ELPC Exhibit 1.0

STATE OF ILLINOIS
ILLINOIS COMMERCE COMMISSION

COMMONWEALTH EDISON COMPANY **Approval of the Energy Efficiency and Demand Response Plan**	)	**Docket No. 07-0540**

Testimony and Exhibits of Geoffrey C. Crandall

On Behalf of

The Environmental Law & Policy Center

December 14, 2007

07-0540
ELPC 10.1.1.2.1.2
11/4/08

Q. What is your name and business address?

A. My name is Geoffrey C. Crandall. My business address is MSB Energy Associates, Inc., 7507 Hubbard Avenue Suite 200, Middleton, Wisconsin 53562.

Q. On whose behalf are you testifying today?

A. I am testifying on behalf of The Environmental Law & Policy Center (ELPC).

Q. Please describe your background and experience in the field of electric utility regulation.

A. I am a principal and the Vice President of MSB Energy Associates, Inc. I have over 33 years of experience dealing with utility regulatory issues, including energy efficiency resource development, resource planning, restructuring, fuel and purchase power planning, cost recovery and other issues. I have provided expert testimony before more than a dozen public utility regulatory bodies throughout the United States. I have provided expert testimony before the United States Congress on several occasions. I have testified previously on energy efficiency and resource planning before the Illinois Commerce Commission.

My experience includes over 15 years of service on the Staff of the Michigan Public Service Commission (MPSC). During my tenure at the MPSC, I served as an analyst in the Electric Division (Rates and Tariff section) and was involved in general rate case as well as fuel and purchase power proceedings. I served as the Technical Assistant to the Chief of Staff, supervisor of the energy conservation section (involving residential and commercial energy efficiency programs) and as the Division Director of the Industrial, Commercial and Institutional Division. In that capacity, I was Director of the Division that had responsibility for the energy efficiency and conservation program design, funding, and implementation of Michigan utilities as well as DOE-funded programs involving Industrial, Commercial and Institutional gas and electric customers throughout Michigan.

In 1990, I became employed by MSB Energy Associates, Inc. and have served clients throughout the United States on projects related to energy efficiency resource development, system planning, fuel and purchase power assessments, electric restructuring and other issues. My vita is attached as Exhibit 1.1.

Q. What is the purpose of your testimony?

A. To provide suggestions and recommendations intended to improve the development and implementation of energy efficiency resources in Illinois. I have several specific recommendations regarding Ameren's proposed programs.

Q. Do you believe that Com Ed's proposed programs in this proceeding are appropriate and should be approved as proposed?

A. I give Com Ed credit for the way in which it responded to its new responsibilities under the Public Utilities Act. Having said that, I do not believe it would be in the public interest for the Commission to approve the programs exactly as Com Ed has proposed. Section 12-103(f) of the Public Utilities Act places the responsibility on Com Ed to offer and operate effective, results oriented energy efficiency programs. It requires that the programs become operational in a short period of time. The law imposes responsibilities on Com Ed including the design, development, oversight and submission of a proposed energy efficiency and demand response plan to the Commission. The Commission has an obligation and duty to seek public input and to review, modify, approve or reject the proposals within 90 days of the filing of the plan with the Commission. In addition, legislation requires that the filings satisfy annual energy savings and peak demand reduction levels and that programs be coordinated with the Department of Commerce and Economic Opportunity.

Q. Has the applicant developed and set forth programs in this application that are in compliance with the Legislative mandate and requirements in 220 ILCS 5/12-103?

A. I have reviewed the application, testimony, exhibits and responses to discovery questions and other relevant materials in conjunction with this application. I believe that Com Ed's proposed programs are a positive and constructive first step in formulating cost effective energy efficiency and demand response programs. However, I have specific concerns and suggestions regarding the proposed programs. I believe after incorporating my suggested modifications the proposed programs would be in the public interest and should be approved by the Commission. The applicant should make a good faith effort to effectively implement this initiative and assist its customers to achieve significant energy efficiency and usage reduction as a means to mitigate adverse environmental impacts, enhance system reliability and minimize costs to its customers.

Q. Have other electric utilities been providing energy efficiency and usage reduction services to their customers?

A. Yes. Com Ed wisely sought outside expertise to take advantage of the lessons learned by others who have implemented extensive energy efficiency programs. Positive program elements from other utilities who have implemented effective energy efficiency services and demand response efforts have been incorporated into the proposed programs.

Q. Do you believe the scope and magnitude of cost-effective energy efficiency and demand management programs proposed by Com Ed are reasonably achievable?

A. Yes I do. Com Ed has proposed a 247 million dollar program (for the first three years). This equates to less than 0.5% of its gross operating revenue. ACEEE has completed a study entitled *Five Years In: An Examination of the First Half-Decade of Public Benefits Energy Efficiency Policies*[1]. Utilities in a number of states have implemented energy efficiency and demand response programs at a higher relative level of funding than what Com Ed is proposing.

Q. Do you believe that a stakeholder input/collaborative process would be useful in developing, implementing and evaluating these energy efficiency and demand response programs?

[1] Available at http://aceee.org/pubs/u041.pdf

A. Yes. Com Ed has indicated that it is interested in such an approach. It identifies a process that has been in place to assist in the development of the programs. However, I believe the stakeholder input/collaborative process needs to be handled in a manner different than what is suggested by Com Ed.

Q. How should an ongoing stakeholder input/collaborative process operate and who should participate?

A. I have been involved in a number of collaborative working groups. In my experience, ongoing stakeholder involvement is critical in the development, implementation, monitoring, evaluation and revision to or elimination of energy efficiency programs. I think it is particularly important since the two investor-owned utilities in Illinois have indicated that they have little experience in running programs of this nature and magnitude. Periodic meetings and presentations to large groups of stakeholders (such as was done prior to filing of the energy efficiency plans) are not adequate. I believe that Com Ed should use a process similar to one proposed by NRDC in this case (see attachment A of their comments in this case). In this collaborative process the facilitator should report to the working group and provide technical expertise to the working group, as needed. An additional technical working group/advisory board should also be established consisting of energy efficiency and program implementation experts. This board would meet in person, hold conference calls and review documents to offer recommendations on program designs and implementation strategies. The purpose of this technical group would be to provide an opportunity for program implementers to brainstorm, address a myriad of issues and questions that arise in the process of implementing programs e.g., initial program results, backlogs, unanticipated demand, marketing and outreach strategies, etc.

Recommendations from the technical advisory board or evaluation, measurement and verification (EM&V) group would be non-binding on the utility with the exception that the designated stakeholder group must agree prior to a dismissal of an EM&V contractor.

Q. Do you have concerns regarding the financial controls and accounting system which needs to be in place to ensure proper tracking and use of ratepayer funded activities?

A. Yes. Com Ed has not explained their plans specifically for internal financial controls and fund tracking. These are unfamiliar activities and tens of millions of dollars will be flowing from ratepayers to the utilities, then out to program contractors, vendors, retail stores and consumers. The utilities need to take the appropriate steps to ensure proper tracking and control of these funds. The ICC staff needs to ensure that Com Ed is setting up its accounting systems appropriately so that tracking and allocations include only the legitimate costs from the new incremental activities. The Commission should direct the Staff to conduct meetings with ComEd, if necessary, and provide specific instructions and guidance as to the proper accounting treatment for these new programs. At the end of the first program year, the ICC staff should conduct a compliance audit or an independent audit should be conducted at the direction of the ICC Staff.

Q. Com Ed is seeking authorization to reallocate funds among the programs. as needed. Does this cause you concern?

A. Yes. In the proposed plan, Com Ed proposes to allocate specified dollars (and kwh/KW savings) to specific programs. It is appropriate to consider that the amounts assigned to each program be considered an operational budget. If a particular program performs better or worse than anticipated, then more or fewer dollars should be able to be allocated to that program, provided that the TRC for the program receiving additional funding continues to be greater than 1.0. Alternatively, if a program is getting a larger or smaller market response than anticipated, the utility should be able to adjust the incentive levels up or down as appropriate, again under the condition that the program still must meet the TRC test.

However, it is important that the relative share of funds assigned to specific sectors (residential, commercial, industrial) remain approximately proportionate to the proposed levels in the plan.

Q. Do you have suggestions regarding contract specifications and potential program impacts resulting from reliance on third party implementers?

A. Witness Jensen made some excellent points in his identification of eleven common elements found in successful best practice programs. In addition to his suggestions, I have a number of concerns and suggestions that should be addressed in developing and implementing the programs.

First, trade ally coordination, training and relationship building will be crucial to the success of these programs and needs to be given high priority. Second, since Illinois customers have limited experience with rebate and incentive programs for energy efficiency technologies, Com Ed may need to be a bit more generous initially with customer incentive levels to help jumpstart the programs and build customer awareness. Third, program delivery (e.g., rebate redemption) will need to be streamlined to minimize customer hassle, customer confusion and barriers to their participation.

Finally, in reviewing the proposed plan, I am concerned that no accommodation has been made to program interruptions (caused, for example, by depletion of available funds or products).. I suggest that this be addressed in the program planning and within the contracts with third party implementers.

Q. Do you agree with the concept of creating a uniform energy efficiency program that is easily identifiable to customers throughout the state?

A. Yes. Branding is an important part of the long-term success of this program. Programs such as Wisconsin's Focus on Energy or California's Flex Your Power campaign enhance consumer awareness of both specific program offerings and the opportunities for energy efficiency in general. Although there are three separate entities running programs in the state (Com Ed, Ameren and DCEO), I believe that the programs would be enhanced by a unified brand and marketing campaign supported by all three. The utilities also may want to consider a shared website and call center to provide information on these programs. However, while the specific programs by the two utilities will be similar, I don't believe that they need to have uniform incentive levels since market conditions vary across the state and each utility should have the flexibility to respond to those differences.

Q. Do you believe that customer education and awareness is necessary for this program effort?

A. Yes. There is a definite need to build customer awareness of energy efficiency options and the financial savings that result from conservation and energy efficiency. General background information using mass media can complement the specific program offerings. Customers need to be aware of both the energy impact of appliance purchase decisions and opportunities to save energy through simple lifestyle changes such as adjusting thermostat settings.

For example, a recent study by Ecos Consulting[2] concluded that large-screen plasma televisions use up to six times the amount of energy of an older-style CRT television. Put another way, average energy consumption from a large plasma tv is roughly equivalent to a refrigerator, the single largest energy-consuming appliance in most households. Growth in sales of these appliances could offset residential energy savings elsewhere if steps are not taken at the outset to make sure this does not happen.

Moreover, customers are often times not aware of common everyday opportunities such as reduction in hot water temperatures in homes,, using programmable thermostats, use of flow restrictors, outlet gaskets, etc. These aspects of efficiency should not be overlooked. The use of public service announcements involving celebrities and well known personalities should be utilized particularly in the beginning phases of this new program. This in combination with customer incentives and program promotions will help to build public awareness and ultimately improve participation levels. This should be a coordinated effort involving ComEd, Ameren, DCEO and the collaborative working group with proper safeguards to ensure that the focus is on energy efficiency and not image building for the utilities.

Q. Do you have concerns regarding the implementation schedule for the programs?

A. Yes. I believe that the residential lighting and appliance program as well as the residential new HVAC incentive programs should be ready to launch as soon as the

[2] Available at http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/tv_vcr/Ecos_Presentation.pdf

Commission files a final order in this case. . Programs similar to these have been long established and I see no credible reason that their implementation should be delayed, as is described in the proposed plan.

Q. Understanding that there was a very short timeframe available to develop this energy efficiency and demand response plan, do you believe there is a need to have an energy efficiency and load management potential study done in Com Ed's service territory at some point in the future?

A. Yes. This is a very important assessment that provides energy efficiency resource planners a better understanding of the magnitude and location of energy efficiency potential in Illinois. Such a study would allow a targeted and more precise approach in efforts to obtain cost effective energy efficiency resources. The last such study done in Illinois was done in 2002 for the Midwest Energy Efficiency Alliance and covered the residential sector only[3]. I suggest that Com Ed conduct a series of statewide studies preferably in conjunction with a university or other organization, Ameren and DCEO. Exhibit 1.2 is the 2007 Georgia Power Company Technical Potential and is an example of the type of study that I am referring to In addition, a survey needs to be done in Illinois to aid in developing and fine tuning energy efficiency resource programs in the future. Exhibit 1.3 is an example of a statewide appliance saturation survey done in another state.

Q. The utility plans are based on technologies using the California Database for Energy Efficiency Resources (DEER data base) savings and performance standards, adjusted for Illinois. Is this adequate?

A. Because Illinois has not had extensive utility-sponsored energy efficiency programs before, there is pent up demand for all of these programs. However, since local labor and equipment costs would be very helpful to obtain for program planning purposes, I believe that the utilities need to commission a revised technology database (Illinois DEER equivalent) to better understand the costs and operating characteristics of various energy efficiency technology and program elements. This need not be done prior to initiating

[3] Midwest Energy Efficiency Alliance, *Illinois Residential Market Analysis*, May 12, 2003. Available at www.mwalliance.org

these programs but should be conducted over the next year to enhance planning for subsequent plan years.

Q. Does this complete your testimony?

A. Yes.

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Exhibit 1.3 of
Geoffrey C. Crandall

On Behalf of

The Environmental Law & Policy Center

December 14, 2007

CALIFORNIA STATEWIDE RESIDENTIAL APPLIANCE SATURATION STUDY

FINAL REPORT EXECUTIVE SUMMARY

Consultant Report

Prepared for:
California Energy Commission

Prepared by:
KEMA-XENERGY
Itron
RoperASW

June 2004
400-04-009

Prepared by:
KEMA-XENERGY
Itron
RoperASW

Contract No. 400-04-009

Prepared for:
California Energy Commission

Contract Manager: Glen Sharp

Sponsors:
Pacific Gas and Electric (PG&E)
San Diego Gas and Electric (SDG&E)
Southern California Edison (SCE)
Southern California Gas Company (SoCalGas)
Los Angeles Department of Water and Power (LADWP)

1.1 Report Overview

This report highlights key findings from the California Energy Commission's 2003 Statewide Residential Appliance Saturation Study (RASS). This executive summary provides an overview of the results from the study including energy use and equipment saturations throughout the State of California.

The executive summary is a companion document to a comprehensive methodology and results report that includes energy consumption tables from the conditional demand analysis along with a series of "cross tabs" which display the RASS results in a comprehensive format.

The sections of this summary report include:

2. **Study Background.** An overview of the project approach.
3. **Unit Energy Consumption and Appliance Saturation Summaries.** Results from the Conditional Demand Analysis (CDA) that was performed on the RASS data. Results are provided for both electric and natural gas end uses.
4. **Fuel Shares.** Gas continued to be the predominant space heating and water heating fuel in the California marketplace. These tables show how the share of gas and electric appliances and equipment vary.
5. **Air Conditioning.** Air conditioning is the primary driver of peak energy demand in California and the saturation of central air conditioning systems is increasing.
6. **New Dwellings.** Newer dwellings (built after 1996) are larger, have a slightly higher average number of residents, and have higher average incomes than older dwellings. New dwelling electricity use has a corresponding increase although it is counteracted by higher incidences of energy efficient equipment.
7. **Income Effects.** Income strongly correlates to energy use because of the resulting larger dwellings and prevalence of more energy consuming equipment. However, this section also demonstrates that all income groups have customers who use above average amounts of energy.
8. **Energy Efficiency Actions.** The use of energy efficiency equipment and conservation actions continue to grow as evidenced by the increase in these items in new dwellings. However, there is still a large market segment that is not adopting these products and practices.
9. **Technology.** The prevalence of technology in the dwelling is increasing as more people work at home, have more equipment, and use their technology to do a wide range of activities. This information is important from the standpoints of energy use and future customer relations and communication vehicles.
10. **Data Comparisons.** The study results provide a reasonable match to Census data. The section also provides information on the effect the non-respondent study had on the final results.

1.2 Study Background

For the first time in California, the large Investor Owned Utilities (IOUs) pooled resources and performed a RASS and Unit Energy Consumption (UEC) Study as a team. The project was administered by the California Energy Commission and sponsored by Pacific Gas and Electric (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE), Southern California Gas Company (SoCalGas), and Los Angeles Department of Water and Power (LADWP). KEMA-XENERGY was the prime consultant. Itron provided data cleaning and performed the Conditional Demand Analysis. RoperASW fielded the non-response follow-up.

The RASS effort has resulted in a research product that provides both statewide and utility-specific results. The study was designed to allow comparison of results across utility service territories, climate zones and other variables of interest (i.e. dwelling type, dwelling vintage, and income). The study includes results for 21,920 residential customers that are weighted to the population represented by the sponsoring utilities. The saturation results capture both individual and master metered dwellings. This rich set of customer data includes information on all appliances, equipment, and general usage habits. The study also includes a detailed conditional demand analysis that calculates unit energy consumption (UEC) values for all individually metered customers.

The study was initiated in late 2002 and the sampling plans and survey implementation occurred throughout 2003. The data was collected using a two stage direct mail survey targeted to a representative sample of California residential customers. The survey requested customers to provide details on their energy equipment and behaviors. A non-response follow-up survey was implemented at the end of the double mailing phase to a sub-sample of non-respondents. The non-response follow-up included telephone and in-person interviews in an effort to minimize non-response bias by using alternative surveying techniques.

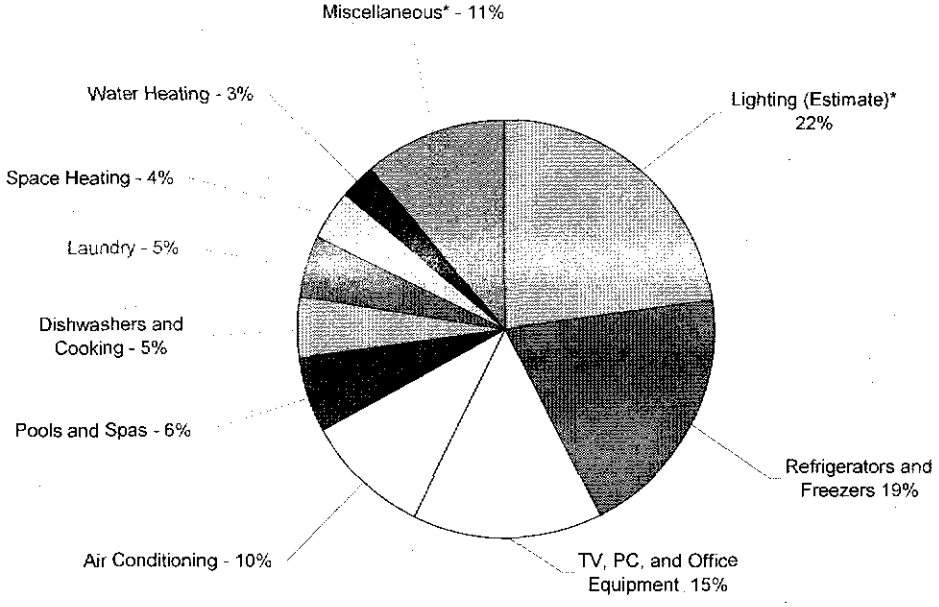
The results from the RASS study were used to develop a CDA model. This analytical method uses a combination of customer energy use with the responses from the customer survey to model end uses and develop unit energy consumption results for those end uses. The results of the CDA are included in summary form along with the general study results in this executive summary and are provided in further detail in the methodology section of the report.

The study also includes onsite metering for a sample of 180 RASS participants. The onsite metering sample was designed to over-sample air conditioning use, with the meters gathering both a whole-house and central air conditioning usage at each dwelling. The onsite meters are in the field at the time of publication and the final results from that portion of the project will be delivered as whole house and air conditioning load shapes after the 2004 cooling season has ended.

1.3 End Use Energy and Appliance Saturation Summaries

Using utility billing data from 2002 and normalized weather data for each climate zone in the state, the CDA was used to determine UEC values for end uses. This UEC section includes the individually metered customers only. As shown in Figure 1, annual electrical energy use in California is 5,914 kWh per household.

Figure 1
Statewide Electricity Use per Household
5,914 kWh per Household



*Note: An estimate of 1,200 kWh per household (20% of the total use) has been designated as interior lighting and was shifted from Miscellaneous to Lighting where it is combined with exterior lighting usage. This number comes from other lighting studies[1] that are better able to pinpoint this estimate than a conditional demand model as was used for the RASS.

The CDA model produced several results that varied from previous studies. The most notable are electric space heating and air conditioning, which are both lower than previous studies.[2] This is likely a result of the statewide electricity price increases and statewide 20/20 Program in effect during 2001 and 2002.[3] These two simultaneous effects combined to provide customers with a strong incentive to reduce their consumption. In the peak summer months, energy use dropped significantly, with roughly 30% of customers in PG&E's territory participating in the program.[4] While 2002 consumption was higher than that achieved in 2001, almost 50% of the conservation observed in 2001 persisted in 2002.[5] The CDA used 2002 billing data in the modeling process and thus was impacted by these effects.

The UECs presented in Table 1 and 2 show the full CDA results displayed first by utility and then by dwelling type.

Table 1
Electric UEC and Appliance Saturation Summaries by Utility

	PG&E		SDG&E		SCE		DWP	
	UEC	Sat.	UEC	Sat.	UEC	Sat.	UEC	Sat.
All Households	6,265		5,445		6,102		4,071	
Primary Conventional Space Heating	1,113	10%	581	13%	734	6%	542	9%
Primary Heat Pump Space Heating	799	2%	458	3%	555	1%	201	3%
Auxilliary Space Heating	331	26%	156	24%	192	23%	103	17%
Furnace Fan (Gas Heat)	180	58%	91	60%	115	56%	71	26%
Attic Fan	102	12%	60	7%	159	10%	243	5%
Central Air Conditioning	1,108	39%	644	35%	1,494	48%	1,075	29%
Room Air Conditioning	181	14%	63	9%	202	20%	158	25%
Evaporative Cooling	469	5%	277	1%	797	5%	372	2%
Water Heating	2,585	9%	2,151	6%	2,342	5%	1,387	5%
Solar Water Heating	1,193	0%	1,501	1%	1,508	0%	0	0%
Dryer	652	45%	648	26%	717	18%	474	7%
Clothes Washer	97	78%	75	77%	129	77%	125	36%
Dish Washer	77	67%	69	71%	80	60%	73	27%
First Refrigerator	788	100%	780	100%	801	100%	754	100%
Additional Refrigerator	1,201	19%	1,054	19%	1,210	19%	933	6%
Freezer	928	23%	841	17%	983	15%	880	5%
Pool Pump	2,580	8%	2,557	12%	2,772	10%	3,096	2%
Spa	428	8%	445	12%	495	10%	423	2%
Outdoor Lighting	260	56%	268	53%	276	55%	218	42%
Range/Oven	268	61%	241	49%	271	27%	200	17%
Television	474	95%	446	94%	520	96%	479	94%
Spa Electric Heat	1,346	5%	903	6%	2,514	4%	895	1%
Microwave	131	95%	119	96%	139	96%	140	89%
Home Office Equipment	152	20%	159	19%	141	16%	134	18%
Personal Computer	602	72%	614	78%	515	66%	516	55%
Water Bed	787	2%	925	1%	818	2%	848	0%
Well Pump	829	8%	831	1%	952	2%	890	1%
Interior Lighting and Miscellaneous	1,840	100%	1,746	100%	1,896	100%	1,483	100%
Ave. Dwelling Size	*1,525*		*1,614*		*1,506*		*1,017*	
Ave. Residents	*2.89*		*2.75*		*3.12*		*2.86*	
Percent Single Family	*62.0%*		*59.4%*		*62.0%*		*25.6%*	
Percent of Population	*41.1%*		*11.5%*		*38.8%*		*8.6%*	

One important note on the results is that the LADWP population frame that was originally supplied for the study appears to have excluded a portion of the LADWP service area. It appears that the missing customers were predominantly single family homes which is part of the reason that the percentage of single family homes is so

low for LADWP. The "missing" customers make up less than two percent of the total statewide population. However, the LADWP results need to take this into consideration when viewed individually.

Table 2
Electric UEC and Appliance Saturation Summaries by Dwelling Type

	All		Single Family		Multi Family		Mobile Home	
	UEC	Sat.	UEC	Sat.	UEC	Sat.	UEC	Sat.
All Households	5,914		7,105		3,953		5,662	
Primary Conventional Space Heating	871	9%	1,494	4%	646	17%	1,150	10%
Primary Heat Pump Space Heating	588	2%	1,077	1%	335	3%	1,031	3%
Auxilliary Space Heating	244	24%	296	28%	87	16%	298	31%
Furnace Fan (Gas Heat)	139	55%	162	68%	62	33%	118	58%
Central Air Conditioning	1,236	41%	1,423	46%	803	32%	1,143	39%
Room Air Conditioning	181	17%	227	15%	114	19%	227	34%
Evaporative Cooling	622	4%	688	5%	430	2%	537	27%
Water Heating	2,389	7%	3,079	5%	1,607	9%	3,258	17%
Solar Water Heating	1,345	0%	1,708	0%	344	0%	0	0%
Dryer	663	29%	713	34%	535	20%	549	42%
Clothes Washer	108	74%	127	95%	45	39%	11	86%
Dish Washer	77	61%	84	70%	62	48%	47	55%
First Refrigerator	789	100%	824	100%	731	100%	809	100%
Additional Refrigerator	1,178	18%	1,245	25%	673	6%	1,143	13%
Freezer	935	18%	937	24%	917	6%	951	30%
Pool Pump	2,671	9%	2,671	14%	0	0%	0	0%
Spa	460	8%	467	13%	270	1%	180	3%
Outdoor Lighting	264	54%	284	67%	201	33%	232	56%
Range/Oven	263	42%	301	41%	209	46%	208	27%
Television	490	95%	519	96%	442	94%	457	93%
Spa Electric Heat	1,704	4%	1,719	7%	694	0%	3,550	2%
Microwave	133	95%	140	97%	124	91%	113	96%
Home Office Equipment	148	18%	148	20%	148	16%	121	13%
Personal Computer	565	69%	578	75%	542	59%	458	45%
Water Bed	817	2%	840	2%	750	1%	773	3%
Well Pump	849	4%	862	5%	862	1%	724	18%
Interior Lighting and Miscellaneous	1,832	100%	2,146	100%	1,332	100%	1,463	100%

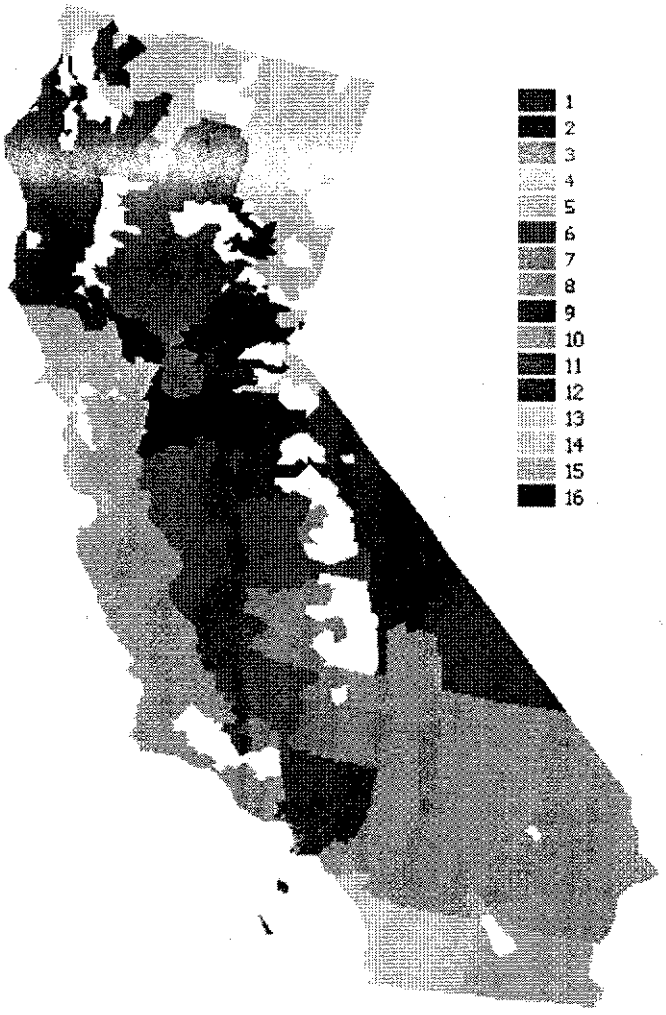
Ave. Dwelling Size	*1,541*	*1,787*	*997*	*1,167*
Ave. Residents	*2.96*	*3.21*	*2.60*	*2.26*
Percent of Population	*100%*	*59%*	*37%*	*4%*

Figure 2 is a map of the Energy Commission forecast climate zones. These zones were used in the CDA modeling and provide regional summaries by climate. (A black and white version of this graph is available at the end of the report.)

Zones 1-5 are served by PG&E (Zones 3 and 4 have some SoCalGas overlap)
Zone 6 is served by SMUD and not included in the results
Zones 7-10 are served by SCE/SoCalGas
Zones 11-12 are served by LADWP/SoCalGas
Zone 13 is served by SDG&E (some SoCalGas overlap)
Zones 14-16 are served by other electric utilities and not included in the results

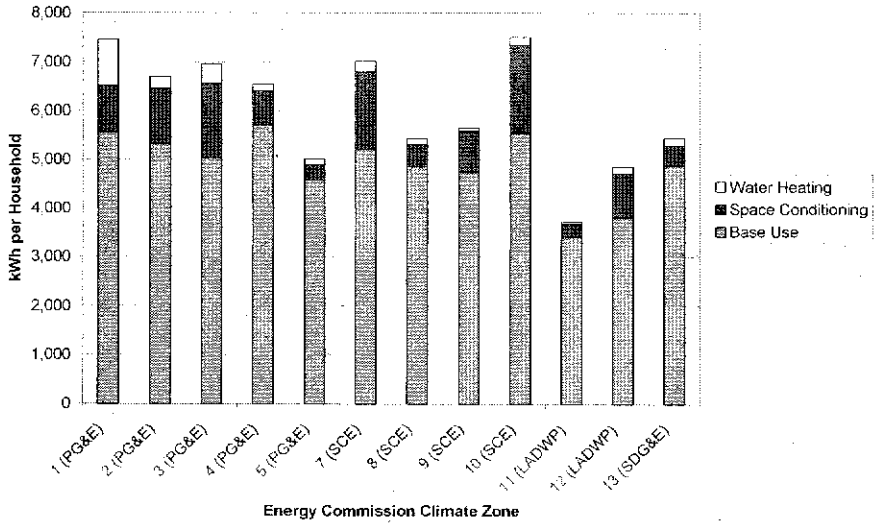
Figure 2

California Energy Commission Forecast Climate Zones



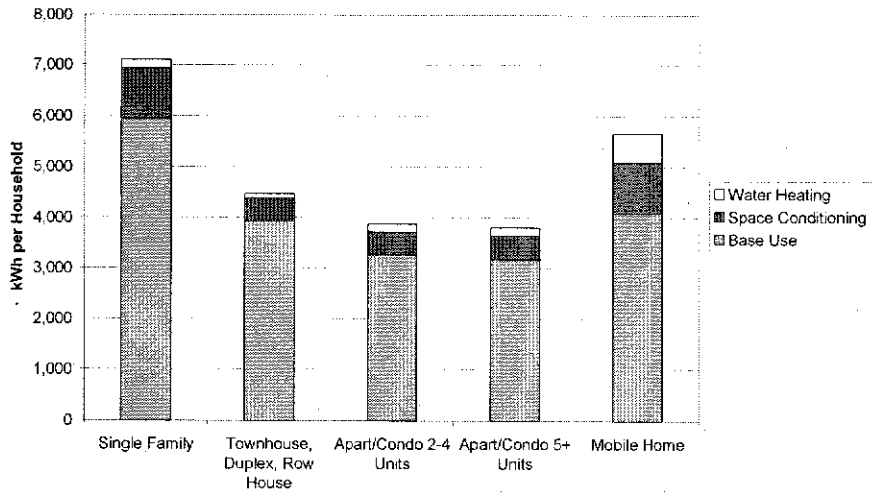
Both base energy use and space conditioning (heating and cooling) vary by climate zone (Figure 3). Climate Zone One has the lowest availability of gas, which is why its water heating UEC is so high.

Figure 3
Electric UECs by Climate Zone



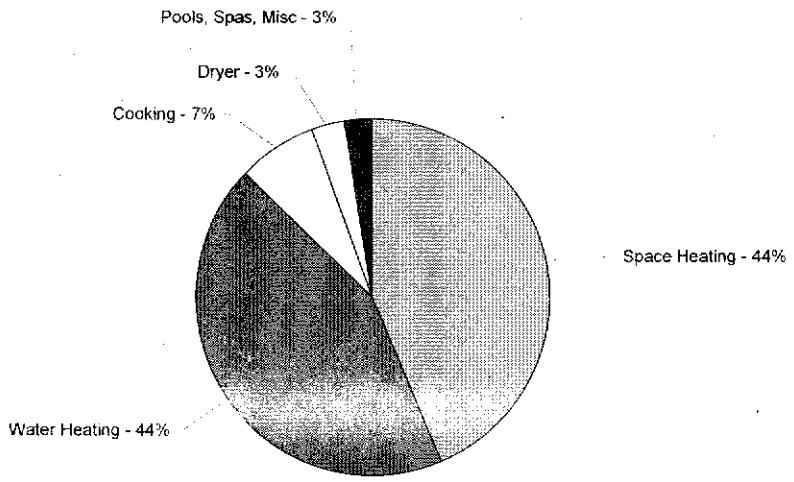
The mix of housing stock explains much of the difference in the base use shown in the climate zone table. Single family dwellings have the highest per dwelling electric use (Figure 4).

Figure 4
Electric UECs by Dwelling Type



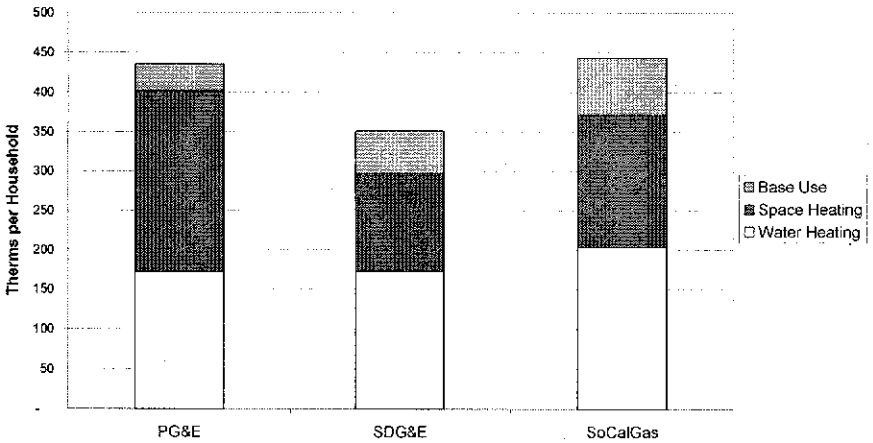
The annual energy consumption of the customers for whom we have gas bills (76% of the population) is 431 therms per household. Overall, 82% of the customers from the electrically based population were provided with gas UECs because they stated that they had a gas appliance. Figure 5 provides the gas consumption breakdown by end use.

Figure 5
Statewide Gas Energy Use



PG&E has the highest natural gas use with the biggest difference across utilities occurring in the heating end uses (Figure 6).

Figure 6
Gas UECs by Utility



Utility - Results include those customers who have a gas bill from the designated utility. 24% of the total electric based population does not have a gas account and is excluded from this table.

Natural gas end uses are listed in Table 3 and 4 for all homes with a gas account. For the combined gas and electric utilities as well as the statewide total, the final row in each table represents the total gas household consumption across the electrically based population. Because the sample was electrically based, this result is not fully representative of statewide gas use because of overlapping gas and electric service territories.

Table 3
Natural Gas UEC and Appliance Saturation Summaries by Utility

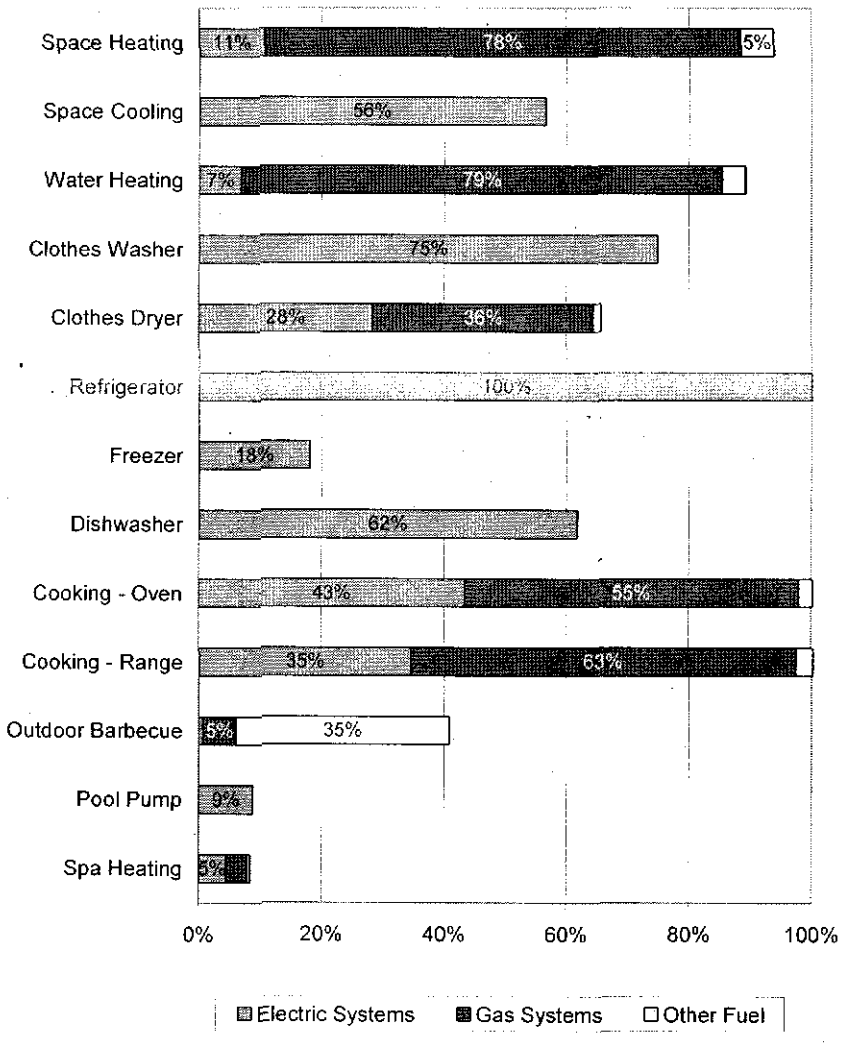
	All		PG&E		SDG&E		SoCalGas	
Homes with Gas Accounts	UEC	Saturation of Homes with Gas Account	UEC	Saturation of Homes with Gas Account	UEC	Saturation of Homes with Gas Account	UEC	Saturation of Homes with Gas Account
All Households	431		436		351		443	
Space Heating	202	93%	244	94%	135	92%	181	93%
Water Heating	201	94%	183	94%	181	96%	219	93%
Dryer	30	43%	25	28%	23	54%	33	53%
Range/Oven	43	72%	37	53%	35	71%	48	86%
Pool Heating	222	3%	225	2%	217	4%	222	3%
Spa Heating	81	5%	76	3%	86	7%	83	6%
Miscellaneous	2	100%	1	100%	2	100%	2	100%
Gas Use Across Electrically Based Utility Population	356		343		279		Not Applicable	

Table 4
Natural Gas UEC and Appliance Saturation Summaries by Dwelling Type

	Single Family		Multi Family		Mobile Home	
Homes with Gas Accounts	UEC	Saturation of Homes with Gas Account	UEC	Saturation of Homes with Gas Account	UEC	Saturation of Homes with Gas Account
All Households	508		270		433	
Space Heating	242	98%	102	83%	209	99%
Water Heating	206	99%	188	82%	193	99%
Dryer	31	55%	22	19%	13	39%
Range/Oven	46	73%	39	68%	28	90%
Pool Heating	222	4%	281	0%	0	0%
Spa Heating	81	7%	89	0%	114	3%
Miscellaneous	2	100%	1	100%	2	100%
Gas Use Across Electrically Based Utility Population	454		198		235	

Figure 7 provides a summary graph of the major saturation rates for all of the individually metered households in the state.

Figure 7
Combined Electric, Gas, and Other Fuel Saturations

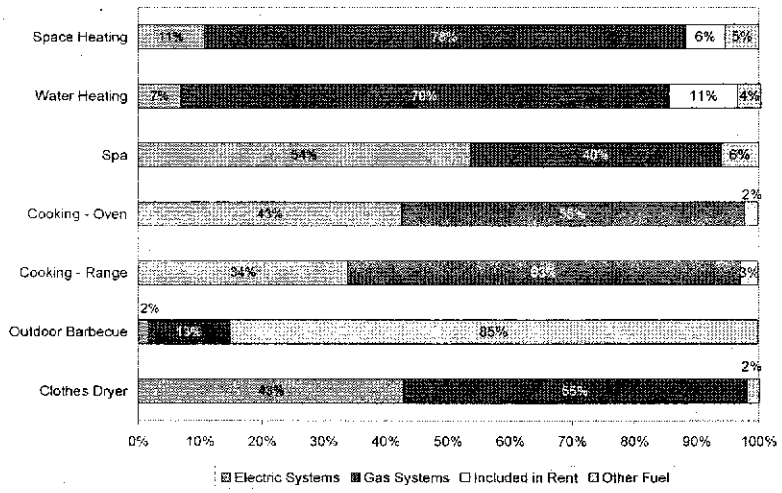


1.4 Fuel Shares

NOTE: *The remainder of the report (except where UECs are explicitly included) includes data from both individually and master metered dwellings. Master metered customers were not included in the CDA.*

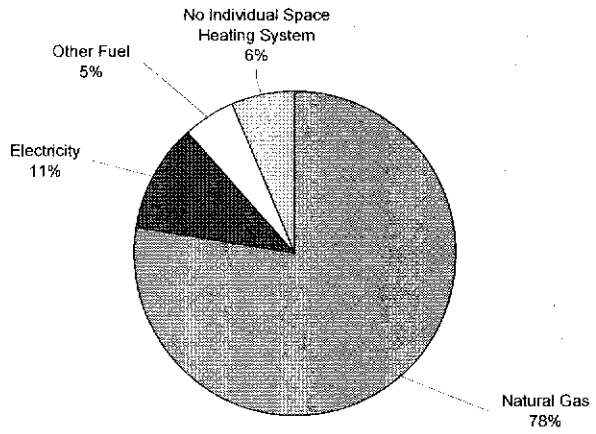
Overall fuel shares are included as Figure 8. Figures 8 and 9 include multi-unit systems, which are typically included in a tenant's rent. Shares represent the fuel share for customers who have the equipment.

Figure 8
Overall Shares of Electric and Gas Systems



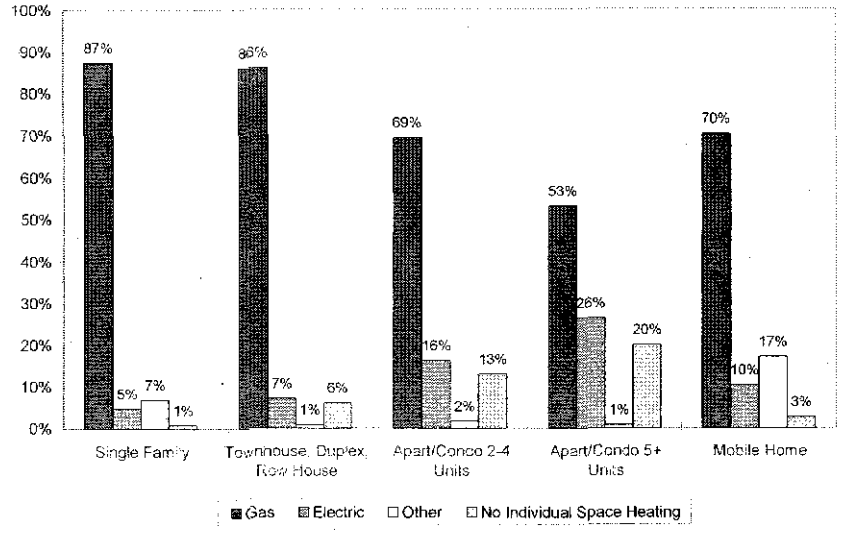
The vast majority of primary space heating systems are gas (Figure 9). The "No Individual Space Heating System" category includes people who have no space heating or a central building system that serves multiple apartments or dwellings.

Figure 9
Primary Space Heating Fuel



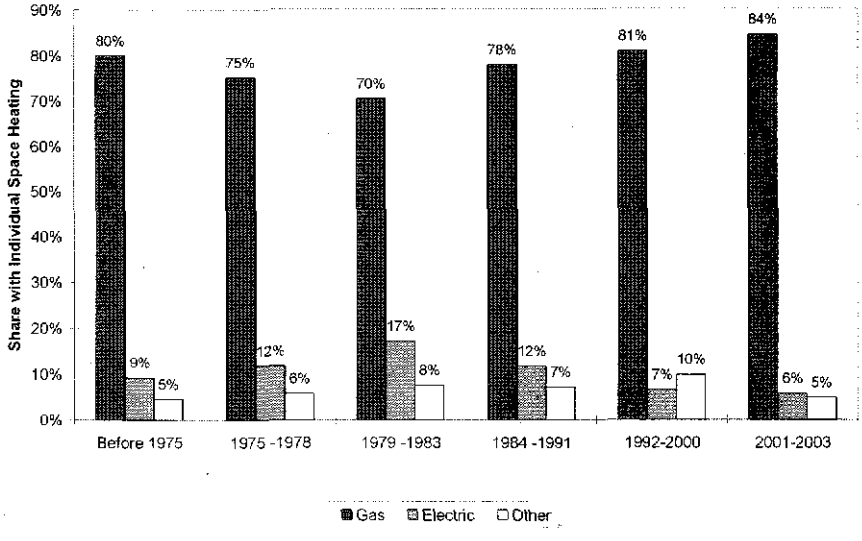
Electric heat is more common in apartments and condos than in single family dwellings (Figure 10). The "Other" fuel includes propane, wood, and other as reported by the customer.

Figure 10
Space Heating Fuel by Dwelling Type



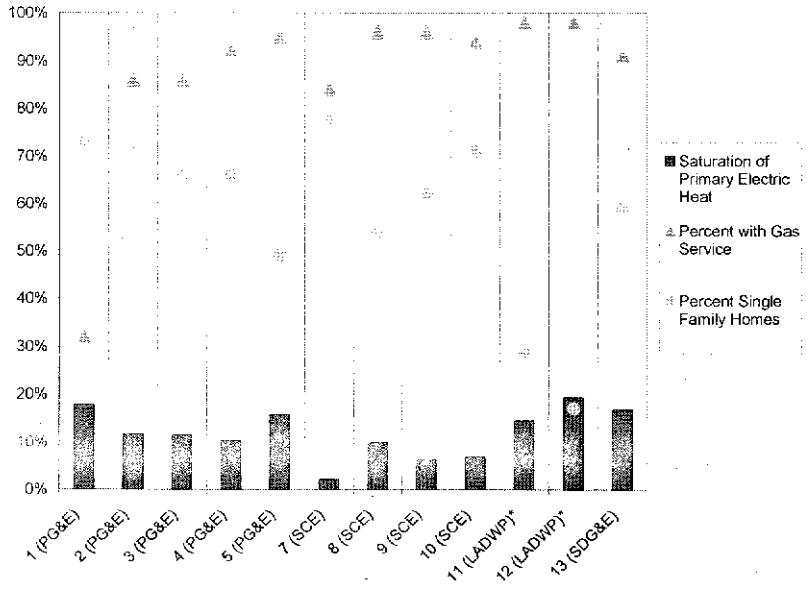
As shown in Figure 11, gas space heating is more common in newer dwellings. Dwellings built between 1979 and 1983 have the highest levels of electric heating. Figure 11 displays individually heated systems only.

Figure 11
Space Heating Fuel by Dwelling Age



Shares of electric space heating (Figure 12) are highest in Zone One where there is the least gas available and then in the more moderate southern climates (11, 12, 13). Zones 11 and 12 are high due to the high number of multifamily dwellings.

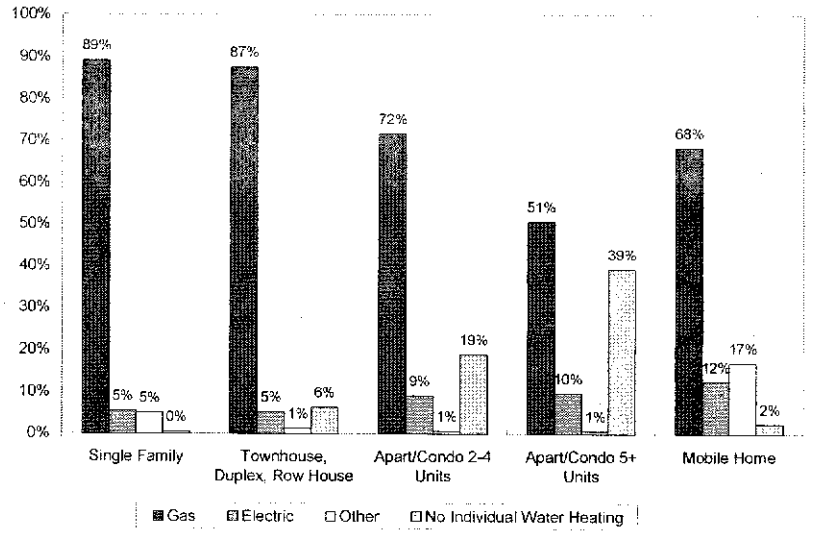
Figure 12
Shares of Electric Space Heating and HDD by Climate Zone



*Note that in Figure 12 the percentage of homes in LADWP's service territory is low. It appears that the original LADWP population file was missing a set of customers who are likely single family dwellings. LADWP's results are thus biased towards their multi-family population. Previous Energy Commission work shows single family rates more on the order of 50% in the LADWP territory as opposed to the 27% and 16% shown here.

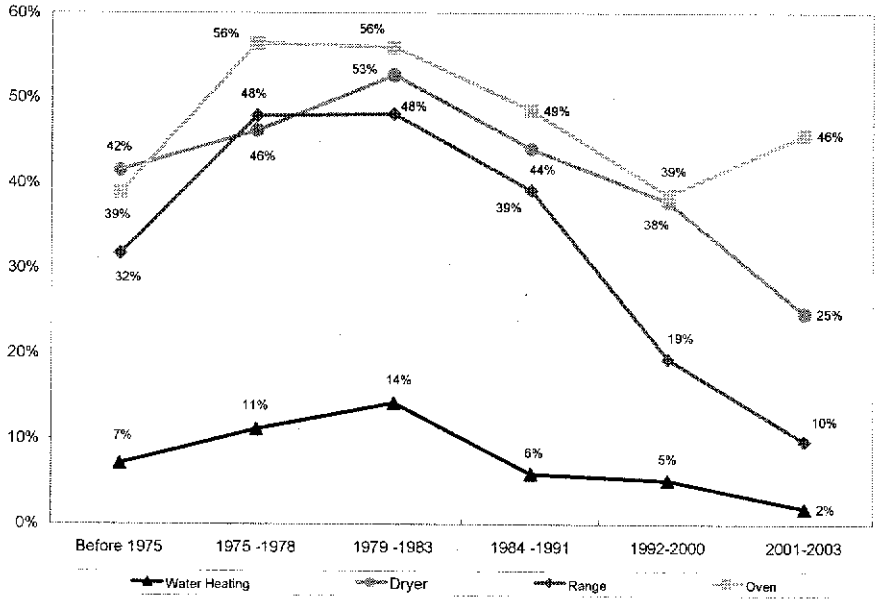
Water heating follows a similar fuel share pattern as space heating (Figure 13).

Figure 13
Water Heating by Dwelling Type



While electric shares are more prevalent in older buildings, it appears that many buildings that are more than 20 years old have been upgraded to natural gas systems and thus show lower shares of electric appliances (Figure 14). Electric ovens are still much more popular than electric ranges and continue to be installed extensively in newer dwellings.

Figure 14
Electric Appliances Share by Dwelling Age



As with most all other electric shares (Figures 15 through 17), the share in apartments is higher than in single family dwellings. Other fuels primarily represent propane, particularly in the mobile home market. All share tables represent the fuel share for customers who have the equipment.

Figure 15
Fuel Shares for Dryers by Dwelling Type

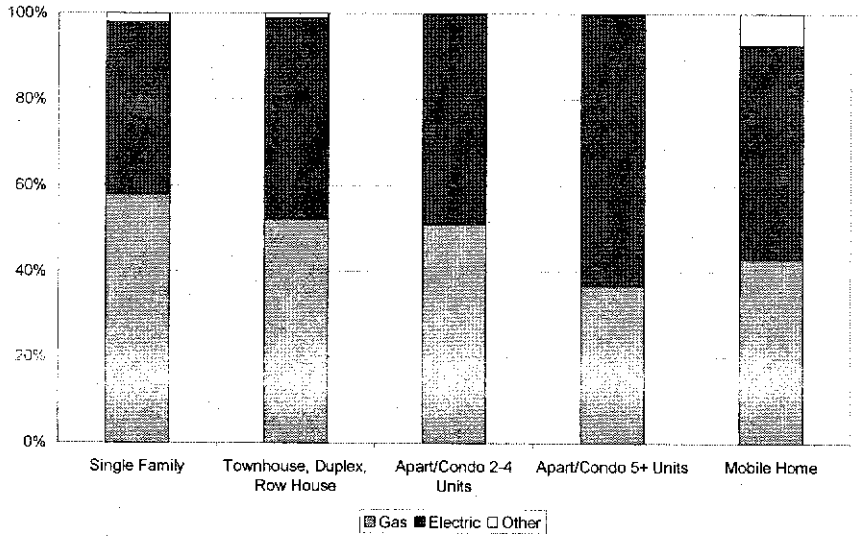


Figure 16
Fuel Shares for Ranges by Dwelling Type

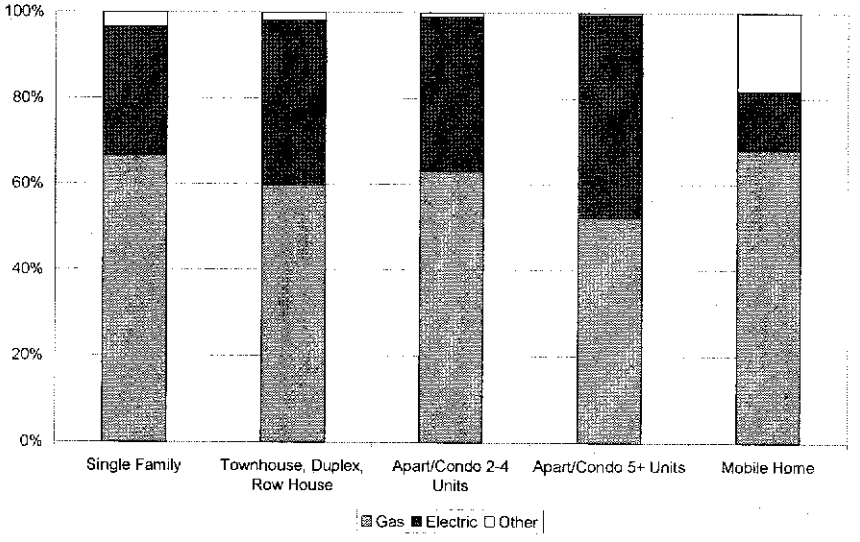
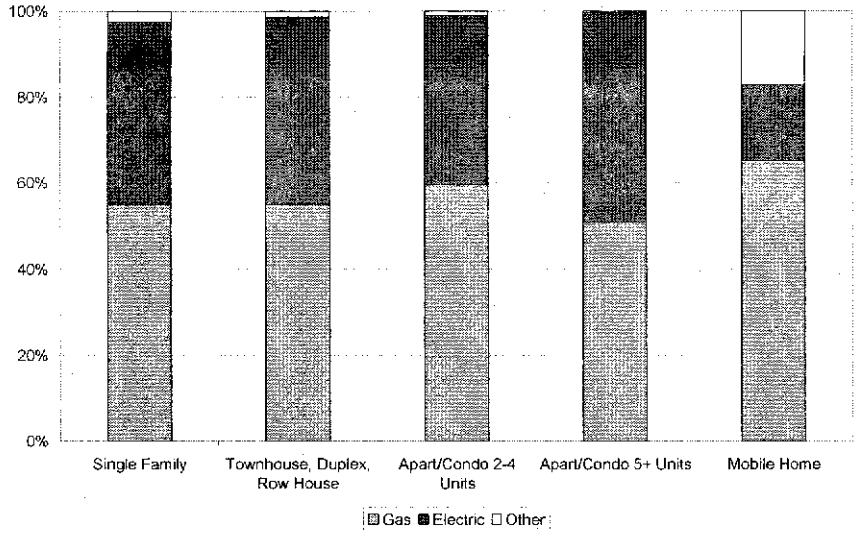


Figure 17
Fuel Shares for Ovens by Dwelling Type

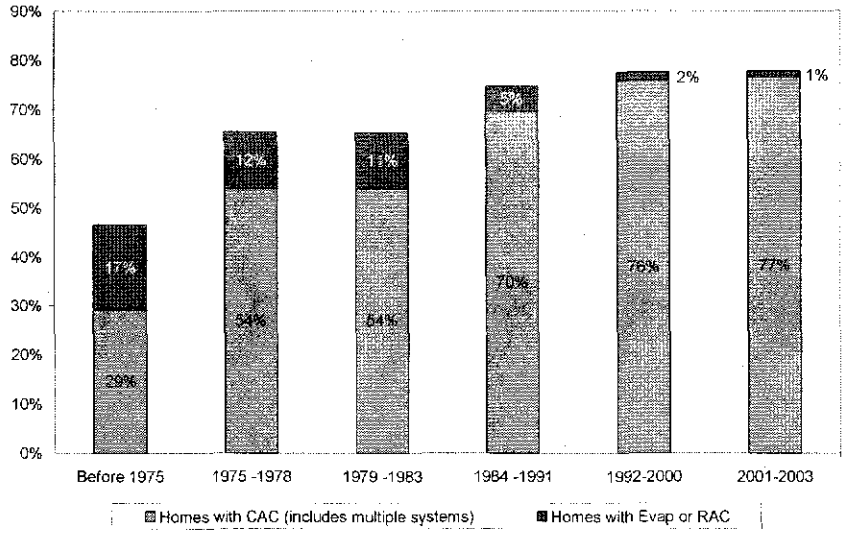


1.5 Air Conditioning

Air conditioning is the peak driver of energy use in California. The overall UEC for central air conditioning is 1,236 kWh per household. Room air conditioning has a UEC of 181 and evaporative systems 622. These values are somewhat lower than previous studies and forecasting values used at the Energy Commission. One possible reason for the lower than average use is attributed to the Statewide 20/20 Program.[6] Billing data for the CDA was from the second half of 2001, all of 2002, and the first part of 2003. UEC results have all been annualized and calibrated to 2002 service territory total usage. It is likely that the UECs reflect the 20/20 program impact and thus these air conditioning values should be considered conservative estimates.

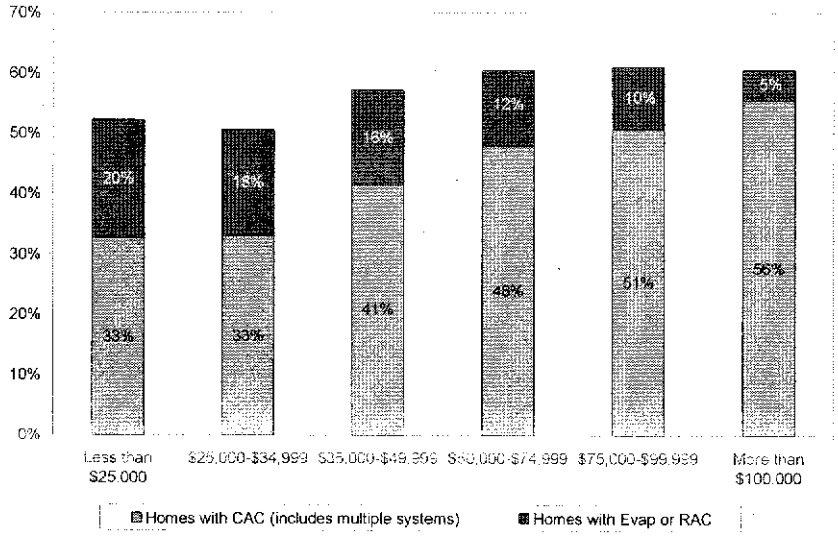
Air conditioning has grown overall with the biggest change in the type of systems installed. Room and evaporative units are going out of favor while central systems are present in 77% of the most recent dwellings (Figure 18).

Figure 18
Air Conditioning by Dwelling Age



Income plays a big role in air conditioning growth (Figure 19) as it is strongly correlated to the type and presence of air conditioning systems. However, dwelling age is a stronger driver of overall air conditioning usage.

Figure 19
Air Conditioning by Income

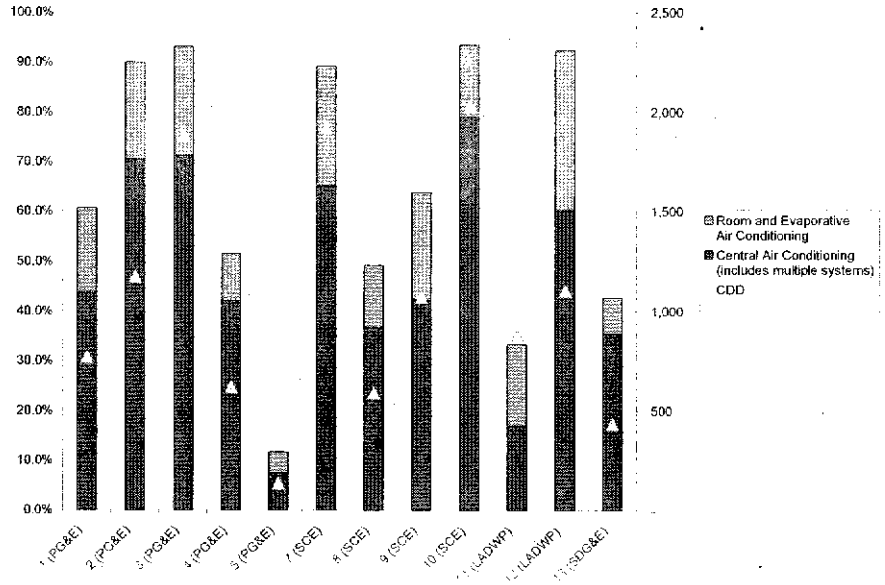


UECs for the state vary significantly by climate. The forecast zones and their respective cooling degree days (CDDs) in Table 5 justify the UECs for central air conditioning. Figure 20 which follows displays the saturations by type of air conditioning system along with the cooling degree days. All cooling degree days represent normalized weather. UECs throughout are based on normalized weather.

Table 5
Central Air Conditioning UECs by Climate Zone with CDDs

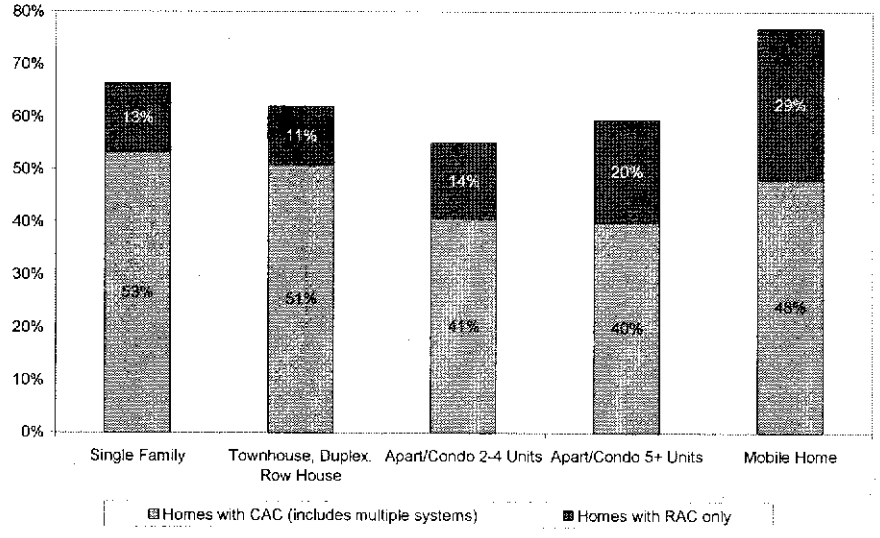
Energy Commission Forecast Climate Zone	Central AC UEC (kWh/Household)	CDD
Zone 1 (PG&E)	941	767
Zone 2 (PG&E)	1,082	1,173
Zone 3 (PG&E)	1,548	1,880
Zone 4 (PG&E)	885	619
Zone 5 (PG&E)	226	133
Zone 7 (SCE)	1,902	1,919
Zone 8 (SCE)	848	590
Zone 9 (SCE)	1,509	1,072
Zone 10 (SCE)	1,908	2,028
Zone 11 (LADWP)	915	879
Zone 12 (LADWP)	1,169	1,101
Zone 13 (SDG&E)	644	433

Figure 20
Saturation of Air Conditioning by Climate Zone



In order to see how the dwelling type affects air conditioning in hot climates, climate zones 5 and 11 were removed from Figure 21 because they had a combination of low air conditioning saturations and a high percentage of multi-family dwellings. The sub-sample better represents areas where air conditioning is more common.

Figure 21
Air Conditioning by Dwelling Type for All Zones Except 5 and 11



In Figure 21, single family dwellings make up 61% of the reported cases, townhouses 7%, apartments with 2-4 units 9%, apartments with more than 5 units 18%, and mobile homes 5%.

While newer dwellings represent the largest growth area for central air conditioning, about one third or 1.3 million of the central air conditioning units in operation are 14 years old or older (Figure 22).

Figure 22
Age Distribution of Central Air Conditioners

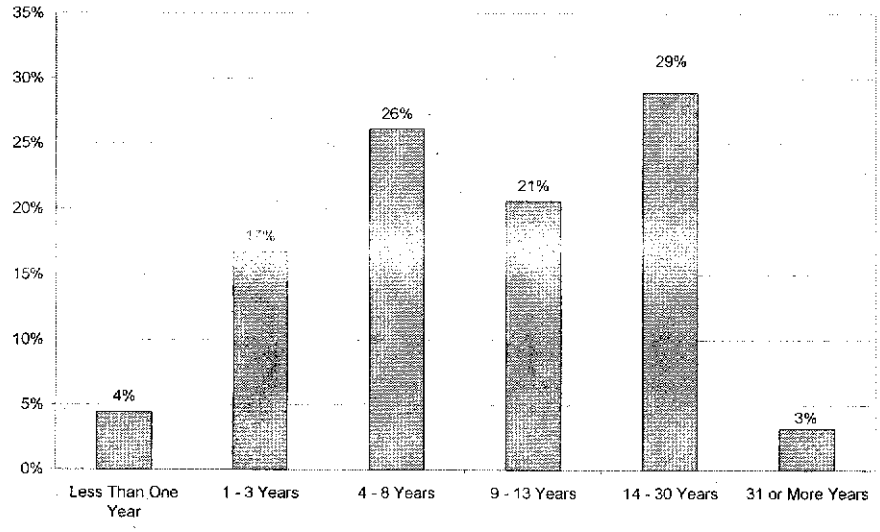
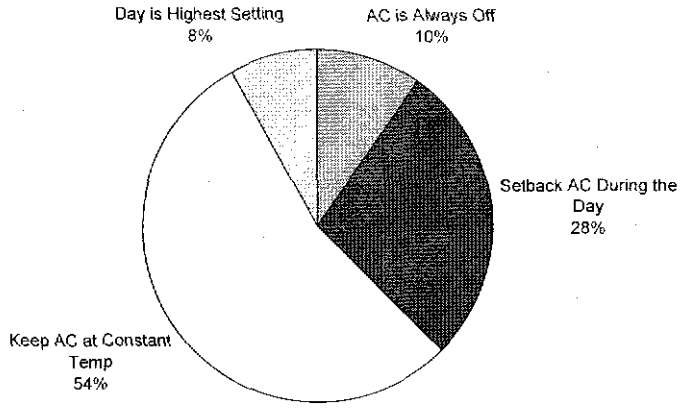


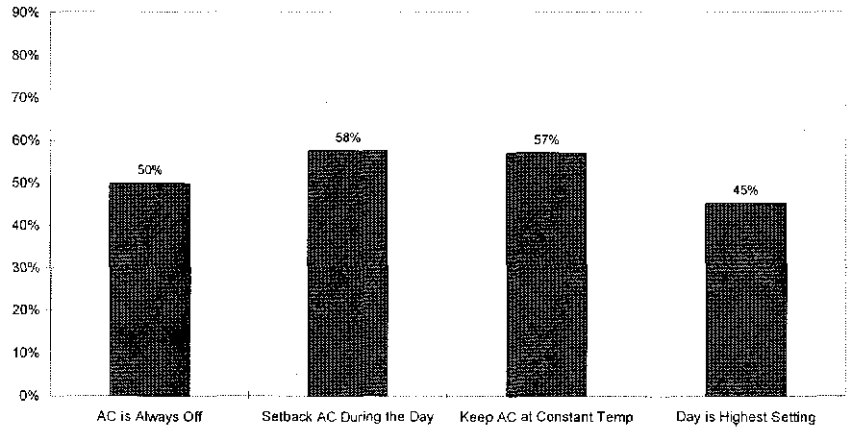
Figure 23 shows the breakdown of how customers with central air conditioning set their thermostats. Over half of all respondents reported keeping their thermostats set at a constant temperature throughout the day.

Figure 23
Air Conditioning Setback Habits



The presence of programmable thermostats slightly increases amongst those who actively setback (58%). However, the results illustrate that the presence of programmable thermostats does not appear to dramatically affect setback behaviors. Overall, 54% of dwellings have programmable thermostats (Figure 24). The average temperature setting using the midpoint of the survey ranges provided is 79.4°F in the morning, 77.4°F degrees during the day, 76.6°F in the evening, and 79.6°F at night.

Figure 24
Presence of Programmable Thermostats by Setback Habits



1.6 New Dwellings

The definition of new dwellings in this section is dwellings that are built after 1996. While the survey asked for the actual year the dwelling was built and included options for 2002 and 2003, the sample was drawn in mid to late 2002 so it best represents new construction that was in place through 2001 and into the first part of 2002. The RASS surveys were sent to customers starting in April 2003. There are a small number of dwellings reported as built in 2002 and 2003 and these are included in the new category. However, the new trends are not fully reported for 2002 and 2003 due to the sampling and surveying timelines. There are just over half a million dwellings built after 1996 which translates into five percent growth for this five year building period.

Almost two thirds of the total residential housing growth falls in just four climate zones (Figure 25). Refer to Figure 2 at the start of the report to view the geographic placement of each of these zones.

Figure 25
Distribution of New Dwellings by Energy Commission Forecast Climate Zone

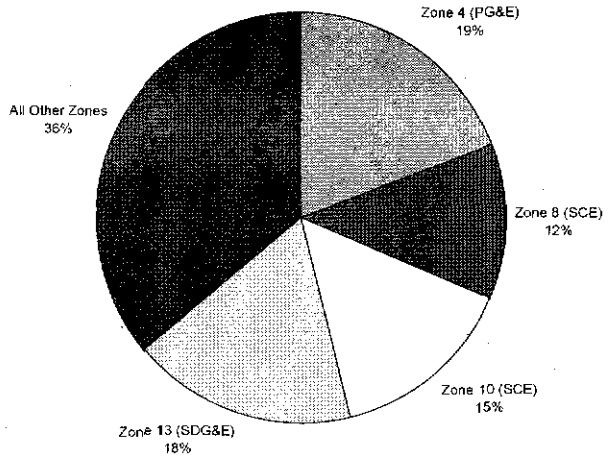
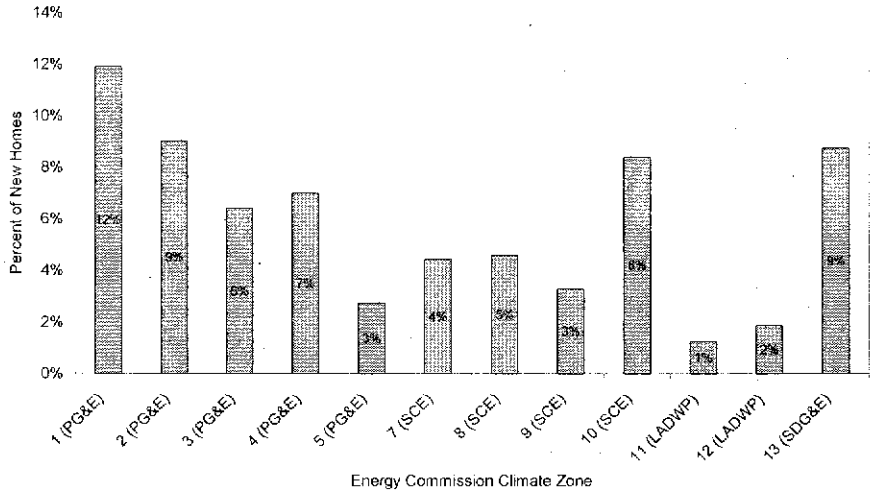


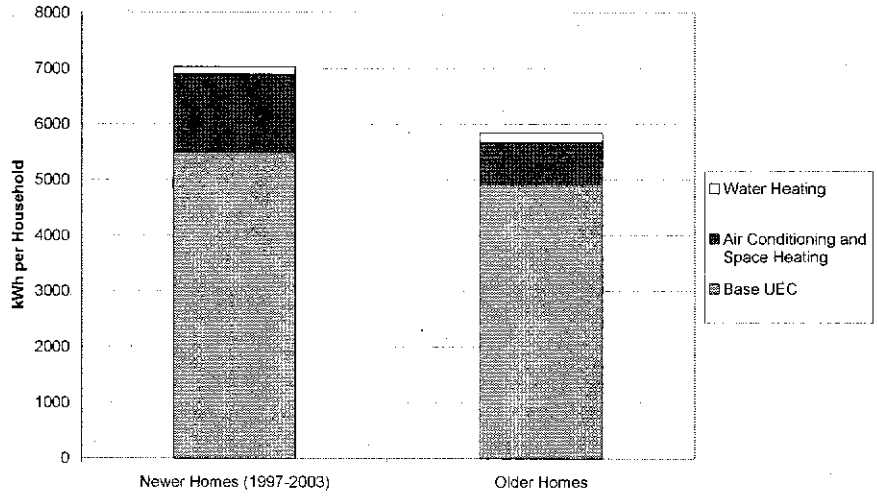
Figure 26 shows housing growth by zone as a percentage of the population in each zone. Zone 1 has the highest relative growth mostly because it is a large area with a relatively low base population that has seen solid growth in recent years.

Figure 26
Housing Growth Rate by Climate Zone



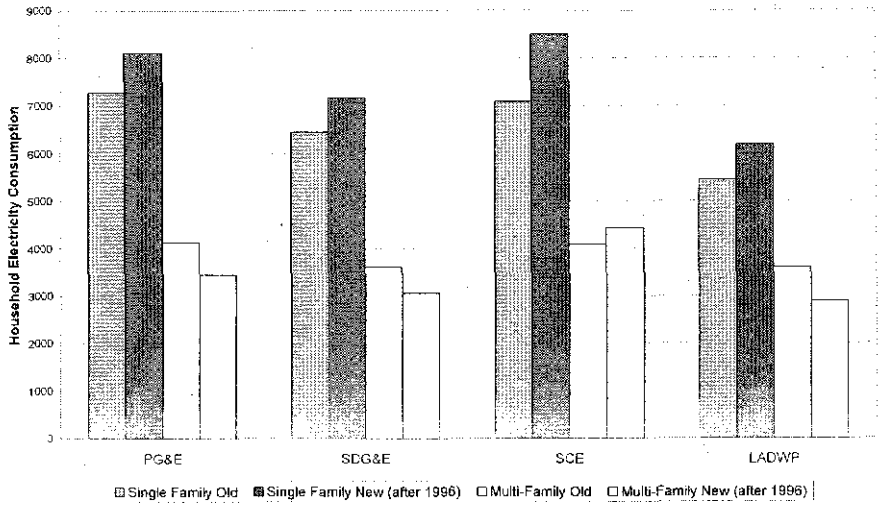
As shown in Figure 27, average electricity use in newer dwellings is 7,035 kWh per year compared to 5,846 in older dwellings. There are several factors affecting the increased usage including larger dwellings, more occupants per home, and more affluent occupants. Space conditioning shows the biggest increase because the saturation of central air conditioning in new dwellings (78%) is higher than that in older dwellings (41%).

Figure 27
Electric UECs for Newer and Older Dwellings



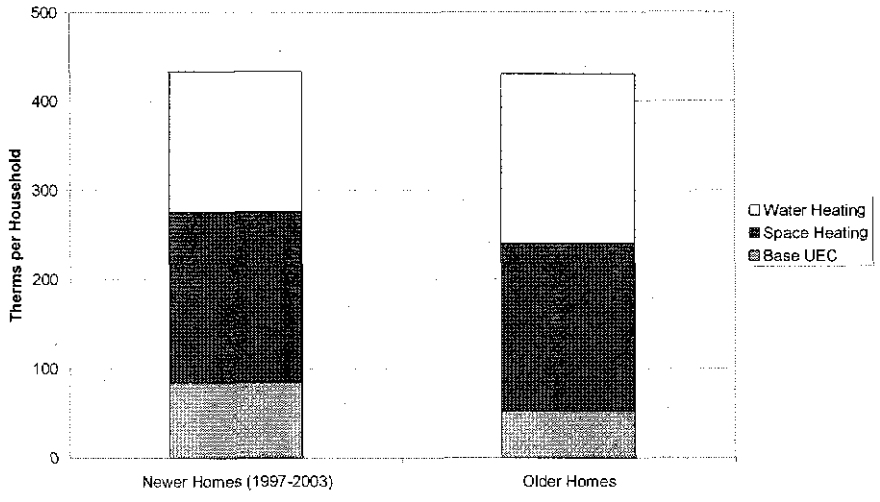
While the overall usage is shifting upwards, the increase is only occurring in single family dwellings (Figure 28). In general, new multi-family dwellings are using less energy than existing buildings with the exception of the SCE service territory.

Figure 28
Electric UECs for Newer and Older Dwellings by Dwelling Type



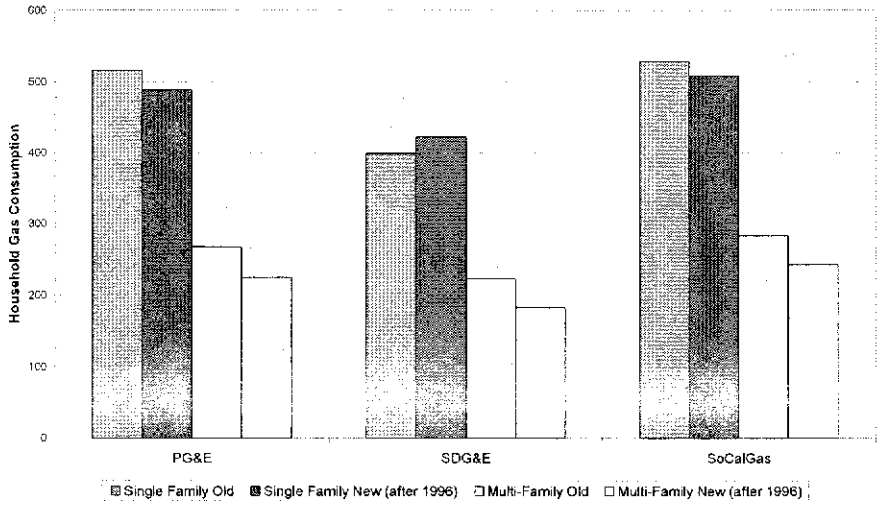
Gas shares are increasing as shown in the fuel share section (1.4). Despite this, new homes are using approximately the same amount of energy as older homes (Figure 29).

Figure 29
Natural Gas UECs for Newer and Older Dwellings



While the average gas use for new dwellings is slightly higher than older dwellings, this can be a little misleading. If you examine usage by utility and dwelling type, the average use is declining for all groups with the exception of single family homes in SDG&E (Figure 30)[7]. A higher portion of new homes are single family dwellings which in turn increases the overall statewide average gas use for new dwellings.[8]

Figure 30
Natural Gas UECs for Newer and Older Dwellings by Dwelling Type



In order to review all of the factors affecting new dwellings, Table 6 provides a comparison of the characteristics of newer and older dwellings. New dwellings are 42% larger than the average existing stock and occupied by homeowners with higher incomes. While newer dwellings have slightly lower cooling degree days than older dwelling, they have central air conditioning installed at almost double the rate of existing dwellings. The overall usage increase from older to newer dwellings is lower than might be expected using these facts alone. New dwellings use 20% more electricity and about the same amount of gas. As a counter to these upward trends, conservation equipment is going into newer dwellings at higher rates which is helping to control the rate of energy consumption growth.

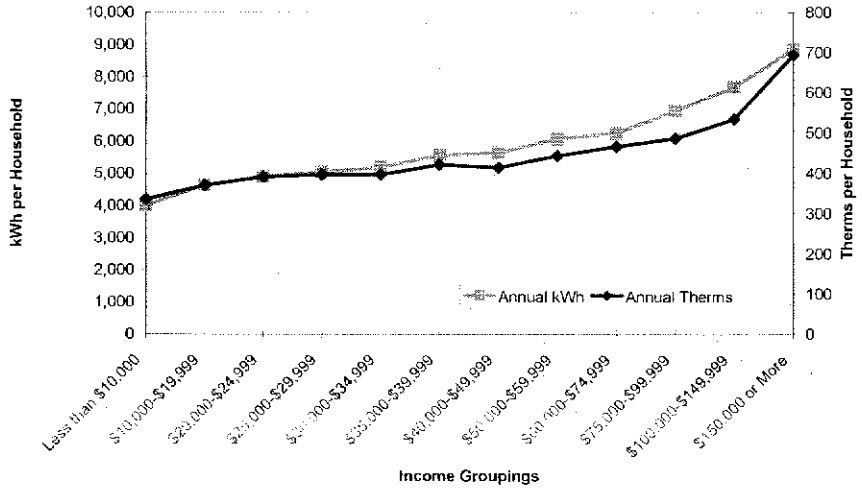
Table 6
Comparison of Newer and Older Dwellings

	Newer Dwellings (Built after 1996)	Older Dwellings	Percent Difference
Annual Electric Household Consumption	7,159	5,960	20%
Annual Gas Household Consumption	468	459	2%
Dwelling Size	2039	1,434	42%
Number of Residents	3.14	2.93	7%
Average Income	86,276	58,082	49%
Percent Single Family	74%	58%	28%
Owners	83%	62%	35%
Saturation of Central AC	78%	41%	93%
Cooling Degree Days	962	900	7%
Cooling Degree Days (those with CAC)	1,119	1,279	-13%
Programmable Cooling Thermostat	85%	47%	83%
Pool Saturation	13%	8%	59%
Average Number of Computers per Home	1.21	0.93	30%
Gas Primary Heating	86%	83%	5%
Heating Degree Days	2,050	2,023	1%
Exterior Wall Insulation Throughout	91%	51%	77%
Attic Insulation	91%	66%	38%
Double Pane Windows Throughout	79%	31%	157%
Low Flow Showerheads Throughout	71%	54%	32%
Average Number of CFLs per Home	2.29	1.74	32%
Horizontal Access Washers	13%	9%	43%

1.7 Income Effects

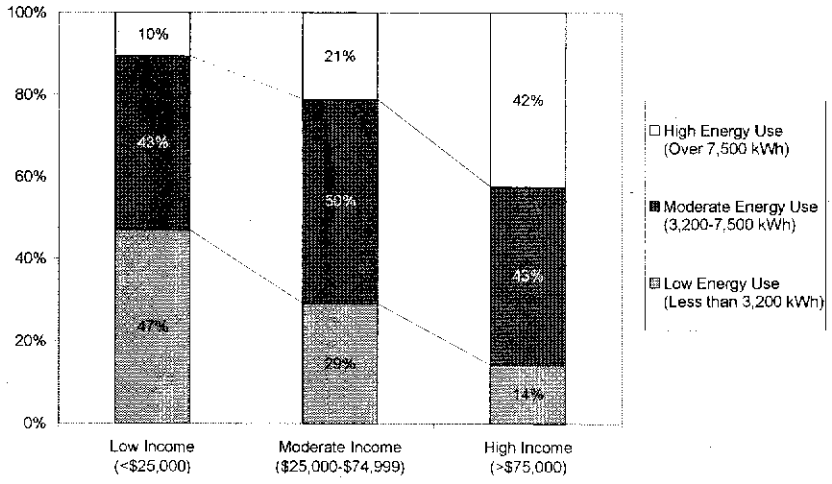
As shown in Figure 31, both electricity and natural gas usage increase as income levels increase.

Figure 31
Average Electricity and Natural Gas Use by Income



While income is strongly correlated with energy use, low usage does not imply that customers are low income (see Figure 32). By breaking electricity usage into quartiles (moderate includes the two middle quartiles for each case), it follows that 12% of the low income group has the highest energy use (over 7,500 kWh per year) while 13% of high income families use less than 3,200 kWh per year.

Figure 32
Electricity Usage Compared with Income



Overall, the income breakdown follows expected trends with respect to the fact that higher income households use more energy. This is indicated in Table 7 by the larger dwellings, increase in central air conditioning, more pools, and more computers.

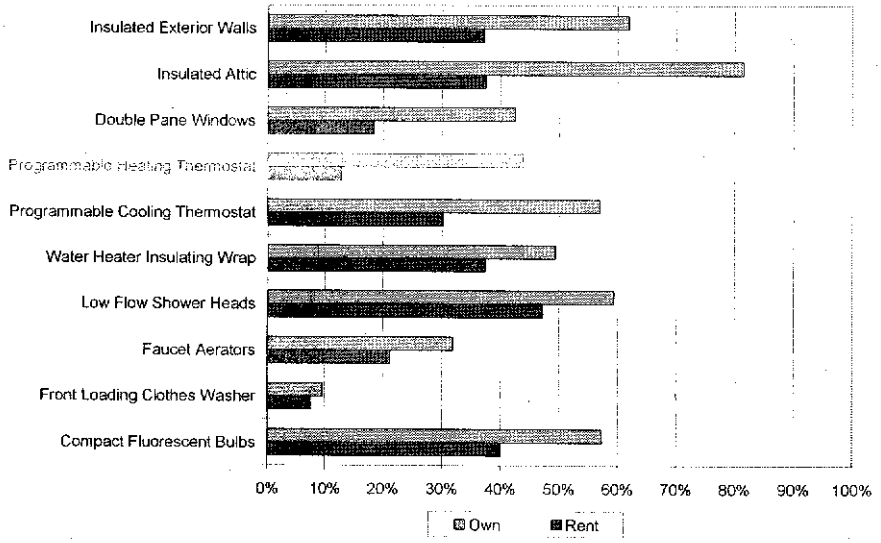
Table 7
Comparison of Households by Income

	Low Income (<$25,000)	Moderate Income ($25,000-$74,999)	High Income (>$75,000)
Percent of Population	24%	50%	26%
Dwelling Size	1,009	1,369	2,062
Dwelling Age	36.3	34.0	29.4
Percent Single Family	37%	59%	78%
Percent Own	37%	63%	86%
Number of People	2.80	2.92	3.11
Annual Electric Household Consumption	4,552	5,683	7,895
Annual Gas Household Consumption	370	430	575
Central Air Conditioning Saturation	32%	42%	54%
Gas Heating Saturation	78%	83%	88%
Pool Saturation	2%	6%	19%
Average Number of Computers per Home	0.46	0.90	1.47
Work at Home	15%	17%	27%
Programmable Heating Thermostat	14%	29%	55%
Dwellings with CFLs	42%	50%	60%

1.8 Energy Efficiency Actions and Opportunities

Energy efficiency actions are present in increasing numbers as technologies become more popular and more readily available or are required by changes in building codes. Figure 33 shows that people who own their dwelling are more likely to take energy efficiency actions than renters. Note that all actions represent the number of homes with a given efficiency improvement in place. In the case of low cost "portable" measures such as compact fluorescent bulbs, which could benefit renters directly and have a very short payback period, there is still a large relative difference in the adoption rates between owners (57%) and renters (40%).

Figure 33
Energy Efficiency Actions/Equipment by Ownership



Owners make up 63% of the population and renters the remaining 37%. Owners are predominantly in single family dwellings (79%) while renters make up 9% of townhouses, 20% of apartments with two to four units, 46% of apartments with more than five units, and 1% of mobile homes.

Figure 34 compares these same energy efficiency actions and equipment across newer and older dwellings. This comparison highlights the fact that participant knowledge of efficiency details is somewhat limited. Saturations of major measures such as insulation and double pane windows should be 100% based on building standards. The fact that they appear lower in Figure 34 is indicative of the fact that not all participants were aware of what they have in their dwellings. Personally driven efficiency actions that are not tied to a new dwelling standard such as front loading clothes washers and compact fluorescent bulbs show a much closer comparison between newer and older dwellings.

Figure 34
Energy Efficiency Actions/Equipment by Dwelling Age

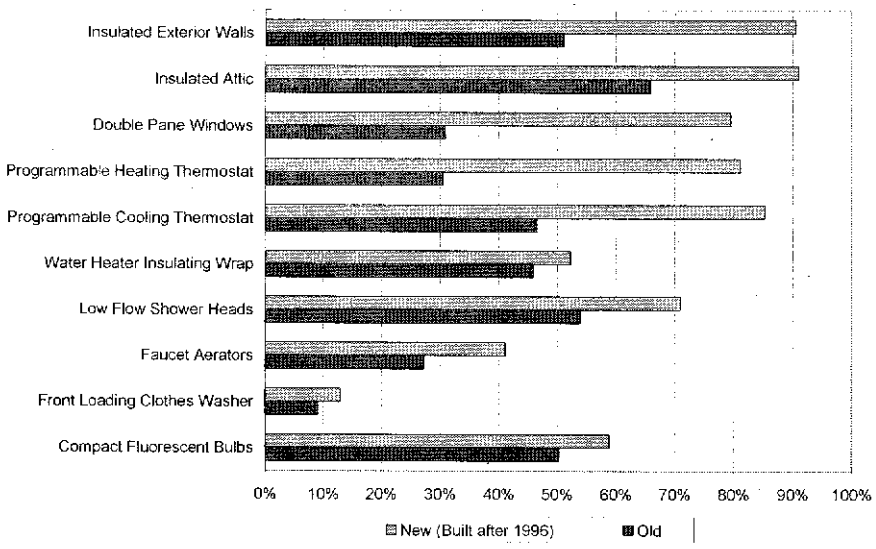
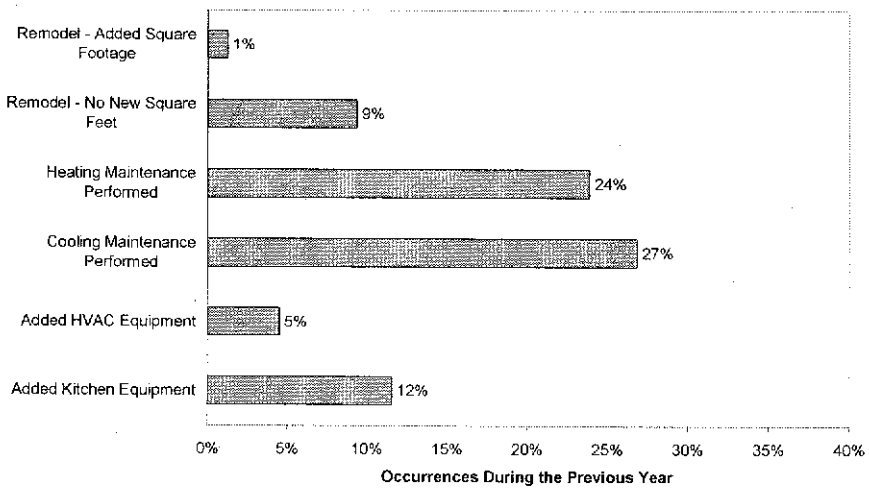


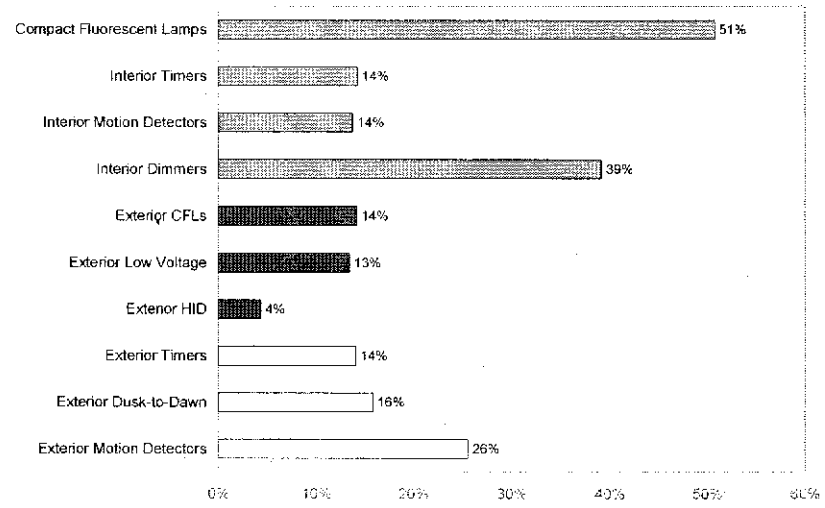
Figure 35 provides examples of opportunities for energy efficiency communication or sales with customers. On average, one in ten dwellings was remodeled in the previous 12 months. Ten percent of those dwellings included the addition of square footage. Maintenance, major equipment replacement, and kitchen appliance remodels also raise opportunities for households to increase efficiency.

Figure 35
Remodeling and Repair Opportunities



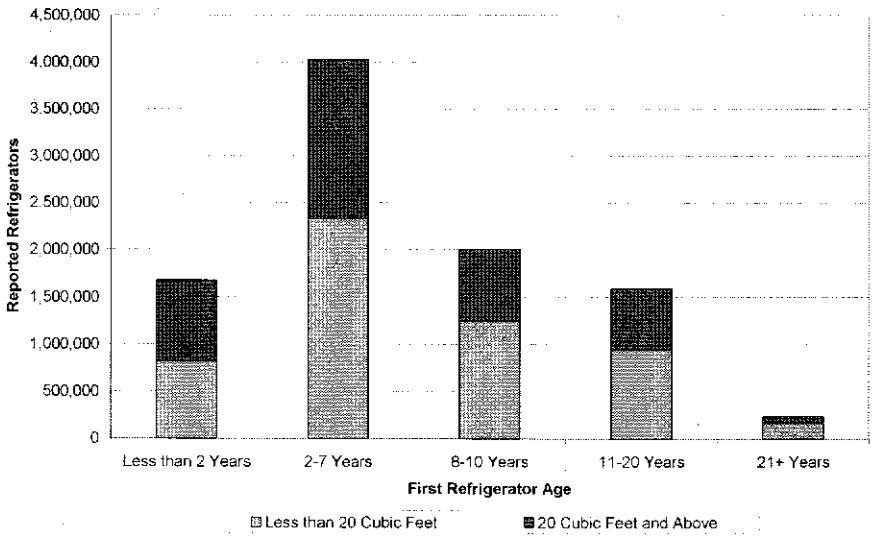
Compact fluorescent lamps (CFLs) have been heavily marketed through various program initiatives throughout the state. Interior CFLs can be found in 51% of all dwellings (Figure 36).

Figure 36
Penetration of Various Lighting Equipment and Devices



The UEC for first refrigerators is 789 kWh per household. From Figure 37, there are a total of 1.8 million refrigerators that are 11 years or older and will likely need to be replaced in the next five years. Currently, 42% of all refrigerators are over 20 cubic feet in size, however, 51% of new refrigerators fall in the over 20 cubic foot category. Six percent of all customers reported that they discarded a refrigerator in the prior twelve months.

Figure 37
First Refrigerators by Size and Age



Second and third refrigerators use an average of 1,178 kWh per unit. 18% of dwellings report at least one additional refrigeration unit. While there are almost 460 thousand additional units that are 11 years or older, there is a relatively strong market for new additional units as well (Figure 38).

Figure 38
Second and Third Refrigerators by Size and Age