CALIFORNIA STATEWIDE RESIDENTIAL APPLIANCE SATURATION STUDY UPDATE TO AIR CONDITIONING UNIT ENERGY CONSUMPTION ESTIMATES USING 2004 BILLING DATA

CONSULTANT REPORT

Prepared For:
CALIFORNIA ENERGY COMMISSION

Prepared By:
KEMA-XENERGY

June 2006
CEC-400-2006-009

Prepared By:
KEMA
Wendy Tobiasson
Oakland, California
With support from Itron

Contract No. 400-04-010

Prepared For:
California Energy Commission

Glen Sharp
Contract Manager

Glen Sharp
Project Manager

Sylvia Bender
Manager

Valerie Hall
Deputy Director

B.B. Blevins
Executive Director

CONTENTS

ILLUSTRATIONS

Abstract

The California Statewide Residential Appliance Saturation Study (RASS) was performed in late 2002, produced through 2003, and delivered in 2004. The original RASS conditional demand model used a combination of customer billing data with the responses from the customer survey to model end uses and develop unit energy consumption results for those end uses. During the original RASS analysis cycle, the project team developed air conditioning unit energy consumption (UEC) estimates that were lower than expected. In reviewing these results, it was hypothesized that these low estimates could have been the result of California's 20/20 program, which provided consumers with incentives to dramatically reduce their energy consumption.

This add-on RASS study revisited the RASS UEC results for cooling using updated billing and weather data for previous study participants. The new data is obtained for a period when the 20/20 program was not offered. Using a Statistically Adjusted Engineering (SAE) modeling approach, the follow-on RASS study included a revised model that assessed the difference in cooling usage between the old and new billing data and developed a new set of cooling and heating UECs.

Keywords

Residential, electricity consumption, air conditioning, cooling, 20/20 program, UEC, conditional demand analysis

1: INTRODUCTION

This study is a follow-up to the California Statewide Residential Appliance Saturation Study (RASS) that was performed for the California Energy Commission in 2003 and 2004. The RASS 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 was the prime consultant and Itron provided data cleaning and performed the Conditional Demand Analysis. All participants except LADWP participated in this follow-up effort.

The RASS was initiated in late 2002, produced through 2003, and delivered in early 2004. That study included direct mail solicitations followed by telephone and in-person non-response follow-up to a sample of non-respondents in an effort to minimize non-response bias by using alternative surveying techniques. The RASS was designed to allow comparison of results across utility service territories, climate zones and other variables of interest such as dwelling type, dwelling vintage, and income). The study includes results for 21,920 residential customers that were weighted to the population represented by the sponsoring utilities. The saturation results captured 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 (CDA) that calculates unit energy consumption (UEC) values for all individually metered customers.

The original RASS conditional demand model used a combination of customer billing data with the responses from the customer survey to model end uses and develop unit energy consumption results for those end uses. During the original RASS analysis cycle, the project team developed air conditioning UECs that were lower than expected. In reviewing these results, it was hypothesized that these low estimates could have been the result of California’s 20/20 program, which provided consumers with incentives to dramatically reduce their energy consumption. This add-on RASS study revisited the RASS UEC results for cooling using updated billing and weather data for previous study participants. The new data is obtained for a period when the 20/20 program was not offered. Using a Statistically Adjusted Engineering (SAE) modeling approach, the follow-on RASS study included a revised model that assessed the difference in cooling usage between the old and new billing data and developed a new set of cooling and heating UECs.

2: STUDY DESIGN

The study was designed to leverage the RASS analysis by using the individually metered RASS customers from the original RASS. The original surveys were collected through mail, phone, and onsite means. There were a total of 19,771 individually metered RASS customers.

The original RASS included a detailed sample plan with a stratified random sample and subsequent weighting of the data to the population.[i] The final database contained 21,920 responses to the RASS survey and with weights formed a statistically representative summary of the population. This follow-on study leveraged the original pool of participants and analyzed the usage changes for those who remained at their residence. The study updated customer billing data but did not include new survey data as appliance stocks and household information was not expected to vary significantly from 2002 and additional data collection was outside of the scope of the project.

The original RASS survey data, billing data and updated weather data were combined with the updated (2003-2004) electric billing data to estimate unit energy consumption. The analytical design included evaluating the differences in usage from the initial study period. The follow-up analysis included a statistically adjusted engineering (SAE) modeling approach that identified the effective differences across cooling seasons, as well as a more detailed analysis that allowed a more refined modeling of the various specific cooling enduses.

The key steps in the analysis are outlined below:

- Refresh billing data including matching to existing surveys, cleaning, and calendaring.
- Update weather data with reassessment of heating and cooling degree days to be used in revised models.
- Merge billing, survey, and weather data.
- Solve the 2002 CDA model using 2002 and updated 2003-2004 weather data to estimate the heating, cooling, and base energy usage for 2002-2004.
- Estimate SAE based CDA model using 2002-2004 billing data.
- Derive updated UECs by applying SAE model parameter estimates to normalized 2002 UECs.

3: ANALYSIS APPROACH

Billing Data

Obtaining New Billing Data

KEMA requested 2003 and 2004 billing data from participating utilities. This time period is a window in which the 20/20 program was not available. Each utility received a list of their original RASS sample frame participants. The RASS databases included generic customer identifiers to protect consumer confidentiality so each utility had an additional "key" file that allowed them to link the study participants to utility billing records. Utilities sent updated billing data to KEMA for processing.

Cleaning Billing Data

The consumption data came directly from the utility billing files. Billing records, while reasonably accurate, contained some anomalies that can be very troublesome in the application of conditional demand analysis. Billing records were inspected closely for the following problems:

- Erroneous billing days and/or read dates.
- Abnormal monthly consumption.
- Missing or zero electricity usage (the latter may indicate an inactive account).

These errors were corrected, or the observation's consumption was set equal to missing. To limit problems with short billing months that were a result of the calendaring routine, the first and last calendar month for each billing record were deleted.

While billing data was provided by billing period, the cleaning process included a summary step to create annual bill totals. These annual values are provided in the final survey and CDA database to allow for analysis using the final billing values. The electric annual pre-cleaned value is *ELEMN12*. The cleaned annualize electric usage is *ELEMNCDA*. The corresponding pre-cleaned annual gas usage is *THMMN12* and the cleaned value is *THMMNCDA*

Calendaring Billing Records

During the creation of the Billing Database, the information on energy consumption and the meter reading date was used to calendar the site's energy consumption for the month standardized to a fixed number of days per month.

Calendaring of the billing data transformed billing cycle data into monthly data. The same process was used for both the initial RASS and the follow-on analysis. Minor differences in the original database formats and the variables included in the billing databases led to slight differences in the calendaring routines used for each utility. The following steps were used to calendaring the follow-on analysis data.

- Billing histories were obtained for those customers with a survey from the original RASS effort.

- Weather data were merged onto the billing databases using the CEUS climate zones and the meter read end dates from the billing records. If the billing data had both a bill start and a bill end date, weather data were merged on for both the start and the stop dates. Heating and cooling monthly degree days were created using either the start and stop dates or the stop date of the current bill and the stop date of the previous bill.

- If the utility provided a customer identification code, the customer code was checked to determine if the customer identification was constant during the billing period. If there was a change in customers during the billing period, billing records for the final customer were retained, and the bills for previous customers were dropped from the billing database[ii].

- A daily database was created from the billing cycle data. To create the daily database, the first step was to determine the number of days in the billing period. The length of the billing period was calculated either as the difference between the start date and the end date, or the difference between the end of the previous bill and the current end date.[iii] Using the calculated number of billing days, monthly consumption and monthly heating and cooling degree days were divided equally into daily consumption and daily heating and cooling degree days. The daily consumption and degree days were deposited into a data set by their calendar day, month, and year variable that was augmented from the start of the billing period. This process spread the billing data into calendar days.

- The daily database was summed over the calendar months to create a data set with calendar monthly consumption and degree days.

- The calendared consumption and degree data was normalized to a 30.4-day month. If the billing data contained less than 10 calendar days in the month, the consumption was set to missing.

Assessing Impacts of Updated Billing Data

Because some consumers have moved or changed residences, the pool of available consumers for the analysis was reduced from the initial population. Overall, 80 percent of the original RASS consumers were available for this follow-on study.[iv] The final survey participants were weighted to the population using the initial RASS weights. The follow-up study pool represents 73 percent of the population for the participating utilities. Table 1 identifies the participants that remained in the follow-up study once new bills were matched to participant identifiers. The dropout rates were within the expected values and provide sufficient remaining customers to perform the analysis using the initial sampling plan and weighting scheme.

Table 1
Overview of Population Remaining in Study

Utility	Total Completed RASS Surveys	Population	Surveys Matched to 2003/2004 Bills	Percent of Surveys Remaining	Population Remaining	Percent of Population Remaining
PGE	9,265	4,047,698	7,463	81%	2,928,904	72%
SCE	7,979	3,857,357	6,326	79%	2,784,697	72%
SDGE	2,527	1,128,804	2,047	81%	855,648	76%
Total	**19,771**	**9,033,859**	**15,836**	**80%**	**6,569,249**	**73%**

Table 2 compares the 2002 average yearly consumption for the entire population and the portion of the population that was represented in September 2004 (those who had billing data from January 2002-September 2004). We have provided comparisons by utility and dwelling type. The purpose of this table was to assess how the customers who remain in the study might differ from those who dropped out because they moved or otherwise left their residence. In general, all groups were within a few percent of the initial average per home for that group, with a few cases that still were within five percent. Overall, we conclude that the population remaining in the study is a reasonable representation of the original 2002 RASS population.

Table 2
Comparison of Annual kWh for Population Remaining In Study

		Completed RASS Surveys		**Customers with Bills in Sept 2004**		
Utility	Grouping	Count	2002 Avg kWh	Count	2002 Avg kWh	% change in Avg kWh
PGE	*All households	9,265	6,392	7,463	6,701	105%
	MF	2,540	4,219	1,666	4,271	101%
	SF	6,725	7,439	5,797	7,486	101%
SDGE	*All households	2,527	5,736	2,047	5,984	104%
	MF	815	3,402	563	3,343	98%
	SF	1,712	6,948	1,484	7,131	103%
SCE	*All households	7,979	6,189	6,326	6,424	104%
	MF	2,474	4,304	1,612	4,401	102%
	SF	5,505	7,080	4,714	7,140	101%

*The average household UECs from the final report are: PGE – 6265, SDGE – 5445, and SCE – 6102.

Table 3 and 4 compare the 2002 monthly average kWh to the 2003 and 2004 monthly averages for those remaining in the study (those who have 2003-2004 billing data). Both tables segment consumers by those having electric cooling (central, evaporative, or room) and those without. Table 3 lists the kWh for each category, and Table 4 lists the difference in kWh between the 2002 and 2003-2004 billing data. Overall, there is an increase in average monthly consumption for both customers with and without electric cooling. This comparison was used as a first step in reviewing the billing data differences and setting up the modeling approach.

Table 3
Monthly Average kWh Comparison by Utility

	PGE						SDGE						SCE					
	2002		2003		2004		2002		2003		2004		2002		2003		2004	
Months	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool	With Elec Cool	W/o Elec Cool
Jan	659	515	650	503	697	537	687	486	650	461	696	501	581	471	566	443	612	487
Feb	610	478	613	480	644	495	628	450	624	442	659	481	537	432	543	432	578	458
Mar	571	447	582	454	588	443	589	421	602	435	616	452	509	407	525	416	551	416
Apr	548	422	571	442	593	424	555	404	580	416	611	434	498	389	511	399	566	397
May	589	408	632	425	625	416	535	386	579	402	626	420	523	376	556	387	617	392
Jun	739	407	767	419	728	418	560	382	617	403	612	426	641	381	659	391	660	395
Jul	838	412	959	428	857	427	614	395	745	416	740	450	763	393	878	420	826	420
Aug	781	419	876	427	868	439	644	401	831	435	757	465	755	398	917	426	853	424
Sep	705	423	771	426	754	441	663	407	733	431	765	466	694	397	778	415	759	428
Oct	597	434	634	436	617	450	585	413	667	433	651	458	547	394	630	414	586	419
Nov	609	476	652	491	654	501	597	443	679	457	687	500	538	417	588	446	585	458
Dec	670	518	722	545	737	559	684	492	729	510	696	555	593	463	637	505	652	500

Table 4
Difference in Monthly Average kWh by Utility

	PGE				SDGE				SCE			
	2003		2004		2003		2004		2003		2004	
Months	with ecool	w/o ecool	with ecool	w/o ecool	with ecool	w/o ecool	with ecool	w/o ecool	with ecool	w/o ecool	with ecool	w/o ecool
Jan	-9	-12	38	22	-37	-25	9	15	-16	-27	30	16
Feb	3	2	34	17	-4	-8	32	31	7	0	41	26
Mar	11	7	16	-4	13	15	27	32	15	8	41	8
Apr	23	21	45	3	25	11	56	30	13	9	68	7
May	43	17	36	9	44	16	91	34	33	11	95	16
Jun	28	12	-11	10	57	21	52	44	17	10	19	14
Jul	121	16	19	15	131	21	126	56	115	27	63	27
Aug	95	8	88	19	187	33	113	64	162	28	98	27
Sep	66	3	50	18	71	24	102	59	84	18	65	31
Oct	37	2	20	15	82	19	66	44	82	20	39	24
Nov	43	15	45	25	82	14	91	57	49	29	46	41
Dec	52	28	67	41	45	18	11	63	44	41	59	37

Weather Data

The cleaned CDA Database contains estimates of each site's normalized electric and gas whole household UEC and UECs for all end uses. The creation of these estimates required the creation of calendared energy consumption and weather data. Energy consumption was used as the dependent variable, and weather was used as one of the independent variables in the UEC models. The normalized weather, used to create the UECs, was also appended to the cleaned and CDA database. The follow-on analysis used updated weather data for the CEUS climate zones, which were used in the initial RASS as the weather stations. Each of the sample points was assigned to one of the stations and the same mapping was used for the follow-on analysis.

The 2003 and 2004 weather data was cleaned and analyzed using degree day bases for heating (65 degrees Fahrenheit) and cooling (65 degrees Fahrenheit) to identify the number of heating and cooling degree days associated with the new analysis study period. Tables 5 and 6 identify the differences in HDD and CDD for the various time periods included in both RASS study efforts; normalized data is provided for comparison. Tables 5 and 6 show differences by CEUS and Title 24 climate zones.

Table 5
CDD by Climate Zone for Years 2002-2004

T24	CEUS	cdd65 2002	cdd65 2003	cdd65 2004	cdd65 Normalized
15	15	4,487	4,538	4,327	4,407
14	14	3,116	3,450	3,193	2,985
13	13	2,363	2,316	2,151	1,945
11	11	2,225	2,004	1,876	1,695
10	102	1,558	1,880	1,533	1,479
9	9	1,152	1,581	1,352	1,249
12	12	1,302	1,384	1,243	1,089
9,16	162	1,255	1,300	949	986
8,10	8	725	1,017	1,103	930
10	101	537	868	800	680
4	4	601	637	622	552
7	7	384	622	890	523
16	161	539	602	402	361
6	6	380	575	651	483
2	2	392	409	444	352
3	32	140	228	162	130
3	31	159	225	232	90
3	33	28	98	84	17
5	5	43	85	99	32
1	1	0	11	3	0

Table 6
HDD by Climate Zone for Years 2002-2004

T24	CEUS	hdd65 2002	hdd65 2003	hdd65 2004	hdd65 Normalized
1	1	4,933	4,482	4,306	4,421
2	2	2,940	2,805	2,593	2,601
4	4	2,158	2,119	2,088	1,844
5	5	2,821	2,549	2,724	2,553
6	6	1,316	1,251	1,244	1,202
7	7	1,206	1,090	998	1,106
8,10	8	1,240	1,170	1,191	1,072
9	9	1,396	1,385	1,407	1,262
11	11	2,595	2,701	2,454	2,472
12	12	2,480	2,405	2,363	2,339
13	13	2,151	2,155	2,230	2,113
14	14	1,895	1,890	2,063	1,790
15	15	855	852	1,072	760
3	31	2,619	2,532	2,291	2,580
3	32	2,699	2,564	2,521	2,285
3	33	3,254	2,965	2,930	2,874
10	101	1,539	1,452	1,430	1,367
10	102	1,497	1,552	1,739	1,662
16	161	5,254	5,310	5,275	5,395
9,16	162	4,082	4,029	4,017	3,961

Survey Data

Review of CDA Data Cleaning Process

The original RASS data went through a detailed cleaning process to prepare it for the CDA modeling process. This multi-part process included checks and cleaning steps for missing values, logical inconsistencies, fuel misreporting, and otherwise incomplete surveys. Using the cleaned database, the CDA used a series of steps to fill and plug missing variables to allow for complete modeling.

The process for filling missing values used a multi-step approach that relied on correlations between the question with the missing response and other questions that contained valid responses. The team used this approach to fill missing values for household income, square footage of the home, number of residents, and the age of the home. These variables are in addition to the cleaned survey data and were developed primarily for use in the conditional demand analysis. In the case of other missing values such as the residence type, the plugging algorithm included a series of logistical checks with other pertinent information supplied from the respondent. The follow-on model used the same CDA cleaning steps and final cleaned CDA variables for all modeling.

Updated CDA Model

The CDA approach essentially makes use of the variation in appliance holdings and whole-house energy consumption across the study sample to econometrically disaggregate billed consumption into end use consumption values. Additional information on the original 2002 CDA model can be found in the final 2002 RASS report.

To analyze the impact of 2003-2004 billing and weather data on the original 2002 CDA model, we created a simplified CDA model using Statistically Adjusted Engineering (SAE) terms for heating, cooling and base usage. These SAE terms were developed by solving the 2002 California RASS CDA model with 2002 and updated 2003 and 2004 weather data. This approach allows us to combine multiple variables into a single variable representing an end use and thus simplifies the ensuing statistical estimation process. The parameter for these SAE terms reflects a required ratio adjustment to the engineering estimate.

Solved 2002 model using updated HDD/CDD

The first step in creating a revised model was to solve the 2002 CDA model using the updated weather data values. Using the final survey database from 2002, containing the original electric model variables, we substituted the 2002 and updated 2003-2004 CDD and HDD values into appropriate electric model terms. By solving the equation for each household, we were able to derive the average UECs for each of the end uses specified in the original model for 2002-2004. These updated terms were then used in the SAE model.

Creating SAE Terms

This section describes the process used to create the SAE terms used in the CDA modeling process. The SAE based approach was used to disaggregate whole-house electricity consumption into five end uses:

- Space Heating
- Central Air Conditioning
- Room Air Conditioning
- Evaporative Cooling
- All Remaining Household Usage (Base)

The estimated household usage for space heating, central cooling, room air conditioning, evaporative cooling and base are equal to linear combinations of the respective terms in the initial 2002 RASS electric model. As such, each of these summary SAE usage values is easily calculated by summing the appropriate terms from the 2002 electric equation. Binary variables were created representing the year an observation occurred (either 2003 or 2004). To evaluate the change in the SAE usage values over time as compared to year 2002, each of these binary variables was interacted with the SAE terms.

Space Heating

The space heating term is the estimate of the usage based on the calculated primary electric space heating specified by the 2002 RASS electric model.

$$HEATUSAGE_{ht} = EHEATUSE_{ht} DEHEAT_{h}$$

This term was then interacted with the yearly binary indicators.

$$HEATUSAGE03_{ht} = HEATUSAGE_{ht} YEAR03_{ht}$$

$$HEATUSAGE04_{ht} = HEATUSAGE_{ht} YEAR04_{ht}$$

Central Air Conditioning

The central air conditioning term is the estimate of the usage based on the central air conditioning model from the 2002 RASS electric model.

$$CACUSAGE_{ht} = CACUSE_{ht} DCAC_{h}$$

This term was then interacted with the yearly binary indicators.

$$CACUSAGE03_{ht} = CACUSAGE_{ht} YEAR03_{ht}$$

$$CACUSAGE04_{ht} = CACUSAGE_{ht} YEAR04_{ht}$$

Room Air Conditioning

This term is the estimate of the room air conditioning usage derived from the 2002 RASS electric model.

$$RACUSE_{ht} = RACUSE_{ht} DRAC_h$$

This term was then interacted with the yearly binary indicators.

$$RACUSE03_{ht} = RACUSE_{ht} YEAR03_{ht}$$

$$RACUSE04_{ht} = RACUSE_{ht} YEAR04_{ht}$$

Evaporative Cooling

The evaporative cooling estimated usage was derived from the 2002 RASS electric model.

$$EVAPUSE_{ht} = EVAPUSE_{ht} DSWAMP_h$$

This term was then interacted with the yearly binary indicators.

$$EVAPUSE03_{ht} = EVAPUSE_{ht} YEAR03_{ht}$$

$$EVAPUSE04_{ht} = EVAPUSE_{ht} YEAR04_{ht}$$

All Remaining Usage (Base)

The base usage was calculated as the sum of the remaining end uses in the 2002 RASS electric model.

$$\begin{aligned}
BASEUSE_{ht} &= EAUXHTUSE_{ht} DEAUXHT_h + FFANUSE_{ht} DFFAN_h \\
&+ EWHEATUSE_{ht} EWHFRAC_t DEWH_h \\
&+ REF1USE_{ht} DREF1_h + REF2USE_{ht} DREF2_h \\
&+ FREEZUSE_{ht} DFRZ_h + RNGEOVNUSE_{ht} DERNGOV_h \\
&+ MICWAVUSE_{ht} MICWVFRAC_t DMWV_h + DWASHUSE_{ht} DWFRAC_t DDW_h \\
&+ EDRYERUSE_{ht} DRYFRAC_t DEDRY_h + OLTUSE_{ht} DOLT_h \\
&+ TVUSE_{ht} DTV_h + EHMOFFUSE_{ht} DHMOFF_h + PCUSE_{ht} DPC_h \\
&+ PLPUMPUSE_{ht} DPLPMP_h + EPLHEATUSE_{ht} DEPLHT_h + SPAPUMPUSE_{ht} DSPA_h \\
&+ ESPAHTUSE_{ht} DESPAHT_h + WBEDHTUSE_{ht} DEWB_h + WELLPUSE_{ht} DWELLP_h \\
&+ MISCUSE_{ht}
\end{aligned}$$

The base usage was also interacted with the yearly indicators.

$$BASEUSE03_{ht} = BASEUSE_{ht} YEAR03_{ht}$$

$$BASEUSE04_{ht} = BASEUSE_{ht} YEAR04_{ht}$$

Summary of Revised SAE Based Electric Model

The SAE-based electric model is derived by summing the above usage specifications, each multiplied by a binary variable representing the presence of the electric end use in question:

$$\begin{aligned} &ELECUSE_{ht} = \\ &HEATUSAGE_{ht} DEHEAT_{h} \beta_0 + HEATUSAGE03_{ht} \beta_1 + HEATUSAGE04_{ht} \beta_2 + \\ &CACUSAGE_{ht} DCAC_{h} \beta_3 + CACUSAGE03_{ht} \beta_4 + CACUSAGE04_{ht} \beta_5 + \\ &RACUSE_{ht} DRAC_{h} \beta_6 + RACUSE03_{ht} \beta_7 + RACUSE04_{ht} \beta_8 + \\ &EVAPUSE_{ht} DSWAMP_{h} \beta_9 + EVAPUSE03_{ht} \beta_{10} + EVAPUSE04_{ht} \beta_{11} + \\ &BASEUSE_{ht} \beta_{12} + BASEUSE03_{ht} \beta_{13} + BASEUSE04_{ht} \beta_{14} \end{aligned}$$

The full 2002 electric model is presented in Table 9 and shows which variables were used to create the four SAE terms.

Table 7
2002 Electric Model

SAE Term	Variable	Parameter	SE	T-Value
	Intercept	0.0443	1.45576	0.03
HEATUSAGE	(1/EFFH)*DHEAT*HDD*AREA	0.000033	0.00005506	0.6
	(1/EFFH)*DEHEAT*HDD*AREA*DPWIN	-0.00008386	0.00006554	-1.28
	(1/EFFH)*DEHEAT*HDD*AREA*MF	-0.00112	0.00008599	-13.06
	(1/EFFH)*DEHEAT*HDD*AREA*INC	-2.90E-10	1.07E-10	-2.71
	(1/EFFH)*DEHEAT*HDD*AREA*INC *DPWIN	1.77E-10	1.26E-10	1.41
	(1/EFFH)*DEHEAT*HDD*AREA*INC*MF	2.01E-11	1.74E-10	0.12
	(1/EFFH)*DEHEAT*HDD*AREA*ROOM	-0.00003423	0.00001057	-3.24
	(1/EFFH)*DEHEAT*HDD*AREA*ROOM *DPWIN	0.00002347	0.00001292	1.82
	(1/EFFH)*DEHEAT*HDD*AREA*ROOM *MF	0.00015439	0.00001706	9.05
	(1/EFFH)*DEHEAT*HDD*AREA*SETBK	-0.00000748	0.00001155	-0.65
	(1/EFFH)*DEHEAT*HDD*AREA*SETBK *DPWIN	-0.00001515	0.00001361	-1.11
	(1/EFFH)*DEHEAT*HDD*AREA*SETBK *MF	0.00005879	0.00001799	3.27
	(1/EFFH)*DEHEAT*HDD*AREA*HTTSET	0.0000035	8.74E-07	4
	(1/EFFH)*DEHEAT*HDD*AREA*HTTSET *DPWIN	-1.64E-07	0.00000105	-0.16
	(1/EFFH)*DEHEAT*HDD*ARE*HTTSET *MF	0.00001861	0.0000014	13.26
	(1/EFFH)*DEHEAT*HDD*AREA *NONELEBK	0.00004832	0.0000063	7.67
	(1/EFFH)*DEHEAT*AREA*WINTER	0.18559	0.00632	29.37
	(1/EFFH)*DEHEAT*AREA*WINTER *MINSOFLIGHT	-0.00025469	0.00000891	-28.6
	(1/EFFH)*DEHEAT*AREA*HDD*T24	-0.00004063	0.0000074	-5.49
	(1/EFFH)*DEHEAT*HDD*SEASONAL	-0.15854	0.02977	-5.33
CACUSAGE	DCAC*CDD*AREA	0.00149	0.00003898	38.09
	DCAC*CDD*AREA*NEWHOME	0.0000485	0.00005925	0.82
	DCAC*CDD*AREA*DPWIN	-0.0001195	0.00004688	-2.55
	DCAC*CDD*AREA*MF	0.00105	0.00008713	12.1
	DCAC*CDD*AREA*INC	9.42E-11	4.38E-11	2.15
	DCAC*CDD*AREA*INC*NEWHOME	-1.68E-10	5.82E-11	-2.9
	DCAC*CDD*AREA*INC*DPWIN	1.25E-10	4.98E-11	2.5
	DCAC*CDD*AREA*INC*MF	-2.11E-09	8.78E-11	-24.01
	DCAC*CDD*AREA*TSETC	-0.00001516	4.93E-07	-30.75
	DCAC*CDD*AREA*TESTC*NEWHOME	-2.14E-07	7.53E-07	-0.28
	DCAC*CDD*AREA*TSETC*DPWIN	9.03E-07	5.93E-07	1.52
	DCAC*CDD*AREA*TSETC*MF	-0.00001014	0.00000111	-9.13
	DCAC*AREA*MINSOFLIGHT*SUMMER	0.00010001	0.0000034	29.38
	DCAC*AREA*DSWAMP*SUMMER	0.01272	0.00198	6.43
	DCAC*CDD*DSWAMP*AREA	-0.00016875	0.00000612	-27.55
	DCAC*AREA*SUMMER	-0.07495	0.00275	-27.21

SAE Term	Variable	Parameter	SE	T-Value
RACUSE	DRAC*CDD*AREA	0.00005146	0.00000754	6.82
	DRAC*CDD*AREA*DPWIN	-0.00001868	0.00000473	-3.95
	DRAC*CDD*AREA*MF	0.00001129	0.00001076	1.05
	DRAC*CDD*AREA*INC	-5.83E-10	5.72E-11	-10.2
	DRAC*CDD*AREA*TSETC	0.00001805	0.00000141	12.82
	DRAC*CDD*AREA*RACCNT	0.00001597	0.00000457	3.49
	DRAC*CDD*DSWAMP*AREA	-0.00008934	0.00000589	-15.16
EVAPUSE	DSWAMP*AREA*CDD	0.00006345	0.00000767	8.27
	DSWAMP*CDD	0.19156	0.01999	9.58
BASEUSE	DAUXHT*HDD	0.01261	0.01127	1.12
	DAUXHT *HDD*AREA	0.00003403	0.00000332	10.24
	DAUXHT *HDD*AREA*MF	-0.00001016	0.00000677	-1.5
	DAUXHT *HDD*AREA*ADDFREQ	0.00000178	1.59E-07	11.19
	DFFAN*HDD*AREA (R)	0.000023	0	Infty
	DRF1*REFUSAGE1 (R)	0.0833	0	Infty
	DRF2*REFUSAGE2	0.1366	0.00202	67.69
	DRF2*SUMMER*REFUSAGE2	-0.00404	0.00156	-2.58
	DRF2*REFUSAGE2*MF	-0.053	0.00586	-9.04
	DFRZR*FZUSAGE	0.12464	0.00219	56.79
	DEWH*FACTAWH*DWASHU	28.89343	1.02908	28.08
	DEWH*FACTAWH*CWASHU	9.98225	0.68911	14.49
	DEWH*FACTAWH*WHTSHWRS	18.4293	1.86502	9.88
	DEWH*FACTAWH*DWHSOLAR	-127.56103	11.68353	-10.92
	DEWH*ADDWHEL*FACTAWH	15.96034	3.89104	4.1
	DEWH*FACTAWH* Log(NUMI+1)	42.08176	7.24915	5.81
	DEWH*FACTAWH* Log(NUMI+1)*MF	-73.10609	3.82932	-19.09
	DEWH*FACTAWH*WHTEMP_DIFF	0.03581	0.00603	5.94
	DEWH*FACTAWH	73.0256	7.01039	10.42
	DERNGOV* Log(NUMI+1)	37.1557	5.11421	7.27
	DERNGOV* Log(NUMI+1)*INC	0.00005195	0.0000188	2.76
	DERNGOV* Log(NUMI+1)*MICRO	-5.78601	3.77348	-1.53
	DERNGOV	-22.0967	4.0174	-5.5
	DMWV *FACTAMI* Log(NUMI+1) (R)	8.33	0	Infty
	DDW* Log(NUMI+1)*FACTADW	9.89775	2.98564	3.32
	DDW*FACTADW	-6.41515	3.81725	-1.68
	DCW*FACTACW* Log(NUMI+1) (R)	37.09798	3.17859	11.67
	DCW*FACTACW (R)	-40.09798	3.17859	-12.62
	DEDRY*FACTADR*EDRYU	16.78199	0.46556	36.05
	DEDRY*FACTADR* Log(NUMI+1)	5.5022	3.53861	1.55
	DEDRY*FACTADR	-27.02423	4.17348	-6.48
	DOLT*OLTFIX*ONOCFL	-5.65594	0.57041	-9.92
	DOLT*OLTFIX*OPROPHID	5.26879	1.19711	4.4
	DOLT*OLTFIX*OPROPSENS	-4.17967	0.68911	-6.07
	DOLT*OLTFIX*OPROPTIM	11.10408	0.47871	23.2
	DOLT*OLTFIX*HRDK	2.11248	0.06226	33.93
	DOLT*OLTFIX	-20.00278	0.75837	-26.38
	DTV*TVKW*TVHRS	36.48776	0.96943	37.64
	DTV*TVKW	99.84392	6.58883	15.15
	DHMOFF*HMOFFHRS	0.80713	0.09919	8.14
	DHMOFF	-0.712	2.05713	-0.35

SAE Term	Variable	Parameter	SE	T-Value
BASEUSE (CONTINUED)	DPC*PCNUM	16.48716	1.3221	12.47
	DPC*PCNUM*PCHRS1	1.68823	0.0487	34.66
	DPC	6.52058	2.04486	3.19
	DPLPMP*PLFILT	-17.9017	1.64402	-10.89
	DPLPMP*PLFILT*PLSIZE	0.00116	0.00005773	20.06
	DPLPMP	177.43949	2.84182	62.44
	DSPA*SPAFREQ	1.8575	0.61018	3.04
	DSPA*SPAFREQ*SPASIZE	0.6434	0.11184	5.75
	DEHTSPA*SPAEHTFREQ	4.11848	0.55963	7.36
	DEHTSPA*SPAEHTFREQ*SPASIZE	-0.19491	0.11672	-1.67
	DEHTSPA*SPASIZE*SPCOV	7.22828	0.80349	9
	DEHTSPA*SPASOLAR	6.29138	17.02186	0.37
	DWB*WBEDHTN	59.92947	3.1606	18.96
	DWELLP* Log(NUMI+1)	55.41209	6.98169	7.94
	DWELLP	0.64884	9.02897	0.07
	INC	0.00030879	0.00002009	15.37
	SQFT	0.04769	0.00105	45.45
	Log(NUMI+1)	43.11824	3.05322	14.12
	NEWHOME	-42.01492	2.42332	-17.34
	MF	-8.54592	1.64028	-5.21
	SEASONAL	-142.36973	4.49941	-31.64
	DCEILF	19.19172	1.19237	16.1
	DATTFAN*CDD	0.35164	0.02095	16.79
	DATTFAN*CDD*AREA	-0.00007051	0.00000574	-12.28
	EPLHT	88.18653	13.11469	6.72

Estimate Revised Electric Model

The SAE based model was estimated using the 2002 RASS survey data and monthly billing records covering the period January 2002 through December 2004. The model was estimated using a least squares regression analysis.

The final SAE electric model estimated coefficients and their respective standard errors are presented in Table 10. The overall fit of the model was reasonably good with a R-squared value of 0.82. All the estimated coefficients take the expected sign and are statistically significant.

Table 8
Revised SAE Based Electric Model

Variable	Parameter	SE	T-Value
HEATUSAGE	1.03866	0.01491	69.68
CACUSAGE	0.99194	0.00548	180.95
RACUSE	0.92331	0.05141	17.96
EVAPUSE	0.72824	0.02921	24.93
BASEUSE	0.95178	0.00136	699.99
HEATUSAGE03	-0.08076	0.02146	-3.76
CACUSAGE03	0.05482	0.00716	7.65
RACUSE03	0.14727	0.06692	2.2
EVAPUSE03	0.13215	0.03908	3.38
BASEUSE03	0.04503	0.00192	23.4
HEATUSAGE04	0.00292	0.02113	0.14
CACUSAGE04	0.04051	0.00759	5.34
RACUSE04	0.18795	0.07096	2.65
EVAPUSE04	0.09905	0.04119	2.4
BASEUSE04	0.06282	0.00194	32.46

The first five variables (HEATUSAGE – BASEUSE) represent an adjustment to the 2002 SAE values derived from the earlier RASS model. Those variables with a –03 and –04 ending are adjustment factors that reflect the change in usage for the periods 2003 and 2004 in comparison to 2002. Focusing on the –04 values, the central cooling end use is adjusted upwards approximately 4 percent, reflecting a slight increase in air conditioning consumption in the more recent period (2004). Base usage is also adjusted upward 6 percent reflecting increased usage from that predicted by the earlier model. The room air conditioning and evaporative cooling end use show an increase of roughly 19 percent and 10 percent, respectively. Heating usage is essentially unchanged compared to the usage predicted by the earlier RASS model.

4: RESULTS

This section presents the results of the SAE based CDA analysis. Revised cooling and heating UECs were developed at the household level by applying the coefficients from the SAE based model to the 2002 estimated, calibrated and weather-normalized heating and cooling UECs only. No change was made to the non-weather sensitive or base UEC values. To provide summary values of the UEC estimates, household values were used, along with the relevant case weights, to compute weighted averages for various customer segments. While the database of household-level UECs provided to the utilities as a project deliverable can be used to develop UECs for any customer segment, we confine our attention here to the following segmentation variables: residence type (single family homes, town homes, 2-4 unit apartments, 5+ unit apartments, and mobile homes); new home versus existing homes; utility service area; and, for weather-sensitive end uses only, ENERGY COMMISSION forecasting climate zones along with residence type.

In what follows, we show the estimated electric UECs by customer segment. When analyzing these UECs, special care must be taken to account for the end use's saturation and the size of the segment. The estimated UEC for end uses with very low saturations, and/or in segments with very small populations, may not accurately represent the actual energy usage for the end use. We recommend that caution be used when examining UECs from end uses that are the result of fewer than 30 observations and that extreme care be employed if fewer than ten observations were used to calculate the segment's end use UEC. Finally, due to the statistical properties of Conditional Demand Analysis (especially the relative ease of disentangling weather-sensitive end-use consumption levels), the number of observations needed to accurately determine a segment's end use UEC will be larger for non-weather sensitive end-uses than for space conditioning and weather sensitive end-uses.

Estimated Electric UECs

Estimated, calibrated, and weather-normalized electric UECs, segment frequencies, and the associated saturations are presented in Tables 12 through 24.

- Table 9 provides a comparison of the 2002 estimated UECS to the revised values. Table 10 presents a comparison by service area.
- Tables 11 and 12 provide a comparison of weather-sensitive end uses by Energy Commission Forecasting Climate Zone.
- Tables 13 through 15 provide a comparison of weather-sensitive end uses by Title 24 weather zones.
- Table 16 provides weather-sensitive UECs, segment frequencies, and the associated saturations by residence type.

- Tables 17 and 18 provide estimates by structural vintage (dwelling age).
- Table 19 presents estimates by service area.
- Tables 20 and 21 provide estimates of weather-sensitive end uses by Energy Commission Forecasting Climate Zone.
- Finally, Tables 24 through 31 present UECs, segment frequencies, and saturations of end uses by Energy Commission Forecasting Climate Zone and residence type.

These UEC estimates are discussed in more detail in the original RASS report. As discussed above, be careful when interpreting the UEC estimates for smaller segments with low saturations.

We will focus our brief discussion of the results on the heating and cooling UEC values only, as these are the only values that were revised from the original calibrated and normalized 2002 results.

Space Heating

Revised UECs were developed for both conventional (resistance) electric space heating and heat pump space heating. As shown in Table 9, the increase in the weather-normalized space heating increases from 871 kWh to 874 kWh annually. This is a 0.3 percent increase in space heating.

Air Conditioning

Three revised air conditioning UECs were developed: central air conditioning, room air conditioning, and evaporative coolers. Central air conditioning shows an overall increase of 4 percent. Although these values are still lower than expected based on previous research related to residential usage, it may be that the effects of the 20/20 program or overall increase in energy conservation awareness are still having an effect on customer behavior. Both room air conditioning and evaporative cooling are higher than the estimated 2002 values with a 15 percent increase in room air conditioning and a 9 percent increase in evaporative cooling.

Table 9
Overall Comparison of 2002 and Revised UEC

	2002 UEC	Revised UEC
All Household	5,914	6,273
Conv. Eheat	871	874
HP Eheat	588	590
Central Air	1,236	1,286
Room Air	181	214
Evap Cooling	622	684

Table 10
Comparison of 2002 and Revised UEC by Utility

	PG&E		SDG&E		SCE		LADWP	
	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC
All Household	6,265	6,645	5,445	5,777	6,102	6,473	4,071	4,322
Conv. Eheat	1,113	1,116	581	583	734	736	542	544
HP Eheat	799	802	458	459	555	557	201	201
Central Air	1,108	1,153	644	671	1,494	1,554	1,075	1,119
Room Air	181	215	63	75	202	240	158	188
Evap Cooling	469	516	277	305	797	875	372	409

Table 11
Comparison of 2002 and Revised UECs in Forecast Zones 1-7

	Forecast 1		Forecast 2		Forecast 3		Forecast 4		Forecast 5		Forecast 7	
	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC
All Household	7,519	7,970	6,668	7,068	7,052	7,476	6,544	6,943	4,971	5,275	7,088	7,517
Conv. Eheat	1,580	1,585	1,306	1,310	1,232	1,236	1,107	1,111	915	918	1,235	1,238
HP Eheat	1,225	1,229	664	666	1,148	1,151	605	607	572	573	953	956
Central Air	941	980	1,082	1,125	1,548	1,611	885	921	226	235	1,902	1,979
Room Air	106	126	176	209	326	388	94	111	20	24	247	294
Evap Cooling	313	344	375	412	618	680	320	352	46	50	606	666

Table 12
Comparison of 2002 and Revised UEC in Forecast Zones 8-13

	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC
All Household	5,417	5,750	5,660	6,007	7,529	7,978	3,736	3,969	4,849	5,142	5,445	5,777
Conv. Eheat	571	573	837	840	969	972	560	562	515	517	581	583
HP Eheat	445	446	495	497	769	772	177	178	254	255	458	459
Central Air	848	883	1,509	1,570	1,908	1,985	915	952	1,169	1,216	644	671
Room Air	126	150	215	255	262	312	153	182	164	194	63	75
Evap Cooling	286	315	772	848	934	1,027	369	405	379	416	277	305

Table 13
Comparison of 2002 and Revised UEC in T24 Zones 1-6

	T24 Zone 1		T24 Zone 2		T24 Zone 3		T24 Zone 4		T24 Zone 5		T24 Zone 6	
	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC
All Household	4,944	5,247	6,383	6,774	5,004	5,310	6,217	6,597	6,254	6,634	5,034	5,344
Conv. Eheat	1,479	1,484	1,548	1,553	969	972	959	962	1,364	1,368	577	579
HP Eheat	1,169	1,172	1,079	1,082	594	596	527	528	650	652	406	407
Central Air	64	66	415	432	155	161	582	605	88	92	506	526
Room Air	0	0	47	56	17	20	75	89	6	8	69	82
Evap Cooling	0	0	128	141	43	47	219	241	8	9	192	211

Table 14
Comparison of 2002 and Revised UEC in T24 Zones 7-12

	T24 Zone 7		T24 Zone 8		T24 Zone 9		T24 Zone 10		T24 Zone 11		T24 Zone 12	
	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC
All Household	4,923	5,226	4,901	5,205	5,228	5,547	6,898	7,311	8,020	8,505	6,964	7,384
Conv. Eheat	483	484	567	568	642	644	909	911	1,102	1,106	1,209	1,213
HP Eheat	289	289	365	367	255	256	638	640	1,183	1,187	769	772
Central Air	511	531	904	940	1,269	1,320	1,336	1,390	1,556	1,619	1,089	1,133
Room Air	55	66	136	161	199	237	206	244	316	375	167	199
Evap Cooling	166	182	279	307	409	450	499	548	619	680	380	418

Table 15
Comparison of 2002 and Revised UEC in T24 Zones 13-16

	T24 Zone 13		T24 Zone 14		T24 Zone 15		T24 Zone 16	
	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC	2002 UEC	Revised UEC
All Household	7,219	7,649	8,531	9,041	8,614	9,103	7,244	7,692
Conv. Eheat	1,350	1,354	1,298	1,302	444	446	1,930	1,936
HP Eheat	962	965	552	553	417	418	1,390	1,394
Central Air	1,741	1,812	2,648	2,755	3,473	3,613	771	802
Room Air	329	391	360	428	277	329	106	126
Evap Cooling	700	770	1,205	1,324	1,626	1,787	394	434

Table 16
Electric UECS, by Residence Type

	Single Family		Town Home		2-4 Unit Apt		5+ Unit Apt		Mobile Home	
	UEC	Sat.	UEC	Sat.	UEC	Sat.	UEC	Sat.	UEC	Sat.
All Household	7,538	13,824 homes	4,740	1,780 homes	4,113	1,608 homes	4,036	3,377 homes	6,014	563 homes
Conv. Eheat	1,498	0.04	726	0.06	589	0.15	660	0.23	1,153	0.10
HP Eheat	1,076	0.01	394	0.01	316	0.02	340	0.05	1,034	0.03
Central Air	1,480	0.46	742	0.41	1,060	0.28	779	0.32	1,189	0.39
Room Air	270	0.15	176	0.14	143	0.16	125	0.22	270	0.34
Evap Cooling	757	0.05	654	0.02	411	0.02	443	0.02	590	0.27

Table 17
Electric UEC by House Age

	New House		Old House	
	UEC	Saturation	UEC	Saturation
All Household	7,451	1,393 homes	6,202	19,760 homes
Conv. Eheat	1,171	0.05	864	0.09
HP Eheat	415	0.01	596	0.02
Central Air	1,468	0.77	1,264	0.39
Room Air	358	0.06	212	0.17
Evap Cooling	1,114	0.01	677	0.04

Table 18 lists the whole household electric UEC by utility and residence type. These calculations show that the statewide increase in electricity usage in newer homes is primarily a result of the increased usage in single family homes. All four electric utilities experienced an increase in electricity usage in newer single family homes. Three of the four utilities, however, have a reduction in usage for newer multi-family homes (town homes, 2-4 unit apartments, and 5+ unit apartments) as compared to their existing multi-family housing stock. New home comparisons were an important area of discussion in the original RASS and details about those comparisons are found in the executive summary of that document as well as the detailed final report.

Table 18
Electric Household UEC by House Age, Utility and Residence Type

	New House		Old House	
	Household UEC	Count	Household UEC	Count
All	7,451	1,393	6,202	19,760
All PG&E	7,429	689	6,593	8,576
SF PG&E	8,602	537	7,721	5,926
MF PG&E	3,630	145	4,383	2,395
All SDG&E	6,723	199	5,686	2,328
SF SDG&E	7,604	163	6,853	1,515
MF SDG&E	3,242	36	3,830	779
All SCE	8,106	468	6,385	7,511
SF SCE	8,998	354	7,515	4,895
MF SCE	4,695	104	4,336	2,370
All LADWP	3,409	37	4,335	1,345
SF LADWP	6,499	8	3,819	426
MF LADWP	3,058	28	4,714	909

Table 19
Electric UECs by Utility

	PG&E		SDG&E		SCE		LADWP	
	UEC	Saturation	UEC	Saturation	UEC	Saturation	UEC	Saturation
All Household	6,645	9,265 homes	5,777	2,527 homes	6,473	7,979 homes	4,322	1,382 homes
Conv. Eheat	1,116	0.10	583	0.13	736	0.06	544	0.09
HP Eheat	802	0.02	459	0.03	557	0.01	201	0.03
Central Air	1,153	0.39	671	0.35	1,554	0.48	1,119	0.29
Room Air	215	0.14	75	0.09	240	0.20	188	0.25
Evap Cooling	516	0.05	305	0.01	875	0.05	409	0.02

Table 20
Electric UEC for Weather Sensitive End Uses in Forecast Zones 1-7

	Forecast 1		Forecast 2		Forecast 3		Forecast 4		Forecast 5		Forecast 7	
	UEC	Sat.	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	7,970	780 homes	7,068	804 homes	7,476	1,676 homes	6,943	3,314 homes	5,275	2,691 homes	7,517	384 homes
Conv. Eheat	1,585	0.15	1,310	0.08	1,236	0.09	1,111	0.09	918	0.13	1,238	0.01
HP Eheat	1,229	0.03	666	0.04	1,151	0.02	607	0.01	573	0.02	956	0.00
Central Air	980	0.41	1,125	0.69	1,611	0.67	921	0.42	235	0.06	1,979	0.57
Room Air	126	0.18	209	0.24	388	0.25	111	0.12	24	0.04	294	0.12
Evap Cooling	344	0.11	412	0.05	680	0.12	352	0.03	50	0.00	666	0.26

Table 21
Electric UECs for Weather Sensitive End Uses in Forecast Zones 8 to 13

	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
	UEC	Sat.	UEC	Sat	UEC	Sat	UEC	Sat.	UEC	Sat	UEC	Sat
All Household	5,750	3,175 homes	6,007	2,461 homes	7,978	1,959 homes	3,969	951 homes	5,142	431 homes	5,777	2,527 homes
Conv. Eheat	573	0.08	840	0.05	972	0.05	562	0.07	517	0.12	583	0.13
HP Eheat	446	0.01	497	0.01	772	0.01	178	0.03	255	0.03	459	0.03
Central Air	883	0.36	1,570	0.40	1,985	0.74	952	0.15	1,216	0.61	671	0.35
Room Air	150	0.15	255	0.26	312	0.21	182	0.19	194	0.39	75	0.09
Evap Cooling	315	0.01	848	0.03	1,027	0.12	405	0.02	416	0.02	305	0.01

Table 22
Space Conditioning Electric UEC for Single Family Residences in Forecast Zones 1-7

Residence 1	Forecast 1		Forecast 2		Forecast 3		Forecast 4		Forecast 5		Forecast 7	
Single Family	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	9,152	607 homes	7,836	653 homes	8,623	1208 homes	7,869	2409 homes	6,423	1586 homes	7,906	288 homes
Conv. Eheat	1,775	0.14	1,861	0.03	1,557	0.08	1,672	0.03	1,644	0.03	1,477	0.01
HP Eheat	1,309	0.03	1,106	0.02	1,312	0.02	1,194	0.00	1,221	0.01	1,407	0.00
Central Air	1,044	0.44	1,262	0.72	1,820	0.70	1,095	0.43	289	0.09	2,066	0.56
Room Air	139	0.17	250	0.22	484	0.21	131	0.12	29	0.05	312	0.11

Table 23
Space Conditioning Electric UEC for Single Family Residences in Forecast Zones 8-13

Residence 1	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
Single Family	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	6,900	1850 homes	7,173	1692 homes	8,850	1419 homes	5,226	295 homes	7,927	139 homes	6,937	1678 homes
Conv. Eheat	1,155	0.01	1,200	0.03	1,554	0.03	1,118	0.03	1,441	0.01	1,186	0.04
HP Eheat	1,111	0.00	1,250	0.00	896	0.01	.	0.00	515	0.00	754	0.02
Central Air	1,164	0.36	1,742	0.49	2,020	0.76	1,688	0.17	1,785	0.82	816	0.38
Room Air	211	0.12	292	0.27	351	0.18	396	0.16	269	0.15	100	0.07

Table 24
Space Conditioning Electric UEC for Town Homes in Forecast Zones 1-7

Residence 2	Forecast 1		Forecast 2		Forecast 3		Forecast 4		Forecast 5		Forecast 7	
Town Home	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	3,683	25 homes	4,780	40 homes	4,777	70 homes	5,249	304 homes	4,545	281 homes	5,653	16 homes
Conv. Eheat	.	0.00	1,534	0.05	487	0.12	1,077	0.05	844	0.06	.	0.00
HP Eheat	680	0.04	403	0.05	507	0.02	.	0.00	.	0.00	158	0.04
Central Air	685	0.65	648	0.43	949	0.51	520	0.59	149	0.07	995	0.80
Room Air	29	0.01	62	0.15	291	0.44	60	0.07	7	0.01	171	0.32

Table 25
Space Conditioning Electric UEC for Town Homes in Forecast Zones 8-13

Residence 2	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
Town Home	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All HHold	5,013	353 homes	4,478	212 homes	6,007	109 homes	3,628	89 homes	4,934	51 homes	4,173	230 homes
Conv. Eheat	625	0.06	827	0.05	946	0.09	396	0.09	185	0.02	551	0.08
HP Eheat	361	0.02	346	0.01	368	0.01	.	0.00	670	0.02	278	0.01
Central Air	544	0.47	907	0.44	1,576	0.84	912	0.04	1,109	0.62	370	0.28
Room Air	92	0.19	283	0.20	190	0.29	347	0.09	168	0.43	59	0.07

Table 26
Space Conditioning Electric UEC for 2-4 Unit Apartments in Forecast Zones 1-7

Residence 3	Forecast 1		Forecast 2		Forecast 3		Forecast 4		Forecast 5		Forecast 7	
2-4 Unit Apt	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	3,126	45 homes	4,531	38 homes	4,164	98 homes	4,971	181 homes	3,843	278 homes	8,532	22 homes
Conv. Eheat	207	0.11	1,038	0.23	711	0.15	923	0.19	816	0.15	369	0.06
HP Eheat	.	0.00	206	0.17	800	0.01	598	0.06	446	0.00	.	0.00
Central Air	754	0.22	538	0.79	969	0.58	555	0.32	107	0.01	2,932	0.68
Room Air	94	0.03	66	0.20	209	0.30	73	0.09	17	0.03	293	0.17

Table 27
Space Conditioning Electric UEC for 2-4 Unit Apartments in Forecast Zones 8-13

Residence 3	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
2-4 Unit Apt	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	4,374	294 homes	3,609	159 homes	5,516	107 homes	3,353	168 homes	4,083	40 homes	3,573	179 homes
Conv. Eheat	489	0.21	493	0.05	312	0.17	269	0.05	336	0.06	343	0.26
HP Eheat	359	0.02	133	0.03	557	0.00	132	0.03	49	0.00	223	0.02
Central Air	476	0.26	1,106	0.19	2,420	0.69	869	0.05	1,295	0.60	369	0.27
Room Air	127	0.13	205	0.21	196	0.22	91	0.15	155	0.40	41	0.14

Table 28
Space Conditioning Electric UEC for 5+ Unit Apartments in Forecast Zones 1-7

Residence 4	Forecast 1		Forecast 2		Forecast 3		Forecast 4		Forecast 5		Forecast 7	
5+ Apt	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	3,704	51 homes	4,358	63 homes	4,533	159 homes	4,439	381 homes	3,964	526 homes	4,563	20 homes
Conv. Eheat	954	0.22	1,008	0.26	659	0.07	936	0.33	813	0.36	1,299	0.04
HP Eheat	912	0.04	314	0.02	638	0.02	435	0.04	445	0.06	547	0.02
Central Air	689	0.33	573	0.45	1,132	0.76	397	0.31	97	0.05	1,404	0.80
Room Air	76	0.09	129	0.40	196	0.19	75	0.20	15	0.04	258	0.09

Table 29
Space Conditioning Electric UEC for 5+ Unit Apartments in Forecast Zones 8-13

Residence 4	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
5+ A[t	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	3,986	652 homes	3,694	355 homes	4,950	175 homes	3,428	396 homes	4,689	193 homes	3,761	406 homes
Conv. Eheat	542	0.20	499	0.10	468	0.13	540	0.11	536	0.18	415	0.38
HP Eheat	392	0.04	373	0.02	296	0.02	188	0.06	243	0.05	263	0.07
Central Air	524	0.35	895	0.19	1,785	0.74	539	0.21	928	0.55	339	0.32
Room Air	102	0.23	144	0.28	195	0.27	99	0.24	201	0.46	56	0.15

Table 30
Space Conditioning Electric UEC for Mobile Homes in Forecast Zones 1-7

Residence 5	Forecast 1		Forecast 2		Forecast 3		Forecast 4		Forecast 5		Forecast 7	
Mobile Home	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	6,766	52 homes	8,650	10 homes	6,723	141 homes	7,432	39 homes	5,010	20 homes	5,397	38 homes
Conv. Eheat	1,530	0.29	3,101	0.10	975	0.12	1,647	0.06	1,122	0.12	.	0.00
HP Eheat	1,099	0.02	926	0.04	1,059	0.08	.	0.00	583	0.05	.	0.00
Central Air	652	0.11	838	0.90	1,214	0.45	532	0.13	192	0.30	1,050	0.40
Room Air	96	0.58	.	0.00	299	0.48	101	0.10	21	0.05	246	0.17

Table 31
Space Conditioning Electric UEC for Mobile Homes in Forecast Zones 8-13

Residence 5	Forecast 8		Forecast 9		Forecast 10		Forecast 11		Forecast 12		Forecast 13	
Mobile Home	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat	UEC	Sat
All Household	3,759	26 homes	5,110	43 homes	5,963	149 homes	5,207	3 homes	4,592	8 homes	4,562	34 homes
Conv. Eheat	692	0.02	1,193	0.03	943	0.02	.	0.00	.	0.00	905	0.23
HP Eheat	.	0.00	1,499	0.00	788	0.01	.	0.00	.	0.00	.	0.00
Central Air	864	0.28	1,178	0.49	1,644	0.47	512	0.36	840	0.50	575	0.35
Room Air	338	0.07	102	0.13	355	0.45	.	0.00	294	0.25	103	0.03

ENDNOTES

[i] The total population[i] was split into 105 strata based on electric utility, age of home, presence of electric heat, home type, and Energy Commission forecast climate zone.

[ii] SCE and SDG&E provided customer identification variables. The RASS survey was in the field during the spring of 2003. For residences with a change in customers, the final customer was retained in an attempt to correctly match survey information with billing data. DWP and PG&E did not provide a customer identifier on their billing databases.

[iii] PG&E and SCG provided bill start and end dates. For SCE and SDG&E only end dates are identified. If the start date of the billing cycle was not provided, the start date was calculated as the end date minus the number of billing days in the billing cycle.

[iv] Only those customers with billing data from January 2002 through September 2004 were included in this analysis.