	2	5	15
7	2.67	0.84	1	4	18
8	3.11	1.08	1	5	18
9	2.87	1.60	1	7	15
10	3.12	1.32	1	7	51
11	2.88	1.27	1	5	25
12	3.08	1.20	1	5	97
13	3.40	1.09	2	5	35
14	3.13	1.30	1	5	15
15	3.33	1.37	1	5	12
16	3.13	1.06	2	5	15

3.2.2 Electric Utility

Table 3-4 displays the electric utilities that provide service to the homes surveyed. This data is provided for each of the climate zones. Data in this table shows that Pacific Gas and Electric provides the electricity to the greatest number of the homes surveyed.

Table 3-4 Electric Utility Serving Household

Climate Zone	City of Anaheim	City of Burbank	Glendale PSD	Imperial Irrigation	Lassen MUD	PG&E	SDG&E	Sierra Pacific	SMUD	Southern Cal. Edison	Truckee Donner PUD	Turlock Irrigation Dist
1	-	-	-	-	-	15	-	-	-	-	-	-
2	-	-	-	-	-	15	-	-	-	-	-	-
3	-	-	-	-	-	18	-	-	-	-	-	-
4	-	-	-	-	-	15	-	-	-	-	-	-
5	-	-	-	-	-	15	-	-	-	-	-	-
6	-	-	-	-	-	-	-	-	-	15	-	-
7	-	-	-	-	-	-	18	-	-	-	-	-
8	11	-	-	-	-	-	7	-	-	-	-	-
9	-	4	11	-	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	52	-	-
11	-	-	-	-	-	25	-	-	-	-	-	-
12	-	-	-	-	-	13	-	-	76	-	-	10
13	-	-	-	-	-	31	-	-	-	4	-	-
14	-	-	-	-	-	-	-	-	-	15	-	-
15	-	-	-	15	-	-	-	-	-	-	-	-
16	-	-	-	-	5	1	-	3	-	-	6	-
Total	11	4	11	15	5	148	25	3	76	86	6	10

3.2.3 Gas Utility

The gas utilities that serve the homes surveyed in this projected are provided in Table 3-5. The gas utilities for each of the homes are summarized by climate zone. The vast majority of the homes surveyed are served by Pacific Gas and Electric and Southern California Gas for their natural gas service.

Table 3-5 Gas Utility Serving Household

Climate Zone	PG&E	SDG&E	South West Gas	Southern Cal. Gas
1	15	-	-	-
2	15	-	-	-
3	18	-	-	-
4	15	-	-	-
5	6	-	-	9
6	-	-	-	15
7	-	18	-	-
8	-	-	-	18
9	-	-	-	15
10	-	-	-	52
11	25	-	-	-
12	99	-	-	-
13	15	-	-	20
14	-	-	7	8
15	-	-	-	15
16	-	-	-	-
Total	208	18	7	152

3.2.4 Other Fuel Sources

Besides electric and gas service, other fuels are used in the homes surveyed. This is especially true in areas that have no natural gas service. These fuels included propane, wood and oil. A summary of the usage of these other fuels are presented in Table 3-6 by climate zone.

Table 3-6 Other Fuel Sources Used By Household

Climate Zone	Propane	Wood	Oil/ Kerosene
1	-	5	-
2	-	3	-
3	-	2	-
4	-	-	-
5	-	2	-
6	-	-	-
7	-	1	-
8	1	-	-
9	-	-	-
10	10	2	1
11	-	4	-
12	-	6	-
13	1	4	-
14	-	-	-
15	-	-	-
16	11	11	1
Total	23	40	2

3.2.5 Type Of Home

For this project, three types of homes were defined. These types were standard tract homes, custom tract homes and custom homes. The standard tract home is one of several models built within a development. Custom tract homes are homes which are built in a development and to certain specifications. Custom homes are built on individual lots and are not within a development.

The home types surveyed are presented in Table 3-7 by climate zone. The vast majority of homes surveyed for this project were standard tract homes.

Table 3-7 Type Of Homes Surveyed

Climate Zone	Standard tract home	Custom tract home	Custom home
1	9	2	4
2	14	-	1
3	14	4	-
4	15	-	-
5	8	4	3
6	15	-	-
7	18	-	-
8	18	-	-
9	12	-	3
10	51	1	-
11	20	3	2
12	84	12	3
13	24	6	5
14	11	2	2
15	14	-	1
16	2	1	12
Total	329	35	36

3.2.6 Number Of Bedrooms

In Table 3-8, the average number of bedrooms for the homes surveyed are presented by climate zone. In addition, the standard deviation, the minimum value and the maximum value are shown in this table. This data shows that the average number of bedrooms in these newly constructed homes is just over three and one-half bedrooms per home. This value is consistent across all climate zones.

Table 3-8 Average Number Of Bedrooms Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	3.20	0.41	3	4	15
2	3.27	0.46	3	4	15
3	3.78	0.65	3	5	18
4	3.93	0.70	3	5	15
5	3.00	0.65	2	4	15
6	3.67	0.82	2	5	15
7	4.00	0.49	3	5	18
8	3.61	0.61	3	5	18
9	3.47	0.99	2	6	15
10	3.44	0.67	2	5	52
11	3.40	0.50	3	4	25
12	3.74	0.65	3	5	99
13	3.49	0.61	3	5	35
14	3.27	0.80	2	5	15
15	3.53	0.52	3	4	15
16	3.20	0.41	3	4	15

3.2.7 Number Of Bathrooms

In the homes surveyed for this project, the average number of bathrooms were just over two and one-half bathrooms per home. Table 3-9 shows the average number of bathrooms in each home by climate zone. These levels are somewhat equal in all climate zones. Also, the standard deviation, the minimum value and the maximum value are presented in this table.

Table 3-9 Average Number Of Bathrooms Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	2.40	0.51	2	3	15
2	3.00	0.00	3	3	15
3	2.83	0.71	2	5	18
4	3.00	0.00	3	3	15
5	2.60	0.83	2	5	15
6	2.80	0.41	2	3	15
7	2.72	0.46	2	3	18
8	3.06	0.24	3	4	18
9	3.53	1.55	3	9	15
10	2.77	0.47	2	4	52
11	2.36	0.49	2	3	25
12	2.54	0.50	2	3	99
13	2.34	0.48	2	3	35
14	2.47	0.52	2	3	15
15	2.13	0.52	2	4	15
16	2.20	0.41	2	3	15

3.2.8 Number Of Other Rooms

Table 3-10 displays the average number of other rooms (not bedrooms or bathrooms) in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of other rooms in these newly constructed homes is just over three and one-half other rooms per home, which is consistent from climate zone to climate zone.

Table 3-10 Average Number Of Other Rooms Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	3.93	1.03	2	6	15
2	3.53	0.64	3	5	15
3	4.12	1.11	2	6	17
4	3.47	0.99	2	5	15
5	3.87	1.51	2	6	15
6	3.60	0.91	2	5	15
7	4.28	0.57	3	5	18
8	3.28	0.57	2	4	18
9	3.33	0.98	2	6	15
10	3.27	0.82	2	6	52
11	3.64	0.64	2	5	25
12	3.66	0.72	2	6	99
13	3.86	1.29	1	8	35
14	3.67	0.72	3	5	15
15	3.67	0.82	3	6	15
16	3.87	0.83	2	5	15

3.2.9 Garage Size

In the newly constructed homes surveyed for this project, the average garage size was less than two and one-half garage spaces per house. Table 3-11 presents the average number of garage spaces at each home by climate zone. Also, the standard deviation, the minimum value and the maximum value of garage spaces are presented in this table.

Table 3-11 Average Number Of Garage Spaces Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	2.07	0.26	2	3	15
2	2.13	0.35	2	3	15
3	2.56	0.51	2	3	18
4	2.20	0.41	2	3	15
5	2.13	0.35	2	3	15
6	2.80	0.41	2	3	15
7	2.94	0.24	2	3	18
8	2.61	0.50	2	3	18
9	2.33	0.49	2	3	15
10	2.58	0.54	1	3	52
11	2.44	0.51	2	3	25
12	2.62	0.49	2	3	99
13	2.29	0.52	2	4	35
14	2.33	0.49	2	3	15
15	2.07	0.26	2	3	15
16	2.00	0.38	1	3	15

3.3 Structure

Results of analyses conducted on the data collected on the 400 homes in the 16 climate zones of California with relation to the structure of the homes are presented here. These analyses include: conditioned floor area, ceiling area, ceiling insulation level, ground floor area, floor type, wall insulation level, window area and glazing type.

3.3.1 Conditioned Floor Area

Table 3-12 presents the average conditioned floor area for each home by climate. In addition, the standard deviation, the minimum and maximum value are presented in this table. This data shows that the average conditioned floor area in these newly constructed homes is just over 2,000 square feet per home.

Table 3-12 Average Conditioned Floor Area Per Household

Climate Zone	Average Floorspace	Standard Deviation	Minimum Floorspace	Maximum Floorspace	# Of Homes
1	1,753	439.4	1,219	3,151	15
2	2,188	418.6	1,780	3,500	15
3	2,543	903.2	1,120	4,930	18
4	2,149	594.4	1,449	3,452	15
5	2,082	962.2	933	4,400	15
6	2,220	444.1	1,027	2,788	15
7	2,323	196.2	1,925	2,600	18
8	2,255	417.0	1,556	2,822	18
9	2,419	1,075.3	1,550	6,000	15
10	2,030	491.3	1,100	3,300	52
11	1,875	410.7	1,150	2,580	25
12	2,116	505.8	1,230	3,400	99
13	2,019	475.8	1,113	3,500	35
14	1,737	494.6	1,053	2,850	15
15	1,525	590.4	933	6,000	15
16	1,815	375.4	1,282	2,500	15

3.3.2 Ceiling Area

Table 3-13 presents the average ceiling area in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average ceiling area in these newly constructed homes is nearly 1,600 square feet per home. Climate Zone 3 has the largest average ceiling area at 1,853 square feet per home, while Climate Zone 8 has the smallest average ceiling area at 1,327 square feet per home.

Table 3-13 Average Ceiling Area Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	1,444	308	815	1,821	15
2	1,579	431	1,160	3,014	15
3	1,853	603	926	3,157	18
4	1,446	475	990	2,412	15
5	1,629	632	933	3,600	15
6	1,507	253	1,027	1,973	15
7	1,879	356	1,417	2,565	18
8	1,327	204	1,056	1,771	18
9	1,341	335	958	2,179	15
10	1,494	392	738	2,400	52
11	1,651	353	1,110	2,580	25
12	1,657	343	857	2,650	99
13	1,773	400	1,003	2,685	35
14	1,469	327	1,053	2,209	15
15	1,525	369	1,210	2,590	15
16	1,419	231	1,113	1,792	15

3.3.3 Ceiling Insulation Level

Table 3-14 presents the average ceiling insulation level by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. For comparison purposes, the 1992 Standards for Package D and E are also included in Table 3-14. The survey data shows the average R-Value as slightly over R-33. The average ceiling R-Value for each of the climate zone is high and in all cases is at least 28.5.

Table 3-14 Average Ceiling Insulation Level Per Household

Climate Zone	Average R-Value	Standard Deviation	Minimum R-Value	Maximum R-Value	# Of Homes	1992 Standard Package D&E
1	32.9	3.6	30	38	15	38
2	31.6	3.2	30	38	15	30
3	29.7	8.1	19	60	18	30
4	33.3	8.5	19	60	15	30
5	28.5	4.8	17	38	15	30
6	37.9	11.2	19	60	15	30
7	33.1	3.9	30	38	18	30
8	34.7	7.0	19	48	18	30
9	34.4	4.6	24	38	15	30
10	30.5	3.3	19	39	52	30
11	35.1	3.8	30	38	25	38
12	34.1	4.3	18	49	99	38
13	32.5	5.4	18	38	35	38
14	33.7	4.0	30	38	15	38
15	32.0	7.5	30	60	15	38
16	34.4	3.8	30	38	15	38

3.3.4 Ground Floor Area

Table 3-15 presents the average ground floor area per home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows the average ground floor area as slightly over 1,500 square feet per home. The average ground floor area for Climate Zone 7 is the highest of the 16 climate zones and Climate Zone 8 the lowest of the 16 climate zones.

Table 3-15 Average Ground Floor Area Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	1,418	313	815	1,821	15
2	1,539	456	1,000	3,014	15
3	1,818	654	606	3,157	18
4	1,325	471	811	2,412	15
5	1,614	630	933	3,600	15
6	1,327	301	938	1,973	15
7	1,879	356	1,417	2,565	18
8	1,079	229	808	1,605	18
9	1,102	390	670	2,179	15
10	1,343	463	512	2,400	52
11	1,642	368	900	2,580	25
12	1,625	350	850	2,650	99
13	1,773	400	1,003	2,685	35
14	1,424	359	840	2,209	15
15	1,525	369	1,210	2,590	15
16	1,419	231	1,113	1,792	15

3.3.5 Floor Type

Table 3-16 presents the predominant floor types by climate zone. Eighty-eight percent of the homes that took part in the on-site survey have a concrete slab as the predominant floor type. The predominant floor type varies greatly from climate zone to climate zone. Vented crawl space is the predominant floor type in Climate Zones 1, 2 and 16.

Table 3-16 Predominate Floor Type Per Household

Climate Zone	**Concrete Slab**		**Vented Crawl Space**		**Garage/Unheated Basement**	
	# Of Homes	**(%)**	**# Of Homes**	**(%)**	**# Of Homes**	**(%)**
1	5	33.3%	10	66.7%	-	0.0%
2	5	33.3%	10	66.7%	-	0.0%
3	12	66.7%	6	33.3%	-	0.0%
4	11	73.3%	4	26.7%	-	0.0%
5	11	73.3%	4	26.7%	-	0.0%
6	14	93.3%	1	6.7%	-	0.0%
7	18	100.0%	-	0.0%	-	0.0%
8	18	100.0%	-	0.0%	-	0.0%
9	15	100.0%	-	0.0%	-	0.0%
10	51	98.1%	1	1.9%	-	0.0%
11	25	100.0%	-	0.0%	-	0.0%
12	86	86.9%	11	11.1%	2	2.0%
13	35	100.0%	-	0.0%	-	0.0%
14	15	100.0%	-	0.0%	-	0.0%
15	15	100.0%	-	0.0%	-	0.0%
16	-	0.0%	14	93.3%	1	6.7%

3.3.6 Wall Insulation Level

Table 3-17 presents the average wall insulation level by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. For comparison purposes, the 1992 Standards for Package D and E are also included in Table 3-17. The on-site data shows that the average R-Value is 15.2. The average wall R-Value for each of the climate zone is high and in all cases is at least 12.8.

Table 3-17 Average Wall Insulation Level Per Household

Climate Zone	Average R-Value	Standard Deviation	Minimum R-Value	Maximum R-Value	# Of Homes	1992 Standard Package D&E
1	13.8	2.0	13	19	15	21
2	13.3	1.7	11	19	15	13
3	16.3	3.9	13	24	18	13
4	13.5	1.7	13	20	15	13
5	13.8	2.0	13	19	15	13
6	15.1	5.0	13	32	15	13
7	13.0	0.0	13	13	18	13
8	12.9	0.5	11	13	18	13
9	12.8	0.5	12	13	15	13
10	14.8	4.3	13	32	52	13
11	14.3	2.5	13	20	25	19
12	16.3	3.5	11	26	99	19
13	16.7	3.3	12	20	35	19
14	13.9	2.2	13	20	15	21
15	18.8	1.6	13	21	15	21
16	18.6	1.5	13	19	15	21

3.3.7 Window Area

Table 3-18 presents the average window percentage per floor area by climate zone. In addition, the standard deviation percentage, the minimum percentage and the maximum percentage are presented in this table. For comparison purposes, the 1992 Standards for Package D and E are also included in Table 3-18. This data shows that the average window percentage is 16.9 percent. Climate Zone 4 has the highest average percentage of window area at 19.6 percent, while Climate Zone 11 has the lowest percentage at 14.7 percent.

Table 3-18 Average Window Area Per Floor Area Percentage

Climate Zone	Average Percentage	Standard Deviation	Minimum Percentage	Maximum Percentage	# Of Homes	1992 Standard Package D&E
1	16.5%	4.1%	9.7%	26.2%	15	16%
2	16.5%	2.5%	11.9%	19.2%	15	16%
3	16.9%	6.3%	10.0%	31.7%	18	20%
4	19.6%	3.3%	15.5%	29.1%	15	20%
5	17.1%	4.0%	12.9%	26.2%	15	16%
6	16.0%	2.4%	11.5%	19.2%	15	20%
7	16.0%	1.9%	12.4%	19.7%	18	20%
8	18.3%	4.2%	13.7%	31.7%	18	20%
9	17.5%	4.8%	9.6%	29.4%	15	20%
10	16.6%	3.7%	6.9%	23.8%	52	20%
11	14.7%	2.2%	10.8%	20.1%	25	16%
12	17.3%	3.5%	10.8%	26.4%	99	16%
13	15.7%	3.7%	9.0%	26.3%	35	16%
14	19.4%	3.5%	13.9%	27.0%	15	16%
15	18.0%	2.9%	12.4%	22.3%	15	16%
16	15.2%	3.5%	10.2%	24.9%	15	16%

3.3.8 Glazing Type

Table 3-19 presents the total window area for all of the homes surveyed in each of the climate zones. This data shows that over 95 percent of all the windows are double pane. The remaining window square footage is single pane except for three square feet of triple pane window in Climate Zone 5.

Table 3-19 Total Window Area By Glazing Type

Climate Zone	**Single Pane (sq.ft.)**	**Single Pane (%)**	**Double Pane (sq.ft.)**	**Double Pane (%)**	**Triple Pane (sq.ft.)**	**Triple Pane (%)**
1	-	0.0%	3,431	100.0%	-	0.0%
2	-	0.0%	3,978	100.0%	-	0.0%
3	76	1.4%	5,460	98.6%	-	0.0%
4	-	0.0%	5,623	100.0%	-	0.0%
5	-	0.0%	3,968	99.9%	3	0.1%
6	1,599	37.4%	2,679	62.6%	-	0.0%
7	-	0.0%	6,401	100.0%	-	0.0%
8	1,926	27.7%	5,023	72.3%	-	0.0%
9	604	13.0%	4,047	87.0%	-	0.0%
10	730	4.8%	14,564	95.2%	-	0.0%
11	20	0.3%	5,781	99.7%	-	0.0%
12	180	0.6%	29,963	99.4%	-	0.0%
13	98	1.2%	8,119	98.8%	-	0.0%
14	-	0.0%	4,124	100.0%	-	0.0%
15	19	0.5%	3,809	99.5%	-	0.0%
16	5	0.1%	3,498	99.9%	-	0.0%

3.4 Equipment Data

Under this subsection, the results of the analyses conducted on the data collected on the 400 homes in the 16 climate zones of California for equipment are presented. These analyses include the average number of fireplaces, televisions, VCRs, computers, computer printers and fax machines.

3.4.1 Number Of Fireplaces

Table 3-20 presents the average number of fireplaces (not including air-tight wood stoves) in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of fireplaces is 1.15, with Climate Zone 3 having the largest average of 1.78 fireplaces per home. Conversely, Climate Zone 16 has lowest average of fireplaces at 0.13 fireplaces per home.

Table 3-20 Average Number Of Fireplaces Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.47	0.52	-	1	15
2	1.20	0.41	1	2	15
3	1.78	0.81	-	3	18
4	1.40	0.63	1	3	15
5	1.40	0.74	1	3	15
6	1.27	0.59	-	2	15
7	1.39	0.61	1	3	18
8	1.50	0.62	1	3	18
9	1.27	0.46	1	2	15
10	1.06	0.31	-	2	52
11	0.88	0.53	-	2	25
12	1.28	0.52	-	3	99
13	0.94	0.24	-	1	35
14	1.00	0.00	1	1	15
15	0.87	0.35	-	1	15
16	0.13	0.52	-	2	15

3.4.2 Number Of Televisions

Table 3-21 presents the average number of televisions in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of televisions in these newly constructed homes is 2.64 televisions per home. The average number of televisions per household is consistent across all climate zones.

Table 3-21 Average Number Of Televisions Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	2.47	0.92	1	4	15
2	3.13	1.19	1	5	15
3	2.83	1.04	1	4	18
4	2.67	0.72	2	4	15
5	3.13	1.64	1	7	15
6	2.60	0.83	2	4	15
7	3.39	1.38	2	7	18
8	2.44	0.86	1	4	18
9	2.80	2.01	1	9	15
10	2.71	1.25	1	6	51
11	2.32	1.18	1	6	25
12	2.44	1.07	1	6	99
13	2.74	1.12	1	5	35
14	2.33	1.11	1	4	15
15	2.80	1.21	1	5	15
16	2.53	1.06	1	5	15

3.4.3 Number Of VCRs

Table 3-22 presents the average number of VCRs in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows the average number of VCRs in these newly constructed homes as slightly over 1.7 VCRs per home.

Table 3-22 Average Number Of VCRs Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	1.47	0.92	-	4	15
2	2.07	1.16	1	5	15
3	2.00	1.24	-	4	18
4	2.47	1.64	1	7	15
5	1.60	0.83	-	3	15
6	1.93	0.59	1	3	15
7	2.06	1.30	1	6	18
8	1.44	0.51	1	2	18
9	1.73	1.03	1	4	15
10	1.88	0.89	1	4	51
11	1.40	0.82	-	4	25
12	1.56	0.73	-	4	99
13	1.51	0.66	1	3	35
14	1.60	0.83	-	3	15
15	1.67	0.62	1	3	15
16	1.87	0.83	1	4	15

3.4.4 Number Of Computers

Table 3-23 presents the average number of computers in each home by climate zone. In addition, standard deviation, minimum value and maximum value are presented in this table. This data shows that the average number of computers in these newly constructed homes is slightly under one computer per home.

Table 3-23 Average Number Of Computers Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.87	1.41	-	4	15
2	1.07	0.46	-	2	15
3	1.50	0.92	-	3	18
4	1.40	0.51	1	2	15
5	0.87	0.64	-	2	15
6	0.93	0.59	-	2	15
7	0.94	1.00	-	4	18
8	0.89	0.58	-	2	18
9	0.80	0.56	-	2	15
10	0.80	0.57	-	2	51
11	0.72	0.74	-	3	25
12	0.89	0.81	-	5	99
13	0.91	0.51	-	2	35
14	0.93	1.03	-	3	15
15	0.67	0.62	-	2	15
16	0.73	0.46	-	1	15

3.4.5 Number Of Computer Printers

Table 3-24 presents the average number of computer printers in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of computer printers in these newly constructed homes is 0.78 printers per home.

Table 3-24 Average Number Of Computer Printers Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.73	1.16	-	4	15
2	0.93	0.46	-	2	15
3	1.06	0.73	-	3	18
4	1.07	0.46	-	2	15
5	0.60	0.63	-	2	15
6	0.87	0.64	-	2	15
7	0.89	0.83	-	3	18
8	0.78	0.43	-	1	18
9	0.67	0.62	-	2	15
10	0.76	0.65	-	3	51
11	0.56	0.58	-	2	25
12	0.77	0.60	-	2	99
13	0.80	0.47	-	2	35
14	0.80	1.08	-	4	15
15	0.53	0.64	-	2	15
16	0.67	0.49	-	1	15

3.4.6 Number Of Fax Machines

Table 3-25 presents the average number of fax machines in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that about 20 percent of all the homes surveyed had fax machines.

Table 3-25 Average Number Of Fax Machines Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.13	0.35	-	1	15
2	0.47	0.52	-	1	15
3	0.44	0.62	-	2	18
4	0.33	0.49	-	1	15
5	0.13	0.35	-	1	15
6	0.07	0.26	-	1	15
7	0.28	0.46	-	1	18
8	0.11	0.32	-	1	18
9	0.33	0.49	-	1	15
10	0.20	0.45	-	2	51
11	0.08	0.28	-	1	25
12	0.20	0.43	-	2	99
13	0.14	0.36	-	1	35
14	0.13	0.35	-	1	15
15	0.27	0.46	-	1	15
16	0.07	0.26	-	1	15

3.5 Kitchen Data

Within this subsection, results of the analyses conducted on the data collected on the 400 homes in the 16 climate zones of California for kitchens are presented. These analyses include: refrigerator and freezer types, the oven and stove fuel types and the number of microwave ovens, dishwashers, garbage compactors and in-line water heaters.

3.5.1 Refrigerator Type

Table 3-26 presents the percentages of various refrigerator types by climate zone. This data shows that the most popular refrigerator types are top freezer and side-by-side units. Several freezers on the bottom refrigerators were found during the data collection.

Table 3-26 Refrigerator Types In Households

Climate Zone	Top freezer	Side-by-side	Bottom freezer	# Of Homes
1	47%	40%	13%	15
2	40%	60%	-%	15
3	33%	67%	-%	18
4	40%	60%	-%	15
5	27%	73%	-%	15
6	67%	33%	-%	15
7	28%	72%	-%	18
8	56%	44%	-%	18
9	33%	67%	-%	15
10	37%	62%	2%	52
11	44%	48%	8%	25
12	47%	51%	2%	99
13	54%	46%	-%	35
14	53%	47%	-%	15
15	60%	40%	-%	15
16	73%	27%	-%	15

3.5.2 Freezer Type

Table 3-27 and Table 3-28 present the average number of upright and chest freezers, respectively, per household in each climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in these tables. This data shows that only 14 percent of the households have upright freezers and 11 percent of the households have chest freezers.

Table 3-27 Average Number Of Upright Freezers Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.53	0.52	-	1	15
2	0.07	0.26	-	1	15
3	0.06	0.24	-	1	18
4	0.07	0.26	-	1	15
5	0.20	0.41	-	1	15
6	0.20	0.41	-	1	15
7	0.17	0.38	-	1	18
8	0.06	0.24	-	1	18
9	0.07	0.26	-	1	15
10	0.15	0.36	-	1	52
11	0.16	0.37	-	1	25
12	0.17	0.38	-	1	99
13	0.14	0.36	-	1	35
14	0.13	0.35	-	1	15
15	-	-	-	-	15
16	0.33	0.49	-	1	15

Table 3-28 Average Number Of Chest Freezers Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.27	0.46	-	1	15
2	0.07	0.26	-	1	15
3	0.06	0.24	-	1	18
4	0.13	0.35	-	1	15
5	-	-	-	-	15
6	0.20	0.41	-	1	15
7	0.17	0.38	-	1	18
8	-	-	-	-	18
9	-	-	-	-	15
10	0.12	0.32	-	1	52
11	0.04	0.20	-	1	25
12	0.06	0.24	-	1	99
13	0.20	0.41	-	1	35
14	0.20	0.41	-	1	15
15	0.07	0.26	-	1	15
16	0.20	0.41	-	1	15

3.5.3 Oven Fuel Type

Table 3-29 shows percentages of oven fuel type by climate zone. This data shows that electricity and natural gas are the most popular fuels for the oven.

Table 3-29 Oven Fuel Types In Households

Climate Zone	Electricity	Natural Gas	Propane	# Of Homes
1	33%	67%	-%	15
2	53%	47%	-%	15
3	61%	39%	-%	18
4	60%	40%	-%	15
5	47%	53%	-%	15
6	67%	33%	-%	15
7	44%	56%	-%	18
8	39%	61%	-%	18
9	40%	60%	-%	15
10	37%	63%	-%	52
11	56%	44%	-%	25
12	73%	26%	1%	99
13	63%	37%	-%	35
14	7%	93%	-%	15
15	7%	93%	-%	15
16	73%	0%	27%	15

3.5.4 Cooking Fuel Type

Table 3-30 presents percentages of cooking fuel type by climate zone. This data shows that natural gas is the predominant cooking fuel in most climate zones.

Table 3-30 Stove Fuel Types In Households

Climate Zone	Electricity	Natural Gas	Propane	# Of Homes
1	13%	87%	-%	15
2	20%	80%	-%	15
3	50%	50%	-%	18
4	13%	87%	-%	15
5	13%	87%	-%	15
6	7%	93%	-%	15
7	-%	100%	-%	18
8	-%	100%	-%	18
9	-%	100%	-%	15
10	-%	100%	-%	52
11	24%	76%	-%	25
12	29%	71%	-%	99
13	37%	63%	-%	35
14	7%	93%	-%	15
15	-%	100%	-%	15
16	80%	0%	20%	15

3.5.5 Number Of Microwave Ovens

Table 3-31 presents the average number of microwave ovens per home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of microwave ovens is just over one microwave oven per home.

Table 3-31 Average Number Of Microwave Ovens Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	1.00	0.00	1	1	15
2	1.07	0.26	1	2	15
3	1.17	0.38	1	2	18
4	1.00	0.38	-	2	15
5	1.00	0.00	1	1	15
6	1.07	0.26	1	2	15
7	1.22	0.43	1	2	18
8	1.11	0.32	1	2	18
9	1.20	0.41	1	2	15
10	1.10	0.30	1	2	52
11	1.04	0.20	1	2	25
12	1.01	0.33	-	2	99
13	1.00	0.00	1	1	35
14	0.73	0.46	-	1	15
15	1.00	0.00	1	1	15
16	1.07	0.26	1	2	15

3.5.6 Number Of Dishwashers

Table 3-32 presents the average number of dishwashers in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of dishwashers in these newly constructed homes is just under one dishwasher per home.

Table 3-32 Average Number Of Dishwashers Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	1.00	0.00	1	1	15
2	1.00	0.00	1	1	15
3	0.94	0.24	-	1	18
4	1.00	0.00	1	1	15
5	1.07	0.26	1	2	15
6	0.93	0.26	-	1	15
7	1.00	0.00	1	1	18
8	1.00	0.00	1	1	18
9	1.00	0.00	1	1	15
10	1.00	0.00	1	1	52
11	0.96	0.20	-	1	25
12	0.99	0.10	-	1	99
13	0.97	0.17	-	1	35
14	1.00	0.00	1	1	15
15	1.00	0.00	1	1	15
16	1.00	0.00	1	1	15

3.5.7 Number Of Garbage Compactors

Table 3-33 presents the average number of garbage compactors in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of garbage compactors in these newly constructed homes is 0.19. In other words, only 19 percent of the homes surveyed had garbage compactors.

Table 3-33 Average Number Of Garbage Compactors Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.13	0.35	-	1	15
2	0.53	0.52	-	1	15
3	0.33	0.49	-	1	18
4	0.07	0.26	-	1	15
5	0.40	0.51	-	1	15
6	0.93	0.26	-	1	15
7	0.06	0.24	-	1	18
8	0.17	0.38	-	1	18
9	0.33	0.49	-	1	15
10	0.06	0.24	-	1	52
11	0.20	0.41	-	1	25
12	0.17	0.38	-	1	99
13	0.09	0.28	-	1	35
14	0.07	0.26	-	1	15
15	0.07	0.26	-	1	15
16	0.07	0.26	-	1	15

3.5.8 Number Of In-Line Water Heaters

Table 3-34 presents the average number of in-line water heaters in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows there are 0.07 in-line water heaters per home. This means of the 400 homes surveyed for this project, only 7 percent of the homes surveyed had in-line water heaters.

Table 3-34 Average Number Of In-Line Water Heaters Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1					15
2	0.40	0.51	-	1	15
3	0.28	0.46	-	1	18
4					15
5	0.07	0.26	-	1	15
6					15
7	0.06	0.24	-	1	18
8					18
9					15
10					52
11	0.12	0.33	-	1	25
12	0.11	0.32	-	1	99
13	0.06	0.24	-	1	35
14					15
15					15
16	0.07	0.26	-	1	15

3.6 Laundry Data

In this subsection, the results of the analyses conducted on the database will be used provide information on various laundry items. These analyses include: the number of clothes washers; the number or clothes dryer; and the dryer fuel type.

3.6.1 Number Of Clothes Washers

Table 3-35 presents the average number of clothes washers in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the average number of clothes washers in these newly constructed homes is exactly one clothes washer per home in all climate zones.

Table 3-35 Average Number Of Clothes Washers Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	1.00	0.00	1	1	15
2	1.00	0.00	1	1	15
3	1.00	0.00	1	1	18
4	1.00	0.00	1	1	15
5	1.00	0.00	1	1	15
6	1.00	0.00	1	1	15
7	1.00	0.00	1	1	18
8	1.00	0.00	1	1	18
9	1.00	0.00	1	1	15
10	1.00	0.00	1	1	52
11	1.00	0.00	1	1	25
12	1.00	0.00	1	1	99
13	1.00	0.00	1	1	35
14	1.00	0.00	1	1	15
15	1.00	0.00	1	1	15
16	1.00	0.00	1	1	15

3.6.2 Number Of Dryers

Table 3-36 presents the average number of clothes dryers in each home by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that almost all of the homes surveyed had a clothes dryer and at least one of the homes in Climate Zone 8 and in Climate Zone 10 had two clothes dryers.

Table 3-36 Average Number Of Dryers Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	1.00	0.00	1	1	15
2	1.00	0.00	1	1	15
3	1.00	0.00	1	1	18
4	1.00	0.00	1	1	15
5	1.00	0.00	1	1	15
6	1.00	0.00	1	1	15
7	1.00	0.00	1	1	18
8	1.11	0.32	1	2	18
9	1.00	0.00	1	1	15
10	1.04	0.19	1	2	52
11	0.96	0.20	-	1	25
12	1.00	0.00	1	1	99
13	1.00	0.00	1	1	35
14	1.00	0.00	1	1	15
15	0.93	0.26	-	1	15
16	1.00	0.00	1	1	15

3.6.3 Dryer Fuel Type

Table 3-37 presents the clothes dryer fuel types for each home by climate zone. According to this data, the use of natural gas as a clothes dryer fuel is just a little greater than the use of electricity as a source of fuel for a clothes dryer. Fuel shares by climate zone varied significantly.

Table 3-37 Dryer Fuel Types In Households

Climate Zone	Electricity	Natural Gas	Propane	# Of Homes
1	67%	33%	-%	15
2	73%	27%	-%	15
3	83%	17%	-%	18
4	73%	27%	-%	15
5	20%	80%	-%	15
6	13%	87%	-%	15
7	17%	83%	-%	18
8	6%	94%	-%	18
9	13%	87%	-%	15
10	15%	85%	-%	52
11	71%	29%	-%	24
12	72%	28%	-%	99
13	40%	60%	-%	35
14	20%	80%	-%	15
15	36%	64%	-%	14
16	93%	-%	7%	15

3.7 Hot Water Data

This subsection reports results of the analyses conducted on the data collected related to water heating from the 400 homes in the 16 climate zones of California. These analyses included: hot water tank fuel data, hot water tank capacity, water heater tank insulation information and the water heater energy factor.

3.7.1 Fuel Type

Table 3-38 presents the water heater fuel types by climate zone. This data shows the frequency of the various fuel types by climate zone. Reviewing this data shows that nearly all of the water heaters in the surveyed homes were natural gas water heaters.

Table 3-38 Water Heater Fuel Types In Households

Climate Zone	Electricity	Natural Gas	Propane	Solar w/NG backup	Solar w/elec backup	# Of Homes
1	-%	100%	-%	-%	-%	15
2	-%	100%	-%	-%	-%	15
3	-%	100%	-%	-%	-%	18
4	-%	100%	-%	-%	-%	15
5	-%	100%	-%	-%	-%	15
6	-%	100%	-%	-%	-%	15
7	-%	100%	-%	-%	-%	18
8	-%	100%	-%	-%	-%	18
9	-%	100%	-%	-%	-%	15
10	-%	100%	-%	-%	-%	52
11	-%	100%	-%	-%	-%	25
12	1%	98%	-%	1%	-%	99
13	-%	100%	-%	-%	-%	35
14	-%	100%	-%	-%	-%	15
15	-%	100%	-%	-%	-%	15
16	7%	-%	87%	-%	7%	15

3.7.2 Tank Capacity

Table 3-39 presents the average water heater tank capacity by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows the average tank capacity as slightly over 48 gallons.

Table 3-39 Average Water Heater Tank Capacity Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	41.53	6.51	38	65	15
2	60.00	12.68	50	75	15
3	63.53	11.83	50	75	17
4	47.33	4.58	40	50	15
5	45.00	5.22	40	50	12
6	48.00	5.61	30	50	15
7	47.00	5.01	38	50	18
8	48.89	3.23	40	50	18
9	50.71	6.16	40	70	14
10	48.50	5.56	40	75	50
11	44.56	5.37	38	50	25
12	48.29	8.01	38	75	93
13	43.55	4.86	40	50	31
14	45.00	5.22	40	50	12
15	44.20	9.50	38	75	15
16	44.62	5.19	40	50	13

3.7.3 Water Heater Tank Insulation

Table 3-40 presents the frequency of insulated water heater tanks in each climate zone. This data shows the overall percentage of insulated water heater tanks as approximately 12 percent.

Table 3-40 Frequency Of Insulated Water Heater Tanks

Climate Zone	Yes	No	# Of Homes
1	7%	93%	15
2	-%	100%	15
3	6%	94%	18
4	-%	100%	15
5	2-%	80%	15
6	7%	93%	15
7	17%	83%	18
8	-%	100%	18
9	13%	87%	15
10	8%	92%	52
11	4%	96%	25
12	11%	89%	99
13	37%	63%	35
14	13%	87%	15
15	7%	93%	15
16	2-%	80%	15

3.7.4 Water Heater Energy Factor

Table 3-41 presents the average water heater Energy Factor (EF) by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that the overall average Energy Factor for this project is 0.58.

Table 3-41 Average Energy Factor (EF) Of Water Heaters

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	0.61	0.03	0.52	0.62	15
2	0.54	0.02	0.53	0.60	9
3	0.55	0.04	0.51	0.60	12
4	0.59	0.03	0.53	0.62	15
5	0.59	0.03	0.51	0.62	12
6	0.59	0.03	0.53	0.62	13
7	0.57	0.03	0.53	0.61	17
8	0.57	0.02	0.53	0.60	18
9	0.59	0.02	0.53	0.60	14
10	0.60	0.02	0.53	0.62	48
11	0.59	0.03	0.53	0.62	22
12	0.58	0.03	0.51	0.62	82
13	0.60	0.02	0.53	0.62	30
14	0.59	0.03	0.53	0.61	11
15	0.61	0.03	0.51	0.62	15
16	0.58	0.03	0.53	0.61	11

3.8 Pool/Spa Data

Under this subsection, results of the analyses conducted on the data collected on the 400 homes in the 16 climate zones of California are presented for pool/spa data. These analyses include: the pool type, pool heater fuel type, spa fuel type, efficiency of pool heater and efficiency of the spa heater.

3.8.1 Pool Type

Table 3-42 presents the frequencies of the swimming pool and spa types by climate zone. This data shows that more than 75 percent of the homes surveyed had no swimming pool or spa. The most popular spa type is an above ground spa. The most popular pool type is the in-ground pool.

Table 3-42 Swimming Pool And Spa Types

Climate Zone	Above ground pool	In ground pool	Above ground pool & spa	In ground pool & spa	In ground pool/ Above ground spa	In ground spa	Above ground spa	No pool or spa	# Of Homes
1	-%	-%	-%	-%	-%	7%	7%	87%	15
2	-%	-%	-%	-%	-%	-%	27%	73%	15
3	-%	-%	-%	-%	-%	-%	11%	89%	18
4	-%	-%	-%	-%	-%	-%	-%	100%	15
5	-%	-%	-%	-%	-%	-%	13%	87%	15
6	-%	-%	-%	-%	-%	-%	27%	73%	15
7	-%	-%	-%	6%	11%	-%	-%	83%	18
8	-%	-%	-%	17%	11%	-%	11%	61%	18
9	-%	-%	-%	7%	-%	-%	-%	93%	15
10	-%	2%	-%	6%	6%	-%	4%	83%	52
11	4%	8%	-%	-%	-%	-%	-%	88%	25
12	2%	11%	1%	5%	5%	-%	12%	64%	99
13	-%	14%	-%	3%	-%	-%	11%	71%	35
14	7%	-%	7%	7%	-%	-%	-%	80%	15
15	-%	-%	-%	13%	-%	-%	-%	87%	15
16	-%	-%	-%	-%	-%	7%	7%	87%	15

3.8.2 *Pool Heater Fuel Type*

Table 3-43 presents frequencies of the pool heater fuel type by climate zone. Of the heated pool types, natural gas is the most popular for heating pools in California.

Table 3-43 Swimming Pool Heater Fuel Types

Climate Zone	Natural Gas	Electricity	Solar only	Insulated blanket/ cover	Solar with insulated cover	Solar w/NG backup & blanket	Not heated	# Of Homes
1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
3	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
4	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
6	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0
7	100%	-%	-%	-%	-%	-%	-%	3
8	100%	-%	-%	-%	-%	-%	-%	5
9	100%	-%	-%	-%	-%	-%	-%	1
10	71%	14%	14%	-%	-%	-%	-%	7
11	33%	-%	-%	-%	-%	-%	67%	3
12	8%	4%	16%	16%	4%	4%	48%	25
13	-%	-%	-%	17%	-%	-%	83%	6
14	33%	-%	-%	-%	-%	-%	67%	3
15	100%	-%	-%	-%	-%	-%	-%	1
16	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0

3.8.3 *Efficiency Of Pool Heater*

Efficiency data for only four natural gas swimming pool heaters was collected during this project. Analysis of these four heaters show the average efficiency for the swimming pool heaters is slightly less than 80 percent.

3.8.4 Spa Fuel Type

Table 3-44 presents the frequencies of the spa heater fuel type by climate zone. The most popular fuel type for heating a spa is electricity. About half as many homes use natural gas for heating their hot tubs.

Table 3-44 Spa Heater Fuel Types

Climate Zone	Natural Gas	Electricity	Insulated blanket /cover	Electric w/insulated cover	Solar w/NG backup & blanket	Not heated	# Of Homes
1	-%	100%	-%	-%	-%	-%	2
2	-%	100%	-%	-%	-%	-%	4
3	-%	-%	-%	100%	-%	-%	2
4	N/A	N/A	N/A	N/A	N/A	N/A	0
5	-%	100%	-%	-%	-%	-%	2
6	25%	75%	-%	-%	-%	-%	4
7	67%	33%	-%	-%	-%	-%	3
8	71%	29%	-%	-%	-%	-%	7
9	100%	-%	-%	-%	-%	-%	1
10	38%	63%	-%	-%	-%	-%	8
11	N/A	N/A	N/A	N/A	N/A	N/A	0
12	9%	61%	4%	22%	4%	-%	23
13	2-%	8-%	-%	-%	-%	-%	5
14	5-%	5-%	-%	-%	-%	-%	2
15	5-%	5-%	-%	-%	-%	-%	2
16	-%	100%	-%	-%	-%	-%	2

3.8.5 Efficiency Of Spa Heater

Efficiency data was collected on only two natural gas spa heaters during this project. Analysis of these two heaters show the average efficiency for the swimming pool heaters is about 80 percent.

3.9 Heating Equipment

Under this subsection, results of the analyses conducted on the project database from the 400 homes in the 16 climate zones of California are documented related to space heating equipment. These analyses include: the heating type, the heating fuel type and the AFUE of the furnaces.

3.9.1 Type

Table 3-45 presents the frequencies of the space heating types in the 400 homes in 16 climate zones surveyed for the project. These frequencies are presented by climate zone. Reviewing this data shows that the vast majority space heating type in all climate zones is a central furnace.

Table 3-45 Household Space Heating Types

Climate Zone	Central furnace	Wall furnace	Other	# Of Homes
1	100%	-%	-%	15
2	100%	-%	-%	15
3	100%	-%	-%	18
4	100%	-%	-%	15
5	80%	-%	2-%	15
6	100%	-%	-%	15
7	100%	-%	-%	18
8	100%	-%	-%	18
9	93%	7%	-%	15
10	100%	-%	-%	52
11	100%	-%	-%	25
12	100%	-%	-%	99
13	100%	-%	-%	35
14	100%	-%	-%	15
15	100%	-%	-%	15
16	87%	7%	7%	15

3.9.2 Fuel Type

Table 3-46 presents frequencies of space heating fuel types by climate zone. This data shows the vast majority of the newly constructed homes in the state are heated by natural gas, except where it is not available. In those cases, propane is the fuel of choice.

Table 3-46 Household Space Heating Fuel Types

Climate Zone	Natural Gas	Propane	Electricity	Other	# Of Homes
1	100%	-%	-%	-%	15
2	100%	-%	-%	-%	15
3	100%	-%	-%	-%	18
4	100%	-%	-%	-%	15
5	100%	-%	-%	-%	15
6	100%	-%	-%	-%	15
7	100%	-%	-%	-%	18
8	100%	-%	-%	-%	18
9	100%	-%	-%	-%	15
10	100%	-%	-%	-%	52
11	100%	-%	-%	-%	25
12	100%	-%	-%	-%	99
13	100%	-%	-%	-%	35
14	100%	-%	-%	-%	15
15	100%	-%	-%	-%	15
16	0%	87%	7%	7%	15

3.9.3 Space Heating Efficiency - AFUE

Table 3-47 presents the average AFUE for the gas furnaces surveyed during this project by climate zone. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. For the 400 homes surveyed for this project, the average AFUE was just over 79 percent. The current AFUE Standard is 78 percent for gas furnaces.

Table 3-47 Average AFUE Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	80.90	3.96	78	92	10
2	78.73	1.62	76	80	15
3	79.18	3.40	76	90	17
4	77.67	1.84	76	80	15
5	78.33	5.29	76	92	9
6	79.64	4.20	75	92	14
7	77.27	2.49	75	81	15
8	76.00	0.00	76	76	14
9	81.08	6.79	76	92	12
10	79.75	6.12	75	92	32
11	78.85	3.42	75	90	20
12	78.00	2.89	75	92	69
13	79.14	1.53	76	81	21
14	81.71	7.25	76	92	7
15	80.07	1.83	75	82	15
16	84.78	5.45	80	91	9

3.10 Cooling Equipment

Under this subsection, results of the analyses conducted on the project database from the 400 homes in the 16 climate zones of California for cooling equipment are documented. These analyses include: the cooling type and the SEER of the air conditioners.

3.10.1 Type

Table 3-48 presents the frequencies of cooling types by climate zone. This data shows that over 70 percent of the homes are cooled with split systems. It also shows that 22 percent of the homes have no mechanical cooling.

Table 3-48 Household Cooling Types

Climate Zone	Packaged System	Split System	Direct Evaporative	None	# Of Homes
1	-%	-%	-%	100%	15
2	-%	33%	-%	67%	15
3	6%	61%	-%	33%	18
4	-%	80%	-%	20%	15
5	-%	-%	-%	100%	15
6	-%	7%	7%	87%	15
7	-%	44%	-%	56%	18
8	-%	100%	-%	-%	18
9	-%	100%	-%	-%	15
10	2%	98%	-%	-%	52
11	-%	100%	-%	-%	25
12	3%	96%	-%	1%	99
13	49%	51%	-%	-%	35
14	2-%	73%	-%	7%	15
15	-%	100%	-%	-%	15
16	-%	-%	20%	80%	15

3.10.2 Space Cooling Efficiency - SEER

Finally, table 3-49 presents the average SEERs by climate zone, with regard to the air-conditioners surveyed for this project. In addition, the standard deviation, the minimum value and the maximum value are presented in this table. This data shows that average SEER for this project is 10.78. The current SEER Standard for package units is 9.7.

Table 3-49 Average SEER Per Household

Climate Zone	Average	Standard Deviation	Minimum	Maximum	# Of Homes
1	N/A	N/A	N/A	N/A	0
2	9.63	0.25	9.5	10.0	4
3	10.10	1.06	9.3	12.5	12
4	10.49	1.19	9.2	12.0	12
5	N/A	N/A	N/A	N/A	0
6	12.00	0.00	12.0	12.0	1
7	10.06	0.56	9.0	10.5	8
8	9.79	0.70	9.3	12.0	17
9	10.02	0.75	9.0	12.0	13
10	10.36	0.94	10.0	12.0	49
11	10.59	1.20	9.0	12.5	24
12	10.11	0.88	9.0	12.3	85
13	11.05	1.23	9.0	12.8	22
14	10.79	1.27	9.0	12.0	11
15	10.78	1.54	9.2	14.0	15
16	N/A	N/A	N/A	N/A	0

4.0 SUMMARY AND ANALYSIS OF REMOVAL OR ADDITION OF ENERGY EFFICIENCY MEASURES

The analysis presented in this section is designed to answer three important questions relating to the addition, removal and replacement of energy efficient measures in these 400 newly constructed homes. These questions are:

- What energy efficient changes have been made in the homes
- Why were these changes made
- What sources of information were used to make the change

These changes are in the area of:

- Lighting (including indoor and outdoor lighting)
- Structure
- Window coverings
- Landscaping
- Water fixtures
- Heating system
- Cooling system

4.1 Lighting

Under this section, changes with regard to general indoor lighting, kitchen lighting, bathroom lighting and outdoor lighting are reviewed. In some cases, these changes may be only a light bulb, but more often than not, relate to more extensive fixture changes.

4.1.1 Indoor Lighting

This section analyses the replacement of incandescent lamps with compact fluorescent lamps and lighting fixture changeouts. In addition to the type of changeout, this section investigates the reason for any lighting changes and the sources of information for any changes.

4.1.1.1 Incandescent Lamp Replacement

Table 4-1 presents a count on the number of homes that replaced an incandescent lamp with a compact fluorescent lamp. As can be seen by the table, roughly 10 percent of the newly constructed homes have replaced incandescent lamps with compact fluorescent lamps.

Table 4-1 Frequency Of Incandescent Lamp Changes

Response	Freq.
Yes	44
No	355
Don't Know	1
TOTAL	400

4.1.1.2 Number Of Incandescent Lamp Replacements

While Table 4-1 presented the frequency of homeowner involvement in the replacement of incandescent lamp with compact fluorescent lamps, Table 4-2 presents the average number lamps changed out in those instances. This table shows the average number of changeouts is 3.1.

Table 4-2 Average Number Of Incandescent Lamps Replaced Per Household

Mean	Std. Dev.	n
3.1	2.87	33

4.1.1.3 Reasons For Incandescent Lamp Change

Table 4-3 presents the reasons homeowners gave for their replacement of incandescent lamps with compact fluorescent lamps. Most of the answers given for this question directly or indirectly relate to energy use, energy savings or the utility.

Table 4-3 Reasons For Incandescent Lamp Change

Response	Freq.
Wanted a change in lighting type	4
Wanted to reduce utility bill	37
Utility rebate	3
PG&E gave lamps	1
Last longer	2
Cooler	1
Conserve energy	1
Reduce heat	1
Experimental	1
Better light	1

4.1.1.4 Fluorescent Lighting Fixture Change

Table 4-4 presents a count on the number of homes that removed, replaced or added fluorescent lighting fixtures. The majority of actions taken by homeowners is to add or replace a fluorescent fixture. Only five homeowners removed the fluorescent fixture.

Table 4-4 Frequency Of Fluorescent Lighting Fixture Changes

Response	Freq.
Removed	5
Replaced	50
Added	97
No	248
TOTAL	400

4.1.1.5 Reason For Fluorescent Lighting Fixture Change

Table 4-5 presents the reasons homeowners gave for their fluorescent lighting fixture change. Most of the answers for this question related to a change in lighting type.

Table 4-5 Reasons For Fluorescent Lighting Fixture Changes

Response	Removed	Replaced	Added
Needed additional/reduced lighting	1	4	8
Wanted a change in lighting type	N/A	44	64
Light fixtures were broken/malfunctioning	-	-	N/A
Wanted to reduce utility bill	1	2	N/A
Utility rebate	N/A	1	-
Did not like	2	-	-
Upgrade fixture	-	1	-
Price	-	1	-
Salvaged building	-	1	-
Aesthetics	-	1	-

4.1.1.6 Source For Change

Past experience was given the most frequently for the source of information for a fluorescent lighting fixture change. This information is provided in Table 4-6.

Table 4-6 Sources For Lighting Fixture Changes

Response	Freq.
Past experience	94
Utility billing insert/utility rep	6
Salesperson	12
Advertisements	9
Electrical/construction contractor	10
Friend or neighbor	6
Brochure	1
Looked at swap meets	1
Lighting specialist	1

4.1.2 Kitchen Lighting

This section analyses the replacement of incandescent lamps with compact fluorescent lamps and lighting fixture changeouts. In addition to the type of changeout, this section also investigates the reason for any lighting changes and the sources of information for any changes.

4.1.2.1 Incandescent Lamp Replacement

Table 4-7 presents a count on the number of homes that replaced an incandescent lamp with a compact fluorescent lamp. As can be seen by the table, roughly two percent of the newly constructed homes have replaced incandescent lamps with compact fluorescent lamps in the kitchen.

Table 4-7 Frequency Of Kitchen Incandescent Lamp Changes

Response	Freq.
Yes	10
No	389
Don't Know	1
TOTAL	400

4.1.2.2 Number Of Incandescent Lamp Replacements

While Table 4-7 presented the frequency of homeowner involvement in the replacement of incandescent lamp with compact fluorescent lamps in the kitchen, Table 4-8 presents the average number lamps changed out in those instances. This table shows the average number of changeouts is 2.0.

Table 4-8 Average Number Of Kitchen Incandescent Lamps Replaced

Mean	Std. Dev.	n
2.0	1.83	7

4.1.2.3 Reasons For Incandescent Lamp Change

Table 4-9 gives the reasons homeowners replaced incandescent lamps with compact fluorescent lamps in the kitchen. Most of the answers for this question directly or indirectly relate to energy use, energy savings or the utility.

Table 4-9 Reasons For Kitchen Incandescent Lamp Change

Response	Freq.
Wanted a change in lighting type	2
Wanted to reduce utility bill	9
Utility rebate	1

4.1.2.4 Lighting Fixture Change

Table 4-10 presents a count on the number of homes that removed, replaced or added fluorescent lighting fixtures in the kitchen. The majority of actions taken by homeowners was to add or replace a fluorescent fixture. Only one homeowner removed the fluorescent fixture in the kitchen.

Table 4-10 Frequency Of Kitchen Lighting Fixture Changes

Response	Freq.
Removed	1
Replaced	11
Added	19
No	369
TOTAL	400

4.1.2.5 Reason For Fluorescent Lighting Fixture Change

Table 4-11 presents the reasons homeowners gave for a fluorescent fixture change in the kitchen. Most of the answers for this question directly or indirectly relate to light level or lighting type.

Table 4-11 Reasons For Kitchen Fluorescent Lighting Fixture Changes

Response	Removed	Replaced	Added
Needed additional/reduced lighting	-	3	18
Wanted a change in lighting type	N/A	5	-
Light fixtures were broken/malfunctioning	-	1	N/A

4.1.2.6 Reason For Incandescent Lighting Fixture Change

Table 4-12 presents the reasons homeowners gave for their replacement of incandescent lighting fixture changes. Most of the answers for this question related to change in lighting type.

Table 4-12 Reasons For Kitchen Incandescent Lighting Fixture Changes

Response	Removed	Replaced	Added
Needed additional/reduced lighting	-	1	2
Wanted a change in lighting type	N/A	6	6
Light fixtures were broken/malfunctioning	-	2	N/A

4.1.2.7 Source For Change

Past experience was the most frequently given information source for a lighting fixture change in the kitchen. This information is provided in Table 4-13.

Table 4-13 Sources For Kitchen Lighting Fixture Changes

Response	Freq.
Past experience	15
Salesperson	1
Advertisements	2
Electrical/construction contractor	2
Friend or neighbor	2
On store shelf	1
Lighting consultant	1

4.1.3 Bathroom Lighting

This section analyses the replacement of incandescent lamps with compact fluorescent lamps and lighting fixture changeouts in the bathrooms. In addition to the type of changeout, this section also investigates the reason for any lighting changes and the sources of information for any changes.

4.1.3.1 Incandescent Lamp Replacement

Table 4-14 presents a count on the number of homes that replaced an incandescent lamp with a compact fluorescent lamp in the bathroom. As can be seen by the table, only one percent of the newly constructed homes have replaced incandescent lamps with compact fluorescent lamps in the bathrooms.

Table 4-14 Frequency Of Bathroom Incandescent Lamp Changes

Response	Freq.
Yes	5
No	393
Don't Know	2
TOTAL	400

4.1.3.2 Number Of Incandescent Lamp Replacements

While Table 4-14 presented the frequency of homeowner involvement in the replacement of incandescent lamp with compact fluorescent lamps in the bathroom, Table 4-15 presents the average number lamps changed out in those instances. This table shows the average number of changeouts is 3.2.

Table 4-15 Average Number Of Bathroom Incandescent Lamps Replaced

Mean	Std. Dev.	n
3.2	3.35	5

4.1.3.3 Reasons For Incandescent Lamp Change

Table 4-16 gives the reasons homeowners replaced incandescent lamps with compact fluorescent lamps in the bathroom. All answers for this question directly relate to energy savings.

Table 4-16 Reasons For Bathroom Incandescent Lamp Change

Response	Freq.
Wanted to reduce utility bill	5

4.1.3.4 Lighting Fixture Change

Table 4-17 presents a count on the number of homes that removed, replaced or added fluorescent lighting fixtures in the bathroom. The majority of actions taken by homeowners was to add or replace a fluorescent fixture. No homeowners removed the fluorescent fixture in the bathroom.

Table 4-17 Frequency Of Bathroom Fluorescent Lighting Fixture Changes

Response	Freq.
Replaced	5
Added	3
No	392
TOTAL	400

4.1.3.5 Reason For Fluorescent Lighting Fixture Change

Table 4-18 gives the reasons homeowners replaced or added fluorescent fixtures in the bathroom. Most of the answers for this question relate to lighting type or light level.

Table 4-18 Reasons For Bathroom Fluorescent Lighting Fixture Changes

Response	Removed	Replaced	Added
Needed additional/reduced lighting	-	1	1
Wanted a change in lighting type	N/A	2	1
Light fixtures were broken/malfunctioning	-	1	N/A
Remodel of bathroom	-	1	-
Wanted to reduce utility bill	-	1	N/A

4.1.3.6 Reason For Incandescent Lighting Fixture Change

Table 4-19 gives the reasons homeowners removed, replaced or added incandescent lighting fixtures. Most of the answers for this question relate to light levels and lighting types.

Table 4-19 Reasons For Bathroom Incandescent Lighting Fixture Changes

Response	Removed	Replaced	Added
Needed additional/reduced lighting	2	-	1
Wanted a change in lighting type	N/A	-	1
Wanted to reduce utility bill	-	1	N/A

4.1.3.7 Source For Change

As in the other lighting measures, past experience was given the most frequently for the source of information for a lighting fixture changes in the bathroom. This information is provided in Table 4-20.

Table 4-20 Sources For Bathroom Lighting Fixture Changes

Response	Freq.
Past experience	3

4.1.4 Outdoor Lighting

Within this section, the replacement of incandescent lamps with compact fluorescent lamps and lighting fixture changeouts are analyzed for outdoor lights. In addition to the type of changeout, this section also investigates the reason for any lighting changes and the sources of information for any changes.

4.1.4.1 Incandescent Lamp Replacement

Table 4-21 presents a count on the number of homes that replaced an outdoor incandescent lamp with a compact fluorescent lamp. As can be seen by the table, roughly two percent of the newly constructed homes have replaced outdoor incandescent lamps with compact fluorescent lamps.

Table 4-21 Frequency Of Outdoor Incandescent Lamp Changes

Response	Freq.
Yes	11
No	389
TOTAL	400

4.1.4.2 Number Of Incandescent Lamp Replacements

While Table 4-21 presented the frequency of homeowner involvement in the replacement of outdoor incandescent lamps with compact fluorescent lamps, Table 4-22 presents the average number lamps changed out in those instances. This table shows the average number of changeouts is 2.5.

Table 4-22 Average Number Of Outdoor Incandescent Lamps Replaced Per Household

Mean	Std. Dev.	n
2.5	1.31	8

4.1.4.3 Reason For Change

Table 4-23 gives the reasons homeowners replaced of outdoor incandescent lamps with compact fluorescent lamps. Most of the answers for this question directly or indirectly relate to energy use, energy savings or the utility.

Table 4-23 Reasons For Outdoor Incandescent Lamp Change

Response	Freq.
Wanted a change in lighting type	1
Wanted to reduce utility bill	6
Utility rebate	2
Increase light level	1
Designed fluorescent	1

4.1.4.4 Fixture Change

Table 4-24 presents a count on the number of homes that removed, replaced or added outdoor lighting fixtures. The majority of actions taken by homeowners were to add a fixture. Only two homeowners removed an outdoor fixture.

Table 4-24 Frequency Of Outdoor Lighting Fixture Changes

Response	Freq.
Removed	2
Replaced	12
Added	144
No	242
TOTAL	400

4.1.4.5 Reason For Change

Table 4-25 gives the reasons homeowners removed, replaced or added outdoor fixtures. Most of the answers for this question were related to additional landscape lighting or security lighting.

Table 4-25 Reasons For Outdoor Lighting Fixture Changes

Response	Removed	Replaced	Added
Added landscape lighting	N/A	N/A	73
Added security lighting	N/A	N/A	81
Needed additional/reduced lighting	1	3	12
Wanted a change in lighting type	N/A	5	3
Light fixtures were broken/malfunctioning	-	1	N/A
Wanted to reduce utility bill	-	1	N/A
Utility rebate	N/A	-	1
Added motion sensor	-	2	2
Dog ate lights	-	-	1
Added pool/spa lights	-	-	1
Added garage lights	-	-	1

4.1.4.6 Source For Change

As with the other lighting measures, past experience was given the most frequently for the source of information for outdoor lighting fixture changes. This information is provided in Table 4-26.

Table 4-26 Sources For Outdoor Lighting Fixture Changes

Response	Freq.
Past experience	105
Salesperson	4
Advertisements	11
Electrical/construction contractor	15
Friend or neighbor	13
Brochure	1
Landscape architect	1
Research	1

4.2 Structure

Under this section, changes with regard to the structure of the house are reviewed. In some cases, these changes relate to nothing more than caulking and weather-stripping.

4.2.1 Structure Changes

This section analyses changes to the structure of the house. Most of these changes are light repair or normal operations and maintenance procedures. Table 4-27 presents the frequency with which actions have been taken on the structure of the home surveyed for this project.

Table 4-27 Frequency Of Changes In House Structure

Response	Freq.
Removed	1
Replaced	66
Added	33
No	299
Don't Know	1
TOTAL	400

4.2.2 Reason For Changes

Table 4-28 gives the reasons homeowners made changes to the structure of their home. Most of the answers for this question relate to tightness of the house. Examples would be that the home was "too drafty" or "the weather-stripping was defective or worn."

Table 4-28 Reasons For Changes In House Structure

Response	Removed	Replaced	Added
Home was too cold	N/A	-	1
Home was too drafty	N/A	1	17
Defective or worn weather-stripping/caulking	1	60	N/A
Wanted to reduce utility bill	N/A	-	1
Utility rebate	N/A	1	-
Leaking window or door	-	3	7
Changed door	-	1	-
Repainted	-	1	-
Preventative maintenance	-	-	6

4.2.3 Source For Changes

Just as with the lighting measures, past experience was given the most frequently for the source of information for changes in the structure of the house. This information is provided in Table 4-29.

Table 4-29 Sources For Changes In House Structure

Response	Freq.
Past experience	49
Utility billing insert/utility rep	3
Salesperson	6
Advertisements	1
Construction contractor	22
Friend or neighbor	6
Store display	3
Building code	1
Packaging/label	2
Builder's warrantee/repair	2

4.3 Window Coverings

This section reviews changes with regard to window coverings. The number of changes in the window coverings is extensive and a major change that homeowners make to their homes.

4.3.1 Window Covering Changes

Within this section the removal, replacement and addition of window coverings are analyzed. Since so many homeowners (80 percent) have added window coverings to their home, the data is provided in climate zone as well as statewide values. A breakdown of the percentage changes in window coverings is shown in Table 4-30. In addition to the type of changeout, this section also investigates the reason for any window covering changes and the sources of information for any of these changes.

Table 4-30 Percentage Of Changes In Window Coverings

Climate Zone	Removed	Replaced	Added	No
1	-	-	80.0	20.0
2	-	-	100.0	-
3	-	-	66.7	33.3
4	-	-	80.0	20.0
5	-	-	80.0	20.0
6	6.7	-	13.3	80.0
7	-	-	100.0	-
8	-	-	77.8	22.2
9	-	-	93.3	6.7
10	-	-	82.7	17.3
11	-	4.0	96.0	-
12	-	1.0	87.9	11.1
13	-	-	77.1	22.9
14	-	-	93.3	6.7
15	-	33.3	33.3	33.3
16	-	-	60.0	40.0
All	0.3	1.8	80.0	18.0

4.3.2 Types Of Changes In Window Coverings

The types of changes in the interior window coverings in the surveyed homes are presented in Table 4-31. In reviewing this data, the addition of venetian blinds is a popular choice for the new homeowner. The popularity of this choice is followed by the addition of standard drapes. Both of these additions affect the energy use in the homes where they are installed.

Table 4-31 Percentage Of Interior Window Covering Type Changes

Type of Window Treatment	Removed	Replaced	Added
Standard drapes	-	-	22.8
Standard white drapes	-	0.3	13.5
Medium venetian blinds	-	1.0	54.8
Wood venetian blinds	-	-	14.0
White roller shades	0.3	-	3.0
Translucent roller shades	-	-	2.0
Duet blinds	-	-	1.0
Mini blinds	-	-	0.8
Shutters	-	-	0.3
Stained glass	-	-	0.3
Vertical blinds	-	-	1.5
Wood shutters	-	-	0.5

Table 4-32 presents the types of changes in exterior window coverings in the homes surveyed. In reviewing this data, exterior sunscreens and window film were the new homeowner's two most popular choices. Both of these additions affect the energy use in the homes where they are installed.

Table 4-32 Percentage Of Exterior Window Covering Type Changes

Type of Window Treatment	Removed	Replaced	Added
Exterior sunscreens	-	-	9.0
Louvered sunscreens	-	-	0.8
Outdoor venetian blinds	-	-	0.3
Window film	-	-	9.3

4.3.3 Reason For Changes

Table 4-33 presents the reasons homeowners gave for the changes in window coverings. The three most frequent reasons given were "to cool the house," for "decorative reasons" and for "privacy." Energy use is not the lone reason in the decision-making process.

Table 4-33 Reasons For Changes In Window Covering

Reasons for Change	Replaced	Added
Decorative Reasons	0.5	59.3
To cool the house	0.5	60.3
Privacy	0.5	43.8
Keep heat in	-	1.0
Protect carpets	-	0.3

4.3.4 Source For Changes

As in the other energy efficiency measures, sources of information for changes in window covering are primarily past experience (57.3 percent). Salespersons or decorators had some impact in the decision-making process (20.5 percent). Other sources of information were less than eight percent and would have to be treat as secondary sources. The data detailing the sources for changes in window coverings is presented in Table 4-34.

Table 4-34 Sources For Changes In Window Covering

Climate Zone	Past Experience	Utility Billing Insert/ Representative	Salesperson/ Decorator	Advertisements	Friends or Neighbors	Other*
1	33.3	6.7	13.3	-	6.7	6.7
2	73.3	-	13.3	-	13.3	-
3	44.4	-	16.7	11.1	5.6	5.6
4	40.0	6.7	20.0	13.3	6.7	6.7
5	40.0	-	13.3	6.7	20.0	6.7
6	13.3	-	-	6.7	-	-
7	94.4	-	27.8	-	-	-
8	77.8	-	5.6	11.1	5.6	-
9	80.0	-	26.7	6.7	6.7	-
1-	65.4	-	15.4	9.6	5.8	-
11	88.0	--	20.0	8.0	-	-
12	60.6	11.1	26.3	4.0	6.1	4.0
13	42.9	5.7	14.3	11.4	14.3	5.7
14	40.0	6.7	86.7	6.7	-	-
15	40.0	-	13.3	6.7	-	-
16	33.3	-	6.7	20.0	-	-
All	57.3	4.0	20.5	7.3	6.0	2.5

* Other responses included: catalogs, fair, literature, lowest cost, personal choice, & wife

4.4 Landscaping Changes

This section reviews landscaping changes. These include shade trees, patio coverings, exterior shade screens and window awnings. Like the window coverings, this is a popular change for a homeowner to make, but the decision to install an energy efficiency measure may have little to do with energy efficiency.

4.4.1 Landscaping Changes

Table 4-35 provides a breakdown of landscaping changes undertaken at the homes surveyed for this project. These changes are listed by frequency and by direction to help determine the energy impact of the measure. Shade trees are the most popular landscaping change made by the homeowners, with patio coverings and window awnings as other popular choices.

Table 4-35 Frequency Of Changes In Household Landscaping

Response	East	South	West	North
Shade trees	65	97	111	46
Window awnings	2	3	35	-
Patio coverings	19	30	-	16
Decoration	1	1	-	-
Trellis	1	2	-	1
Exterior shade screen	-	1	1	-
Fruit trees	1	1	1	2
Exterior blinds	-	-	1	-
Sunroom	-	-	1	-
Trellis plants	-	-	1	-

4.4.2 Reason For Changes

Table 4-36 gives the reasons for homeowner changes in household landscaping. "To cool the house" is by far the most popular reason for making any change in the household landscaping. General landscaping and appearance of the home were frequent reasons given for changes in household landscaping.

Table 4-36 Reasons For Change In Household Landscaping

Response	Shade Trees	Window Awnings	Patio Covering	Other
General landscaping of the yard	111	-	19	5
Appearance of the home	35	-	30	4
To cool house	147	9	75	7
Privacy	24	-	8	2
Fruit	5	-	-	-
Comfort	-	-	1	1
Recreation	-	-	2	-
More room	-	-	1	-

4.4.3 Source For Changes

As in the other energy efficiency measures, past experience is the main information source for changes in household landscaping. Landscaping guides also were used frequently in the decision-making process. The data detailing sources for changes in household landscaping is presented in Table 4-37.

Table 4-37 Sources For Change In Household Landscaping

Response	Freq.
Past experience	173
Landscape guides	41
Utility billing insert/utility rep	32
Salesperson	7
Advertisements	8
Landscaping or window treatment contractor	29
Friend or neighbor	13
Non-profit organization	1
Free trees	1
Nursery staff	2
Research	1
Sunset Magazine	1

4.5 Faucet And Showerhead

This section reviews changes with regard to water fixtures. These changes included replacement or repair of existing faucets and showerheads.

4.5.1 Fixture Changes

Within this section the removal, replacement or addition of household water fixtures are analyzed. Table 4-38 shows that the majority of water fixture changes are replacements of existing fixtures.

Table 4-38 Frequency Of Changes In Household Water Fixtures

Response	Freq.
Removed	3
Replaced	148
Added	8
No	241
TOTAL	400

4.5.2 Reason For Changes

Table 4-39 give the reasons homeowners change their water fixtures. The top three reasons were: "wanted a change in fixture type," "wanted to reduce water flow" and "the fixture was broken or malfunctioning."

Table 4-39 Reasons For Change In Household Water Fixtures

Response	Removed	Replaced	Added
Wanted additional water flow	N/A	14	1
Wanted reduced water flow	2	34	N/A
Wanted a change in fixture type	N/A	74	3
Faucets or showerheads were broken/malfunctioning	1	27	N/A
Remodel of bathroom	-	3	-
Water conservation	-	15	N/A
Comfort	-	2	-
Massage	-	1	2

4.5.3 Source For Changes

Past experience was given most frequently as the source for changes in household water fixtures. Advertisements and utility billing inserts/utility representatives were also given as sources of information for changes in household water fixtures. The data detailing the sources for changes in household water fixtures is presented in Table 4-40.

Table 4-40 Sources For Change In Household Water Fixtures

Response	Freq.
Past experience	103
Consumer guides	8
Utility billing insert/utility rep	12
Salesperson	9
Advertisements	16
Construction contractor	4
Friend or neighbor	7
Store display	1
Packaging	1

4.6 Heating System

Under this section, changes with regard to heating equipment is detailed from previously conducted analysis. This includes changes in the heating system, reasons for the changes in the heating system and the sources for the changes in the heating system.

4.6.1 Equipment Changes

Four homeowners reported they changed their heating equipment after moving into their houses. Another three homeowners added to their heating system during ownership of the house. No homeowner reported they had removed their heating system.

4.6.2 Reason For Changes

Two homeowners added to their heating system because the original heating system was inadequate. Two other homeowners wanted to reduce their utility bill or receive a utility rebate. Finally, two heating units had to be replaced because they were broken or malfunctioning.

4.6.3 Source For Changes

The sources used for adding or replacing heating system equipment included past experience, salesman, a utility bill insert, an advertisement and friends/neighbors. All of these sources were used equally in the decision-making process.

4.7 Cooling System

Under this section, changes with regard to cooling equipment is detailed from previously conducted analysis. This includes changes in the cooling system, reasons for the changes in the cooling system and the sources for the changes in the cooling system.

4.7.1 Equipment Changes

Two homeowners reported that they changed their cooling equipment since they moved into their house. Another nine homeowners added to their cooling system during their ownership of the house. One homeowner reported that they had removed their cooling system.

4.7.2 Reason For Changes

Three homeowners added to their cooling system because the original cooling system was inadequate. Eight homeowners added air-conditioners because their home originally did not have air-conditioning. Two homeowners added evaporative coolers after moving into their house. Finally, two cooling units had to be replaced because they were broken or malfunctioning.

4.7.3 Source For Changes

The sources used for adding or replacing cooling system equipment included past experience, salesman, a utility bill insert, an advertisement and friends/neighbors. All of these sources were used equally in the decision-making process.

5.0 SUMMARY AND ANALYSIS OF CALRES SIMULATIONS

The objective of the CALRES analysis phase of the project was to determine if the home complied with the Title 24 standards at the time the occupants moved in, and if the home, as it currently exists, also complies. As such, the interview questions played an important role in determining the proper inputs to the CALRES model, and were used to adjust certain parameters which may differ from the actual observed conditions at the time of the survey. Once these factors were included and accounted for in the CALRES input data, conducting the analyses required from this task was a relatively straightforward process.

Although CALRES is designed to simulate the energy uses in a residential building, there are end-uses and homeowner actions that it will not capture. The energy use changes relating to equipment changes, other than HVAC or hot water equipment, are not shown by a CALRES simulations. This means that changes relating to kitchen and laundry equipment are not captured in a CALRES simulation. Also, changes in indoor and outdoor lighting are not simulated using the CALRES simulation model. Finally, differences in exterior landscaping are do not appear in the simulations using CALRES. While all of these issues will affect the energy use in a newly constructed home, a CALRES simulation and for the matter, the Title 24 Energy Standards do not take these issues into consideration when determining compliance.

The database management system designed for this project included the ability to develop CALRES input files directly from the data. In doing so, care was taken to ensure that all of the necessary data were obtained from the field and recorded in the survey form (and hence the database). In addition, default values and data were defined for certain parameters which were not obtained directly in the field. Such variables included wall insulation levels or R-values, window U-values, equipment efficiency parameters and others. These default values were substituted for blank or non-available information required by the CALRES model as appropriate to the climate zone in which the home was located. A table is provided in Appendix C, which displays the sources of data (- for observed by the surveyor, A for assumed by the surveyor, and C for defaulted by CALRES) for these key variables.

Using a Microsoft FoxPro program developed by Aquila Technologies, data from the project database were used to directly develop the electronic input files for the CALRES simulation model. This program selected window, wall, ceiling, floor, heating, cooling, and hot water information from the project database to establish the CALRES input files, depending on the vintage of the home. Since an updated version of the CALRES program was introduced during the time period from July, 1989 to the present, the construction date of each home was used to determine which version of CALRES should be used for the analysis. Energy use for homes that were built prior to January, 1994 was simulated using CALRES Version 1.10 (or CALRES). There were 354 of these houses. Energy use for the remaining 46 houses, which were built after January 1994, was simulated using CALRES Version 1.31 (or CALRES2). A sixth month lag was used past the effective date for the change in the

Standards, July, 1993. This lag was designed to capture homes that passed compliance using the old Standards, but were built after the new Standards took effect.

Finally, two CALRES energy simulations were completed for each home in the survey. The first simulation was for the pre-occupancy case. This simulation removed or added the energy efficiency items the homeowner had added or removed since occupancy. The second simulation was for the post-occupancy case, which was the as-surveyed case. Energy efficiency items that were added or removed by the homeowner were included in this simulation case. Results of the CALRES model runs were tabulated and provided to the Commission, along with the CALRES input files. These simulation results are provided in Appendix C. These results display the standard design values for each home, the energy consumption for the pre-occupancy condition, and the energy consumption for the post-occupancy condition.

Since the CALRES program provides analysis for compliance with residential energy standards, simulating each home with the CALRES program presents an indication of compliance for each of the 400 homes. Figure 5-1 graphically displays the distribution of compliance margin for the 400 homes surveyed for this project. This figure shows the margin of compliance for the homes prior to occupancy by the homeowner. According to this figure, 38 percent of the homes complied with the energy requirements, while 62 percent of the homes failed to comply with the energy codes.

Figure 5-1 Compliance Margin Of Surveyed Homes
Before Occupancy All Climate Zones

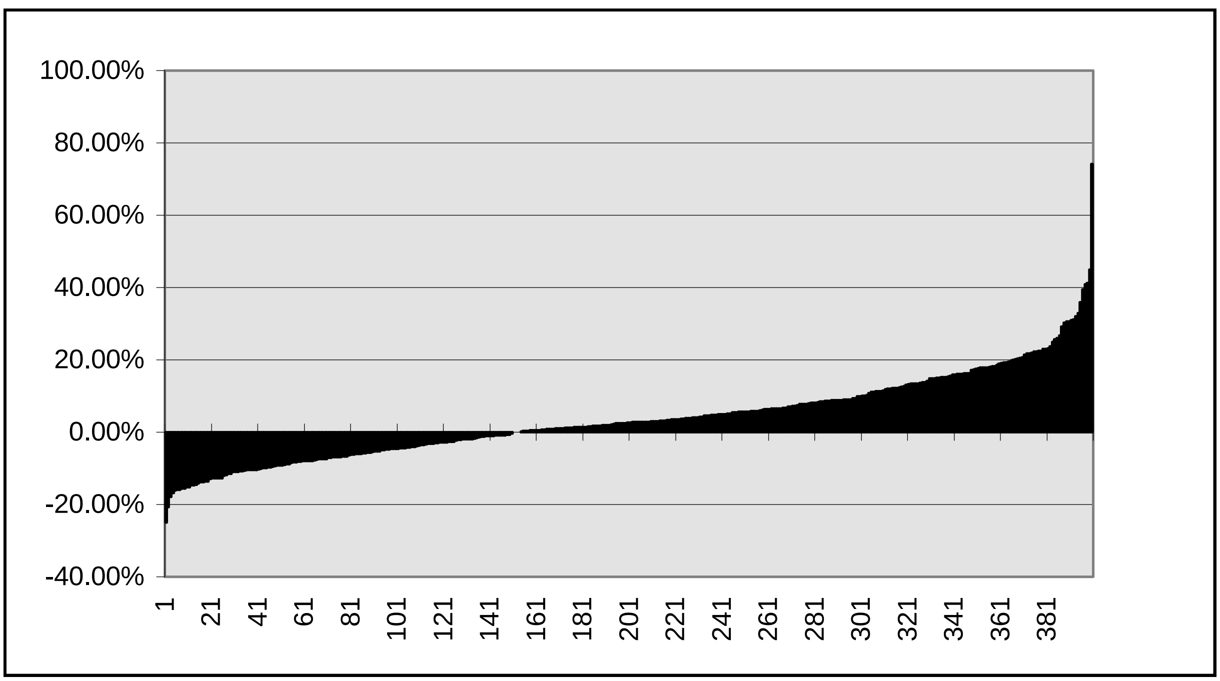
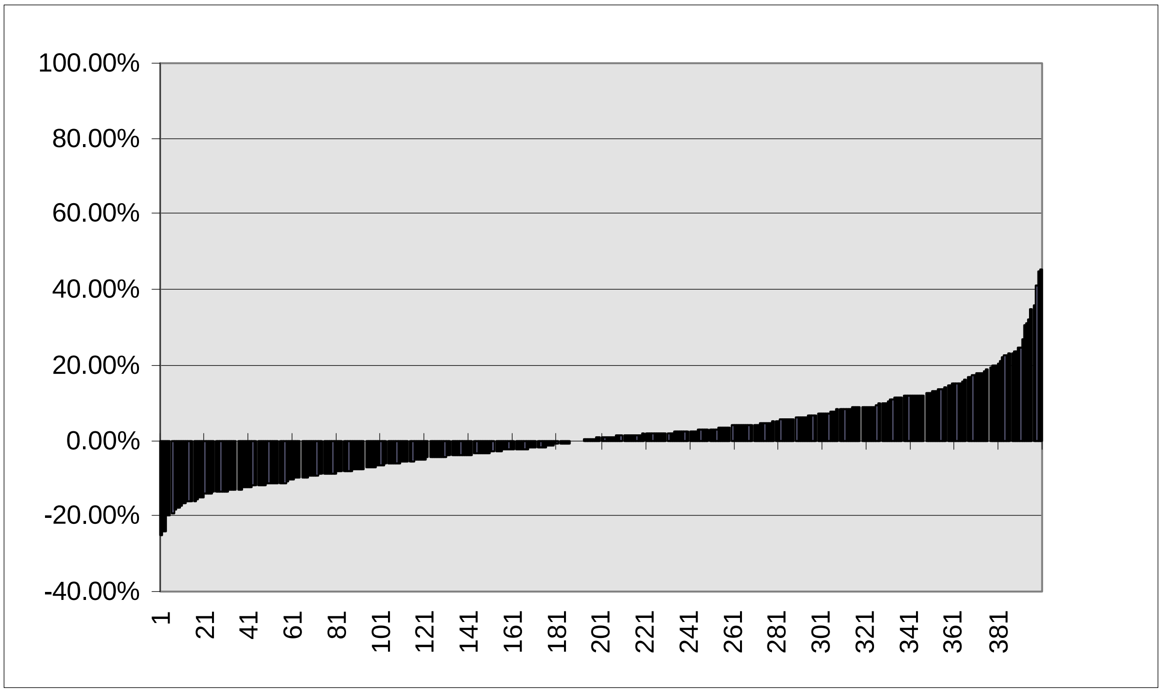


Figure 5-2 shows the distribution of compliance margin for the post-occupancy cases. The data for this figure states that 48 percent of the homes complied with the energy requirements after energy efficiency actions were undertaken by the homeowner. Therefore, 52 percent of the post occupancy homes failed to comply with the energy codes.

Figure 5-2 Compliance Margin Of Surveyed Homes
Post-Occupancy All Climate Zones



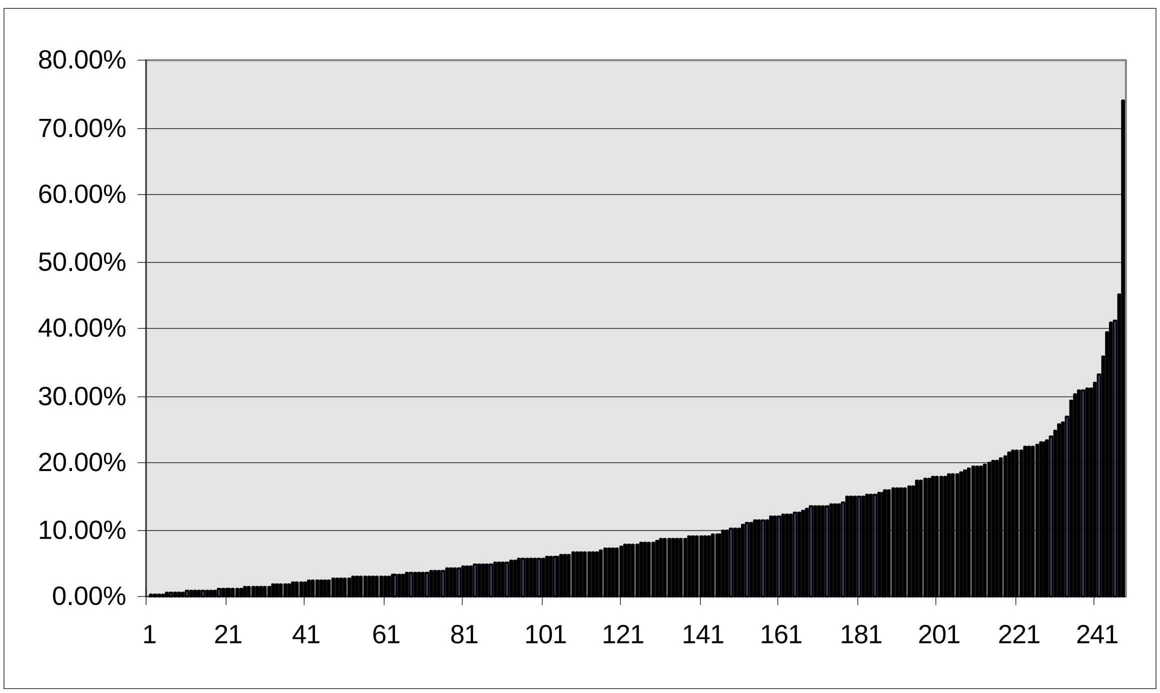
Although statewide results have been presented, analysis of the results at the climate zone level represent the important observations to be made here. The statewide results are weighted heavily toward Climate Zone 12 (25 percent of the total), while the compliance rate for Climate Zone 12 is quite low. The large variation of compliance rate from climate zone to climate zone led to a further examination of energy standard compliance by climate zone. The following sections present the results of the pre-occupancy and post-occupancy CALRES simulations by climate zone. While the average home did not comply with the Standards for Climate Zones 1, 3, 5, 8, 9, 10, 11, 12, 13, 14, and 15, the average home in Climate Zones 2, 4, 6, 7, and 16 did comply with the Standards.

5.1 Average Cost Of Non-Compliance

The estimated high level of non-compliance with the Title 24 energy codes raised concerns with the Commission regarding the cost effect on the homeowners. While 62% of the houses in this survey were determined to be out of compliance with the Standards, what does this mean to the average new homeowner? To answer this question, marginal utility rates were applied to the difference in the CALRES results, standard vs. proposed, for the houses which should non-compliance. This data, when multiplied by the square footage of these houses, presents an annual cost to the homeowner for the lack of compliance with the Standards.

In Figure 5-3, the compliance margin data from Figure 5-1 is presented, but with the elimination of the houses that complied with the Standards. In analyzing the CALRES results for these non-complying houses, the average margin of non-compliance was 10.5 percent, which signifies the energy budget, on average for these houses, is roughly 10 percent greater than the energy codes require.

Figure 5-3 Compliance Margin For Non-Complying Surveyed Homes In All Climate Zones



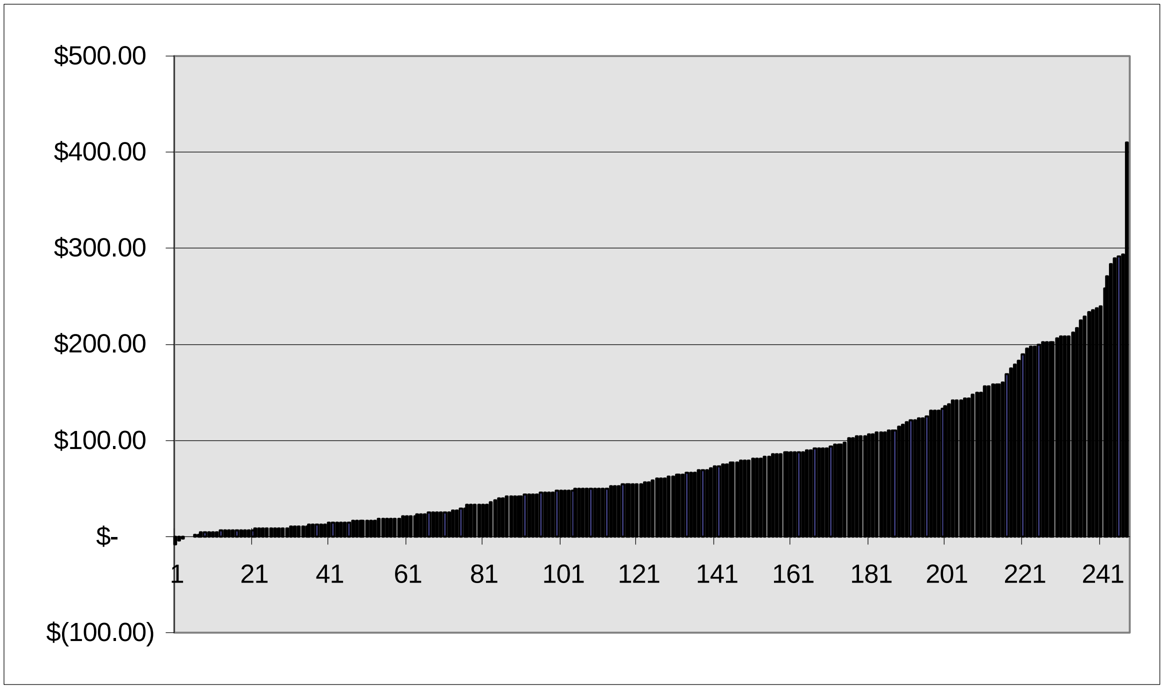
To determine an estimated cost of this non-compliance to the homeowner, marginal energy costs were determined for each of the fuels and utility providers. This data is presented in Table 5-1. This table provides these costs in units that are standard for each fuel: kilowatt-hours (kWh) for electricity, therms for natural gas, and gallons for propane.

Table 5-1 Marginal Energy Cost
By Utility Provider

Utility	Electricity ($/kWh)	Natural Gas ($/Therm)	Propane ($/Gal.)
City Of Anaheim	$0.0730	-	-
City Of Burbank	$0.0865	-	-
Glendale PSD	$0.0865	-	-
Imperial Irrigation	$0.0730	-	-
Lassen MUD	$0.0730	-	-
PG&E	$0.0974	$0.638	-
Propane	-	-	$1.00
SDG&E	$0.0974	$0.638	-
Sierra Pacific	$0.0730	-	-
SMUD	$0.0942	-	-
South West Gas	-	$0.631	-
Southern Cal. Edison	$0.0932	-	-
Southern Cal. Gas	-	$0.638	-
Truckee Donner PUD	$0.0730	-	-
Turlock Irrigation Dist.	$0.0730	-	-

Since the results from CALRES are presented by end-use as source energy in kBtu/sq.ft./yr., these values had to be converted to appropriate units before applying the utility rates. Propane kBtus were converted to gallons using the value of 91.6 kBtu/gallon, natural gas kBtus were converted to therms using the value of 100 kBtu/therm and electricity kBtus were converted to kWh using the value of 3.413 kBtu/kWh. The electricity values were also divided by three to convert the values from source energy to end-use energy. For each non-complying house, the differential values for each end-use (heating, cooling and hot water) were then multiplied by the square footage of the house and by the appropriate utility rate. The values for each end-use were summed to determine the annual cost of the non-compliance to the homeowner. The results of this analysis are summarized in Figure 5-4 and provided in detail in Appendix C. For the 62 percent of the homes which were determined to be out of compliance by an average of 10.5 percent, the average annual additional cost to the homeowner is $79.52.

Figure 5-4 Additional Annual Cost For Non-Complying Surveyed Homes In All Climate Zones



The results from the previous analysis are presented by climate zone in Table 5-2. These results show the average cost for non-compliance varies by climate zone. Homes which are not in compliance in milder climate zones incur less additional cost than the homes which are in more extreme climate zones. For example, the average non-complying house in Climate Zone 6 had a non-compliance margin of 5.5 percent with an additional average cost of $10.85 per year. Conversely, the average non-compliance margin for Climate Zone 2 is 3.9 percent with an additional average cost of $36.20 per year. These values indicate that the additional costs associated with non-compliance should be reviewed by climate zone in addition to the statewide values.

Table 5-2 Additional Annual Cost For Non-Complying Surveyed Homes By Climate Zone

Climate Zone	Average Non-Compliance Margin (%)	Average Cost For Non-Compliance ($/Year)	# Of Surveyed Homes Not In Compliance
1	15.59	$62.25	15
2	3.92	$36.20	7
3	6.28	$19.61	14
4	6.80	$24.90	5
5	6.89	$21.53	14
6	5.54	$10.85	4
7	3.00	$2.81	3
8	19.74	$82.90	12
9	10.62	$62.71	8
10	8.71	$65.77	28
11	6.97	$71.28	12
12	10.17	$100.34	75
13	11.58	$90.77	21
14	17.70	$193.65	14
15	11.50	$86.38	12
16	14.38	$102.27	4

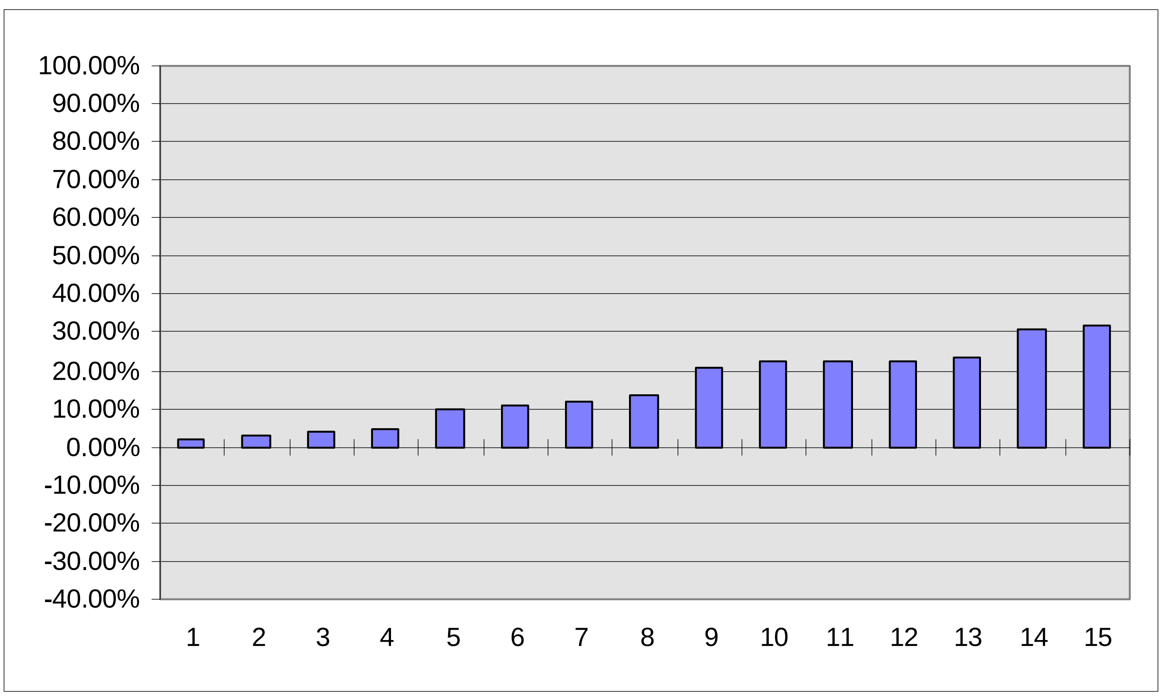
5.2 Climate Zone 1 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 1 region. Results of these CALRES simulations show that the average estimated energy use was 41.82 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 16 percent higher than the standard design of 36.14 kBtu/sq.ft.-yr. Actions by the new homeowners increased the estimated energy use to 42.07 kBtu/sq.ft.-yr. or 16 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-3. A graph of the pre-occupancy compliance margin is presented in Figure 5-5. This figure shows that the houses surveyed in this climate zone range in compliance from failing compliance by 2 percent to failing compliance by 32 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $62.25 per year.

Table 5-3 Climate Zone 1 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	36.14	6.08	44.31	26.42	15
Pre-Occupancy	41.82	8.42	56.80	29.52	15
Post-Occupancy	42.07	8.48	56.79	29.45	15

Figure 5-5 Compliance Margin Of Surveyed Homes In Climate Zone 1



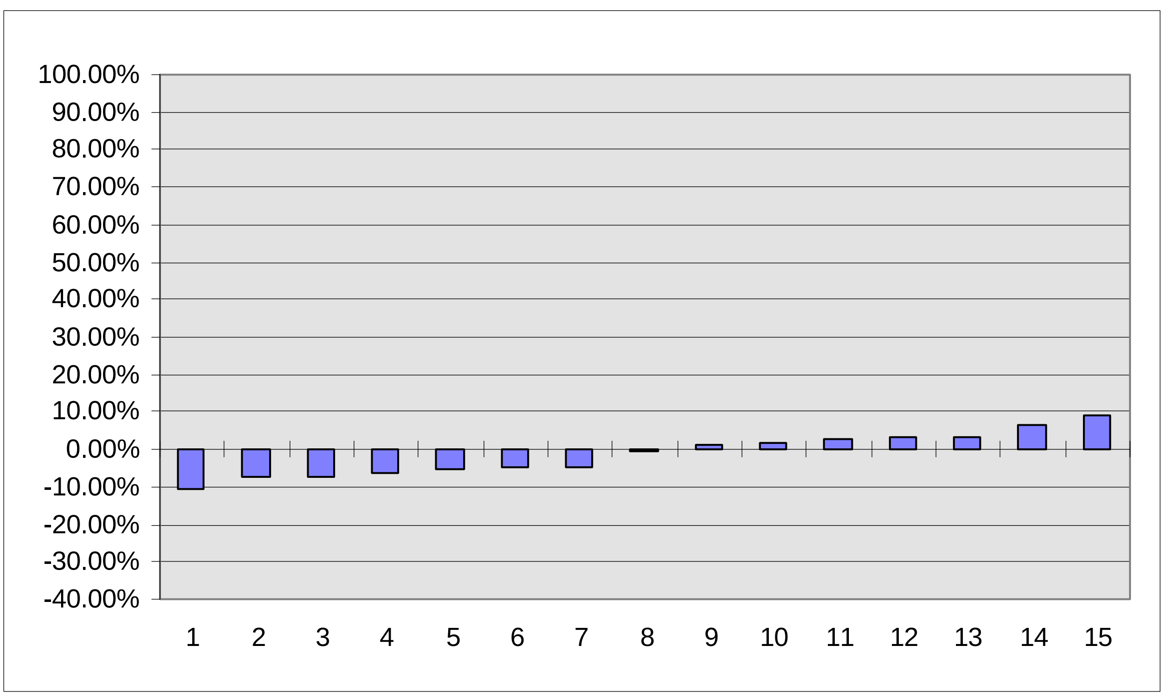
5.3 Climate Zone 2 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 2 region. Results of these CALRES simulations show that the average estimated energy use was 51.07 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 1.4 percent lower than the standard design of 51.80 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 49.67 kBtu/sq.ft.-yr. or 4.1 percent lower than the standard design. Summaries of the CALRES simulations are presented in Table 5-4. A graph of the pre-occupancy compliance margin is presented in Figure 5-6. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 11 percent to failing compliance by 9 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $36.20 per year.

Table 5-4 Climate Zone 2 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	51.80	3.99	58.02	47.91	15
Pre-Occupancy	51.07	4.56	59.92	44.79	15
Post-Occupancy	49.67	4.65	57.42	41.66	15

Figure 5-6 Compliance Margin Of Surveyed Homes In Climate Zone 2



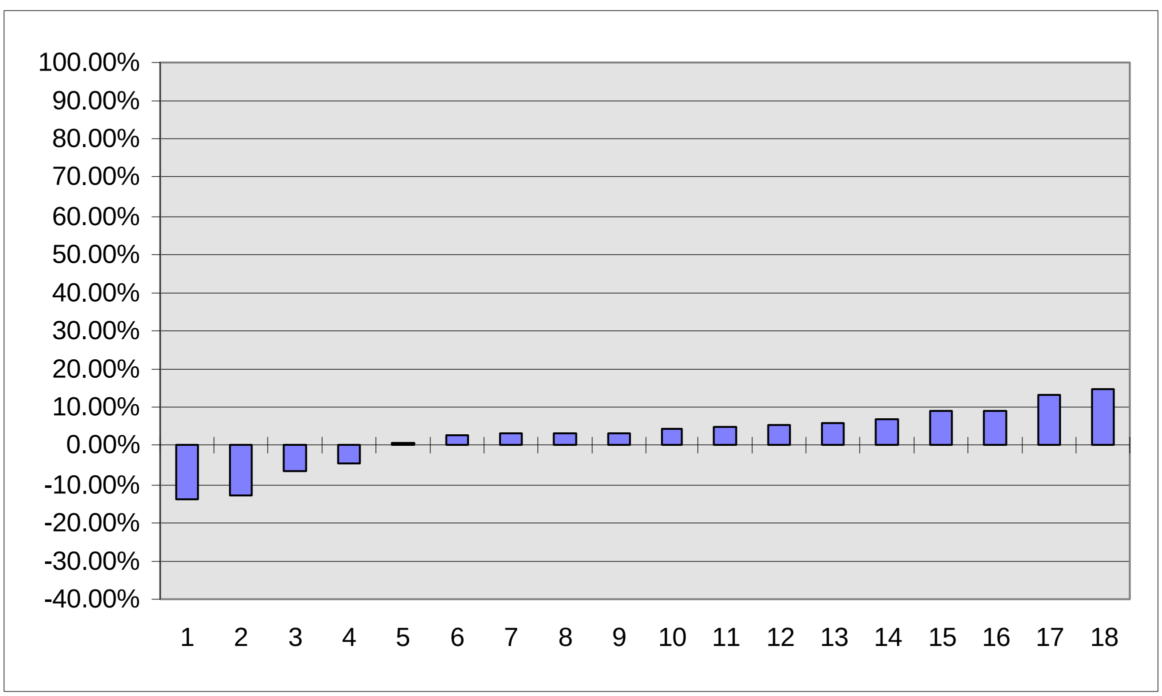
5.4 Climate Zone 3 CALRES Simulation Results

Eighteen homes were surveyed in the Climate Zone 3 region. Results of these CALRES simulations show that the average estimated energy use was 28.45 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 3 percent higher than the standard design of 27.51 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 28.30 kBtu/sq.ft.-yr. or 2.9 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-5. A graph of the pre-occupancy compliance margin is presented in Figure 5-7. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 14 percent to failing compliance by 15 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $19.61 per year.

Table 5-5 Climate Zone 3 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	27.51	5.35	40.12	19.63	18
Pre-Occupancy	28.45	6.56	41.44	16.95	18
Post-Occupancy	28.30	6.54	41.44	16.95	18

Figure 5-7 Compliance Margin Of Surveyed Homes In Climate Zone 3



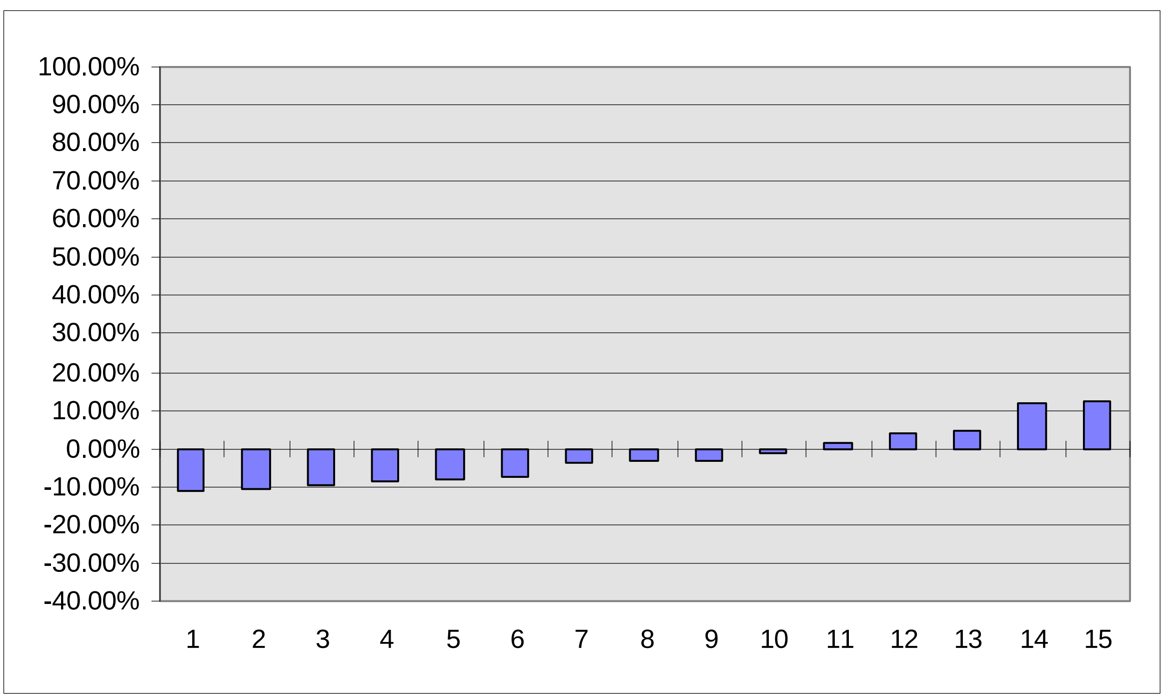
5.5 Climate Zone 4 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 4 region. Results of these CALRES simulations show that the average estimated energy use was 28.31 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 2 percent lower than the standard design of 28.86 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 27.90 kBtu/sq.ft.-yr. or 3.3 percent lower than the standard design. Summaries of the CALRES simulations are presented in Table 5-6. A graph of the pre-occupancy compliance margin is presented in Figure 5-8. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 11 percent to failing compliance by 12 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $24.90 per year.

Table 5-6 Climate Zone 4 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	28.86	3.78	33.85	21.53	15
Pre-Occupancy	28.31	4.95	37.59	21.83	15
Post-Occupancy	27.90	4.85	37.59	21.18	15

Figure 5-8 Compliance Margin Of Surveyed Homes In Climate Zone 4



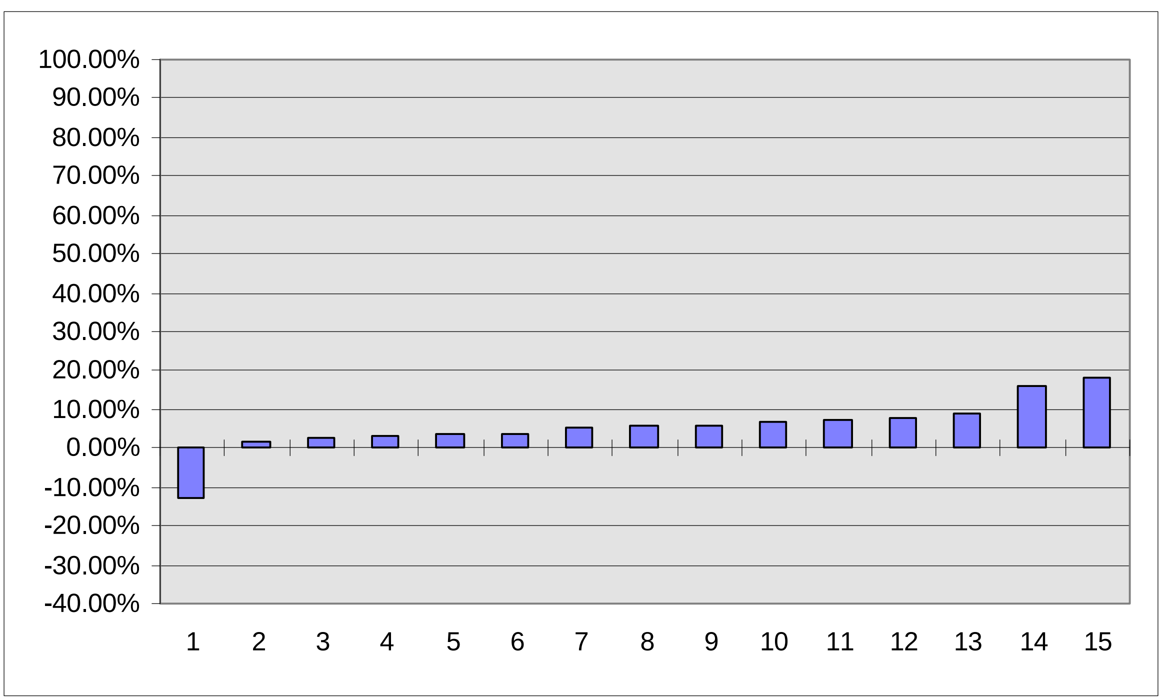
5.6 Climate Zone 5 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 5 region. Results of these CALRES simulations show that the average estimated energy use was 33.54 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 6.3 percent higher than the standard design of 31.55 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 33.41 kBtu/sq.ft.-yr. or 5.9 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-7. A graph of the pre-occupancy compliance margin is presented in Figure 5-9. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 13 percent to failing compliance by 18 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $21.53 per year.

Table 5-7 Climate Zone 5 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	31.55	7.46	46.91	24.01	15
Pre-Occupancy	33.54	9.28	53.90	20.94	15
Post-Occupancy	33.41	9.07	53.30	20.94	15

Figure 5-9 Compliance Margin Of Surveyed Homes In Climate Zone 5



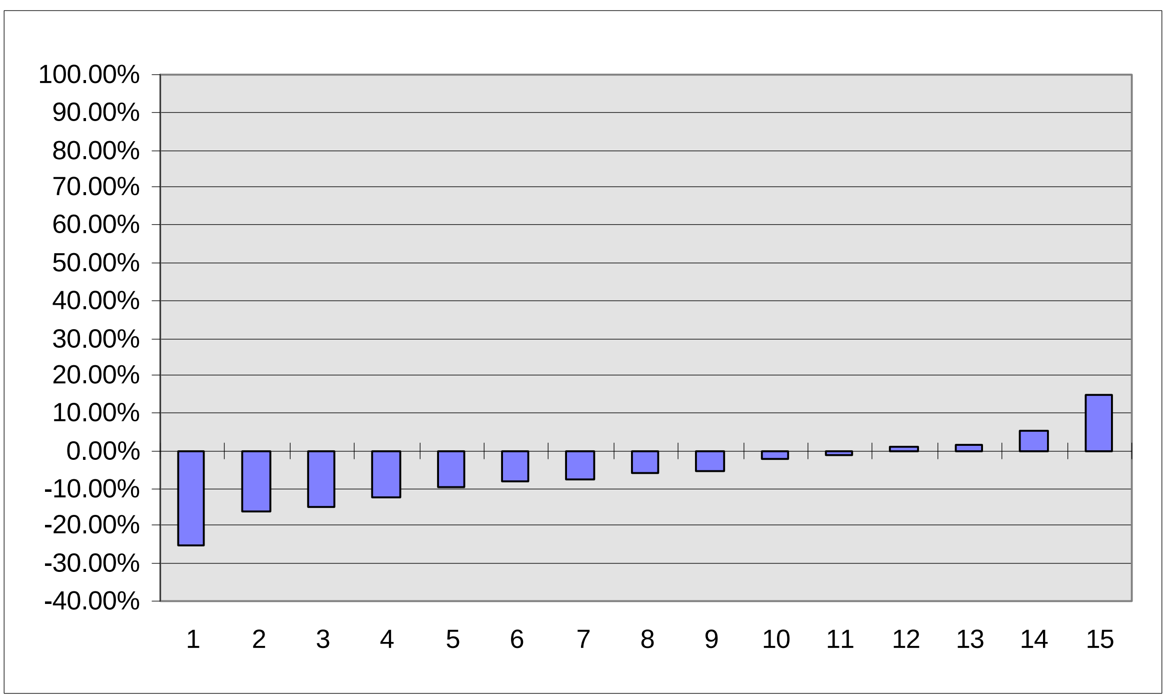
5.7 Climate Zone 6 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 6 region. Results of these CALRES simulations show that the average estimated energy use was 23.60 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 6.7 percent higher than the standard design of 25.29 kBtu/sq.ft.-yr. Actions by the new homeowners had little effect on the estimated energy use, which decreased to 23.59 kBtu/sq.ft.-yr. or 6.7 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-8. A graph of the pre-occupancy compliance margin is presented in Figure 5-10. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 25 percent to failing compliance by 15 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $10.85 per year.

Table 5-8 Climate Zone 6 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	25.29	5.46	32.50	16.45	15
Pre-Occupancy	23.60	4.60	31.30	16.25	15
Post-Occupancy	23.59	4.62	31.30	16.11	15

Figure 5-10 Compliance Margin Of Surveyed Homes In Climate Zone 6



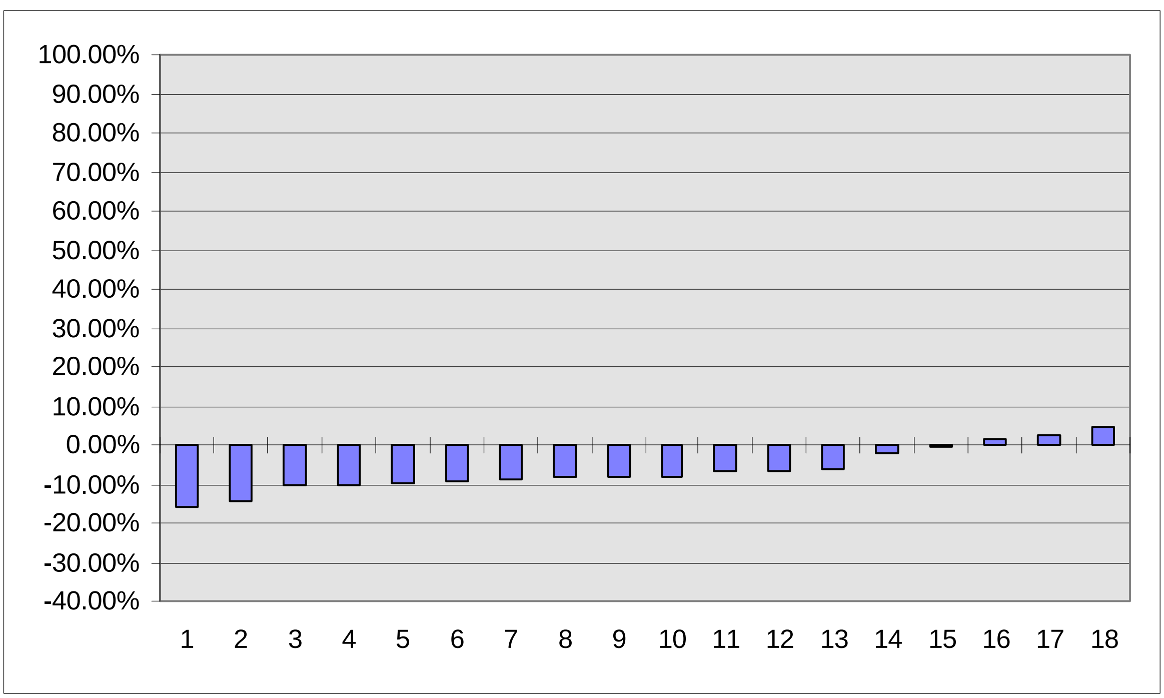
5.8 Climate Zone 7 CALRES Simulation Results

Eighteen homes were surveyed in the Climate Zone 7 region. Results of these CALRES simulations show that the average estimated energy use was 18.86 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 6.5 percent lower than the standard design of 20.18 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 18.20 kBtu/sq.ft.-yr. or 9.8 percent lower than the standard design. Summaries of the CALRES simulations are presented in Table 5-9. A graph of the pre-occupancy compliance margin is presented in Figure 5-11. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 16 percent to failing compliance by 5 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $2.81 per year.

Table 5-9 Climate Zone 7 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	20.18	1.16	22.30	18.28	18
Pre-Occupancy	18.86	1.53	21.42	16.38	18
Post-Occupancy	18.20	1.53	21.42	15.83	18

Figure 5-11 Compliance Margin Of Surveyed Homes In Climate Zone 7



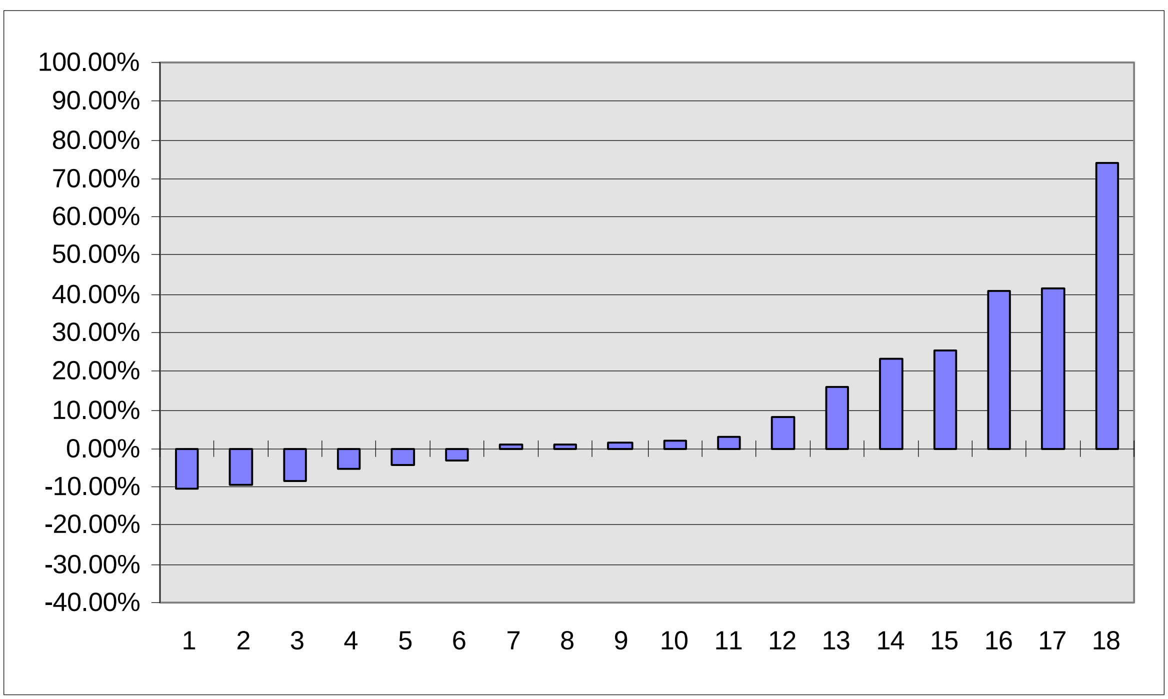
5.9 Climate Zone 8 CALRES Simulation Results

Eighteen homes were surveyed in the Climate Zone 8 region. Results of these CALRES simulations show that the average estimated energy use was 28.10 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 12 percent higher than the standard design of 25.17 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 26.25 kBtu/sq.ft.-yr. or 4 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-10. A graph of the pre-occupancy compliance margin is presented in Figure 5-12. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 10 percent to failing compliance by 74 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $82.90 per year.

Table 5-10 Climate Zone 8 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	25.17	2.49	29.97	21.36	18
Pre-Occupancy	28.10	7.54	52.19	19.40	18
Post-Occupancy	26.25	6.05	43.55	18.67	18

Figure 5-12 Compliance Margin Of Surveyed Homes In Climate Zone 8



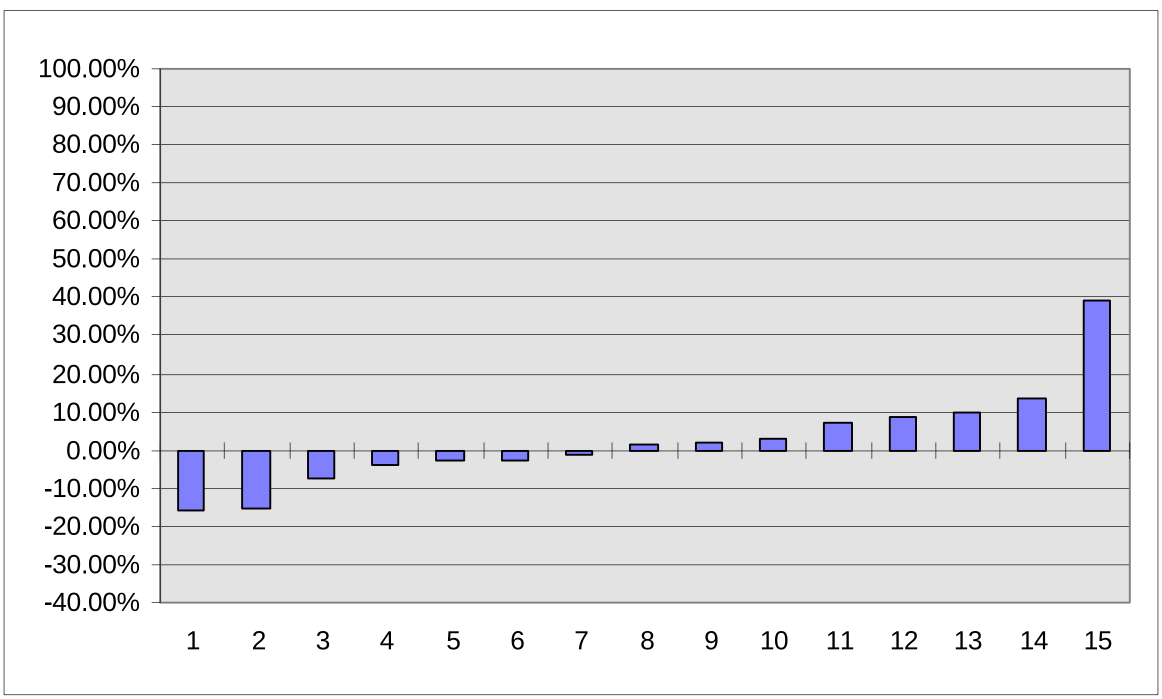
5.10 Climate Zone 9 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 9 region. Results of these CALRES simulations show that the average estimated energy use was 30.56 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 3 percent higher than the standard design of 29.57 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 28.78 kBtu/sq.ft.-yr. or 3 percent lower than the standard design. Summaries of the CALRES simulations are presented in Table 5-11. A graph of the pre-occupancy compliance margin is presented in Figure 5-13. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 16 percent to failing compliance by 39 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $62.71 per year.

Table 5-11 Climate Zone 9 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	29.57	6.58	49.37	19.55	15
Pre-Occupancy	30.56	9.21	56.00	18.99	15
Post-Occupancy	28.78	8.77	53.69	18.71	15

Figure 5-13 Compliance Margin Of Surveyed Homes In Climate Zone 9



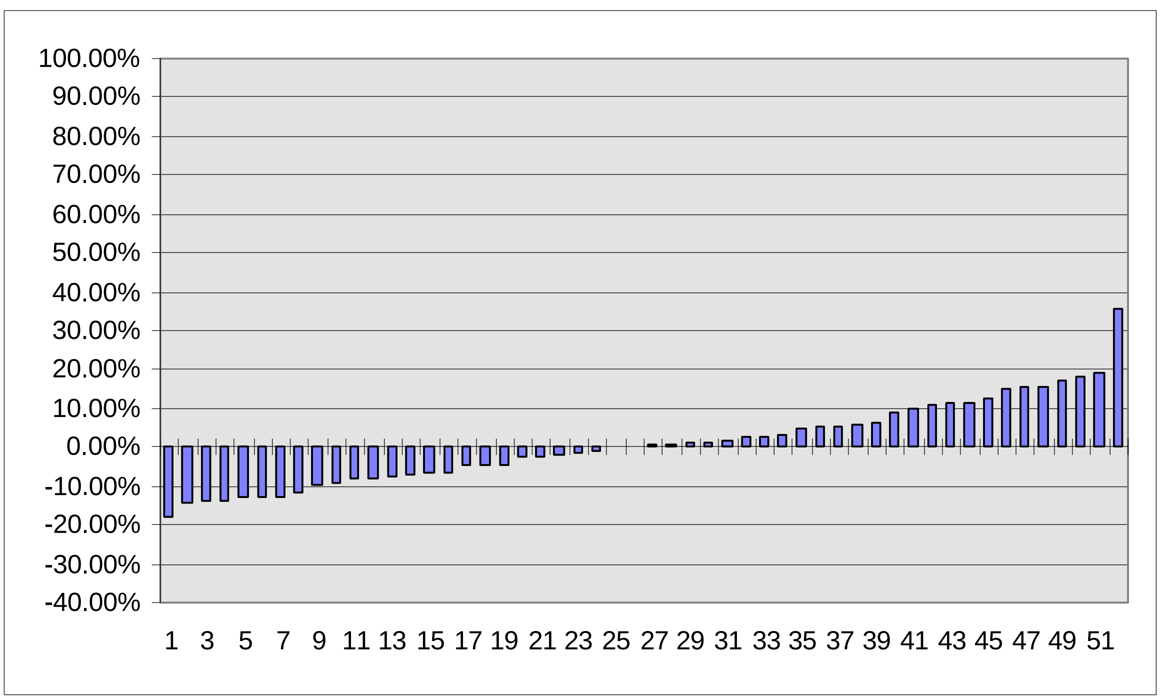
5.11 Climate Zone 10 CALRES Simulation Results

Fifty-two homes were surveyed in the Climate Zone 10 region. Results of these CALRES simulations show that the average estimated energy use was 42.14 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 1 percent higher than the standard design of 41.62 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 40.54 kBtu/sq.ft.-yr. or 3 percent lower than the standard design. Summaries of the CALRES simulations are presented in Table 5-12. A graph of the pre-occupancy compliance margin is presented in Figure 5-14. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 18 percent to failing compliance by 36 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $65.77 per year.

Table 5-12 Climate Zone 10 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	41.62	5.68	53.04	29.06	52
Pre-Occupancy	42.14	7.86	62.88	24.93	52
Post-Occupancy	40.54	7.90	62.88	24.26	52

Figure 5-14 Compliance Margin Of Surveyed Homes In Climate Zone 10



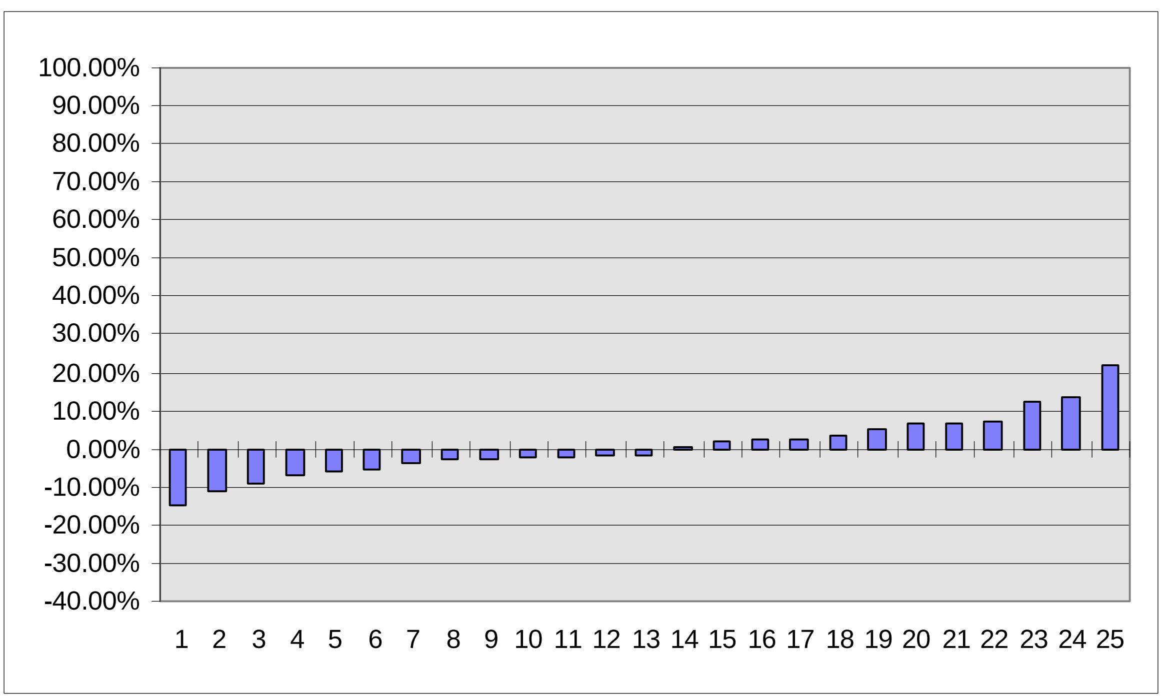
5.12 Climate Zone 11 CALRES Simulation Results

Twenty-five homes were surveyed in the Climate Zone 11 region. Results of these CALRES simulations show that the average estimated energy use was 62.31 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is essentially equal to the standard design of 62.30 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 60.66 kBtu/sq.ft.-yr. or 2.6 percent lower than the standard design. Summaries of the CALRES simulations are presented in Table 5-13. A graph of the pre-occupancy compliance margin is presented in Figure 5-15. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 15 percent to failing compliance by 22 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $71.28 per year.

Table 5-13 Climate Zone 11 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	62.30	10.22	89.51	41.91	25
Pre-Occupancy	62.31	9.64	85.88	42.67	25
Post-Occupancy	60.66	9.58	85.93	42.01	25

Figure 5-15 Compliance Margin Of Surveyed Homes In Climate Zone 11



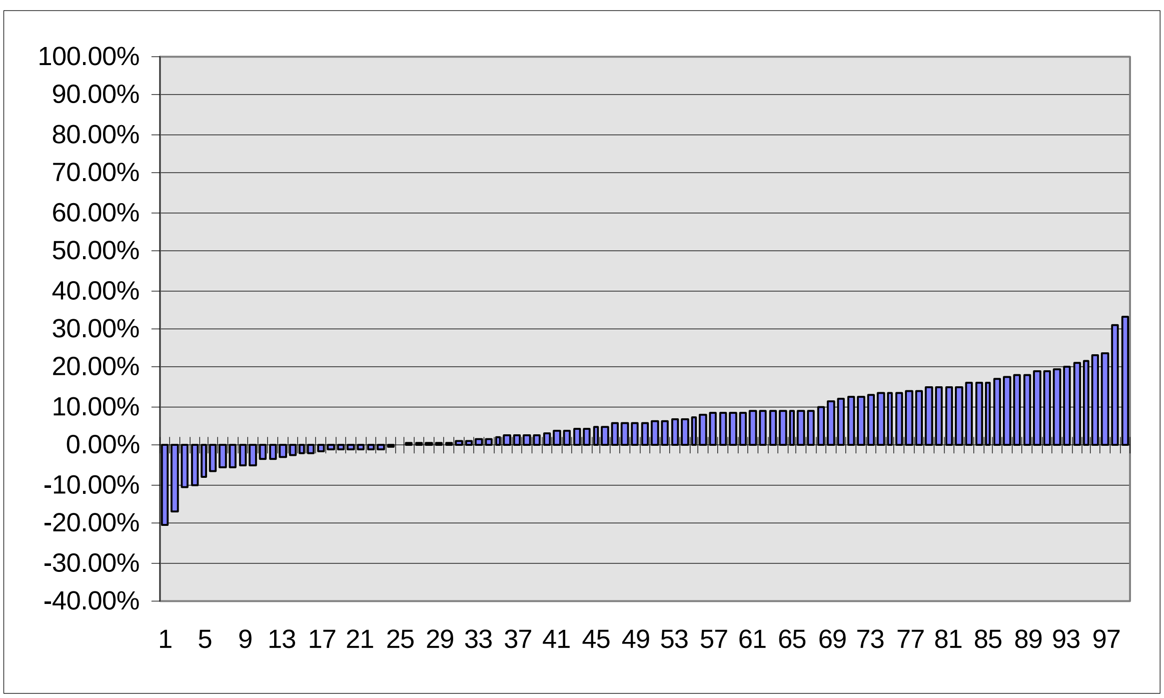
5.13 Climate Zone 12 CALRES Simulation Results

Ninety-nine homes were surveyed in the Climate Zone 12 region. Results of these CALRES simulations show that the average estimated energy use was 49.86 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 6 percent higher than the standard design of 46.94 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 48.30 kBtu/sq.ft.-yr. or 3 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-14. A graph of the pre-occupancy compliance margin is presented in Figure 5-16. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 21 percent to failing compliance by 33 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $100.34 per year.

Table 5-14 Climate Zone 12 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	46.94	6.43	68.46	34.07	99
Pre-Occupancy	49.86	7.01	65.20	32.73	99
Post-Occupancy	48.30	6.85	63.28	31.28	99

Figure 5-16 Compliance Margin Of Surveyed Homes In Climate Zone 12



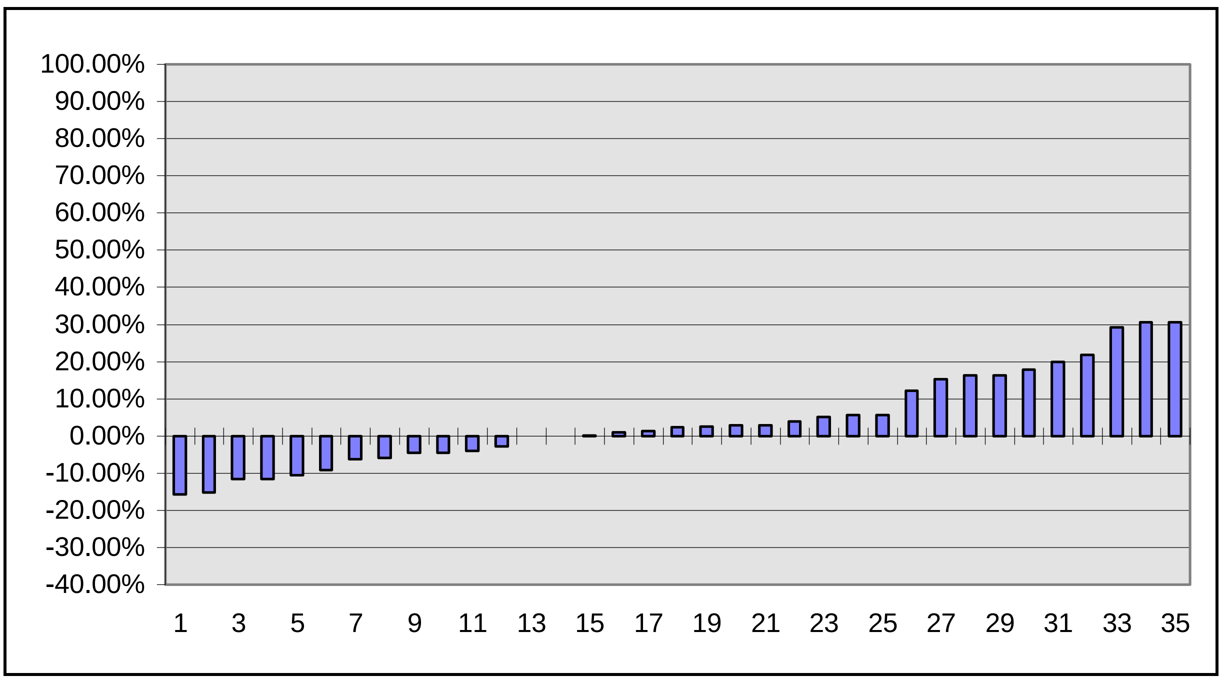
5.14 Climate Zone 13 CALRES Simulation Results

Thirty-five homes were surveyed in the Climate Zone 13 region. Results of these CALRES simulations show that the average estimated energy use was 53.24 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 4 percent higher than the standard design of 51.42 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 52.24 kBtu/sq.ft.-yr. or 2 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-14. A graph of the pre-occupancy compliance margin is presented in Figure 5-16. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 16 percent to failing compliance by 31 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $90.77 per year.

Table 5-14 Climate Zone 13 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	51.71	8.51	67.96	36.60	35
Pre-Occupancy	53.24	7.63	71.96	37.45	35
Post-Occupancy	52.24	7.44	69.64	37.45	35

Figure 5-16 Compliance Margin Of Surveyed Homes In Climate Zone 13



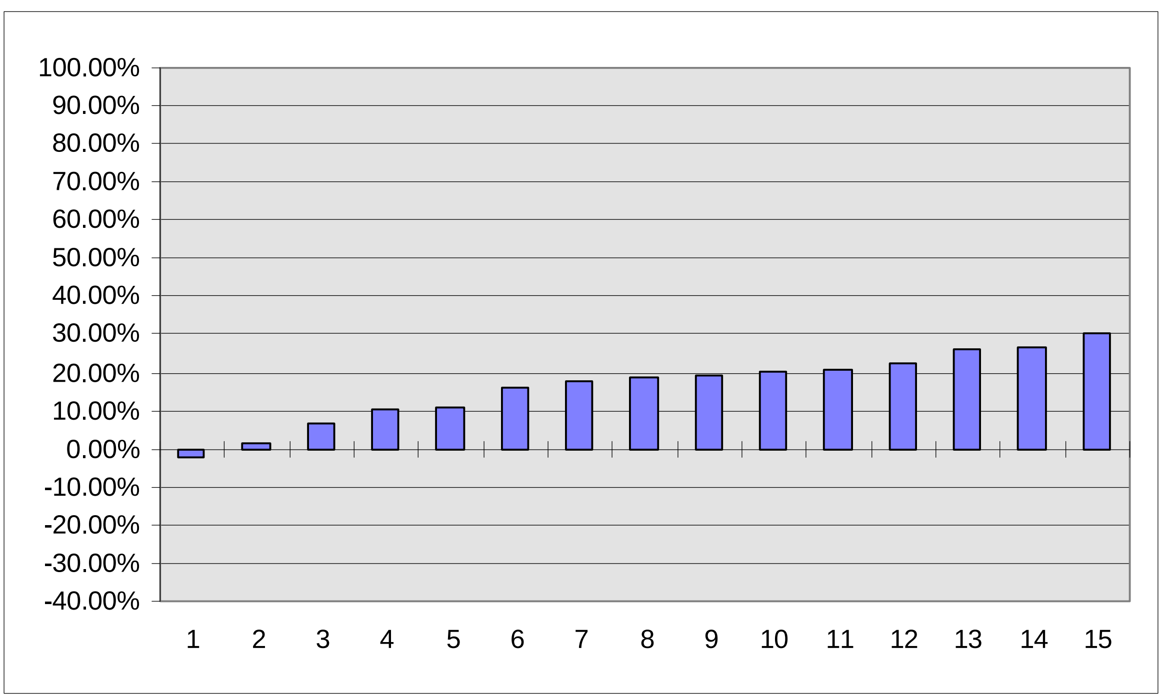
5.15 Climate Zone 14 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 14 region. Results of these CALRES simulations show that the average estimated energy use was 78.36 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 16 percent higher than the standard design of 67.62 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 75.15 kBtu/sq.ft.-yr. or 11 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-16. A graph of the pre-occupancy compliance margin is presented in Figure 5-18. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 2 percent to failing compliance by 30 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $193.65 per year.

Table 5-16 Climate Zone 14 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	67.62	8.31	75.68	53.75	15
Pre-Occupancy	78.36	8.98	91.22	64.13	15
Post-Occupancy	75.15	8.55	87.59	61.44	15

Figure 5-18 Compliance Margin Of Surveyed Homes In Climate Zone 14



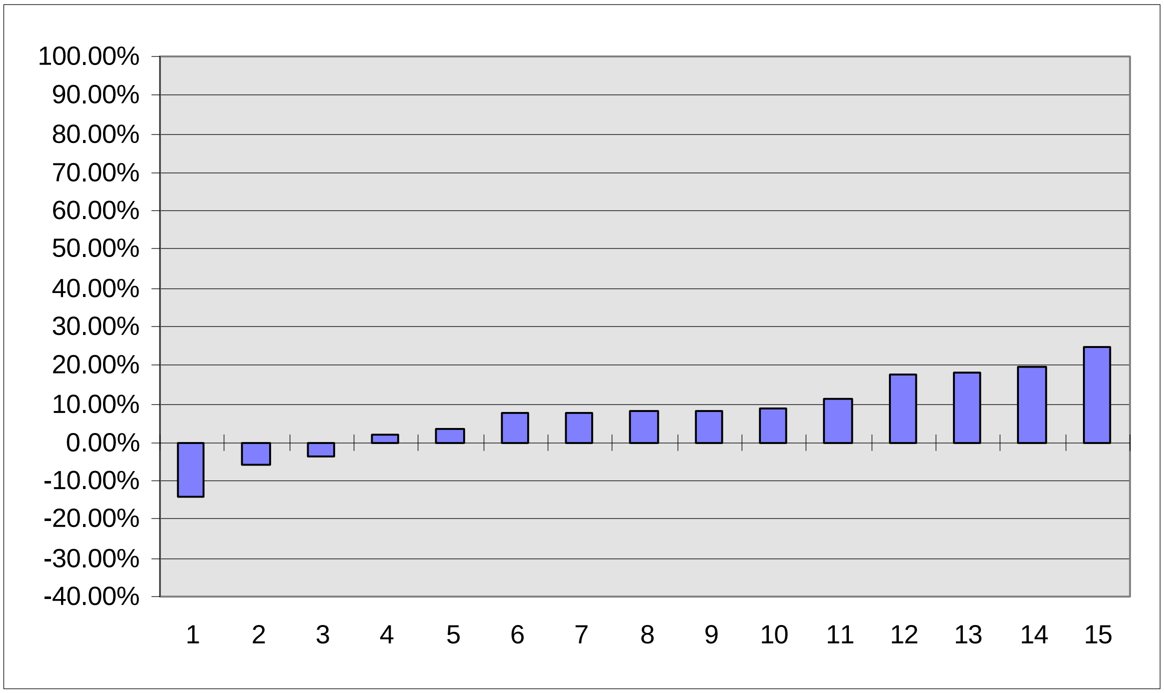
5.16 Climate Zone 15 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 15 region. Results of these CALRES simulations show that the average estimated energy use was 72.86 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 8 percent higher than the standard design of 67.76 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 71.86 kBtu/sq.ft.-yr. or 6 percent higher than the standard design. Summaries of the CALRES simulations are presented in Table 5-17. A graph of the pre-occupancy compliance margin is presented in Figure 5-19. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 14 percent to failing compliance by 25 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $86.38 per year.

Table 5-17 Climate Zone 15 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	67.76	3.41	73.95	61.45	15
Pre-Occupancy	72.86	7.13	87.59	61.12	15
Post-Occupancy	71.86	7.20	87.59	61.12	15

Figure 5-19 Compliance Margin Of Surveyed Homes In Climate Zone 15



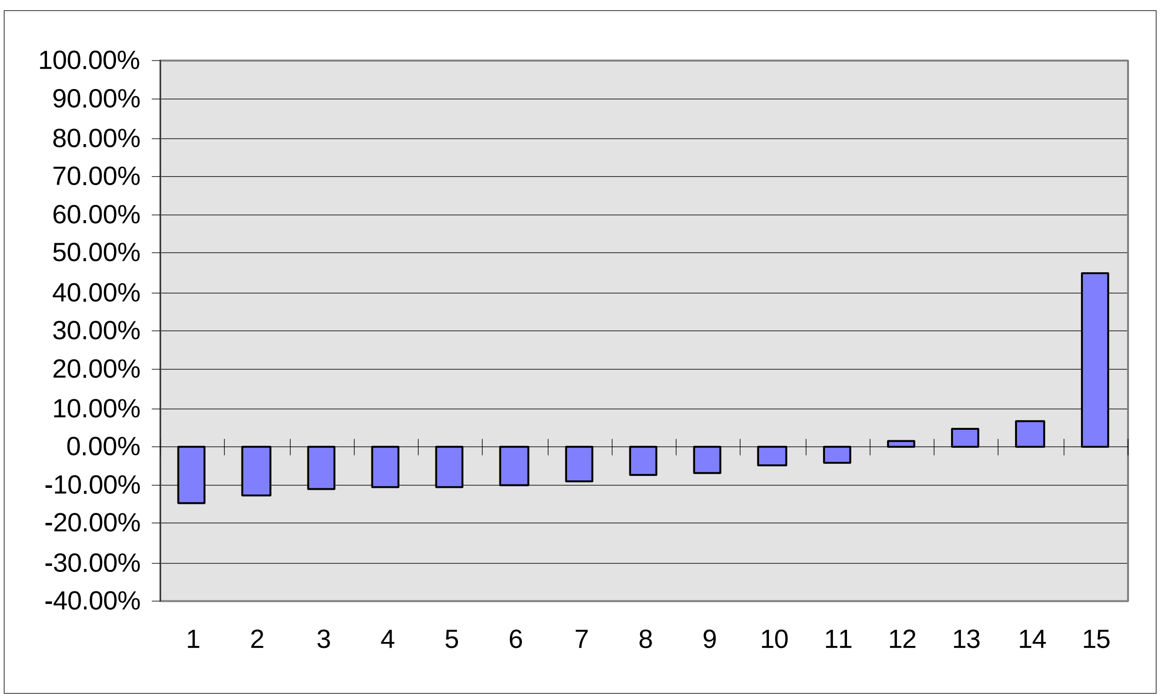
5.17 Climate Zone 16 CALRES Simulation Results

Fifteen homes were surveyed in the Climate Zone 16 region. Results of these CALRES simulations show that the average estimated energy use was 57.00 kBtu/sq.ft.-yr. before occupancy of the homeowners. This is 3.6 percent lower than the standard design of 59.12 kBtu/sq.ft.-yr. Actions by the new homeowners decreased the estimated energy use to 56.64 kBtu/sq.ft.-yr. or 4.2 percent lower than the standard design. Summaries of the CALRES simulations are presented in Table 5-18. A graph of the pre-occupancy compliance margin is presented in Figure 5-20. This figure shows that the houses surveyed in this climate zone range in compliance from passing compliance by 15 percent to failing compliance by 45 percent. The additional homeowner cost associated with the houses found not to be in compliance is an average of $102.27 per year.

Table 5-18 Climate Zone 16 CALRES Simulation Results

	Average	Standard Deviation	Maximum	Minimum	Count
Standard	59.12	7.84	70.54	45.96	15
Pre-Occupancy	57.00	8.28	69.67	45.32	15
Post-Occupancy	56.64	8.24	69.67	44.50	15

Figure 5-20 Compliance Margin Of Surveyed Homes In Climate Zone 16



6.0 DESCRIPTION OF COMPARISON REPORT

This report compares the analyses conducted by NEOS for the Post-Occupancy Residential Survey project with the results and observations obtained from previous similar survey projects conducted for the California Energy Commission (Commission). Comparisons were made between all applicable cross-sections of the new data obtained from the 400 on-site surveys of single-family homes during this study and the data contained in two previous Commission reports. These previous two reports together comprise the major elements of the "Residential Building Standards Monitoring Project" conducted over the period of 1988 through 1995. The two reports indicated are:

1. Occupancy Patterns & Energy Consumption in New California Houses (CEC Report P400-90-009, September 1990). This project entailed primary data collection by means of a nested sample of mail surveys (2,845), on-site surveys (299), on-site monitoring (40), and more detailed Short Term Energy Monitoring (STEM) tests (4). A second phase of this project was later added to carry out additional monitoring activities for more homes in order to expand the sample size for cooling load calculations. This project was carried out by means of a contract with the Berkeley Solar Group (BSG) and Xenergy, Inc. This report encompasses Phase One and Phase Two of the Residential Building Standards Monitoring Project, respectively, and are referred to as such in the remainder of this report.

2. Energy Characteristics, Code Compliance and Occupancy of California 1993 Title 24 Houses (CEC Report P400-91-031CN, May 1995). Under this project, also contracted with BSG, primary data collection activities were undertaken to obtain the CF-1R compliance forms for over 1,200 homes in Climate Zones 10, 12, 13, and 14. Additional on-site audits, metering, and duct leakage measurement activities were then conducted for a sample of approximately 100 homes. This report comprises Phase Three of the Residential Building Standards Monitoring Project, and is also referred to in this manner throughout the remainder of this report.

The data and information contained in these two reports were compared with the on-site data and building simulation results obtained from this project. The objective of these comparisons was to show trends in building construction practices, construction component and equipment efficiencies, as well as in compliance rates with building standards over time.

6.1 Background

The California Legislature passed the Warren-Alquist Act in 1976, which created the Commission and directed it, among other things, to develop Energy Efficiency Standards (Standards) for new buildings. Such Standards were to be periodically updated to be cost effective with respect to historic and current practice. The Commission issued the first energy efficiency standards in 1978 and has revised and updated them regularly since that time.

Field research information is considered an essential component of the review process for the Standards, which occurs under the Public Resources Code (PRC), Section 2540Z. In fiscal year 1995-96, the Commission solicited proposals for several contracts which were to help evaluate:

- Whether the Standards are based on realistic assumptions
- Whether the expected energy savings are being realized
- How selected elements of the program could be more effective

The Post-Occupancy Residential Survey project conducted by NEOS is one of the contracts designed to provide information to the Commission necessary to satisfy these objectives. This project was designed to collect data from 400 single-family detached houses constructed since July 1, 1989, distributed across all 16 California climate zones. While incremental changes in climate zone boundaries have occurred over time, they have remained essentially the same since the inception of the Standards in 1978, and are consistent over the course of all three projects included in this report.

The primary objectives of the Post-Occupancy Residential Survey project were to examine:

1. If and how the surveyed houses initially complied with Title 24 Standards
2. If energy efficiency measures were removed after homeowner occupancy
3. If additional energy efficiency measures were installed after homeowner occupancy
4. Why energy efficiency or energy saving measures were removed or installed by homeowners
5. How the results of these 400 surveys compare with two previous Commission surveys

This report specifically addresses the last of these objectives in detail. The remainder of this section provides a brief qualitative overview of the comparison results. Section 2 provides a description of all three projects and lays the foundation for the quantitative comparisons of the data and analyses contained in Section 3. Section 4 presents the results of the CALRES simulations across all comparable segments of the data between the projects. Section 5 provides the summary and conclusions from the comparison exercise.

6.2 Overall Comparisons

Data regarding building energy efficiency characteristics were compared between the three projects for four building components: structure, HVAC equipment, hot water equipment, and appliances. In general, variations between the energy efficiency characteristics of the homes in the three surveys were strongly correlated with the vintage of the home and the Standards in place at the time.

The houses surveyed in Phases One and Two of the Residential Building Standards Monitoring Project were built in the years 1984 through 1988. The houses surveyed in Phase Three of the project were built primarily in 1993, with some houses built in 1994. Houses surveyed for the Post-Occupancy Residential Survey Project were built in the years 1989 to 1995, with most of the homes built in 1990 through 1993. Consequently, data from the Phase Three survey and the current project represent approximately the same time frame, while the Phase One survey data represent homes built under prior energy standards and building practices.

For building structure, there appeared to be little difference among the houses from the three projects in terms of number of floors, average floor area, floor type, window area per floor area, and average window area per household. Houses in the NEOS project, however, appear to have higher levels of roof, wall, and floor insulation as well as more efficient window glazing. This is expected since the more recent energy standards require higher levels of insulation and more efficient window glazing.

With regard to HVAC equipment, there appeared to be little difference between the houses participating in the NEOS project and the houses that participated in the 1993 project. Differences are evident in HVAC system efficiency between the Phase One and Two homes and both the Phase Three and the current project. In the latter projects, the cooling equipment SEER and heating equipment AFUEs are higher, which matches the stricter requirements of the newer Standards.

For hot water equipment, comparisons between the projects were made by examining the water heater efficiencies and the water heater fuel types. These comparisons could only be made between the current project and the 1990 report for Phase One and Two. Data for these variables were not available from the Phase Three report. Comparisons between the current project and the 1990 project results indicate that the water heater equipment installed in the homes was very similar . The water heater efficiencies were nearly identical in both projects, and natural gas was the predominant water heater fuel type.

For other general appliances in the home, comparisons between the projects were made by looking at the presence, and in some cases the fuel type, of clothes washers and dryers, cooking equipment, freezers, and hot tubs/spas. Except for the cooking fuel type, comparable data were only available between the current project and the Phase One and Two 1990 project. The presence of freezers was lower in the current project when compared to the earlier data. Natural gas is more common as the fuel type of choice for clothes drying and cooking in the current data than in the two previous projects. The presence of hot tubs/spas appears to be lower in the current project compared to the Phase One and Two project.

6.3 Summary Of Calculated Energy Performance

Although the CALRES building energy simulation computer program was used in all three projects, insufficient detail was provided in the Phase One and Two data to permit a valid comparison of the results with the other projects. Comparisons were, therefore, limited to the cross-section of applicable climate zones between the Phase Three data and the current Post-Occupancy data. For these comparisons, the pre-occupancy compliance data were used since that is how the homes were shown to comply with the Title 24 energy codes.

A comparison of the levels of compliance for the two projects indicated is presented in Table 6-1. While the levels of compliance are not identical between these two projects, the comparisons do show consistency by climate zone. Both projects showed that the lowest levels of compliance occurred in Climate Zone 14 and the highest levels of compliance occurred in Climate Zone 10. These results also indicate a relatively low compliance rate in Climate Zone 12, which is somewhat troublesome, due to the large amount of past, current, and projected residential construction activity in this climate zone.

Table 6-1 Performance Compliance of As Built Audited Houses (1993 and 1996 On-Site Survey Projects)

Climate Zone	1993 On-Site		1996 On-Site	
	# of Homes	% Complying	# of Homes	% Complying
10	26	69%	52	46%
12	24	29%	99	24%
13	22	50%	35	40%
14	24	8%	15	7%
Total	96	40%	201	31%

Table 6-2 presents a comparison of the percentage margin in the compliance rates between the comparable data from the two projects indicated. The percent margin is defined as the amount over (negative) or under (positive) the required compliance rate that the average for each climate zone represents. A margin of positive percentage indicates that the average compliance rate for the region is better than the required value.

As this table shows, the margins between three of the climate zones are within four percentage points of each other, and can be considered quite comparable between the two projects. The exception is Climate Zone 14, which showed similar trends between the projects, but with a much greater magnitude of difference. Differences in the sample size, house size, window area to floor area ratios, as well as heating and cooling equipment efficiencies are all factors which can effect the results of the energy simulations between the two projects.

Table 6-2 Average Energy Performance of As Built Audited Houses (1993 and 1996 On-Site Survey Projects)

Climate Zone	1993 On-Site		1996 On-Site	
	Total	% Margin	Total	% Margin
10	26	3%	52	-1%
12	24	-6%	99	-6%
13	22	-1%	35	-3%
14	24	-8%	15	-16%

7.0 CONCLUSION

Five basic questions were laid out on initiation of this project:

1. If, and how, the surveyed homes initially complied with Title 24 standards
2. If energy efficiency measures were removed after homeowner occupancy
3. If additional energy efficiency measures were installed after homeowner occupancy
4. Why energy efficiency or energy saving measures were removed or installed by homeowners
5. How the results of these 400 surveys compare with two previous Commission surveys

7.1 Title 24 Compliance

The CALRES Energy Simulation Program was used to determine compliance with the Title 24 energy standards. Based on these energy simulations, 38 percent of the homes complied with Title 24 before homeowner occupancy. Because the level of compliance varied greatly from climate zone to climate zone, the sample size per climate zone greatly determines this 38 percent compliance value. Climate Zone 7 had the highest level of compliance, 83 percent, but was represented by only 18 homes in the total sample of 400 homes. Conversely, Climate Zone 12 was represented by 99 homes, but had a low level compliance, 24 percent. For this reason, it is much more important to review the compliance levels at climate zone level. A breakdown of the compliance levels for each climate zone is presented in Table 7-1.

Table 7-1 Performance Compliance of As Built Audited Houses

Climate Zone	Comply	Don't Comply	Total	% Complying
1	0	15	15	0%
2	8	7	15	53%
3	4	14	18	22%
4	10	5	15	67%
5	1	14	15	7%
6	11	4	15	73%
7	15	3	18	83%
8	6	12	18	33%
9	7	8	15	47%
10	24	28	52	46%
11	13	12	25	52%
12	24	75	99	24%
13	14	21	35	40%
14	1	14	15	7%
15	3	12	15	20%
16	11	4	15	73%
Total	**151**	**249**	**400**	**38%**

Since the compliance rate was so low in Climate Zones 1, 5, and 14, a further examination of the various CALRES simulation inputs on an average climate zone level. In general, discrepancies with the Standards were found in three areas. Packages D & E of the Title 24 energy standard prescriptive packages require an insulation level of R-38 in Climate Zones 1 and 14 and a level of R-30 in Climate Zone 5. The homes surveyed for this project had average ceiling insulation levels of R-33 and R-34 for Climate Zones 1 and 14, respectively, while Climate Zone 5 had an average ceiling insulation value of R-29. The wall insulation requirements of Packages D & E require an insulation level of R-21 in Climate Zones 1 and 14. The homes surveyed for this project had average wall insulation levels of R-14 for both Climate Zones 1 and 14. Finally, Packages D & E have a maximum window area to floor area percentage of 16 percent for Climate Zone 14. In Climate Zone 14, the homes surveyed had an average window area to floor area percentage of over 19 percent. While none of these measures on their own may not have caused a failure to comply with the Standards, each item does reduce the level of energy efficiency in these homes.

While these items contributed to the low compliance rates in Climate Zones, 1, 5, and 14, a review of the CALRES simulation inputs for climate zones with high compliance rates may give some keys to the reasons for the higher rates of compliance with the Standards. For this reason, Climate Zones 6 and 7 were reviewed for higher than expected energy efficiency items. Higher efficiency values than the Standards were found in four areas. Packages D & E of the Title 24 energy standard prescriptive packages require an insulation level of R-30 in Climate Zones 6 and 7. The homes surveyed for this project had average ceiling insulation levels of R-38 for Climate Zone 6 and R-33 for Climate Zone 7. The wall insulation requirements of Packages D & E require an insulation level of R-13 in Climate Zone 6. The homes surveyed for this project had average wall insulation levels of R-15 for Climate Zone 6. For the maximum window area to floor area percentage, Packages D & E have a maximum percentage of 20 percent for Climate Zones 6 and 7. In Climate Zones 6 and 7, the homes surveyed had an average window area to floor area percentage of 16 percent. Finally, the air-conditioning minimum SEER requirement for a split-system is 10.0. In Climate Zone 6, the homes surveyed had an average SEER of 12.0. When all of these average values are used, there is a much higher likelihood that a particular house will pass the energy standard compliance requirement.

7.2 Removal Of Energy Efficiency Measures

Based on the data collected from these 400 homes, there were no substantive levels of energy efficiency measure removal in newly constructed homes in California. This included lighting measures, structure measures, window covering measures, landscaping measures, and water fixture measures. Removal of energy efficiency measures does not seem to be a major issue in energy performance of newly constructed homes in California.

7.3 Addition Or Replacement Of Energy Efficiency Measures

This survey project determined a major amount of addition or replacement of energy efficient measures. Areas where considerable activity is taking place includes:

- Window coverings
- Shade trees
- Outdoor fixtures
- Faucets or showerhead replacement
- Incandescent lamp changeouts
- Fluorescent fixtures addition
- Replacement of worn or defective weather-stripping/caulking

As expected, most homeowners add window coverings (80 percent of the homeowners) and shade trees (at least 25 percent of the homeowners) to their homes after they move into the home. The data collected from this on-site survey reports that window coverings are added mainly for decorative reasons, to keep the house cool and for privacy. Shade trees, on the other hand, are added to keep the house cool and for general landscaping reasons. Regardless of the reasons given by the homeowner, the end result is still higher energy efficiency.

Some of the new homeowners added landscape (18 percent) or security lighting (20 percent). These lights are not taken into consideration in the energy compliance requirements because outdoor lights are not part of Standards, but additions of outdoor lights will increase energy use at the home.

This project uncovered a considerable amount of replacement of showerheads and faucets (37 percent). In some cases, this replacement was due to a desire to change the showerhead or fixture type (18 percent), but there also were homeowners who replaced showerheads and faucets to decrease water flow (8 percent). These replacements would tend to decrease hot water use and overall water use, which increases two conservation opportunities.

Homeowners interested in reducing their utility bill had changed out incandescent lamps to compact fluorescent lamps (10 percent). While not included in the original energy compliance, use of these compact fluorescent lamps will reduce the energy use in the home.

When applicable, homeowners are adding fluorescent fixtures (25 percent) or replacing incandescent fixtures with fluorescent fixtures (12 percent). While adding fixtures does not help reduce energy use in a home, replacing existing incandescent fixtures with fluorescent fixtures does help reduce energy use. Although these items are not dealt with in the Standards, these actions do affect energy use at the home.

A considerable portion of the homeowners replaced weather-stripping and caulking (17 percent) because the original weather-stripping and caulking had worn out. Since the actions of the homeowner really keep the house to the original as-built condition, these actions have no impact on the Title 24 compliance. These actions help reduce energy use in the newly constructed homes.

7.4 Sources Of Information For Homeowner Removal Or Installation

In reviewing the sources of information relied upon by the homeowner in making energy decisions, past experience is always the main resource the homeowner relies upon. For certain measures, an interior decorator or a contractor may be consulted, but the primary source is always past experience. For equipment purchases, consumer guides also were mentioned frequently.

The reasons for making a change in a home were strongly based on past experience. Except in cases where equipment broke down and needed to be replaced, past experience was nearly always the guide for an energy efficient action. This included everything from shade trees to window coverings to faucet replacement.

7.5 Previous Commission Surveys

A report was prepared comparing the data and results from the two reports generated for the "Residential Building Standards Monitoring Project", *Occupancy Patterns & Energy Consumption in New California Houses* and *Energy Characteristics, Code Compliance and Occupancy of California 1993 Title 24 Houses*, with the data and results from the "Post-Occupancy Residential Survey Project." Overall conclusions were drawn in three major areas. First, since these projects collected data on newly constructed homes over an eight year period, conclusions could be made regarding the changes in building insulation levels and equipment efficiency over time. Second, levels of compliance with the Title 24 energy standards were compared and contrasted on a climate zone level. Finally, like data elements from the two reports and the current project were analyzed to determine if the homes surveyed in these projects showed enough similarity to provide credence to the results documented in the "Post-Occupancy Residential Survey Project" final report.

Since the data collected from these projects were collected on homes that were built at different points in time, the data should show improvements in energy efficiency and technology as newer homes are compared homes built under previous energy standards. This is expected because the Standards have become more stringent and the energy efficiency of equipment has improved. This assumption was verified by the data. The two data collection efforts which covered the same time period, Phase Three of the "Residential Building Standards Monitoring Project" and the "Post-Occupancy Residential Survey Project" had higher ceiling, wall, and floor insulation levels and more efficient window glazing than data collected on homes built from 1984 through 1988 (Phase One). Similarly, improvements in the efficiencies of HVAC equipment are shown through comparison of the three projects. There appeared to be little difference between the HVAC equipment in the “Post-Occupancy Residential Survey Project” and the houses that participated in the 1993 project (Phase Three). Differences do appear between the Phase One project houses. In the more recent projects, the cooling equipment SEER and heating equipment AFUE appear to be higher, which is expected based on differences in year of construction for the houses. Historic comparisons on the efficiency of the hot water equipment were not made, since efficiencies in the Phase One data were collected using Recovery Efficiencies and the “Post-Occupancy Residential Survey Project” collected the efficiency data using Energy Factors.

Comparisons of compliance with energy codes were made using the CALRES simulation model. These comparisons were between simulations made on the houses surveyed in Phase Three of the “Residential Building Standards Monitoring Project” and the houses surveyed in the “Post-Occupancy Residential Survey Project”. While the levels of compliance were not identical between these two projects, the comparisons did show consistency by climate zone. Both projects showed the lowest levels of compliance occurred in Climate Zone 14 and the highest levels of compliance occurred in Climate Zone 10. A comparison of the average percentage margin of compliance between these two projects show the compliance margins were within four percentage points in Climate Zones 10, 12, and 13. This indicates that, on an average, the simulation results were comparable between the two projects. The lone exception is Climate Zone 14, which had similar results, but a greater magnitude of difference, which may be related to the small sample size for this climate zone in the “Post-Occupancy Residential Survey Project.”

Finally, comparisons were made on a wide range of data elements between the three on-site survey projects. While these data elements were not expected to show variance based on the year of construction, they do show an indication of the similarity in the type and characteristics of the houses surveyed in the three projects. In the area of building structure, there appeared to be little difference among the houses from the three projects in terms of number of floors, average floor area, or floor type, For home appliance information, comparisons between the projects were made by looking at the presence and in some case fuel type of clothes washers and dryers, cooking equipment, freezers, and hot tub/spa. The only major differences between the three on-site surveys is that the presence of freezers was lower in the “Post-Occupancy Residential Survey Project” when compared to the Phase One data collection. Also, natural gas was used more commonly as the fuel for clothes drying and cooking with the “Post-Occupancy Residential Survey Project” than the two previous projects and the presence of hot tubs/spas appears to be lower in the current project compared to the 1990 project. These small differences are most likely based on the sample selection rather than any true differences in the homes surveyed for these projects. In general, the characteristics of the homes surveyed in these three on-site surveys are very similar and show no major differences.

7.6 Recommendations

Through the conduction of this project, NEOS Corporation and its subcontractors have gained insights which may be helpful to the Commission in future on-site data collection efforts, CALRES simulation efforts, and projects that require comparison with data collected from previous projects. These insights are related to project design, homeowner recruitment, data collection, and database management. In addition, as stated earlier, NEOS Corporation has concerns relating to the wide variation of compliance rates between the climate zones.

In retrospect, the design of this project should have been more well-defined. While there were five primary purposes to this project, the interpretation of how best to fulfill those purposes varied within the Commission, at NEOS, and at the subcontractor level. The primary purposes for the project were not always complementary. Compliance with Title 24 and the use of CALRES should have been structured as an on-site data collection/compliance form comparison. Actions by the homeowner, while in some cases may have required on-site inspection, could have been captured through less expensive means, such as telephone or mail surveys. Sending engineers/technical surveyors to collect market and demographic information on-site is expensive and not the most productive approach.

On a related topic, the data collection form designed for this project was too large and attempted to collect too much data. NEOS originally intended to use a survey form of between 10 and 15 pages. By the time the survey form was finalized, the survey form had risen to 41 pages. This size of survey was too large for a surveyor to use effectively in a field survey. More emphasis should have been made on capturing data inputs for the CALRES program, which would have provided more precise CALRES simulations. Data elements that should have been removed related to appliance data. The final survey form tried to capture every situation and appliance. After completing the data collection, analysis of the data showed that the vast majority of the homes had very similar characteristics. As such, these characteristics did not need to be documented or at least not in the detail the survey form required. The final recommendation for future survey form design is to prioritize the data that has been requested and be realistic in the data elements that can be captured.

The homeowner recruitment phase of this project proved to be more troublesome than was expected. Recruitment levels for the project were lower than expected. The participation levels improved as the California Energy Commission name, letterhead and contact names were used in place of the contractor's name, letterhead and contact names. This gave more credibility to the project and should be the first approach in future projects. Since this project was a statewide project, NEOS was able to determine that recruitment levels varied by climate zones. Roughly, participation levels were higher in areas of greater residential building activity. When recruitment efforts were made in housing developments, the participation levels were higher. Recruitment efforts for individual home sites were much more difficult and had lower participation levels.

In reviewing the project, the use of three different subcontractors to collect the on-site data may have been too complex. While providing good coverage of the state and reducing travel costs, the work priorities of the subcontractors caused unreasonable delays to the project. This could have been eliminated by using one subcontractor that was dedicated to the project rather three subcontractors, all of which had other projects in competition with this project. On a related subject, NEOS should not have provided, in detail, the travel and subcontractor costs until after the final sample had been selected. These original details caused too much distraction from the primary purposes of the project.

Although the recruitment of houses for the project proved troublesome, the actual scheduling and surveying of the houses was relatively trouble-free. There were instances where homeowners failed to meet appointments, but those instances were rare. The exceptions were the houses recruited by the Commission for the "Non-Response Bias Study." These houses had a much higher scheduling and on-site drop-out rate and were a source of difficulty for the sub-contractor. Once on-site, the surveys ran smoothly except for issues of access. Attic access was the most difficult item. While all houses have an access to the attic, the surveyors frequently found this access to be blocked or inaccessible because of actions by the homeowner through storage of items or messy rooms where the homeowner would not allow access.

One of the requirements of this project comprised a comparison of data from previous projects with data collected in this project. Before a requirement like this is considered again, an analysis of the previous data should be undertaken. NEOS Corporation's comparison discovered that data had been collected in non-comparable ways. In the previous projects, many data elements were collected in the form of ranges. The data in this project had to be collected using distinct values for the CALRES simulations. These two types of data proved difficult and sometimes impossible to compare, thus lessening the effectiveness of the comparisons. Also, a specific database should be selected and used in all future projects. Data from previous projects were stored in the form of SAS datasets, Excel spreadsheets, and in the case of the current project, a FoxPro database. To conduct analysis of the data from these projects, these databases had to be analyzed in three different formats. A consistent database would reduce the amount of movement required between dissimilar database programs.

The final recommendation is for the Commission to further investigate the wide variations in compliance rates between the various climate zones. CALRES simulations from this project and the previous project found that compliance with the energy standards seemed to depend greatly on the climate zone. Whether these variances are based on a lack of enforcement of the energy standards or a built-in bias in the compliance requirements was not determined in this project, but may be an issue that will need to be investigated in a future project.

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Appendix C - CALRES Results And Sources

Table Of Variable Sources
Table Of Individual CALRES Results
Table Of Non-Compliance Costs

Source

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
201	1	1	38.90	39.69	-	-	A	C	-	-
199	1	1	38.13	39.25	-	A	A	-	-	-
379	1	1	38.15	39.79	A	-	-	-	-	-
200	1	1	38.49	40.25	-	A	A	-	-	-
205	1	2	26.82	29.52	A	-	A	-	-	-
377	1	1	43.19	47.88	-	-	-	-	-	-
203	1	1	32.66	36.58	A	A	A	-	-	-
202	1	1	28.73	32.57	A	A	A	-	-	-
206	1	1	44.31	53.44	A	A	A	-	-	-
198	1	2	33.71	41.22	-	-	A	C	-	-
400	1	1	37.09	45.37	-	A	A	-	-	-
378	1	2	26.42	32.34	-	-	A	C	-	-
204	1	2	30.07	37.05	A	A	A	-	-	-
402	1	1	42.45	55.58	A	A	A	C	-	-
401	1	1	43.04	56.80	A	A	A	C	-	-
67	2	1	54.78	48.85	-	A	A	-	-	-
80	2	1	49.50	45.71	-	A	A	-	C	C
74	2	1	48.37	44.79	-	A	A	-	-	-
73	2	1	48.88	45.88	-	A	A	-	-	-
75	2	1	57.55	54.41	-	A	A	-	-	-
71	2	1	58.02	55.12	-	A	A	-	-	-
72	2	1	58.02	55.34	-	A	A	-	-	-
68	2	1	49.25	48.94	-	A	A	-	-	-
66	2	1	50.07	50.58	-	A	A	-	-	C
78	2	1	48.37	49.09	-	A	A	-	-	C
77	2	1	47.91	49.25	-	A	A	-	-	C
76	2	1	48.34	49.85	-	A	A	-	-	C
79	2	1	48.37	49.96	-	A	A	-	-	C
70	2	1	54.81	58.31	-	A	A	-	-	-
69	2	1	54.81	59.92	-	A	A	-	-	-
246	3	1	19.63	16.95	A	A	A	-	-	-
244	3	1	23.82	20.77	A	A	C	-	-	-
242	3	1	23.67	22.15	A	A	C	-	-	-
282	3	1	21.55	20.62	A	A	A	-	-	C
399	3	1	23.21	23.35	A	-	C	-	-	C
290	3	1	28.67	29.49	A	A	A	-	-	C
238	3	1	30.20	31.17	-	A	A	-	-	C
398	3	1	40.12	41.44	A	-	C	-	-	-
240	3	1	30.83	31.93	-	A	C	-	-	-
245	3	1	36.66	38.18	A	A	A	C	-	C
99	3	1	25.52	26.77	A	A	A	-	-	C
289	3	1	27.62	29.18	A	A	A	-	-	-
241	3	1	30.58	32.39	A	-	A	-	-	-
98	3	1	25.71	27.57	A	A	A	-	-	-
243	3	1	25.68	28.02	A	A	C	-	-	-
286	3	1	22.28	24.36	A	A	C	-	-	-
239	3	1	26.30	29.80	A	-	C	-	-	-
291	3	1	33.06	37.97	A	A	A	-	-	-
382	4	1	26.57	23.66	A	A	A	-	-	-
381	4	1	33.85	30.30	A	A	A	-	-	-
389	4	1	24.36	22.02	A	A	A	-	-	-
383	4	1	26.57	24.32	A	A	A	-	-	-
285	4	1	29.72	27.33	A	A	C	-	-	-
388	4	1	24.96	23.10	A	A	A	-	-	-
293	4	1	33.42	32.11	A	A	A	-	-	-

Keys To Table

- = Observed by surveyor   A = Assumed by surveyor   C = CALRES Default

Source

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
292	4	1	30.35	29.30	A	A	A	-	-	-
287	4	1	28.45	27.53	C	A	-	-	-	-
288	4	1	25.73	25.41	A	A	A	-	-	-
390	4	1	21.53	21.83	A	A	A	-	-	-
236	4	1	30.54	31.71	A	A	A	-	-	-
294	4	1	32.53	34.06	A	A	A	-	-	-
237	4	1	30.75	34.40	A	A	A	-	-	-
284	4	1	33.50	37.59	A	A	C	-	-	-
387	5	1	24.01	20.94	A	-	C	-	-	-
385	5	1	24.45	24.87	A	A	C	C	-	-
279	5	1	26.55	27.32	-	-	C	C	-	-
394	5	1	33.25	34.26	-	A	-	C	-	-
397	5	1	38.67	40.07	A	-	A	C	-	-
386	5	1	25.91	26.94	A	-	C	-	-	C
281	5	1	31.09	32.70	A	-	C	C	-	-
384	5	1	26.87	28.38	A	-	A	-	-	-
393	5	1	34.54	36.62	-	A	C	C	-	-
391	5	1	24.08	25.67	A	-	-	-	-	C
283	5	1	35.15	37.65	-	-	C	-	-	C
280	5	1	28.44	30.66	C	-	C	-	-	-
392	5	1	46.91	51.03	-	-	A	-	-	-
395	5	2	27.64	32.09	-	-	C	-	-	-
396	5	1	45.71	53.90	-	-	C	-	-	-
120	6	1	25.22	18.93	A	-	-	-	-	-
122	6	1	32.50	27.32	A	-	-	-	-	-
124	6	1	27.27	23.12	A	-	-	-	-	-
121	6	2	31.60	27.77	A	A	A	-	-	-
102	6	1	23.63	21.33	-	-	-	C	-	-
112	6	2	17.67	16.25	A	-	A	-	-	-
105	6	1	28.02	25.84	A	-	-	-	-	-
106	6	1	27.22	25.65	A	-	-	-	-	-
113	6	1	28.19	26.61	A	-	-	-	-	-
123	6	1	31.93	31.30	A	-	-	-	-	-
100	6	1	25.92	25.63	A	-	-	-	-	-
111	6	1	28.07	28.28	A	-	-	-	-	-
101	6	2	16.45	16.68	-	-	-	-	-	-
108	6	2	17.97	18.87	A	-	-	-	-	C
107	6	2	17.71	20.37	-	-	-	-	-	C
146	7	1	19.69	16.52	-	A	A	-	-	-
133	7	1	21.24	18.14	-	A	A	-	-	-
138	7	1	19.77	17.70	-	A	A	-	-	-
136	7	2	18.28	16.38	-	A	A	C	-	-
139	7	1	22.30	20.09	-	A	A	-	-	-
142	7	1	20.28	18.42	-	A	A	-	-	-
140	7	1	19.14	17.45	C	A	A	C	-	-
137	7	1	22.08	20.26	-	A	A	-	-	-
135	7	1	20.95	19.24	C	A	A	-	-	-
148	7	1	18.72	17.23	-	A	A	-	-	-
147	7	1	21.09	19.64	-	A	A	-	-	-
149	7	1	21.09	19.65	-	A	A	-	-	-
145	7	1	18.58	17.45	-	A	A	-	-	-
141	7	1	19.23	18.83	-	A	A	-	-	-
132	7	2	19.72	19.57	A	A	A	C	-	-
144	7	2	19.92	20.22	-	A	A	-	-	C
143	7	1	20.85	21.42	-	A	A	-	-	-

Keys To Table

- = Observed by surveyor　　A = Assumed by surveyor　　C = CALRES Default

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
134	7	1	20.32	21.29	-	A	A	-	-	-
301	8	1	22.85	20.46	-	-	A	-	-	-
103	8	1	21.36	19.40	A	-	A	-	-	-
302	8	1	27.87	25.57	-	-	-	-	-	-
109	8	1	28.34	26.85	A	-	A	C	-	-
104	8	1	22.07	21.09	-	-	-	C	-	-
296	8	1	23.17	22.42	A	-	-	C	-	-
305	8	1	27.72	27.94	-	-	-	-	-	-
119	8	1	24.04	24.29	-	-	-	-	-	-
313	8	1	26.48	26.83	-	-	-	-	-	-
295	8	1	25.21	25.71	A	-	-	-	-	-
306	8	1	26.15	26.93	-	-	-	C	-	-
300	8	1	25.29	27.32	-	-	-	-	-	-
110	8	1	23.21	26.90	A	-	A	-	C	-
115	8	1	27.48	33.81	-	-	A	-	-	-
116	8	1	21.85	27.44	A	-	-	-	-	-
118	8	1	24.48	34.49	A	-	-	-	-	-
114	8	1	25.56	36.08	C	-	A	-	-	-
117	8	1	29.97	52.19	A	-	-	-	-	-
183	9	1	26.06	21.93	-	-	-	C	-	-
178	9	1	24.59	20.75	-	-	-	-	C	C
165	9	2	28.58	26.45	-	-	-	-	-	-
180	9	1	29.22	28.17	-	-	-	-	C	-
181	9	1	27.62	26.82	-	-	-	-	-	-
185	9	1	19.55	18.99	-	-	A	-	-	-
161	9	1	33.93	33.54	-	-	-	-	-	-
184	9	1	29.03	29.37	-	-	-	-	-	-
164	9	2	28.81	29.35	-	-	-	-	-	-
177	9	1	26.71	27.47	-	-	-	-	-	-
163	9	1	30.50	32.75	A	-	A	C	-	-
162	9	1	34.65	37.75	-	-	-	-	-	-
166	9	2	25.35	27.86	-	-	-	-	-	-
182	9	1	49.37	56.00	C	-	-	C	-	-
179	9	1	29.56	41.21	-	-	-	-	-	-
46	10	1	39.76	32.67	A	-	-	-	-	-
175	10	2	29.06	24.93	-	-	-	C	-	-
40	10	1	47.99	41.40	A	-	A	-	-	-
322	10	1	49.35	42.62	-	-	-	C	-	-
173	10	2	31.57	27.51	A	-	-	-	-	-
298	10	2	31.74	27.70	A	-	-	-	-	-
48	10	1	41.36	36.10	A	-	A	C	-	-
41	10	1	45.15	39.81	-	-	-	C	-	-
43	10	1	46.67	42.08	-	-	C	-	-	-
308	10	1	43.46	39.53	A	-	A	C	-	-
331	10	1	42.92	39.48	-	-	-	-	-	-
172	10	2	31.07	28.58	A	-	-	-	-	-
312	10	2	31.59	29.22	-	-	-	-	-	-
51	10	1	45.15	42.00	A	-	-	-	C	-
311	10	2	31.59	29.46	-	-	-	-	-	C
297	10	2	31.60	29.48	A	-	-	-	-	-
314	10	1	46.21	44.03	-	-	-	-	-	-
325	10	1	48.16	46.01	-	-	-	-	-	C
42	10	1	42.35	40.55	A	-	C	C	-	-
52	10	1	42.77	41.66	A	-	-	-	C	-
50	10	1	46.79	45.58	A	-	-	-	-	-

Keys To Table

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Source

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
315	10	1	42.89	42.15	-	-	-	-	-	-
317	10	1	37.02	36.49	-	-	-	-	-	-
324	10	1	47.64	47.20	-	-	-	C	-	-
170	10	1	40.02	40.10	A	-	-	C	-	-
45	10	1	41.23	41.39	-	-	C	-	-	-
316	10	1	38.73	38.91	-	-	-	-	-	-
310	10	1	44.79	45.04	-	-	-	-	-	-
323	10	1	47.72	48.24	-	-	-	C	-	-
303	10	2	37.06	37.59	-	-	A	-	-	-
327	10	1	36.65	37.33	-	-	-	-	-	C
329	10	1	39.54	40.52	-	-	-	C	-	-
326	10	1	38.29	39.24	-	-	-	-	-	-
320	10	1	48.54	50.12	-	-	-	C	-	-
44	10	1	53.04	55.46	-	-	C	-	-	-
318	10	1	43.93	46.32	-	-	-	-	-	-
49	10	1	46.60	49.17	A	-	-	C	-	-
330	10	1	43.39	45.96	-	-	-	C	-	-
319	10	1	43.21	45.94	-	-	-	-	-	C
321	10	1	40.02	43.59	-	-	-	C	-	-
169	10	1	49.85	54.78	A	-	-	-	-	-
309	10	1	38.68	42.96	-	-	-	-	-	-
304	10	1	38.38	42.70	-	-	-	-	-	-
307	10	1	39.48	44.00	-	-	-	-	-	-
168	10	1	40.54	45.70	A	-	-	-	-	-
176	10	1	43.41	49.99	-	-	-	C	-	-
332	10	1	51.16	59.06	A	-	-	-	-	-
299	10	1	41.05	47.42	-	-	-	-	-	-
174	10	1	37.17	43.58	-	-	-	C	-	-
328	10	1	40.29	47.61	-	-	-	C	C	-
167	10	1	41.44	49.35	-	-	-	C	-	-
171	10	1	46.28	62.88	-	-	-	C	-	-
211	11	1	64.61	55.09	-	A	A	-	-	-
59	11	1	62.39	55.49	-	-	-	-	-	C
214	11	1	71.53	64.88	-	-	A	-	-	-
209	11	1	63.94	59.42	-	A	A	-	-	-
212	11	1	56.71	53.30	-	A	A	-	-	-
65	11	1	56.30	53.35	-	A	A	-	-	-
213	11	1	89.51	85.88	-	A	A	-	-	-
64	11	1	61.47	59.64	A	A	A	C	-	-
207	11	1	55.70	54.09	-	A	A	C	-	-
53	11	1	54.62	53.39	-	A	A	-	-	-
215	11	1	70.44	68.95	-	-	A	C	-	-
217	11	1	70.86	69.51	-	-	A	C	-	-
218	11	1	70.86	69.71	-	-	A	C	-	-
61	11	1	66.16	66.36	-	A	A	-	C	C
208	11	2	41.91	42.67	-	A	A	-	-	-
57	11	1	67.80	69.46	-	A	A	-	-	C
60	11	1	57.34	58.89	-	-	-	-	-	-
62	11	1	62.59	64.76	-	A	A	-	-	-
55	11	1	64.56	67.81	-	A	A	-	-	-
58	11	1	64.17	68.32	-	-	-	-	-	-
63	11	1	75.36	80.31	-	A	A	-	-	-
56	11	1	64.51	69.05	-	A	A	-	-	-
216	11	2	46.05	51.67	-	-	-	-	-	-
210	11	2	47.12	53.56	-	A	A	-	-	-

Keys To Table

- = Observed by surveyor   A = Assumed by surveyor   C = CALRES Default

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
54	11	1	51.07	62.26	-	A	A	-	-	-
29	12	1	41.26	32.73	A	A	A	-	-	C
219	12	1	44.11	36.70	A	-	A	-	C	-
251	12	1	68.46	61.12	A	A	A	C	-	-
195	12	1	59.98	53.93	-	A	A	-	-	-
369	12	1	46.22	42.49	-	A	A	C	-	-
228	12	1	42.33	39.46	-	A	A	-	-	-
12	12	1	40.33	38.07	-	A	A	-	C	-
220	12	1	43.94	41.62	-	A	A	-	-	-
368	12	1	52.21	49.65	-	A	A	-	-	-
235	12	1	56.99	54.23	-	A	A	-	-	C
371	12	1	49.59	47.93	-	A	A	-	-	-
254	12	1	43.66	42.24	A	A	A	-	-	-
34	12	1	40.86	39.60	A	A	A	-	-	-
349	12	1	52.13	50.77	A	A	A	-	-	-
129	12	1	50.57	49.61	-	A	A	-	-	-
19	12	1	51.94	50.97	A	A	A	C	-	-
370	12	1	49.38	48.73	A	A	-	-	-	-
225	12	1	49.18	48.65	-	A	A	-	-	-
197	12	1	51.45	50.90	-	A	A	C	C	-
232	12	1	48.10	47.65	-	A	A	-	C	-
230	12	1	49.85	49.41	-	A	A	-	-	-
30	12	1	47.87	47.46	A	A	A	-	-	-
4	12	1	58.71	58.22	-	A	A	-	-	C
8	12	1	35.44	35.34	A	A	A	-	-	-
227	12	1	42.11	42.23	-	A	A	-	-	C
253	12	1	39.85	40.05	A	A	A	-	C	-
260	12	1	46.96	47.22	A	A	A	-	-	-
6	12	1	52.31	52.73	A	-	A	-	-	C
277	12	1	51.81	52.24	A	A	A	C	-	-
158	12	1	49.90	50.35	-	A	A	C	-	-
275	12	1	42.04	42.50	A	A	A	-	-	-
221	12	1	43.95	44.48	A	A	A	-	C	-
348	12	1	50.19	50.96	-	A	A	C	-	-
347	12	1	52.25	53.18	A	A	-	-	-	-
257	12	1	39.85	40.63	A	A	A	-	-	-
128	12	1	46.46	47.61	-	A	A	-	-	-
231	12	1	56.96	58.53	-	A	A	-	C	-
352	12	1	59.07	60.72	-	A	A	-	-	-
223	12	1	43.94	45.23	-	-	-	-	-	-
39	12	1	37.23	38.52	A	A	A	C	C	-
13	12	1	41.27	42.80	A	A	-	-	-	-
233	12	1	50.20	52.19	-	A	A	-	-	C
229	12	1	44.24	46.03	-	A	A	C	-	-
263	12	1	55.81	58.16	-	A	A	C	-	-
276	12	1	39.02	40.81	A	A	A	C	-	-
130	12	1	36.11	37.87	-	A	A	-	-	C
376	12	1	54.76	57.82	-	A	A	C	-	-
264	12	1	52.56	55.58	A	A	A	C	-	-
278	12	1	51.33	54.31	A	A	A	C	-	-
266	12	1	39.29	41.58	A	A	A	-	-	-
249	12	1	54.16	57.49	-	A	A	-	-	-
157	12	1	54.47	57.98	-	A	A	C	-	-
152	12	1	42.96	45.79	-	A	A	-	-	-
252	12	1	46.01	49.13	A	A	A	-	-	-

Keys To Table

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Source

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
3	12	1	47.48	50.95	A	A	A	-	-	C
126	12	1	51.28	55.29	-	A	A	C	-	C
35	12	1	50.95	55.13	-	A	A	-	-	-
11	12	1	40.39	43.72	-	A	A	-	-	C
27	12	1	37.58	40.78	A	-	A	-	-	C
7	12	1	46.37	50.36	A	A	A	C	-	-
226	12	1	60.01	65.20	-	A	A	-	-	-
224	12	1	38.34	41.68	A	-	-	C	-	C
375	12	1	52.13	56.71	-	A	A	-	-	-
261	12	1	58.35	63.50	A	A	A	-	-	C
38	12	1	45.02	49.02	A	A	A	C	C	-
247	12	1	49.14	53.58	A	A	A	C	-	-
125	12	1	45.98	50.14	-	A	A	-	-	-
194	12	1	53.40	58.79	-	A	A	-	-	-
255	12	1	40.15	44.68	-	A	A	C	-	-
222	12	2	35.80	40.11	-	A	A	C	C	-
196	12	1	48.80	54.88	-	A	A	-	-	C
21	12	1	43.19	48.65	A	-	A	-	-	-
20	12	1	49.21	55.69	-	A	-	C	-	-
31	12	1	47.69	54.09	A	A	A	C	-	-
37	12	1	51.63	58.57	A	A	A	-	-	-
9	12	1	50.28	57.19	A	A	A	-	-	-
265	12	1	42.64	48.52	A	A	A	-	-	-
248	12	1	48.50	55.33	-	A	-	-	-	-
250	12	1	46.96	53.95	A	A	A	-	-	-
374	12	1	54.31	62.40	-	A	A	C	-	-
18	12	1	43.87	50.47	-	A	A	-	-	-
28	12	1	39.98	46.05	A	A	A	C	-	-
256	12	1	46.14	53.46	-	A	A	C	-	-
131	12	1	39.46	45.81	-	A	A	-	-	-
262	12	1	49.54	57.62	-	A	A	-	-	-
5	12	1	46.00	53.98	-	A	A	-	-	-
234	12	2	38.67	45.52	-	A	A	-	-	-
33	12	2	41.42	48.86	-	A	-	-	-	-
372	12	2	39.19	46.27	-	A	A	-	-	-
32	12	1	43.88	52.19	A	A	A	-	-	C
36	12	1	43.46	51.84	A	A	A	-	-	-
258	12	1	50.32	60.34	A	A	A	C	C	-
151	12	2	34.07	41.01	-	A	A	-	-	-
14	12	1	46.37	56.33	A	A	A	C	-	C
150	12	2	42.78	52.07	-	A	A	-	-	-
127	12	1	50.57	62.23	-	A	A	-	-	-
259	12	1	41.22	51.03	A	A	A	-	C	C
373	12	1	43.24	56.71	A	A	A	-	-	-
351	12	2	39.88	53.04	-	A	A	C	C	-
274	13	1	52.11	43.95	-	A	A	C	C	-
83	13	1	54.35	46.08	A	A	A	-	-	-
81	13	1	56.38	49.88	-	-	A	-	-	-
272	13	1	59.21	52.39	-	A	A	-	-	-
92	13	1	65.74	58.85	-	A	A	-	-	-
91	13	1	55.76	50.64	-	A	A	-	-	-
90	13	1	65.01	60.93	-	A	A	-	-	C
25	13	1	43.75	41.14	-	-	A	-	-	-
24	13	1	56.04	53.46	A	A	A	-	-	-
47	13	1	45.32	43.24	-	-	A	-	-	-

Keys To Table

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Source

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
95	13	1	50.11	48.10	A	A	A	-	-	-
268	13	1	59.30	57.60	-	A	A	C	C	-
82	13	1	49.67	49.67	A	A	A	C	C	C
94	13	1	59.67	59.67	A	-	-	C	C	C
17	13	1	67.96	68.00	-	-	A	-	-	-
84	13	1	53.17	53.68	A	A	A	C	C	-
267	13	1	62.77	63.63	-	A	A	C	C	-
96	13	2	36.60	37.45	A	A	A	-	-	-
22	13	1	57.32	58.75	-	-	A	-	-	-
10	13	1	55.03	56.62	-	-	-	C	C	-
93	13	1	47.53	48.91	A	-	A	C	C	-
271	13	1	54.29	56.46	-	A	A	-	-	-
270	13	1	62.44	65.59	-	A	A	-	-	-
86	13	1	48.43	51.12	A	-	A	-	-	-
85	13	1	44.33	46.84	A	A	A	C	C	-
15	13	2	43.26	48.51	A	-	A	-	-	-
87	13	2	42.46	48.94	-	A	A	-	-	-
269	13	2	40.31	46.85	A	A	A	-	-	-
23	13	1	61.84	71.96	-	-	-	C	-	-
89	13	2	40.66	47.92	-	A	A	C	C	-
97	13	2	47.67	57.13	-	-	A	C	C	C
273	13	2	42.41	51.64	-	A	A	C	C	-
26	13	2	47.41	61.23	-	-	-	-	-	-
16	13	2	40.52	52.92	-	-	-	-	-	C
88	13	2	41.01	53.57	-	A	A	C	C	-
350	14	1	71.74	70.30	-	A	A	-	-	-
334	14	1	74.31	75.24	-	A	A	C	-	-
339	14	1	75.13	80.15	A	A	A	C	-	C
340	14	1	72.06	79.43	-	A	A	C	-	C
341	14	1	75.68	84.09	A	A	A	C	-	C
333	14	1	72.74	84.49	-	A	A	C	C	C
343	14	1	70.53	83.14	A	A	-	C	-	-
337	14	1	54.77	64.98	A	A	A	-	C	-
338	14	1	53.75	64.13	A	A	A	-	-	-
344	14	1	54.26	65.21	-	A	C	-	-	-
335	14	1	74.04	89.41	-	A	A	C	-	-
336	14	1	72.26	88.55	-	A	A	C	-	-
345	14	1	72.40	91.22	-	A	A	-	C	-
346	14	1	59.42	75.35	-	A	A	-	-	-
342	14	1	61.24	79.75	-	A	A	-	-	-
364	15	1	70.92	61.12	A	A	A	-	-	-
359	15	1	68.08	64.10	A	A	A	-	-	-
362	15	1	65.06	62.69	-	A	A	-	-	-
366	15	1	69.77	71.30	-	A	A	-	-	-
367	15	1	73.95	76.68	A	A	A	-	-	-
355	15	1	61.45	66.26	A	A	A	-	-	-
356	15	1	68.69	74.08	A	A	A	-	-	-
363	15	1	70.92	76.68	A	A	A	-	-	-
360	15	1	70.39	76.14	A	A	A	-	-	-
361	15	1	63.05	68.43	-	-	A	-	-	-
353	15	1	67.87	75.55	A	A	C	-	-	-
358	15	1	65.73	77.29	A	A	A	-	-	-
354	15	1	65.31	77.26	A	A	A	-	-	-
365	15	1	65.06	77.72	A	A	A	-	-	-
357	15	1	70.12	87.59	A	A	A	-	-	-

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Source

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Roof Insulation	Wall Insulation	Rigid Insulation	Heating AFUE	Cooling SEER	DHW EF/RE
155	16	1	59.07	50.38	A	A	A	-	-	-
186	16	1	61.97	54.12	A	A	A	C	-	-
153	16	1	62.75	55.91	A	-	A	-	-	-
154	16	1	51.26	45.86	A	-	A	-	-	-
160	16	1	50.49	45.32	A	A	A	C	-	-
188	16	1	66.08	59.66	A	A	A	C	-	C
380	16	1	53.10	48.40	A	-	A	-	-	-
159	16	1	66.02	61.33	-	A	A	-	-	C
190	16	1	58.66	54.56	A	A	A	C	-	-
193	16	1	69.52	66.28	A	A	A	-	-	-
156	16	1	70.54	67.45	-	-	A	-	-	C
192	16	1	65.02	65.89	-	-	A	-	-	-
187	16	2	45.96	48.13	A	-	A	-	-	-
189	16	1	58.28	62.07	-	-	A	C	-	-
191	16	2	48.06	69.67	A	A	A	C	-	C

Keys To Table

- = Observed by surveyor   A = Assumed by surveyor   C = CALRES Default

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
3	12	1	47.48	50.95	50.95	7.31%
4	12	1	58.71	58.22	59.34	-0.83%
5	12	1	46.00	53.98	53.98	17.35%
6	12	1	52.31	52.73	51.04	0.80%
7	12	1	46.37	50.36	50.36	8.60%
8	12	1	35.44	35.34	33.64	-0.28%
9	12	1	50.28	57.19	54.78	13.74%
10	13	1	55.03	56.62	54.89	2.89%
11	12	1	40.39	43.72	42.65	8.24%
12	12	1	40.33	38.07	37.28	-5.60%
13	12	1	41.27	42.80	41.68	3.71%
14	12	1	46.37	56.33	52.45	21.48%
15	13	2	43.26	48.51	47.17	12.14%
16	13	2	40.52	52.92	52.92	30.60%
17	13	1	67.96	68.00	66.05	0.06%
18	12	1	43.87	50.47	50.47	15.04%
19	12	1	51.94	50.97	50.97	-1.87%
20	12	1	49.21	55.69	53.14	13.17%
21	12	1	43.19	48.65	48.28	12.64%
22	13	1	57.32	58.75	57.00	2.49%
23	13	1	61.84	71.96	69.64	16.36%
24	13	1	56.04	53.46	51.43	-4.60%
25	13	1	43.75	41.14	39.58	-5.97%
26	13	2	47.41	61.23	58.74	29.15%
27	12	1	37.58	40.78	38.75	8.52%
28	12	1	39.98	46.05	42.39	15.18%
29	12	1	41.26	32.73	31.28	-20.67%
30	12	1	47.87	47.46	44.90	-0.86%
31	12	1	47.69	54.09	53.29	13.42%
32	12	1	43.88	52.19	49.43	18.94%
33	12	2	41.42	48.86	47.75	17.96%
34	12	1	40.86	39.60	39.43	-3.08%
35	12	1	50.95	55.13	52.29	8.20%
36	12	1	43.46	51.84	47.32	19.28%
37	12	1	51.63	58.57	55.96	13.44%
38	12	1	45.02	49.02	46.94	8.88%
39	12	1	37.23	38.52	37.10	3.46%
40	10	1	47.99	41.40	41.40	-13.73%
41	10	1	45.15	39.81	39.81	-11.83%
42	10	1	42.35	40.55	38.56	-4.25%
43	10	1	46.67	42.08	40.94	-9.84%
44	10	1	53.04	55.46	55.46	4.56%
45	10	1	41.23	41.39	41.39	0.39%
46	10	1	39.76	32.67	32.67	-17.83%
47	13	1	45.32	43.24	41.54	-4.59%
48	10	1	41.36	36.10	34.62	-12.72%
49	10	1	46.60	49.17	49.17	5.52%
50	10	1	46.79	45.58	45.58	-2.59%
51	10	1	45.15	42.00	42.00	-6.98%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
52	10	1	42.77	41.66	41.66	-2.60%
53	11	1	54.62	53.39	52.35	-2.25%
54	11	1	51.07	62.26	55.57	21.91%
55	11	1	64.56	67.81	65.94	5.03%
56	11	1	64.51	69.05	66.76	7.04%
57	11	1	67.80	69.46	69.46	2.45%
58	11	1	64.17	68.32	64.92	6.47%
59	11	1	62.39	55.49	53.90	-11.06%
60	11	1	57.34	58.89	56.70	2.70%
61	11	1	66.16	66.36	64.61	0.30%
62	11	1	62.59	64.76	63.02	3.47%
63	11	1	75.36	80.31	76.27	6.57%
64	11	1	61.47	59.64	58.57	-2.98%
65	11	1	56.30	53.35	51.48	-5.24%
66	2	1	50.07	50.58	50.58	1.02%
67	2	1	54.78	48.85	41.66	-10.83%
68	2	1	49.25	48.94	47.36	-0.63%
69	2	1	54.81	59.92	57.42	9.32%
70	2	1	54.81	58.31	55.12	6.39%
71	2	1	58.02	55.12	55.12	-5.00%
72	2	1	58.02	55.34	53.92	-4.62%
73	2	1	48.88	45.88	45.88	-6.14%
74	2	1	48.37	44.79	44.79	-7.40%
75	2	1	57.55	54.41	54.41	-5.46%
76	2	1	48.34	49.85	48.00	3.12%
77	2	1	47.91	49.25	48.76	2.80%
78	2	1	48.37	49.09	47.28	1.49%
79	2	1	48.37	49.96	49.96	3.29%
80	2	1	49.50	45.71	44.75	-7.66%
81	13	1	56.38	49.88	49.88	-11.53%
82	13	1	49.67	49.67	48.85	0.00%
83	13	1	54.35	46.08	45.13	-15.22%
84	13	1	53.17	53.68	51.72	0.96%
85	13	1	44.33	46.84	44.80	5.66%
86	13	1	48.43	51.12	49.09	5.55%
87	13	2	42.46	48.94	48.94	15.26%
88	13	2	41.01	53.57	51.19	30.63%
89	13	2	40.66	47.92	47.92	17.86%
90	13	1	65.01	60.93	60.93	-6.28%
91	13	1	55.76	50.64	50.64	-9.18%
92	13	1	65.74	58.85	57.52	-10.48%
93	13	1	47.53	48.91	48.91	2.90%
94	13	1	59.67	59.67	59.67	0.00%
95	13	1	50.11	48.10	48.10	-4.01%
96	13	2	36.60	37.45	37.45	2.32%
97	13	2	47.67	57.13	57.13	19.84%
98	3	1	25.71	27.57	27.57	7.23%
99	3	1	25.52	26.77	26.77	4.90%
100	6	1	25.92	25.63	25.63	-1.12%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
101	6	2	16.45	16.68	16.68	1.40%
102	6	1	23.63	21.33	21.33	-9.73%
103	8	1	21.36	19.40	18.67	-9.18%
104	8	1	22.07	21.09	20.31	-4.44%
105	6	1	28.02	25.84	25.84	-7.78%
106	6	1	27.22	25.65	25.65	-5.77%
107	6	2	17.71	20.37	20.37	15.02%
108	6	2	17.97	18.87	18.87	5.01%
109	8	1	28.34	26.85	26.85	-5.26%
110	8	1	23.21	26.90	24.67	15.90%
111	6	1	28.07	28.28	28.28	0.75%
112	6	2	17.67	16.25	16.11	-8.04%
113	6	1	28.19	26.61	26.61	-5.60%
114	8	1	25.56	36.08	36.08	41.16%
115	8	1	27.48	33.81	30.62	23.03%
116	8	1	21.85	27.44	22.97	25.58%
117	8	1	29.97	52.19	43.55	74.14%
118	8	1	24.48	34.49	31.03	40.89%
119	8	1	24.04	24.29	23.04	1.04%
120	6	1	25.22	18.93	18.93	-24.94%
121	6	2	31.60	27.77	27.77	-12.12%
122	6	1	32.50	27.32	27.32	-15.94%
123	6	1	31.93	31.30	31.30	-1.97%
124	6	1	27.27	23.12	23.12	-15.22%
125	12	1	45.98	50.14	47.88	9.05%
126	12	1	51.28	55.29	53.20	7.82%
127	12	1	50.57	62.23	62.33	23.06%
128	12	1	46.46	47.61	47.61	2.48%
129	12	1	50.57	49.61	49.61	-1.90%
130	12	1	36.11	37.87	36.33	4.87%
131	12	1	39.46	45.81	40.49	16.09%
132	7	2	19.72	19.57	19.25	-0.76%
133	7	1	21.24	18.14	17.37	-14.60%
134	7	1	20.32	21.29	19.62	4.77%
135	7	1	20.95	19.24	18.27	-8.16%
136	7	2	18.28	16.38	16.06	-10.39%
137	7	1	22.08	20.26	20.26	-8.24%
138	7	1	19.77	17.70	16.97	-10.47%
139	7	1	22.30	20.09	19.17	-9.91%
140	7	1	19.14	17.45	17.18	-8.83%
141	7	1	19.23	18.83	17.70	-2.08%
142	7	1	20.28	18.42	17.60	-9.17%
143	7	1	20.85	21.42	21.42	2.73%
144	7	2	19.92	20.22	19.78	1.51%
145	7	1	18.58	17.45	17.45	-6.08%
146	7	1	19.69	16.52	15.83	-16.10%
147	7	1	21.09	19.64	18.70	-6.88%
148	7	1	18.72	17.23	16.35	-7.96%
149	7	1	21.09	19.65	18.70	-6.83%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
150	12	2	42.78	52.07	50.84	21.72%
151	12	2	34.07	41.01	39.84	20.37%
152	12	1	42.96	45.79	45.79	6.59%
153	16	1	62.75	55.91	55.91	-10.90%
154	16	1	51.26	45.86	45.86	-10.53%
155	16	1	59.07	50.38	49.46	-14.71%
156	16	1	70.54	67.45	65.72	-4.38%
157	12	1	54.47	57.98	57.98	6.44%
158	12	1	49.90	50.35	51.07	0.90%
159	16	1	66.02	61.33	59.98	-7.10%
160	16	1	50.49	45.32	44.50	-10.24%
161	9	1	33.93	33.54	31.82	-1.15%
162	9	1	34.65	37.75	37.75	8.95%
163	9	1	30.50	32.75	30.98	7.38%
164	9	2	28.81	29.35	29.35	1.87%
165	9	2	28.58	26.45	26.45	-7.45%
166	9	2	25.35	27.86	22.52	9.90%
167	10	1	41.44	49.35	47.42	19.09%
168	10	1	40.54	45.70	43.98	12.73%
169	10	1	49.85	54.78	54.78	9.89%
170	10	1	40.02	40.10	38.27	0.20%
171	10	1	46.28	62.88	62.88	35.87%
172	10	2	31.07	28.58	27.50	-8.01%
173	10	2	31.57	27.51	26.84	-12.86%
174	10	1	37.17	43.58	38.60	17.25%
175	10	2	29.06	24.93	24.26	-14.21%
176	10	1	43.41	49.99	47.64	15.16%
177	9	1	26.71	27.47	25.52	2.85%
178	9	1	24.59	20.75	19.76	-15.62%
179	9	1	29.56	41.21	34.98	39.41%
180	9	1	29.22	28.17	27.19	-3.59%
181	9	1	27.62	26.82	24.04	-2.90%
182	9	1	49.37	56.00	53.69	13.43%
183	9	1	26.06	21.93	21.01	-15.85%
184	9	1	29.03	29.37	27.91	1.17%
185	9	1	19.55	18.99	18.71	-2.86%
186	16	1	61.97	54.12	53.51	-12.67%
187	16	2	45.96	48.13	48.13	4.72%
188	16	1	66.08	59.66	59.66	-9.72%
189	16	1	58.28	62.07	62.07	6.50%
190	16	1	58.66	54.56	54.56	-6.99%
191	16	2	48.06	69.67	69.67	44.96%
192	16	1	65.02	65.89	65.89	1.34%
193	16	1	69.52	66.28	66.28	-4.66%
194	12	1	53.40	58.79	58.79	10.09%
195	12	1	59.98	53.93	53.14	-10.09%
196	12	1	48.80	54.88	52.77	12.46%
197	12	1	51.45	50.90	49.60	-1.07%
198	1	2	33.71	41.22	45.36	22.28%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
199	1	1	38.13	39.25	39.22	2.94%
200	1	1	38.49	40.25	40.13	4.57%
201	1	1	38.90	39.69	39.65	2.03%
202	1	1	28.73	32.57	32.55	13.37%
203	1	1	32.66	36.58	36.53	12.00%
204	1	2	30.07	37.05	37.01	23.21%
205	1	2	26.82	29.52	29.45	10.07%
206	1	1	44.31	53.44	53.39	20.60%
207	11	1	55.70	54.09	52.57	-2.89%
208	11	2	41.91	42.67	42.01	1.81%
209	11	1	63.94	59.42	58.46	-7.07%
210	11	2	47.12	53.56	52.41	13.67%
211	11	1	64.61	55.09	54.26	-14.73%
212	11	1	56.71	53.30	51.91	-6.01%
213	11	1	89.51	85.88	85.93	-4.06%
214	11	1	71.53	64.88	63.20	-9.30%
215	11	1	70.44	68.95	67.63	-2.12%
216	11	2	46.05	51.67	50.73	12.20%
217	11	1	70.86	69.51	68.18	-1.91%
218	11	1	70.86	69.71	69.71	-1.62%
219	12	1	44.11	36.70	36.70	-16.80%
220	12	1	43.94	41.62	41.62	-5.28%
221	12	1	43.95	44.48	44.63	1.21%
222	12	2	35.80	40.11	40.11	12.04%
223	12	1	43.94	45.23	45.23	2.94%
224	12	1	38.34	41.68	36.58	8.71%
225	12	1	49.18	48.65	47.42	-1.08%
226	12	1	60.01	65.20	63.28	8.65%
227	12	1	42.11	42.23	40.40	0.28%
228	12	1	42.33	39.46	38.44	-6.78%
229	12	1	44.24	46.03	44.63	4.05%
230	12	1	49.85	49.41	50.47	-0.88%
231	12	1	56.96	58.53	56.98	2.76%
232	12	1	48.10	47.65	45.77	-0.94%
233	12	1	50.20	52.19	52.19	3.96%
234	12	2	38.67	45.52	44.52	17.71%
235	12	1	56.99	54.23	54.23	-4.84%
236	4	1	30.54	31.71	31.15	3.83%
237	4	1	30.75	34.40	33.22	11.87%
238	3	1	30.20	31.17	30.84	3.21%
239	3	1	26.30	29.80	29.77	13.31%
240	3	1	30.83	31.93	31.89	3.57%
241	3	1	30.58	32.39	32.02	5.92%
242	3	1	23.67	22.15	22.15	-6.42%
243	3	1	25.68	28.02	27.96	9.11%
244	3	1	23.82	20.77	20.64	-12.80%
245	3	1	36.66	38.18	38.18	4.15%
246	3	1	19.63	16.95	16.95	-13.65%
247	12	1	49.14	53.58	50.67	9.04%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
248	12	1	48.50	55.33	52.49	14.08%
249	12	1	54.16	57.49	57.49	6.15%
250	12	1	46.96	53.95	49.96	14.89%
251	12	1	68.46	61.12	60.09	-10.72%
252	12	1	46.01	49.13	46.97	6.78%
253	12	1	39.85	40.05	38.71	0.50%
254	12	1	43.66	42.24	42.24	-3.25%
255	12	1	40.15	44.68	41.76	11.28%
256	12	1	46.14	53.46	51.77	15.86%
257	12	1	39.85	40.63	40.63	1.96%
258	12	1	50.32	60.34	56.51	19.91%
259	12	1	41.22	51.03	47.66	23.80%
260	12	1	46.96	47.22	45.84	0.55%
261	12	1	58.35	63.50	61.70	8.83%
262	12	1	49.54	57.62	53.91	16.31%
263	12	1	55.81	58.16	55.75	4.21%
264	12	1	52.56	55.58	55.58	5.75%
265	12	1	42.64	48.52	45.77	13.79%
266	12	1	39.29	41.58	39.78	5.83%
267	13	1	62.77	63.63	63.63	1.37%
268	13	1	59.30	57.60	57.22	-2.87%
269	13	2	40.31	46.85	45.63	16.22%
270	13	1	62.44	65.59	63.49	5.04%
271	13	1	54.29	56.46	56.46	4.00%
272	13	1	59.21	52.39	51.30	-11.52%
273	13	2	42.41	51.64	50.05	21.76%
274	13	1	52.11	43.95	43.95	-15.66%
275	12	1	42.04	42.50	41.03	1.09%
276	12	1	39.02	40.81	39.09	4.59%
277	12	1	51.81	52.24	50.70	0.83%
278	12	1	51.33	54.31	52.47	5.81%
279	5	1	26.55	27.32	26.91	2.90%
280	5	1	28.44	30.66	30.66	7.81%
281	5	1	31.09	32.70	32.34	5.18%
282	3	1	21.55	20.62	20.28	-4.32%
283	5	1	35.15	37.65	37.65	7.11%
284	4	1	33.50	37.59	37.59	12.21%
285	4	1	29.72	27.33	26.90	-8.04%
286	3	1	22.28	24.36	24.36	9.34%
287	4	1	28.45	27.53	27.53	-3.23%
288	4	1	25.73	25.41	24.94	-1.24%
289	3	1	27.62	29.18	28.75	5.65%
290	3	1	28.67	29.49	29.19	2.86%
291	3	1	33.06	37.97	37.56	14.85%
292	4	1	30.35	29.30	28.93	-3.46%
293	4	1	33.42	32.11	31.71	-3.92%
294	4	1	32.53	34.06	33.07	4.70%
295	8	1	25.21	25.71	23.60	1.98%
296	8	1	23.17	22.42	21.26	-3.24%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
297	10	2	31.60	29.48	28.08	-6.71%
298	10	2	31.74	27.70	27.02	-12.73%
299	10	1	41.05	47.42	44.68	15.52%
300	8	1	25.29	27.32	26.27	8.03%
301	8	1	22.85	20.46	20.46	-10.46%
302	8	1	27.87	25.57	24.60	-8.25%
303	10	2	37.06	37.59	36.18	1.43%
304	10	1	38.38	42.70	39.77	11.26%
305	8	1	27.72	27.94	26.44	0.79%
306	8	1	26.15	26.93	26.12	2.98%
307	10	1	39.48	44.00	41.37	11.45%
308	10	1	43.46	39.53	37.88	-9.04%
309	10	1	38.68	42.96	35.57	11.07%
310	10	1	44.79	45.04	43.10	0.56%
311	10	2	31.59	29.46	27.36	-6.74%
312	10	2	31.59	29.22	27.16	-7.50%
313	8	1	26.48	26.83	25.92	1.32%
314	10	1	46.21	44.03	42.35	-4.72%
315	10	1	42.89	42.15	40.03	-1.73%
316	10	1	38.73	38.91	37.15	0.46%
317	10	1	37.02	36.49	33.83	-1.43%
318	10	1	43.93	46.32	46.32	5.44%
319	10	1	43.21	45.94	43.24	6.32%
320	10	1	48.54	50.12	47.62	3.26%
321	10	1	40.02	43.59	40.61	8.92%
322	10	1	49.35	42.62	40.56	-13.64%
323	10	1	47.72	48.24	46.42	1.09%
324	10	1	47.64	47.20	47.20	-0.92%
325	10	1	48.16	46.01	44.67	-4.46%
326	10	1	38.29	39.24	35.43	2.48%
327	10	1	36.65	37.33	36.34	1.86%
328	10	1	40.29	47.61	42.83	18.17%
329	10	1	39.54	40.52	40.52	2.48%
330	10	1	43.39	45.96	45.96	5.92%
331	10	1	42.92	39.48	38.03	-8.01%
332	10	1	51.16	59.06	55.23	15.44%
333	14	1	72.74	84.49	81.58	16.15%
334	14	1	74.31	75.24	72.47	1.25%
335	14	1	74.04	89.41	84.19	20.76%
336	14	1	72.26	88.55	84.55	22.54%
337	14	1	54.77	64.98	61.44	18.64%
338	14	1	53.75	64.13	61.46	19.31%
339	14	1	75.13	80.15	76.68	6.68%
340	14	1	72.06	79.43	77.10	10.23%
341	14	1	75.68	84.09	82.00	11.11%
342	14	1	61.24	79.75	75.64	30.23%
343	14	1	70.53	83.14	78.79	17.88%
344	14	1	54.26	65.21	62.05	20.18%
345	14	1	72.40	91.22	87.59	25.99%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
346	14	1	59.42	75.35	71.40	26.81%
347	12	1	52.25	53.18	51.73	1.78%
348	12	1	50.19	50.96	49.47	1.53%
349	12	1	52.13	50.77	49.76	-2.61%
350	14	1	71.74	70.30	70.30	-2.01%
351	12	2	39.88	53.04	47.89	33.00%
352	12	1	59.07	60.72	59.43	2.79%
353	15	1	67.87	75.55	75.55	11.32%
354	15	1	65.31	77.26	72.37	18.30%
355	15	1	61.45	66.26	63.00	7.83%
356	15	1	68.69	74.08	70.65	7.85%
357	15	1	70.12	87.59	87.59	24.91%
358	15	1	65.73	77.29	77.29	17.59%
359	15	1	68.08	64.10	64.10	-5.85%
360	15	1	70.39	76.14	72.64	8.17%
361	15	1	63.05	68.43	68.43	8.53%
362	15	1	65.06	62.69	62.69	-3.64%
363	15	1	70.92	76.68	76.68	8.12%
364	15	1	70.92	61.12	61.12	-13.82%
365	15	1	65.06	77.72	77.72	19.46%
366	15	1	69.77	71.30	71.30	2.19%
367	15	1	73.95	76.68	76.78	3.69%
368	12	1	52.21	49.65	49.26	-4.90%
369	12	1	46.22	42.49	41.74	-8.07%
370	12	1	49.38	48.73	48.73	-1.32%
371	12	1	49.59	47.93	45.36	-3.35%
372	12	2	39.19	46.27	46.27	18.07%
373	12	1	43.24	56.71	52.98	31.15%
374	12	1	54.31	62.40	52.29	14.90%
375	12	1	52.13	56.71	54.36	8.79%
376	12	1	54.76	57.82	55.85	5.59%
377	1	1	43.19	47.88	47.88	10.86%
378	1	2	26.42	32.34	32.34	22.41%
379	1	1	38.15	39.79	39.79	4.30%
380	16	1	53.10	48.40	48.40	-8.85%
381	4	1	33.85	30.30	29.92	-10.49%
382	4	1	26.57	23.66	23.17	-10.95%
383	4	1	26.57	24.32	23.95	-8.47%
384	5	1	26.87	28.38	30.00	5.62%
385	5	1	24.45	24.87	24.49	1.72%
386	5	1	25.91	26.94	26.70	3.98%
387	5	1	24.01	20.94	20.94	-12.79%
388	4	1	24.96	23.10	23.10	-7.45%
389	4	1	24.36	22.02	22.11	-9.61%
390	4	1	21.53	21.83	21.18	1.39%
391	5	1	24.08	25.67	25.67	6.60%
392	5	1	46.91	51.03	50.29	8.78%
393	5	1	34.54	36.62	36.53	6.02%
394	5	1	33.25	34.26	33.96	3.04%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	CALRES POST	% Of Compliance
395	5	2	27.64	32.09	32.09	16.10%
396	5	1	45.71	53.90	53.30	17.92%
397	5	1	38.67	40.07	39.68	3.62%
398	3	1	40.12	41.44	41.44	3.29%
399	3	1	23.21	23.35	23.05	0.60%
400	1	1	37.09	45.37	45.34	22.32%
401	1	1	43.04	56.80	56.79	31.97%
402	1	1	42.45	55.58	55.58	30.93%

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Heat Cost	Cool Cost	DHW Cost	Total Cost	Floor Area
144	7	2	19.92	20.22	$ 0.0080	$(0.0182)	$ 0.0061	$ (8.95)	2,200
208	11	2	41.91	42.67	$ 0.0216	$(0.0205)	$(0.0031)	$ (3.68)	1,855
399	3	1	23.21	23.35	$(0.0013)	$(0.0047)	$ 0.0054	$ (1.85)	3,203
170	10	1	40.02	40.10	$ 0.0019	$(0.0019)	$ -	$ (0.17)	2,756
390	4	1	21.53	21.83	$ 0.0062	$(0.0053)	$(0.0007)	$ 0.55	3,452
111	6	1	28.07	28.28	$ 0.0027	$(0.0019)	$ -	$ 1.93	2,320
143	7	1	20.85	21.42	$ 0.0052	$(0.0068)	$ 0.0030	$ 3.04	2,200
108	6	2	17.97	18.87	$ 0.0098	$(0.0141)	$ 0.0058	$ 3.50	2,300
66	2	1	50.07	50.58	$(0.0010)	$(0.0050)	$ 0.0076	$ 3.51	2,200
45	10	1	41.23	41.39	$(0.0063)	$ 0.0049	$ 0.0039	$ 4.16	1,672
305	8	1	27.72	27.94	$(0.0068)	$ 0.0091	$ -	$ 4.18	1,820
101	6	2	16.45	16.68	$ 0.0027	$ 0.0015	$(0.0025)	$ 4.45	2,700
394	5	1	33.25	34.26	$ 0.0082	$(0.0096)	$ 0.0047	$ 5.37	1,606
385	5	1	24.45	24.87	$ 0.0042	$(0.0023)	$ -	$ 5.76	2,989
313	8	1	26.48	26.83	$(0.0048)	$ 0.0079	$ -	$ 5.76	1,880
240	3	1	30.83	31.93	$ 0.0114	$(0.0120)	$ 0.0036	$ 5.93	1,973
386	5	1	25.91	26.94	$ 0.0153	$(0.0130)	$ -	$ 6.22	2,730
119	8	1	24.04	24.29	$(0.0001)	$ 0.0025	$ -	$ 6.46	2,680
17	13	1	67.96	68.00	$(0.0070)	$ 0.0133	$(0.0017)	$ 6.49	1,380
303	10	2	37.06	37.59	$ 0.0044	$ 0.0032	$(0.0033)	$ 6.93	1,600
245	3	1	36.66	38.18	$ 0.0164	$(0.0101)	$ -	$ 7.07	1,120
192	16	1	65.02	65.89	$(0.0004)	$ 0.0090	$(0.0036)	$ 7.38	1,474
99	3	1	25.52	26.77	$ 0.0176	$(0.0144)	$ -	$ 7.79	2,400
236	4	1	30.54	31.71	$ 0.0135	$(0.0089)	$ -	$ 8.04	1,754
323	10	1	47.72	48.24	$ 0.0008	$ 0.0036	$ -	$ 8.10	1,813
201	1	1	38.90	39.69	$ 0.0071	$(0.0003)	$(0.0019)	$ 8.18	1,654
290	3	1	28.67	29.49	$ 0.0071	$(0.0029)	$ -	$ 8.38	1,953
397	5	1	38.67	40.07	$ 0.0330	$(0.0049)	$(0.0209)	$ 8.39	1,144
316	10	1	38.73	38.91	$(0.0030)	$ 0.0059	$ -	$ 8.42	2,884
295	8	1	25.21	25.71	$(0.0068)	$ 0.0079	$ 0.0029	$ 8.71	2,200
184	9	1	29.03	29.37	$(0.0082)	$ 0.0137	$ -	$ 9.77	1,770
96	13	2	36.60	37.45	$ 0.0113	$(0.0031)	$(0.0038)	$ 10.45	2,358
221	12	1	43.95	44.48	$(0.0151)	$ 0.0206	$ 0.0001	$ 10.62	1,893
393	5	1	34.54	36.62	$ 0.0425	$(0.0161)	$(0.0185)	$ 11.31	1,430
78	2	1	48.37	49.09	$(0.0036)	$ 0.0012	$ 0.0074	$ 11.40	2,250
199	1	1	38.13	39.25	$ 0.0094	$(0.0004)	$(0.0019)	$ 11.81	1,652
398	3	1	40.12	41.44	$ 0.0063	$ 0.0032	$ -	$ 11.92	1,256
238	3	1	30.20	31.17	$ 0.0033	$(0.0078)	$ 0.0082	$ 12.27	3,390
279	5	1	26.55	27.32	$ 0.0048	$ 0.0001	$ -	$ 12.36	2,500
306	8	1	26.15	26.93	$(0.0069)	$ 0.0154	$(0.0019)	$ 12.47	1,891
366	15	1	69.77	71.30	$(0.0014)	$ 0.0126	$(0.0002)	$ 14.22	1,290
134	7	1	20.32	21.29	$ 0.0028	$ 0.0006	$ 0.0030	$ 14.35	2,250
177	9	1	26.71	27.47	$ 0.0029	$ 0.0026	$ -	$ 14.44	2,600
277	12	1	51.81	52.24	$(0.0135)	$ 0.0233	$ -	$ 14.48	1,475
164	9	2	28.81	29.35	$(0.0068)	$ 0.0175	$(0.0030)	$ 14.68	1,900
310	10	1	44.79	45.04	$(0.0091)	$ 0.0152	$ -	$ 14.76	2,404
379	1	1	38.15	39.79	$ 0.0107	$(0.0002)	$(0.0001)	$ 15.63	1,503
384	5	1	26.87	28.38	$ 0.0177	$(0.0121)	$ -	$ 16.77	3,000
61	11	1	66.16	66.36	$(0.0150)	$ 0.0250	$(0.0004)	$ 16.81	1,755
6	12	1	52.31	52.73	$(0.0195)	$ 0.0319	$ -	$ 16.87	1,360
281	5	1	31.09	32.70	$ 0.0124	$(0.0028)	$(0.0003)	$ 16.97	1,800
334	14	1	74.31	75.24	$(0.0101)	$ 0.0274	$(0.0032)	$ 17.56	1,243
327	10	1	36.65	37.33	$(0.0056)	$ 0.0063	$ 0.0056	$ 17.59	2,800
267	13	1	62.77	63.63	$(0.0064)	$ 0.0177	$ -	$ 18.10	1,600
348	12	1	50.19	50.96	$(0.0066)	$ 0.0160	$ 0.0004	$ 18.17	1,850

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Heat Cost	Cool Cost	DHW Cost	Total Cost	Floor Area
283	5	1	35.15	37.65	$ 0.0218	$(0.0087)	$ -	$ 18.34	1,400
98	3	1	25.71	27.57	$ 0.0144	$(0.0130)	$ 0.0063	$ 18.94	2,500
294	4	1	32.53	34.06	$ 0.0055	$ 0.0064	$ -	$ 19.47	1,642
329	10	1	39.54	40.52	$ 0.0017	$ 0.0065	$ -	$ 19.64	2,400
352	12	1	59.07	60.72	$(0.0004)	$ 0.0205	$(0.0033)	$ 20.68	1,230
241	3	1	30.58	32.39	$ 0.0108	$ 0.0011	$ -	$ 20.74	1,730
200	1	1	38.49	40.25	$ 0.0113	$ 0.0027	$(0.0018)	$ 20.98	1,724
280	5	1	28.44	30.66	$ 0.0225	$(0.0090)	$(0.0022)	$ 21.38	1,900
289	3	1	27.62	29.18	$ 0.0075	$ 0.0036	$ -	$ 23.10	2,073
76	2	1	48.34	49.85	$(0.0002)	$ 0.0032	$ 0.0076	$ 23.40	2,200
223	12	1	43.94	45.23	$(0.0168)	$ 0.0284	$(0.0003)	$ 23.55	2,075
260	12	1	46.96	47.22	$(0.0149)	$ 0.0239	$ -	$ 24.00	2,650
158	12	1	49.90	50.35	$(0.0227)	$ 0.0317	$ 0.0035	$ 24.26	1,935
79	2	1	48.37	49.96	$ 0.0013	$ 0.0023	$ 0.0074	$ 24.66	2,250
49	10	1	46.60	49.17	$ 0.0197	$(0.0014)	$(0.0024)	$ 25.00	1,570
367	15	1	73.95	76.68	$ 0.0020	$ 0.0182	$(0.0002)	$ 25.34	1,269
243	3	1	25.68	28.02	$ 0.0175	$(0.0121)	$ 0.0054	$ 25.98	2,400
205	1	2	26.82	29.52	$ 0.0234	$(0.0002)	$(0.0066)	$ 27.54	1,654
44	10	1	53.04	55.46	$(0.0009)	$ 0.0263	$(0.0022)	$ 27.89	1,200
320	10	1	48.54	50.12	$(0.0054)	$ 0.0221	$ -	$ 30.05	1,800
392	5	1	46.91	51.03	$ 0.0199	$ 0.0104	$(0.0006)	$ 30.21	1,017
300	8	1	25.29	27.32	$(0.0014)	$ 0.0160	$ -	$ 32.57	2,225
227	12	1	42.11	42.23	$(0.0333)	$ 0.0492	$ -	$ 32.73	2,056
231	12	1	56.96	58.53	$(0.0186)	$ 0.0411	$ 0.0001	$ 32.90	1,450
107	6	2	17.71	20.37	$ 0.0175	$(0.0092)	$ 0.0056	$ 33.52	2,400
84	13	1	53.17	53.68	$(0.0243)	$ 0.0429	$(0.0011)	$ 33.53	1,922
253	12	1	39.85	40.05	$(0.0219)	$ 0.0335	$ -	$ 33.77	2,926
10	13	1	55.03	56.62	$(0.0062)	$ 0.0245	$(0.0001)	$ 35.14	1,928
163	9	1	30.50	32.75	$ 0.0023	$ 0.0161	$ -	$ 36.70	2,000
286	3	1	22.28	24.36	$ 0.0112	$(0.0042)	$ 0.0048	$ 38.84	3,284
377	1	1	43.19	47.88	$ 0.0329	$(0.0010)	$(0.0023)	$ 39.91	1,348
60	11	1	57.34	58.89	$(0.0107)	$ 0.0262	$ 0.0030	$ 40.71	2,200
128	12	1	46.46	47.61	$(0.0309)	$ 0.0510	$ 0.0039	$ 40.80	1,700
257	12	1	39.85	40.63	$(0.0155)	$ 0.0295	$ -	$ 41.05	2,926
239	3	1	26.30	29.80	$ 0.0261	$(0.0138)	$ 0.0056	$ 41.94	2,350
326	10	1	38.29	39.24	$(0.0100)	$ 0.0228	$ -	$ 42.55	3,300
318	10	1	43.93	46.32	$(0.0068)	$ 0.0315	$ -	$ 43.12	1,748
57	11	1	67.80	69.46	$(0.0086)	$ 0.0314	$(0.0019)	$ 43.48	2,084
162	9	1	34.65	37.75	$(0.0059)	$ 0.0340	$ -	$ 43.57	1,550
395	5	2	27.64	32.09	$ 0.0188	$ 0.0196	$(0.0038)	$ 44.15	1,274
77	2	1	47.91	49.25	$(0.0056)	$ 0.0139	$ 0.0048	$ 45.93	3,500
157	12	1	54.47	57.98	$ 0.0085	$ 0.0235	$(0.0025)	$ 46.05	1,560
284	4	1	33.50	37.59	$ 0.0239	$ 0.0034	$ -	$ 46.39	1,700
319	10	1	43.21	45.94	$(0.0059)	$ 0.0332	$ -	$ 46.39	1,700
222	12	2	35.80	40.11	$ 0.0168	$ 0.0186	$(0.0061)	$ 47.67	1,622
22	13	1	57.32	58.75	$(0.0147)	$ 0.0355	$ -	$ 48.11	2,312
275	12	1	42.04	42.50	$(0.0289)	$ 0.0458	$ -	$ 48.21	2,850
347	12	1	52.25	53.18	$(0.0253)	$ 0.0414	$ 0.0026	$ 48.21	2,580
216	11	2	46.05	51.67	$ 0.0192	$ 0.0294	$(0.0077)	$ 48.31	1,180
356	15	1	68.69	74.08	$(0.0107)	$ 0.0523	$(0.0018)	$ 49.35	1,239
339	14	1	75.13	80.15	$(0.0029)	$ 0.0499	$ -	$ 49.50	1,053
396	5	1	45.71	53.90	$ 0.0493	$ 0.0034	$ 0.0006	$ 49.80	933
13	12	1	41.27	42.80	$(0.0116)	$ 0.0273	$ 0.0024	$ 49.88	2,750
237	4	1	30.75	34.40	$ 0.0128	$ 0.0157	$ -	$ 50.02	1,754
363	15	1	70.92	76.68	$(0.0056)	$ 0.0473	$ -	$ 50.48	1,210

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Heat Cost	Cool Cost	DHW Cost	Total Cost	Floor Area
187	16	2	45.96	48.13	$ 0.0435	$(0.0102)	$(0.0067)	$ 50.93	1,920
203	1	1	32.66	36.58	$ 0.0262	$ 0.0005	$(0.0015)	$ 50.94	2,024
229	12	1	44.24	46.03	$(0.0098)	$ 0.0269	$ 0.0026	$ 50.94	2,600
233	12	1	50.20	52.19	$(0.0239)	$ 0.0527	$ -	$ 51.36	1,780
330	10	1	43.39	45.96	$(0.0054)	$ 0.0311	$ -	$ 52.80	2,054
62	11	1	62.59	64.76	$(0.0071)	$ 0.0311	$ -	$ 52.85	2,200
39	12	1	37.23	38.52	$(0.0193)	$ 0.0397	$ 0.0000	$ 53.24	2,600
291	3	1	33.06	37.97	$ 0.0260	$ 0.0016	$ 0.0043	$ 53.44	1,674
391	5	1	24.08	25.67	$ 0.0058	$ 0.0066	$ -	$ 54.43	4,400
70	2	1	54.81	58.31	$ 0.0130	$ 0.0093	$ 0.0031	$ 54.61	2,150
166	9	2	25.35	27.86	$ 0.0047	$ 0.0182	$(0.0025)	$ 54.90	2,700
194	12	1	53.40	58.79	$(0.0175)	$ 0.0578	$ 0.0001	$ 55.15	1,365
360	15	1	70.39	76.14	$(0.0086)	$ 0.0508	$(0.0001)	$ 55.27	1,313
169	10	1	49.85	54.78	$(0.0038)	$ 0.0502	$ -	$ 55.67	1,200
198	1	2	33.71	41.22	$ 0.0559	$(0.0007)	$(0.0075)	$ 58.22	1,219
210	11	2	47.12	53.56	$ 0.0271	$ 0.0326	$(0.0078)	$ 59.68	1,150
93	13	1	47.53	48.91	$(0.0279)	$ 0.0563	$(0.0011)	$ 59.84	2,188
263	12	1	55.81	58.16	$(0.0337)	$ 0.0703	$ -	$ 60.83	1,662
378	1	2	26.42	32.34	$ 0.0450	$(0.0020)	$(0.0059)	$ 63.05	1,696
376	12	1	54.76	57.82	$(0.0099)	$ 0.0454	$(0.0020)	$ 63.51	1,900
55	11	1	64.56	67.81	$(0.0058)	$ 0.0393	$ 0.0002	$ 63.64	1,890
321	10	1	40.02	43.59	$(0.0109)	$ 0.0482	$ -	$ 64.91	1,743
15	13	2	43.26	48.51	$ 0.0241	$ 0.0209	$(0.0047)	$ 65.43	1,620
355	15	1	61.45	66.26	$(0.0160)	$ 0.0521	$ -	$ 66.22	1,831
224	12	1	38.34	41.68	$(0.0263)	$ 0.0532	$ -	$ 66.72	2,480
196	12	1	48.80	54.88	$(0.0101)	$ 0.0548	$ -	$ 66.92	1,500
226	12	1	60.01	65.20	$(0.0061)	$ 0.0587	$(0.0015)	$ 68.02	1,331
86	13	1	48.43	51.12	$(0.0185)	$ 0.0482	$ 0.0033	$ 69.62	2,111
130	12	1	36.11	37.87	$(0.0133)	$ 0.0364	$ -	$ 69.77	3,012
264	12	1	52.56	55.58	$(0.0239)	$ 0.0644	$(0.0014)	$ 70.76	1,811
278	12	1	51.33	54.31	$(0.0094)	$ 0.0409	$ -	$ 72.59	2,300
204	1	2	30.07	37.05	$ 0.0486	$ 0.0009	$(0.0047)	$ 73.12	1,634
234	12	2	38.67	45.52	$ 0.0140	$ 0.0290	$ 0.0096	$ 74.03	1,406
353	15	1	67.87	75.55	$(0.0080)	$ 0.0631	$ 0.0004	$ 75.63	1,361
202	1	1	28.73	32.57	$ 0.0216	$(0.0007)	$ 0.0033	$ 76.30	3,151
85	13	1	44.33	46.84	$(0.0202)	$ 0.0555	$(0.0010)	$ 77.36	2,257
63	11	1	75.36	80.31	$(0.0214)	$ 0.0791	$ -	$ 77.58	1,345
126	12	1	51.28	55.29	$(0.0111)	$ 0.0547	$ -	$ 78.47	1,800
11	12	1	40.39	43.72	$(0.0151)	$ 0.0422	$ 0.0071	$ 78.64	2,300
189	16	1	58.28	62.07	$ 0.0604	$(0.0145)	$(0.0010)	$ 79.59	1,773
97	13	2	47.67	57.13	$ 0.0207	$ 0.0392	$ 0.0122	$ 80.23	1,113
152	12	1	42.96	45.79	$(0.0207)	$ 0.0576	$ 0.0001	$ 81.63	2,200
332	10	1	51.16	59.06	$(0.0058)	$ 0.0803	$ -	$ 81.93	1,100
249	12	1	54.16	57.49	$(0.0272)	$ 0.0728	$(0.0020)	$ 82.75	1,900
56	11	1	64.51	69.05	$(0.0114)	$ 0.0546	$ 0.0037	$ 83.80	1,785
266	12	1	39.29	41.58	$(0.0178)	$ 0.0468	$ -	$ 84.94	2,926
270	13	1	62.44	65.59	$(0.0131)	$ 0.0504	$ -	$ 85.88	2,300
150	12	2	42.78	52.07	$ 0.0281	$ 0.0303	$ 0.0108	$ 86.44	1,248
372	12	2	39.19	46.27	$ 0.0278	$ 0.0341	$(0.0062)	$ 86.89	1,560
33	12	2	41.42	48.86	$ 0.0355	$ 0.0175	$(0.0003)	$ 87.32	1,655
261	12	1	58.35	63.50	$ 0.0031	$ 0.0431	$ -	$ 87.63	1,900
341	14	1	75.68	84.09	$ 0.0209	$ 0.0467	$ -	$ 87.83	1,300
174	10	1	37.17	43.58	$ 0.0185	$ 0.0319	$ -	$ 87.94	1,743
58	11	1	64.17	68.32	$(0.0219)	$ 0.0666	$ 0.0038	$ 88.21	1,820
271	13	1	54.29	56.46	$(0.0259)	$ 0.0594	$(0.0001)	$ 89.66	2,685

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Heat Cost	Cool Cost	DHW Cost	Total Cost	Floor Area
69	2	1	54.81	59.92	$ 0.0109	$ 0.0278	$ 0.0031	$ 89.90	2,150
3	12	1	47.48	50.95	$(0.0278)	$ 0.0719	$ -	$ 91.04	2,060
206	1	1	44.31	53.44	$ 0.0602	$ -	$(0.0019)	$ 91.14	1,563
38	12	1	45.02	49.02	$(0.0189)	$ 0.0641	$ -	$ 91.71	2,030
375	12	1	52.13	56.71	$(0.0235)	$ 0.0753	$ 0.0005	$ 92.03	1,760
247	12	1	49.14	53.58	$(0.0168)	$ 0.0604	$ 0.0033	$ 93.65	2,000
35	12	1	50.95	55.13	$(0.0295)	$ 0.0702	$ 0.0074	$ 95.62	1,987
276	12	1	39.02	40.81	$(0.0286)	$ 0.0549	$ 0.0020	$ 96.07	3,400
309	10	1	38.68	42.96	$(0.0031)	$ 0.0434	$ -	$ 96.70	2,400
304	10	1	38.38	42.70	$(0.0033)	$ 0.0441	$ -	$ 98.15	2,404
125	12	1	45.98	50.14	$(0.0228)	$ 0.0734	$ -	$ 101.07	1,995
361	15	1	63.05	68.43	$(0.0147)	$ 0.0494	$ 0.0048	$ 102.52	2,590
7	12	1	46.37	50.36	$(0.0162)	$ 0.0516	$ 0.0059	$ 103.19	2,500
110	8	1	23.21	26.90	$(0.0042)	$ 0.0414	$ -	$ 103.33	2,780
89	13	2	40.66	47.92	$ 0.0185	$ 0.0503	$(0.0060)	$ 104.61	1,665
252	12	1	46.01	49.13	$(0.0270)	$ 0.0677	$ -	$ 105.89	2,600
87	13	2	42.46	48.94	$ 0.0302	$ 0.0224	$(0.0039)	$ 106.19	2,179
115	8	1	27.48	33.81	$ 0.0137	$ 0.0397	$ -	$ 107.52	2,014
151	12	2	34.07	41.01	$ 0.0263	$ 0.0311	$(0.0029)	$ 108.99	1,999
269	13	2	40.31	46.85	$ 0.0233	$ 0.0352	$(0.0052)	$ 109.06	2,048
340	14	1	72.06	79.43	$(0.0027)	$ 0.0709	$ -	$ 109.71	1,608
307	10	1	39.48	44.00	$ 0.0029	$ 0.0370	$ -	$ 109.76	2,756
21	12	1	43.19	48.65	$ 0.0007	$ 0.0451	$ 0.0029	$ 110.78	2,274
9	12	1	50.28	57.19	$(0.0104)	$ 0.0675	$ 0.0077	$ 115.32	1,780
374	12	1	54.31	62.40	$(0.0129)	$ 0.0968	$(0.0027)	$ 116.86	1,440
400	1	1	37.09	45.37	$ 0.0546	$ 0.0006	$(0.0020)	$ 119.04	2,240
168	10	1	40.54	45.70	$(0.0002)	$ 0.0472	$ -	$ 121.20	2,576
31	12	1	47.69	54.09	$(0.0126)	$ 0.0665	$ 0.0074	$ 121.77	1,987
255	12	1	40.15	44.68	$(0.0196)	$ 0.0661	$ 0.0027	$ 122.87	2,500
176	10	1	43.41	49.99	$(0.0001)	$ 0.0601	$ -	$ 123.13	2,054
273	13	2	42.41	51.64	$ 0.0344	$ 0.0433	$(0.0045)	$ 124.56	1,703
37	12	1	51.63	58.57	$(0.0163)	$ 0.0822	$ 0.0036	$ 130.38	1,877
27	12	1	37.58	40.78	$(0.0332)	$ 0.0195	$ 0.0577	$ 131.85	3,000
182	9	1	49.37	56.00	$ 0.0100	$ 0.0428	$ -	$ 132.12	2,500
358	15	1	65.73	77.29	$(0.0036)	$ 0.0866	$(0.0001)	$ 132.81	1,603
402	1	1	42.45	55.58	$ 0.0866	$(0.0002)	$(0.0027)	$ 135.71	1,620
20	12	1	49.21	55.69	$(0.0167)	$ 0.0790	$ 0.0032	$ 137.69	2,100
299	10	1	41.05	47.42	$(0.0015)	$ 0.0601	$ -	$ 140.66	2,400
401	1	1	43.04	56.80	$ 0.0907	$(0.0002)	$(0.0027)	$ 142.22	1,620
118	8	1	24.48	34.49	$ 0.0300	$ 0.0378	$ -	$ 142.46	2,100
18	12	1	43.87	50.47	$(0.0182)	$ 0.0868	$ -	$ 142.76	2,080
116	8	1	21.85	27.44	$ 0.0018	$ 0.0470	$ 0.0024	$ 143.19	2,800
167	10	1	41.44	49.35	$ 0.0006	$ 0.0711	$ -	$ 147.33	2,054
354	15	1	65.31	77.26	$(0.0140)	$ 0.1010	$(0.0001)	$ 150.15	1,726
265	12	1	42.64	48.52	$(0.0255)	$ 0.0868	$ 0.0028	$ 150.72	2,350
357	15	1	70.12	87.59	$(0.0093)	$ 0.1351	$(0.0001)	$ 155.78	1,239
5	12	1	46.00	53.98	$(0.0084)	$ 0.0808	$ 0.0033	$ 155.89	2,060
131	12	1	39.46	45.81	$(0.0168)	$ 0.0812	$ 0.0028	$ 158.07	2,350
328	10	1	40.29	47.61	$ 0.0019	$ 0.0641	$ -	$ 158.24	2,400
365	15	1	65.06	77.72	$(0.0141)	$ 0.1062	$(0.0001)	$ 158.79	1,726
256	12	1	46.14	53.46	$(0.0024)	$ 0.0667	$ 0.0028	$ 159.41	2,374
26	13	2	47.41	61.23	$ 0.0420	$ 0.0756	$(0.0049)	$ 169.59	1,504
337	14	1	54.77	64.98	$(0.0128)	$ 0.1126	$(0.0009)	$ 174.13	1,761
333	14	1	72.74	84.49	$ 0.0063	$ 0.1013	$(0.0024)	$ 178.95	1,700
336	14	1	72.26	88.55	$ 0.0415	$ 0.0891	$ -	$ 182.82	1,400

ID #	CLIMATE ZONE	CALRES VERSION	CALRES STAND.	CALRES PRE	Heat Cost	Cool Cost	DHW Cost	Total Cost	Floor Area
114	8	1	25.56	36.08	$ 0.0194	$ 0.0711	$ -	$ 189.95	2,100
179	9	1	29.56	41.21	$ 0.0021	$ 0.0956	$ -	$ 195.48	2,000
23	13	1	61.84	71.96	$ 0.0131	$ 0.0768	$(0.0000)	$ 197.80	2,200
32	12	1	43.88	52.19	$(0.0135)	$ 0.0960	$ -	$ 197.99	2,400
250	12	1	46.96	53.95	$(0.0253)	$ 0.1009	$ -	$ 200.33	2,650
335	14	1	74.04	89.41	$(0.0088)	$ 0.1525	$ -	$ 201.13	1,400
127	12	1	50.57	62.23	$(0.0133)	$ 0.1291	$ -	$ 202.57	1,750
28	12	1	39.98	46.05	$(0.0119)	$ 0.0821	$ -	$ 202.59	2,886
248	12	1	48.50	55.33	$(0.0107)	$ 0.0782	$ -	$ 202.64	3,000
16	13	2	40.52	52.92	$ 0.0329	$ 0.0593	$ 0.0064	$ 206.69	2,097
36	12	1	43.46	51.84	$(0.0115)	$ 0.0900	$ 0.0026	$ 207.31	2,560
88	13	2	41.01	53.57	$ 0.0274	$ 0.0848	$(0.0042)	$ 207.76	1,924
171	10	1	46.28	62.88	$ 0.0279	$ 0.1112	$ -	$ 208.81	1,501
258	12	1	50.32	60.34	$(0.0311)	$ 0.1369	$ -	$ 211.65	2,000
338	14	1	53.75	64.13	$ 0.0038	$ 0.0890	$ -	$ 217.64	2,344
351	12	2	39.88	53.04	$ 0.0243	$ 0.0937	$(0.0053)	$ 225.11	1,998
259	12	1	41.22	51.03	$(0.0172)	$ 0.1150	$ -	$ 229.92	2,350
262	12	1	49.54	57.62	$(0.0357)	$ 0.1259	$ -	$ 234.34	2,600
14	12	1	46.37	56.33	$(0.0118)	$ 0.0993	$ 0.0065	$ 234.93	2,500
117	8	1	29.97	52.19	$ 0.0420	$ 0.1068	$ 0.0043	$ 238.16	1,556
343	14	1	70.53	83.14	$(0.0148)	$ 0.1359	$ -	$ 238.56	1,970
344	14	1	54.26	65.21	$ 0.0012	$ 0.0979	$ -	$ 257.57	2,600
191	16	2	48.06	69.67	$ 0.0748	$(0.0026)	$ 0.0819	$ 271.16	1,760
54	11	1	51.07	62.26	$(0.0100)	$ 0.1213	$ -	$ 283.90	2,550
373	12	1	43.24	56.71	$(0.0072)	$ 0.1415	$(0.0018)	$ 290.16	2,189
345	14	1	72.40	91.22	$(0.0023)	$ 0.1767	$(0.0015)	$ 292.12	1,690
342	14	1	61.24	79.75	$ 0.0004	$ 0.1695	$(0.0011)	$ 293.97	1,741
346	14	1	59.42	75.35	$ 0.0008	$ 0.1405	$ 0.0025	$ 409.56	2,850

Appendix D

Non-Response Bias Study

ASSESSING NON-RESPONSE BIAS IN THE NEOS SURVEY

Background

After reviewing the results of the pilot phase study, the Energy Commission staff became concerned that the homeowners participating in the project might be homeowners who were more interested in energy efficiency. The Commission staff subsequently decided to explore whether the survey results were also representative of all homeowners eligible to participate in the project -- not just those who chose to participate in the project.

Methodology to Assess Non-response Bias

A failure to obtain observations on some members of the sample who would respond to the survey in a different, and systematic way than the respondents often introduces non-response bias. Non-response bias can cause estimation from a survey to be systematically under or over the true population values and thus can distort inferences. The Commission staff decided to assess the possibility of non-response bias in the NEOS survey, but the approach had to be adapted to satisfy some key constraints: the Commission staff felt that collecting additional demographic data would be too intrusive, the contract completion date could not be extended and no additional funds were available.

There are several important approaches to assessing non-response bias. The Commission staff evaluated the applicability of the following approaches: external population checks, substitution of non-respondents, estimating non-response from respondents and sampling of non-respondents. The Commission staff choose to use sampling of non-respondents to assess non-response bias. For a variety of reasons, rather than sampling non-respondents statewide, the Commission staff focused on sampling non-respondents in a limited geographic area (Folsom). The following section reviews the different methodologies and discusses the considerations which lead to the methodology chosen.

With external population checks, the researcher compares the obtained sample's data on a particular variable with the known population parameter. If the data on the known population parameters is closely correlated with the variables of interest, external checks offer crude indicators of bias. The usefulness of this approach is limited because it can be imprecise. External population checks do not assess non-response bias directly; an external population check assesses non-response bias with all other sources of error.

Known population parameters can be obtained from census data and billing data. Census data includes information on the vintage of houses, fuel type and demographic characteristics of persons living in the house. Census data could have been compared to survey data to see if there were significant differences. This would have provided an indirect indicator of any non-response bias. However, the most recent census was completed in 1990, and the Commission staff determined that the data was too old for this purpose. For example, one would not be able to derive information on whether the person has moved since 1989. The other possible external population check was comparing utility bills of study participants to the utility bills of the population or non-respondents. This would have been the best method to give an indication of non-response bias because billing data available for every household and is correlated to a household's energy use (in contrast to census data which may not be closely correlated to energy use) making it relatively precise. However, the Commission staff ruled out this method because utilities refused to cooperate in giving utility bills. Specific reasons included administrative costs to the utility, the difficulty in accessing archived data and the need to obtain personal authorization from each homeowner. Thus, external population checks were ruled out as a method to assess non-response bias.

Substitution of non-respondents attempts to handle the non-response problem by substituting alternative households to replace the non-respondent ones. A difficulty with this approach is that it tends to substitute non-respondents with people who more closely represent the respondents than the non-respondents. Kish (1965) has proposed a most sophisticated version of this general method. His replacement procedure substitutes non-respondent households from an earlier and similar survey for non-respondents to the current survey with similar characteristics. Similar might mean things residing in the same area, using comparable energy in the past year, similar demographics, having been non-respondents for the same reason (e.g., not at home or outright refusal). The Commission staff preferred to use another method because staff was not aware of any existing data on changes that homeowners have made to their houses specific enough to substitute for non-respondents.

There are several ways to estimate non-response from respondents. Two important methods include: the difficulty extrapolation technique and the conversion adjustment technique. The difficulty extrapolation technique is one of the most widely adopted techniques. The researcher measures how hard it was to obtain the interview -- usually the number of visits, mailings, or telephone calls -- and then each variable of the survey is tested against this measure of difficulty to see if any regular relationships emerge. There are several advantages to the difficulty extrapolation technique -- namely that it is relatively simple and inexpensive, it is generalizable because it allows a test of each variable, and it is applicable to all types of surveys (face to face, mail or telephone). The problem with this technique is that it requires accepting the assumption that the difficulty of obtaining an interview from those who did eventually respond is systematically related to final non-response. If many non-responders are qualitatively different from the merely difficult, then the technique will misestimate the attributes of the final non-responders.

The conversion adjustment technique uses converted refusals as the estimate for final refusals either to be used as substitutes or for extrapolated estimates. The technique rests on the assumption that temporary refusers are more like final refusers than are the initially cooperative responders.

Neither the difficulty extrapolation technique nor the conversion adjustment technique could be applied to this study because the sampling plan was devised so that the no information at all was collected on non-respondents. NEOS' recruitment letter was sent to a list of homeowners who reside in a home constructed since 1989 and who have not moved since 1989. If a person were interested in getting an audit, they returned a post card, if not, they did nothing. So there was no information at all on refusers. This made the estimation of non-response bias from respondents untenable.

The sub-sampling of non-respondents technique estimates non-response bias by making intensive efforts to interview a strong probability sample of non-respondents from an earlier wave. The major problem with this method is that unless a high response rate is obtained from people who are, by definition, difficult to interview, this effort fails. The literature suggests that special emphasis needs to be placed on obtaining a minimum of 80 percent response rate in the phone wave by not ceasing efforts to interview even those non-respondents who at first refused (Pettigrew, 1988). The Commission staff decided to assess non-response bias in the study by using this method and evaluating if there were significant difference in the CALRES model outputs between the two groups.

The approach had to be adapted to satisfy some key constraints: the contract completion date could not be extended and no additional funds were available. In order to satisfy these constraints, the Commission staff found that they had to reduce the number of homes surveyed in as yet unsurveyed climate zones and use the freed up funds to sample non-respondents in previously surveyed climate zones. Given this, the Commission staff could sample a total of only 38 of the former non-respondents. Sampling more than 38 homes would have reduced the number of homes to be surveyed in the as yet unsurveyed climate zones below acceptable bounds. In other words, too few data points in those climate zones would have remained to have precise and statistically valid estimates.

The Commission staff was concerned that, if they collected data on 38 non-respondents over all climate zones and compared to all respondents over all previously surveyed climate zones, they would introduce error due to different behavior in different climate zones. Getting statistically valid results with more climate zones involved would require stratification of the 38 households by climate zone, causing the sample sizes within each climate zone to be too small to have an acceptable level of precision.

In order to correct for these potential problems, the Commission staff concentrated on assessing non-response bias in the Folsom area (climate zone 12). Limiting the scope to Folsom provided two benefits. First, it controlled for differences in survey results between climate zones. By focusing on only one climate zone (climate zone 12), the analysis did not add error associated with differences due to climate zones. Second, larger sample sizes within a climate zone decreased sampling error. By the end of July, 27 homes in the Folsom area were already surveyed. By recruiting up to 38 former non-respondents in the Folsom area, the Commission staff attempted to make the sample sizes as large as feasible given the constraints to support valid comparisons across the two groups.

There are some limitations to this approach. The most important limitation is that the Commission staff did not assess non-response bias statewide, rather only for the Folsom area. It is not clear if the results from the Folsom area can be generalized statewide. Another limitation was that the households were difficult to survey, and some households refused to be surveyed. The Commission staff does not know if these households are different from the ones that eventually agreed to be surveyed.

Recruitment Method and Results

NEOS expected about 20 percent of the eligible homeowners in the Folsom area to respond to their initial letter. However, of the 362 letters mailed, 27 people were willing to participate in the study, a response rate of 7.46 percent.

The Commission staff needed to sample the former non-respondents. In order to get these difficult to survey households to change their mind and agree to be surveyed, extra care was needed in developing the recruitment method. The Commission staff adapted Dillman's total design method (Dillman, 1978) by modifying the approach for on site surveys. The method used was:

1. First, the Commission staff created a list of former non-respondents. The Commission's goal was to recruit 38 former non-respondent households. Because with the Dillman method response rates in the 70 percent to 80 percent range are expected, the Commission staff started with 55 randomly selected non-respondents in the Folsom area.

2. A carefully composed cover letter with a personal signature and a postage stamp was mailed on a Tuesday. The purpose of this letter was to: a) describe an important study sponsored by the California Energy Commission, b) let the receiver know that their participation was very crucial, and c) reassure households that the process would be convenient, simple and not cause them any embarrassment.

3. On the following Tuesday, a post card was mailed to all 55 former non-respondents. The purpose of the post card was to thank those who had responded to the letter and remind those who had not yet responded.

4. Two weeks later, a shorter and more insistent letter was sent to all the people who did not yet agree to be surveyed. The purpose of this letter was to demonstrate to all who had not yet responded that they were receiving personal attention and therefore their participation was important.

5. About a month later, each household which still did not agree to be surveyed was called at home. Intensive efforts were made to reach reluctant respondents. Those hard to reach by phone were called in the evening and on weekends. During the phone call the Commission staff explained the purpose of the survey, emphasized the household's importance to the survey, and attempted to overcome any objections. If necessary, an increased incentive was offered.

6. The names of people who finally agreed to have their home surveyed were given to a NEOS subcontractor who scheduled the site visit and surveyed the homes.

Cumulative response rates from the initial letter, the follow up post card, the second letter and the phone recruitment were 21.1 percent, 41.1 percent, 61.8 percent and 74.6 percent, respectively. When the subcontractor called to schedule on site surveys, some attrition occurred. Ultimately, 26 of the original non-respondents in the Folsom area agreed to have their homes surveyed, representing a 47.8 percent response rate.

The final response rate was much lower than the targeted response rate of 80 percent. The implication of this is that there still might be a difference between the energy efficiency decisions made by the homeowners who participated in the non-response bias study and the homeowners who refused to participate at all.

Analysis of the Data

After the data from the on site surveys in the Folsom were collected, NEOS developed CALRES building data input files and conducted CALRES runs for each house. See Tables D-1 and D-2 for the CALRES simulation output data. The Commission staff assessed whether there was an indication of non-response bias by comparing the CALRES simulation results for the Folsom area respondents recruited by NEOS and the respondents recruited by the Commission staff. There were two analyses done on the CALRES simulation outputs: first, staff calculated and compared the kBtu/sq.ft./yr. standard budget for each group, and second, staff calculated and compared the difference between the kBtu/sq.ft./yr. value for each home as constructed and each home as currently configured.

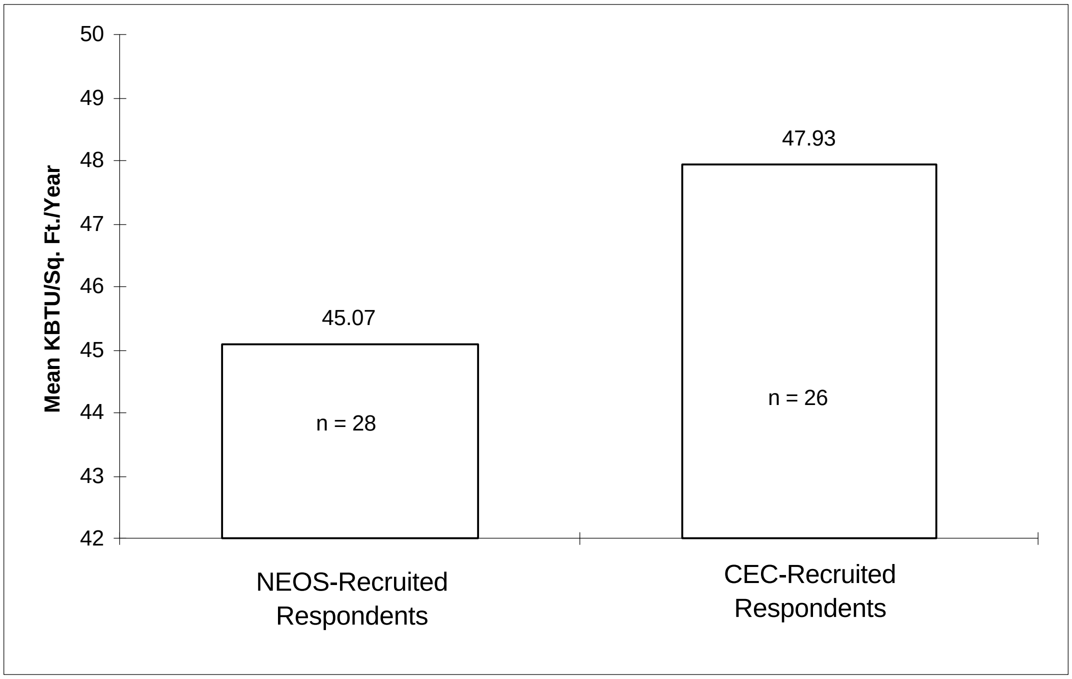
The statistical test was constructed similarly for each of the two analyses. The null hypothesis was that the two groups of Folsom residents have the same mean kBtu/sq.ft./yr. The alternative hypothesis was that the groups have different means. If the test statistic using the t-test were to fall in the rejection region, the Commission staff would reject the null hypothesis and conclude in favor of the alternative hypothesis. This would provide evidence of non-response bias.

If the test statistic using the t-test were to fall in the acceptance region, the Commission staff would accept the null hypothesis and conclude that there is not statistical evidence of non-response bias. Therefore, even if the observed sample means are different, the difference is not statistically significant. In other words, if there is no statistical evidence of non-response bias, the results from the NEOS' post occupancy survey would most likely be representative of all homeowners eligible to participate in the project -- not just those who chose to participate in the project.

Significant differences were found between the two groups' standard budgets. First, the standard budget variances of the NEOS-recruited participants and the Commission-recruited participants were compared. The two groups had significantly different variances (F=.61), indicating different underlying distributions. The Commission-recruited participants tended to have standard budgets more dispersed from the mean than the NEOS-recruited participants.

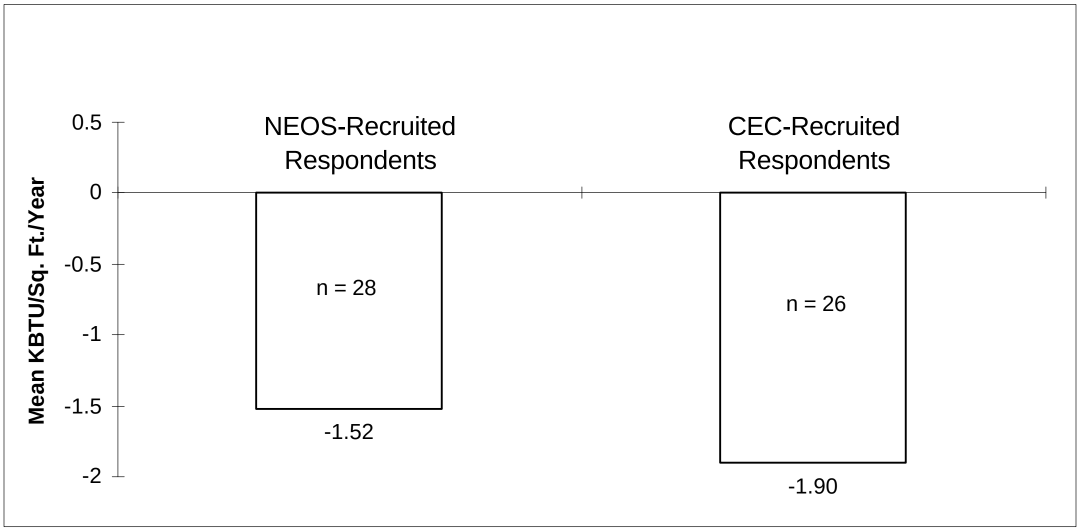
Second, the mean standard budgets were compared. See Figure D-1. The Commission-recruited homes' mean standard budget was larger than the mean standard budget in the group recruited by NEOS (47.93 kBtu/sq.ft./yr. versus 45.07 kBtu/sq.ft./yr.). At the 95 percent level of significance and using a one-tailed, unequal variance t-test, this difference was significant (T=1.69). This is evidence supporting the existence of non-response bias. In other words, the standard budget estimates derived from NEOS' post-occupancy residential survey may be lower than the actual average of the population. The indication was not strong, however, because this difference was not significant for a two-tailed test at the 95 percent level of significance or for a one-tailed test at the 99 percent level of significance.

Figure D-1. Mean Standard Budget of NEOS-Recruited versus Commission-Recruited Respondents in Folsom



Next, for both the NEOS-recruited participants' homes and the Commission-recruited participants' homes, the Commission staff compared the mean difference between the kBtu/sq.ft./yr. value for homes as constructed and homes as currently configured. In this case, the sample variances were not significantly different (F=1.11). The sample means were then compared. See Figure D-2. The group of Commission-recruited participants reduced their energy use more than the NEOS-recruited participants (-1.90 kBtu/sq.ft./yr. vis-à-vis -1.52 kBtu/sq.ft./yr.). The difference between the two groups, however, was not statistically significant at the 95 percent level of significance (T=1.11). This means that, although the groups have different means, there is not statistical evidence at the 95 percent level of significance that homeowners in the NEOS-recruited group behaved differently after they moved into their homes compared to the Commission-recruited group.

Figure D-2. Mean Change in Energy Use in Folsom from House as Built to House as Currently Configured



Conclusion

The differences between the mean standard budgets of the groups recruited by NEOS and the Commission staff provide some evidence of non-response bias in the Folsom area. The fact that the Commission-recruited group's mean standard budget was larger than NEOS-recruited group's mean standard budget is an indication that the Commission-recruited participants' homes are different than the NEOS-recruited participants' homes. Non-response bias may make the standard budget estimates derived from NEOS' post occupancy residential survey lower than the actual average of the population.

Based on comparing the mean difference between the kBtu/sq.ft./yr. value for homes as constructed and homes as currently configured, homeowners in the NEOS-recruited group did not behave differently after they moved into their homes compared to the Commission-recruited group. While the group recruited by the Commission staff reduced their energy use more than the group recruited by NEOS, the difference was not statistically significant.

Table D-2 Key Data for Commission Recruited Households in Folsom (kBtu/Sq. Ft/Year)

Survey ID Number	CALRES STANDARD BUDGET	CALRES PRE-OCCUPANCY	CALRES POST-OCCUPANCY	POST-PRE
247	49.14	53.58	50.67	-2.91
248	48.50	55.33	52.49	-2.84
249	54.16	57.49	57.49	0.00
250	46.96	53.95	49.96	-3.99
251	68.46	61.12	60.09	-1.03
252	46.01	49.13	46.97	-2.16
253	39.85	40.05	38.71	-1.34
254	43.66	42.24	42.24	0.00
255	40.15	44.68	41.76	-2.92
256	46.14	53.46	51.77	-1.69
257	39.85	40.63	40.63	0.00
258	50.32	60.34	56.51	-3.83
259	41.22	51.03	47.66	-3.37
260	46.96	47.22	45.84	-1.38
261	58.35	63.50	61.70	-1.80
262	49.54	57.62	53.91	-3.71
263	55.81	58.16	55.75	-2.41
264	52.56	55.58	55.58	0.00
265	42.64	48.52	45.77	-2.75
266	39.29	41.58	39.78	-1.80
275	42.04	42.50	41.03	-1.47
276	39.02	40.81	39.09	-1.72
277	51.81	52.24	50.70	-1.54
278	51.33	54.31	52.47	-1.84
347	52.25	53.18	51.73	-1.45
348	50.19	50.96	49.47	-1.49

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Pettigrew, Thomas F. (1988) Assessing and Minimizing Bias in the Residential Appliance Saturation Surveys University of Santa Cruz, UER-194