LG&E AND KU
ENERGY EFFICIENCY PROGRAM PLAN

Volume IV

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Exhibit H

SUMMIT BLUE
CONSULTING, LLC

Memorandum

To: **Jason Knoy**

Cc: Mike Hornung, John Hayden, Jeff Erickson, Floyd Keneipp

From: Stuart Schare and Erik Gilbert

Date: November 24, 2009

RE: Marketing of E.ON's residential DLC programs to increase participation

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This memo provides a brief overview of the activities, findings, and recommendations from Summit Blue's review of residential direct load control (DLC) program participation rates and marketing efforts. Per the initial discussions between Stuart Schare of Summit Blue and Jason Knoy of E.ON, this was intended to be a limited effort to obtain readily available data and to discern from program managers of some leading utility DLC programs the keys to increasing participation.

Summary

Available data on program participation rates suggest that E.ON's programs are relatively well-subscribed and that the "low-hanging fruit" has already been picked. Thus, it is certainly reasonable to expect that a rapid increase in new enrollments will be difficult to achieve. Measured against other programs in the U.S., E.ON's growth goals are ambitious and additional marketing efforts and incentives may be needed to attract significantly greater participation.

Research Activities

Summit Blue leveraged the firm's existing base of relevant projects and contacts, and individuals' personal knowledge of direct load control programs, to provide support for E.ON's DSM filing. Specifically, the following activities were conducted:

1. **Review and update of existing information on residential DLC programs demonstrating typical participation rates.** Previously compiled information on more than a dozen DLC programs was used to pull the relevant data on participation rates as a percent of eligible customers and of total customers. Two sources were utilized:
    a. A Summit Blue data appendix from a confidential 2007 report covering 14 DLC programs, including participation as a share of eligible customers and total residential customers.
    b. A 2008 Esource "brief"entitled "Market Penetration Rates for Residential Load Control Programs," which provides participation as a share of total residential customers only.

2. **Interviews with program managers at 3 utilities with highly subscribed DLC programs, including:**
    a. Xcel Energy – Minnesota (Patrik Ronnings)
    b. Xcel Energy – Colorado (Peter Narog)
    c. SMUD – (Craig Sherman)

    Topics addressed included:
    a. Confirmation of participation levels, customer population, and eligible customer population
    b. Confirm incentive levels, both initial sign-up and annual, and whether this has changed
    c. Discussion of marketing and branding
    d. Keys to success, barriers to participation, and whether they are reaching saturation

Findings

Research findings are presented separately for each of the two major research activities discussed above:

1. Review of DLC program participation data

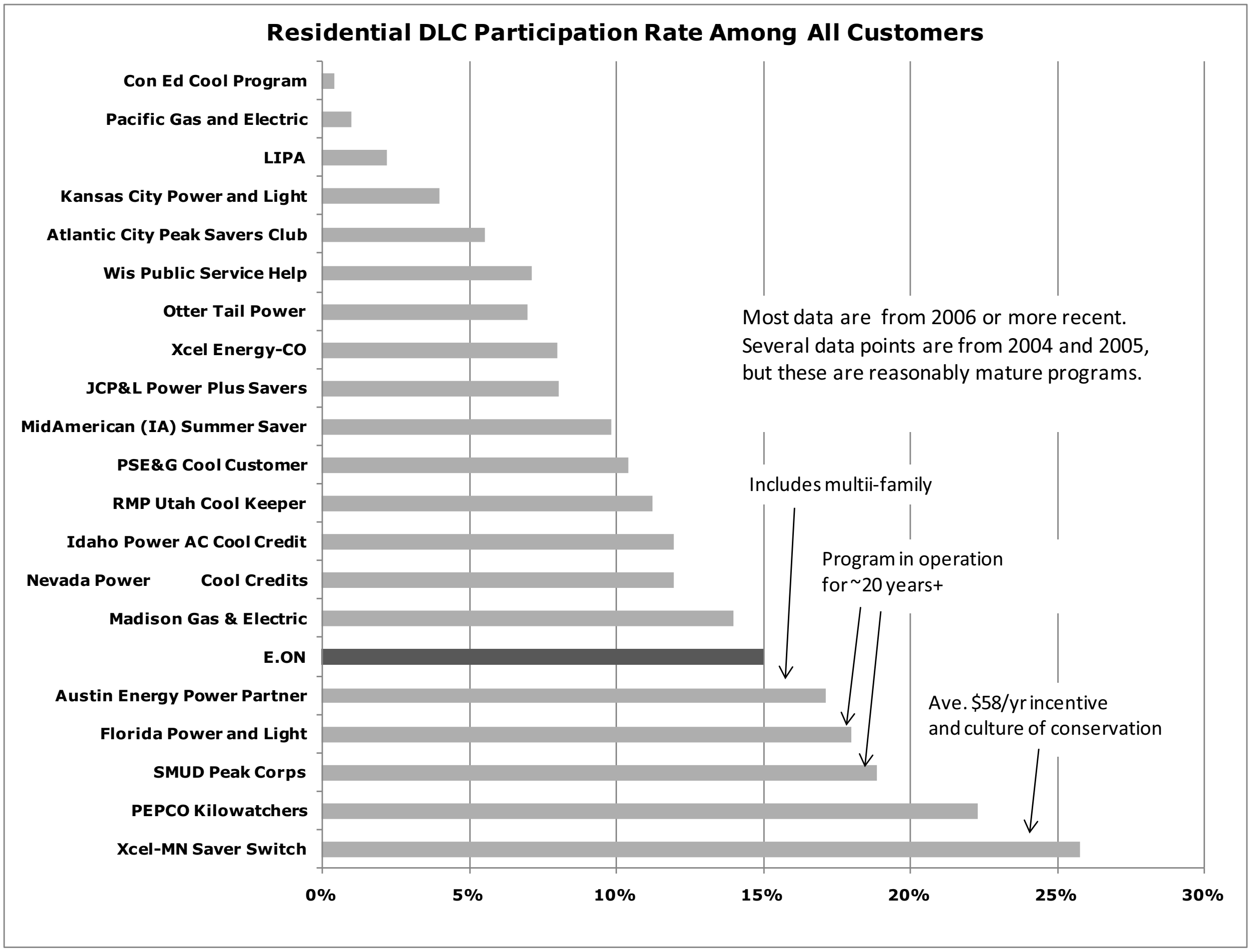
2. Interviews with DLC program managers

Review of DLC program participation data

DLC program data indicate that E.ON has achieved penetration rates among the highest in the country. Not all programs in the country are included in the available data, but most of the larger, more actively promoted programs were selected by Summit Blue and Esource in past research. Therefore, the "missing" programs are likely to have participation rates lower than the programs highlighted below.

Figure 1 shows participation rate for 21 utility DLC programs among ALL customers, whether they are eligible to participate or not. Only five of the other 20 utility programs have participation rates higher than at E.ON, and most of these are longer-running programs with higher incentives.

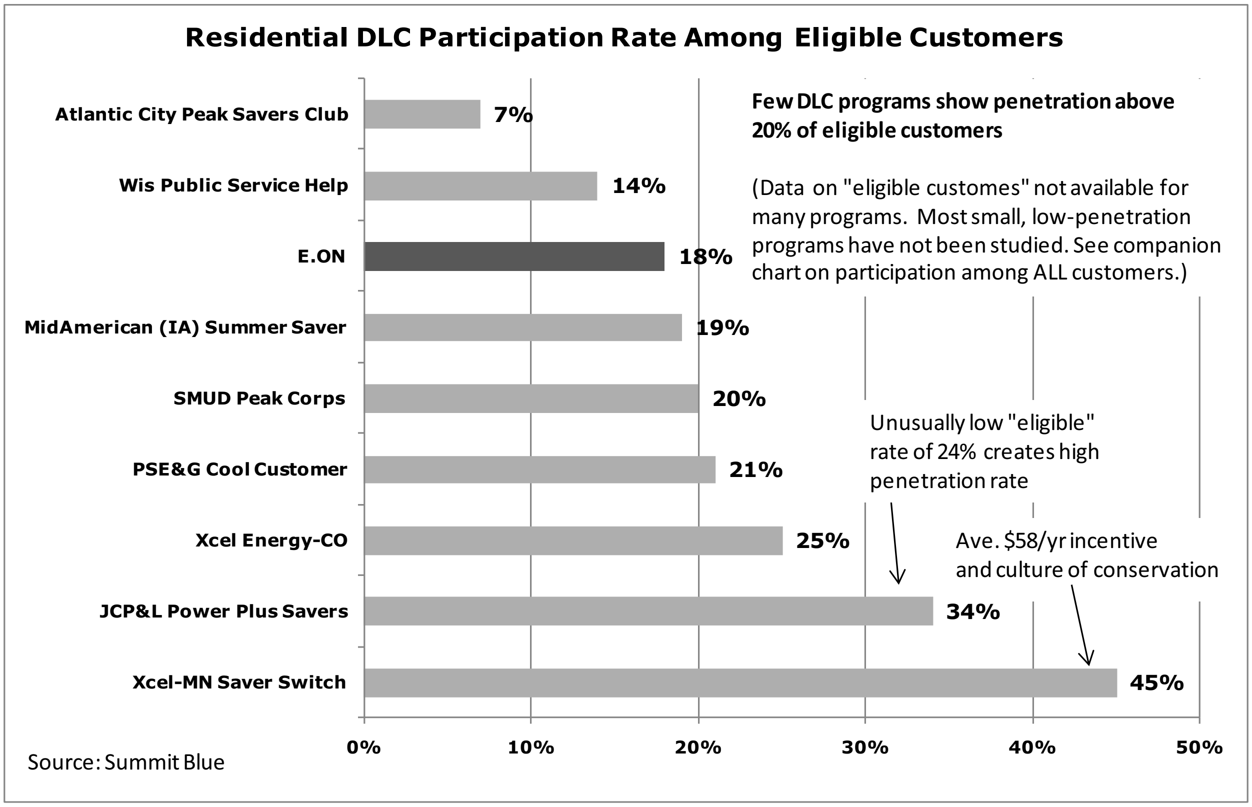
Figure 1. Residential DLC Participation Rates (All Customers)



Source: Summit Blue Consulting and Esource

Figure 2 shows penetration among eligible customers only. It appears that most programs have higher participation rates than E.ON, but it should be noted that most of the programs with participation rates higher than E.ON (among eligible customers) also had higher participation rates among all customers (from Figure 1). And many of the programs with low participation rates from Figure 1 do not appear in Figure 2 because data on eligibility was not available. In fact, each utility has different criteria for eligibility; for example, many only allow single-family homes to participate, while others allow multi-family. For this reason, comparisons across utilities may not be wholly applicable.

Figure 2. Residential DLC Participation Rates (Eligible Customers)



Source: Summit Blue Consulting

Interviews with DLC Program Managers

DLC program managers from Xcel's Minnesota and Colorado programs and from SMUD's program provided insights into their incentives and marketing approaches. A summary of these insights follows:

Participation and Incentives

- SMUD has the lowest incentives of the three, yet has achieved a 20% participation rate among eligible customers (and the PM claimed around 25% but data were not readily available). This relatively high rate is due in part to the fact that SMUD has offered its program for nearly 20 years and had a high participation rate in the early years.

  SMUD offers customers three participation levels, based on cycling of AC units at 50%, 67%, and 100%. Incentives are $10, $15, and $20 per summer, respectively. Roughly 75% of participants are on the 67% cycling option. SMUD reports that 15% saturation is typical in the industry and that going beyond 15% usually requires creative marketing and incentive structures, which can get expensive. Apparently, acquisition costs for some established programs have reached $90 per customer, including marketing and one-time incentives.

- Xcel Colorado has achieved a 25% participation rate among eligible customers and has been offering summer incentives of $25. This was recently increased to $40 in order to attract more participation.

- Xcel Minnesota has had an extremely successful program, with participation approaching 50% of eligible customers. One reason for the high participation is the incentive structure: a 15% discount off the electricity commodity portion of the monthly bill for the four months between June and September. This has averaged to about $58 per participant for the summer season and can amount to well over $100 for high consumption customers.

Marketing and Recruitment Strategies

SMUD uses bill inserts each summer to all eligible homes, and consistently gets new sign-ups at a response rate of about 0.15%. SMUD also started an "opt-out" program that they were able to write into their rate design for all new builds. This means that new homes will be equipped with programmable communicating thermostats that can be used with the program, and customers will be automatically enrolled unless they specifically opt out. Early indications are that opt out rates are about 30%.

Xcel in Colorado has shifted approaches as the program moved beyond the 20% participation level. They launched a brand awareness campaign, and they now use more customer segmentation data and do more targeted marketing through telemarketing and direct mail. Sign-up rates are about 20-25% among eligible customers reached by telephone. In addition to the seasonal incentives, they have started using one-time incentives such as gift cards (eg, $50 to Home Depot, Target, or Starbucks depending on the demographic), donations to charities, and energy savings kits (with CFLs and other efficient devices).

Xcel Minnesota has needed to do little to attract participation, but it's high incentive level has made it easy. And the PM explained that the culture of environmentalism and conservation has helped as well. Most people know someone who is on the program, so the social marketing aspect has boosted acceptance and interest.

Conclusions

Available data on program participation rates suggest that E.ON's programs are relatively well-subscribed and that the "low-hanging fruit" has already been picked. Thus, it is certainly reasonable to expect that a rapid increase in new enrollments will be difficult to achieve. Some of the programs with high participation rates are in areas with high levels of environmental awareness (Xcel) or smaller, municipal service territories (SMUD, Austin); or the programs have been around for more than a decade (FPL, SMUD, Xcel) and may have higher incentive levels (Xcel).

There is precedence for programs to modify marketing and incentives once they reach approximately 20% participation levels. This may include direct marketing with customer segmentation, one-time gifts/incentives, and annual incentives of $40 or more.

Xcel Minnesota's incentive that is tied (as a percentage) to the electric bill offers the advantage that the incentive varies based roughly on the load control contribution to the system and gives a bigger incentive to the bigger customers…who may ignore a fixed $25 or $40 incentive. However, the overall incentive cost could be high, and some customers may benefit disproportionately if they have significant non-AC loads.

E.ON has operated highly successful programs and achieved among the better participation rates in the country. Measured against other programs in the U.S., E.ON's growth goals are ambitious and additional marketing efforts and incentives may be needed to attract significantly greater participation.

Exhibit I-1

NBER WORKING PAPER SERIES

EVIDENCE FROM TWO LARGE FIELD EXPERIMENTS THAT PEER COMPARISON FEEDBACK CAN REDUCE RESIDENTIAL ENERGY USAGE

Ian Ayres
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Working Paper 15386
http://www.nber.org/papers/w15386

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Evidence from Two Large Field Experiments that Peer Comparison Feedback Can Reduce Residential Energy Usage
Ian Ayres, Sophie Raseman, and Alice Shih
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ABSTRACT

By providing feedback to customers on home electricity and natural gas usage with a focus on peer comparisons, utilities can reduce energy consumption at a low cost. We analyze data from two large-scale, random-assignment field experiments conducted by utility companies providing electricity (the Sacramento Municipal Utility District (SMUD)) and electricity and natural gas (Puget Sound Energy (PSE)), in partnership with a private company, Positive Energy/oPower, which provides monthly or quarterly mailed peer feedback reports to customers. We find reductions in energy consumption of 1.2% (PSE) to 2.1% percent (SMUD), with the decrease sustained over time (seven months (PSE) and twelve months (SMUD)).

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Evidence from Two Large Field Experiments that Peer Comparison Feedback Can Reduce Residential Energy Usage

I. Introduction

In this paper we analyze two field experiments conducted on a total of approximately 75,000 household customers of two utilities, the Sacramento Municipal Utility District (SMUD) and Puget Sound Energy (PSE). These utilities, in partnership with a private company, Positive Energy/oPower, randomly assigned a subset of these households to periodically receive mailed reports comparing their energy usage to that of nearby neighbors in similarly sized houses. We find that households receiving Positive Energy/oPower's reports make significant and lasting reductions in their energy consumption.

Studies that have tested the impact of peer comparisons on conservation have had mixed results. For example, Goldstein, Cialdini, and Griksevicius (2008) have found that social norms can increase towel reuse by hotel guests. Yet, in a literature review of the effect of feedback on home energy consumption, Fischer (2008) notes that of the dozen studies that she reviews that test the impact of comparisons to others, none had shown an effect. She attributes the failure to the "boomerang" problem, where informing individuals of typical peer behavior inadvertently inspires those who have been *under*-estimating the prevalence of an activity to increase the unwanted behavior. Cialdini, Kallgren, and Reno (1991) argue that combining injunctive norms (norms that express social values rather than actual behavior) with descriptive norms can neutralize the boomerang effect. Schultz, Nolan, Cialdini, Goldstein, and Griskevicius (2007) conducted a randomized field study in San Marcos, California, of the effectiveness of social norms messaging (alongside energy-saving tips) to reduce home energy consumption. They found that combining the descriptive and injunctive messages (in this case, the emoticons ☺ and ☹) lowered energy consumption and reduced the undesirable boomerang effect.

The Positive Energy/oPower experiments build on the findings of the San Marcos study. As in the San Marcos study, the Positive Energy/oPower reports use descriptive norms as well as injunctive norms, such as ☺ emoticons, to reduce consumption and in order to counteract the boomerang effect. The Positive Energy/oPower experiments reported here, however, go beyond the San Marcos experiment in a number of ways. First, the Positive Energy/oPower experiments have a significantly larger sample size than in San Marcos, which included 290 households vs. 35,000 in the SMUD study and 40,000 in the PSE study. Second, the Positive Energy/oPower studies also allow us to test multiple new aspects of the dynamics of energy use feedback:

- **Measuring longer term impacts**. Whereas the San Marcos study's observation period was only one month, the SMUD and PSE experiments have twelve and seven months of data, respectively.
- **Measuring daily impacts**. Unlike the San Marcos study, the PSE experiment gives access to daily energy readings.
- **Measuring impacts on both electricity and natural gas**. The PSE experiment tested the effect of feedback on both electricity and natural gas usage, allowing a fuller picture of household energy use.
- **Measuring impacts of different message frequencies (quarterly vs. monthly), different report content, and different envelope sizes.**

Moreover, the Positive Energy/oPower experiments were conducted using a more realistically scalable intervention. Instead of mailed reports, the San Marcos study used hanging doorknockers with hand-drawn emoticons. Together, the SMUD and PSE experiments provide compelling evidence that properly framed peer comparisons can predictably lower energy consumption, particularly of the highest energy using households.

II. SMUD Experiment

Experimental design. The SMUD messaging experiment began in April 2008 and is still ongoing; the results presented in this paper cover the period from April 2008 through April 2009.[1] The sample includes 85,000 households who are customers of SMUD. To select participants, Positive Energy/oPower filtered by census tract within SMUD's footprint to maximize the number of single family homes with more than twelve months of billing history,

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[1] All the data in this paper, including data originally obtained from the utilities themselves as well as from third parties, was generously provided to the authors by Positive Energy/oPower. SMUD has contracted with ADM & Associates to independently assess the success of the program. In addition, Positive Energy/oPower engaged Summit Blue to do its own evaluation of the SMUD result in May 2009. PSE plans to select a third party in October 2009 to conduct program measurement and verification services.

that were on standard rate plans (non-medical rate, non-photovoltaic), and that had a matching parcel record with details about the home, such as house size and value.

Once participants were selected, the randomization process used "batch" assignment: homes were randomly assigned to the treatment and control groups in 959 batches of census blocks. These "batch blocks" consist of 50 to 100 homes. 35,000 households were assigned to the treatment group, and 50,000 were assigned to the control. Positive Energy/oPower used this assignment methodology to increase the likelihood that neighbors would receive reports and have the opportunity to discuss the reports with each other, thereby increasing the motivation for taking actions to reduce home electricity consumption. The batch approach did have a drawback, however, in that treatment and control groups differed on some pre-treatment attributes.

All members of the treatment group received home energy reports on a periodic basis. Each home energy report contains four key personalized components: 1) Current period neighbor comparison: A bar chart comparing the household's recent electricity use to a group of comparable neighbors and "efficient neighbors," with both normative and injunctive messages designed to motivate action; 2) Twelve-month neighbor comparison: A chart comparing the household's electricity usage to its comparable neighbors and "efficient neighbors" over the last twelve months; 3) Personal historical comparison: A section comparing the household's usage in the current year by month with the same months from the previous year; 4) Targeted energy efficiency advice: tips selected based on the household's energy use pattern, housing characteristics, and household demographics. All reports were printed in color on a single 8½" x 11" sheet of paper. Examples of the elements of the front page of this report are included in Appendix A3a and Appendix A3b.

The 35,000 treatment households were then assigned to different sub-treatment groups that varied the intervention. Some of the assignments were random, while others depended on household characteristics. All households (test and control) were randomly assigned to one of two different report template groups and one of two different envelope groups. The two report template groups were "graphical" and "narrative." Both templates included the same core elements, including graphs with feedback information, but the narrative version (shown in Appendix A3a and A3b) included a blurb of text explaining the charts, reinforcing the normative messages, and highlighting tips on how to save energy (including both mentioning tips in the blurbs and pointing the reader toward the personalized tips section on the back of the report).

The two envelope types tested included a standard business "#10" envelope (similar to the envelope used to deliver SMUD customer bills) and a larger 6" x 9" envelope. Envelope size did not affect the envelope content, which was always printed on 8½" x 11" paper; but folded differently to accommodate the different envelope sizes.

Some elements of the treatment varied based on household characteristics. Households were assigned to receive the reports either monthly or quarterly based on historical usage levels: the 25,000 households with higher consumption levels were assigned to the monthly frequency group, while the 10,000 households using less energy (< 21.85 kWh/day) were assigned to receive the report quarterly. Households were also assigned to various tip segments based on home characteristics (i.e. presence of a pool), which allowed for characteristic-contingent targeting of energy efficiency messages.

SMUD provided the basic data on energy consumption, including historical billing information dating back to January 1, 2006 (over two years before the beginning of the treatment in April 2008). Data on household parcel characteristics (such as square footage and home values) comes from the Sacramento County Assessor's Office.[2] Household demographic data (such as income level and length of residence) came from private direct marketing and data aggregation service databases.

SMUD Results. Appendix A1 investigates whether the sample is well-balanced between the control and treatment groups. Since the randomization occurred at the census level, there were statistically significant differences in some pre-treatment variables. For example, the households in the treatment group on average were 16 square feet smaller and used .3 kWh per day more in 2006 than the average control group households. A parallel analysis (also reported in Appendix A1) of the sub-randomization of envelope size and the graphical/narrative template shows that the data was well-balanced between these groups.

Households in the treatment group that complained about receiving the Positive Energy/oPower reports or who asked to stop receiving the report were allowed to opt out of the treatment. Only 2% of the treatment group opted out of the experiment. The following regressions, which retain these observations and which only control for pretreatment variables,

[2] The heating fuel type was derived from the customers' rate codes as SMUD offers lower rates to households with electric heat.

should be interpreted as "intent to treat" effects. Unreported treatment on the treated (IV) estimates were of similar in size and significance. In addition, similar proportions of treatment and control households (8% and 7%, respectively (p. = .10)) closed their SMUD accounts due to moving after the experiment began.

Figure 1 reports the results from monthly regressions on approximately 83,500 household observations where the log of monthly average kWh/day was regressed on a treatment group indicator and a constant. As shown in Figure 1, the treatment group's energy consumption (relative to the control group) moved erratically before the start of the experiment (indicated by a vertical line marking April, 2008). For example, the treatment group used more electricity than the control group in February 2007 and less in June 2007, and these differences were statistically significant. Still, even before other factors are controlled for, there was a significant drop in energy usage for the treatment group relative to the control for all the months following the initial report mailing.

To account for factors besides the reports that may be driving the change in energy usage, we control for house characteristics (square feet, age of house, presence of pool or spa, house value, gas user, census tracts), household demographics (energy usage in 2006, length of residence at particular house, number of residents, income, age, affluence), and the number of cooling degree days and heating degree days[3]. Figure 2 shows that after controlling for these characteristics there was no systematic difference in energy usage between the treatment and control groups. With the exception of one month in the pretreatment stage, the difference between the energy usage of the control and treatment groups is statistically insignificant, straddling 0%. After the first reports are arrived around April 15, 2008, we observe a significant drop in the electricity consumption of treatment households relative to control households, on the order of 1% in May 2008. The rapidity of this decline suggests that the reductions may be driven by more "behavioral" changes (such as turning off lights in empty rooms) rather than "durable" changes (such as caulking or replacing inefficient appliances). There is a steady decline until August 2008, where the treatment group saw a reduction in electricity usage by more than 2.5%. The gap between the usage levels of the control and treatment groups then narrows in the fall

[3] Cooling degree days and heating degree days are based on a base temperature of 65 degrees. For example, a day with an average temperature of 68 degrees will count as 3 cooling degree days. Similarly a day with an average temperature of 62 degrees will count as 3 heating degree days.

months (Sept. 2008 – Nov. 2008), though the reductions made by the treatment group are still significantly negative. After November 2008 the effect of the treatment grows in all months except April 2009, with the greatest reduction in electricity consumption since the beginning of the experiment (greater than 2.5%) occurring in March 2009, almost a year after the study first began.

To simultaneously investigate the impact of treatment across different months, we "stacked" the house-month data and again regressed the log of average monthly kWh/day for individual households on the controls reported in Table 1 (calculating standard errors by clustering on household IDs). The interaction between treatment and the variable named "After first mailing (April '08)" captures the effect of being in the treatment group after the start of the experiment. The average effect of the treatment on energy reduction is significant and robustly estimated in Table 1 at about 2.1%, with or without ancillary controls.

To understand the impact of template styles and envelope size combinations, we interacted these four variables with the treatment effect (Treatment x After first mailing) in a regression with the full controls from Table 1. As shown in Figure 3, the graphic template sent in a #10 business envelope reduced energy usage significantly more (nearly 3% relative to the control group) than the other three combinations (each less than 2%). More exploration is needed to determine why this combination of envelope size and template type had a stronger effect. One possible factor is that the #10 business envelopes resemble the envelopes in which SMUD sends its monthly bills, which may have inspired more individuals to open and read the communication. Figure 4 reports the treatment effects separately for households who received the reports monthly or quarterly from a parallel regression with full controls and interacting the treatment effect with monthly and quarterly indicators. Because lower (higher) energy using households were non-randomly assigned to receive reports quarterly (monthly), it is not surprising that monthly recipients reduce their energy consumption by 2.35% while quarterly recipients reduced their energy consumption by about 1.5%. As quarterly recipients had lower energy use to begin with, they likely had fewer opportunities to easily reduce kWh.

We also investigated whether the treatment effect varied for households with differing demographics. To capture the effects of wealth, we used house value as a proxy. Figure 5 reports the results of interacting the treatment effect with house value quintile indicators in a regression with full controls. Every house-value quintile of the treatment group used statistically less electricity than the control group; however the three lower-value quintiles had a reduction greater than the average of 2.1%, while the two higher quintiles saw a decrease less than the average.

We also investigated whether there were different treatment effects for households with different levels of pretreatment energy usage adjusted by house size. We created deciles of pretreatment energy usage per house square foot which was calculated using the usage fifteen months prior to experiment, and again interacted these indicators with the treatment effect in a regression with full controls. Figure 6 shows that households with larger pre-treatment usage generally experienced larger percentage reductions from receiving the reports. Reductions reported are relative to households from the same decile in the control group. In fact, the treated households in the two lowest deciles of pretreatment energy users increased their energy usage. It is possible that some of this phenomenon was driven by the fact that the households learned that their peers were consuming more electricity, in what Cialdini, Kallgren, and Reno (1991) have called the "boomerang" effect. The presence of a boomerang effect contradicts the findings Schultz, Nolan, Cialdini, Goldstein, and Griskevicius (2007) in the San Marcos study, where lower-consuming households did not increase their energy usage. This boomerang effect is not a necessary drawback of the treatment, however, as any program using peer feedback reports can always omit sending reports to the lowest-consuming households. In this case, the boomerang effect was overwhelmed by enhanced energy conservation in the other eight deciles. The highest energy users reduced their energy consumption by nearly 7% relative to high energy users who did not receive the report. It is not surprising that the households with higher historic usage per square foot should see a larger impact from the reports, since they were more likely to receive a message that they used more energy than their neighbors and were more likely to have discretionary energy use that was easy to reduce.

Table 2 estimates the potential yearly impact of the reports on both dollars saved and energy conservation if SMUD were to send the reports to all of the households in its customer base. At an average reduction of 2.35% for monthly recipients, the reports would reduce consumption 211 kWh per year per household for a total savings of about $31 a year per household (figures are based on SMUD system-wide average usage, which is about 2,000 kWh per year lower than the average for households in the experiment). Quarterly recipients would decrease their energy use by 130 kWh per year for a total annual savings of $13. If the nearly 593,000 households in SMUD's customer base received reports using the same formula by which SMUD treatment households were assigned to monthly or quarterly reports, we could expect to see a reduction of over 110 million kWh in a year—the energy equivalent of saving over 9 million gallons of gas. SMUD customers would save over $15.2 million on their energy bills under the current SMUD rate plan. For every mailing in SMUD's customer base, $2.57 would be saved for monthly recipients, and $3.29 for quarterly. Since, as shown in Figure 6, higher energy users made significantly larger reductions in energy, it is likely that that targeting reports at only higher energy consumers would be particularly cost effective. By our analysis, SMUD could achieve a significant environmental impact by sending reports to all of its customers. The reports would save the equivalent of nearly 80,000 metric tons of carbon emissions. Quarterly reports produce a bigger energy saving per mailing (the equivalent of 1.43 and 2.64 gallons of gasoline per mailing for monthly and quarterly reports respectively).

Including report information with the regular bill may make the feedback even more cost effective. However, more research is needed into this question. It remains an open question whether including the reports in the bill would in fact reduce production costs, as such integration may require significant investments to change current legacy billing systems, which are typically in black and white and do not allow for extensive customization and graphics. Secondly, more research is needed to determine whether reports integrated into bills have the same level of impact on conservation. Similarly, researchers should investigate the effectiveness of electronic forms of delivery (such as email), which can further increase cost savings. Although such forms of delivery are likely to impact fewer households than direct mail for the time being, they promise significant production cost savings. Another approach to increasing the cost effectiveness of feedback reports would be to only send reports to households where there was not a danger of a "boomerang effect" (here, the lowest two deciles of pretreatment energy users).

III. PSE Experiment

Experimental design. In October 2008 Puget Sound Energy (PSE) and Positive Energy/oPower launched another energy feedback report experiment in King County, Washington. There were three major differences in program design between the SMUD and PSE studies: first, the reports encompassed both electricity and natural gas, allowing for a fuller picture of what is happening to households' energy use; second, the study included a randomized test of report frequency (monthly or quarterly), and did not test envelope size or template type; and third, the study used household-level randomization, which was more robust than the batch-level randomization used in the SMUD study.

The PSE experiment consisted of approximately 84,000 homes randomly assigned to control and treatment groups. These homes were chosen from PSE's 1.3 million residential customers who met the following criteria:

- Single family homes located in King County, WA
- Exactly one active electric account and one active gas account with PSE
- History for both gas and electric accounts dating to January, 2007
- Matched parcel record available from the King County Assessor's data
- Not identified by the King County Department of Assessments as having solar heat

This filter created a pool of approximately 100,000 households that were eligible to participate in the program. Additional exclusions were made to eliminate homes with distant neighbors or with unusual home sizes (so that neighbor comparisons would be more meaningful) and homes that used relatively little energy (less than approximately 80 MBTU). In order to test the effect of frequency of the reports on home energy consumption, households were also randomly assigned to receive the report on a monthly or quarterly basis in the ratio of 3:1. Unlike in the SMUD case, the PSE reports all used the same template and standard-business envelope size.

The PSE reports were based on the more effective "graphical" template deployed in the SMUD study. Sample elements from the front page of this report are included in Appendix A4a and A4b. However, the PSE report included energy information regarding both electricity and natural gas consumption. In addition to two charts tracking the last twelve months of households kWh and therm consumption relative to nearby neighbors in similar size homes, the template began with a combined energy cost (CEC) comparison to neighbors.[4]

[4] The combined energy cost is an estimate of the cost of electricity and gas used by the household. On the reports the combined energy cost was reported in terms of a price-weighted index (PWI), where PWI =12.51*therms + kWh. The factor 12.51 represents the kilowatt-equivalent price of one additional therm for a PSE customer. An estimate of the combined energy cost (CEC) can then be found by multiplying the PWI by the approximate price of one kWh, 8 cents. The combined energy cost does not exactly reflect the relative costs to the households because the actual pricing formula took into account other factors (e.g., fixed costs).

PSE Results. Appendix A2 shows that the randomization was successful in producing treatment and control households with similar pre-treatment attributes. The table does reveal some statistically significant differences between the randomly assigned monthly or quarterly groups, but the raw differences in levels was not substantial (for example, in 2007 the average kWh per day was 30.2 and 30.5 for the monthly and quarterly households respectively). Only 1% of the treatment group opted out of receiving the reports, which, as in the SMUD experiment, suggests that the following intent to treat estimates will be nearly identical to treatment on the treated effects. About 2% of both the control and treatment households closed their accounts during the experiment because they moved.

Figures 7a and 7b report the results of regressions of the log of monthly average kWh per day and therms per day usage on a treatment indicator and a constant. Unlike SMUD, where census-tract level randomization created some substantial pre-experiment differences between treatment and control households, the PSE data show no substantial differences in pre-experiment usage. All differences between the control and treatment groups for pre-experiment usage, as expected, were statistically insignificant and close to 0%. As Figures 7a and 7b show, however, the treatment households reduced their use of both electrical and natural gas energy relative to the control households in November 2008, after the reports were sent out first on October 20, 2008. As in SMUD, the rapidity of the decrease in electricity use may indicate that the reductions in energy may flow largely from behavioral rather than durable changes.

Table 3 displays the results of stacked monthly regressions (analogous to the SMUD regressions in Table 1) on approximately 1.4 million household-month observations. The regressions are run on the log of three measures of energy use: average monthly kWh per day, average monthly therms per day, and the combined energy cost (CEC). As in the SMUD Table 1, we report the results of parallel regressions with and without controls for house demographics (such as square footage, age of house, house value), household demographics (such as past energy usage), month, and cooling degree days and heating degree days. As with the SMUD data, the estimated treatment effects are quite robust to the inclusion of ancillary controls. On average, households in the treatment group reduced kWh usage by 1.2%, therm usage by 1.2%, and a combined price-weighted usage by 1.1% compared to the control group. One potential explanation for why this figure is lower than the SMUD average is that the experiment has been running for a shorter time. There is evidence, as shown in Figures 7a and 7b (discussed below), that the effect may continue to increase.

One advantage of this experiment is that PSE collects daily data on energy usage, with the aid of an automated meter read system called CellNet. Figure 8 reports the results of a regression (with the Table 3 controls) of household-day energy usage where the treatment variable from Table 3 (Treatment x After first mailing) was interacted with day of week indicators. The figure shows that the lion's share of treatment impact, 38%, comes from Sunday and Monday (12:00 AM Sunday morning to 11:59 PM Monday night). It may be that the energy savings is even more tightly concentrated in the weekend, with the bulk of the "Monday" savings occurring during the night between Sunday and Monday. For example, if a person decides to turn her thermostat down on Sunday, she may leave whatever setting she has chosen on all night. The evidence that the bulk of the savings is happening on two contiguous days roughly overlapping with the weekend suggests that the primary impact of the energy reports may not be driven by durable conservation efforts, but is instead from increased mindfulness of energy consumption on the weekends. On the other hand, it may be that increased savings on the weekends could be the result of durable, one-time actions as well. For example, if an individual buys a new energy-efficient washing machine, and she does the bulk of her laundry on the weekends, she would show the greatest percentage drop in energy on the weekends.

As already discussed, in the SMUD experiment, as shown in Figure 4, those who received the report monthly saved more electricity than those who received it quarterly. However, in SMUD only the lower (pre-treatment) energy-using households were assigned to the quarterly treatment group, leading to the possibility that the smaller estimated quarterly treatment effect was driven by lower pre-treatment energy usage. In the PSE experiment, however, with randomized monthly and quarterly recipients, we are better able to gauge the causal impact of report frequency. Figure 9 shows the results of a regression interacting the treatment effect (Treatment x After first mailing) with report frequency indicators. For kWh, monthly recipients reduce their usage by about 1.25% and quarterly recipients reduce their usage of about 1.05% However, for therms, both quarterly recipients reduce their usage about1.2%, with the quarterly households reducing slightly more than the monthly. In terms of the combined energy cost, the monthly group shows a slight improvement over the quarterly group, with the monthly group reducing 1.2% and quarterly group reducing 1.05%. On net, quarterly treatment effects are statistically indistinguishable from monthly effects. Given that quarterly reports are just as effective, and cost less to produce and mail, they appear to be the more efficient intervention.

The PSE data also allows us to investigate how the reductions in energy use change across the month, and observe how effects may vary based on proximity to the time the most recent report was sent out. Figures 10a and 10b report the results of a series of regressions (using full Table 3 controls) calculating the treatment effect in terms of kWh and therms for particular weeks before and after the experiment began. Figure 10a reports the week by week treatment effects on kWh and therms for recipients of monthly reports. The vertical lines denote the approximate delivery dates of the reports. All 6 mailings after the first mailing had treatment effects that were statistically lower than zero for both kWh and therms. Figure 10b analogously reports the weekly treatment effects for quarterly report recipients on kWh and therms. After the first mailing, 52% of the treatment effects observed on therms were statistically lower than zero for therms, and 77% of the treatment effects for kWh were statistically significant ($p. < .05$) reductions. Somewhat contrary to our expectations, there is no consistent or pronounced retrenchment for either monthly or quarterly recipients as the time from last report increases—although the reductions for the smaller quarterly recipients sample are less precisely measured. The lack of retrenchment suggests that the energy reductions may in large part be driven by durable behaviors, the effects of which would not wane with time; yet, as there is some retrenchment (such as in the electricity usage of quarterly recipients after the second report was received), some of the effect appears to be driven by non-durable behavior.

As in the SMUD experiment, we again see larger treatment effects for lower house value quintiles. Figure 11 shows that the lower three quintiles perform at or below the average reduction of 1.1%. Again, all quintiles saw a reduction, but in the two highest quintiles, the treatment reduction was not as pronounced.

Figure 12 reports the results of a regression (with the full set of controls) interacting the treatment effect with pretreatment energy usage deciles (based on household energy usage for the twelve months prior to the beginning of the experiment, adjusted for house size), with the reductions reported relative to control households in the same usage deciles. We see that in the PSE data the treatment effect is even more strongly correlated with the pretreatment energy usage. As in SMUD, we observe that the lower half of pretreatment energy users reduce usage less than the average reduction of 1.1% (in fact, for the 3 smallest deciles we estimate statistically significant *increases* in energy usage) while the higher half of pretreatment energy users reduce more than the average. Here the range of effects is wider than in the SMUD experiment, with the lowest pretreatment decile increasing usage by 3.4% (suggesting a more pronounced "boomerang" effect) and the highest pretreatment decile decreasing use by 6.0%. As mentioned earlier, these findings contradict Schultz, Nolan, Cialdini, Goldstein, and Griskevicius (2007), but do not give significant cause for concern as programs based on the treatment can be controlled so that the lowest energy users do not receive reports.

Finally, Table 4 assesses the potential economic and environmental impact if reports were sent to all households in PSE's customer base. Per household, monthly recipients save nearly $14 a year from kWh reduction and $11 a year from therms reduction for a total of nearly $25 saving a year. Quarterly recipients are only slightly behind, with total yearly savings of $22.28 ($11.19 from kWh and $11.09 from therms). With over 930,000 households receiving electric service and over 681,000 households receiving gas service from PSE, PSE customers would stand to save annually $23 million from monthly reports and $20.7 million from quarterly reports per year. In environmental terms this projected customer-base-wide savings from quarterly reports is the equivalent to saving the carbon emissions of 14.3 million gallons of gas. PSE households save $2.06 per mailing for the monthly reports and $5.57 per mailing for the quarterly reports. As we mentioned in the SMUD cost and impact analysis above, more research is needed into alternative delivery mechanisms for the reports, such as integration into the bill and electronic mail, in order to determine the most efficient and effective channels of communication. Selectively mailing reports only to households where we did not expect a "boomerang" effect would also increase the efficiency of the treatment.

IV. Conclusion

Both the PSE and SMUD experiments reveal that Positive Energy/oPower peer comparison reports cause significant reductions in home energy use, confirming the direction of the reductions found by Schultz, Wesley, Nolan, Cialdini, Goldstein, and Griskevicius (2007) in their earlier study in San Marcos. The PSE and SMUD experiments show that the effects of the report continue to be strong, up to seven and twelve months after the households begin to receive reports, respectively. The experiments analyzed here do contradict the findings of the San Marcos study to the extent we found a "boomerang" effect for both SMUD and PSE. The boomerang effects are not problematic, however, as reports can be targeted only at households where a boomerang effect is not expected. The experiments also teach us more about the most effective and efficient methods of designing the reporting system. In the SMUD experiment, out of four possible types of envelope size and report type combinations, the most effective was a graphical version of the report sent in a number 10 standard business size envelope. In the PSE experiment, perhaps surprisingly, sending the reports monthly did not have a significantly greater effect than sending them quarterly.

The experiments also reveal interesting dynamics about how different demographics were affected. In both experiments, households in the treatment group with lower house values saved more, on average, than households with higher house values. Also in both experiments, households with higher pre-treatment energy use saved more than households with lower pre-treatment energy use. The experiments also provide some evidence about the types of behavior that may be driving energy reductions, although more research is needed in this area. In both the SMUD and PSE studies, the significant reductions achieved in the period immediately after the first reports are sent out may suggest that changes may be behavioral rather than durable. Further supporting the idea that changes are behavioral is the fact that in the PSE experiment, the treatment group reduces its energy use more in a two day period roughly overlapping with the weekend, suggesting that reductions are caused by increased mindfulness, although the results are not conclusive. However, we also learn that the treatment effect does not wane as the time from the report increases, but instead is relatively smooth over the entire month or quarter, which may indicate that energy reductions are caused by more durable changes.

The Positive Energy/oPower experiments suggest that governmental entities should consider mandating or incentivizing peer comparison reporting. As we have shown in our simple calculations above, peer comparison reports can create significant net cost and carbon savings, benefiting both individual households and the environment. The efficiency of savings would be even more pronounced—and possible "boomerang effects" averted—if comparative information were only mandated for those who consume the most energy. Although some utilities, such as those that are publically owned (like SMUD), or private but regulated (like PSE), are beginning to provide such feedback, often utilities do not have adequate incentives to reduce energy consumption on their own. Government officials should also consider investing in scientifically designed studies that could increase knowledge in this area, such as determining the cost effectiveness of sending peer feedback inside the regular utility bill.

Finally, the Positive Energy/oPower experiments suggest that privately-delivered peer comparison feedback, such as direct mailings, might prove an effective tool in a range of other situations. There are endless ways public or private entities might employ such feedback to drive desired behavior. Schools might mail parents reports of how many absences or times late their children had compared to peers. Dentists might send mailings to their infrequent visitors indicating how often typical patients come in for cleanings. A gym might inform its lazier patrons of how often typical members work out. Government might even step in to require private entities conduct this type of reporting where it believes there are significant welfare gains. To take one example, the federal government might require that employers inform low-saving employees how much more their peers are saving in the company 401(k) plan. As these preliminary examples show, the area of peer comparison feedback is ripe for innovation and experimentation.

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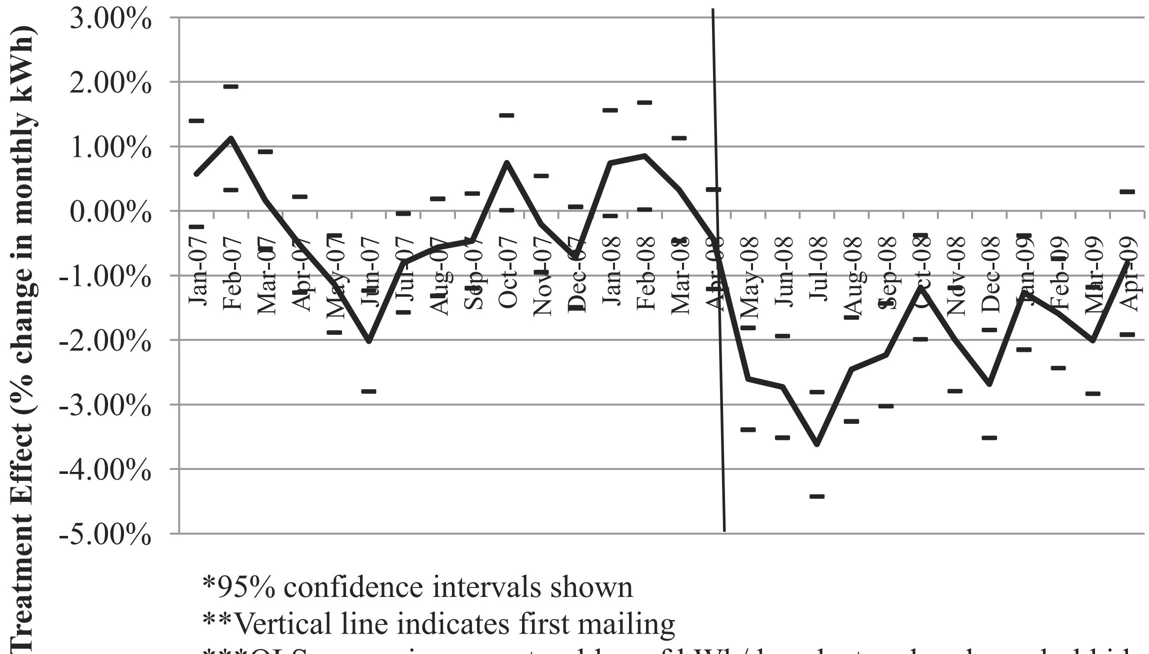
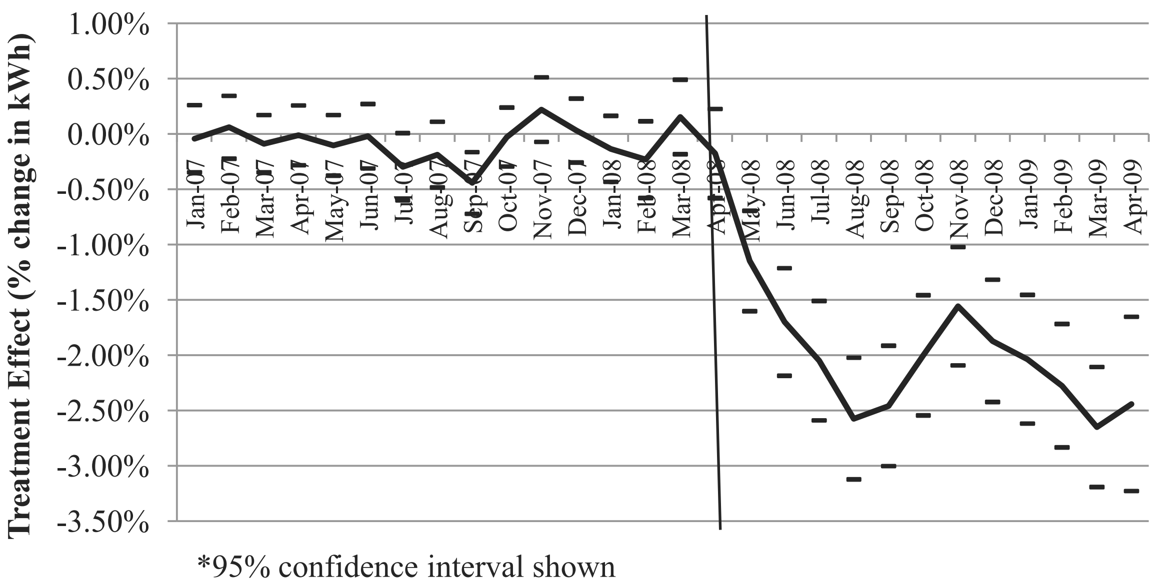
Schultz, P. Wesley, Jessica M. Nolan, Robert B. Cialdini, Noah J. Goldstein, and Vladas Griskevicius. 2007. The Constructive, Destructive, and Reconstructive Power of Social Norms. *Psychological Science* 18, 429 –34.

Figure 1: SMUD Treatment Effect
(% change in kWh - without controls)



*95% confidence intervals shown
**Vertical line indicates first mailing
***OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 1

Figure 2: SMUD Treatment Effect
(% change in kWh- with controls)



*95% confidence interval shown
**Vertical line indicates first mailing
***OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 1

Table 1: SMUD OLS Regression of log household monthly average kWh/day, clustering on household id		
	No controls n=2,262,815	**With Controls n=1,585,490**
Treatment household	-0.001	0.000
After first mailing (April '08)	-0.018 ***	0.078 ***
Treatment x After first mailing	-0.020 ***	-0.021 ***
Narrative template		0.001
6x9 envelope		0.001
Quarterly recipients		-0.117 ***
Cooling degree days		0.002 ***
Heating degree days		0.001 ***
House square foot		0.000 ***
House age		0.000 **
Pool		0.048 ***
Spa		-0.003
House value		0.000 ***
Gas heat		0.033 **
kWh/day usage in 2006		0.783 ***
Length of residence		-0.001 ***
Number in residence		0.008 ***
Head of household age effects	no	yes
Income quartile effects	no	yes
Affluence effects +	no	yes
Proprietary segment effects++	no	yes
Census tracts fixed effects	no	yes
Month Fixed Effects	no	yes
R-squared	0.001	0.706

+Ten Affluence groups were created by Direct Group

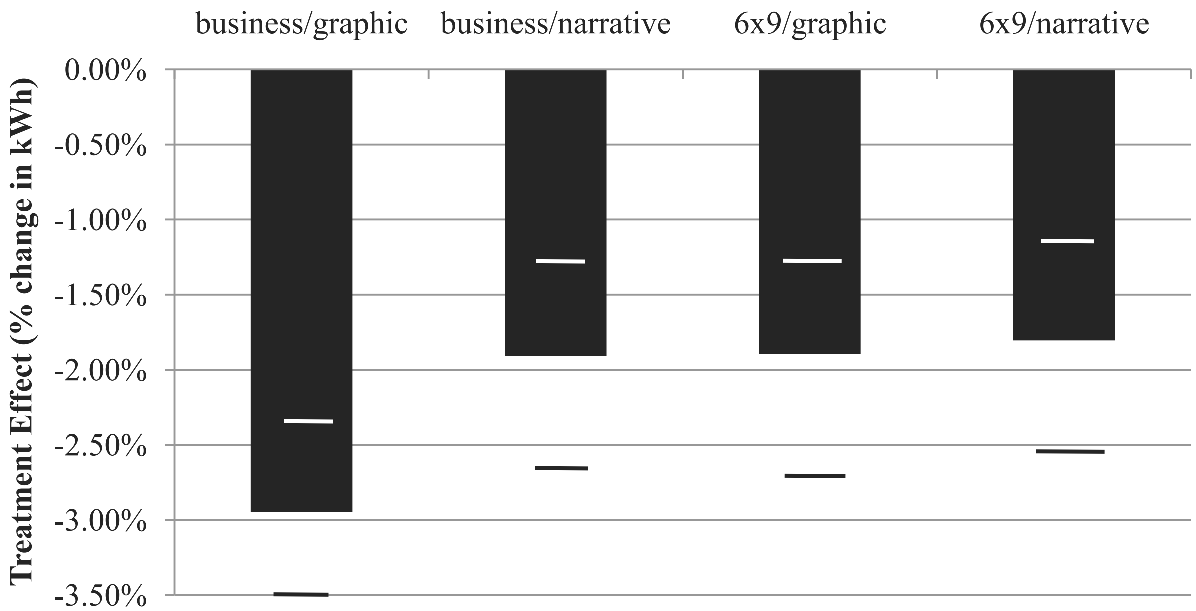
++Proprietary segment groups created by Positive Energy based on house characteristics

*significance at the 90% level

**significance at the 95% level

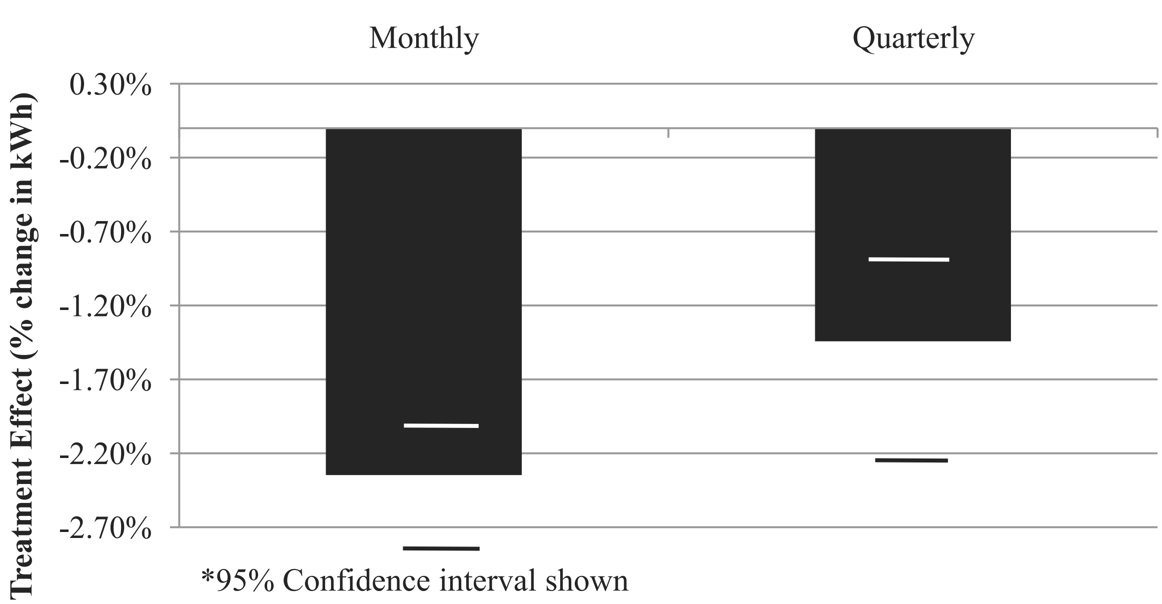
***significance at the 99% level

Figure 3: SMUD Treatment Effect (% change in Kwh) by templates/envelopes



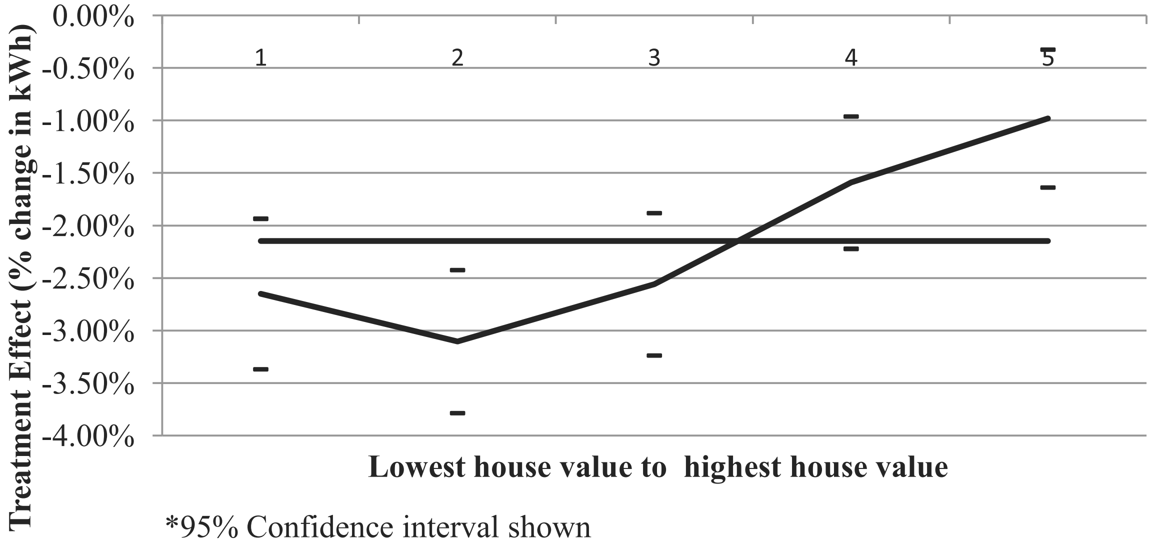
*95% Confidence interval shown
**OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 1

Figure 4: SMUD Treatment Effect (% change in kWh) by monthly vs quarterly reports



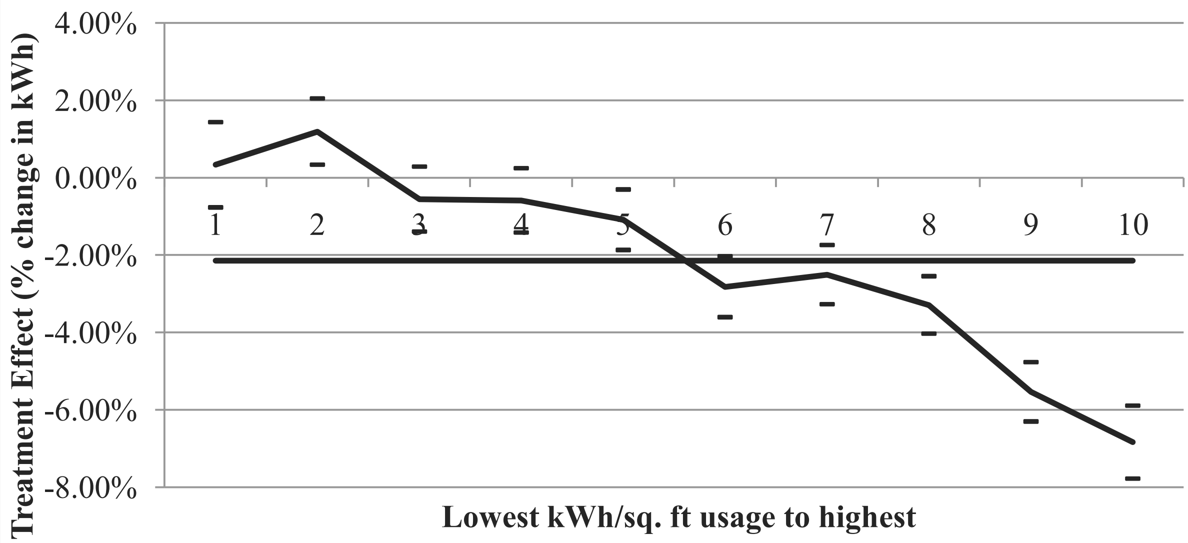
*95% Confidence interval shown
**OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 1

Figure 5: SMUD Treatment Effect (% change in kWh) by house value quintile



*95% Confidence interval shown
**Horizontal line indicates average change in kWh
***OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 1

Figure 6: SMUD Treatment Effect (% change in kWh) by pretreatment kWh/sq. ft. usage



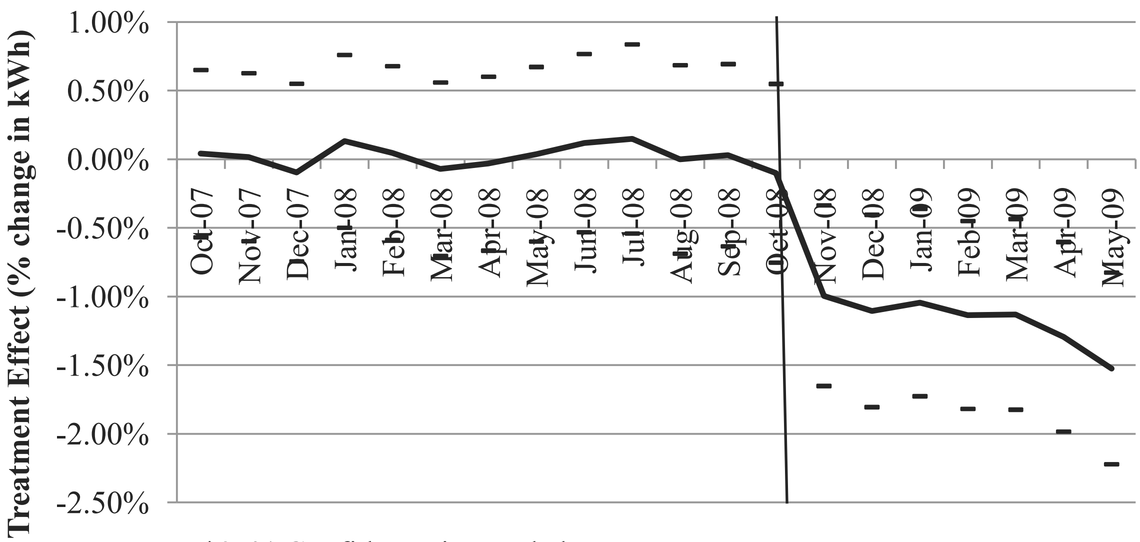
*95% Confidence interval shown
**Horizontal line indicates average change in kWh
***OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 1

Table 2: SMUD Projected Cost Savings and Environmental Impact		
Per Household	**Monthly and Quarterly weighted effect**	
Reduction kWh/day		0.51
Reduction kWh in a year		187.20
Total savings in a year	$	25.74
Savings per mailing	$	2.78
For customer base of SMUD		
Annual kWh reduction		110,917,005
Annual reduction in metric tons CO2*		79,638
Annual reduction in gallons of gas**		9,039,547
Annual savings	$	15,250,601

*Based on 7.18 x 10-4 metric tons CO2 / kWh calculated by the EPA

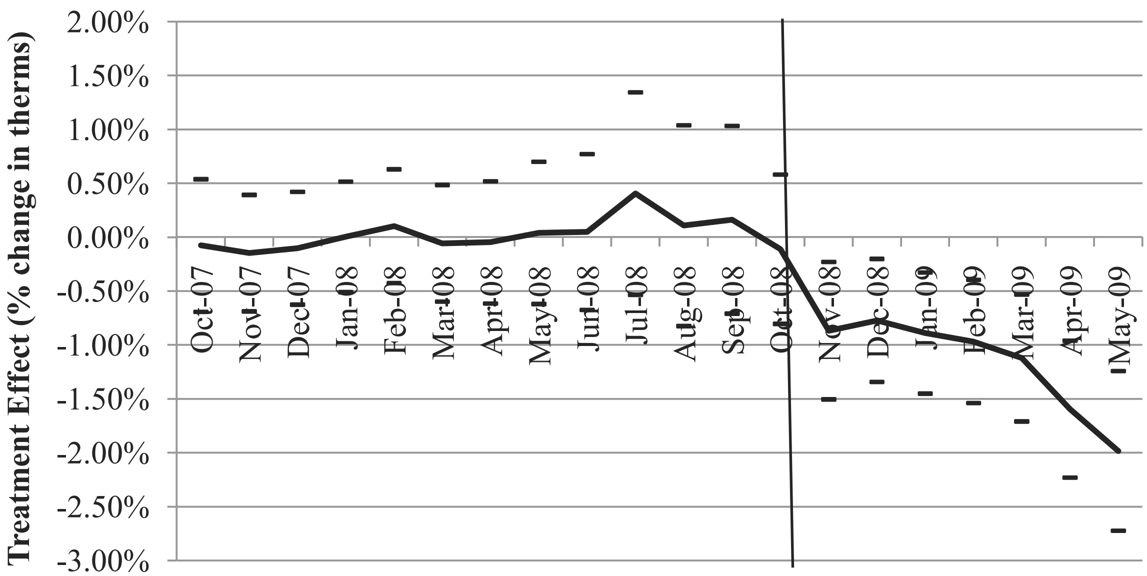
**Based on 8.81*10-3 metric tons CO2/gallon calculated by the EPA

Figure 7a: PSE Treatment Effect
(% change in kWh-without controls)



*95% Confidence interval shown
**Vertical line indicates first mailing
***OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 3

Figure7b: PSE Treatment Effect
(% change in therms -without controls)

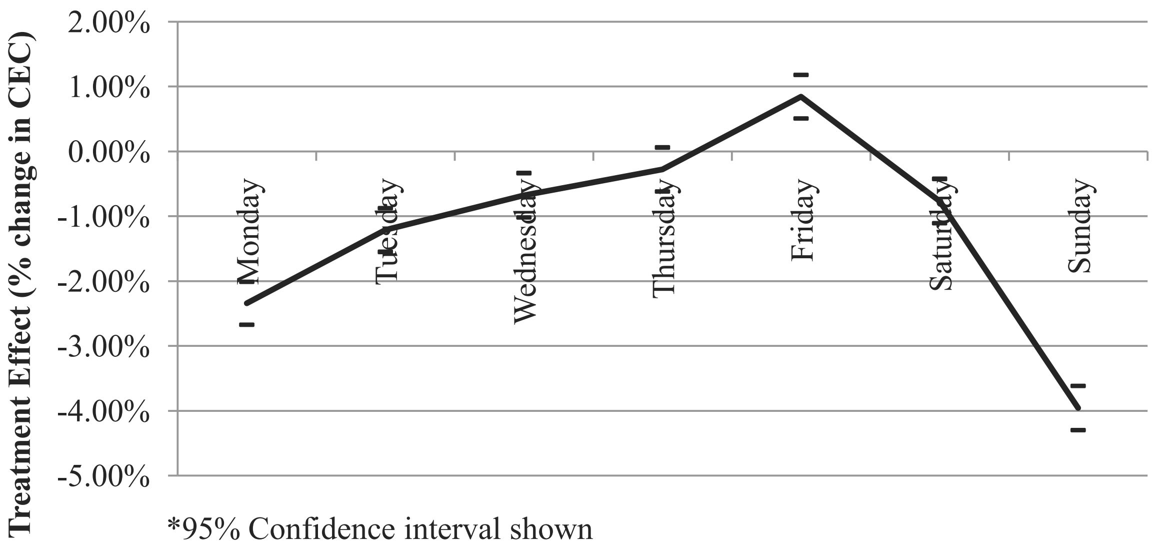


*95% Confidence interval shown
**Vertical line indicates first mailing
***OLS regression on natural log of kWh/day clustered on household id with same controls as in Table 3

Table 3: PSE OLS regression of natural log of kWh/day, therms/day, CEU/day clustering on household id					
	kWh/day (without controls)	**kWh/day (with controls) n=1419949**	**therms/day (without controls)**	**therms/day (with controls) n=1410933**	**CEC/da (without con n=14203**
Treatment household	0.000	0.000	0.000	0.001	0.00
After first mailing (Oct '08)	0.042 ***	-0.292 ***	0.436 ***	-2.151 ***	0.21
Treatment x After first mailing	-0.012 ***	-0.012 ***	-0.012 ***	-0.012 ***	-0.01
House square foot		0.000 ***		0.000	
House age		0.000		-0.001 ***	
House value		0.000		0.000 **	
Quarterly recipient		-0.001		0.000	
Therms usage in 2007		0.000 *		1.001 ***	
kWh usage in 2007		0.932		-0.001	
Cooling degree days		-0.001		-0.006 ***	
Heating degree days		0.000		0.005 ***	
Proprietary segment effects +	no	yes	no	yes	n
Month Fixed Effects	no	yes	no	yes	n
R-Squared	0.001	0.717	0.065	0.849	0.04

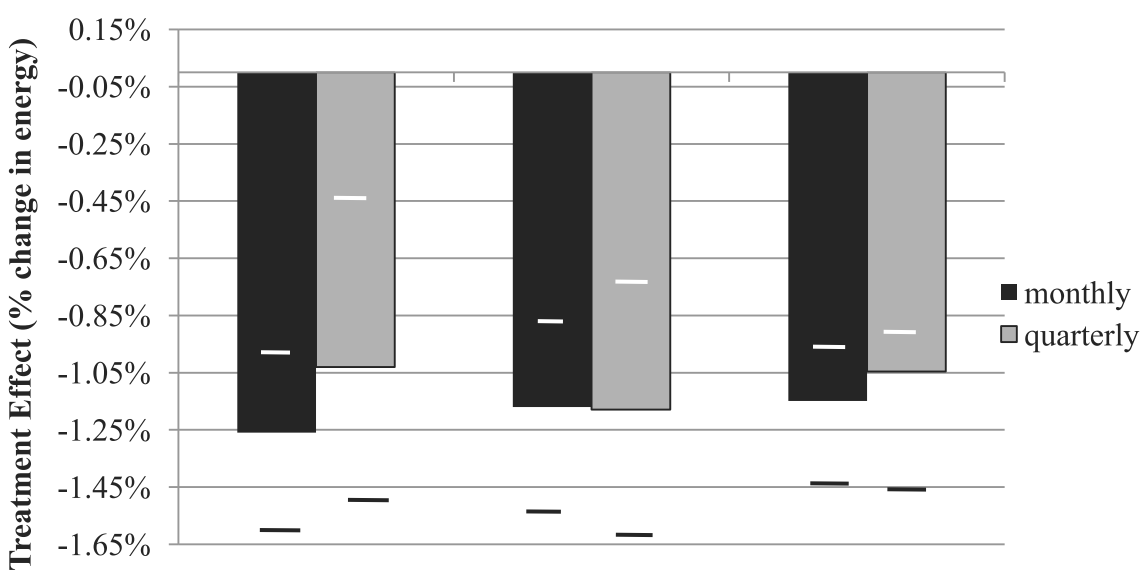
+Proprietary segment groups created by Positive Energy based on house characteristics
*significance at the 90% level
**significance at the 95% level
***significance at the 99% level

Figure 8: PSE Treatment Effect (% change in CEC)
Day of the Week



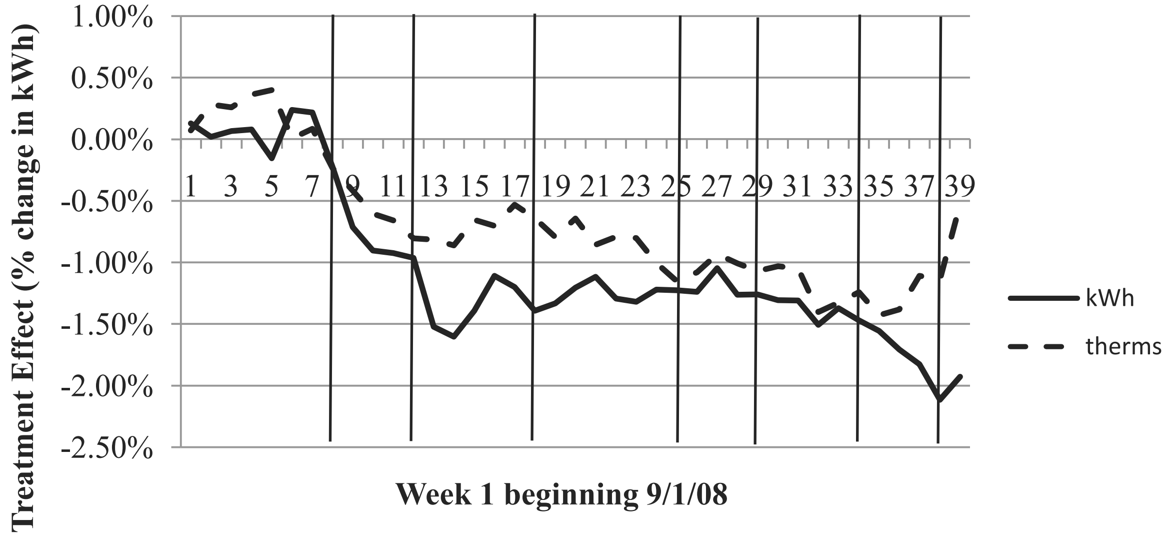
*95% Confidence interval shown
**OLS regression on natural log of CEC/day clustered on household id with same controls as in Table 3

Figure 9: PSE Treatment Effect
by Monthly vs Quarterly



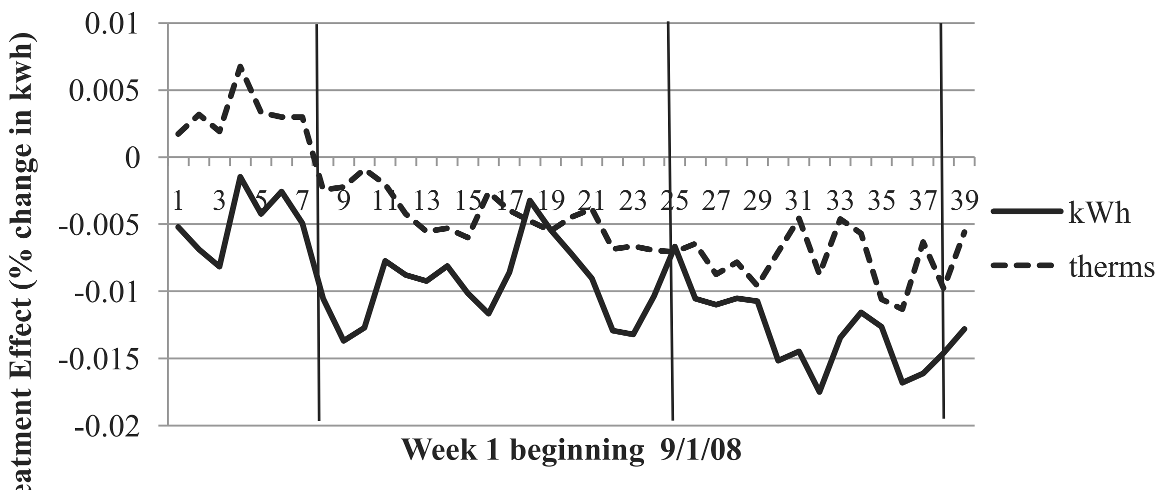
*95% Confidence interval shown
**OLS regression on natural log of energy use clustered on household id with same controls as in Table 3

Figure 10a: PSE Treatment Effect (% change in kWh and therms)- Monthly recipients



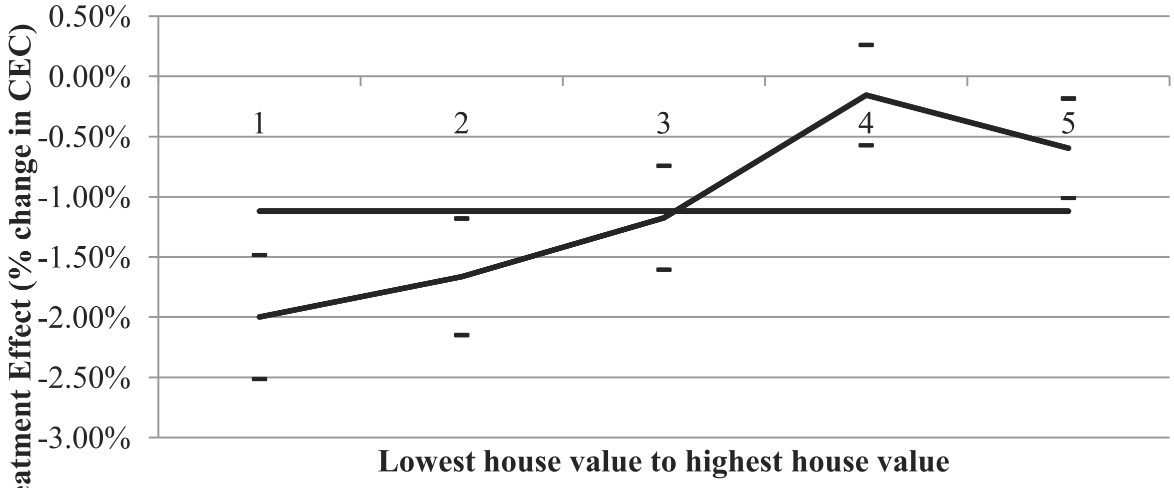
*95% Confidence Interval shown
**Vertical lines indicate mailings
***OLS regression on natural log CEC/day clustered on household id with same controls as in Table 3

Figure 10b: PSE Treatment Effect (% change in kwh and therms) - Quarterly recipients



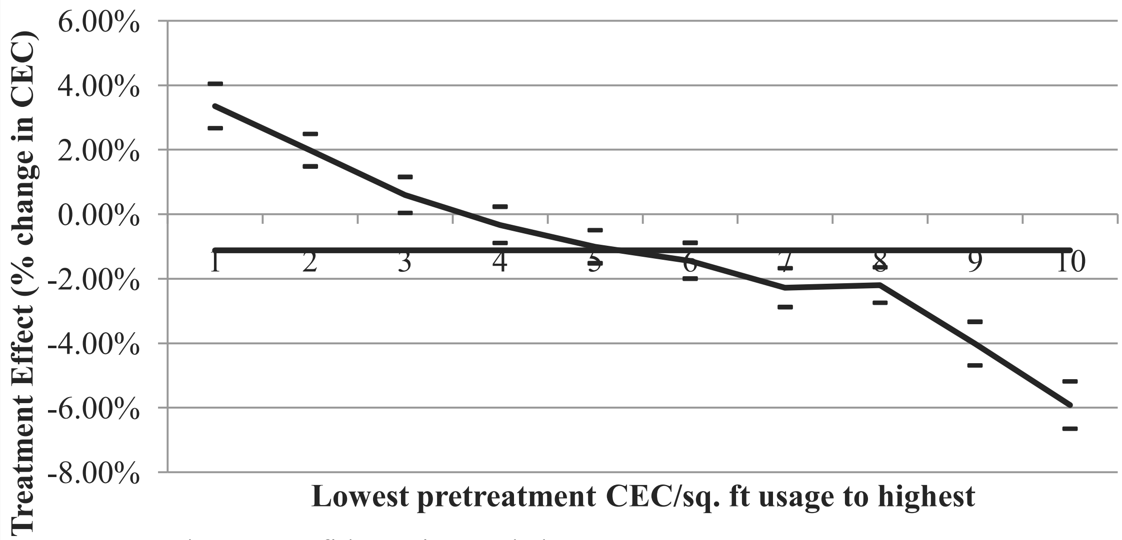
*95% Confidence Interval shown
**Vertical lines indicate mailings
***OLS regression on natural log CEC/day clustered on household id with same controls as in Table 3

Figure 11: PSE Treatment Effect (% change in CEC) by house value quintiles



*95% Confidence interval shown
**Horizontal line indicates average change in CEC
***OLS regression on natural log of CEC/day clustered on household id with same controls as in Table 3

Figure 12: PSE Treatment Effect (% change in CEC) by pretreatment CEC/sq. ft. deciles



*95% Confidence interval shown
**Horizontal line indicates average change in CEC
***OLS regression on natural log of CEC/day clustered on household id with same controls as in Table 3

Table 4: PSE Projected Cost Savings and Environmental Impact		
Per Household - kWh	**Monthly**	**Quarterly**
Reduction kWh/day	0.41	0.33
Total kWh reduction in a year	148.55	121.53
Total kWh savings in a year	$ 13.68	$ 11.19
Per Household - therms		
Reduction therms/day	0.028	0.028
Total therms reduction in a year	10.120	10.203
Total therms savings in a year	$ 11.00	$ 11.09
For customer base of PSE		
Annual Savings per household	$ 24.68	$ 22.28
Savings per mailing	$ 2.06	$ 5.57
Annual Savings for Puget Sound	$ 22,962,206	$ 20,730,469
Annual savings in metric tons of CO2*	3,169,489,576	115,943
Annual savings in gallons of gas**	391,295,009,340	14,313,900
*Based on 7.18 x 10-4 metric tons CO2 / kWh and 0.005 metric tons CO2/therm		
**Based on 8.81 x 10-3 metric tons CO2/gallon calculated by the EPA		

A1: Mean comparison of all SMUD pre-treatment variables

Variable Name	Experiment n=34557	Control n=49570		Graphical n=41841	Narrative n=41856		#10 Envelope n=42276	6x9 e n=4
House square foot	1,737	1,753	***	1,742	1,732		1,731	
House age	35.73	36.92		35.79	35.66		35.62	
Pool	0.21	0.22	***	0.21	0.21		0.20	
Spa	0.04	0.04		0.04	0.04		0.04	
House value	$ 213,584	$ 215,189		$ 214,336	$ 212,833		$ 212,478	$
Gas heat	0.73	0.75		0.73	0.73		0.73	
Account closed	0.08	0.07		0.07	0.08		0.08	
Opt out	0.02	.		0.02	0.02		0.02	
Quarterly recipient	0.29	0.29	*	0.29	0.29		0.29	
kWh usage in 2006	31.95	31.65	***	31.62	31.68		31.71	
Length of residence	14.03	14.21	**	14.11	13.94		13.99	
Number at residence	1.93	1.93		1.93	1.94		1.94	
Quartile 1 income group	0.11	0.11	**	0.11	0.11		0.11	
Quartile 2 income group	0.19	0.19		0.20	0.19	**	0.20	
Quartile 3 income group	0.16	0.16		0.16	0.16		0.16	
Quartile 4 income group	0.23	0.23		0.23	0.23		0.23	
Age- 24 years or less	0.00	0.00		0.00	0.00		0.00	
Age- 25-29	0.01	0.01		0.01	0.01		0.01	
Age- 30-34	0.03	0.03		0.03	0.03		0.03	
Age- 35-39	0.06	0.05		0.05	0.06		0.06	
Age- 40-44	0.07	0.07		0.07	0.07		0.07	
Age- 45-59	0.09	0.09		0.09	0.09		0.09	
Age- 50-54	0.10	0.10	*	0.10	0.10		0.10	
Age- 55-59	0.09	0.09	**	0.09	0.09		0.10	
Age- 60-64	0.07	0.07		0.07	0.07		0.07	
Age- 65+ years	0.01	0.02		0.01	0.01		0.01	
Age- 65-69	0.05	0.05		0.05	0.05		0.05	

A1 continued: Mean comparison of all SMUD pre-treatment variables							
Variable Name	Experiment n=34557	Control n=49570		Graphical n=41841	Narrative n=41856	#10 Envelope n=42276	6x9 e n=4
Age- 70-74	0.04	0.04		0.04	0.04	0.04	
Age- 75+ years	0.07	0.07		0.07	0.07	0.07	
kWh/day spent in…							
Jan-07	36.71	36.72		36.69	36.74	36.78	
Feb-07	33.10	32.95		33.04	33.17	33.13	
Mar-07	28.00	28.14		27.94	28.07	28.01	
Apr-07	24.67	24.95	***	24.63	24.72	24.72	
May-07	25.44	25.89		25.39	25.49	25.50	
Jun-07	28.53	29.28		28.48	28.58	28.58	
Jul-07	36.92	37.32	***	36.88	36.95	36.96	
Aug-07	36.80	37.13	***	36.73	36.87	36.87	
Sep-07	37.78	38.01	*	37.81	37.76	37.86	
Oct-07	25.70	25.63		25.68	25.72	25.78	
Nov-07	25.21	25.44	**	25.15	25.27	25.28	
Dec-07	30.77	31.18	***	30.69	30.86	30.79	
Jan-08	36.07	36.00		36.02	36.12	36.08	
Feb-08	32.81	32.75		32.75	32.87	32.87	
Mar-08	27.48	27.57		27.47	27.49	27.53	

A1 continued: Mean comparison of all SMUD pre-treatment variables								
Variable Name	**Experiment n=34557**	**Control n=49570**		**Graphical n=41841**	**Narrative n=41856**		**#10 Envelope n=42276**	**6x9 e n=4**
Affluence1	0.01	0.01	**	0.01	0.01		0.01	
Affluence2	0.03	0.03	*	0.03	0.03		0.03	
Affluence3	0.16	0.15		0.16	0.16		0.16	
Affluence4	0.10	0.10		0.10	0.10		0.10	
Affluence5	0.17	0.17		0.17	0.17		0.17	
Affluence6	0.10	0.08		0.10	0.10		0.10	
Affluence7	0.08	0.08		0.07	0.08		0.08	
Affluence8	0.04	0.08	**	0.04	0.04		0.04	
Affluence9	0.03	0.08		0.03	0.03		0.03	
Affluence10	0.00	0.08	***	0.00	0.00	**	0.00	
Greenergy	0.09	0.08		0.09	0.09		0.09	
Electric heat	0.27	0.08		0.27	0.26		0.27	

*significance at the 90% level
**significance at the 95% level
***significance at the 99% level

A2: Mean comparison of all PSE pre-treatment variables				
Variable Name	Experiment n=34891	Control n=44121	Monthly n=24949	Quarterly n=9949
House square foot	2138.56	2139.99	2139.316	2136.675
House age	29.98	29.98	30.05507	29.77646
House value	$ 345,046	$ 346,041	$ 345,874	$ 342,971
Account closed	0.02	0.02	0.0230069	0.0252287
Opt out	0.01 .		0.0096597	0.0023118 ***
Therms usage in 2007	2.50	2.50	2.503947	2.49931
kWh usage in 2007	30.31	30.26	30.22907	30.49656 *
Quarterly recipient	0.29	0.25 ***		
kwh/day use in…				
Oct-07	29.71	29.68	29.63603	29.89212
Nov-07	33.29	33.24	33.22576	33.46124
Dec-07	39.21	39.16	39.12722	39.42908
Jan-08	35.68	35.58	35.57679	35.92857 *
Feb-08	32.68	32.61	32.59502	32.8943
Mar-08	31.62	31.60	31.55034	31.80635
Apr-08	29.26	29.25	29.19247	29.41191
May-08	27.01	27.00	26.93957	27.19525
Jun-08	26.98	26.98	26.90792	27.168 *
Jul-08	26.16	26.16	26.09187	26.32582
Aug-08	27.14	27.20	27.06467	27.33903
Sep-08	26.60	26.62	26.546	26.71831
therms/day use in…				
Oct-07	2.45	2.45	2.454846	2.447256
Nov-07	3.69	3.69	3.690222	3.675695
Dec-07	4.63	4.63	4.639679	4.614194
Jan-08	5.07	5.07	5.080978	5.049723
Feb-08	3.95	3.94	3.955583	3.93895
Mar-08	3.84	3.84	3.849284	3.829371
Apr-08	3.07	3.07	3.073234	3.055617
May-08	1.61	1.61	1.609415	1.610046
Jun-08	1.37	1.37	1.368782	1.369664
Jul-08	0.66	0.66	0.6498722	0.6711754 ***
Aug-08	0.66	0.66	0.6489835	0.6704728 ***
Sep-08	0.96	0.96	0.961564	0.9733857

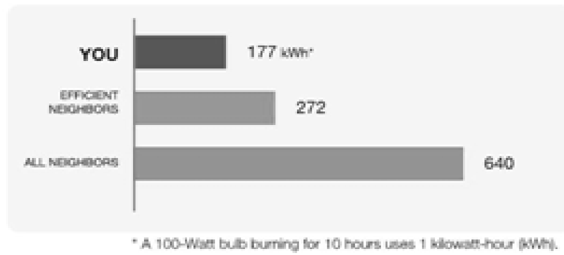
*significance at the 90% level
**significance at the 95% level
***significance at the 99% level

A3a: SMUD sample report, narrative template

Last month you used 35% LESS electricity than your efficient neighbors.

Your energy efficiency for the month was: Great!

You should feel good about your energy efficiency and the savings this means for you. To save even more energy and cost, see the back of this report for some personalized suggestions to help you improve your efficiency even more.

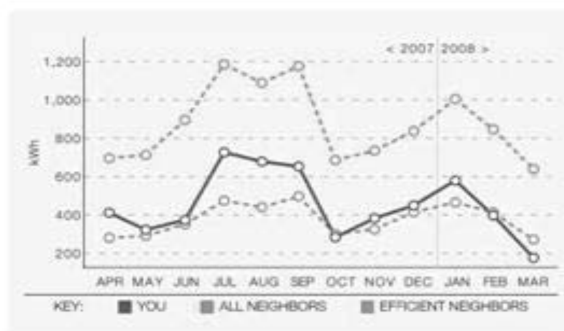


A3b: SMUD sample report, narrative template

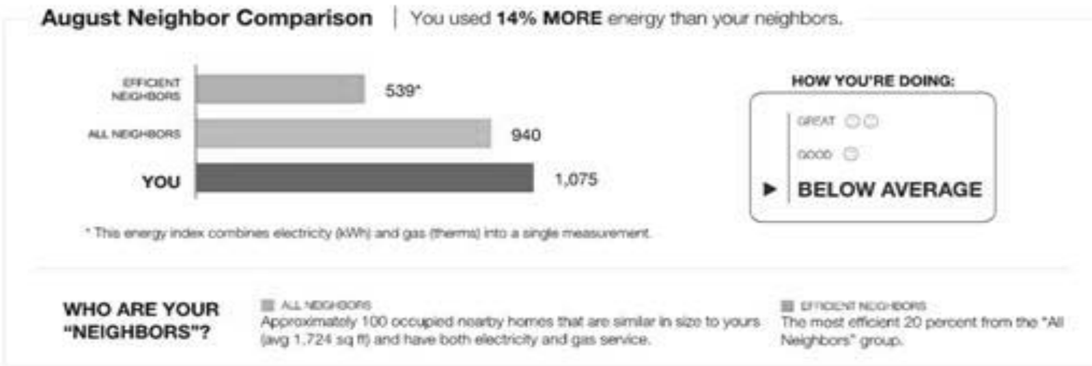
In the last 12 months you used 20% MORE than your efficient neighbors.
At today's rates this COSTS YOU ABOUT $85 EXTRA PER YEAR.

This means you have a great opportunity to save energy and money in the future.

The summer is a great time to focus on energy efficiency because of the high cost of air conditioning. You can reduce your home cooling costs by replacing your AC filter, maintaining your AC unit each year, and using fans.



A4a: PSE sample report



A4b: PSE sample report

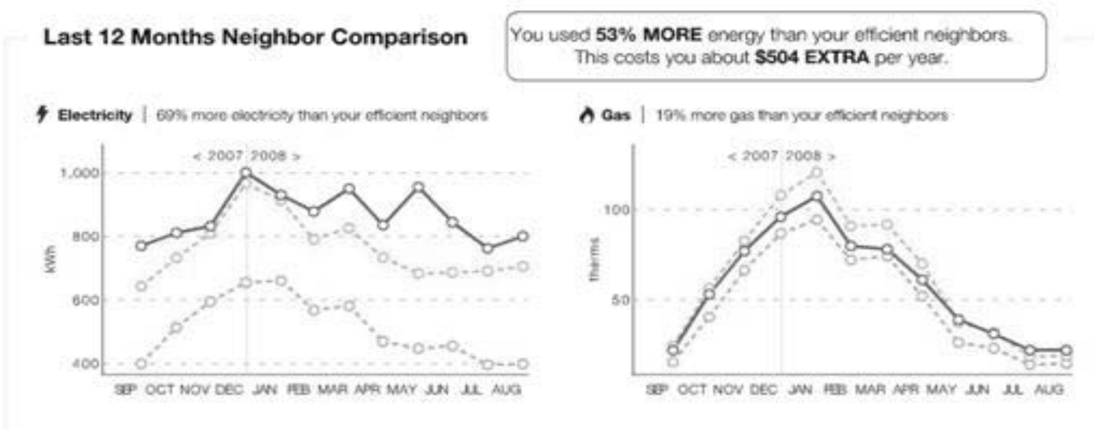


Exhibit I-2

IMPACT EVALUATION OF OPOWER SMUD PILOT STUDY

UPDATE – September 24, 2009

SUMMIT BLUE
CONSULTING, LLC

FINAL REPORT

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TABLE OF CONTENTS

1 EXECUTIVE SUMMARY

Information technologies designed to assist and encourage customers to use less energy are increasing in the industry. OPOWER offers an information program to help customers manage their energy use by providing reports comparing their energy use to the energy use of other similar households. These energy reports provide customers with normative comparisons of their current energy use compared to their neighbors and suggest actions that they can take to reduce their electric use. It is believed that there is a social driver at work in the presentation of energy use in this comparative fashion. If households learn they use more energy than their neighbors, it is assumed they will be motivated to reduce energy use and possibly do more than their neighbors.

OPOWER put this theory to the test with an aggressive experimental design across the Sacramento Municipal Utility District (SMUD). Census blocks were randomly assigned to treatment and control groups. Thirty-five thousand single-family residential customers in the treatment group received regular reports over the period of a year on how their energy use compared to their neighbors' energy use. Fifty thousand single-family customers in the control group did not receive any reports. The pilot began in April 2008. Billing data has been collected for all customers since the start of the program, including one year of billing data from before the test began, to support the impact evaluation of the program.

This report presents Summit Blue's independent third-party impact evaluation of the SMUD experimental design pilot conducted by OPOWER. The updated impact evaluation focuses on answering four basic research questions:

1. Does receiving the reports lead to energy savings?

2. Can the characteristics of large savers be identified?

3. What is the distribution of savings across customers?

4. What is the observed trend for energy savings in the second year of the pilot?

Does receiving the reports lead to energy savings?

Three different statistical methods were used to estimate savings from the program based on analysis of the first year of billing data. Table 1-1 shows that all three methods provided similar results, leading to the conclusion that the reports did indeed encourage customers to reduce their energy use. The estimate of annual savings from each of the three methods ranged from 2.1% to 2.2% showing strong robustness of results. The range around each of these estimates is tight, providing good reliability and precision.

The strength of these estimates rests on the clean design of the experiment and the very large sample sizes that were used. It is often difficult to accurately assess a program savings of 2% from billing analysis because of the wide range of variability in customer bills, but the large scale of this experiment allowed for accurate assessment of savings from this program. Given the consistent estimate of savings found across several methods and the tight range of precision around each estimate, it is clear that the OPOWER reports did encourage a reduction in energy use among customers who received them.

Table 1-1. Comparison of Savings Estimates from Three Statistical Methods

Method	*Average annual kWh savings*	*95% Confidence interval on avg. annual savings*	*Average annual percent savings*	*95% Confidence interval on avg. percent savings*
Method 1: Difference-in-Difference Statistic	257	-	2.20%	-
Method 2: Baseline OLS Linear Model	253.75	{216.81, 290.69)	2.24%	{1.91%, 2.56%}
Method 3: Baseline Differenced Linear Fixed Effects Model	240.88	{222.81, 258.95)	2.13%	{1.97%, 2.28%}

While annual savings were consistently estimated between 2.1% and 2.2%, this is an average of savings that actually varied by season across year one. Table 1-2 uses the difference in difference method to show that savings were the greatest during the summer at 2.6%, followed by a savings of 2.2% during the winter and 1.7% during the other shoulder months. Differences by season are reasonable and expected given that customers use electricity for different purposes during each season. Summer electric use and savings are the highest due to air-conditioning load. Winter use reflects additional lighting and some space heating. The shoulder months have the lowest overall use and savings.

Table 1-2. Savings by Season

Season	*Group*	*2007 KWH/Day*	*2008 KWH/Day*	*Difference KWH/Day*	*Percent Difference*
Summer: July, Aug, Sept Billing Months	Participants	37.53	37.10	-0.43	
	Control Group	37.83	38.37	+0.54	
				-0.97	-2.6%
Winter: Dec, Jan, Feb, Mar, Apr Billing Months	Participants	33.19	31.56	-1.63	
	Control Group	33.34	32.45	-0.89	
				-0.74	-2.2%
Shoulder Months: May, June, Oct, Nov	Participants	26.58	26.73	+0.15	
	Control Group	26.91	27.52	+0.61	
				-0.46	-1.7%

Participants with low electric use (less than 21.863 kWh/day) received reports quarterly while most participants received reports monthly

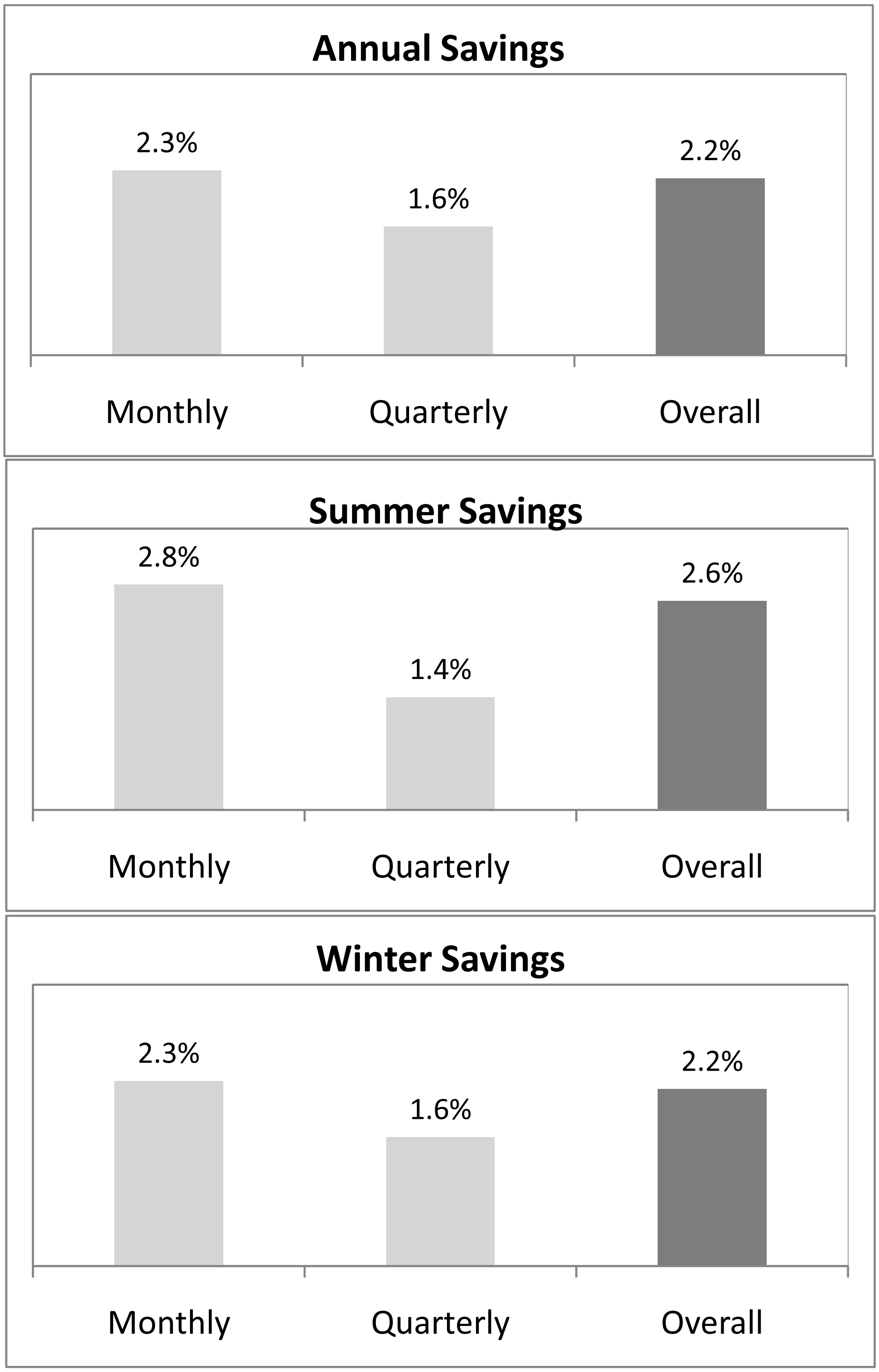
Table 1-3 shows that the high use customers receiving monthly reports achieved greater savings than low use customers receiving quarterly reports. However, both groups achieved savings in each season. Summer was the season showing the greatest savings for high use customers, while low use customers showed relatively consistent savings across all of the seasons.

Table 1-3. Comparison of Savings for Quarterly vs. Monthly Report Recipients

Method	***Summer Impact***	***Winter Impact***	***Shoulder Months Impact***	***Annual Impact***
Monthly Reports (High Use Customers)	-2.8%	-2.3%	-1.9%	-2.3%
Quarterly Reports (Low Use Customers)	-1.4%	-1.6%	-1.4%	-1.6%
Overall	-2.6%	-2.2%	-1.7%	-2.2%

These seasonal differences for the different report frequencies are illustrated in **Error! Reference source not found.**.1 on the next page.

Figure 1-1. Comparison of Savings for Monthly vs. Quarterly Report Recipients



Can the characteristics of large savers be identified?

Both methods 2 and 3 were used to test the contribution of different customer characteristics to savings.

Using method 2, it was found that the only housing characteristics that have a statistically significant effect on energy savings under the program are the presence of a pool and the value of the residence, though as a practical matter the effect of the latter is minor (a $10,000 increase in home value increases savings by 0.077 Kwh/day). The other housing characteristics examined in the analysis—*the presence of a spa, electric space heating, square footage and age of the home* —were not statistically significant at the .05 alpha level.

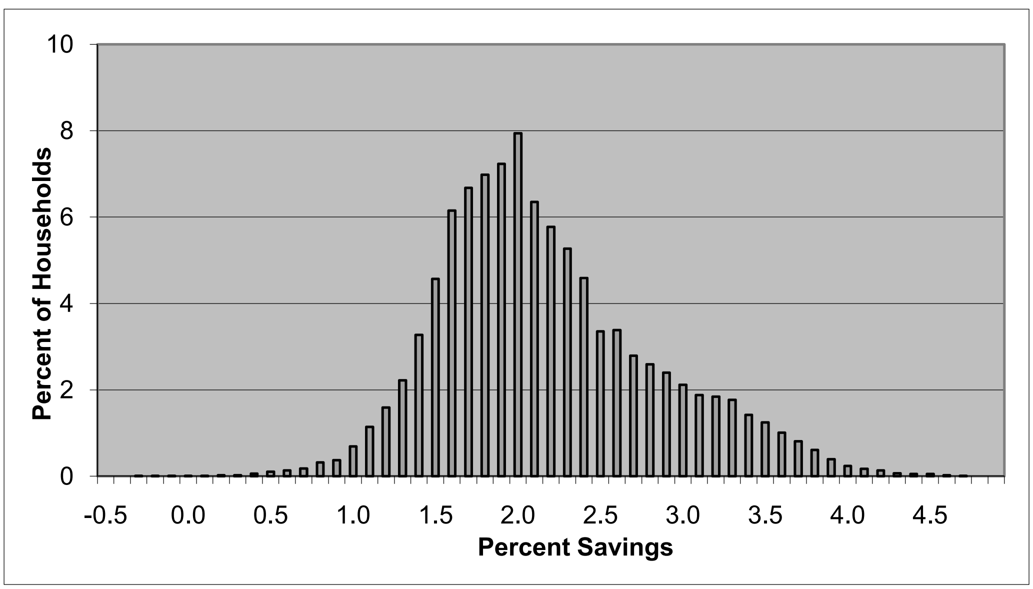
Using method 3, the only housing characteristic affecting energy savings is the presence of a pool.

The upshot of the analysis is that except for the presence/absence of a pool, it is difficult to forecast savings under the program based on housing characteristics. It must be remembered, however, that there is a strong savings response to cooling degree days which indicates that the presence of air conditioning contributes to the overall savings.

What is the distribution of savings across customers?

The method 2 linear regression model was used to predict the distribution of savings within the participant group. Figure 1-2 shows that savings were predicted for nearly all customers. As noted previously, the average savings is about 2.2%. Predicted percent savings for 50% of all households lie in the interval {1.6, 2.2}, predicted savings for 80% of all households lie in the interval {1.4, 2.9}, and predicted savings for 95% of all households lie in the interval {1.1, 3.5}.

Figure 1-2. Frequency distribution of predicted percent annual energy savings (2007 as base year) within the treatment group



This distribution curve shows that savings are predicted for virtually all individuals, rather than being possible for just a small subset of customers with particular characteristics. It is important to emphasize that this frequency distribution describes *expected* savings within the sample, *conditional* on observed housing characteristics such as square footage of the residence, the presence/absence of a pool, the assessed value of the residence, and so forth, based on the point estimates of the OLS regression of method 2. For a given set of housing characteristics, some households in the real world will generate greater savings and some less than indicated in this modeled distribution.

What is the observed trend for energy savings in the second year of the pilot?

Initial analysis based on four months of data from the second year of the pilot, May through August 2009, indicates that the energy savings are going up in the second year. Two of these months, May and June, are Shoulder Months while July and August are part of the Summer season. The difference of differences approach was used to estimate the savings over this entire four month period, and also to give a focused look at what happened over the two summer months.

Table 1-4. Second Year Savings based on Difference of Differences Method

Period	*Group*	*2007 kWh per Cust*	*2008 kWh per Cust*	*2009 kWh per Cust*	*2007-2008 Difference*	*Percent Savings*	*2007-2009 Difference*	*Percent Savings*
May, June, July, and August	Participants	3,921	3,909	3,769	-12		-152	
	Control Group	*3,979*	*4,054*	*3,935*	*75*		*-44*	
					-87	**-2.2%**	**-108**	**-2.8%**
July and August	Participants	2254	2260	2165	6		-89	
	Control Group	*2275*	*2345*	*2266*	*70*		*-9*	
					-64	**-2.8%**	**-80**	**-3.5%**

Table 1.4 shows that looking at both the four month period and the two month summer period, savings increased during the second year of the pilot compared to what was achieved in the first year. During the four month period of May, June, July and August, participants reduced their energy use by 2.2% in 2008 and then achieved even more savings in 2009, dropping their energy use by 2.8% from the base year period. This indicates that there is a cumulative effect to the program and as it continues over time the participants find additional ways to reduce their energy consumption, or, alternatively, additional participants start taking energy saving actions.

The cumulative increase in savings is even more pronounced when focusing only on the high use summer months of July and August. In these two months, participants reduced their energy use by 2.8% in 2008 and then managed to achieve a reduction of 3.5% in 2009. The ability to easily adjust their air-conditioning use, which is typically the largest electric use in homes during these months, is likely to be the cause of these higher summer month savings.

It is of interest to note that savings increased in the second year even while the months of May through August in 2009 were slightly cooler than the same months in 2008.

2 BACKGROUND AND OBJECTIVES

Information technologies designed to assist and encourage customers to use less energy are increasing in the industry. There are a wide variety of information technology options available for accomplishing this purpose. Some focus on hardware solutions that put devices into a customer's home to give them information on current energy use. These devices can be expensive.

OPOWER offers an alternative low cost information program to help customers manage their energy use by providing reports comparing their energy use to the energy use of other similar households. These energy reports provide customers with normative comparisons of their current energy use compared to their neighbors and suggest actions that they can take to reduce their electric use.

It is believed that there is a social driver at work in the presentation of energy use in this comparative fashion. If households learn they use more energy than their neighbors, it is assumed they will be motivated to reduce energy use and possibly do more than their neighbors.

OPOWER put this theory to the test with an aggressive experimental design across the Sacramento Municipal Utility District (SMUD). Census blocks were randomly assigned to treatment and control groups. Thirty-five thousand single-family residential customers in the treatment group received regular reports over the period of a year on how their energy use compared to their neighbors' energy use. Fifty thousand single-family customers in the control group did not receive any reports.

The pilot began in April 2008. Billing data has been collected for all customers since the start of the program, including one year of billing data from before the test began, to support the impact evaluation of the program. Summit Blue provided an initial impact evaluation of the program after one year of test data had been collected. The initial report was issued in May of 2009 and evaluated annual savings and savings by season for the first year. This report is an update of the original and provides results from additional billing data collected for May through August of 2009. Most of this update repeats the results of the first year analysis from the initial report, with updated savings estimates for the first four months of the second year of the pilot presented separately in Section 4.2.

Evaluation Objectives

The impact evaluation which is the focus of this report has both primary and secondary evaluation objectives related to the OPOWER customer reports that were tested in the SMUD pilot.

The primary objective is to answer the basic question:

> Does receiving the reports lead to energy savings?

Additional secondary objectives were also identified. These include:

1. What is the distribution of savings across customers?
2. Can the characteristics of large savers be identified?
3. What is the observed trend for energy savings in the second year of the pilot?

The remainder of this report will present the findings to these key evaluation questions.

3 ANALYSIS METHODS

A large set of data generated by a well-constructed experimental design was provided for estimation of impacts of the SMUD Pilot Study. We estimated program impacts using three distinct statistical approaches. Each approach is presented below. Results are presented in section 4.

3.1 Method 1: Difference-in-Difference Statistic

Assuming random assignment of a large number of treatment and control households, a simple difference-in-difference statistic provides a good estimate of the average annual household savings in energy use (measured in kwh) from the treatment.

Denote by $\overline{E}_{pg}$ the average annual rate of kwh use in period *p* (*p*=0 for the pre-treatment period, *p*=1 for the post-treatment period) by households in group *g* (*g*=0 for the treatment group, *g*=1 for control group). The difference-in-difference statistic is the difference between the control and treatment groups in the *change* in their annual rate of kwh use across the pre- and post-treatment periods. Formally,

$$\begin{aligned} \triangle E &= \left(\overline{E}_{11} - \overline{E}_{01}\right) - \left(\overline{E}_{10} - \overline{E}_{00}\right) \\ &= \triangle\overline{E}_1 - \triangle\overline{E}_0 \end{aligned} \quad . \qquad (1)$$

Dividing the difference-in-difference statistic by the average energy use of the control group in the pre-treatment period gives the proportional reduction from treatment,

$$\text{Prop reduction} = \frac{\triangle E}{\overline{E}_{01}} \ . \qquad (2)$$

3.2 Method 2: Linear Regression (LR) Models

A second approach is to cast household energy use as a function of a variety of explanatory variables including: a) group membership (treatment vs. control); b) observation period (pre- versus post-treatment); c) relevant weather-related variables such as heating degree days; d) observable housing/household characteristics such as square footage of the residence and the number of household members; and e) an error term reflecting unobservable variables (or alternatively, variables that are not included in the available data set).

The simplest version convenient for exposition is a linear specification in which average daily use (*ADU*) of kilowatt-hours by household *k* in month t (where months are assigned consecutively throughout the study period), is a function of three variables: the binary variable $Treatment_k$, taking a value of 0 if household *k* is assigned to the control group, and 1 if assigned to the treatment group; the binary variable $Post_t$, taking a value of 0 if month *t* is in the pre-treatment period, and 1 if in the post-treatment period; and the interaction between these variables, $Treatment_k \cdot Post_t$. Formally,

$$ADU_{kt} = \alpha_0 + \alpha_1 Treatment_k + \alpha_2 Post_t + \alpha_3 Treatment_k \cdot Post_t + \varepsilon_{kt} \qquad (3)$$

Three observations about this specification deserve comment. First, the treatment response is captured by the coefficient α_3. This term captures the *difference in the difference* in average daily kwh use between the treatment group and the control group across the pre- and post-treatment periods. In other words, whereas the coefficient α_2 captures the change in average daily kwh use across the pre- and post-treatment for the *control* group, the sum $\alpha_2 + \alpha_3$ captures this change for the treatment group.

Second, the coefficient α_1 captures the effect of assignment to the treatment group *before* the treatment is actually administered. Given assignment of households to the treatment group via random assignment of census blocks, the *a priori* expected value of α_1 is of course zero, though because the sample of census blocks in the analysis is finite it is not necessarily zero. In other words, including the variable $Treatment_k$ prevents the possibility of bias in the estimate of the treatment effect α_3 that would otherwise exist if households in the treatment group were systematically different than those in the control group.

Third, if the error term ε_{kt} is independent and identically distributed across observations, ordinary least squares (OLS) regression will generate unbiased and efficient estimates. As noted in section 3.3, if the error term includes unobservable housing/household characteristics, then errors are temporally correlated, and ordinary least squares (OLS) regression will generate inefficient parameter estimates. Nonetheless, OLS regression is a useful benchmark, will give good estimates if unobserved household-level effects are negligible, and the method discussed in section 3.3 addresses the case when they are not.

The model can be expanded to include three other types of variables. weather-related variables, housing/household characteristics, and treatment variables reflecting differences in the particular treatment of treatment households. For each of the weather variables and housing characteristics included in estimation, four terms are added: the variable itself; the variable interacted with $Treatment_k$ to capture differential effects due to treatment category; the variable interacted with $Post_t$ to capture differential effects of the variable due to exogenous shocks across the two study periods; and the variable interacted with the interaction $Treatment_k \cdot Post_t$ to capture the effect of the variable on the treatment response.

For each of the treatment variables included in estimation, three terms are added to the model: the variable interacted with $Treatment_k$, the variable interacted with $Post_t$, and the variable interacted with $Treatment_k \cdot Post_t$. This last interaction term captures the effect of the differential treatment on the treatment response.

Formally, defining $\mathbf{V}_k$ as a vector of treatment variables, $\boldsymbol{W}_t$ as a vector of weather characteristics in month t, and $\boldsymbol{Z}_k$ as a vector of housing/household characteristics for household k, we have the expanded linear model,

$$\begin{aligned} ADU_{kt} = {} & \alpha_0 + \alpha_1 Treatment_k + \alpha_2 Post_t + \alpha_3 Treatment_k \cdot Post_t \\ & + \lambda_1 \mathbf{V}_k \cdot Treatment_k + \lambda_2 \mathbf{V}_k \cdot Post_t + \lambda_3 \mathbf{V}_k \cdot Treatment_k \cdot Post_t \\ & + \beta_0 \mathbf{W}_t + \beta_1 \mathbf{W}_t \cdot Treatment_k + \beta_2 \mathbf{W}_t \cdot Post_t + \beta_3 \mathbf{W}_t \cdot Treatment_k \cdot Post_t \\ & + \delta_0 \mathbf{Z}_k + \delta_1 \mathbf{Z}_k \cdot Treatment_k + \delta_2 \mathbf{Z}_k \cdot Post_t + \delta_3 \mathbf{Z}_k \cdot Treatment_k \cdot Post_t + \varepsilon_{kt} \end{aligned} \quad , \tag{4}$$

where the coefficients λ_i, β_i and δ_i are vector-valued of conformable dimension. In this model, the average daily treatment effect (ADTE) is the sum of all terms multiplying the interaction term $Treatment_k \cdot Post_t$:

$$ADTE_{kt} = \alpha_3 + \lambda_3 \mathbf{V}_k + \beta_3 \mathbf{W}_t + \delta_3 \mathbf{Z}_k \ . \tag{5}$$

3.3 Method 3: Differenced Linear Fixed Effects (DLFE) Model

The linear regression (LR) models of section 3.2 will generate biased estimates of treatment response *if* the household-specific error ε_{kt} is correlated with the treatment assignment variable $Treatment_k$. Given the careful experimental design of the study, this seems highly unlikely. However remote the possibility, it can be avoided by estimating a fixed effects model in which a household fixed effects parameter α_{0k} captures all household-specific effects on energy use that do not change over time, including those that are unobservable. With reference to section 3.2 above, and defining φ_k as the household-specific portion of the error, the fixed effects parameter is defined as:

$$\alpha_{0k} = \alpha_0 + \alpha_1 Treatment_k + \lambda_1 \mathbf{V}_k \cdot Treatment_k + \delta_0 \mathbf{Z}_k + \delta_1 \mathbf{Z}_k \cdot Treatment_k + \varphi_k \quad , \tag{6}$$

and the fixed effects model is the corresponding modification of (4):

$$\begin{aligned} ADU_{kt} &= \alpha_{0k} + \alpha_2 Post_t + \alpha_3 Treatment_k \cdot Post_t \\ &+ \lambda_2 \mathbf{V}_k \cdot Post_t + \lambda_3 \mathbf{V}_k \cdot Treatment_k \cdot Post_t \\ &+ \beta_0 \mathbf{W}_t + \beta_1 \mathbf{W}_t \cdot Treatment_k + \beta_2 \mathbf{W}_t \cdot Post_t + \beta_3 \mathbf{W}_t \cdot Treatment_k \cdot Post_t \\ &+ \delta_2 \mathbf{Z}_k \cdot Post_t + \delta_3 \mathbf{Z}_k \cdot Treatment_k \cdot Post_t + \varepsilon_{kt} \end{aligned} \tag{7}$$

In the fixed effect model, estimation of the set of parameters $\{\alpha_0, \alpha_1, \delta_0, \delta_1\}$ in the LR model (4) is replaced by estimation of the fixed effects parameter α_{0k} for *each* household in the sample; in the current study of approximately 85,000 households, this is not a feasible exercise. We instead take advantage of the favorable properties of the fixed effects model—in particular the elimination of the aforementioned potential bias—while avoiding the estimation of the fixed effects parameters, as follows. First, the average of monthly *ADU* is modeled for each household using (7), by taking the average over all variables (this includes the average of variables that are interactions). Using (7) to average across all such monthly observations for a household gives (where "bars" on variables indicate means):

$$\begin{aligned} \overline{ADU}_k &= \alpha_{0k} + \alpha_2 \overline{Post}_t + \alpha_3 \left(\overline{Treatment_k \cdot Post_t} \right) \\ &+ \lambda_2 \left(\overline{\mathbf{V}_k \cdot Post_t} \right) + \lambda_3 \left(\overline{\mathbf{V}_k \cdot Treatment_k \cdot Post_t} \right) \\ &+ \beta_0 \overline{\mathbf{W}}_t + \beta_1 \left(\overline{\mathbf{W}_t \cdot Treatment_k} \right) + \beta_2 \left(\overline{\mathbf{W}_t \cdot Post_t} \right) + \beta_3 \left(\overline{\mathbf{W}_t \cdot Treatment_k \cdot Post_t} \right) \\ &+ \delta_2 \left(\overline{\mathbf{Z}_k \cdot Post_t} \right) + \delta_3 \left(\overline{\mathbf{Z}_k \cdot Treatment_k \cdot Post_t} \right) + \overline{\varepsilon}_{kt} \end{aligned} \quad . \tag{8}$$

Equation (8) is then subtracted from (7) for each household. This generates deviations in monthly household ADU from the household's average monthly ADU. Defining deviations by the symbol "$\vartriangle$" (so, for instance, the deviation in the dependent variable is $\vartriangle ADU_{kt} = ADU_{kt} - \overline{ADU}_k$), we have,

$$
\begin{aligned}
\triangle ADU_k &= \alpha_2 \triangle Post_t + \alpha_3 \triangle \left(Treatment_k \cdot Post_t \right) \\
&+ \lambda_2 \triangle \left(\mathbf{V}_k \cdot Post_t \right) + \lambda_3 \triangle \left(\mathbf{V}_k \cdot Treatment_k \cdot Post_t \right) \\
&+ \beta_0 \triangle \mathbf{W}_t + \beta_1 \triangle \left(\mathbf{W}_t \cdot Treatment_k \right) + \beta_2 \triangle \left(\mathbf{W}_t \cdot Post_t \right) + \beta_3 \triangle \left(\mathbf{W}_t \cdot Treatment_k \cdot Post_t \right) \\
&+ \delta_2 \triangle \left(\mathbf{Z}_k \cdot Post_t \right) + \delta_3 \triangle \left(\mathbf{Z}_k \cdot Treatment_k \cdot Post_t \right) + \triangle \varepsilon_{kt}
\end{aligned} \qquad (9)
$$

Note that because the fixed effect α_{0k} is the same in every observation period, $\bar{\alpha}_{0k} = \alpha_{0k}$, it is eliminated from (9). Moreover, if ε_{kt} in (7) is an independent and identically distributed normal random variable, then so too is $\triangle\varepsilon_{kt}$, and unbiased parameter estimates are obtained via OLS regression. Finally, the equation generating the estimate of the average daily treatment effect is the same as in the LR model, equation (5).

3.4 Summary of Methods: Relative Strengths and Weaknesses

The difference-in-difference statistic (method 1) has the advantage of simplicity. However, if the assignment of households to the treatment and control groups is not random, or the sample is small, it may deviate substantially from the true treatment effect. Moreover, it provides no information about the effect of household characteristics and treatment variables on program efficacy.

The LR models of method 2 allow examination of the effect of housing/household characteristics on the treatment effect. The main potential disadvantage of these models is that if unobservable housing/household characteristics affecting the treatment response are correlated with assignment to the treatment group—highly unlikely given the careful experimental design of the study—the estimated effect of the average treatment response will be biased. Moreover, correlation of household-level unobservables over time and/or across households will bias the estimates of standard errors and therefore invalidate statistical inference (more on this in the concluding paragraph of this section below).

The DLFE models of method 3 forego the opportunity to estimate the effect of housing/household characteristics on average daily use of kwh in exchange for assuring no bias in estimates of the average treatment response due to correlation between housing/household characteristics and household assignment across the treatment and control groups. All housing/household characteristics that do not change over time—observable and unobservable characteristics alike—are embedded in the fixed effect, which in turn is eliminated from estimation by differencing. It is important to emphasize, though, that estimating the effect of housing characteristics and treatment variables on treatment response *is* possible, because the variables used to measure this effect—interactions involving the variable $Post_t$—do change over time.

We present the results of all three methods to demonstrate that the estimate of overall savings is robust to the modeling approach. But on theoretical grounds we strongly favor the third method—the DLFE model—because of the role that the household-level fixed effect parameters play in eliminating correlation among errors. This correlation may have severe consequences for statistical inference and may arise for several reasons. The most obvious is that certain unobservable household characteristics likely persist over time. A second is that certain unobservables may be common to households within a neighborhood, causing spatially-correlated errors across households within a neighborhood. Finally, despite the randomization by census block of the assignment of households to the treatment and control groups, there remains the possibility that households within the control group, or within the treatment group, share certain unobservable characteristics.

In the LR model we account for this last source of correlation by including the treatment variable $Treatment_k$, which effectively removes the correlation from the error term by capturing treatment-specific unobservables in the coefficient α_1. In the absence of census-block dummy variables in the model, it is possible that α_1 is also capturing spatial correlations across households, because of the block randomization of the experiment. The DLFE model addresses all three sources of correlation by sweeping them into the household-level fixed effects parameter and then eliminating this parameter from estimation by differencing the data. In other words, this approach accounts for household-specific unobservables broadly defined, including neighborhood-level unobservables (a characteristic of the household is its neighborhood) and unobservables possibly arising from the particular grouping of households into treatment vs. control (a characteristic of the household is its assignment to treatment vs. control).

4 FINDINGS

The calculation of the difference-in-difference statistic from (1) is straightforward, but the calculation of energy savings from the LR model (method 2) and the DLFE model (method 3) depends on the particular specification of the models. In the next section we provide the average annual savings generated by the difference-in-difference statistic and the *baseline* LR and DLFE models. In section 4.2, we discuss the baseline LR and DLFE models in more detail, and in section 4.4 we expand the LR model to examine the effect of household characteristics on the treatment response. In section 4.5, we examine the distribution of savings in the population, including the difference in savings between households contacted monthly and those contacted quarterly.

4.1 Estimates of Average Annual Savings

As discussed in the previous section, three different methods were used to estimate average annual savings from the program. Results from each method will now be presented.

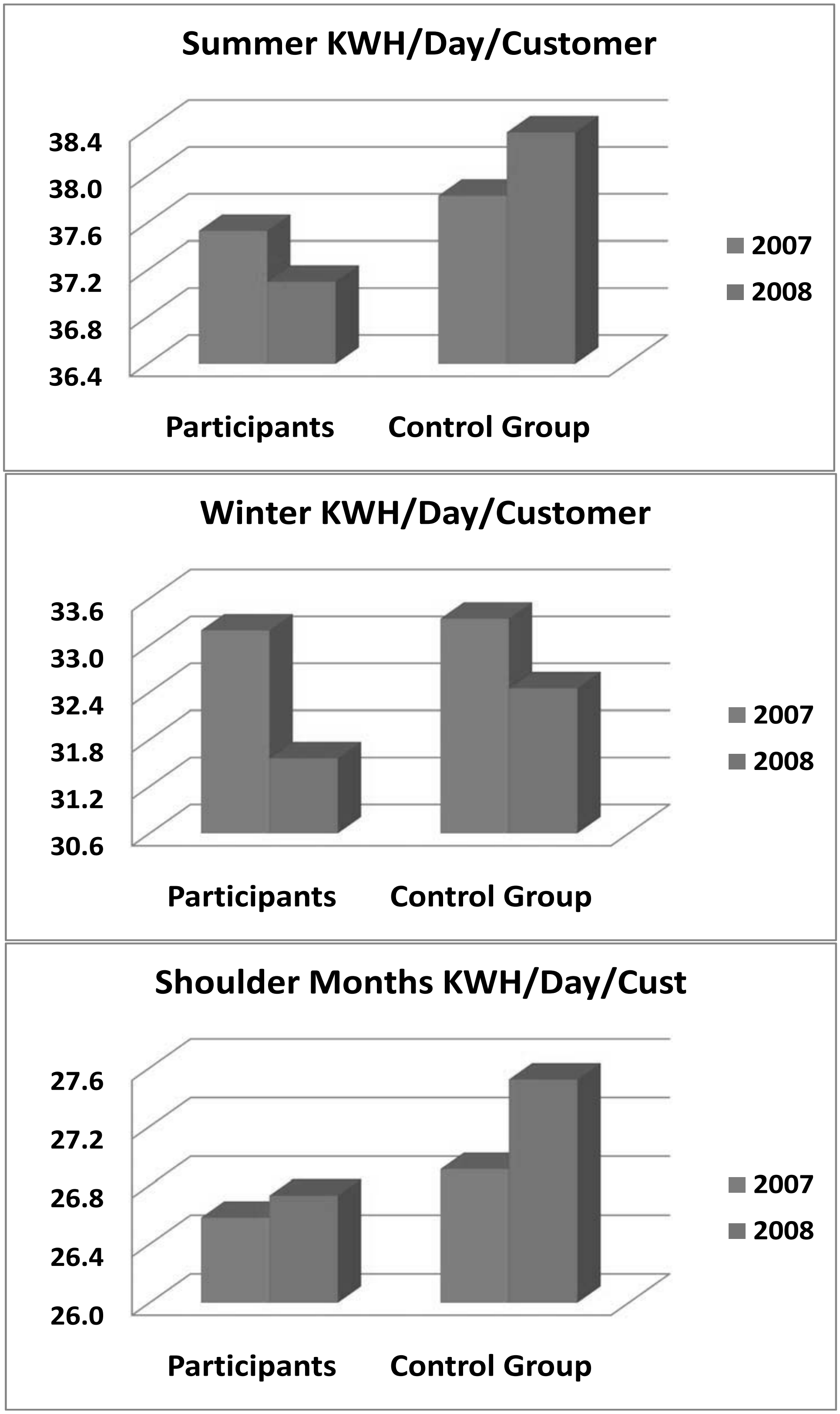
Table 4-1 summarizes the estimation of savings by season using method 1, the difference in differences approach, with the first full year of billing data . It shows that savings were the greatest during the summer at 2.6%, followed by a savings of 2.2% during the winter and 1.7% during the other shoulder months. Differences by season are reasonable and expected given that customers use electricity for different purposes during each season. Summer electric use, and savings, are the highest due to air-conditioning load. Winter use reflects additional lighting and some space heating. The shoulder months have the lowest overall use and savings.

Table 4-1. Savings by Season from Difference in Differences Method

Season	*Group*	*2007 KWH/Day*	*2008 KWH/Day*	*Difference KWH/Day*	*Percent Difference*
Summer: July, Aug, Sept Billing Months	Participants	37.53	37.10	-0.43	
	Control Group	37.83	38.37	+0.54	
				-0.97	-2.6%
Winter: Dec, Jan, Feb, Mar, Apr Billing Months	Participants	33.19	31.56	-1.63	
	Control Group	33.34	32.45	-0.89	
				-0.74	-2.2%
Shoulder Months: May, June, Oct, Nov	Participants	26.58	26.73	+0.15	
	Control Group	26.91	27.52	+0.61	
				-0.46	-1.7%

The consistent savings behavior of the participants across all of the seasons can be clearly seen in Figure 4-1. This is most dramatic during the summer when participants reduce their use while control group use increases.

Figure 4-1. Savings by Season from Difference in Differences Method



The observed savings per day by season can be used to estimate the annual savings from the program based on the first full year of data. Table 4-2 shows that the estimated annual savings is 257 kWh per customer which represents a 2.2% reduction in use for participants.

Table 4-2. Annual Savings from Difference in Difference Method

Method	*KWH per Day per Customer Difference*	*Days per Year*	*Annual KWH Savings per Customer*	*Percent Savings*
Summer	-0.97	92	-89	
Winter	-0.74	151	-112	
Shoulder Months	-0.46	122	-56	
Annual			-257	-2.2%

Estimated savings from methods 2 and 3 are based on a baseline model specification in which terms concerning heating and cooling degree days are added to the simplest model (3). In particular, the baseline LR model is,

$$\begin{aligned} ADU_{kt} &= \alpha_0 + \alpha_1 Treatment_k + \alpha_2 Post_t + \alpha_3 Treatment_k \cdot Post_t \\ &+ \beta_{H0} HDDd_t + \beta_{H1} HDDd_t \cdot Treatment_k + \beta_{H2} HDDd_t \cdot Post_t + \beta_{H3} HDDd_t \cdot Treatment_k \cdot Post_t \\ &+ \beta_{C0} CDDd_t + \beta_{C1} CDDd_t \cdot Treatment_k + \beta_{C2} CDDd_t \cdot Post_t + \beta_{C3} CDDd_t \cdot Treatment_k \cdot Post_t + \varepsilon_{kt} \end{aligned} \quad ,(10)$$

where $HDDd_t$ is heating degree days per day in month *t*, and $CDDd_t$ is cooling degree days per day in month *t*. Similarly, the baseline DLFE model is,

$$\begin{aligned} ADU_{kt} &= \alpha_2 Post_t + \alpha_3 Treatment_k \cdot Post_t \\ &+ \beta_{H0} \Delta HDDd_t + \beta_{H1} \Delta (HDDd_t \cdot Treatment_k) + \beta_{H2} \Delta (HDDd_t \cdot Post_t) + \beta_{H3} \Delta (HDDd_t \cdot Treatment_k \cdot Post_t) \\ &+ \beta_{C0} \Delta CDDd_t + \beta_{C1} \Delta (CDDd_t \cdot Treatment_k) + \beta_{C2} \Delta (CDDd_t \cdot Post_t) + \beta_{C3} \Delta (CDDd_t \cdot Treatment_k \cdot Post_t) + \varepsilon_{kt} \end{aligned} \quad . (11)$$

From (5), for both models the effect of treatment on average daily Kwh use—the average daily treatment effect (ADTE)— is,

$$ADTE_t = \alpha_3 + \beta_{H3} HDDd_t + \beta_{C3} CDDd_t \ . \quad (12)$$

Expanding (12) by using 2007 values of $HDDd_t$ and $CDDd_t$ generates the equation used in the calculation of annual savings due to the treatment effect (*AnnTE*) reported in Table 4-3:

$$AnnTE = \alpha_3 \cdot 365 + \beta_{H3} \cdot 2622 + \beta_{C3} \cdot 853 \quad (13)$$

Table 4-3 compares the estimated annual savings from each of the three methods. Two results deserve comment. First, all three methods give approximately the same result of an annual savings of about 2.1-2.2%. We found this result to hold across a wide variety of model specifications. Second, these estimates are very reliable, having a range of 1.9 to 2.6% at the 95% confidence level. The confidence intervals for methods 2 and 3 were calculated using the delta method (Greene 2002). They reflect the degree of precision in model parameter estimates, and are based on energy use in the sample in 2007 (the pre-treatment period), and thus on heating and cooling degree days in 2007. Along with the mean savings, these intervals would expand or contract somewhat depending on annual weather.

Table 4-3. Summary of Average Annual KWH Savings

Method	*Average annual kWh savings*	*95% Confidence interval on avg. annual savings*	*Average annual percent savings*	*95% Confidence interval on avg. percent savings*
Method 1: Difference-in-Difference Statistic:	257	-	2.20%	-
Method 2: Baseline OLS Linear Model	253.75	{216.81, 290.69)	2.24%	{1.91%, 2.56%}
Method 3: Baseline Differenced Linear Fixed Effects Model	240.88	{222.81, 258.95)	2.13%	{1.97%, 2.28%}

4.2 New Results with Additional Data

This section presents updated savings results for the first four months of the second year of the pilot, May through August 2009. Two of these months, May and June, are Shoulder Months while July and August are part of the Summer season. This update uses the difference of differences approach to estimate the savings seen in the additional data. First we will look at total savings over the new four months, and then we will give a focused look at what happened over the two summer months.

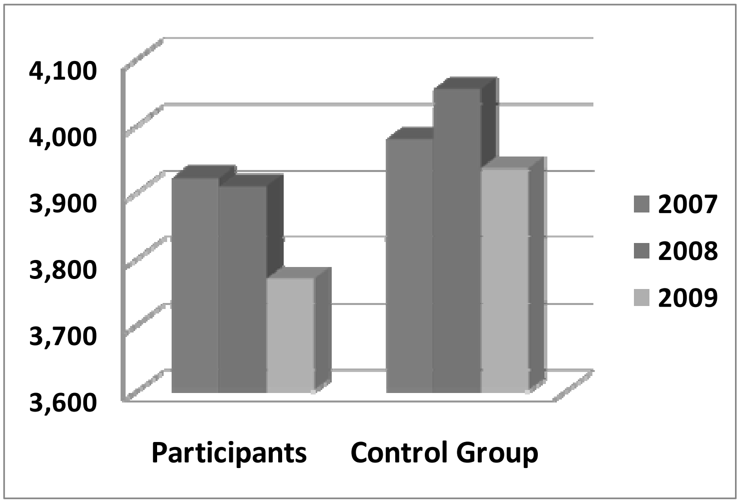
Table 4-4. Second Year Savings based on Difference of Differences Method

Period	*Group*	*2007 kWh per Cust*	*2008 kWh per Cust*	*2009 kWh per Cust*	*2007-2008 Difference*	*Percent Savings*	*2007-2009 Difference*	*Percent Savings*
May, June, July, and August	Participants	3,921	3,909	3,769	-12		-152	
	Control Group	*3,979*	*4,054*	*3,935*	*75*		*-44*	
					-87	**-2.2%**	**-108**	**-2.8%**
July and August	Participants	2254	2260	2165	6		-89	
	Control Group	*2275*	*2345*	*2266*	*70*		*-9*	
					-64	**-2.8%**	**-80**	**-3.5%**

Table 4.4 shows that looking at both the four month period and the two month summer period, savings increased during the second year of the pilot compared to what was achieved in the first year. During the four month period of May, June, July and August, participants reduced their energy use by 2.2% in 2008

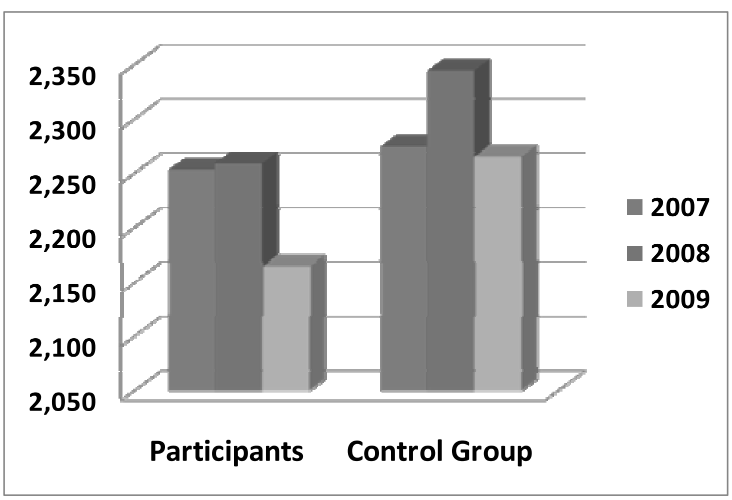
and then achieved even more savings in 2009, dropping their energy use by 2.8% compared to the base year period. This indicates that there is a cumulative effect to the program and as it continues over time the participants find additional ways to reduce their energy consumption, or, alternatively, additional participants start taking energy saving actions. Figure 4.2 illustrates how average kWh per customer changed for the participants and the control group during these four months over the study timeframe.

Figure 4-2. Average kWh per Customer for May, June, July and August



The cumulative increase in savings is even more pronounced when focusing only on the high use summer months of July and August. In these two months, participants reduced their energy use by 2.8% in 2008 and then managed to achieve a reduction of 3.5% in 2009. The ability to easily adjust their air-conditioning use, which is typically the largest electric use in homes during these months, is likely to be the cause of these higher summer month savings. Figure 4.3 shows average kWh use for these two months.

Figure 4-3. Average kWh per Customer for July and August



It is of interest to note that savings increased in the second year even while the months of May through August in 2009 were slightly cooler than the same months in 2008.

4.3 Differential Effect of Heating/Cooling Degree Days on Treatment and Control Households

Parameter estimates derived from the baseline LR model (10) are presented in Table 4-5, and estimates of the same parameters derived from the baseline DLFE model (11) are presented in Table 4.6.

Parameter estimates are interpreted as the marginal effect of a change in the variable on energy use. So, for instance, the LR model indicates that a 1-unit increase in heating degrees days per day increases average daily consumption of energy by .739 Kwh, while the DLFE model indicates such a change would increase average daily consumption by .730 Kwh.

The models are in good agreement with regard to the average daily treatment effect (see equation (12)). The LR model indicates that on a day free of heating and cooling degree days, the treatment reduces consumption of energy by 0.448 Kwh; each heating degree day adds 0.0182 to the savings, and each cooling degree day adds 0.0498 to the savings. These figures for the DLFE model are 0.326, 0.0245, and 0.0675, respectively. In the DLFE model, all treatment terms are significant at the .01 level. Estimates of the treatment effects in the LR model are less precise; the treatment terms $Treatment_k \cdot Post_t$ and $CDDd_t \cdot Treatment_k \cdot Post_t$ are significant at the .05 level, and the treatment term $HDDd_t \cdot Treatment_k \cdot Post_t$ is significant at the .08 level.

Table 4-5. Parameter estimates using the baseline Linear Regression (LR) Model (Dependent variable: Average daily Kwh; treatment terms shaded)

Variable	*Parameter estimate*	*Standard error*	*t-statistic*
Intercept	20.03454	0.05397	371.24
$Treatment_k$	-0.34995	0.08422	-4.16
$Post_t$	1.01504	0.08935	11.36
$Treatment_k \cdot Post_t$	-0.44838	0.13928	-3.22
$HDDd_t$	0.73943	0.00393	188.39
$HDDd_t \cdot Post_t$	-0.06662	0.00664	-10.04
$HDDd_t \cdot Treatment_k$	0.00277	0.00612	0.45
$HDDd_t \cdot Treatment_k \cdot Post_t$	-0.01815	0.01036	-1.75
$CDDd_t$	2.49685	0.01061	235.42
$CDDd_t \cdot Post_t$	-0.30645	0.01588	-19.3
$CDDd_t \cdot Treatment_k$	-0.03342	0.01652	-2.02
$CDDd_t \cdot Treatment_k \cdot Post_t$	-0.04983	0.0247	-2.02

Table 4-6. Parameter estimates using the baseline Differenced Linear Fixed Effects (DLFE) model (Dependent variable: Average daily Kwh)

Variable	*Parameter estimate*	*Standard error*	*t-statistic*
$Post_t$	-0.13361	0.04369	-3.06
$Treatment_k \cdot Post_t$	-0.32591	0.0681	-4.79
$HDDd_t$	0.73034	0.00192	380.76
$HDDd_t \cdot Post_t$	-0.01074	0.00324	-3.31
$HDDd_t \cdot Treatment_k$	0.0041	0.00299	1.37
$HDDd_t \cdot Treatment_k \cdot Post_t$	-0.02453	0.00506	-4.85
$CDDd_t$	2.44219	0.00518	471.24
$CDDd_t \cdot Post_t$	-0.16486	0.00776	-21.24
$CDDd_t \cdot Treatment_k$	-0.02305	0.00807	-2.86
$CDDd_t \cdot Treatment_k \cdot Post_t$	-0.06754	0.01208	-5.59

4.4 Extending the Analysis: The Effect of Housing Characteristics and Treatment Variables on Energy Savings

To the baseline models we added the following housing characteristics to examine the effect of these characteristics on energy savings under treatment:

- A binary variable indicating the presence of a pool ($Pool_k$ takes a value of 1 if household k has a pool, and 0 otherwise;
- A binary variable indicating the presence of a spa (Spa_k takes a value of 1 if household k has a spa, and 0 otherwise;
- An interaction term multiplying a binary variable indicating the presence of electric heat ($Eheat_k$ takes a value of 1 if household k has electric heat, and 0 otherwise) by the heating degree days per day, $HDDd_t$;
- Square footage of the residence ($Sqft_k$), measured in units of 100 square feet;
- Age of the residence (Age_k) measured in years; and
- The assessed value of the property ($Value_k$) measured in $10,000 of assessed value.

A number of household characteristics for which data was available (income, age of head of household, number of household members, length of residence) were excluded from the analysis because preliminary analyses indicated these variables did not affect the treatment response and because using these variables would significantly reduce the sample size.

We also included in estimation two treatment variables: $Template_k$ is a binary variable taking a value of 1 if a household is assigned a "graphical" presentation of information and 0 for the "narrative" presentation of information. $Envelope_k$ is a binary variable taking a value of 1 if a household receives its material in a large (6x9) envelope and a 0 if it receives its material in a regular business envelope.

Results are presented in Table 4-7 (LR model) and Table 4-8 (DLFE model). As in the baseline models, coefficients reflect the marginal effect of the characteristic on average daily consumption of Kwh. So, for instance, results from the LR model indicate that a 100-ft^2 increase in the size of a residence increases average daily consumption of Kwh by 0.772; a pool increases average daily Kwh use by 10.90 Kwh.

In the LR model, the only housing characteristics that have a statistically significant effect on energy savings under the program are the presence of a pool and the value of the residence, though as a practical matter the effect of the latter is minor (a $10,000 increase in home value increases savings by 0.077 Kwh/day. The other housing characteristics examined in the analysis—Spa_k , $Eheat_k$, $Sqft_k$, and Age_k — were not statistically significant at the .05 alpha level.

In the DLFE model (Table 4-8), the only housing characteristic affecting energy savings is the presence of a pool. The upshot of the analysis is that except for the presence/absence of a pool, it is difficult to forecast savings under the treatment program based on housing characteristics.

Finally, neither model predicts that energy savings under the program is affected by the treatment variables $Envelope_k$ and $Template_k$.

Table 4-7. Parameter estimates using the extended Linear Regression (LR) Model (Dependent variable: Average daily Kwh; terms affecting treatment response are shaded)

Variable	*Parameter estimate*	*Standard error*	*t-statistic*
Intercept	2.58923	0.08741	29.62
$Treatment_k$	1.16059	0.13963	8.31
$Post_t$	1.4126	0.14112	10.01
$Treatment_k \cdot Post_t$	-0.1095	0.22251	-0.49
$HDDd_t$	0.42534	0.00334	127.39
$HDDd_t \cdot Post_t$	-0.03041	0.00564	-5.39
$HDDd_t \cdot Treatment_k$	-0.00836	0.00522	-1.6
$HDDd_t \cdot Treatment_k \cdot Post_t$	-0.01879	0.00882	-2.13
$CDDd_t$	2.47496	0.00872	283.91
$CDDd_t \cdot Post_t$	-0.25433	0.01305	-19.49
$CDDd_t \cdot Treatment_k$	-0.02555	0.01358	-1.88
$CDDd_t \cdot Treatment_k \cdot Post_t$	-0.06357	0.02031	-3.13
$Pool_k$	10.90364	0.04539	240.25

$Pool_k \cdot Post_t$	0.01959	0.07028	0.28
$Pool_k \cdot Treatment_k$	-0.12378	0.07189	-1.72
$Pool_k \cdot Treatment_k \cdot Post_t$	-0.69719	0.1114	-6.26
Spa_k	0.7963	0.09075	8.78
$Spa_k \cdot Post_t$	0.03275	0.14022	0.23
$Spa_k \cdot Treatment_k$	0.40093	0.14198	2.82
$Spa_k \cdot Treatment_k \cdot Post_t$	-0.31411	0.21966	-1.43
$Eheat_k$	1.26684	0.00345	367.46
$Eheat_k \cdot Post_t$	-0.06718	0.00586	-11.46
$Eheat_k \cdot Treatment_k$	-0.02382	0.00534	-4.46
$Eheat_k \cdot Treatment_k \cdot Post_t$	-0.01397	0.00909	-1.54
$Sqft_k$	0.7717	0.00371	208.24
$Sqft_k \cdot Post_t$	-0.02808	0.00575	-4.88
$Sqft_k \cdot Treatment_k$	-0.03334	0.0059	-5.65
$Sqft_k \cdot Treatment_k \cdot Post_t$	-0.01467	0.00916	-1.6
Age_k	-0.00408	0.00102	-4.02
$Age_k \cdot Post_t$	-0.0167	0.00158	-10.57
$Age_k \cdot Treatment_k$	-0.01144	0.00158	-7.24
$Age_k \cdot Treatment_k \cdot Post_t$	0.00116	0.00246	0.47
$Value_k$ (per $10,000)	0.07725	0.00143	54.04
$Value_k \cdot Post_t$	0.0142	0.00222	6.4
$Value_k \cdot Treatment_k$	-0.00981	0.00228	-4.31
$Value_k \cdot Treatment_k \cdot Post_t$	0.00636	0.00354	1.8
$Envelope_k \cdot Treatment_k$	0.02942	0.04088	0.72
$Envelope_k \cdot Post_t$	0.06717	0.04043	1.66
$Envelope_k \cdot Treatment_k \cdot Post_t$	-0.1137	0.07544	-1.51
$Template_k \cdot Treatment_k$	-0.18351	0.04088	-4.49
$Template_k \cdot Post_t$	-0.06236	0.04043	-1.54
$Template_k \cdot Treatment_k \cdot Post_t$	0.07479	0.07543	0.99

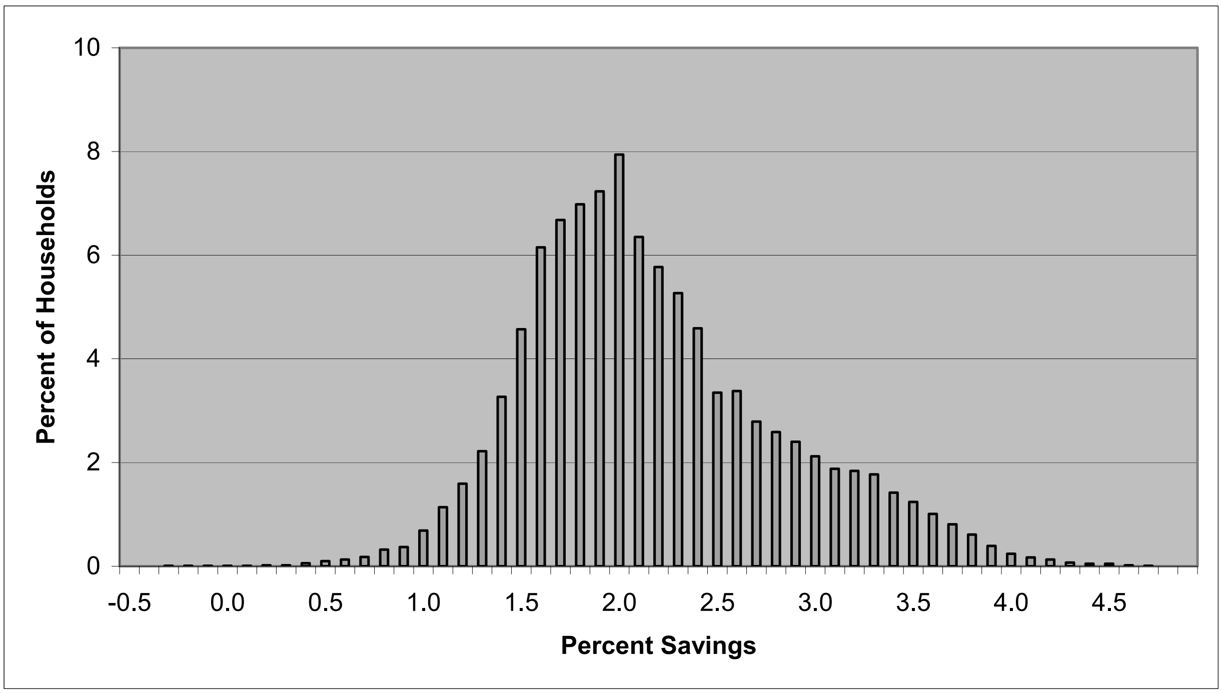
Table 4-8. Parameter estimates using the extended Differenced Linear Fixed Effects (DLFE) Model (Dependent variable: Average daily Kwh; terms affecting treatment response are shaded)

Variable	*Parameter estimate*	*Standard error*	*t-statistic*
$Post_t$	-2.39049	0.35686	-6.7
$Treatment_k \cdot Post_t$	-0.72654	0.55769	-1.3
$HDDd_t$	0.73135	0.00806	90.68
$HDDd_t \cdot Post_t$	-0.14781	0.01402	-10.54
$HDDd_t \cdot Treatment_k$	0.00426	0.01258	0.34
$HDDd_t \cdot Treatment_k \cdot Post_t$	-0.0348	0.02191	-1.59
$CDDd_t$	2.44438	0.02179	112.18
$CDDd_t \cdot Post_t$	-0.16331	0.03263	-5.01
$CDDd_t \cdot Treatment_k$	-0.0234	0.03395	-0.69
$CDDd_t \cdot Treatment_k \cdot Post_t$	-0.06932	0.05077	-1.37
$Pool_k \cdot Post_t$	0.37842	0.1758	2.15
$Pool_k \cdot Treatment_k \cdot Post_t$	-0.67809	0.27869	-2.43
$Spa_k \cdot Post_t$	-0.36664	0.35071	-1.05
$Spa_k \cdot Treatment_k \cdot Post_t$	-0.06743	0.54948	-0.12
$Eheat_k \cdot Post_t$	0.55903	0.01316	42.46
$Eheat_k \cdot Treatment_k \cdot Post_t$	0.00447	0.02041	0.22
$Sqft_k \cdot Post_t$	0.03128	0.01438	2.18
$Sqft_k \cdot Treatment_k \cdot Post_t$	0.02671	0.02289	1.17
$Age_k \cdot Post_t$	0.03545	0.00392	9.04
$Age_k \cdot Treatment_k \cdot Post_t$	0.00223	0.0061	0.36
$Value_k \cdot Post_t$	0.01346	0.00555	2.42
$Value_k \cdot Treatment_k \cdot Post_t$	0.00542	0.00887	0.61
$Envelope_k \cdot Post_t$	0.0192	0.13202	0.15
$Envelope_k \cdot Treatment_k \cdot Post_t$	-0.04618	0.20694	-0.22
$Template_k \cdot Post_t$	0.03245	0.13201	0.25
$Template_k \cdot Treatment_k \cdot Post_t$	-0.04626	0.20692	-0.22

4.5 Predicted Distribution of Savings in the Treatment Group

Using the LR model of the previous section, the predicted distribution of savings within the treatment group is presented in Figure 4-4. As noted previously, the average savings is about 2.2%. Predicted percent savings for 50% of all households lie in the interval {1.6, 2.2}, predicted savings for 80% of all households lie in the interval {1.4, 2.9}, and predicted savings for 95% of all households lie in the interval {1.1, 3.5}.

Figure 4-4. Frequency distribution of predicted percent annual energy savings (2007 as base year) within the treatment group



This distribution curve shows that savings are predicted for virtually all individuals, rather than being possible for just a small subset of customers with particular characteristics. It is important to emphasize that this frequency distribution describes *expected* savings within the sample, *conditional* on observed housing characteristics such as square footage of the residence, the presence/absence of a pool, the assessed value of the residence, and so forth, based on the point estimates of the OLS regression of method 2. For a given set of housing characteristics, some households in the real world will generate greater savings and some less than indicated in this modeled distribution.

4.6 Energy Savings of Treatment Households Receiving Monthly Versus Quarterly Reports

A treatment variable not included in the above analysis was the frequency of reports (monthly vs. quarterly) sent to treatment households. This is because the experimental design targeted households with relatively high energy use for monthly reports, and so including this variable would confound the estimated effects of housing characteristics correlated with high energy use.

To examine seasonal impacts by frequency of reporting, we ran the seasonal difference in difference model of Table 4-1 separately for households receiving monthly reports and households receiving quarterly reports. Control households were designated for the different report frequencies based on their level of use to properly match the participant groups. Results are presented in Table 4-9.

Table 4-9. Comparison of Impacts by Season and Frequency of Reports

Method	***Summer Impact***	***Winter Impact***	***Shoulder Months Impact***	***Annual Impact***
Monthly Reports (High Use Customers)	-2.8%	-2.3%	-1.9%	-2.3%
Quarterly Reports (Low Use Customers)	-1.4%	-1.6%	-1.4%	-1.6%
Overall	-2.6%	-2.2%	-1.7%	-2.2%

Low use customers receiving quarterly reports show relatively consistent savings throughout the seasons, with slightly higher savings in winter. High use customers receiving monthly reports reflect the overall pattern of savings, showing greatest savings in summer and lowest savings in the shoulder months.

5 AUTHOR BIOGRAPHIES

Daniel Violette, Ph. D. -- Dr. Violette is a Principal with Summit Blue Consulting who has over 20 years of experience in the energy industry. He is a founder and former CEO of Summit Blue and also served as a Vice President and Director with Hagler Bailly Consulting for over 10 years. He has also held officer-level positions with other major companies including serving as a Sr. Vice President with XENERGY, Inc., an energy services company, and with the Management Consulting Services Business Unit of Electronic Data Systems (EDS), one of the largest worldwide management services and technology companies.

Dr. Violette has managed many complex projects resulting in recommendations to senior management regarding actions to be taken related to demand response (DR), pricing and rates, resource planning, and energy efficiency. Current projects include several multi-year efforts examining the role of energy efficiency (EE) and DR in resource planning and development of integrated resource plans that address risk and uncertainty. He also has completed projects for the International Energy Agency on the value of EE and DR in resource planning including hedge/option values and risk management of system costs with a dozen US utilities and 20 countries, and he has authored a report for the Demand Response Research Center (CEC) on an integrated framework for assessing energy efficiency and DR. He is well known for his years of work on demand-side issues including planning, design, evaluation and integration. Dr. Violette has presented testimony and served on expert panels in over 25 regulatory jurisdictions in North America.

Bill Provencher, Ph.D. – Dr. Provencher serves as a full professor in the Department of Agriculture and Applied Economics at the University of Wisconsin-Madison. His published work has two distinct emphases: the dynamic allocation of resources and the valuation of nonmarket goods and services. His current research program focuses on three areas: a) the development of discrete choice models of the consumption of nonmarket goods and services; b) the interaction between socioeconomic and ecological systems; and c) dynamic issues in resource allocation, with attention focused mainly on using statistical methods to recover the dynamic behavior of resource owners. He has served on the board of the Association of Environmental and Resource Economists (AERE), co-edited and served on the editorial council of the *Journal of Environmental Economics and Management* (JEEM), and is currently on the editorial board of *Land Economics*. Dr. Provencher received an undergraduate degree in natural resources at Cornell University, an M.S. degree in forestry at Duke University in 1985, and a Ph.D. in agricultural economics from UC-Davis in 1991.

Mary Klos – Ms. Klos is a Senior Consultant at Summit Blue and has over 20 years of experience in the energy industry. Currently, she leads projects focused on impact analysis of energy efficiency and demand response programs. In her time at the Wisconsin Public Service Corporation, Ms. Klos worked consistently with energy efficiency and demand response issues from a variety of positions, including load forecasting, market research and demand-side management planning. She has worked with generation planners, transmission and distribution planners, rate design experts and marketing professionals to develop an integrated view of the entire DSM effort, and she has testified in rate proceedings and integrated resource planning dockets. Ms. Klos earned a BA in Economics from Beloit College and a Masters in Business Administration from the University of Wisconsin. Ms. Klos is also a certified Statistical Analysis System (SAS) Base Programmer.

APPENDIX A:

DETAILED MODEL RESULTS

Method 2: Linear Regression Base Model

The REG Procedure
Model: OrigOLS
Dependent Variable: AveDailyKWH

Number of Observations Read	2029885
Number of Observations Used	2029885

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	11	46553310	4232119	14082	<.0001
Error	2.03E+06	610043717	300.53295		
Corrected Total	2.03E+06	656597027			

Root MSE	17.33589	**R-Square**	0.0709
Dependent Mean	31.07693	**Adj R-Sq**	0.0709
Coeff Var	55.78378		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	20.03454	0.05397	371.24	<.0001
hddD	**1**	0.73943	0.00393	188.39	<.0001
cddD	**1**	2.49685	0.01061	235.42	<.0001
Post	**1**	1.01504	0.08935	11.36	<.0001
PosthddD	**1**	-0.06662	0.00664	-10.04	<.0001
PostcddD	**1**	-0.30645	0.01588	-19.3	<.0001
ParticPost	**1**	-0.44838	0.13928	-3.22	0.0013
ParticPosthddD	**1**	-0.01815	0.01036	-1.75	0.0796
ParticPostcddD	**1**	-0.04983	0.0247	-2.02	0.0437
Partic	**1**	-0.34995	0.08422	-4.16	<.0001
ParticHddD	**1**	0.00277	0.00612	0.45	0.6505
ParticcddD	**1**	-0.03342	0.01652	-2.02	0.0431

Method 3: Fixed Effects Base
Model

The REG Procedure
Model: base
Dependent Variable: diffaveDailykWh

Number of Observations Read	2029885
Number of Observations Used	2029885

Note: No intercept in model. R-Square is

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	10	46287941	4628794	64523.2	<.0001
Error	2.03E+06	145619983	71.7384		
Uncorrected Total	2.03E+06	191907924			

Root MSE	8.46985	**R-Square**	0.2412
Dependent Mean	1.80E-17	**Adj R-Sq**	0.2412
Coeff Var	4.71E+19		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
diffcddD	**1**	2.44219	0.00518	471.24	<.0001
diffhddD	**1**	0.73034	0.00192	380.76	<.0001
diffPost	**1**	-0.13361	0.04369	-3.06	0.0022
diffPosthddD	**1**	-0.01074	0.00324	-3.31	0.0009
diffPostcddD	**1**	-0.16486	0.00776	-21.24	<.0001
diffParticPost	**1**	-0.32591	0.0681	-4.79	<.0001
diffParticPosthddD	**1**	-0.02453	0.00506	-4.85	<.0001
diffParticPostcddD	**1**	-0.06754	0.01208	-5.59	<.0001
diffParticHDDd	**1**	0.0041	0.00299	1.37	0.1704
diffParticCDDd	**1**	-0.02305	0.00807	-2.86	0.0043

Method 2: Linear Regression
Expanded Model

The REG Procedure
Model: HeterOLS
Dependent Variable: AveDailyKWH

Number of Observations Read	2029885
Number of Observations Used	2025212
Number of Observations with Missing Values	4673

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	41	245023876	5976192	29501.5	<.0001
Error	2.03E+06	410244298	202.57277		
Corrected Total	2.03E+06	655268174			

Root MSE	14.23281	**R-Square**	0.3739
Dependent Mean	31.09019	**Adj R-Sq**	0.3739
Coeff Var	45.7791		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
Intercept	**1**	2.58923	0.08741	29.62	<.0001
Post	**1**	1.4126	0.14112	10.01	<.0001
ParticPost	**1**	-0.1095	0.22251	-0.49	0.6226
Partic	**1**	1.16059	0.13963	8.31	<.0001
cddD	**1**	2.47496	0.00872	283.91	<.0001
PostcddD	**1**	-0.25433	0.01305	-19.49	<.0001
ParticPostcddD	**1**	-0.06357	0.02031	-3.13	0.0017
ParticcddD	**1**	-0.02555	0.01358	-1.88	0.0599
hddD	**1**	0.42534	0.00334	127.39	<.0001
PosthddD	**1**	-0.03041	0.00564	-5.39	<.0001
ParticPosthddD	**1**	-0.01879	0.00882	-2.13	0.0331
ParticHddD	**1**	-0.00836	0.00522	-1.6	0.109
pool	**1**	10.90364	0.04539	240.25	<.0001
PostPool	**1**	0.01959	0.07028	0.28	0.7805
ParticPostPool	**1**	-0.69719	0.1114	-6.26	<.0001
ParticPool	**1**	-0.12378	0.07189	-1.72	0.0851
spa	**1**	0.7963	0.09075	8.78	<.0001
PostSpa	**1**	0.03275	0.14022	0.23	0.8153
ParticPostSpa	**1**	-0.31411	0.21966	-1.43	0.1527
ParticSpa	**1**	0.40093	0.14198	2.82	0.0047
ElecHeatHDDd	**1**	1.26684	0.00345	367.46	<.0001
PostElecHeatHDDd	**1**	-0.06718	0.00586	-11.46	<.0001
ParticPostElecHeatHDDd	**1**	-0.01397	0.00909	-1.54	0.1243
ParticElecHeatHDDd	**1**	-0.02382	0.00534	-4.46	<.0001
sqft_00	**1**	0.7717	0.00371	208.24	<.0001
PostSqft_00	**1**	-0.02808	0.00575	-4.88	<.0001
ParticPostSqft_00	**1**	-0.01467	0.00916	-1.6	0.1094
ParticSqft_00	**1**	-0.03334	0.0059	-5.65	<.0001
age	**1**	-0.00408	0.00102	-4.02	<.0001
Postage	**1**	-0.0167	0.00158	-10.57	<.0001
ParticPostAge	**1**	0.00116	0.00246	0.47	0.6359
Particage	**1**	-0.01144	0.00158	-7.24	<.0001
house_value_0000	**1**	0.07725	0.00143	54.04	<.0001
Posthouse_value_0000	**1**	0.0142	0.00222	6.4	<.0001
ParticPostHouse_value_0000	**1**	0.00636	0.00354	1.8	0.0724
Partichouse_value_0000	**1**	-0.00981	0.00228	-4.31	<.0001
PostTemplate	**1**	-0.06236	0.04043	-1.54	0.123
ParticPostTemplate	**1**	0.07479	0.07543	0.99	0.3214
ParticTemplate	**1**	-0.18351	0.04088	-4.49	<.0001
PostEnvelope	**1**	0.06717	0.04043	1.66	0.0967
ParticPostEnvelope	**1**	-0.1137	0.07544	-1.51	0.1318
ParticEnvelope	**1**	0.02942	0.04088	0.72	0.4718

Method 3: Fixed Effects Expanded Model

The REG Procedure
Model: HeterDF
Dependent Variable: AveDailyKWH

Number of Observations Read	2029885
Number of Observations Used	2025212
Number of Observations with Missing Values	4673

Note: No intercept in model. R-Square is redefined.

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	26	50192832	1930494	1525.61	<.0001
Error	2.03E+06	2562644528	1265.38724		
Uncorrected Total	2.03E+06	2612837360			

Root MSE	35.57228	**R-Square**	0.0192
Dependent Mean	31.09019	**Adj R-Sq**	0.0192
Coeff Var	114.41643		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
diffPost	**1**	-2.39049	0.35686	-6.7	<.0001
diffParticPost	**1**	-0.72654	0.55769	-1.3	0.1927
diffcddD	**1**	2.44438	0.02179	112.18	<.0001
diffPostcddD	**1**	-0.16331	0.03263	-5.01	<.0001
diffParticPostcddD	**1**	-0.06932	0.05077	-1.37	0.1721
diffParticCDDd	**1**	-0.0234	0.03395	-0.69	0.4906
diffhddD	**1**	0.73135	0.00806	90.68	<.0001
diffPosthddD	**1**	-0.14781	0.01402	-10.54	<.0001
diffParticPosthddD	**1**	-0.0348	0.02191	-1.59	0.1122
diffParticHDDd	**1**	0.00426	0.01258	0.34	0.7349
diffPostPool	**1**	0.37842	0.1758	2.15	0.0314
diffParticPostPool	**1**	-0.67809	0.27869	-2.43	0.015
diffPostSpa	**1**	-0.36664	0.35071	-1.05	0.2958
diffParticPostSpa	**1**	-0.06743	0.54948	-0.12	0.9023
diffPostElecHeatHDDd	**1**	0.55903	0.01316	42.46	<.0001
diffParticPostElecHeatHDDd	**1**	0.00447	0.02041	0.22	0.8267
diffPostSqft_00	**1**	0.03128	0.01438	2.18	0.0296
diffParticPostSqft_00	**1**	0.02671	0.02289	1.17	0.2434
diffPostAge	**1**	0.03545	0.00392	9.04	<.0001
diffParticPostAge	**1**	0.00223	0.0061	0.36	0.7151
diffPostHouse_Value_0000	**1**	0.01346	0.00555	2.42	0.0154
diffParticPostHouse_Value_0000	**1**	0.00542	0.00887	0.61	0.5411
diffPostTemplate	**1**	0.03245	0.13201	0.25	0.8058
diffParticPostTemplate	**1**	-0.04626	0.20692	-0.22	0.8231
diffPostEnvelope	**1**	0.0192	0.13202	0.15	0.8844
diffParticPostEnvelope	**1**	-0.04618	0.20694	-0.22	0.8234

Base Model for Quarterly Report
Group

The REG Procedure
Model: Qtrly
Dependent Variable: diffaveDailykWh

Number of Observations Read	240168
Number of Observations Used	240168

Note: No intercept in model. R-Square is redefined.

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	5	1901600	380320	19722.3	<.0001
Error	240163	4631247	19.28376		
Uncorrected Total	240168	6532846			

Root MSE	4.39133	**R-Square**	0.2911
Dependent Mean	-4.51E-18	**Adj R-Sq**	0.2911
Coeff Var	-9.73E+19		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
diffPost	**1**	0.30321	0.05111	5.93	<.0001
diffcddD	**1**	1.39007	0.00593	234.31	<.0001
diffPostcddD	**1**	-0.09566	0.00897	-10.66	<.0001
diffhddD	**1**	0.34707	0.0022	157.56	<.0001
diffPosthddD	**1**	-0.00083494	0.00378	-0.22	0.8253

Covariance of Estimates					
Variable	**diffPost**	**diffcddD**	**diffPostcddD**	**diffhddD**	**diffPosthddD**
diffPost	0.002612615	0.000141865	-0.000385561	5.94168E-05	-0.000172727
diffcddD	0.000141865	3.51952E-05	-0.000035206	9.21E-06	-9.21E-06
diffPostcddD	-0.000385561	-0.000035206	8.04653E-05	-9.21E-06	2.53404E-05
diffhddD	5.94168E-05	9.21E-06	-9.21E-06	4.85E-06	-4.86E-06
diffPosthddD	-0.000172727	-9.21E-06	2.53404E-05	-4.86E-06	1.43038E-05

Base Model for Monthly Report
Group

The REG Procedure
Model: Month
Dependent Variable: diffaveDailykWh

Number of Observations Read	586698
Number of Observations Used	586698

Note: No intercept in model. R-Square is redefined.

Analysis of Variance					
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Value**	**Pr > F**
Model	5	18214496	3642899	40555.2	<.0001
Error	586693	52700128	89.82573		
Uncorrected Total	586698	70914624			

Root MSE	9.47764	**R-Square**	0.2569
Dependent Mean	3.17E-17	**Adj R-Sq**	0.2568
Coeff Var	2.99E+19		

Parameter Estimates					
Variable	**DF**	**Parameter Estimate**	**Standard Error**	**t Value**	**Pr > |t|**
diffPost	**1**	-0.56019	0.06894	-8.13	<.0001
diffcddD	**1**	2.84333	0.00824	345.22	<.0001
diffPostcddD	**1**	-0.31349	0.01225	-25.59	<.0001
diffhddD	**1**	0.89418	0.00305	292.81	<.0001
diffPosthddD	**1**	-0.0613	0.00514	-11.93	<.0001

Covariance of Estimates					
Variable	**diffPost**	**diffcddD**	**diffPostcddD**	**diffhddD**	**diffPosthddD**
diffPost	0.004752634	0.000276504	-0.000708873	0.000114856	-0.000314899
diffcddD	0.000276504	6.78382E-05	-0.000067851	1.77594E-05	-0.000017764
diffPostcddD	-0.000708873	-0.000067851	0.000150131	-0.000017762	4.66113E-05
diffhddD	0.000114856	1.77594E-05	-0.000017762	9.33E-06	-9.33E-06
diffPosthddD	-0.000314899	-0.000017764	4.66113E-05	-9.33E-06	2.63913E-05

Exhibit J-1

EVALUATION STUDY
OF THE
2004-05 STATEWIDE
RESIDENTIAL APPLIANCE
RECYCLING PROGRAM

2004-2005 Programs
#1114, #1157, #1232 and #1348

Final Report

April 2008

Prepared by:

ADM Associates, Inc.
Athens Research
Hiner & Partners
Innovologie LLC

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ACKNOWLEDGEMENTS

The evaluation of the 2004-05 Statewide Residential Appliance Recycling Program (RARP) was performed on behalf of the California Public Utilities Commission. Peter Lai of the CPUC Energy Division and Nick Hall from TecMarket Works (as prime contractor for the CPUC's Master Evaluation Contract Team) provided overall guidance and oversight for the project.

The evaluation work was performed under contract with Southern California Edison Company. Shahana Samiullah of SCE was responsible for contract management. Rob Rubin of San Diego Gas and Electric and Craig Tyler for Pacific Gas and Electric acted as project advisors.

The contractor team for performing the evaluation was comprised of four firms.

- ADM Associates, Inc. was the prime contractor. ADM's work was directed by Donald Dohrmann.
- Athens Research was responsible for development of the tracking system data and for the analysis of gross unit savings. Athens' work was directed by John Peterson.
- Hiner and Partners was responsible for the fielding of the participant and non-participant telephone surveys and for conducting the conjoint analysis. Hiner and Partners' work was directed by Steve Westberg.
- Innovologie LLC was responsible for the process evaluation work and contributed to the net-to-gross analyses. Innovologie's work was directed by John Reed.

RARP staff at PG&E, SCE and SDG&E greatly assisted the evaluation effort by providing data and answering questions regarding the implementation of the program in their service utilities. PG&E, SCE and SDG&E staff were also instrumental in providing the tracking data for their programs.

Staff from the implementation contractors (ARCA and JACO) also provided valuable assistance to the evaluation effort, particularly in providing information on their operations and allowing personnel from the evaluation team to observe those operations.

This study was conducted at the request of the California Public Utilities Commission. The study was managed by Southern California Edison. It was funded through the public goods charge (PGC) for energy efficiency and is available for download at www.calmac.org.

EXECUTIVE SUMMARY OF KEY FINDINGS

This report presents the results of the evaluation, measurement and verification study (EM&V) study of the Statewide Residential Appliance Recycling Program (RARP) that PG&E, SCE and SDG&E offered to their residential customers in 2004-2005. The program offered incentives to eligible customers to recycle older, less-efficient but still-working refrigerators and freezers. The goal was to remove such units from the grid sooner than otherwise might be the case, thereby reducing consumption and demand on the grid.

ES.1 GROSS AND NET-OF-FREERIDERSHIP KWH SAVINGS

Figure ES-1, which is based on data for 2005, shows the disposition of refrigerators that were transferred during that year by households that were eligible to participate in the RARP Program. About 12 percent of the units were disposed of through RARP.

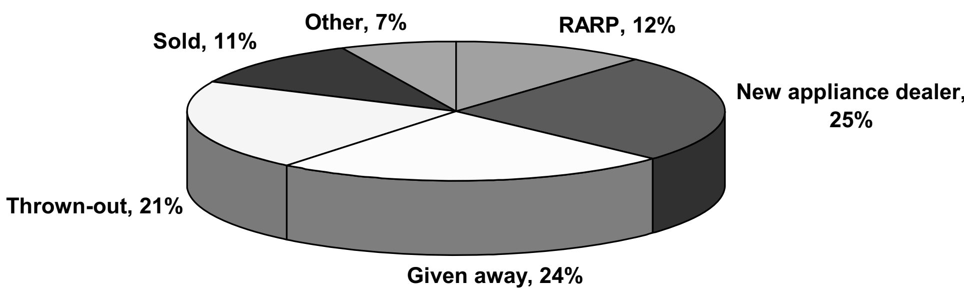

Figure ES-1. How Refrigerators Were Disposed of in 2005

Over the two-year period 2004-2005, a total of 165,594 refrigerators and freezers were collected and demanufactured through the Statewide RARP. Table ES-1 shows how the numbers of refrigerators and freezers recycled through the RARP were distributed by type and by utility / program.

Table ES-1. Numbers of Refrigerators and Freezers Recycled through RARP during 2004-2005

Utility	*Numbers of Refrigerators Recycled*	*Numbers of Freezers Recycled*	*Total Numbers of Units Recycled*
PG&E	22,721	3,194	25,915
SCE: PGC	68,274	9,580	77,854
SCE: Procurement	14,760	1,745	16,505
SCE: 2005 Summer Initiative	22,420	3,553	25,973
SDG&E	16,584	2,763	19,347
Totals	144,759	20,835	165,594

Total gross kWh savings from the 2004-2005 Statewide RARP were just over 267 million kWh. Net kWh savings were calculated using several different methods, including a method that uses the CPUC definition for calculating savings net of free-ridership and the methods used in the evaluation of the 2002 RARP. Using a net-of-free-ridership method based on the CPUC definition, the overall net-to-gross ratio for the 2004-2005 RARP was 0.62 and savings net of free-ridership were just over 166 million kWh. The distributions of gross and net savings by utility / program are summarized in Table ES-2.

Table ES-2. Summary of Gross and Net kWh Savings for 2004-2005 Statewide RARP

Utility / Program	***Total Gross kWh Savings***	***Total kWh Savings Net of Free-Ridership***
PG&E	41,324,555	25,732,359
SCE-PGC	125,180,444	77,975,713
SCE-Procurement	26,649,985	16,566,174
SCE-2005 Summer Initiative	43,011,288	26,408,931
SDG&E	31,057,809	19,389,527
Totals	267,224,081	166,072,704

ES.2 PROGRAM AWARENESS

Awareness of RARP is essential for participation. However, more then half (52 percent) of IOU service customers who acquired or disposed of a refrigerator or freezer in the past four years were unaware of the program. The percentage of unaware residents was greater among PG&E and SDG&E customers than among SCE customers.

In PG&E's service area, most RARP participants learned of the program through word-of mouth (e.g., from appliance dealers, from friends or relatives). In the service territories of SCE and SDG&E, the vast majority of participants learned of the program through direct utility broadcast means (e.g., bill inserts). Media outlets (i.e., TV, radio and newspaper advertisements) informed roughly a third of participants in each service territory.

ES.3 PROGRAM PARTICIPATION

Because 85 percent of the participants in RARP were replacing an appliance with a new or used one, the annual cycle of appliance replacement is the major underlying driver for participation in the program. The weekly and monthly volumes of removals track the annual appliance buying cycle.

The effectiveness and volume of utility promotional and marketing activities determine the actual level of participation. This could be seen when the effects of PG&E's and SCE's marketing and promotional activities were analyzed in relation to scheduling call volumes.

- One of the more useful and interesting findings from this analysis is that information in different formats included with the bill has very different effects. Regular bill inserts (e.g., a bi-fold the size of an envelope) appear to be quite effective while a message placed directly on the bill or a single line message with a telephone number on a single page included with a bill did not have significant effects. In other words, two short paragraphs in the regular stuffer is more effective than other forms of bill related information. This implies that the amount and location of information is a key to customer's getting and heeding the message.

- For the PG&E service territory, the use of large-scale newspaper advertising (more than 100,000 circulation) had the effect of increasing call volumes by about 240 calls a week. Advertising in more limited circulation newspapers (less than 100,000 circulation) had the effect of increasing scheduling call volumes by about 170 calls per week.
- SCE has a more diversified promotional program. Analysis of SCE's efforts showed that truck signage appeared to have a substantial effect. The Customer Connection Stuffer (i.e., a bill stuffer), mailers, and newspaper inserts also appeared to have significant effects. Retail promotion, a magazine advertisement, movie advertisements, and email blasts did not produce statistically significant increases in call volumes.

Based on analysis of survey data collected from participants and non-participants, there are three basic motivations for participating in RARP.

- Convenience/free pick-up is an important motivating factor, with nearly two-thirds of customers giving this as a reason for participating.
- Almost half of all respondents listed the incentive as a motivating factor, although the incentive is a necessary condition for just 15 percent of the population.
- Roughly a quarter of the respondents listed the environment as a motivating factor.

A conjoint analysis was conducted to assess the quantitative importance of the factors affecting the decision to participate in RARP. The conjoint analysis showed the following:

- For RARP participants, the payment mattered. Consumers who participated in the program choose this disposal option primarily because they receive payment ($35) for their old appliance. Boosting the payment (to $50) increases the preference for the program among participants. Secondary considerations for participants are the timing of the pickup and the disposition of their old unit. Timing and disposition are of equal importance although shortening the time between scheduling and pickup (from 7 days to 3 days) increases preference for the program considerably. (Share of preference for the program among participants increases from 34.3 percent to 41.4 percent when scheduling and pick-up time is shortened.) Participants were generally indifferent about having their old unit completely recycled and having it used by someone else.
- For non-participants, the timing of the pickup is what matters most, followed by cost and disposition. Shortening the pickup time from 7 days to 3 days boosts preference for the program by non-participants from 28.8 percent to 34.6 percent. The program gets an additional boost among non-participants if pickup can be made same day. Non-participants are less interested in getting paid for their old unit. They still want to avoid having to pay for disposal but they are more willing than participants to give it up for free.

Overall, consumers are primarily seeking a convenient, no cost way for someone else to take the old unit off their hands. Receiving payment for the unit matters to some consumers (including those who have participated in the program), though is of less consequence to others.

Cancellations are a major issue for the program, with about 20 percent of scheduled appointments being cancelled. Pick-ups that are cancelled are not likely to be re-scheduled. Many of the cancellations resulted from units that were transferred to someone else before they could be picked up, and some for units that were informally removed by logistics personnel. Such units are likely to be returned to the market. Some customers decided to keep their units. These cancellations represent missed opportunities because the units from the cancelled pick-ups are likely to remain on the grid, and the cancellation results in a loss of the resources that went into initially scheduling and recovering these units.

Reducing cancellations may be an attractive and relative quick way to increase participation levels, since 89 percent of canceled units were eligible for the program. Reducing the time between scheduling and the pick-up may help reduce cancellation rates. The recycling contractors (i.e., ARCA, JACO) are best equipped to offer suggestions for ways to reduce pick-up time. Another way to reduce dropouts the program may want to experiment with messages in letters and e-mails sent to confirm the pick-up time. Such letters might emphasize that the homeowner has made a good decision, the cost of owning older units, and the value of recycling. In view that the best predictor of participation in energy programs is often past program participants these messages could also include referrals, coupons and messages about other programs.

ES.4 CUSTOMER SATISFACTION WITH RARP

Overall, customer satisfaction with the RARP is very high. More than 80 percent of customers reported that they were very satisfied, and more than 95 percent reported that they were somewhat or very satisfied. The one area where there appears to be an opportunity gap is educating participants about the program or their units. The survey data show that about 14 percent of customers indicated that they were not as well informed as they would like to be before they signed up for the program. About 18 percent said that they did not learn that older refrigerators used more energy than newer refrigerators. PG&E respondents were less likely to know this than SDG&E and SCE customers, and the difference was statistically significant. Twenty-eight percent of participants that were surveyed said that they did not know that refrigerators that were being removed were being recycled.

Only a small percentage of customers indicated areas of the program that did not function as well as it might. These included having to place more than one call to the call center, having too much time elapse between scheduling and pick-up, calling to confirm the appointment, receiving the incentive check, and having to wait too long for the incentive check.

ES.5 ASSESSMENT OF APPLIANCE RECYCLING MARKET

An assessment of the appliance recycling market revealed that the market is evolving. There is increased regulation designed to prevent harmful substances from entering the environment. The market for materials is changing as well. The market for R12 refrigerant is declining as the number of older appliances using R12 declines. On the other hand, the value of steel and copper has increased in recent years and may continue to increase based on demand in world markets. With the decline of the market for CFCs, the recovery of CFC's from foam may no longer be advantageous and the incineration of foam either directly in incinerators or as a byproduct of shredding may represent a more economical method of disposal.

Shredding is potentially an economical method for disposing of refrigerators. However, shredding requires a substantial stream of raw materials. It is both unclear and quite unlikely that the RARP would generate enough materials to sustain a shredding operation. In the future contract shredding could be a cost-effective alternative to current disassembly methods assuming that the temperatures in the shredders is sufficiently high to destroy harmful materials.

ES.6 POTENTIAL FOR RARP IN THE FUTURE

RARP has not reached saturation and is not likely to soon. Thus, there is potential to increase participation in RARP.

There are two important groups from which more units may be obtained

- Second units in homes: The 2002 Residential Appliance Saturation Survey (RASS) showed that there are nearly two million second refrigerators in the service territories of PG&E, SCE, and SDG&E. Because 40 percent of the refrigerators captured by RARP are second refrigerators, there is still a significant number of second refrigerators that could be captured. These should be a high priority target because of their age. Potentially, the program could make substantial headway with second refrigerators, although developing a good strategy for doing this requires more information about the status of second refrigerators and why households retain them.
- The used market: A second group which may hold potential is the homes that give away or sell refrigerators or freezers. Nearly all of these units are working and are likely stay in the system for at least a few more years. People giving units away may want to "help" someone else or perhaps to see a unit with "life" remain in use. Units that the customer wants to sell may be more difficult to capture because sellers may need to recover some of the value of a refrigerator. Units being sold are typically newer, with an average age of 6.7 years. Recent newer units may have a used retail market value that exceeds $200. Newer units that are purchased for continued use may have less impact on the system because they do not have significantly different energy usage from the newest units, and especially if they are being used as primary units, a frequent outcome.

ES.7 RECOMMENDATIONS

Based on the results from this study, a set of recommendations has been developed regarding the following:

- Increasing customer awareness of RARP;
- Refining program marketing and design;
- Undertaking market research to better focus program design and marketing;
- Enhancing program operation; and
- Collecting additional data for program marketing and evaluation.

It is recommended that RARP undertake additional activities to increase customer awareness of the program. Based on survey data collected during this study, almost half of those who acquired or disposed of a refrigerator between 2003 and 2007 were unaware of the program. When told about the program, many expressed participation interest. Thus, program awareness and customer education are opportunities for increasing participation. Specific recommendations include:

- *Increased promotion of awareness and removing refrigerators more quickly should take priority over increasing incentives.*
- *Awareness activities should be geographically targeted to avoid surges in demand for services*. Marketing channels that can be geographically focused are recommended.
- *Utilities should use more messages to inform people of the advantages/benefits of recycling*. An example of a message might be, "last year X number of people in your neighborhood (zip code, community) recycled their refrigerators, be a good neighbor and join them," "save yourself, your friends, or a neighbor $150 each year. Recycle that old refrigerator rather than keeping it or giving it away and get $35 to boot." Or, good neighbors like you recycle their old refrigerators. Emphasize your neighbors are doing it.

It is recommended that some refinements be made to RARP program design and marketing. Specific recommendations include:

- *It is recommended that the two million estimated second refrigerators be a high priority target* because of their age, their potential for malfunctioning causing excessive energy use, and their potential for release of refrigerant into the atmosphere.
- *Marketing designed to attract second refrigerators should be increased.* In the short run and in the absence of better market intelligence, marketing efforts should highlight the cost, energy, and environmental consequences of keeping a second refrigerator or giving a refrigerator to a relative, friend or neighbor.
- *However, program design should recognize that there are legitimate reasons for having more than one refrigerator* and should include, for example, an assessment of the energy

conserved by avoiding trips to purchase food and other supplies or shared housing units where two or more cohabiting units may have separate refrigerators.

- *RARP should put some focus on the units that are given to friends, neighbors and relatives (an estimated 172,000 in 2005).* Approximately 94 percent of these are older working units that are likely stay in the market and on the grid if not captured by the program
- *RARP should consider partnering with charities, allowing them to retrieve working refrigerators.* The charities could be reimbursed for the cost of the pick-up and receive an incentive. An arrangement might be made to allow charities to retain for sale units manufactured within four years of the pick-up. It is estimated that this arrangement might result in 25,000 units being removed from the market.

It is recommended that market research be undertaken to provide better information to focus program design and marketing. Specific recommendations include:

- *RARP should experiment with stories in bill inserts to determine their effectiveness.* Bill inserts provide an opportunity for area targeting. The same insert does not have to go to all areas.
- *RARP should conduct experiments with direct mail pieces containing messages encouraging people to be mindful of relatives, neighbors and friends.*
- *RARP should run controlled experiments to test the value of including benefits information at the beginning of the letter confirming the pick-up appointment.* Customers could be told that X number of neighbors just like them in their zip code also participated in the program.
- *A market research study should be undertaken that addresses how second refrigerators are being used.* It is important to understand how second refrigerators are being used, what households understand about the energy and environmental consequences of a second refrigerator, the willingness of households to give-up a second refrigerator, and the efficacy of information and incentives that might motivate households to remove them.

It is recommended that RARP attempt to find ways to improve program operation pertaining to collection of the appliances. In particular, because convenience is a major factor in motivating people to use the program, RARP should attempt to find ways to collect appliances more quickly. Specific recommendations include:

- *ARCA and JACO should be asked to offer suggestions for ways to reduce pick-up time.*
- *RARP should try more geographically targeted and intensive marketing to temporarily increase the number of pick-ups in specific areas, making more frequent pick-ups economic before moving on to the next area.*
- *The recycling companies should incorporate a small script at the end of the scheduling call or in the reply e-mail to make sure that the customers understand that their action benefit themselves and the community.* Customers respond to appeals to community good.

- *For remote areas with low volumes, RARP should investigate the use of a local contractor to do pick-ups and take units to a local holding facility.*
- *Because persons signing up for appliance pick-ups on the internet appear to be more likely to drop out, they should receive an e-mail or a telephone call or a message on the answering machine thanking them and explaining the benefits.*
- *RARP should attempt to reduce cancelled pick-ups.* In 2004-5, roughly 20 percent of appointments were cancelled.
- It has been suggested the RARP work with the major new appliance dealers to remove working refrigerators. Based on the findings in this study, *it is strongly recommended that RARP **not** engage new appliance dealers to capture used units.* The percentage of units that return to the market through new appliance dealers is less than 20 percent. Further, it is difficult to insure that units collected in this way are the units that were collected from householders and are working.

Although the recycling contractors have developed sophisticated data collection systems. there are issues that need to be addressed to make the data being collected more usable for both marketing and evaluation. Specific recommendations here include:

- *The recycling contractors should collect the same information about refrigerators and store it in a consistent manner.* Specifically they need to collect, information about the age, size, configuration, and consumption. Model number is not sufficient.
- *To facilitate uniform data collection by the recycling contractors, the utilities should identify a standard for the data collection and incorporate that into the contracts with the recycling companies*.
- *The recycling contractors should continue the random survey of households that they conduct at the end of a customer call scheduling a pick-up, but both the content and the method for collecting the information be standardized.* This survey can be a valuable tool for program operation and evaluation, but it needs to be substantially improved or dropped if it is not improved. Standardized questions and a standard protocol for collecting the data should be incorporated into the recycling company contracts. (A set of recommended questions is included in this report.) Information about the location of the appliance should also be asked as part of the random survey and not of the driver.
- *Standardized data should be collected from customers who cancel their pick-up orders.* Specific information about cancellations could be used to identify ways to reduce cancellations. (Recommendations for the information to be obtained are contained in the report.)

1. INTRODUCTION

This is the final report for the evaluation, measurement and verification (EM&V) study of the 2004-2005 Statewide Residential Appliance Recycling Program (RARP). The RARP was a statewide program administered by three California investor-owned utilities: Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E). The program offered incentives to eligible customers to recycle older, less-efficient but still-working refrigerators and freezers. The goal was to remove such units from the grid sooner than otherwise might be the case, thereby reducing consumption and demand on the grid.

This evaluation effort was guided by the California Public Utilities Commission's Energy Division (CPUC) and its Master Evaluation Contractor Team, with PG&E, SCE and SDG&E providing critical support and feedback. The evaluation was funded through the public goods charge (PGC) for energy efficiency.

1.1 EVALUATION OBJECTIVES

There were five (5) main objectives for this EM&V study.

- To develop reliable estimates of program energy savings;
- To develop a reliable approach that can simultaneously answer issues regarding lab-test versus *in situ* metered data;
- To provide an analysis of the efficiency and effectiveness of the program implementation, focused on opportunities for improving program's approach towards achieving its stated goals in energy savings;
- To document customer knowledge and attitudes related to older refrigerators and freezers, including (1) determining what current attitudes and knowledge are, to be used as a guide for developing changes in program messages and delivery mechanisms and (2) assessing the extent to which the program is changing attitudes and knowledge; and
- To analyze the operation of the used appliance market in order to determine its impact on the energy savings potential for the RARP.

In addition, there are general objectives for EM&V studies that the CPUC has established that also were addressed in this study. These objectives include the following:

- Measuring level of energy and peak demand savings achieved;
- Providing up-front market assessments and baseline analysis;
- Providing ongoing feedback and corrective and constructive guidance regarding the implementation of the program;
- Measuring indicators of the effectiveness of the program, including testing of the assumptions that underlie the program theory and approach;

- Assessing the overall levels of performance and success of the program;\
- Informing decisions regarding compensation and final payments; and
- Helping to assess whether there is a continuing need for the program.

Also included among CPUC's objectives are objectives pertaining to verification of number of recycled units, evaluation of specific procedures, feedback on program logic and procedures, and extent to which hard-to-reach (HTR) goals are being met.

1.2 EVALUATION APPROACH

Components were included for the evaluation of the 2004-2005 Statewide RARP that address the various objectives that the EM&V work should accomplish. The components of the RARP evaluation included the following:

- Conducting load impact analyses
  - Estimating gross kWh savings and kW reductions
  - Examining the relationship between in-situ and DOE lab test data on energy use of refrigerators and freezers
  - Estimating net savings
- Preparing market assessment analyses
- Conducting process evaluation
- Conducting verification activities

The relationship among these components is depicted graphically in Figure 1-1. The shaded boxes are within the purview of this evaluation, with the results produced feeding into succeeding outside analyses pertaining to avoided cost of energy, non-energy benefits, and future program planning. The various components shared data sources, particularly the process evaluation and market assessment shared in the data produced through surveys of program participants and non-participants.

The approach used to perform these components had a number of important aspects.

- For developing UEC estimates using DOE lab test data, an incremental, cumulative approach was used that was respectful of previous data collection efforts, making full use of prior work as the base from which to start. The approach was based on the considerable previous work that Athens Research has done with respect to estimating UEC values for refrigerators and freezers.
- The relationship between energy use as measured through DOE lab testing and *in situ* monitored data was analyzed.
- A survey of participant households was conducted to provide information for the net-to-gross analysis, the market assessment, and the process evaluation. The collection of data through

the survey was complemented by conducting numerous interviews with utility staff and market actors. This information was used to conduct an analysis of the secondary market for refrigerators and freezers in terms of supply and demand streams, including estimating market flows through these streams and estimating market potential.

- Data on acquisition and disposal of older refrigerators and freezers by utility customers who had not participated in RARP were also collected through a telephone survey.

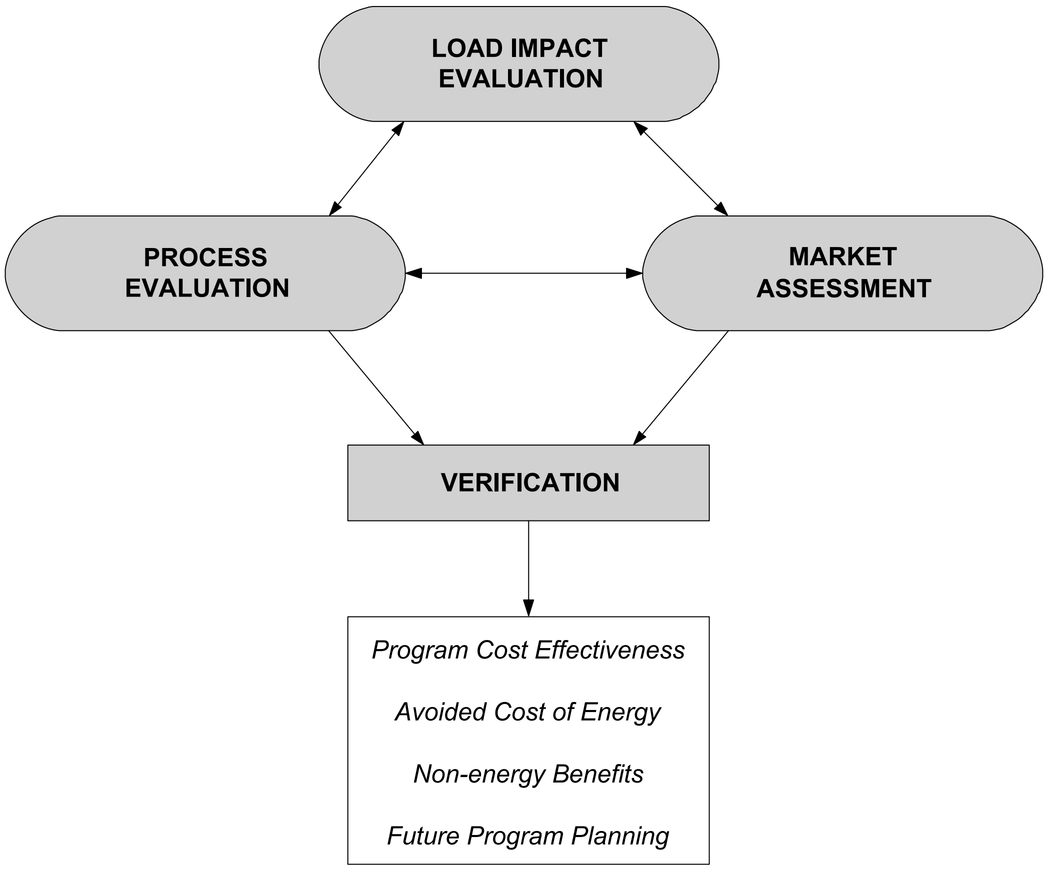

Figure 1-1. Relationships among Project Components

1.3 ORGANIZATION OF REPORT

This final report on the EM&V study of the 2004-2005 RARP is organized as follows.

- Chapter 2 discusses the estimating of gross savings for the program. This includes examining the relationship between *in situ* and DOE lab test data on energy use of refrigerators and freezers.
- Chapter 3 addresses the estimating of the net savings for the program.
- Chapter 4 provides the results of the process evaluation.

- Chapter 5 provides information on the awareness of, participation in, and satisfaction with the 2004-2005 RARP by customers who participated in the program.
- Chapter 6 provides an assessment of the market for disposing of refrigerators and freezers.

Various appendices provide copies of the interview guides and survey instruments and other supporting material developed through the EM&V effort.

- Appendix A: CPUC Impact Reporting Tables
- Appendix B: RARP History and Theory
- Appendix C: Appliance Recycling and Demanufacturing
- Appendix D: Survey Data Collection
- Appendix E: Survey Questionnaires
- Appendix F: Verification of Program Reporting and HTR
- Appendix G: Description of Dual Monitoring Study
- Appendix H: Supporting Materials for Gross Savings Estimation

2. GROSS SAVINGS ESTIMATION

This chapter reports on the analysis of gross savings for refrigerators and freezers recycled through the 2004-2005 RARP. The discussion is organized as follows.

- Section 2.1 addresses the estimation of program-level gross savings using estimates of appliance energy use developed through the DOE test procedure. Information is presented in this section on the numbers and characteristics of appliances recycled through RARP during 2004-2005; on the estimation of per-unit gross savings using DOE test data on appliance energy use; and on the estimation of program-level gross savings.
- Section 2.2 discusses analyses of the relationship between energy use as measured through the DOE test procedure and through in situ monitoring. The analyses discussed include investigating determinants of in situ energy use of refrigerators and freezers, using data from a dual monitoring project; presenting methods for extrapolating short term in situ data on energy use to provide a full-year representation of energy use; and analyzing relationships between DOE test procedure and in situ measures of energy use.

Appendix H provides background and supporting materials regarding the estimation of gross savings.

2.1 ESTIMATION OF PROGRAM-LEVEL SAVINGS USING DOE TEST UECS

This section addresses the estimation of program-level gross kWh savings for the 2004-2005 RARP.

2.1.1 Numbers and Characteristics of Appliances Recycled

The numbers of refrigerators and freezers that the three utilities reported as being recycled through their programs during 2004-2005 are reported in Table 2-1.

*Table 2-1. Numbers of Refrigerators and Freezers Recycled through RARP during 2004-2005**

Utility	***Numbers of Refrigerators Recycled***	***Numbers of Freezers Recycled***
PG&E	22,721	3,194
SCE: PGC	68,274	9,580
SCE: Procurement	14,760	1,745
SCE: 2005 Summer Initiative	22,420	3,553
SDG&E	16,584	2,763
Totals	144,759	20,835

*Sources: Program Report Workbooks for RARP, January 2006. Downloaded from EEGA

Additional data with which to characterize the refrigerators and freezers recycled were available from the utility tracking systems for RARP. Ideally, all utility tracking systems would include reliable values on appliance type, configuration (e.g., whether a refrigerator was a top freezer model or a side-by-side model), age, volume, and defrost type. However, because two different contractors were responsible for implementing RARP during 2004-2005 (i.e., ARCA for SCE and SDG&E and JACO for PG&E), the data elements included in the tracking systems differed somewhat. ARCA had also worked with SCE and SDG&E to implement RARP in earlier program years, and the tracking data that ARCA collected for the 2004-2005 RARP were consistent with that collected in earlier years. In the tracking system that JACO used for its work for PG&E, however, fewer tracking system variables were available than in ARCA's system. In particular, while ARCA had its personnel record the configuration and type of defrost method for the units they picked up, JACO personnel did not record this information. Rather, JACO entered the model number of the units picked up. Thus, all of the PG&E records lacked a configuration and defrost specification, and a handful (502) lacked type, size, or manufacture year, from the tracking data. Table 2-2 shows the items of information available without imputation on the PG&E tracking system.

Table 2-2. Data Available Without Imputation from PG&E Tracking, 2004-2005

Tracking Data Available	*Frequency*
Type	70
Type, Year of manufacture	52
Type,Size	380
Type, Size, Year of manufacture	26,334
Total	26,836

Because many of the PG&E records did include model number for the recycled units, look-up tables and routines were developed to use the model number information to impute configuration and defrost information. The lookup tables were built from data available from several databases that include information on appliance characteristics:

- Directories published by AHAM;
- Directories published by the California Energy Commission with information on refrigerators and freezers
- WAPTAC, and
- Website maintained by Kouba-Cavallo, Inc.; and
- Look-up tables maintained by JACO,

These sources provided information not only for imputing configuration and defrost information but also for assigning at-manufacture energy use estimates that would allow auxiliary analyses relating to degradation, quality of age indicators, etc.

Several look-up routines to extract information from the look-up tables were developed.

- A probabilistic look-up routine was developed to use model number and ancillary JACO-supplied data to match information from the look-up tables against data for appliances included in PG&E's tracking system data. Matches of fairly high quality were obtained for approximately 50 percent of the PG&E tracking records. About 40% of PG&E tracking records had complete data on type, size, manufacture year (or year range), configuration, and defrost type, while another 10% of the records gained some data from the lookup process, with one or more gaps remaining,
- Other imputation routines created multiple fractionally-weighted records to fill in, in an unbiased way, the remaining gaps, per appliance, for the five main variables of interest. These were based on quantitative correspondence tables developed from complete data on either (a) ARCA distributions at SDGE/SCE plus the completed lookups for PGE, or (b) the ARCA distributions only,
- Regression models for imputing amperage data for the records in the PG&E tracking system were developed and calibrated using data collected by ARCA on the characteristics of the appliances they picked up through RARP.
- In order to support eventual use of DOE test and / or *in situ* models that might be sensitive to distinctions either of primary / secondary use or of location in conditioned / unconditioned space, logistic regressions were developed to indicate the likelihood of such situations in the tracking data.
- Using the look-up tables and routines, six separate files were created to represent PG&E tracking data, with each file representing a different combination of look-up table rigor and imputation strategy.

2.1.2 Estimating Per Unit Gross Savings Using DOE Test UECs

As part of the effort to determine program-level gross savings, estimates were needed of the per-unit savings associated with the refrigerators and freezers that were recycled. Several different measures of energy use have been used or proposed for use in evaluations of refrigerator/freezer recycling programs to determine gross savings for recycled units. These measures include:

- Energy use as measured before recycling with the DOE test protocol for refrigerators or freezers actually recycled;
- At-manufacture nameplate energy use as measured using the DOE test protocol; and
- Energy use measured through *in-situ* monitoring of refrigerators or freezers;

For the analysis of gross savings in this evaluation, energy use as measured with the DOE test procedure and through *in situ* monitoring were both used. The estimation of per unit gross savings using DOE test data is discussed in this section, while the next section addresses the use of energy use measured through *in situ* monitoring.

2.1.2.1 Characteristics of DOE Test Procedure for Refrigerators and Freezers

Minimum standards of energy efficiency for refrigerators, freezers, and refrigerator-freezers were first established in the National Appliance Energy Conservation Act (NAECA) of 1987. Appliance manufacturers must produce products that either meet the minimum level of energy efficiency or that consume no more than the amount of energy that the standard allows. The U.S. Department of Energy (DOE) has developed test procedures measuring the energy use of refrigerators and freezers. These procedures are published in the Code of Federal Regulations (10 CFR, Chapter II, Part 430).[1]

The essential features of the DOE test procedures are as follows:

1. The test chamber is stabilized at 90F.
2. The interpolated result (based on systematically varied test conditions) is extrapolated by 365 days.
3. There is no ambient relative humidity specification.
4. There are no door openings.
5. The fresh food compartment and freezer compartments are empty.
6. Freezer and fresh food compartments are served by three thermocouples
7. The test incorporates on/off settings of the anti-condensate heater switch.
8. Consumption of the appliance is calculated by interpolation of tests bracketing the standard freezer temperature.

Harrington points out that energy consumption is interpolated for a freezer temperature of -15C (5F), subject to the fresh food compartment being at less than 7.22C (45F). Otherwise, the key interpolation temperature becomes the fresh food compartment at 7.22C (45F). Where two controls exist, they must be moved together to develop test points. For standalone freezers, the key interpolation point is -17.8C (0 F).

The DOE test provides standardized results, useful in providing comparisons among appliances both at birth and at death (i.e., at recycling), and in assessing degradation from birth to death. The test will fail to exactly mirror any one appliance's performance *in situ*, but does serve as a valuable anchor by which to efficiently leverage *in situ* results toward estimates covering a wide variety of appliance circumstances.

2.1.2.2 Use of UEC Data from DOE Testing in Previous Evaluations of RARP

Although the DOE test procedure was originally developed to apply to new appliances at manufacture, the test procedure has also been applied to provide data on energy use for

[1] A description of the DOE test procedure is available at http://www.eren.doe.gov/buildings/codes_standards/. Further descriptions are offered by Meier and Jansky (1993: 705) and Harrington (2001).

appliances being recycled. In their evaluation of the 1994 SCE appliance turn-in program that ARCA implemented for SCE, Barakat and Chamberlin (1996) examined monitored data from several sources, notably including data for approximately 1,100 lab-metered recycled appliances that were part of the ARCA Monitoring Program (*circa* 1993-1994). Their overall findings suggested a lab-based full year UEC of 2,276 kWh for refrigerators. Based on an unreferenced E-Source report, Barakat and Chamberlin recommended a reduction by 18%, to 1,866 (Barakat and Chamberlin, 1996: 11).

In support of the 1998 evaluation of the 1996 SCE appliance recycling program and taking into consideration California regulatory criticism of the auspices of the ARCA monitoring data base, 136 additional recycled appliances that had been selected using a carefully stratified sampling plan were tested with the DOE procedure at BR Labs of Huntington Beach, California. The data for these units were added to the existing library of ARCA-sponsored DOE test data. In this study, a literature review was produced that made it clear that the jury remained out on whether in-use UEC of the removed appliance was systematically lower, higher or contingently related to the values obtained by the reliable, standardized, but perhaps unrealistic DOE test. XENERGY made use of the full lab-based UEC values from the Athens sub-study: 2,148 kWh for refrigerators and 2,058 kWh for freezers (Athens, 1998; XENERGY, 1998).

In 2004, KEMA evaluated the 2002 statewide program. In this study, KEMA worked with BR Labs to augment again the existing database of energy use estimated for recycled appliances using the DOE test procedure. This study added 90 refrigerators and 10 freezers, allowing KEMA to follow up on the Athens approach by adding/testing terms reflecting sample cohorts and various interactions. KEMA did report considering other options, which included (1) making greater use of “at manufacture ratings” maintained in California Energy Commission, WAPTAC, and other sources and (2) developing a DOE test/*in situ* dual metered sample for the 2002 study. However, KEMA rejected the use of these options, based on grounds both practical and data-availability-related. KEMA’s results based on the sample DOE-test regression combined with tracking data (statewide) revealed a clear drop in UECs from previous SCE evaluations: 1,946 kWh for refrigerators and 1,662 kWh for freezers (KEMA, 2004).

Table 2-3 provides a summary showing the per-unit energy use values (i.e., UECs) for recycled appliance as estimated in previous evaluations of appliance recycling programs in California. As can be seen, estimated per-unit energy use has decreased over time. Factors contributing to the decline include:

- Simple cohort or consumption-at-manufacture changes,
- Changes in program eligibility requirements to include primary appliances,
- Changes in the freezer/refrigerator mix,
- Impacts (possibly minor) of methodology shifts, and
- Impacts (possibly minor) of program penetration.

Table 2-3. Recent History of RARP UEC Gross Energy Impact Estimates

Program	Study	Refrigerator	Freezer	Overall
1994	Barakat and Chamberlin(1996)	2,276		
1994	B&K (1996), 18% reduction	1,866		
SCE, 1996	Athens Research (1998), KEMA (1998)	2,148	2,058	2,130
2002, Statewide	KEMA (2004)	1,946	1,662	1,695

2.1.2.3 UEC Regression Model Using DOE Test Data

For this evaluation of the 2004-2005 RARP, analysis of per unit gross savings using DOE test data built on the analyses of gross savings from previous evaluations of the RARP, particularly the evaluation of the 2002 RARP. In those evaluations, regression analyses of DOE test data were used to determine full year energy consumption (i.e., UECs) of the recycled refrigerators and freezers. This previous work on estimating UECs for the gross savings analysis was extended in this evaluation by adding DOE test data from a dual monitoring project that was conducted to support this evaluation to data from the three prior samples of DOE test data. The dual monitoring project provided DOE test data for an additional sample of about 200 refrigerators and freezers, as well as data on *in situ* energy use for the units. Thus, the data used in the regression modeling included the following:

- Data from the original ARCA Monitoring Study sample from 1993-1994 (approximately 1,143 records),
- Data for 136 DOE-tested sample appliances (SCE-BR Labs, 1998),
- Data for 100 DOE-tested appliances (Statewide-KEMA-BR Labs, 2003),
- Data for 202 appliances from dual monitoring study (Statewide-ADM-BR Labs, 2005).

As noted above, the basic principles for this regression analysis approach were developed by Athens Research in its evaluation of SCE's 1994 Spare Refrigerator Recycling Program. Subsequent evaluations built on this CPUC-supported approach but used different data sets (i.e., by adding to the initial sample initially used in the 1994 evaluation) and modified the regression equation slightly.

Several general principles guided the regression modeling effort.

- A non-negotiable base set of terms was included (additively) as explanatory variables to represent appliance type, configuration, defrost type, and age. Inclusion of these variables was considered necessary not only on substantive terms but to reflect the various ways that the samples have been stratified in past years. That is, blocking the regression on all factors ever relevant to stratification prevented confusion arising from the stratification.
- Terms were included to reflect sample year. Attention was also paid to the interaction of age with cohort, in an attempt to capture age x cohort impacts in the analysis.

- Alternative specifications on age were investigated.
- Interaction terms were developed hierarchically, with an interaction effect always being assessed net of base additive terms.
- Specific criteria for identifying and down-weighting outlier records with extreme influence were maintained; these criteria were the same as used in Athens (1998) and KEMA(2004).
- Diagnostics were applied to give careful consideration to collinearity.

The model developed through the regression analysis of the DOE test data is reported in Table 2-4.

- The model specification accounts for appliance type and configuration, defrost type, age, and amperage, as well as including interaction terms for configuration and defrost type, for side-by-side configuration and amperage (which has persisted over waves of studies), and sample-specific intercept terms.
- Consistent with earlier work by KEMA (2004), age of a unit was represented in the regression analysis by ln(age). Choice of this representation for age was based on both explained variance and RMSE-related aspects of fit.
- An interaction term between age and frost free defrost is also included, following on previous work by both Athens and KEMA.
- Preliminary fitting of the model showed that significant improvement in fit resulted (net of all other factors considered) if age impacts subsequent to age 15 were depressed somewhat by including the age 15 up dummy directly and in interaction with the natural logarithm of age..

Alternative versions of the model are presented in Appendix H, as are diagnostics specific to the current version. Note that while some collinearity indices are moderately substantial, these pertain to the natural, expected, and essentially necessary multi-collinearity that occurs when polytomies are represented in a regression ("families" of binaries or binaries/slope terms required to represent a categorical effect or an interaction with a categorical variable).

Estimates of average full-year UECs by appliance type were developed for the 2004-2005 RARP overall and by utility by using the estimated regression equation as reported in Table 2-4 to impute energy use to the units on the utility tracking systems for the program. The average UECs are reported overall and by utility in Table 2-5. Because the average vintages of refrigerators and freezers recycled through RARP has gone up, the average efficiency of the units being turned in has increased. The effect is to lower the estimated energy savings for refrigerators and freezers being recycled through RARP.

Table 2-4. Regression Relating DOE Test Annual UEC for Recycled Appliances to Explanatory Variables

Variable Description	Coefficient	t-value
Intercept	-422.4106	-0.77
Freezer dummy (=1 if freezer)	169.0536	1.84
Bottom freezer dummy (=1 if unit is bottom freezer)	595.3794	2.91
Side by side dummy (= 1 if unit is side-by-side)	-129.3553	-0.34
Single door dummy (= 1 if unit is single door)	-417.1026	-4.73
Frost free dummy (= 1 if unit is frost free)	-445.0348	-1.00
Natural log of unit age	405.2134	2.15
Cubic Feet of unit (per tracking system data)	43.6478	4.59
Label Amps	104.1018	4.83
Freezer dummy x frost free dummy	319.1097	1.94
Bottom freezer dummy x frost free dummy	-302.0484	-1.28
Side by side dummy x frost free dummy	1451.3206	3.80
Side-side dummy x amps	-126.4332	-2.88
Dummy if unit from SCE/KEMA/BRLABS sample-1998	-48.9460	-0.69
Dummy if unit from KEMA/BRLABS sample-2003	-435.8978	-5.38
Dummy if unit from ADM/BRLABS dual monitoring study-2005	-649.2073	-10.30
Frost free dummy x ln(age)	299.8206	2.09
Dummy if unit age is 15 years or greater	1197.8349	2.61
Ln age x age 15 up dummy	-524.9782	-3.08
Model, error degrees of freedom	18, 1564	
R-squared	0.4337	
RMSE	751.5023	

Table 2-5. Estimates of Full-Year UECs (kWh per year) for Refrigerators and Freezers Recycled through 2004-2005 RARP – Overall and by Utility

	Overall	By Utility		
		SCE	PGE	SDGE
Refrigerators	1,775	1,776	1,766	1,783
(Standard errors)	(53.4)	(53.6)	(54.3)	(53.9)
Freezers	1,406	1,415	1,367	1,409
(Standard errors)	(82.2)	(83.4)	(80.2)	(82.2)
All Units	1,729	1,732	1,717	1,729
(Standard errors)	(53.2)	(53.5)	(53.9)	(53.7)

2.1.2.4 Adjusting Gross Per-Unit UECs for Part Use

While Table 2-5 provides estimates of full-year UECs for recycled refrigerators and freezers, some of the appliances that were recycled were not used throughout the entire year. An adjustment to gross savings was therefore appropriate for such units to reflect part use (i.e., the proportion of a year that a given recycled appliance had been used rather than switched off).[2]

Different values for use factors were assigned based on three categories into which recycled refrigerators fall.

- Some units that were recycled were not being used at all before being sent for recycling. The use factor for such units therefore would 0. That is, these units were not being used even before recycling and therefore had no energy use.
- Other units were being used, but for only part of the year. For these units, the use factor is calculated by dividing the number of months in the past year that the unit had been plugged in and running by the number of months in the year (i.e., 12). Based on data collected through a survey of participants, the average number of months in use for a refrigerator that was being partly used was 2.99 months, implying a use factor of 0.249 (i.e., 2.99/12). For freezers in this category, the use factor was calculated to be 0.229, reflecting an average of 2.75 months in use for freezers being partly used.
- Units used all of the time have a use factor of 1.

The overall use factor and the corresponding overall UEC are calculated as a weighted average across the three categories, where the weights are determined by the percentages of units falling into the three categories. Table 2-6 shows the calculation of the overall UECs for refrigerators and freezers when part use is accounted for.

Table 2-6. Calculation of UECs Adjusted for Part Use

Operating Status of Unit	Percentage of Recycled Units in Category	Use Factor	UECs			
			Overall	By Utility		
				SCE	PG&E	SDG&E
Refrigerators						
Not running	4.2%	0.000	0	0	0	0
Running part time	3.4%	0.249	442	442	440	444
Running all time	92.4%	1.000	1,775	1,776	1,766	1,783
Weighted Average UECs			1,655	1,656	1,647	1,663
Freezers						
Not running	5.%7	0.000	0	0	0	0
Running part time	6.4%	0.229	322	324	313	323
Running all time	87.9%	1.000	1,406	1,415	1,367	1,409
Weighted Average UECs			1,257	1,265	1,222	1,259

[2] In their evaluation of the 2002 RARP, KEMA addressed part-use as part of their net-to-gross analysis. However, for this evaluation part-use has been analyzed as an aspect of gross savings analysis.

2.1.3 Program-Level Gross Savings

Table 2-7 brings together the data presented in Sections 2.1.1 and 2.1.2 to calculate total gross kWh savings for the RARP. Savings are calculated by utility/program, type of appliance, and program year. Savings are calculated using the weighted average UECs reported in Table 2-6. Table 2-8 shows the total gross savings when savings are rolled-up to the utility/program level.

Table 2-7. Gross Savings (kWh per Year) for Refrigerators and Freezers Recycled through RARP in 2004-2005: By Utility/Program, Type of Appliance, and Program Year

Utility/Program	Type of Appliance	Program Year	Number of Units	kWh Savings per Unit	Total Gross kWh Savings
PG&E	Refrigerators	2004	8,584	1,647	14,137,848
PG&E	Refrigerators	2005	14,137	1,647	23,283,639
PG&E	Refrigerators	All	22,721		37,421,487
PG&E	Freezers	2004	1,012	1,222	1,236,664
PG&E	Freezers	2005	2,182	1,222	2,666,404
PG&E	Freezers	All	3,194		3,903,068
SCE-PGC	Refrigerators	2004	32,919	1,656	54,513,864
SCE-PGC	Refrigerators	2005	35,355	1,656	58,547,880
SCE-PGC	Refrigerators	All	68,274		113,061,744
SCE-PGC	Freezers	2004	4,233	1,265	5,354,745
SCE-PGC	Freezers	2005	5,347	1,265	6,763,955
SCE-PGC	Freezers	All	9,580		12,118,700
SCE-Procurement	Refrigerators	2004	9,857	1,656	16,323,192
SCE-Procurement	Refrigerators	2005	4,903	1,656	8,119,368
SCE-Procurement	Refrigerators	All	14,760		24,442,560
SCE-Procurement	Freezers	2004	1,067	1,265	1,349,755
SCE-Procurement	Freezers	2005	678	1,265	857,670
SCE-Procurement	Freezers	All	1,745		2,207,425
SCE-Summer Initiative	Refrigerators	2005	22,420	1,656	37,127,520
SCE-Summer Initiative	Freezers	2005	3,553	1,656	5,883,768
SCE-Summer Initiative	Freezers	All	25,973		43,011,288
SDG&E	Refrigerators	2004	8,036	1,663	13,363,868
SDG&E	Refrigerators	2005	8,548	1,663	14,215,324
SDG&E	Refrigerators	All	16,584		27,579,192
SDG&E	Freezers	2004	1,398	1,259	1,760,082
SDG&E	Freezers	2005	1,365	1,259	1,718,535
SDG&E	Freezers	All	2,763		3,478,617

Table 2-8. Total Gross Savings for RARP by Utility / Program

Utility / Program	Total Gross kWh Savings
PG&E	41,324,555
SCE-PGC	125,180,444
SCE-Procurement	26,649,985
SCE-2005 Summer Initiative	43,011,288
SDG&E	31,057,809
Total	267,224,081

2.2 ANALYSIS OF RELATIONSHIP BETWEEN DOE TEST AND *IN SITU* ENERGY USE DATA

Over time, evaluations of appliance recycling programs in California have continued to add to the library of data on energy use for recycled appliances, as estimated through the DOE test procedure. (The appliances represented in the library are of course a select subpopulation of poorly performing but operable and transferable appliances.) Although the DOE test procedure produces reliable, standardized estimates of energy use, there has been interest in developing a methodologically defensible dual metering sample (i.e., with energy use measured through both the DOE test procedure and through *in situ* metering) that would support systematic investigation and possible adjustment of the estimates that are obtained from applying the DOE test procedure.

Several reviews pertaining to the use of *in situ* data as well as data from the DOE test procedure in estimating UECs have been developed, including reviews by Athens Research (1998), KEMA (2004), and ADM (2004). In general, the information found in the studies reviewed is mixed with respect to the degree to which appliance energy use estimated through the DOE test procedure overstates or understates actual consumption.

On one hand, several studies (i.e., by Proctor Engineering Group, by AAG and Associates, and by the Pacific Northwest National Laboratory) have provided evidence that actual refrigerator energy use for a sample of refrigerators is lower than the energy use estimated through the DOE test protocol.

On the other hand, KEMA (2004, p. 8-1) concluded from its review that:

> "There is no significant trend between lab results and *in situ* results. Therefore, there is no definitive basis present at this time for making an adjustment to the lab-metered estimates of UEC. The results of these studies point in different directions. Some studies found that lab tests over-predicted actual energy consumption; others were inconclusive. None of the studies reviewed involved conditions similar to those of the statewide RARP.

This section provides the results of work using the data developed through a dual monitoring project[3] to develop an understanding of the components of the difference between energy use estimated through the DOE test procedure and through *in situ* monitoring (i.e., the lab/*in situ* delta). The general approach has been to develop evidence regarding the lab (DOE Test) / *in situ* relationship and to determine whether *in situ* data can be used to adjust energy use estimated through the DOE test procedure (e.g., either through regression or through simple estimation of critical ratios). In particular, the work discussed in this section has been directed to determining whether the relationships between energy use estimated through the DOE test procedure and through *in situ* monitoring are contingent upon key variables that may be influenced by program

[3] A description of the dual monitoring project is provided in Appendix G.

design (e.g., secondary appliances, automatic defrost, large households, hotter climate zones, etc.).

2.1.3 Measuring Per-Unit Energy Use With In Situ Data

To provide an initial set of data with which to examine the question of how well energy use measured through the DOE test procedure represents the energy use of refrigerators and appliances as they are actually used, a dual monitoring project was conducted to support evaluation of the RARP. The dual monitoring project provided energy use data for a total of 202 appliances that were metered short term *in situ*. The energy use of each appliance in this sample was also measured through the DOE test protocols. Thus, there were two measures of energy use for each appliance in the sample from the dual monitoring project.

Appendix G provides a description of the sampling, data collection, and analysis methods used in conducting the dual monitoring project. In brief:

- A sampling plan was prepared that provided for stratifying by appliance type, configuration, size, primary and secondary status, and utility territory.
- Operationally, appliances were actually selected to meet the requirements of the sampling plan by intervening in the pick-up logistics for the program operation, either (a) by sampling from within scheduled appliance pickups or (b) by sampling from contacts provided through retailers identifying new appliance purchasers with existing appliances needing disposal. A total of 202 refrigerators and freezers were recruited for monitoring through this effort.
- For each appliance included in the sample, one-time measurements were taken of true rms power, voltage, current, power factor, and food load. A plug-in power logger was also installed to record (at five-minute intervals) the amperage of the electric current powering the appliance. From these, kW demand per interval was calculated as a product of monitored amps, the one-time volt reading, and a one-time power factor measurement specific to whether or not defrost heating is underway. In addition, temperatures in fresh food and freezer cabinets (as applicable) were monitored at five-minute intervals, as was the ambient temperature where the appliance was located. Lighting loggers were used to record the frequency and duration of door openings. Monitoring was generally conducted over a period of 7 to 10 days.
- Each household for which an appliance was monitored was administered a survey in which information was collected on household size, on household income/educational levels, on characteristics of the monitored appliance, on whether the appliance being monitored was a primary or a secondary unit, and on whether the appliance was located in conditioned or in non-conditioned space. Descriptive statistics were developed from these survey data regarding appliance features, primary/secondary status of the appliances, their locations in conditioned versus unconditioned space, activity levels (i.e., door openings and food load), average interior temperatures, average ambient indoor temperatures, average temperature deltas, etc.

- After the *in situ* monitoring of an appliance was completed, the unit was transported to BR Labs (in Huntington Beach, CA) where the DOE test procedure was used to develop a second estimate of the appliance's energy use.

2.1.4 Regression Analysis of Hourly Data from Dual Metering Sample

As a first step toward analyzing the relationship between energy use estimated through DOE test procedure and through *in situ* monitoring, a micro analysis of the *in situ* data was conducted to identify and better understand factors that are the primary contributors to variations in hourly kW demand over time within the experience of the specific individual appliances.

For the analysis, it was hypothesized that major variables determining differences between a given appliance's consumption over a week-long period in the home and the result from a subsequent DOE test include average temperature (vs. 90^{o}F), door opening frequency (vs. none), fresh food load (vs. none), and possibly interactions among these factors. Accordingly, regression analysis was used to examine how much of the variability in hourly energy use over time for appliances in the dual monitoring project is accounted for by such factors as ambient temperature variability within each metered location, interior cabinet temperatures, and door opening activity (both in number of openings and length of the openings). The regression model was specified to relate hourly kWh consumption for appliances to a set of variables that include individual intercepts for the individual appliances, monitored cabinet temperature, ambient or room temperature, door openings within the measurement hour, and minutes per door opening.

To perform the regression analysis, the time series data on hourly kWh energy use were pooled for a specified set of appliances. A least squares dummy variable (LSDV) covariance estimation procedure was used for the regression analysis.[4] A "fixed-effects" specification was used in which the estimated equation contains an intercept term that is unique to each appliance. In this approach, a binary dummy variable is created for each appliance included in the cross-section sample for a particular regression, and the full set of these dummy variables is included in the regression analysis.[5] The individual intercepts capture the effects of all of the determinants of that appliance's energy use that are constant over time. In effect, this approach automatically controls for differences among appliances that influence the average level of consumption across the appliances. The specification of appliance-specific effects allowed the model to capture much of the baseline differences across appliances while obtaining reliable estimates of the impacts of the various explanatory variables.

As shown in Section 2.1.1, most of the refrigerators recycled through RARP are either top freezer models or side-by-side models. The results of the regression analyses of *in situ* hourly energy use for these two types of refrigerators are reported in Table 2-9.

[4] For a discussion of this approach, see Kmenta, J., **Elements of Econometrics**, 2nd Edition, Macmillan Publishing Company, 1986, pp. 630-635.

[5] In practice, this approach was implemented using PROC GLM in SAS, with appliance identification used as a class variable.

Table 2-9. Results of Cross-sectional Time Series Regression Analyses of In Situ Hourly Energy Use Data for Top Freezer and for Side-by-Side Refrigerators

Variable	***Coefficient***	***Standard Error***	***t-value***
Top Freezer Refrigerators			
Cabinet Temperature, lagged one hour	0.00331	0.00018	17.90
Room temperature, lagged one hour	0.00335	0.00014	23.71
Door openings during hour	0.00467	0.00023	20.23
Minutes per door opening	-0.00037	0.00038	-0.98
Side-by-Side Refrigerators			
Cabinet Temperature, lagged one hour			
Room temperature, lagged one hour			
Door openings during hour			
Minutes per door opening			

The models developed through the regression analysis of the hourly *in situ* energy use data were used to consider the gap between the *in situ* consumption of the appliances and the expected consumption were they subjected to the mean temperatures and door openings specified for the DOE test procedure.

The average cabinet temperature, average room temperature, and average number of door openings for the appliances monitored in the dual monitoring project were 44.1^{o}F, 73.3^{o}F, and 0.69 respectively. (Because minutes per door opening were not statistically significant, this parameter is not considered in this evaluation). By contrast, the average cabinet temperature assumed for the DOE test is roughly 38.1^{o}F, based on the average result of the cold setting for cabinet temperature used by BR Labs in the "on" condition for the anti-condensate heater.[6] Further, the room temperature assumed for the DOE test procedure was of course 90^{o}F, and door openings were set at 0.

As shown in Table 2-10, when these values are used with the estimated, significant regression coefficients, the consumption differential expected for these appliances amounted to approximately 286 kWh per year, with *in situ* energy use being lower than energy use estimated through the DOE test procedure.

[6] Although this serves to provide a reasonable example, further work on the gap between *in situ* and lab conditions might consider the cabinet temperatures that are averaged over the DOE test's interpolation.

Table 2-10. Regression Implications: Gap between DOE Test and In Situ Estimates of Energy Use

Difference in:	***Implied Difference in kWh***
Cabinet temperature	-176.67
Room temperature	490.67
Door opening	-28.245
Total difference	285.75

2.1.5 Extrapolation of Short-Term Metering Data to Represent Full-Year UECs

The energy use data collected *in situ* during the dual monitoring project covered periods of 7 to 10 days. However, the energy use estimated for an appliance through the DOE test procedure is a representation of full-year energy use. Accordingly, the *in situ* data for an appliance needed to be extrapolated to also provide a full-year representation of energy use. Several methods were developed to accomplish this extrapolation.

The most simple method of extrapolation is to multiply the average of the hourly kW readings developed from the *in situ* monitored data by 8,760 hours. However, this method of extrapolation does not take into account that energy use for an appliance generally varies between different parts of a year. Such variation occurs in part because appliance energy use varies with outdoor temperatures (albeit mediated by changes in indoor temperature and the indoor-internal cabinet temperatures). Studies that have referenced the effects of outdoor temperature on appliance energy use include Proctor, PNNL, Meier (1993), and Australian Greenhouse Office (2002). For example, the study conducted for the Australian Greenhouse Office concluded that weather-related variance accounted for 42% of the variance in energy use for refrigerators and for 67% of such variance for freezers.[7]

To quantify the relationship between hourly consumption and hourly outdoor temperature, regression models were estimated using monitored data on appliance energy use that SCE and PG&E collected in the early and middle 1990's.[8] Two regression models were estimated.

- Model A included intercept terms per appliance to reflect "base load," as well as variables for hourly outdoor temperature and temperature x month interactions.

[7] Data on door openings and on food load collected for appliances in the dual monitoring project also showed differences between seasons.

[8] The PG&E data are the monitoring records analyzed in Dutt et. al (1994), under types "E" and "S," while the SCE data were collected during the 1990's as part of SCE's Residential Appliance Enduse Study (RAEUS), administered by SCE. Each of these records was carefully associated with its PG&E or SCE weather station. In the case of the PG&E data, this required some extra "temperature pattern matching" work, because weather station indicators were not provided along with the 1990's hourly temperatures included in the PG&E data set.

- Model B incorporated the same hourly temperature and month specifications as Model A, but also included an additive expression of month (so that the hourly temperature x month term truly captured the temperature slope specific to that month).

As variants for both models, regressions were also estimated by using a single base load term for each appliance that was equal to the appliance's mean observed wH/hour. These terms were used in place of the individual intercept terms.

Regression models were estimated for four separate sets of appliances:

- Top freezer refrigerators;
- Side-by-side refrigerators;
- Stand-alone freezers;
- Secondary refrigerators located in unconditioned space.

Hourly weather data for the regression analyses were obtained for the same periods and locations covered by the hourly energy use data. The weather data used were from the various weather stations maintained by the utilities.

To illustrate this regression modeling, Table 2-11 provides the coefficients and standard errors for the Model B hourly regression for top freezer appliances in conditioned space. Note that the results for this model suggest (a) substantial "month" effects on hourly consumption, (b) substantial temperature by volume interactions, (c) volume by month interactions, and (d) non-trivial three-way interactions between temperature, volume, and month. (Appendix H provides the results of the regression analyses for both Model A and Model B for each combination of appliance type, configuration, and conditioned/unconditioned space.)

The results of the regression analyses provided equations relating hourly appliance energy to hourly outdoor temperatures that were then used to produce appliance-type-specific estimates of predicted mean monthly consumption and average annual consumption for several different sets of outdoor temperature data.

- One set of outdoor temperature data was for utility weather stations for 2004-2005.
- A second set of hourly outdoor temperature data was from Typical Meteorological Year (TMY) data for each California Climate Zone.

For each regression model, weather station, and appliance type, ratios of monthly energy use to annual energy use were calculated.[9] This "lookup table" allowed the *in situ* energy use for an appliance to be extrapolated to represent full-year energy use. The extrapolation procedure is then as follows.

[9] Standard error was calculated conservatively, omitting any "discount" owing to correlation of monthly and annual predictions.

Table 2-11. Top Freezer Extrapolation Model, Based on Hourly Temperature and Consumption Data, PG&E/SCE 1990's Refrigerator Monitoring Data Sets (Dependent Variable: watthours per hour)

Variable Description	***Coefficient***	***Standard Error***
Intercept	-98.3825	1.1319
Mean baseload	0.9815	0.0005
Dummy for January	3.8639	0.9128
Dummy for February	-0.1099	0.9076
Dummy for March	5.6952	0.9017
Dummy for April	12.9591	0.9349
Dummy for May	7.6151	0.9584
Dummy for June	9.6176	1.015
Dummy for July	16.1311	1.0328
Dummy for August	6.4387	1.0689
Dummy for September	6.8108	1.0192
Dummy for October	15.1539	1.1215
Dummy for November	4.4913	0.9349
Dummy for December	Suppressed	
Ambient Temperature (^{9}F)	1.4172	0.0185
Appliance Volume (cubic feet)	3.0881	0.0578
Dummy for January * Appliance Volume	-0.5238	0.0524
Dummy for February * Appliance Volume	-0.4686	0.0558
Dummy for March * Appliance Volume	-0.8596	0.0588
Dummy for April * Appliance Volume	-1.6753	0.0582
Dummy for May * Appliance Volume	-1.7853	0.0607
Dummy for June * Appliance Volume	-1.647	0.061
Dummy for July * Appliance Volume	-1.7913	0.0625
Dummy for August * Appliance Volume	-1.2161	0.0642
Dummy for September * Appliance Volume	-0.9315	0.0622
Dummy for October * Appliance Volume	-2.1263	0.0767
Dummy for November * Appliance Volume	-0.8015	0.0571
Dummy for December * Appliance Volume	Suppressed	
Ambient temperature * Appliance volume	-0.0488	0.0010
Dummy for January * Ambient temperature * Appliance volume	0.0079	0.0007
Dummy for January * Ambient temperature * Appliance volume	0.0096	0.0007
Dummy for January * Ambient temperature * Appliance volume	0.0145	0.0007
Dummy for January * Ambient temperature * Appliance volume	0.0228	0.0007
Dummy for January * Ambient temperature * Appliance volume	0.0307	0.0006
Dummy for January * Ambient temperature * Appliance volume	0.0309	0.0006
Dummy for January * Ambient temperature * Appliance volume	0.0301	0.0006
Dummy for January * Ambient temperature * Appliance volume	0.0279	0.0006
Dummy for January * Ambient temperature * Appliance volume	0.0299	0.0006
Dummy for January * Ambient temperature * Appliance volume	0.0264	0.0008
Dummy for January * Ambient temperature * Appliance volume	0.0118	0.0007
Dummy for January * Ambient temperature * Appliance volume	Suppressed	
Model, error degrees of freedom		
R-squared	0.5189	
Root MSE	54.3281	

- Begin by determining the set of expansion ratios most appropriate for the given appliance (e.g., the results from the side-by-side regression model are most appropriate for an indoor side-by-side primary refrigerator) and also whether the extrapolation from the observation period is to be to full-year 2005 energy use, full-year energy use for 2004-2005 , or full-year TMY.
- If, for example, the in situ energy use data were from monitoring that occurred during March 2005, expand to a full-year 2005 UEC for the same weather station by using the March-specific expansion ratio for that weather station.
- To continue the example, in situ energy use data that were from monitoring that occurred during March 2005 can be expanded to a 2004-2005 full-year UEC for the same weather station by (a) first calculating the ratio between regression predictions for 2004-2005 and 2005, (b) adjusting the observed in situ consumption accordingly, and then (c) expanding to full year 2004-2005 using the 2004-2005 March-to-full year ratio.
- Similarly, energy use estimated from in situ monitoring in 2005 can be extrapolated for TMY data or for data from another weather zone or climate zone by using the same straightforward lookup or correspondence table.

Table 2-12 provides an example of extrapolated records from the dual monitoring data set; these records are for appliances for which metering occurred in February-March of 2005. The records include a mix of top freezer refrigerators, single door refrigerators, and upright freezers. One extrapolation provided is the simple annual kWh calculated by normalizing observed consumption to a full year (i.e., EXTRAP 8760). Another is the extrapolation performed, as described above, to expand to full year hourly temperatures averaged over 2004-2005 (probably the appropriate ultimate criterion for evaluating the 2004-2005 programs). A standard error is attached, making the point that all extrapolations from short-term to full-year are error prone. This standard error takes into account the error in developing predicted kWh for mean 2004 February temperatures, mean 2004-2005 February temperature, in ratio adjusting from the former to the latter, and in adjusting from February to full year. It is almost certainly an *understatement* of the error involved, in that it relies upon the huge volume of hourly records available to the underlying regression on 1990's SCE/PGE refrigerator monitoring data.

Table 2-12. A Handful of Records from the Dual Metering Data Set, Including Regression-Based Extrapolation to Full Year kWh, 2004-2005 Temperature Scenario

ID	***Configuration***	***Monitoring Started***	***Monitoring Ended***	***Extrapolated 8760***	***2004-2005 Extrapolation Model B***	***Standard Error***
RF009	Top freezer	05-02-02	05-02-09	700	751	1.86
RF010	Top freezer	05-02-02	05-02-09	931	999	2.47
RF011	Top freezer	05-02-02	05-02-09	456	526	4.78
RF012	Single door	05-02-04	05-02-11	764	840	2.07
RF013	Upright Freezer	05-02-04	05-02-11	632	691	2.46

As this discussion demonstrates, extrapolating energy use estimates developed through short-term *in situ* monitoring necessarily entails some error (e.g., as shown by the listed standard errors for the extrapolated estimates in Table 2-12). Additionally, note that the extrapolation is heavily dependent upon the weather characteristics of the period in which short-term monitoring occurs. The preponderance of *in situ* monitoring occurred in warmer months; more than half of the appliance monitoring occurred in five months, May-September 2005. Consequently, the regression-based extrapolations all produce smaller full-year UEC estimates, on average, over the full dual metering sample than does simple 8760-hour extrapolation. The regression-based extrapolation essentially down-weights the observed consumption.

The immediate purpose of this extrapolation work was to develop full-year estimates of energy use for the appliances in the dual monitoring project that could be compared to the full-year estimates of energy use developed for those appliances through the DOE test procedure. However, extrapolated estimates tailored to specific temperature scenarios may be useful in further analysis and in program planning scenario development (e.g., planning for activity focused in hotter climate zones or utility weather zones in future years).

2.1.6 Comparisons of Annual UECs

To compare the estimates of energy use developed through the DOE test procedure and through *in situ* monitoring, a model was carefully and hierarchically developed to reflect the relationship, taking into consideration, as potential determinants of in situ consumption, a number of variables: the laboratory UEC estimate from BR Labs, appliance type, configuration, defrost type, location in conditioned vs. unconditioned space, the average delta between ambient (room) temperature, household size, and whether the dwelling is located among hotter climate zones. This model is used to consider some of the key interactions involving laboratory UEC values, which were considered and rejected from inclusion (in part because of the small number of cases available to the regression analysis).

Table 2-13 represents this final model, which is case-weighted consistent with the sample stratification plan provided by ADM in its dual monitoring final report (ADM, 2006), and also is subject to the same moderate-to-severe influential observations restriction that was applied to the laboratory UEC

Table 2-13. Regression of Extrapolated 2004-2005 Own-Weather Station In Situ Energy Use on DOE Test UEC and Key Appliance/Household Characteristics

Variable Description	***Coefficient***	***t-value***
Dependent Variable: *in situ* consumption extrapolated to full year 2004-2005		
Intercept	-1546.8790	-3.21
DOE Test value–laboratory measurement	1.1072	7.32
Freezer dummy	-100.2853	-0.66
Dummy for unconditioned space	-224.3353	-3.01
Dummy for warmer climate zone	144.8669	2.10
Frost free dummy	918.1004	3.42
Interaction, DOE Test value x frost free dummy	-0.5683	-3.54
Dummy	259.0887	3.78
Log(average room temperature - average cabinet temperature ^{o}F	309.1803	2.56
Dummy for mean plug on missing delta	-27.2552	-0.15
Model, error degrees of freedom	9, 190	
R-Squared	0.4938	
RMSE	463.9250	

The model, which is based on 200 records that survived influence diagnostic screening, contains some very important effects.

- All other things being equal, freezers use somewhat less energy in situ. (Although this effect is not statistically significant, it is retained in the model as a non-negotiable base term).
- If an appliance is used in unconditioned space rather than in conditioned space, full-year consumption is lower. (Note that this effect remained consistent through multiple specifications and checks.)
- Appliances used in warmer climate zones have somewhat higher energy use.
- Frost free appliances tend to have net higher in situ energy use. DOE test energy use interacts with frost free defrost to strongly discount the DOE test-in situ energy use relationship.
- If there are more than two people in a household, there is a net increase in in situ energy use of 259 kWh. (Household size is moderately correlated with door openings in the monitoring data set.)
- The all-important room-to-cabinet temperature delta is included in the model, along with a trivially important dummy variable that is required to flag the handful of cases where a mean value for this variable was substituted.

The model was used to create a set of hypothetical scenarios for examining the effects of the following:

- Different combinations of appliance type, conditioned/unconditioned space, hot/cooler climate zones, defrost type,
- A fixed average room temperature-cabinet temperature delta, and
- Different annual kWh from DOE testing (including 1300, 1500, 1700, 1900, 2100, 2300, 2500, and 2700 kWh per year).

Using combinations of these parameters, the model was used to generate 384 scenarios. Predicted *in situ* 2004-2005 UECs for the scenarios were compared to the hypothetical DOE test kWh. This comparison exercise showed that the bulk of outcomes (80%) indicated that *in situ* UECs were lower than DOE test UECs, with 54% of the outcomes showing the *in situ* UEC to fall in the range of being 80-100% of the DOE test UEC. Twenty random examples from the 384 generated scenarios for this model are shown in Table 2-14.

Table 2-14. Examples of Scenarios Based on DOE Test / In Situ Model

Appliance Status	***Conditioned?***	***Climate Zone***	***Defrost***	***Household Size***	***Lab UEC***	***Predicted In Situ 2004-05***	***Pct of Lab Uec***
Freezer	Conditioned	Cooler CZ	Manual	HH size<3	2,100	1,981.3	94.35
Freezer	Conditioned	Hotter CZ	Frost Free	HH size3+	2,100	2,109.9	100.47
Freezer	Unconditioned	Cooler CZ	Frost Free	HH size<3	1,700	1,266.1	74.47
Freezer	Unconditioned	Cooler CZ	Frost Free	HH size3+	2,100	1,740.8	82.89
Freezer	Unconditioned	Cooler CZ	Manual	HH size3+	2,500	2,458.9	98.36
Freezer	Unconditioned	Hotter CZ	Frost Free	HH size3+	2,100	1,885.6	89.79
Refrigerator	Conditioned	Cooler CZ	Manual	HH size<3	2,300	2,073.8	90.17
Refrigerator	Conditioned	Cooler CZ	Manual	HH size<3	2,700	2,516.7	93.21
Refrigerator	Conditioned	Hotter CZ	Frost Free	HH size3+	1,300	1,549.9	119.22
Refrigerator	Conditioned	Hotter CZ	Manual	HH size<3	1,500	1,333.0	88.86
Refrigerator	Conditioned	Hotter CZ	Manual	HH size<3	2,300	2,218.7	96.47
Refrigerator	Unconditioned	Cooler CZ	Frost Free	HH size3+	1,500	1,288.5	85.90
Refrigerator	Unconditioned	Cooler CZ	Frost Free	HH size3+	1,700	1,396.3	82.13
Refrigerator	Unconditioned	Hotter CZ	Frost Free	HH size3+	2,700	2,080.0	77.04
Secondary Ref	Conditioned	Hotter CZ	Frost Free	HH size<3	2,700	2,060.8	76.33
Secondary Ref	Conditioned	Hotter CZ	Frost Free	HH size3+	2,300	2,104.4	91.49
Secondary Ref	Conditioned	Hotter CZ	Manual	HH size<3	1,700	1,570.0	92.35
Secondary Ref	Unconditioned	Cooler CZ	Frost Free	HH size3+	2,100	1,627.4	77.50
Secondary Ref	Unconditioned	Hotter CZ	Frost Free	HH size<3	2,300	1,620.9	70.48
Secondary Ref	Unconditioned	Hotter CZ	Manual	HH size3+	2,700	2,711.9	100.44

To extend the model, a number of specific interactions terms were included to identify whether there were other interactions that rivaled the frost free interactions in terms of accounting for variances. Very little evidence was found for other interactions being important, with the exception of a possible interaction with very high room temperature (average room temperature >= 85F x DOE test UEC value). This is not to say that a larger set of dual monitoring data with more representation of variations in appliance type, age, size, and defrost method would not have allowed more interactions to be uncovered.

Table 2-15 provides information summarizing the relationships between various UEC estimates: DOE test, simple extrapolation of *in situ* measurement (i.e., based on 8,760 hours), extrapolation of *in situ* measurement to 2004-2005 through temperature-based model, and extrapolation of *in situ* measurement to TMY based on the model. The results, which are reported by appliance subgroups, include the DOE test UEC and the average *in situ* measurements, expressed as proportions of the average lab UEC.

Table 2-15. Relationship between DOE Lab Result and In Situ Measurements- Dual Metering Sample, Contrasts by Type, Defrost, Age Group, Conditioned Space

Contrast	***Number of Cases***	***UEC (kWh per year) Estimated through DOE Test Procedure***	***Extrapolation Method***		
			Simple	***2004-05 Weather***	***TMY Weather***
Overall	202	1,809	0.87	0.85	0.81
Appliance Type					
Freezers	18	1,560	0.80	0.81	0.75
Refrigerators	184	1,834	0.88	0.85	0.81
Defrost Method					
Frost free	177	1,830	0.88	0.85	0.81
Manual defrost	25	1,662	0.80	0.81	0.76
Age Group					
Greater than 20 years	89	1,908	0.85	0.84	0.80
Less than 20 years	113	1,731	0.89	0.86	0.81
Space Located					
Conditioned space	134	1,861	0.89	0.87	0.82
Non-conditioned space	68	1,707	0.83	0.80	0.77

The simple two-way contrasts shown in Table 2-15 indicate that, overall, *in situ* UECs are about 13-15% lower than DOE test UECs, but are 19% lower if the extrapolation is to the cooler TMY temperature series. Although the sample size for freezers is relatively small, the results for freezers do seem to show a steeper drop off in *in situ* UEC *vis-à-vis* DOE test UEC than is seen for refrigerators. For either age-related or placement-related reasons, the ratios of *in situ* UECs to DOE test UECs are lower for appliances older than 20 years than for appliances less than 20 years old. Finally, the difference between DOE test and *in situ* UECs is less for appliances in conditioned space than for those in unconditioned space.

Table 2-16 provides contrasts between DOE test and *in situ* UECs that based on three variables: appliance type, defrost type, and space type. Note that with the exception for the small number of freezers, the relationship favoring a tighter DOE test-*in situ* connection for conditioned space than for unconditioned space is maintained.

Table 2-16. Relationship between DOE Lab Result and In Situ Measurements- Dual Metering Sample, Contrasts by Combinations of Type, Defrost, and Conditioned Space

Type of Appliance	Defrost Method	Space Located	Number of Cases	UEC (kWh per year) Estimated through DOE Test Procedure	Extrapolation Method		
					Simple	2004-05	TMY
Freezers	Frost free	Conditioned	1	1,043	0.89	0.99	0.92
Freezers	Frost free	Non-conditioned	2	1,066	0.93	0.93	0.87
Freezers	Manual	Conditioned	4	1,359	0.64	0.69	0.64
Freezers	Manual	Non-conditioned	11	1,770	0.83	0.83	0.76
Refrigerators	Frost free	Conditioned	124	1,902	0.90	0.87	0.82
Refrigerators	Frost free	Non-conditioned	50	1,698	0.83	0.80	0.78
Refrigerators	Manual	Conditioned	5	1,405	0.88	0.93	0.88
Refrigerators	Manual	Non-conditioned	5	1,922	0.79	0.76	0.73

The import of these various comparisons is that appliance energy use for a given appliance is generally lower when measured through *in situ* monitoring than when measured through the DOE test procedure. However, at this point in time the number of appliances for which carefully measured *in situ* energy use is available is relatively limited when compared to the much larger body of data for appliances whose energy use has been measured through the DOE test procedure. In effect, the reductions in sampling error that are associated with the larger body of DOE test data probably offset the possible measurement error in these data.

The addition of the *dual metering* data to the evaluation effort, although from a small sample of appliances, allows headway to be made on determining whether and how the reliable DOE test/regression analysis-based results of the past ought to be adjusted and whether adjustments ought to be contingent upon certain appliance characteristics or conditions.

The results obtained so far suggest that a downward adjustment of approximately 10-15 percent seems to pertain overall, but the regression analysis of the DOE test lab / *in situ* relationship and the simpler tabular analysis indicate that this is probably not appropriately handled as an across-the-board adjustment. *In situ* monitoring of appliance energy use is relatively more expensive than measuring through the DOE test procedure, and because of that is somewhat more difficult to use in adequately representing program populations. Despite its validity, *in situ* monitoring provides data that represent sampling in time and that will be prone to error if inappropriately extrapolated to represent full-year energy use. In this connection, this study was able to again use full-year monitoring data for appliance energy use that PG&E and SCE had previously collected. However, it would be helpful to have more long term California-wide metering data, for aged appliances of various types as an adjunct to the data used for this study.

In future evaluations of RARP, it would be helpful to have continued inclusion of dual metering approaches. Adding another 200 dually metered appliances increases the amount of data available to estimate the lab / *in situ* relationship for important appliance subgroups and household conditions. In adding to this sample, it is important to seek out variation with disproportionately stratified samples that adequately cover the extremes of appliance characteristics and climate zones, as well as filling in for recent lack of small or younger appliances due to temporary guideline changes.

3. ESTIMATION OF NET SAVINGS

This chapter addresses the evaluation of net savings for the 2004-2005 RARP. The purpose of the net-to-gross (NTG) analysis is to determine the program-level net savings that are attributable to the participants of the RARP. That is, what proportion of gross net resulted because of RARP? At the heart of such a question is determining what alternative dispositions of the removed working unit would lead to continued use of older, inefficient units in the absence of the program.

This chapter is organized as follows.

- Section 3.1 discusses the background for estimation of net savings for appliance recycling programs. This discussion draws on a literature review of NTG analyses used in evaluation studies of similar programs.
- Section 3.2 presents estimates of program free-ridership and net savings for the 2004-2005 RARP that conform with the standards for estimating net of free-ridership effects outlined in the EM&V protocols published by the CPUC.
- Section 3.3 discusses the results from applying to the 2004-05 RARP the approach used by KEMA in its evaluation of the 2002 and other Residential Appliance Recycling Programs in California.
- Section 3.4 uses a counterfactual approach to assess the net effects of the RARP.

3.1 BACKGROUND AND LITERATURE REVIEW

The purpose of the 2004-2005 Statewide RARP was to remove working but inefficient refrigerators (both primary and secondary) and freezers from utility distribution systems. However, even without the program some refrigerators or freezers that were removed by the program might have been disposed of in a way that would have resulted in their removal from the electric grid. Thus the question to be addressed in the net savings analysis was what proportion of gross savings resulting from the removal of refrigerators and freezers was attributable to the RARP.

This question has been examined for other appliance turn-in programs in prior studies. Table 3-1 shows the estimates of the net-to-gross (NTG) ratios for refrigerators that have been estimated for California appliance recycling programs (using somewhat different methods).

Table 3-1. Estimates of Net-to-Gross Ratios for Refrigerators and Freezers in Studies Evaluating California Appliance Recycling Programs

Study	Estimated NTG Ratios	
	Refrigerators	Freezers
Impact Evaluation of 1994 Spare Refrigerator Recycling Program, Project ID 515, Final Report to SCE, Xenergy, 1996	0.423	0.379
Impact Evaluation of the Spare Refrigerator Recycling Program, CEC Study #537, Final Report to SCE, Xenergy, 1998	0.53	0.57
Measurement and Evaluation Study of 2002 Statewide Residential Appliance Recycling Program, Final Report, KEMA-Xenergy, 2004	0.35	0.54
Measurement and Verification Report for NCPA SB5X Refrigerator Recycling, Final Report, Robert Mowris & Associates, 2003	0.64	
Measurement and Verification of SB5X Energy Efficiency Programs for the Sacramento Municipal Utility District, Final Report, Heschong Mahone Group, 2003	0.55	0.68

As these citations show, there is a wide range in the estimates of free-ridership and net-to-gross rates for appliance retirement programs. There have also been differences in the approaches taken to the net savings analysis. Most evaluations have used a traditional approach in which estimated free-ridership savings are taken-away from gross savings to measure net savings. However, KEMA used an approach in its several evaluations of appliance recycling programs in California in which net savings were determined by attributing savings to the program.

Given these results, several related objectives were set for the NTG analysis for the evaluation of the 2004-2005 RARP. These objectives were as follows.

- A first objective was to prepare estimates of program free-ridership and net savings that are in conformity with the standard practices of NTG estimation (e.g., as outlined in the EM&V protocols published by the CPUC). This objective included determining whether net-to-gross ratios differ by utility program, by appliance type, and appliance status (i.e., primary refrigerator, secondary refrigerator, freezer).
- A second objective was to prepare a comprehensive description of the approach to net-to-gross (NTG) estimation that KEMA used in its evaluations of the 2002 and earlier RARPs, including a clear delineation of how the net-to-gross ratio as estimated through the KEMA approach decomposes into components that the consumer may or may not consider to be related to the net influence of the program. Part of this objective was to replicate the KEMA approach with the larger samples of data that were collected for the evaluation of the 2004-2005 RARP.

- A third objective was to compare the approaches to determine which provides the best perspective for understanding the purposes of the program and for best defining the conditions under which energy savings should be credited to RARP.

3.2 ANALYSIS OF NET-OF-FREERIDERSHIP FOR 2004-2005 STATEWIDE RARP

Over the years the California Public Utilities Commission (CPUC) has prepared and published protocols for evaluation of energy efficiency programs. Under the protocols published in 2006, the analysis of the net impacts of a program is to focus on free-ridership and participant spillover.[1] For example, consider the following quotation from the protocols pertaining to the estimation of the net impacts of a program.

> "Impact evaluations estimate net changes in electricity usage, electricity demand, therm usage and/or behavioral impacts that are expected to produce changes in energy use and demand. Impact evaluations are limited to addressing the direct or indirect energy impacts of the program on participants, including participant spillover impacts. However, while the Protocols provide for the assessment of participant spillover, these results are not to be counted toward program or portfolio energy savings goal accomplishments, and as such are to be distinctly and separately identified in any impact reporting. The impact evaluation studies are also not expected to document program influences on the operations of a market or the program's impacts on non-participants. Program-induced changes that affect non-participants or the way a market operates are addressed in the Market Effects Evaluation Protocol."[2]

Per the protocols, the goal of a program impact evaluation is to determine what would have occurred in the absence of the program on participants. For RARP, this means determining what proportion of participants would have disposed of their refrigerators or freezers without RARP in a way that would have removed the units permanently from the grid.

As a framework for the net savings analysis, a taxonomy that KEMA developed for its net savings analysis of the 2002 RARP was used. That taxonomy has four categories for what could have happened to a refrigerator or freezer had it not been recycled:

- Unit that would have been kept by the household but not used;
- Unit that would have been kept by the household and still used;
- Unit that would have been discarded by the household through a method in which the unit would be destroyed; and

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[1] The TecMarket Works Team, *California Energy Efficiency Evaluation Protocols: Technical, Methodological, and Reporting Requirements for Evaluation Professionals.* Prepared for California Public Utilities Commission, April 2006.

[2] Ibid, pp. 3-4.

- Unit that would have been discarded by the household through a method in which the unit would be transferred and kept in use.

Of the four categories in this taxonomy, two are indicative of free-ridership:

- Unit that would have been kept by the household but not used; or
- Unit that would have been discarded by the household through a method in which the unit would be destroyed.

These categories are indicative of free-ridership because the units would have been removed from the grid and not used / destroyed even if they had not been recycled through the program.

To use this taxonomy to estimate the free-ridership percentages for refrigerators and freezers recycled through RARP, estimates are needed for (1) the percentage of recycled refrigerators or freezers that would have been kept by a household but not used and (2) the percentage of refrigerators or freezers that would have been discarded by a household through a method in which the refrigerator would have been destroyed. For this evaluation of the 2004-2005 Statewide RARP, data with which to develop these estimates were obtained by asking questions about the discarding of units in surveys of both participants and non-participants. (Copies of the questionnaires used in these surveys are provided in Appendix F.)

The survey of participants provided information on the "stated intentions" of what the participants in RARP would have done with a refrigerator or freezer had it not been recycled through the program. However, various studies have shown that the stated intentions of individuals do not always result in actual actions. The survey of non-participants was therefore used to provide "revealed preferences" information as to how households that had not participated in RARP had actually disposed of a refrigerator or freezer. Accordingly, the two surveys provided two sets of data with which to estimate the proportion of units that would have been discarded and destroyed.

3.2.1 Analysis of Net of Free-Ridership for Refrigerators

To estimate the free-ridership percentage for refrigerators recycled through RARP, estimates were needed for (1) the percentage of recycled refrigerators that would have been kept by a household but not used and (2) the percentage of refrigerators that would have been discarded by a household through a method in which the refrigerator would have been destroyed.

Data from a survey of 716 participants in the 2004-2005 Statewide RARP were used to determine the percentage of refrigerators that would have been kept but not used. These percentages are reported by utility and overall in Table 3-2. Because different sampling rates were used to survey participants from the three utility service areas, sampling weights assigned to the respondents were used to develop the overall estimate of the percentage who would have kept but not used the refrigerator.

Table 3-2. Percentages of Recycled Primary and Secondary Refrigerators That Would Have Been Kept but Not Used If Not Disposed of Through RARP

	PG&E	***SCE***	***SDG&E***	***All***
All Refrigerators				
% of units kept	16.7%	15.9%	16.8%	16.1%
% of units kept that would not be used	25.0%	24.7%	37.5%	26.4%
% of all units that would be kept and not used	4.2%	3.9%	6.3%	4.3%
Primary Refrigerators				
% of units kept	11.0%	10.0%	10.1%	10.2%
% of units kept that would not be used	25.0%	24.7%	37.5%	26.4%
% of all units that would be kept and not used	2.8%	2.5%	3.8%	2.7%
Secondary Refrigerators				
% of units kept	24.3%	23.7%	25.7%	24.0%
% of units kept that would not be used	25.0%	24.7%	37.5%	26.4%
% of all units that would be kept and not used	6.1%	5.8%	9.6%	6.3%

As noted above, two sets of survey data were available for estimating the percentage of refrigerators that would have been discarded by a household through a method in which the refrigerator would have been destroyed. Responses from a survey of non-participants provided data on how non-participants had actually disposed of refrigerators. Responses from a survey of participants provided data on how participants in RARP would have disposed of a refrigerator recycled through RARP had they not used the program. The distributions of responses for both primary and secondary refrigerators for non-participants are provided overall and classified by utility service area in Table 3-3. The response distributions for participants are provided in Table 3-4.

These tabulations illustrate the difference between stated intentions and actual actions. In particular, just over a quarter of participants indicated that if they had not recycled a refrigerator through the program they would have given it away to a charity organization (e.g., Goodwill Industries, a church). However, as discussed in the market assessment in Chapter 6, few charity organizations now take used refrigerators. Thus, participants would not have been able to realize their stated intentions of giving the unit to a charity.

Table 3-3. Distribution of Non-Participants' Responses as to How They Disposed of Refrigerators, by Utility and Overall, Main Refrigerators

Response	***PG&E***	***SCE***	***SDG&E***	***All***
Main Refrigerators				
Took it to a recycler or scrap dealer	7.3%	6.0%	1.1%	14.4%
Took it to the landfill or threw it away	0.9%	1.5%	0.0%	2.5%
Sold it to a friend, acquaintance or relative	4.7%	5.2%	0.9%	10.8%
Sold it to a used refrigerator / freezer dealer	0.0%	0.0%	0.3%	0.3%
Sold it via garage sale, estate sale, or newspaper ad	4.0%	2.2%	0.0%	6.1%
Hired someone to pick it up (for junking or dumping)	4.1%	4.5%	1.3%	9.9%
Traded it for a replacement unit	0.0%	4.1%	0.7%	4.8%
Dealer I bought a new one from took it away	13.8%	11.6%	2.7%	28.1%
Gave it away	18.1%	27.1%	5.7%	50.9%
Left it behind when moved (for new occupant)	0.0%	2.4%	0.9%	3.3%
Called utility's appliance recycling program	10.1%	12.7%	3.6%	26.5%
Sold it when you moved to new occupant	0.0%	0.9%	0.0%	0.9%
Other	3.1%	0.0%	1.0%	4.0%
Don't know	0.0%	1.7%	1.4%	3.1%
Totals	100.0%	100.0%	100.0%	100.0%
Spare Refrigerators				
Took it to a recycler or scrap dealer	7.4%	1.7%	0.0%	9.1%
Took it to the landfill or threw it away	5.8%	1.7%	0.0%	7.5%
Sold it to a friend, acquaintance or relative Where is the 2nd dealer response?	2.0%	3.6%	0.8%	6.5%
Sold it via garage sale, estate sale, or newspaper ad	2.1%	3.7%	1.2%	7.0%
Hired someone to pick it up (for junking or dumping)	8.5%	0.9%	0.4%	9.9%
Traded it for a replacement unit	2.3%	2.1%	0.5%	4.9%
Dealer I bought a new one from took it away	9.5%	5.3%	1.4%	16.2%
Gave it away	15.8%	12.9%	5.2%	33.9%
Left it behind when moved (for new occupant)	0.0%	1.4%	0.0%	1.4%
Called utility's appliance recycling program	9.4%	12.5%	0.0%	21.9%
Other	6.9%	0.0%	0.7%	7.6%
Don't know	0.0%	5.0%	0.0%	5.0%
Totals	100.0%	100.0%	100.0%	100.0%

Table 3-4. Distribution of Participants' Responses as to How They Would Have Disposed of Refrigerators without RARP, by Utility and Overall, Main Refrigerators

Response	PG&E	SCE	SDG&E	All
	Main Refrigerators			
Sold it to a private party, either by running an ad or to someone you know	11.7%	6.8%	7.0%	7.7%
Sold it to an appliance dealer	0.0%	0.8%	4.0%	1.1%
Given it away to a private party, such as a friend or neighbor	10.7%	14.1%	7.0%	12.7%
Given it away to a charity organization, such as Goodwill Industries or a church	12.6%	29.9%	26.0%	26.7%
Had it removed by the dealer you got your new or replacement appliance from	14.6%	15.0%	11.0%	14.5%
Hauled it to the dump yourself	17.5%	4.8%	10.0%	7.5%
Hauled to a recycling center yourself	13.6%	7.7%	11.0%	9.0%
Had someone else pick it up for junking or dumping	10.7%	6.1%	14.0%	7.8%
Kept it	1.9%	3.3%	4.0%	3.2%
Disposed some other way	4.9%	6.3%	2.0%	5.6%
Don't know	1.9%	4.6%	4.0%	4.1%
Refused	0.0%	0.5%	0.0%	0.4%
	100.0%	100.0%	100.0%	100.0%
	Spare Refrigerators			
Sold it to a private party, either by running an ad or to someone you know	5.3%	5.8%	3.9%	5.5%
Sold it to an appliance dealer	2.7%	1.2%	1.3%	1.5%
Given it away to a private party, such as a friend or neighbor	8.0%	18.7%	10.5%	16.1%
Given it away to a charity organization, such as Goodwill Industries or a church	24.0%	35.5%	50.0%	35.3%
Had it removed by the dealer you got your new or replacement appliance from	6.7%	4.8%	3.9%	5.0%
Hauled it to the dump yourself	13.3%	7.0%	11.8%	8.6%
Hauled to a recycling center yourself	16.0%	7.8%	5.3%	8.8%
Had someone else pick it up for junking or dumping	8.0%	4.7%	5.3%	5.3%
Kept it	9.3%	5.7%	6.6%	6.3%
Disposed some other way	2.7%	3.3%	1.3%	3.0%
Don't know	4.0%	5.5%	0.0%	4.6%
Totals	100.0%	100.0%	100.0%	100.0%

From Table 3-3 and Table 3-4, several response categories are directly associated with the destroying of refrigerators even without RARP. For non-participants, these response categories include:

- Took it to a recycler or scrap dealer
- Took it to the landfill or threw it away
- Hired someone to pick it up (for junking or dumping)

- Called utility's appliance recycling program

For participants, the response categories directly associated with destroying the refrigerator include:

- Would have hauled it to the dump yourself
- Would have hauled to a recycling center yourself
- Would have had someone else pick it up for junking or dumping

In both surveys, a very small fraction of respondents indicated that they would have disposed of their old refrigerator through an appliance dealer. However, the evidence developed through the market assessment study (discussed in Chapter 6) showed that most new appliance dealers are no longer in the business of selling used refrigerators and instead contract with recyclers to take the units that are removed from households. New appliance dealers also contract with many of these same dealers to take out-of-box and scratch and dented units. Used dealers who sell appliances are primarily interested in clean, full-featured units that are less than 10 years old. Thus, this evidence indicated that some percentage of the refrigerators that would go to dealers would also be destroyed.

An estimate of the percentage of refrigerators sent to dealers that would be destroyed was developed by analyzing survey responses by RARP participants to determine what percentage of units recycled were over 10 years old. That is, only used refrigerators less than 10 years were likely to be sold and remain in use; refrigerators over 10 years old were likely to be destroyed. The analysis of the survey data indicated that about 77.0% of primary refrigerators recycled and about 67.4% of the secondary refrigerators recycled were over 10 years old.

Bringing together the data from the survey responses in Tables 3-3 and 3-4 with the analysis of refrigerators sent to dealers and destroyed, estimates were derived of the percentages of primary and secondary refrigerators that would have been destroyed even without the RARP. Estimates derived using data from the survey of non-participants are reported in Table 3-5; estimates derived using data from the survey of participants are presented in Table 3-6. The percentages estimated for primary refrigerators from the two surveys are fairly close, but the percentages estimated for secondary refrigerators show a greater difference.

Table 3-5. Percentages of Recycled Primary and Secondary Refrigerators That Would Have Been Destroyed Even If Not Disposed of Through RARP: Estimated Using Non-Participant Survey Data

	PG&E	**SCE**	**SDG&E**	**All**
All Refrigerators				
% of units discarded	83.3%	84.1%	83.2%	83.9%
% of units discarded that would have been destroyed	50.3%	40.0%	41.3%	44.5%
% of all units that would have been discarded and destroyed	41.9%	33.6%	34.4%	37.3%
Primary Refrigerators				
% of units discarded	89.0%	90.0%	89.9%	89.8%
% of units discarded that would have been destroyed	47.8%	39.8%	45.4%	43.6%
% of all units that would have been discarded and destroyed	42.5%	35.8%	40.8%	39.1%
Secondary Refrigerators				
% of units discarded	75.7%	76.3%	74.3%	76.0%
% of units discarded that would have been destroyed	59.5%	41.4%	15.7%	48.9%
% of all units that would have been discarded and destroyed	45.0%	31.6%	11.7%	37.2%

Table 3-6. Percentages of Recycled Refrigerators That Would Have Been Destroyed Even If Not Disposed of Through RARP: Estimated Using Participant Survey Data

	PG&E	***SCE***	***SDG&E***	***All***
All Refrigerators				
% of units discarded	83.3%	84.1%	83.2%	83.9%
% of units discarded that would have been destroyed	56.8%	32.9%	49.8%	39.1%
% of all units that would have been discarded and destroyed	47.3%	27.7%	41.5%	32.8%
Primary Refrigerators				
% of units discarded	89.0%	90.0%	89.9%	89.8%
% of units discarded that would have been destroyed	58.0%	36.1%	51.7%	41.7%
% of all units that would have been discarded and destroyed	51.6%	32.5%	46.5%	37.5%
Secondary Refrigerators				
% of units discarded	75.7%	76.3%	74.3%	76.0%
% of units discarded that would have been destroyed	55.5%	29.3%	47.7%	36.2%
% of all units that would have been discarded and destroyed	42.0%	22.4%	35.5%	27.5%

The estimates from Table 3-2, Table 3-5, and Table 3-6 were used to estimate the free-ridership percentage for primary and secondary refrigerators recycled through the 2004-2005 Statewide RARP. These estimates of free-ridership are presented in Table 3-7. Three sets of estimates are presented.

- A first set of estimates is based on responses to the survey of non-participants.
- A second set is based on responses to the survey of participants.
- A third set of estimates was then developed by taking weighted averages of the estimates in the first and second sets, with the inverse variances of the estimates being used as the weights. (That is, more weight is given to the estimate with the smaller variance.)

Based on this analysis, the estimated percentage of gross savings that are net of free-ridership are as follows:

- For all refrigerators (i.e., both primary and secondary), savings net of free-ridership are 61.4% of gross savings for the program as a whole.

- For primary refrigerators only, savings net of free-ridership are 59.0% of gross savings for the program as a whole.
- For secondary refrigerators only, savings net of free-ridership are 62.2% of gross savings for the program as a whole.

Table 3-7. Estimates of Free-Ridership for Refrigerators for 2004-2005 Statewide RARP (Standard Errors in Parentheses)

	PG&E	***SCE***	***SDG&E***	***All***
	All Refrigerators			
Estimated free-ridership using non-participant survey data	46.0% (4.9%)	37.6% (3.3%)	40.7% (4.9%)	41.6% (2.4%)
Estimated free-ridership using participant survey data	51.5% (3.6%)	31.6% (2.3%)	47.8% (3.6%)	37.1% (1.7%)
Weighted average estimate of free-ridership	49.6% (2.9%)	33.6% (1.9%)	45.3% (2.9%)	38.6% (1.4%)
Estimated net of free-ridership	50.4%	66.4%	54.7%	61.4%
	Primary Refrigerators			
Estimated free-ridership using non-participant survey data	45.2% (12.8%)	38.3% (8.2%)	44.6% (13.1%)	41.8% (6.2%)
Estimated free-ridership using participant survey data	54.4% (15.1%)	35.0% (7.5%)	50.3% (14.6%)	40.2% (5.9%)
Weighted average estimate of free-ridership	49.0% (9.8%)	36.5% (5.5%)	47.1% (9.8%)	41.0% (4.3%)
Estimated net of free-ridership	51.0%	63.5%	52.9%	59.0%
	Secondary Refrigerators			
Estimated free-ridership using non-participant survey data	51.1% (10.1%)	37.5% (5.4%)	21.3% (4.2%)	43.5% (4.3%)
Estimated free-ridership using participant survey data	48.1% (9.7%)	28.2% (4.4%)	45.1% (8.4%)	33.8% (3.6%)
Weighted average estimate of free-ridership	49.5% (7.0%)	31.9% (3.4%)	26.1% (3.8%)	37.8% (2.8%)
Estimated net of free-ridership	50.5%	68.1%	73.9%	62.2%

3.2.2 Analysis of Free-Ridership for Freezers

The analysis used in Section 3.2.1 to estimate the free-ridership percentage for refrigerators recycled through RARP was also applied to estimate free-ridership for freezers recycled through RARP.

Data from a survey of 292 participants in the 2004-2005 Statewide RARP were used to determine the percentage of freezers that would have been kept but not used. These percentages are reported by utility and overall in Table 3-8. Because different sampling rates were used to survey participants from the three utility service areas, sampling weights assigned to the respondents were used to develop the overall estimate of the percentage who would have kept but not used the freezer.

Table 3-8. Percentages of Recycled Freezers That Would Have Been Kept but Not Used If Not Disposed of Through RARP

	PG&E	SCE	SDG&E	All
% of units kept	22.5%	26.5%	28.2%	26.1%
% of units kept that would not be used	40.0%	26.4%	0.0%	27.3%
% of all units that would be kept and not used	9.0%	7.0%	0.0%	7.1%

Data from the surveys of participants and non-participants were used to estimate the percentage of freezers that would have been discarded by a household through a method in which the freezer would have been destroyed. Distributions of responses for freezers for non-participants and participants are provided overall and classified by utility service area in Table 3-9.

In both surveys, some respondents indicated that they would have disposed of their old freezer through an appliance dealer. An estimate of the percentage of freezers sent to dealers that would be destroyed was developed by analyzing survey responses by RARP participants to determine what percentage of freezers recycled were over 10 years old. That is, only used freezers less than 10 years were likely to be sold and remain in use; freezers over 10 years old were likely to be destroyed. The analysis of the survey data indicated that about 71.7% of freezers recycled were over 10 years old.

Bringing together the data from the survey responses in Table 3-9 with the analysis of freezers sent to dealers and destroyed, Table 3-10 shows the estimated percentages of freezers that would have been destroyed even without the RARP. Estimates are presented that were derived using data from both the survey of non-participants and the survey of participants. The overall percentages estimated from the two surveys are fairly close, although there are apparent differences among the individual utility estimates.

Table 3-9. Distribution of Non-Participants' and Participants' Responses as to Disposal of Freezers, by Utility and Overall

Response	PG&E	SCE	SDG&E	All
	Non-Participants			
Took it to a recycler or scrap dealer	0.0%	3.3%	0.0%	3.3%
Took it to the landfill or threw it away	0.0%	1.7%	1.7%	3.4%
Sold it to a friend, acquaintance or relative	8.8%	3.3%	0.4%	12.6%
Sold it via garage sale, estate sale, or newspaper ad	6.5%	1.8%	0.0%	8.3%
Hired someone to pick it up (for junking or dumping)	6.9%	0.0%	0.5%	7.4%
Dealer I bought a new one from took it away	7.4%	1.0%	0.0%	8.4%
Gave it away	16.0%	14.6%	1.7%	32.4%
Called utility's appliance recycling program	4.8%	6.7%	1.4%	12.8%
Other	5.0%	0.0%	0.0%	5.0%
Don't know	10.5%	1.5%	0.8%	12.8%
Totals	100.0%	100.0%	100.0%	100.0%
	Participants			
Sold it to a private party, either by running an ad or to someone you know	6.8%	17.1%	7.0%	14.3%
Sold it to an appliance dealer	1.4%	2.5%	0.0%	2.0%
Given it away to a private party, such as a friend or neighbor	13.7%	13.5%	19.7%	14.3%
Given it away to a charity organization, such as Goodwill	21.9%	29.3%	29.6%	28.2%
Had it removed by the dealer you got your new or	5.5%	2.5%	0.0%	2.6%
Hauled it to the dump yourself	19.2%	7.4%	8.5%	9.3%
Hauled to a recycling center yourself	5.5%	10.0%	14.1%	9.8%
Had someone else pick it up for junking or dumping	13.7%	3.0%	5.6%	5.0%
Kept it	6.8%	7.2%	2.8%	6.6%
Other	4.1%	5.0%	7.0%	5.1%
Don't know	1.4%	2.0%	5.6%	2.4%
Refused	0.0%	0.5%	0.0%	0.3%
Totals	100.0%	100.0%	100.0%	100.0%

Table 3-10. Percentages of Recycled Freezers That Would Have Been Destroyed Even If Not Disposed of Through RARP

	PG&E	SCE	SDG&E	All
Estimated Using Non-Participant Survey Data				
% of units discarded	77.5%	73.5%	71.8%	73.9%
% of units discarded that would have been destroyed	21.4%	28.6%	41.7%	25.3%
% of all units that would have been discarded and destroyed	16.6%	21.0%	29.9%	18.7%
Estimated Using Participant Survey Data				
% of units discarded	77.5%	73.5%	71.8%	73.9%
% of units discarded that would have been destroyed	49.4%	28.1%	33.3%	32.1%
% of all units that would have been discarded and destroyed	38.2%	20.6%	23.9%	23.7%

The estimates from Table 3-8 and from Table 3-10 were used to estimate the free-ridership percentage for freezers recycled through the 2004-2005 Statewide RARP. These estimates of free-ridership are presented in Table 3-11. As with the analysis of refrigerators, three sets of estimates are presented. Based on the weighted average estimate of free-ridership, the estimated percentage of gross savings for freezers that are net of free-ridership is 70.6% for the program as a whole.

Table 3-11. Estimates of Freezer Free-Ridership for 2004-2005 Statewide RARP (Standard Errors in Parentheses)

	PG&E	SCE	SDG&E	All
Estimated free-ridership using non-participant survey data	25.6% (8.4%)	28.0% (7.2%)	29.9% (10.1%)	25.8% (4.7%)
Estimated free-ridership using participant survey data	47.2% (6.3%)	27.6% (3.9%)	23.9% (5.6%)	30.8% (2.9%)
Weighted average estimate of free-ridership	39.4% (5.0%)	27.7% (3.4%)	25.3% (4.9%)	29.4% (2.5%)
Estimated net of free-ridership	60.6%	72.3%	74.7%	70.6%

3.2.3 Program-Level Savings Net of Free-Ridership

Table 3-12 brings together the gross savings estimates from Table 2-7 and the net of free-ridership estimates developed in this section to show the total savings net of free-ridership for refrigerators and freezers recycled through RARP during 2004-2005. Net savings are calculated using a net of free-ridership rate of 61.4% for refrigerators and of 70.6% for freezers.

Table 3-13 shows the kWh savings net of free-ridership when the results in Table 3-12 are rolled up to the utility / program level.

Table 3-12. Total Savings (kWh per Year) Net of Free-Ridership for Refrigerators and Freezers Recycled through RARP in 2004-2005: By Utility/Program, Type of Appliance, and Program Year

Utility/Program	Type of Appliance	Program Year	Number of Units	Total Gross kWh Savings	Total Savings Net of Free-Ridership
PG&E	Refrigerators	2004	8,584	14,137,848	8,680,639
PG&E	Refrigerators	2005	14,137	23,283,639	14,296,154
PG&E	Refrigerators	All	22,721	37,421,487	22,976,793
PG&E	Freezers	2004	1,012	1,236,664	873,085
PG&E	Freezers	2005	2,182	2,666,404	1,882,481
PG&E	Freezers	All	3,194	3,903,068	2,755,566
SCE-PGC	Refrigerators	2004	32,919	54,513,864	33,471,512
SCE-PGC	Refrigerators	2005	35,355	58,547,880	35,948,398
SCE-PGC	Refrigerators	All	68,274	113,061,744	69,419,911
SCE-PGC	Freezers	2004	4,233	5,354,745	3,780,450
SCE-PGC	Freezers	2005	5,347	6,763,955	4,775,352
SCE-PGC	Freezers	All	9,580	12,118,700	8,555,802
SCE-Procurement	Refrigerators	2004	9,857	16,323,192	10,022,440
SCE-Procurement	Refrigerators	2005	4,903	8,119,368	4,985,292
SCE-Procurement	Refrigerators	All	14,760	24,442,560	15,007,732
SCE-Procurement	Freezers	2004	1,067	1,349,755	952,927
SCE-Procurement	Freezers	2005	678	857,670	605,515
SCE-Procurement	Freezers	All	1,745	2,207,425	1,558,442
SCE-Summer Initiative	Refrigerators	2005	22,420	37,127,520	22,796,297
SCE-Summer Initiative	Freezers	2005	3,553	5,883,768	3,612,634
SCE-Summer Initiative	Freezers	All	25,973	43,011,288	26,408,931
SDG&E	Refrigerators	2004	8,036	13,363,868	8,205,415
SDG&E	Refrigerators	2005	8,548	14,215,324	8,728,209
SDG&E	Refrigerators	All	16,584	27,579,192	16,933,624
SDG&E	Freezers	2004	1,398	1,760,082	1,242,618
SDG&E	Freezers	2005	1,365	1,718,535	1,213,286
SDG&E	Freezers	All	2,763	3,478,617	2,455,904

Table 3-13. Total kWh Savings Net of Free-Ridership for RARP by Utility / Program

Utility / Program	Total Gross kWh Savings	Total kWh Savings Net of Free-Ridership
PG&E	41,324,555	25,732,359
SCE-PGC	125,180,444	77,975,713
SCE-Procurement	26,649,985	16,566,174
SCE-2005 Summer Initiative	43,011,288	26,408,931
SDG&E	31,057,809	19,389,527

3.3 APPLYING KEMA APPROACH TO NTG ANALYSIS FOR EVALUATION OF 2004-2005 STATEWIDE RARP

In an effort to provide continuity with the net-to-gross analyses performed for earlier evaluations of RARP, a second aspect of the net-to-gross analysis for this evaluation of the 2004-2005 Statewide RARP was to apply the NTG approach that KEMA used for the evaluation of the 2002 RARP, but to use the updated, larger sets of sample data collected through the surveys conducted for this evaluation. As a background, the calculations for KEMA's NTG analysis of the 2002 RARP were replicated. The results of applying the KEMA approach to NTG analysis for this evaluation of the 2004-2005 Statewide RARP are presented in this section.

3.3.1 Overview of KEMA Approach to NTG Analysis for RARP

In the evaluation it conducted of the 2002 RARP, KEMA used an approach for the net-to-gross analysis that has two main components: assigning *attribution* factors and assigning *part use* factors. As described in KEMA's report: "The attribution factor adjusts for the percentage of participants that would have disposed of the unit anyway, and gives partial credit to the program for destroying a unit that would otherwise have been transferred to another user. The part-use factor adjusts for the fraction of the time that participants would have used the unit if they had kept it."[3]

The attribution component of KEMA's net-to-gross (NTG) analysis pertains to what would have happened to an appliance unit recycled through RARP if it had not been recycled. There are four categories for what could have happened to a unit had it not been recycled. These categories are:

- Unit is kept by the household but not used;
- Unit is kept by the household and still used;
- Unit is discarded by the household through a method in which the unit would be destroyed; and
- Unit is discarded by the household through a method in which the unit would be transferred and kept in use.

For each category, there is an attribution factor that determines how much of the energy savings associated with a recycled appliance unit should be credited to RARP. The overall attribution factor for the program is a weighted average of these attribution factors across categories, where the weights are determined by the percentages of recycled units that would fall into the different categories.

In KEMA's approach to the net to gross analysis, part-use factors are used to adjust for the fraction of the time that participants would have used a recycled unit if they had kept it.

[3] KEMA-XENERGY, Inc. *Final Report: Measurement and Evaluation Study of 2002 Statewide Residential Appliance Recycling Program,* Prepared for Southern California Edison, February 2004.

Different values for the part use factors were assigned to the four categories into which recycled units would fall if they had not been recycled.

- For units that would have been kept but not used or that would have been destroyed when discarded, the part use factor is 0. That is, these units would not have been used even if not recycled and therefore have no energy use.
- For units that would have been kept by households and still used, the part use factor is calculated by dividing the number of months in the year (i.e., 12) by the number of months in the past year that the unit had been plugged in and running.
- For units in the discarded-transferred category, the part use factor is calculated as a weighted average of the part use factors for main refrigerators and for spare refrigerators.

3.3.2 Application of KEMA Approach to Estimate NTG Ratio for Refrigerators Recycled through 2004-2005 Statewide RARP

The calculation of attribution factors for the refrigerators recycled though the 2004-2005 Statewide RARP was accomplished using data collected from surveys of samples of program participants and non-participants.

- Data from a survey of 716 participants in the 2004-2005 Statewide RARP were used to determine the percentage of refrigerators that would have been kept and the percentage that would have been discarded if they had not disposed of through the RARP. Because different sampling rates were used to survey participants from the three utility service areas, sampling weights were assigned to the respondents and used to develop estimates of the percentages who would have kept but not used the refrigerator (4.1%), who would have kept the refrigerator in use (12.0%), and who would have discarded the refrigerator some other way (83.9%).
- Responses from a survey of 354 non-participant discarders of refrigerators provided data on the proportions of discarded refrigerators that would be destroyed or that would be transferred through sale, gift, donation, etc. These responses were also weighted to account for different sampling rates for the three utility service areas. Based on data obtained from these non-participant discarders, it was determined that 25.8% of the discarded refrigerators would have been destroyed and 58.1% would have been transferred.[4]

Following the KEMA approach, each of the four categories was assigned an attribution factor, which specifies the percentage of savings from recycled refrigerators that should be credited to RARP.

[4] These values were calculated as follows:
For discarded-destroyed refrigerators: 25.8% = 83.9% x 30.7%
For discarded-transferred refrigerators: 58.1% = 83.9% x 69.3%

- For a refrigerator that would otherwise have been kept in place (either used or not), the attribution factor was assigned a value of 1. That is, the program receives full credit for the savings associated with the removal of such refrigerators.
- For a discarded refrigerator that would otherwise have been destroyed, the attribution factor was assigned a value of 0. That is, because such refrigerators would have been destroyed (removed from the grid) without the program, the program receives no credit for savings from such refrigerators.

Refrigerators in the discarded-transferred category are those refrigerators whose transfers to other parties were precluded because the refrigerators were recycled through RARP. Attribution factors for these refrigerators were assigned based on the actions of transferees (i.e., potential recipients) because the refrigerator was recycled rather than transferred. That is, what did the transferees do when the recycled refrigerator was not available?

Table 3-14 shows the values assigned for the attribution factors for eight different cases, defined by (1) what transferees would do because recycling made a refrigerator not available and (2) whether the refrigerator would be used as a main or a spare refrigerator. For cases where a new refrigerator would have been bought, the attribution factor was computed as the difference in annual energy use (UEC) between a new refrigerator and the average refrigerator picked up by the program, expressed as a fraction of the program's average UEC. For the evaluation of the 2004-2005 Statewide RARP, the assigned attribution factor was 0.70.

Table 3-14. Attribution Factors for Discarded-Transferred Refrigerator Cases

What Would Transferee Do Because Recycling Made Refrigerator Not Available?	***How Would Refrigerator Be Used?***	
	As Main Refrigerator	***As Spare Refrigerator***
Buy a new refrigerator	0.700	0.700
Buy/fix similar used refrigerator	0.00	0.00
Buy worse used refrigerator	0.00	0.00
Not buy another refrigerator	1.00	1.00

The overall attribution factor for the discarded-transferred category is determined as a weighted average of the attribution values in Table 3-14, where the weights are determined by the percentage distribution of refrigerators in the discarded-transferred category across the eight cases. This percentage distribution for the evaluation of the 2004-2005 Statewide RARP was obtained from a survey of recent acquirers of used refrigerators. The percentage distribution resulting from these survey data is shown in Table 3-15, along with the calculation of the overall attribution factor for the discarded-transferred category. As can be seen, the attribution factor calculated for refrigerators in the discarded-transferred category in the evaluation of the 2004-2005 Statewide RARP is 0.520.

Table 3-15. Calculation of Attribution Factor for Discarded-Transferred Category: Refrigerators

Main or Spare Unit	What Would Transferee Do Because Recycling Made Refrigerator Not Available?	Percent of Total N	Attribution Factor	Weight x Attribution Factor
Main	Buy a new refrigerator	44.4%	0.70	0.311
Main	Buy/fix similar used refrigerator	21.4%	0.00	0.000
Main	Buy worse used refrigerator	3.8%	0.00	0.000
Main	Not buy another refrigerator	14.1%	1.00	0.141
Spare	Buy a new refrigerator	3.7%	0.70	0.026
Spare	Buy/fix similar used refrigerator	7.5%	0.00	0.000
Spare	Buy worse used refrigerator	0.8%	0.00	0.000
Spare	Not buy another refrigerator	4.2%	1.00	0.042
Totals		100.0%		0.520

Table 3-16 shows the results from the calculation of an overall attribution factor for refrigerators recycled through the 2004-2005 Statewide RARP. The overall attribution rate is calculated to be 0.464, somewhat higher than the 0.414 attribution factor that KEMA calculated for the evaluation of the 2002 RARP.

Table 3-16. Calculation of Overall Attribution Factor for Refrigerators Using Survey Data Collected for Evaluation of 2004-2005 Statewide RARP

What Would Have Happened to Recycled Refrigerator	Percentage of Refrigerators in Category	Attribution Factor for Category	Weight x Attribution Factor
Kept but not used	4.1%	1.000	0.041
Kept, in use	12.0%	1.000	0.120
Discarded-Destroyed	25.8%	0.000	0.000
Discarded-Transferred	58.1%	0.520	0.302
Overall attribution			0.464

KEMA's approach to NTG analysis also includes use of a part load factor that accounts for the fraction of the time that participants would have used a recycled unit if they had kept it. Different values for the part use factors are assigned to the four categories into which recycled refrigerators would fall if they had not been recycled.

- For units that would have been kept but not used or that would have been destroyed when discarded, the part use factor is 0. That is, these units would not have been used even if not recycled and therefore have no energy use.
- For units that would have been kept by households and still used, the part use factor is calculated by dividing the number of months in the year (i.e., 12) by the number of months in the past year that the unit had been plugged in and running. Based on data collected through

the survey of participants, the average number of months that respondents would have used a spare refrigerator was 11.07 months, implying a part-use factor of 0.923 (i.e., 11.07/12).

- For units in the discarded-transferred category, the part use factor is calculated as a weighted average of the part use factors for main refrigerators and for spare refrigerators. Main refrigerators were estimated to represent 83.8% of this category and spare refrigerators 16.2%. Thus, the weighted part use factor for the discarded-transferred category was calculated as follows:

  (83.8% x 1) + (16.2% x 0.923) = 0.988

Table 3-17 brings together the attribution data and the part use data for calculation of the overall net to gross ratio for refrigerators in the 2004-2005 Statewide RARP following the KEMA approach to NTG analysis. These various calculations using the KEMA approach produce an estimated net-to-gross ratio of 0.409 for refrigerators recycled through the 2004-2005 Statewide RARP.

Table 3-17. Overall Net-to-Gross Ratio Calculated with KEMA Approach for Refrigerators Recycled through 2004-2005 Statewide RARP

What Would Have Happened to Recycled Refrigerator	***Percentage of Refrigerators in Category***	***Attribution Factor for Category***	***Part Use Factor***	***PxAxU***
Kept but not used	4.1%	1.000	0.00	0.000
Kept, in use	12.0%	1.000	0.923	0.111
Discarded-Destroyed	25.8%	0.000	0.00	0.000
Discarded-Transferred	58.1%	0.520	0.988	0.298
Overall net to gross ratio				0.409

3.3.3 Application of KEMA Approach to Estimate NTG Ratio for Freezers Recycled through 2004-2005 Statewide RARP

As with the NTG analysis for refrigerators, attribution factors for freezers recycled though the 2004-2005 Statewide RARP were calculated using data collected from surveys of samples of program participants and non-participants.

- Data from a survey of 292 participants in the 2004-2005 Statewide RARP who recycled freezers were used to determine the percentage of freezers that would have been kept and the percentage that would have been discarded if they had not disposed of through the RARP. Because different sampling rates were used to survey participants from the three utility service areas, sampling weights were assigned to the respondents and used to develop estimates of the percentages of freezers that would have been kept but not used the freezer (7.1%), that would have been kept in use (19.0%), and that would have been discarded in some other way (73.9%).

- Responses from a survey of 91 non-participant discarders of freezers provided data on the proportions of discarded freezers that would be destroyed or that would be transferred through sale, gift, donation, etc. These responses were weighted to account for different sampling rates for the three utility service areas. Based on data obtained from these non-participant discarders, it was determined that 18.7% of the discarded freezers would have been destroyed and 55.2% would have been transferred.[5]

Following the KEMA approach, each of the four categories was assigned an attribution factor that specifies the percentage of savings from recycled freezers that should be credited to RARP.

- For a freezer that would otherwise have been kept in place (either used or not), the attribution factor was assigned a value of 1. That is, the program receives full credit for the savings associated with the removal of such freezers.
- For a discarded freezer that would otherwise have been destroyed, the attribution factor was assigned a value of 0. That is, because such freezers would have been destroyed (removed from the grid) without the program, the program receives no credit for savings from such freezers.

Freezers in the discarded-transferred category are those freezers whose transfers to other parties were precluded because the freezers were recycled through RARP. The attribution factor assigned for this category of freezers is based on survey responses on the actions of transferees (i.e., potential recipients) because the freezer was recycled rather than transferred. Table 3-18 shows the values assigned for the attribution factors for four different cases, defined by what transferees would do because recycling made a freezer not available. For cases where a new freezer would have been bought, the attribution factor was computed as the difference in annual energy use (UEC) between a new freezer and the average freezer picked up by the program, expressed as a fraction of the program's average UEC. For the evaluation of the 2004-2005 RARP, the assigned attribution factor was 0.72.

Table 3-18. Attribution Factors Assigned for Freezers in Discarded-Transferred Category

What Would Transferee Do Because Recycling Made Freezer Not Available?	***Assigned Attribution Factor***
Buy a new freezer	0.720
Buy/fix similar used freezer	0.00
Buy worse used freezer	0.00
Not buy another freezer	1.00

The overall attribution factor for the discarded-transferred category of freezers is determined as a weighted average of the attribution values in Table 3-18, where the weights are determined by

[5] These values were calculated as follows:
For discarded-destroyed freezers: 18.7% = 73.9% x 25.3%
For discarded-transferred freezers: 55.2% = 73.9% x 74.7%

the percentage distribution of freezers in the discarded-transferred category across the four cases. This percentage distribution for the evaluation of the 2004-2005 Statewide RARP was obtained from a survey of recent acquirers of used freezers. The percentage distribution resulting from these survey data is shown in Table 3-19, along with the calculation of the overall attribution factor for the discarded-transferred category. As can be seen, the attribution factor calculated for freezers in the discarded-transferred category in the 2004-2005 Statewide RARP was 0.517.

Table 3-19. Calculation of Attribution Factor for Discarded-Transferred Category: Freezers

What Would Transferee Do Because Recycling Made Freezer Not Available?	Percent of Total N	Attribution Factor	Weight x Attribution Factor
Buy a new freezer	18.1%	0.720	0.130
Buy/fix similar used freezer	43.3%	0.000	0.000
Buy worse used freezer	0.0%	0.000	0.000
Not buy another freezer	38.7%	1.000	0.387
	100.0%		0.517

Table 3-20 shows the calculation of an overall attribution factor for freezers recycled through the 2004-2005 Statewide RARP. The overall attribution rate is calculated to be 0.546, which is lower than the 0.730 attribution factor that KEMA calculated for the evaluation of the 2002 RARP.

Table 3-20. Calculation of Overall Attribution Factor for Freezers Using Survey Data Collected for Evaluation of 2004-2005 Statewide RARP

What Would Have Happened to Recycled Freezer	Percentage of Freezers in Category	Attribution Factor for Category	Weight x Attribution Factor
Kept but not used	7.1%	1.000	0.071
Kept, in use	19.0%	1.000	0.190
Discarded-Destroyed	18.7%	0.000	0.000
Discarded-Transferred	55.2%	0.517	0.285
Overall attribution			0.546

Following KEMA's approach, part load factors for freezers were also calculated that account for the fraction of the time that participants would have used a recycled freezer if they had kept it. Different values for the part use factors are assigned to the four categories into which recycled freezers would fall if they had not been recycled.

- For freezers that would have been kept but not used or that would have been destroyed when discarded, the part use factor is 0. That is, these freezers would not have been used even if not recycled and therefore have no energy use.
- For freezers that would have been kept by households and still used, the part use factor is calculated by dividing the number of months in the year (i.e., 12) by the number of months in

the past year that the freezer had been plugged in and running. Based on data collected through the survey of participants, the average number of months that respondents would have used a spare freezer was 10.8 months, implying a part-use factor of 0.899 (i.e., 10.8/12).

Table 3-21 brings together the attribution data and the part use data for the calculation of the overall net to gross ratio for freezers in the 2004-2005 Statewide RARP. These various calculations using the KEMA approach produce an estimated a net-to-gross ratio of 0.425 for freezers recycled through the 2004-2005 Statewide RARP.

Table 3-21. Overall Net-to-Gross Ratio Calculated with KEMA Approach for Freezers Recycled through 2004-2005 Statewide RARP

What Would Have Happened to Recycled Freezer	***Percentage of Freezers in Category***	***Attribution Factor for Category***	***Part Use Factor***	***PxAxU***
Kept but not used	7.1%	1.000	0.000	0.000
Kept, in use	19.0%	1.000	0.899	0.171
Discarded-Destroyed	18.7%	0.000	0.000	0.000
Discarded-Transferred	55.2%	0.517	0.899	0.255
Overall net to gross ratio				0.425

3.3.4 Further Analysis of Attribution of Savings for Discarded-Transferred Cases

Considering both statistical precision and bias, determining the NTG ratio with KEMA's approach depends significantly on the attribution factor derived for the discarded-transferred category.

Consider first statistical precision. For refrigerators, the net-to-gross value estimated for refrigerators using the KEMA approach was 40.9%, but with a standard error of 12.5%. By contrast, the free-ridership analysis in Section 3.2 showed that the estimated value for gross savings net of free-ridership was 61.4% with a standard error of 1.4%. Thus, the net of free-ridership analysis presented in Section 3.1 provides an estimate that is of higher statistical precision.

Perhaps more importantly, however, is the question of bias in the estimation procedure. In particular, there are two assumptions implicit in KEMA's approach to analysis of the discarded-transferred category that can significantly affect the value of the estimated net-to-gross.

- In KEMA's approach to analysis of the discarded-transferred category, no savings are attributed to RARP for cases where a refrigerator that was not transferred because of the program would have been replaced through the purchase of a used refrigerator. The argument is that this is a like-for-like replacement: the used unit that would replace the transferred unit uses the same or more energy and hence there are no savings. Implicitly, this argument assumes that the used unit that would be purchased has been off the grid for at least a year and is coming back on the grid "like new" to replace the unit that would have been transferred.

- A second assumption implicit in KEMA's approach is that the used unit that is acquired uses the same amount of energy as the recycled unit. However, it is likely that a used appliance that might be acquired is of different, newer vintage than the unit being recycled and hence is likely to be more efficient (albeit not as efficient as a new unit).

The implications of these assumptions can be illustrated with Table 3-22.

- For this example, α represents the portion of the previous year that the unit was on the grid and using electricity.
- β is used to account for the likelihood that a used unit that is purchased will be more efficient than the recycled unit that it is being substituted for. In particular, if the unit that would be recycled and not transferred is assumed to have annual energy use of E, the unit that would be purchased as the replacement unit has annual energy use βE.
- For the unit that would be recycled through RARP and not transferred, energy use goes from E to 0 for a savings of E. For the unit that is purchased to replace the unit recycled through RARP, it is assumed that its energy use goes from αBE to βE, for a negative savings of (α - 1)βE. Thus, from the perspective of load on the electric grid, total savings are E(1 + $\alpha\beta$ - β).

Table 3-22. Example to Illustrate Calculation of Savings from Purchasing Used Unit to Replace Recycled Unit

	Energy Use		Savings
	Before	After	
Unit recycled and not transferred	E	0	E
Unit to be purchased	$\alpha\beta$E	βE	(α -1)βE
Totals	E + $\alpha\beta$E	βE	E(1 + $\alpha\beta$ - β)

Viewing KEMA's analysis in this framework, $\alpha = 0$ and $\beta = 1$, resulting in energy savings = 0. However, further analysis suggests that it is reasonable to assume other values for both α and β.

The value of α will depend on the time that elapses between a used unit being removed from the grid and the unit coming back on the grid after being purchased to replace a recycled unit that was not transferred. The overall value of α depends on the mix of sources from which the replacement unit is purchased. The value of α is likely to be high for units purchased from relatives, neighbors, or friends and likely to be lower for units purchased from used appliance dealers. For the situation being addressed here, where RARP has prevented a transfer of a unit, data from the survey of non-participant acquirers of refrigerators and freezers indicated that replacement units are most likely to be purchased from used appliance dealers.

The value of α for units purchased from used appliance dealers will reflect (1) the time that is involved for a dealer to acquire a unit and (2) the time that a unit is on the sales floor before it is purchased. With respect to the first time factor, a survey of used appliance dealers that was conducted for the evaluation of the 2004-2005 RARP indicated that the major sources from which dealers obtain used units are contracts with appliance dealers (48%), direct pick-up from homes (10%), recovery of a unit as a result of selling a new unit (10%), and auctions (10%). Thus, used appliance dealers have relatively well-established sources that minimize the time they use to acquire used appliances.

The average number of days that a used appliance is on the sales floor before being purchased can be estimated from inventory turnover rates. For example, an inventory turnover rate of 2.0 implies that an average unit is in inventory (i.e., on the sales floor) for six months before being sold. On these assumptions, the value of α for used appliance dealers would be .50.

Reported values of inventory turnover rates for used merchandise stores (which includes used appliance stores) are shown in Table 3-21.

Table 3-23. Inventory Turnover Rates for Used Merchandise Stores and Household Appliance Stores

Year	***Inventory Turnover Ratio***	***Implied α***
2004	2.2	0.545
2005	3.6	0.722

The value of β accounts for the likelihood that a used unit that is purchased will be more efficient than the recycled unit that it is being substituted for. That is, used appliances that might be acquired are of different, newer vintage than the units being recycled and hence are likely to be more efficient (albeit not as efficient as new units). With this argument, for those cases where a newer vintage used unit would have been bought, the attribution factor can be computed as the difference in annual energy use (UEC) between the newer vintage used unit and the average unit picked up by the program, expressed as a fraction of the program's average UEC.

Data collected through the surveys of participant discarders and non-participant acquirers were analyzed to determine any difference in ages between discarded units and acquired units. The average age of discarded units in the discarded-transferred category was calculated from data in the survey of participant discarders. The average age of acquired used units was calculated from data collected in the survey of non-participant acquirers.

For refrigerators, the average age of units in the discarded-transferred category was 15.6 years. The average age of acquired used units was 6.4 years. According to data published by AHAM, the average energy use was 934 kWh per year for refrigerators manufactured in 1990 and 680 kWh per year for refrigerators manufactured in 1998. If energy use is assumed to increase by 0.6% per year, energy use of a six-year old refrigerator in 2004-2005 would be about 70% of the energy use of a sixteen-year old refrigerator. That is, the value of β would be 0.70. Thus, replacing a refrigerator aged 15.6 years with one aged 6.4 years would result in savings of about 30%.

Table 3-24 shows how the attribution factor and associated net-to-gross ratio for refrigerators change with different combinations of values for α and β.

Table 3-24. Changes in Attribution Factor and NTG Ratio for Refrigerators for Different Values of α and β

Inventory Turnover	α	β	***Attribution Factor***	***NTG***
0	0	1.0	0.520	0.409
2.2	0.545	1.0	0.677	0.500
3.6	0.722	1.0	0.728	0.529
0	0	0.7	0.606	0.459
2.2	0.545	0.7	0.717	0.522
3.6	0.722	0.7	0.753	0.543

From Table 3-24, the most likely case is for α = .545 (i.e., an inventory turnover rate of 2.2) and β = 0.70 (i.e., savings of 30% attributed to replacing an older used refrigerator with a newer used refrigerator). With these values, the attribution factor calculated for refrigerators in the discarded-transferred category is 0.717 and the estimated net-to-gross ratio is 0.522. This compares to the estimated net-to-gross ratio of 0.409 that is derived under the assumptions that KEMA used.

For freezers, the average age of discarded units in the discarded-transferred category was 19.0 years, while the average age of acquired used freezers was 10.4 years. According to data published by AHAM, the average energy use of freezers manufactured in 1990 was 787 kWh per year; for freezers manufactured in 1998 the average energy use was 471 kWh per year. If energy use is assumed to increase by 0.6% per year, energy use of a ten-year old freezer in 2004-2005 would be about 57% of the energy use of a nineteen-year old freezer. Thus, replacing a freezer aged 19.0 years with one aged 10.4 years would result in savings of about 43%.

With a savings of 43% attributed to replacing an older used freezer with a newer used freezer, the attribution factor calculated for freezers in the discarded-transferred category in the evaluation of the 2004-2005 Statewide RARP increases from 0.517 to 0.664. The overall attribution rate for freezers increases from 0.546 to 0.628. With these changes, the estimated net-to-gross ratio calculated with the KEMA approach for freezers recycled through the 2004-2005 Statewide RARP increases from 0.425 to 0.500 a 17% increase.

3.4 COUNTERFACTUAL ANALYSIS TO DETERMINE NET-TO-GROSS

One way to assess the impact of the RARP is through a counter-factual analysis that examines what customers would have done to dispose of refrigerators and freezers taken by RARP if the program were not in place. In other words, what percentage of the refrigerators and freezers recycled through RARP would have remained on the grid if the program were not available? One way to do this is to compare the percentage of refrigerators that were demanufactured in 2005 to the percentage of refrigerators that would have been demanufactured without the program.

Before examining alternative disposal methods, it is useful to see how units were actually disposed. Table 3-25 shows how participants disposed of working units and the likelihood that the unit would have remained on the grid. The RARP captured 14 percent of the working units. Residents gave away 31 percent and sold 15 percent. New dealers took 22 percent of refrigerators and residents sent16 percent to the dump or a recycler. It is unclear what happened to three percent of the units.

Table 3-25. Disposal Method for Working Refrigerators in IOU Service Territory in 2005

Disposal Method	***Percent***	***Likely Result***
RARP	14	De-manufactured
Gave Away to private party/charity	31	Still in use
Sold to friend/neighbor or through ad	15	Still in use
New dealer took when delivering replacement	22	87 percent de-manufactured
Took or had someone take to dump/recycler	16	De-manufactured
Unknown	3	Unknown
Total	100	
N Total	333	

In the survey of participants, respondents were asked what methods other than RARP they considered for disposing of their appliance. Customers were asked their most likely alternative. The responses, which were tabulated above in Table 3-4, indicated that the majority (43 percent) said that they would have likely given their unit to charity or a private party. Ten percent would have sold it to a private party or appliance dealer. Twenty-nine percent of customers would have been likely to haul or have someone haul their unit to the dump or recycling site. Nine percent would have had the dealer from whom they purchased a new appliance take the old one. Disposers of refrigerators and freezers were analyzed separately along with other factors, but there was little variation in response.

Units belonging to customers who kept their unit, gave it away, or sold it were likely to have remained on the grid. Units of customers who hauled it or had someone else haul it to the dump, used a recycling company, or used a community trash program were likely to have been removed from the grid. Other analysis showed that approximately 87 percent of the working units taken by appliance dealers find their way to recycling companies or the dump. Since these comprise nine percent of the total, assume one percent of these units remain on the grid (.09 X 0.13). Adding together the five percent who would keep their unit, the 43 percent who would give it away, the 10 percent who would sell the unit, and the one percent that remain with dealers, then

59 percent of disposed appliances would remain on the electrical grid and the remainder excluding the unknown appliances, 37 percent, would be demanufactured.

From Table 3-25, it can be seen that the number of units removed from the grid was the 14 percent from RARP, 19 percent of the units going to new dealers (0.22 X 0.87, and the 16 percent of the units that were taken to the dump for a total of 49 percent. Accounting for the three percent of unknown units, 48 percent would have remained on the grid.

Table 3-26 shows what would happen if we take what the participants say they would have done with their units in the absence of the program and redistribute them.

- Column A of Table 3-26 shows the actual distribution for the disposal of the units in 2005.
- Column B shows how the RARP participants said that they would have disposed of the units.
- Column C shows how the 14 percent of the RARP units in column A would be redistributed if they were disposed based on how the respondents said that they would dispose of the units. Column C is the product of column A and column B (percents).
- Column D is the sum of Columns A and C and represents how units would have been disposed assuming RARP participants accurately represented how they would have disposed of the units.
- Column E spells out the like result.

Table 3-26. What would have happened in the absence of the program

	(A)	(B)	(C)	(D)	(E)
Disposal Method	***Actual 2005 distribution (percent)***	***How RARP participants say they would have disposed of units***	***Percent of RARP units redistributed***	***What would have happened in the absence of the program***	***Likely Result***
RARP	14				De-manufactured
Gave away to private party/charity	31	43	6.0	37.0	Still in use
Sold to friend/neighbor or through ad	15	10	1.4	16.4	Still in use
New dealer took when delivering replacement	22	9	1.3	23.3	87 percent de-manufactured
Took or had someone take to dump/recycler	16	29	4.1	20.1	De-manufactured
Kept it		5	0.7	0.7	Still in use
Unknown	3	3	0.4	3.4	Unknown
Total	100	99		99.9	
N Total	333				

Using the same procedure as was used to calculate the units that remained on the grid from 2005 with RARP, the percentage of units that would remain on the grid without RARP can be calculated. Thirty-seven percent of units would have been given away and would still be in use, 16 percent of units would have been sold, 3 percent of the units would have been collected by dealers and remain on the grid and 0.7 percent of participants would have kept their units. Essentially, 57 percent of the units would have remained on the grid.

Figure 3-1 and Figure 3-2 show the units remaining on the grid with and without the program. Thus, through this calculation it is estimated that there are eight percent fewer units remaining on the grid with the program than without the program. Estimating that there are roughly 530,000 working disposed units in the IOU service territory, without the RARP roughly 42,400 refrigerators would still be in operation after the 2005 program year. Calculating another way, this implies that the net to gross ratio implied by this method is 8 / 14 or 0.57 (i.e., eight is the difference in percent of units and 14 is the percentage of the RARP units).

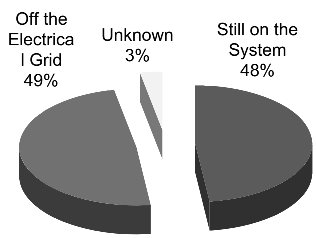

Figure 3-1. Grid Status with RARP

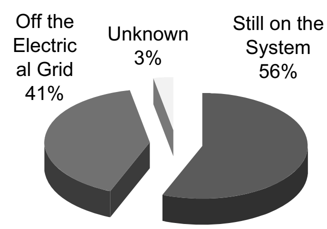

Figure 3-2. Grid Status without RARP

As a check, a comparison was made between what respondents in the survey of participants that was conducted for this evaluation said that they would have done with their units and what was shown in the results of the survey PG&E conducted in 2005. The PG&E survey used an open-ended question that was coded for this comparison. Table 3-27 compares the responses from the two surveys; the responses are strikingly consistent. (For the tabulations of the PG&E survey data, a respondent's first response is used.)

Table 3-27. Comparison of Alternate Disposal Methods as Given by Respondents to RARP Survey and to PG&E Survey (Percentages)

Alternate Disposal Method	***RARP Survey***	***PG&E***
Take or have someone take to dump or trash	29	25
Donate or give it away	43	43
Keep it	5	5
Sell	10	10
Used or new retailer service	9	8
Other / unknown	3	8
Total percent		115
N of cases		1,359

3.5 DISCUSSION OF RESULTS AND FINDINGS FROM ANALYSIS OF NET SAVINGS

The analysis presented in this chapter has addressed the issue and defined the conditions under which energy savings should be credited to RARP. Three alternative approaches were applied. One approach was based on the traditional methods for free-ridership analysis as required by the CPUC for the 04-05 evaluation report, a second was the approach used by KEMA in previous evaluations to determine the net impacts of RARP, and the third was a simple counterfactual analysis.

A conceptual review of the approach used by KEMA showed that the approach provides a useful taxonomy for categorizing the appliances that are recycled through RARP. These categories are defined by considering what would have happened to an appliance unit recycled through RARP if it had not been recycled. There are essentially four categories for what could have happened to a unit had it not been recycled.

Of these four categories, two are representative of free-ridership: units that would have been kept by the household but not used; and units that would have been discarded by the household through a method in which the unit would be destroyed. Savings from units falling in these two categories are therefore netted out in the analysis of program impacts.

Savings are to be credited to the program for units that fall into the following two categories: units that would have been kept by the household and still used; and units that would have been discarded by the household through a method in which the unit would be transferred and kept in use.

This taxonomy was used in the first approach to estimating net savings. Using a traditional approach to free-ridership analysis, the following estimates were derived for the proportions of gross savings that are net of free-ridership for refrigerators and freezers recycled through RARP.

- For all refrigerators (i.e., both primary and secondary), savings net of free-ridership are 61.4% of gross savings for the program as a whole.
- For primary refrigerators only, savings net of free-ridership are 59.0% of gross savings for the program as a whole.
- For secondary refrigerators only, savings net of free-ridership are 62.2% of gross savings for the program as a whole.
- For freezers, savings net of free-ridership are 70.6% of gross savings for the program as a whole.

The approach used by KEMA in its previous evaluations of RARP was used as a second approach to estimating net savings. Using the KEMA approach with the larger data sets from the evaluation of the 2004-2005 Statewide RARP gave an estimated NTG ratio for refrigerators

(40.9%) that is somewhat higher than that estimated in the evaluation of the 2002 Statewide RARP (35.1%).

However, more detailed inspection of the KEMA method showed that assumptions made in applying the approach can significantly affect the estimates. In particular, in applying its approach to the evaluation of the 2002 RARP, KEMA assumed that there are no savings attributable to the program if would-be transferees purchase a used refrigerator. However, examination of this assumption showed that used refrigerators that are available for purchase will be more efficient than the units being recycled through the program, thereby also increasing the NTG ratio. Changing these assumptions resulted in an increase of the NTG ratio for refrigerators for the 2004-2005 Statewide RARP from 40.9% to 52.2%.

Conceptually, the treatment of discarded-transferred cases in KEMA's approach can be argued to intermingle market effects with program impacts. Recall that refrigerators or freezers in the discarded-transferred category are those units whose transfers to other parties were precluded because the units were recycled through RARP and that savings are attributed based on the actions that transferees (i.e., the would-be recipients of the refrigerators) would take if they could not receive a recycled refrigerator. However, transferees, which may include relatives, neighbors, friends, charities, used appliance dealers, etc., are by and large not participants in RARP. Thus, their actions are more appropriately analyzed with respect to non-participant spillover, which is part of the estimation of market effects and not the estimation of program impacts. In other words, net savings with respect to participant impacts have nothing to do with the wide or narrow option set among hypothetical transfer recipients in the market at large.

The KEMA procedure for analyzing the discarded-transferred cases as part of the net impact analysis can also confound the net effects of the program with the market effects that occur because of the penetration of the program into the market (i.e., a change over time that is a market effect or a characteristic of markets that differs between geographical areas or eras within a particular area). It appears that the treatment of discarded-transferred cases in KEMA's approach implicitly assumes that the goal of the RARP is to prevent existing demand for used appliances from being met by *any* low performance used appliances. That is, with KEMA's procedure the question is whether another appliance of equal or lesser efficiency will be available, in which case an inefficient appliance that would have been transferred absent the program is counted, via "attribution", as contributing nothing to net savings.

However, the availability of used appliances and hence the proportion of transferees that would acquire a used refrigerator if a transfer were prevented is affected by the penetration of the recycling program into the market. To illustrate this point, assume that two recycling programs are functioning equally effectively in two different service territories, say North and South. Suppose, however, that the available stock of older used appliances is larger in North than in South. Then acquirers in North have more used appliances available to them, making it more likely that they would have purchased another used appliance if their desired acquisition had been precluded. That is, a survey of acquirers in North would be more likely to provide a higher proportion of acquirers of used refrigerators that the KEMA approach would assign an attribution score of 0.0. While this would lower the net-to-gross estimated with KEMA's approach, it is a consequence of a market effect and not a direct program impact.

Looked at another way, suppose that a program operated the same way in a small jurisdiction for 20 years (i.e., with the same persuasiveness year after year and with same annual removals of appliances). Although the program would function exactly the same in each year, the net-to-gross calculated for the program through KEMA's approach would be higher in year 20 than in year 1. That is, because of the high penetration of the program into the market by year 20, the stock of used appliances in the small jurisdiction would be considerably reduced, driving up the price of used refrigerators relative to new units and thereby making it less likely that appliances taken out of service by the program would be replaced by similar used appliances. The proportion of acquirers obtaining used refrigerators (with an attribution score of 0) would therefore be lower in year 20 than year 1, not because of changes in program impacts but because of the higher penetration of the program in the market.

Per the CPUC's protocols for impact evaluations of a program, the analysis of the net impacts of the RARP should be focused on *participants* and be directed at estimating the "*proportion of savings that is program-induced and net of free-ridership estimates (not including spillover or market effects savings estimates).*" Net program impacts are to be estimated only as those impacts that are net of free-ridership. Spillover effects (either participant or non-participant) and market effects are to be analyzed but are not to be included in the estimation of net program impacts. The goal is to determine what would have occurred in the absence of the program. For RARP, this means determining what proportion of participants would have disposed of their refrigerators or freezers without RARP in a way that would have removed the refrigerators permanently from the grid.

4. PROCESS EVALUATION OF 2004-2005 RARP

This chapter addresses the process evaluation work that was conducted as part of the overall evaluation of the 2004-2005 RARP. The objectives for the process evaluation of the RARP were as follows:

- Describe, understand and document how the utilities have implemented RARP;
- Identify opportunities to improve efficiency and effectiveness of delivery of energy efficiency services through the program; and
- Identify gaps in program design and operation, both retrospectively and prospectively.

Section 4.1 discusses the findings from the process evaluation, while Section 4.2 discusses opportunities for better collecting data with which to manage and evaluate the effectiveness of the program.

4.1 FINDINGS FROM PROCESS EVALUATION

Various aspects of fielding the RARP were reviewed for the process evaluation, including program marketing, program logistics (e.g., scheduling, pick-up, etc.), and cancellations. The findings from the process evaluation of the various aspects of the RARP are presented in this section.

4.1.1 Marketing of the RARP

Although the 2004-2005 RARP was a statewide program, individual utilities took different approaches to marketing the program. Those marketing efforts were reviewed, and the findings from that review are presented here.

4.1.1.1 SCE's Marketing

For SCE, marketing for RARP was handled internally in order to utilize resources more efficiently. This allowed access to the utility name and/or logo and the opportunity to place information in *Customer Connections*, the monthly newsletter to customers included with the bill, bill inserts, and bill messages (information placed on the billing). The SCE marketing campaign, which was quite varied, included several elements.

- Website: There is a page on the SCE website that explains the program and links the customer to a website where the customer can sign-up for the program.
- Truck signs: ARCA's trucks designated for the program have advertising printed on the side with a telephone number.
- Retail promotion: Material is developed for distribution to retail outlets and promoted with sales representatives.
- Poster/flier: A poster was developed for the Catalina pick-up effort.

- Radio/newspaper: Media campaign featuring English, Spanish and Asian advertisements.
- Press release: English and Spanish press releases placed on wire services for media pick-up.
- Mailer: Letter sent to all (3.9 million) residential customers using recycling model.
- Newspaper insert: Freestanding insert in various Sunday papers.
- Email blasts: Email blast to approximately 150,000 residential customers.
- Brochure: English and Spanish brochure.
- Bill message: Message placed on all (3.9 million) residential customer bills.
- Bill inserts: Bill insert to all (3.9 million) residential customers.
- Customer Connection stuffer: Special insert sent to all (3.9 million) residential customers in bill.
- Movie advertisement: Advertisements displayed on over 500 cinema screens (in 35 theaters) within SCE territory.
- Magazine advertisement: Advertisement appearing in Apartment Management Magazine.

Data supplied by SCE were used to construct a timeline showing marketing events. In some instances the precise release date of the materials was unclear because only a month was given. In some instances it was unclear if the materials were released over the entire month or on a given day. For materials such as bill inserts and bill messages, the releases reached about five percent of total customers daily over the 22 day billing cycle (monthly). For purposes of consistency, the entire month is shown in the figure.

The timeline, which is depicted graphically in Figure 4-1, shows that SCE's marketing was spread over the 24-month period with a modest increase in intensity during the spring and summer. There were some differences in the amount and timing of activities in the two years. Truck signage was used starting in August of 2004. Retail promotions were done in April 2004 and then again in January 2005 and May of 2005. Mailers were used in late 2005. Newspaper inserts were used in September of 2004 and again in July and August of 2005. E-mail blasts were used in August and then again in October and November of 2004. Brochures were used in April and May of 2005.

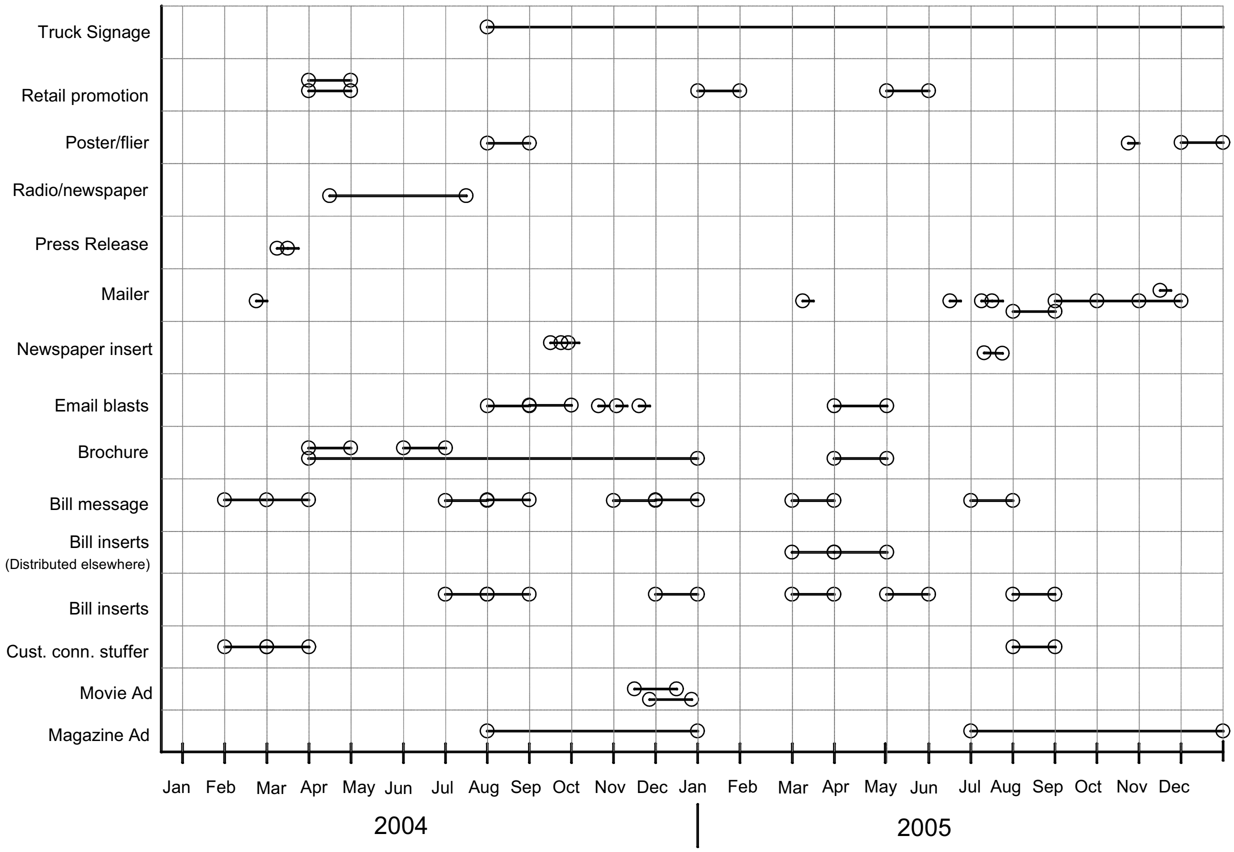

Figure 4-1.Timing of SCE's Marketing Efforts

Three forms of program notices that were included with the bill could be distinguished. As discussed later, this is important because they appear to be differentially effective.

- One form is a story in *Customer Connections*. This is typically a two-paragraph story that is on one page of four in a bi-fold containing four stories. The bi-fold is slightly smaller than the size of the envelope in which the bill is mailed. It is typically colorful and may contain graphics.
- A bill message is a simple phrase such as "get $35 for your old refrigerators, call 555 555-1515" printed on the bill.
- The last form of bill insert is a single envelope size sheet that is colorful and has a simple one or two line message.

Customer Connections was used in February and March of 2004 and then again in August of 2005. Bill inserts were used in nine of 24 months. Movie advertisements were an ongoing activity from late 2004 throughout 2006.

For retail promotion, SCE used Organizational Support Services, Inc (OSS). OSS compiled a list of about 500 appliance retailers in the SCE service territory. SCE asked OSS to target about

300 of these that are mostly big box and large appliance stores with a few smaller dealers and "mom and pop" stores.

Organizational Support Services visited these stores. OSS staff said that they have been doing this long enough that they have rapport with the store managers, eliminating any problem with cold calling. The field people have a goal of visiting 10 to 12 stores within a ten-hour workday.

In the stores, OSS staff met with the on-duty department managers. They placed easel back signs with coupons for appliance rebates and about 100 tear off information sheets. The number of easel back signs varies with store size. In a typical big box store they install about six. They also place stickers on appliances stating that the customer can receive from 50 to 85 dollars depending on the appliances. The dollar amount includes all incentives and rebates available, not just the ones available through the RARP. Retailers typically ask that they only sticker appliances that are eligible for all of the incentives and rebates (Energy Star units) to minimize customer confusion.

After the signage and stickers are in place, the field people visit with the salespeople to make sure they are aware of the program and its benefits. Stores with low employee turn over typically don't need as much attention as ones with more frequent turnover. A representative of OSS noted that personnel turnover in the stores is typically not high.

According to Organizational Support Services, most of the large stores push the program to customers ahead of their own pick-up services. When the sale is for under $300 there is typically a charge for the pick-up but it is usually free above that amount. OSS thinks the salespeople recognize the value of the incentive to the customer and pitch it to get the sale. OSS reports that some smaller stores say that it cuts into their resale opportunities and they do not push as hard.

Before leaving the store, the field person takes a picture of the store and each appliance on which a sticker has been placed in case there are any questions about what was done. These photos are included in a report that OSS compiles for each visit. They give the reports to SCE with their invoices.

Some of those interviewed regarding SCE's marketing of RARP shared some observations about marketing. The recycling contractors collect some survey data from a random sample of customers when they call to have a refrigerator or freezer removed. The 2004 data from the ARCA call centers suggested that truck signs were very effective in marketing the program and creating awareness in 2004. During interviews, ARCA respondents suggested that the ads aren't as significant as the data indicates. There was a significant drop in the number of persons recalling the signs in 2005, suggesting that ARCA is probably correct. ARCA is of the opinion that the stand-alone bill inserts are much more effective as well as inexpensive. They also believe word-of-mouth from family, peers and flyers left at registers in retail stores, are valuable resources of customer awareness.

In the discussion about retail promotions, it was observed that giving any information about the RARP to the retail customer is an act of goodwill on the part of the salesperson. OSS does not have control over information the retailer relays to the customer. In many cases, customers are given options, including that a retailer's own service will pick-up a working unit when the new unit is delivered. This service may be provided at no extra cost if the value of the unit exceeds $300 or may cost the customer from $60 to $75 if the new unit costs less than $300. Depending on the dealer and how the removal is handled, there may be a disincentive for the dealer to recommend the RARP. This may especially be true if the customer is anxious to have a single drop-off and pick-up.

Organizational Support Services also pointed out that stores serving the Hispanic and Asian communities are less specialized and have more diversified inventories. While appliance sales are a smaller portion of the business, OSS said that they felt that it was important to have language specific coupons and information for these stores.

In 2004-5, OSS visited stores just twice a year. They felt that they would have substantially greater impact if they were able to visit the stores quarterly.

4.1.1.2 PG&E's Marketing

PG&E's marketing is done by Runyon, Saltzman, and Einhorn (RS&E) through a subcontract with JACO. JACO coordinates closely with RS&E to throttle the marketing to match JACO's ability to remove units in a timely way. (In interviews, it was mentioned that JACO and RS&E had to throttle back marketing to prevent exceeding their goal too early in the funding cycle.)

RS&E coordinated initial press events in the service territories in which the program opened. There are signs on JACO trucks advertising the service. In addition, there is program information on the PG&E website. RS&E also generated attention from the Associated Press. Unlike SCE, PG&E has not included a description of the program in bill inserts or bill stuffers. However, information about the RARP was included in corporate level promotional materials that were released. JACO and RS&E had not been forewarned about these materials and had to respond quickly.

The timeline for PG&E's marketing of RARP is shown in Figure 4-2. As can be seen, RS&E's marketing focused primarily on newspaper advertisements. Figure 4-2 shows weekly releases of promotional materials to newspapers, with each dot in the figure representing a marketing release. For example, in the second week of June 2004 PG&E put ads in three newspapers (as represented by the three dots in the figure).

RS&E buys space in both local circulation newspapers and papers with broader audiences. About 29 percent of the advertisements went to newspapers with circulations of less than 25,000, 38 percent to newspapers with circulations between 25 and 50,000, and 18 percent went to advertisements in newspapers with circulation of greater than 100,000. Circulation data were not available for the remaining newspapers where advertisements were placed. There were 82 days over two years with newspaper advertisements. On 25 percent of those days the advertisements were placed in newspapers with total circulation of less than 25,000 readers. On another 43 percent of days the advertisements were placed in newspapers with circulation between 25,000 and 100,000. On 15 percent of the days advertisements were placed in newspapers with circulation greater than 100,000.

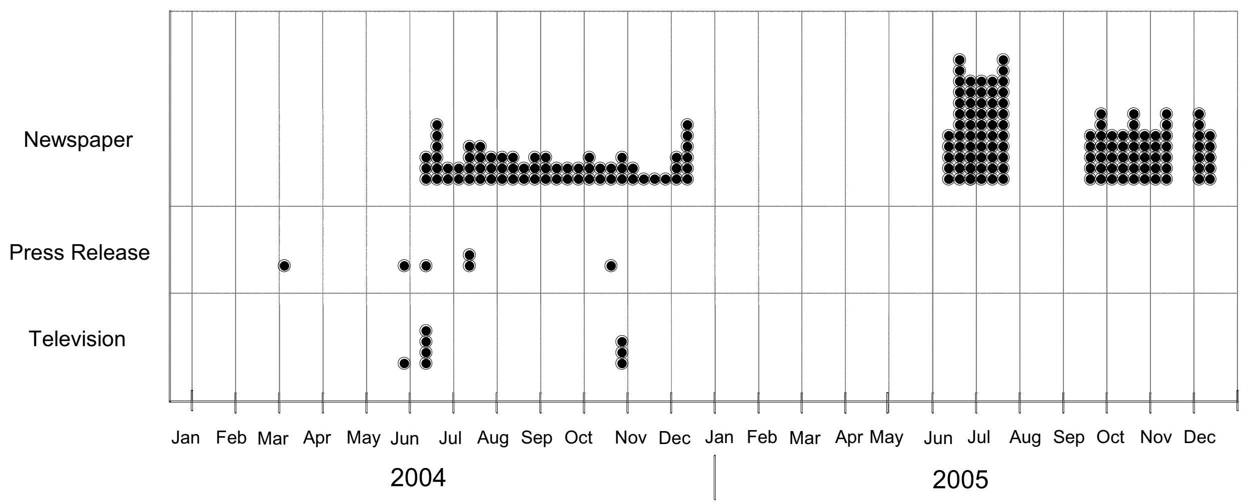

Figure 4-2. Weekly Marketing Releases for PG&E

4.1.1.3 SDG&E Marketing

Prior to the summer of 2004, ARCA provided SDG&E with a turnkey program including marketing. In June 2004, SDG&E renegotiated its contract with ARCA and assumed all marketing activities required for the program. The media used by SDG&E to market the RARP included the following:

- Radio
- Television
- Newspaper
- Bill inserts
- Truck signage
- Retail Promotions.

Information was placed in SDG&E monthly inserts that accompanied the customers' bills in March of 2004 and April of 2005. ARCA trucks carry signs while pick-ups are being made in the service territory. Detailed information was not obtained about SDG&E's newspaper advertising and media buys.

Feedback from the contractors in each of the three service territories was that more units would be available for removal with additional marketing. For example, JACO staff said that they typically spend about $25 per unit on marketing for similar campaigns in other service territories. JACO started with that amount of funding but reduced it to about $10 per unit because the more aggressive amount would quickly have resulted in "blowing through their entire budget." JACO feels that doubling the current amount would double the number of units being retrieved, while halving the amount would halve the number of calls. JACO was of the impression that if a campaign to capture first refrigerators was really marketed that the number of refrigerators would increase substantially. ARCA also expressed the opinion that they could increase the number of units that are retrieved, perhaps increasing the yield by three to four times. An analysis about the effects of different types of promotions is presented and discussed later in this report.

SDG&E had exhausted its 2004-5 budget by late August 2005 and sought permission to transfer $700,000, which was in turn exhausted by mid September of 2005. This accounts for the decline in turn-ins in that territory in late 2005. JACO and RS&E were trying to husband the PG&E media budget in order to have funds available throughout the program year. PG&E, as part of its "Good Corporate Citizenship" branding campaign, included the appliance-recycling program in its efforts, triggering a wave of calls to the call center. A similar incident occurred with the Flex-Your-Power program. A Spanish language television commercial appeared on Univision, causing a surge in calls to the PG&E call center rather than the recycling line for PG&E at JACO's call center.

4.1.2 Customer Response to Marketing

Section 4.1.1 described the IOU marketing efforts. This section examines customer response to marketing efforts. For many customers the message may have little salience and represent noise in the system to be ignored. Some customers may find the information interesting and simply tuck it away for future reference. For other customers who are thinking about acquiring or disposing of a refrigerator, the information may have some salience and may trigger an action such as calling and scheduling a pick-up. This section includes an analysis of how marketing efforts relate to calls placed to call centers.

4.1.2.1 Timing of Participation

The tracking data from the recycling contractors were used to examine when customers called to schedule pick-ups. The tracking data indicates the day on which a recycling contractor received a request to remove a refrigerator. These data were organized by date, the frequency of requests was counted, and the data were plotted by utility for each day from January 1st 2004 to December 31st 2005. Figure 4-3, Figure 4-4, and Figure 4-5 show when calls were placed to PG&E, SCE and SDG&E respectively.

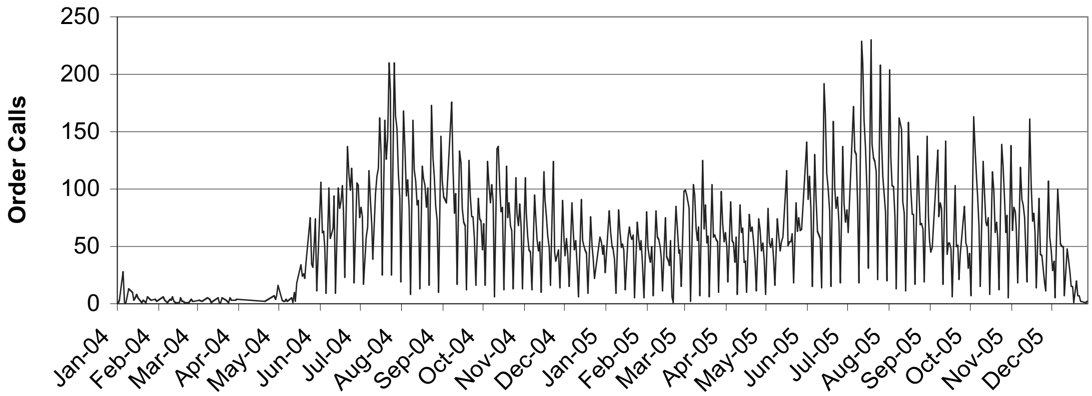

Figure 4-3. Appliance Pick-up Orders Per Day for PG&E

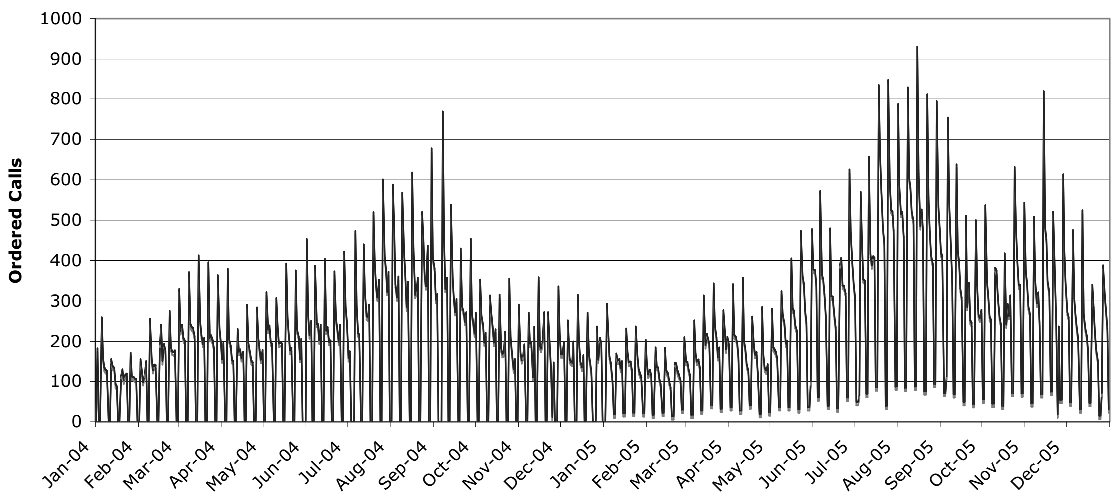

Figure 4-4. Appliances Pick-up Orders Per Day for SCE

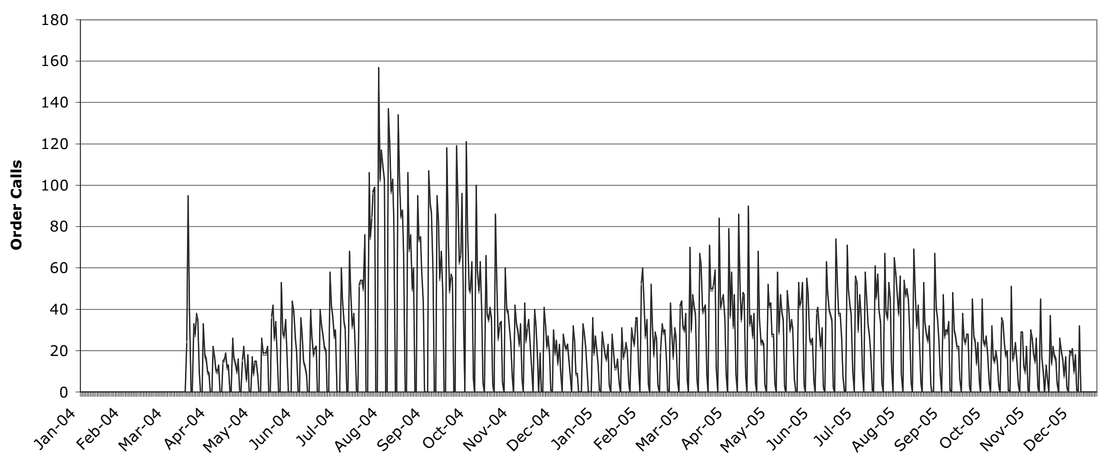

Figure 4-5. Appliance Pick-up Orders Per Day for SDG&E

All three graphs show a rise of orders in the summer and a decline in winter months, indicating that customers are much more likely to participate in the summer months. In July, calls to PG&E eclipsed 200 a day on several occasions while in the winter months (December to February) the number of calls was below 100 on the busiest days and more typically around 75. The dearth of calls between January and April of 2004 is because the program got a late start.

The same annual pattern occurs for SCE. The most active month is August. On August 15, 2005, ARCA received 931 calls from SCE customers. On other days ARCA received fewer than 400 calls. From the first of July to the end of September, ARCA received almost 34,000 calls (39 percent of total calls for 2005), while a little over 11,000 calls were received from January through March (13 percent of total calls for 2005). SCE's summer initiative occurred between May 1 and August 30, 2005.

SDG&E's annual pattern is also similar although there are some differences in 2005. In 2004, 23 percent of SDG&E's calls for the entire year were received in August, and more then half (52 percent) of all calls occurred in August, September, and October. However, in 2005, there was no summer push because funds for the program were running low. Calls were received at a relatively even rate from February through September, but fell off slightly over the last three months as funds were exhausted. As pointed out earlier, this was because SDG&E had used up much of its program allocation and was trying to throttle the program to avoid having to refuse customers. SDG&E had used its program funds by mid-August of 2005 and continued the program through mid-September 2005 with a supplemental allocation of $700,000.

4.1.2.2 What Can Be Learned from the Call Data about Marketing

Closer examination of the call data shows that there are three periodicities in the data.

- There is a weekly periodicity. Monday is always the busiest day at the call centers. This probably reflects the fact that most people make purchases of new appliances on the weekends or decide to dispose of an appliance on the weekend and then contact the telephone center on Monday.
- There is also a monthly periodicity in the data. This is not as pronounced as the weekly and annual periodicities but it can be observed in the data. People are more likely to arrange for appliance pick-ups near the middle of the month than near the beginning or end. Remembering that a major factor in the disposal of appliances is appliance purchases, purchases are less likely near the beginning of the month when mortgage and car payments may be due and more likely in the middle of the month when people receive mid-month salary and wages.
- Finally, there is an annual periodicity. It has already been noted that appliance collections peak in the summer. This is when new appliance sales peak as well. People are on vacation and they may be refreshing their homes. At the end of the year and at the beginning of the new year, people are concerned about holiday spending so sales of new appliances may be limited although some people may purchase new appliances for the holiday.

Recall from earlier discussion that 75 percent of appliance pick-ups are driven by new purchases. New purchases drive the periodicities in the data. Figure 4-6 shows the weekly call volumes in 2004-5 for PG&E. Superimposed on this graph is an estimate of the underlying effects of new sales. Looking back at Figure 4-2, it can be seen that most of PG&E's marketing activity was between June and December in 2004 and June / July and late September through early December in 2005. The marketing activities correspond quite closely with the most dramatic peaks in call volume.

There is however the anomaly of the call volume increase in March/April of 2005. There were no marketing activities that correspond with this period. This peak corresponds to the national sales efforts of the major appliance dealers such as Sears and others. Keep in mind the discussion above about the effects of word-of-mouth from appliance dealers in the PG&E service territory, so that this increase makes sense. Looking closely at the graphs for SCE and SDG&E, it is apparent that there is a secondary peak in the April timeframe in the data for those utilities as well.

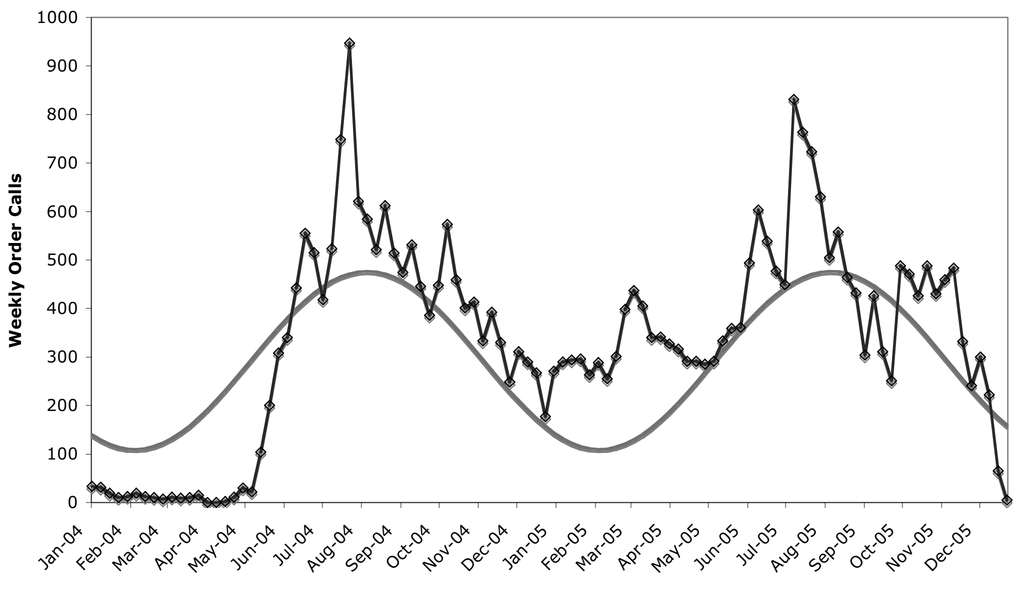

Figure 4-6. Weekly Scheduling Volume for PG&E Service Territory

A similar graphic for SCE is shown in Figure 4-7. SCE has a much more diversified marketing campaign but the summer peaks are quite clear. Also, the peak in March/April is quite clear in both years.

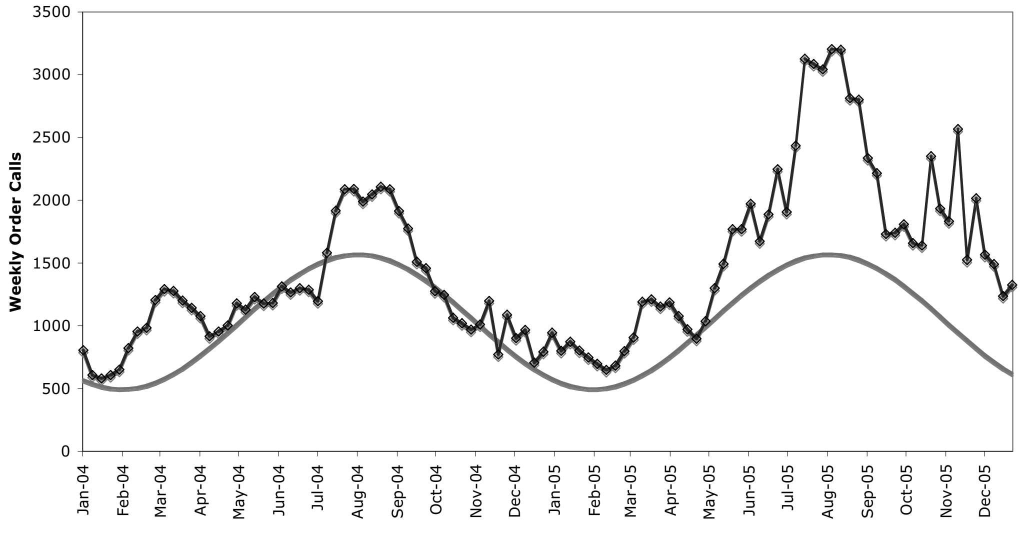

Figure 4-7. Weekly Scheduling Volume for SCE for 2004-5 with Underlying Appliance Sales

Now, the important point is that new appliance sales are a significant underlying driver of program participation. When news sales are up, participation in the program tends to increase and when they are down participation tends to decline. This is not always the case. For example, looking at participation in the SDG&E program in 2005 shows that participation increased only slightly during the summer of 2005 and then declined through the end of the year. This departs somewhat from what has just been reported. What this represents is the program slowdown. Another way of putting this is that new sales are a partial driver or necessary condition for program participation but not a sufficient one and that promotion is necessary to make the program work.

4.1.2.3 Relative Effects of Marketing Activities

The marketing data were further analyzed in an attempt to estimate the effects of different marketing activities. This was done by regressing weekly call volume data on dummy variables for the marketing activities. For example, dummy variables were created for each type of marketing, bill inserts, newspaper advertisements, etc. For any week in which customers received an insert, the dummy variable takes a value of one; otherwise it takes a value of zero. The regression equation can then be used to estimate the effects of a specific promotion.

Normally, a constant would be included in the regression equation to estimate the average effect. In this analysis, however, the constant was constrained to be zero. The unstandardized coefficients represent the incremental effects of the marketing activity. Thus, an unstandardized coefficient of 150 associated with a newspaper advertisement would represent 150 additional calls received during the week because of the advertisement. As noted above, consumers' purchasing behaviors are the underlying driver for the number of calls. Examining the figures shows recurring annual patterns much like a sine wave. Instead of using a sine and cosines to represent the underlying phenomena, dummy 0-1 variables were used to represent the months. Only 11 months needed to be represented because the 12th month can be determined by knowing the other 11.

This technique was used to examine PG&E's marketing activities. In addition to the PG&E weekly call volume, four dummy 0-1 variables were created to indicate whether one of the following marketing activities occurred in a week:

- a television advertisement,
- a press release,
- newspaper advertisements reaching more than 100,000 people, and
- newspaper advertisements reaching fewer than 100,000 households.

In addition the 11 monthly dummy variables were included to capture the underlying behavior.

Several different versions of the model were estimated. The R-values were typically between 0.76 and 0.92 with corresponding R-squared values ranging from .58 to .86. In other words, the models were able to explain between 60 and 86 percent of the variance in weekly calling patterns. Table 4-1 shows the results for a model that includes the monthly variables and the placement of advertisements with large and small circulations. This particular model explains 86 percent of the variance.

Table 4-1. Effects of Press Releases and Newspaper Advertisements on Call Volume at PG&E

Variable	***Unstandandarized Coefficient***	***Significance***
TV coverage	95	0.512
Press release	0	.999
Placement in newspapers with combined circulation greater than 100,000 circulation	241	0.000
Placement in newspapers with combined circulation less than 100,000 circulation	169	0.004
Dummy variable for January	153	0.006
Dummy variable for February	147	0.009
Dummy variable for March	163	0.003
Dummy variable for April	108	0.043
Dummy variable for May	180	0.001
Dummy variable for June	176	0.005
Dummy variable for July	426	0.000
Dummy variable for August	387	0.000
Dummy variable for Sept	183	0.002
Dummy variable for October	209	0.002
Dummy variable for November	176	0.005

These results show the following.

- In July there were on average about 426 calls per week.
- If an advertisement were placed in large circulation newspapers it resulted in an increment of about 241 calls for the week.
- If an advertisement were placed in smaller newspapers with more limited circulation, the incremental number of calls was about 169 calls.
- TV coverage generated an additional 95 calls.
- A press release generated zero additional calls.
- Also notice that there is a slight uptick in calls in March and downtick in April. This is likely the effect of spring appliance sales.

A number of caveats apply to these results. First, a high percentage of PG&E customers indicated that they hear about the program from a sales representative. This is an on-going effect and cannot be captured because it appears to more or less be a constant in the environment. The model captures only immediate effects. A customer who is planning to purchase a new refrigerator and then get rid of an old unit may not act for two or even three weeks following the appearance of a television or newspaper advertisement. In other words, this approach assumes that the response will be immediate rather than long term. Also, there are substantial limitations within the data such that judgments had to be made about how best to code the data.

The same type of regression analysis was applied to the SCE data. Because SCE had a more diverse marketing program, it was possible to examine additional effects.

- For instance, SCE added truck signage toward the end of the first year, so that it was possible to examine the effects of truck signage.
- SCE used different methods with their bills. They have the Customer Connection bi-fold with four stories one of which was about appliance recycling, the bill message, and the bill insert which is the same size as the Customer Connection but a single sheet with a message containing just a few words.
- There were also magazine advertisements, movie advertisements, and e-mail blasts.

The results of the regression analysis of SCE's marketing efforts are reported in Table 4-1. Truck signage appears to have a substantial effect. The Customer Connection Stuffer, the mailers, and the newspaper insert also appear to have had effects. The remaining marketing efforts had effects that could not be differentiated from zero or appeared to be negative (i.e., significance greater than .05).

Table 4-2. Effects of Promotional Materials on Call Volume at SCE

Variable	*Unstandardized Coefficients*	*Standard Error*	*t-value*	*Significance*
Truck Signage	810.917	106.857	7.589	0
Customer Connection Stuffer	581.059	181.407	3.203	0.002
Mailer	526.143	136.379	3.858	0
Newspaper Insert	491.507	247.947	1.982	0.051
Press Release	408.538	329.662	1.239	0.219
Bill Message	228.834	149.887	1.527	0.131
Magazine Ad	-72.583	126.914	-0.572	0.569
Bill Insert	-121.79	138.887	-0.877	0.383
Retail Promotion	-195.555	164.385	-1.19	0.238
Movie Ad	-206.674	252.34	-0.819	0.415
Email Blasts	-268.696	180.909	-1.485	0.141
January	426.519	156.591	2.724	0.008
February	-137.487	162.877	-0.844	0.401
March	67.069	202.747	0.331	0.742
April	667.028	180.172	3.702	0
May	932.31	143.773	6.485	0
June	733.637	135.602	5.41	0
July	1278.927	194.184	6.586	0
August	1202.851	231.246	5.202	0
September	553.716	162.95	3.398	0.001
October	401.652	144.181	2.786	0.007
November	404.516	165.455	2.445	0.017

From previous discussion, a fairly high percentage of SCE customers reported that information with the bill was an important way they heard about the program. These data suggest that the information included with the bill may have very different effects. The Customer Connections pieces appear to be quite effective, the bill message has some effect (although the effect cannot be differentiated from zero), and the bill insert has a negative sign and also cannot be differentiated from having a zero effect. What this suggests is that customers read and pay attention to Customer Connections. They may pay attention to the bill message because of its location but probably discard the bill insert. This implies that the amount and location of information is key to customer's getting the message. One-liner bill stuffers are probably ineffective. It is also noteworthy that mailers that may contain more information also appear to be effective. This suggests that SCE could try some well-designed experiments using different types of bill information in different parts of the service territory to assess the impact of the different types of pieces. For example, the bill insert might be designed as a one-liner and with a simple story. These could then be distributed in different parts of the service territory in two months and the results monitored.

These data also suggest that SCE's retail promotion efforts are less effective than other efforts. This is consistent with data reported in previous discussion that more PG&E customers were likely to have heard about RARP at a retail outlet than were SCE or SDG&E customers. There are issues with the data for the retail promotions because it is not known how long retail outlets may retain the promotional materials and to what extent the may continue to recommend program to customers. Without that information it is difficult assess the true effects of retail promotion.

Finally, the movie advertisements that were mostly in November and December and the e-mail blasts also appear to be ineffective.

4.1.3 Conclusions about Marketing of RARP

Several things can be concluded about the marketing of RARP.

- First, increasing the amount of promotion appears to increase the number of units available. Saturation has not been reached and is not likely to be soon. This topic is discussed in greater detail later.
- Second, there are repercussions when promotions are not carefully managed. One repercussion is that the program exceeds its goals, which means that it either has to moderate subsequent efforts to stay within budget, appeal to the PUC for more funding in order to meet the demand, or cut the program off causing discontent among customers wishing to participate. A second problem is that the sudden increases in demand cause the contractors to become backlogged. As will be discussed later, a major reason for participants canceling their pick-up is the amount of time between their initial call to the program and the actual pick-up date. Thus, it is important to coordinate advertising with resources available for retrieving refrigerators and freezers.

4.2 SCHEDULING PICK-UPS

As part of the RARP evaluation, an Innovologie staff member visited ARCA's call center in Minneapolis MN and JACO's call center in Everett WA. The purpose of these visits was to see how calls are handled and pick-ups scheduled, as well as to see what differences might exist. This review, which is discussed in this section, addressed the following topics:

- Companies scheduling protocols: call logistics, the initial greeting, eligibility determination, and choosing a pick-up day;
- Call data and calling cycles;

- Databases where the call information is stored (i.e., tables that are generated, how the data reaches the utilities, and questionnaires or surveys in which customers are asked to participate).

4.2.1 Call Capacity

Both ARCA and JACO have the capacity to receive many more calls then they are currently. ARCA has 24 call station pods. If needed, it can expand by moving into a training room or split the pods to add staff. On a busy day ARCA uses about 12 of these pods for 12 staff members. At the time of the visit, seven operators were taking calls. JACO has a capacity of 27 stations. At the time of the visit, there were five operators taking calls for the utility side. Additional operators were in an adjacent room.

4.2.2 Handling Calls

The call centers for both ARCA and JACO receive calls from multiple utilities and programs at the same time. While onsite at JACO, the Innovologie staff member witnessed calls from Nevada, Utah, Wyoming, PG&E, and Washington area utilities. Similarly, while on site at ARCA in Minnesota, calls were coming from California, Wisconsin, and Minnesota.

For JACO, the NORTEL system routes the calls to a specific telephone. The system identifies the utility by the toll free number that the customer called. It alerts the operator to which utility the call is for through an LED display on their telephone. This allows the operator to answer the telephone with the proper greeting.

In the case of PG&E calls, the operators answered saying “Appliance Recycling Program.” The caller’s language is determined and an appropriate response is made. The operator verifies the name of the utility and selects the appropriate options. At JACO the caller is asked to choose a language and utility by an enhanced call processing touch-tone menu, which then routes the call to the appropriate attendant.

If it is after business hours, ARCA queues calls to voice mail. The ARCA announcement machine shows how many calls are currently active and where they are being routed. It shows who is on the line and busy, who is available to take calls and what kind of call it is. The system automatically queues calls to available people, and if after 12 seconds there is no answer, it is queued to the next person or voice mail.

4.2.3 Initial Eligibility

The way that the calls are handled is quite similar between ARCA and JACO. Once a week, JACO loads the latest list of the names and addresses of approximately 1.5 million customers into an SQL server database on its system. In a typical call, there is a simple exchange. The operator requests the caller’s zip code and enters that. The caller is then asked for their street address. The operator enters the numeric portion of the address. This results in an almost instantaneous display of addresses in that zip code with that numeric address. Sometimes there may be fewer than 10 addresses. In other instances the list might be quite lengthy, especially when the address is an apartment building. The operator picks the address with the appropriate street name and then asks the customer for the name of the account holder to verify that the correct address has been picked. While observing the JACO operation, there was an instance in which there was an exchange about a name that was not consistent with the address. Because only one side of the conversation could be heard, the reason for the discrepancy was unclear, but the caller and the operator quickly resolved the discrepancy. The caller may have supplied their own name, which was not consistent with the listed account holder. Although this process was not timed, the whole identification process seldom took more than 30 seconds.

Once the JACO operator verifies the customer's name and address, there is usually a slight delay while scheduling information appears on the screen. The operator usually fills this time by asking eligibility questions, such as whether the motor is running and if the refrigerator is greater than 10 cubic feet. During the observation period one customer was told that their refrigerator did not qualify because it was not running. At least one customer had a refrigerator that was smaller than 10 cubic feet. The size question seemed to be the one that caused the most significant delay. During the observation period, there was one customer who clearly didn't understand the concept of cubic feet. There was a second customer who took the requirement extremely seriously. The operator asked for the interior measurements in inches. In that case, the operator explained how to do the inside side measurement. When the customer did not have a measuring tool readily available they agreed that the customer would call back with the dimensions and the operator would do the calculations. We do not know if the customer returned the call. Also, we do not know how often this occurs. Operators are usually able to verify size without going to such great lengths.

At the time of the Innovologie staff visit, ARCA was in the process of upgrading their phone system and associated software. The ARCA system and process is similar to JACOs. The operator identifies whether the call is a new order, an existing order, or another type of call. The operator verifies that the appliance is operating and that and the type and size of the unit. The operator also verifies the caller's zip code, city, street address, and customer name.

The operators of both systems can determine if a customer has previously placed an order for pick-up or some other service. This allows the operator to determine if a customer has reached or exceeded their annual limit.

In the ARCA system, once eligibility has been established, the attendant records the appliance type, age, brand, color and location of the refrigerator or freezer. If the caller has an additional qualifying appliance, the attendant repeats this step. If the unit is found to be ineligible, ARCA refers the customer to their municipal refuse/trash haulers.

4.2.4 Location of Unit

Both ARCA and JACO customers are asked the physical location of the refrigerator at the pick-up location. By far, the most common answer is the garage. During the JACO visit, there was one instance of a customer who did not know where the refrigerator would be located at the time of the pick-up. The operator assured the customer that it could be inside our out. While only one side of this conversation could be heard, it appeared that the customer was concerned that an inside pick-up might be a hassle for the crews. The customer was reassured two or three times that it didn't matter.

The actual physical location is more critical for ARCA than JACO. ARCA attempts to establish whether or not stairs are involved in the removal. Typically ARCA has a single driver on a truck. If they determine that a removal may require a second person, they assign that unit to a special route that has a two-man crew. JACO has two man crews so that the location within the facility is not critical.

4.2.5 Date Selection

Once the location and eligibility is established, operators are presented with a schedule of times when a truck will service the customer's neighborhood. The customer is offered a pick-up date. If that is not acceptable, the next available pick-up date for that area is offered. While observing the calls, nearly everyone appeared to accept the first offered date.

Both ARCA and JACO establish schedules based on geographic areas. Availability of pick-up dates is driven by anticipated demand for pick-ups in a given area. ARCA has SCE and SDG&E service territories divided into 25 geographic zones for pick-up routes. The software for both companies connects the customer's location with a zone.

During the JACO observation conducted in early May 2006, dates were being scheduled as far out as early July and as close in as the next day. There are contract provisions that require pick-ups to be offered within a certain number of business days. The fact that one or two customers were scheduled for more than a month later was a result of the customer being on vacation on more than one of the next regularly scheduled and available pick-up times.

Areas with low demand (e.g., areas with low population densities within the SCE, SDG&E, and PG&E service territories) are allocated fewer pick-up days to allow for sufficient volume of refrigerators to be accumulated. The contractors are fairly good at allocating days for pick-ups. At JACO, the operator can see the quota for the day, the number of slots already filled, and the anticipated number of refrigerators. The number of refrigerators to actually be picked up fluctuates. Customers may cancel their appointments in which case a slot may become available on a day that might previously have been closed. The limitations on pick-ups are the capacity of the trucks and the length of the runs.

4.2.6 After Pick-up Date Has Been Scheduled

Once the pick-up date is agreed to, both the JACO and ARCA operators inform the customer that they will be contacted 24 hours in advance to confirm the pick-up and that the refrigerator needs to be plugged in with the motor running when the driver arrives.

In some instances customers called JACO from areas where no currently scheduled dates were available. These customers were placed on a priority-calling list. When call volume is light, the operators pull up this list and determine if a pick-up day has been scheduled for the area where these priority customers live. If a date had been scheduled, they call customers to establish a date.

Operators also would take calls from customers who were already scheduled, although none of these occurred while observers were present. Such calls might be driven by the need to change a pick-up date or cancel a planned pick-up.

ARCA treats rural/remote customers and customers who could not pick a date in a similar fashion. The operator will select the schedule later checkbox on the computer screen and ARCA's dispatch department will call the customer within two weeks to schedule an appointment.

4.2.7 Internet Usage

Internet scheduling is becoming more prevalent. ARCA was the first to develop the Internet sign-up. Callers can enter a pick-up and get confirmation of their order 24/7. Customers enter their zip code and then select the city in which they live. Customers see a list of pick-up dates and after selecting one provide some additional information to verify that they are eligible for the program.

JACO's system is more recent. The information from customers who schedule through the Internet is written directly to the fields in the database. At the time we viewed the system, a completed order generated an email to a folder that a JACO representative maintains. Originally this was done as a backup and to monitor the web activity. Although it is not clear as to what value the emails still hold, the JACO representative said that she still found value in the feature. To remind the customer, JACO sends an e-mail notification 48 hours before the scheduled pick-up.

At ARCA, Internet use and sign-up has increased substantially. When ARCA receives a web sign-up, they immediately e-mail the customer to confirm the web-based appointment. Webb based and telephone sign-ins are integrated by supervisors on a daily basis. Internet customers get an order number just as if they used the phone. The customers can print a confirmation letter.

Neither call center indicated the percentage or amount of inquiries received through the Internet. Using data from the survey of RARP participants, the estimate shown in Table 4-3 was developed. For the program overall, 13 percent of orders are placed over the Internet. However, Internet orders have become more common and so that 13 percent is a low estimate. The survey data suggest that 16 percent of SCE customers and eight percent of PG&E customers used the Internet. Three percent of SDG&E customers indicated that they used the Internet but we believe the SDG&E responses are in error. Internet sign-ups were available for only part of the 2004-5 program years for SCE and PG&E service territories.

Table 4-3. Customers who Sign-up Over the Telephone Versus Internet (Percentages)

Did you Sign-up online or on the telephone?	*PG&E*	*SCE*	*SDG&E*	*Total*
Telephone	86	78	94	81
Online	8	16	3	13
Other	2	1	0	1
Don't know	4	6	3	5
Total	100	100	100	100
N Total	135	581	105	821

Internet sign-ups may be much higher now. A recent discussion with the SCE project manager indicated that Internet sign-ups might be as high as 30 percent. In some of the discussion about Internet sign-ups, the SCE project manager indicated that he thought that the drop-out rate was much higher for people who signed up using the Internet than for those who signed-up by telephone. One hypothesis is that the human telephone interaction generates a greater commitment to follow through than an anonymous request made through the Internet. This theory along with others will be examined in the discussion regarding cancellations.

4.2.8 Language

Both companies have processes in place to deal with language barriers. At JACO, there were three English and two bilingual operators in the room at the time of the interview. If someone asked for a Spanish-speaking operator or it was clear the call could better be handled in Spanish, the call was routed to one of the bilingual operators. This happened several times while the Innovologie staffer observed. The transfer occurred smoothly and was almost unnoticeable. We did not determine how JACO customers who speak other languages are dealt with.

ARCA also has Spanish-speaking operators in-house. At the time of the interview, 8 of the 18 operators that work at ARCA spoke Spanish. For other languages such as Korean or Chinese, ARCA conferences in an AT&T interpreter.

4.2.9 Efficiency/Call Statistics

Both companies can receive large volumes of calls each day. In response to these calls, both companies track a variety of information.

The NORTEL system used by JACO tracks statistics for each of the active lines. Thus, it is possible to monitor wait times, length of calls, etc. While the call center was being observed, the average wait time was about 13 seconds. Because that is a rolling average it may have reflected heavier volumes earlier in the day. No calls were observed that were not answered on the first or second ring with the exception of one call where the operator went to another room on an errand. The wait time may include some call routing time as well.

For the most part, the JACO calls were very efficient with many lasting less than three-minutes. There was little discussion. The calls were most efficient when the operator was able to manage the call. The calls tended to take longer when customers presented information that was unnecessary, too detailed, or out of order. There were some informational calls.

Calls for ARCA are also very efficient. They are tracked statistically on a daily and monthly basis. ARCA reports these statistics to the utility and reviews them in-house.

4.2.10 Call Cycle

The summer months are the busiest, as seen in the time series graphs of call volumes shown above. Each graph showed that the number of calls begins to raise dramatically starting in June and peak in late August or September. In 2005, the summer marketing campaign may have increased the rate. The least amount of seasonal change occurred within SDG&E customers where a lack of funding in 2005 held back the summer marketing push. To facilitate more pick-ups during he summer ARCA will often add a Saturday to the weekly pick-up schedule.

Call volumes are also cyclical during the week. For both companies, the highest call volumes are on Monday, gradually tapering off throughout the week, with Friday being the lightest day. Figure 4-8 shows the typical weekly pattern based on data from ARCA and JACO for the three summer months in 2005. According to the ARCA representative, people tend to make household decisions about what to do with old refrigerators over the weekend and then act on the decision on Monday by calling to schedule a pick-up appointment. It also is likely that most new appliances are purchased and/or delivered over the weekend, which could prompt a pick-up call for the old appliance on a Monday.

4.2.11 Tracking Systems

The JACO database is comprised of a SQL Server Data Base with an ACCESS front end. The front-end appeared very responsive although we were viewing it on a Friday at mid-day which as previously noted is a light day. A former Microsoft employee who is under subcontract developed it. There are three servers supporting the database. The database is set-up so that the developer can shadow the administrator or other users of the database. This allows the developer to observe problems and make fixes to the database in real time. According to the developer, the JACO database has about 50 tables. Examples of the table include the utility customer table, the participant customer table, questionnaire table, and tables for supplying labels or information dynamically. The various tables were not examined in-depth on site but it is possible for administrators to quickly bring up the tables and work on them. For example, it is possible to collect customer records for any time period and for any geography that might be desired as long as it can be tied to zip code. The database also has reporting capability. For example, the input screens dynamically report information about the number of customers, refrigerators, etc. Also, there are reports that allow JACO to produce billings and summary tables of customers.

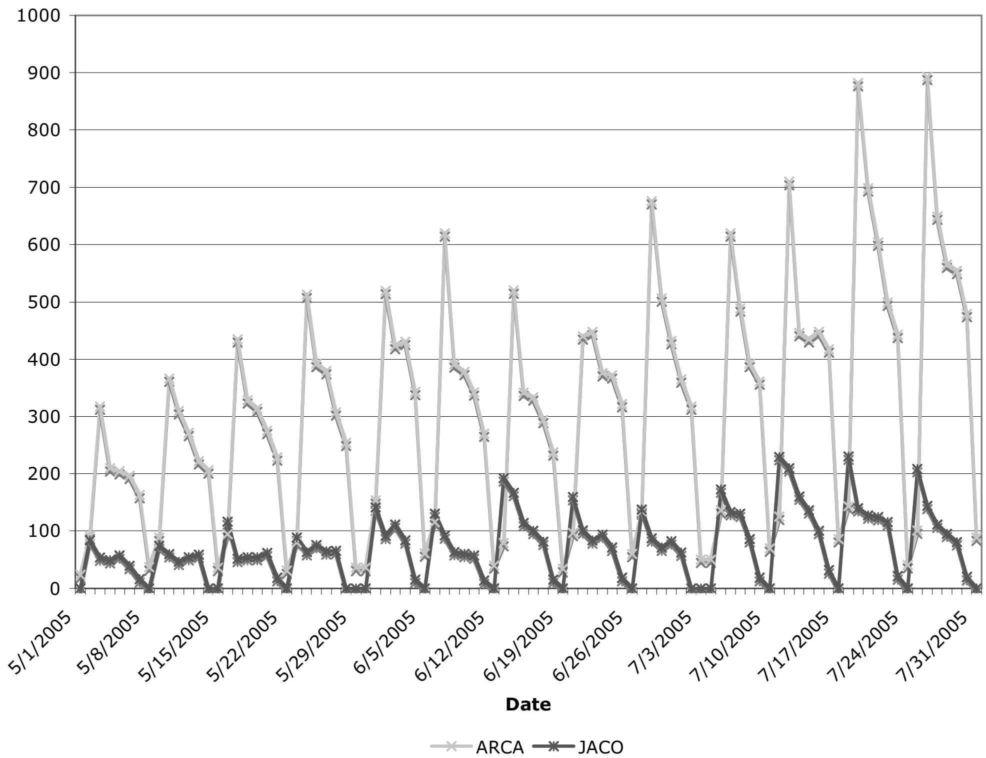

Figure 4-8. Number of RARP Calls Received Daily from May 2005 Through July 2005 for ARCA (green) and JACO (purple)

ARCA's system is comprehensive and seamless covering initial contact, scheduling, pick-up, tracking, and incentives. ARCA subcontracts their software support to Solutions at Work. ARCA's software is similar to that of JACO. It is a proprietary with a Cold Fusion front end with an SQL (Structured Query Language database) behind it. ARCA can also generate reports directly from the SQL database. Examples include the number of pick-ups, size categories, color of the refrigerator, how the customer heard about program, gender of the caller, etc. It will do the basic statistics and produce graphs. The same application handles both web and phone scheduling and integrates them together. For scheduling online, the customer gets an order confirmation number, which can be printed for the customer's records. The system also produces a paper receipt that the customer signs at pick-up.

4.2.12 Questionnaires and Surveys

Both firms collect survey data for a sample of customers when the customer calls to schedule an appointment. In JACO's case the questionnaire screen automatically pops up every fifth call. Operators have the choice of keeping or dismissing the screen. Operators determine whether to ask questions based on context. For example, if children are yelling or screaming in the background or a baby is crying it may be difficult to complete the call. They can dismiss the screen three times before they are forced to ask the questions. The important point is that there is some selectiveness in who gets asked survey questions.

A sample of ARCA customers is required to answer a similar questionnaire. All customers answer several questions at the time of scheduling such as how they heard about the program and demographic information. ARCA then asks 20 percent of the calls to take a long survey although the customers are told that it is optional. The computer computes the sample randomly. According to an ARCA executive, the survey is pretty straightforward and they would not change anything about it unless SCE is looking for something different. However, according to this executive, some questions could be removed or reworded because of the difficulty in responding. ARCA uses the long survey data internally and finds it helpful but they are not aware of whether or how SCE uses it. Once per month the long survey data is transferred to SCE.

4.2.13 How Information Is Transferred to Utilities and Others

ARCA is responsible for fulfilling the incentives. When a unit is picked-up and processed the need for a payment is flagged. The customer information and rebate information are transmitted by secure link to a fulfillment center, which produces the check and mails it. The customer information along with the payment information is returned to ARCA where it is loaded into the system. Thus, ARCA is able to track the entire process from the initial call to the number of the check and the date that is sent to the customer.

Unlike ARCA, JACO transmits information to PG&E, who then produces the payments for the customers internally.

4.2.14 Real Time Tracking

JACO has been assembling a dashboard that displays "real time" summary information in a form that is of use to a program manager. This display is not currently being used by the California IOUs. The version of the dashboard that our observer saw had six gauges, a bar graph, and a table of information in cellular format at the bottom of the display. Three of the gauges estimate progress toward goals. For instance, the anticipated monthly goals, number of units, kWh, and kW are computed through the software. The program then interpolates for the month and day. The three gauges have a green, yellow, and red area. The gauge is designed so that it shows the percentage of goal. On the day on which the system was viewed, the gauges were showing that JACO was running at about 98 percent of the goals for that day for a client who uses the gauges.

The bar graphic shows: the anticipated number of units for the month, the number of calls, and the units extracted from households. One use of this is to allow program manager to determine if more marketing is needed, if pick-ups may be lagging, or if calls are running ahead of schedule.

JACO reported that the clients that are using the Dashboard like the system. When asked if clients were looking at it frequently, JACO said that they thought the clients were using it quite often, maybe on a daily basis, but they had not looked at the web hit data to see if that was in fact the case.

The California IOUs are aware of this feature. The utilities do monthly reporting to the CPUC, which are generated by the system. The real value of it may be for managers of new recycling programs or new program managers who may need feedback about marketing efforts and response to the program. It may also be useful in unusual circumstances where managers have need to stimulate participation in the short-term or in a particular geographic area and may want to monitor the results of their efforts. Given the long-term nature of the program in the California IOUs, the program managers' long experience with the program, and the monthly reporting requirements, the dashboard may not have as much perceived value, but it is an effective way to demonstrate to supervisors and visitors what is happening in a program and how closely programs can be tracked. It may also provide a model for how to track programs in general.

4.2.15 Conclusion

A review of the call center operations of ARCA and JACO showed that both firm's are well able to handle customer calls. It would be difficult to identify improvements that would significantly alter the responsiveness of the systems. Both firms appear to be investing the necessary resources to keep pace with technology and the need to change how they interact with customers. There seems to be ample capacity to handle increased loads.

It appears that Internet sign-up capabilities are evolving nicely and are beginning to be used by a significant percentage of customers. A possible concern is that Internet customers may be more likely to drop out of the program before their units are picked-up.

4.3 CANCELLATIONS

Cancellations of pick-up requests occur frequently. Roughly 40,000 of the scheduled pick-ups or about 19 percent of requests received by the recycling companies in 2004-5 were cancelled. Fourteen percent of the cancellations were rescheduled and a unit was later picked-up. The 86 percent of cancellations that are not rescheduled represent a significant missed opportunity for the program. Customers that cancel are aware of the program, have made the initial decision to participate, but do not follow through. In some instances the contractor may not know that the customer is canceling until the pick-up crew is at the curb. This represents an expense to the program. If units are lost then other customers must be recruited to fill the quota. It is also likely that the units will remain on the grid. If we can understand why customers cancel we might be able to improve the productivity of the program.

Cancellations principally occur in three ways:

- When customers call the call center and request that their order be cancelled;
- When customers are contacted by telephone prior to the pick-up and they cancel the appointment; and
- When customers are not at home and there is no unit for pick-up.

Although the utilities have not asked them to do so, both ARCA and JACO have attempted to track the reasons why customers cancel. When customers call and cancel or when they cancel in response to a call that a pick-up will take place, the contractors attempt to find out why the customer cancelled. This information is then entered into the database. Customers do not always provide the information, the contractors are not always able to request the information, and contractors do not record the same information in the same ways. Nonetheless, the existing information is useful in pointing to the source of the problem.

Because cancellations are effectively a "lost opportunity" for RARP, cancellation data were analyzed to determine what was driving customers to cancel. The analysis, which is discussed in this section, addressed the following:

- Volume of cancellations
- Reasons for cancellations
- Other factors that influence cancellations
- Logistics drivers for new appliance dealers taking advantage of the system
- Online sign-up versus telephone sign-up
- Length of time between schedule and pick-up

4.3.1 Volume of Cancellations

For the 2004 and 2005 program years, approximately 34,500 pick-up orders were canceled with no subsequent pick-up by the recycling companies.

- At ARCA cancellation data was available for a little over 30,000 customers. By matching those records against pickup data, it was determined that about 11 percent (roughly 3,400) of cancellations were eventually picked-up by the program. Therefore, about 27,000 cancellations occurred with no subsequent pick-up representing about 18 percent of the initial orders.
- At JACO, cancellation data were made available for about 9,500 customers. By matching these records against those that were picked-up, it was determined that approximately 22 percent of the cancellations were eventually picked-up by the program. JACO had a higher

pick-up rate because a higher percentage of JACO's cancellations were caused by scheduling issues that were often resolved at a later time. Overall, about 7,500 cancellations occurred, which was 24 percent of all scheduled pick-ups for JACO.

The cancellation data for the two contractors are tabulated in Table 4-4, showing the known reasons for cancellation.

Table 4-4 Broad Cancellation Descriptions for ARCA and JACO

Reason for Cancellation	ARCA		JACO		
	Total	Reason Percent	Total	Reason Percent	Total Percent
Appliance does not qualify	2,458	8.8	231	13.1	2.4
Customer disposed of unit before pickup	16,288	58.3	750	42.4	7.8
Probably being used	13,329	47.7	205	11.6	2.1
Disposed through another source	2,847	10.2	538	30.4	5.6
Took to landfill	112	0.4	7	0.4	0.1
Scheduling issues	9,205	32.9	789	44.6	8.2
Canceled for unknown reason	2,626	NA	7,801	NA	81.5
Total with a reason	27,951	100.0	1,770	100.0	21.3
Total	30,577	NA	9,571	NA	100.0
Canceled but picked-up later	3,426	11.2	2,064	NA	21.6
Total Canceled	27,151	18.0*	7,507	NA	23.5*
Total Orders Picked Up	123,491	82.0*	24,444	NA	76.5*
Total Orders Scheduled	150,642	100.0*	31,951	NA	100.0*

* Percent out of Total Orders Scheduled

Because the data were collected differently, it is inappropriate to attempt to compare the two companies with respect to differences in cancellation rates. Based on the similarity of the procedures that the companies follow, it is doubtful that the differences have to do with how the companies deal with customers or the procedures. Rather, the differences are probably linked to differences in data collection and differences in the demographics of customers using the program.

4.3.2 Reasons for Cancellations

Table 4-4 provides a comparison of the reasons for the cancellations as derived from the contractor data. The top half of the table shows the various reasons. The bottom half of the table presents subtotals and totals. There are two sets of percentages for the JACO data – reason given percent and total percent. Only about 20 percent of JACO's data included reasons for cancellation

Roughly eight percent of ARCA cancellations and 13 percent of JACO cancellations occurred because the unit did not qualify. It was either too big or small, too new (age is no longer a requirement, but was in 2004), or not working. The RARP did not accept these units and therefore they cannot be counted as lost opportunities. All other canceled units, however, could have been removed from use permanently through the program.

Approximately 58 and 42 percent of the cancellations for ARCA and JACO respectively occurred because the unit was transferred before it could be picked-up. Many of these units will remain on the electrical grid. In the case of ARCA, 82 percent of the 16,288 units that were transferred before pick-up are probably still in use (47.7 percent of the cancellations). A break down of these units shows that 57 percent were given away, five percent were sold, and 38 percent were retained for use. About 9 percent of customers told ARCA that their units went to another source (unspecified).

In JACO's case, the distribution of transfers before pick-up was somewhat different. About a quarter of the transfers, or 12 percent of the total units, were given away (eight percent), kept (two percent), sold (one percent), or taken by the dealer (1 percent). About three quarters of these units, or 30 percent of the total units, were removed some other way. Curbside and exchange accounted for four and three percent of the total units. The remaining 23 percent were picked-up by an unknown service.

Crews delivering new refrigerators may have removed a substantial number of the nine percent of ARCA units and the 23 percent of JACO units that were picked up by an unknown service. Customers sometimes indicate that the appliance delivery crews offer to take units. They may make the offer when they spot units with high resale value. Customers agree to this because it means that they do not have to deal with the hassles of a pick-up. It is probable that these units are sold to used appliance dealers or sold privately through advertisements. These units are likely still in service.

Scheduling issues were also cited for a large portion of cancellations, 32 percent for ARCA and 45 percent for JACO. About four percent of the total cancellations were a result of the pick-up arriving before the old unit was no longer needed.

4.3.3 Other Factors Influencing Cancellations

Interviews with representatives at SCE and PGE as well as ARCA and JACO prompted an investigation as to whether the number of cancellations is related to the method of scheduling. For example, it was suggested that those who scheduled by telephone are more likely to keep the appointment than those who schedule using the Internet. Only ARCA had data with sufficient detail to allow this to be examined.

Table 4-5 shows the number of contacts and cancellations by whether the customer used the telephone or the Internet. These data show that 14 percent of pick-ups in 2004-5 (21,788/150,642) were scheduled using the Internet. Eighteen percent of the pick-ups scheduled by telephone were cancelled compared to 34 percent of the pickups that were scheduled through the Internet.

Table 4-5. How Customers who Cancel Contact ARCA

Mode of Contact	***Cancelled***	***Percent Cancelled*****	***Total****
Call	23,236	18	128,854
Internet	7,402	34	21,788
Total	30,638	20	150,642

*Based on SCE order data and participant survey

**Not taking into account those that were later picked up

There are least two plausible hypotheses that might explain this difference

- Limited commitment by those using the Internet
- Socioeconomic differences

Customers who schedule by telephone speak with an operator. This personal interaction with the operator may generate a stronger commitment to completing the commitment. Customers who use the internet may be "researching" options and may sign-up because it is so easily done while they are at the site. Later they may have reconsider their decision and/or discover other options.

Another possibility is that customers who use the Internet may be of higher socio-economic status. For these customers, convenience may be an important aspect of discarding the unit. Presented with a more convenient option subsequent to sign-up, these customers may be more likely to use it.

Data are not available to decide whether one, both, or some third hypothesis may explain the difference.

4.3.4 Cancellations and the Convenience Factor

The analysis regarding customers' motivations for participating in the program (discussed in Chapter 5) showed that convenience and minimal effort were among the reasons people selected the program. Recall that people preferred a pick-up from within one to three days of scheduling. Based on this, it was hypothesized that customers that have to wait for a long time for pick-ups may be more likely to cancel because of the inconvenience and the likelihood that that they might find a buyer or someone to whom to give the unit.

For each caller for whom data were available, the time between the call date and the scheduled pick-up date were calculated. Figure 4-9 and Figure 4-10 are bar charts showing the length of time between scheduling and scheduled pick-up for ARCA and JACO for those that had a pick-up and those who cancelled. In both figures it is clear that a higher percentage of those who cancelled had pick-up dates that were more than two weeks from the date that they scheduled the pick-up. Thus, there appears to be a relationship between the amount of time to pick-up and canceling the pick-up.

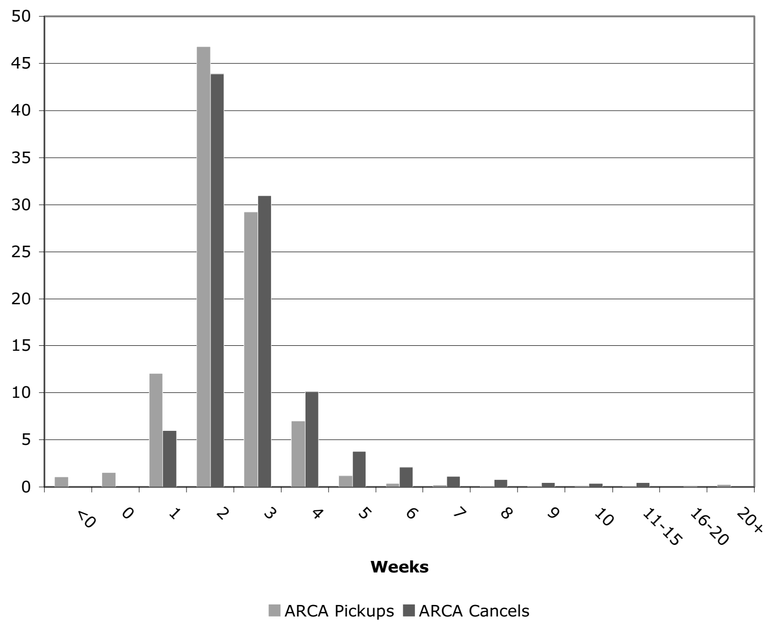

Figure 4-9. Time Elapsed between a Scheduled Pick-Up for a Household Completing or Canceling a Pick-Up for ARCA

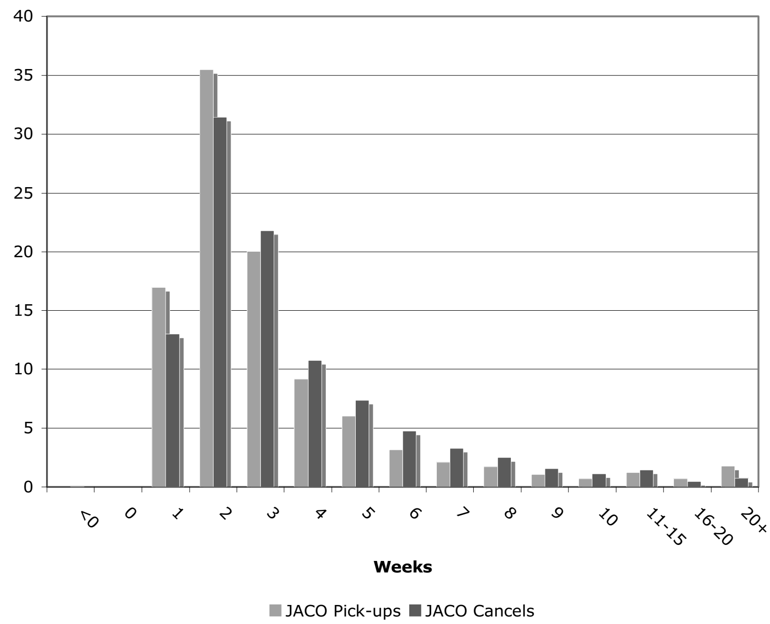

Figure 4-10. Time Elapsed between a Scheduled Pick-Up for a Household Completing or Canceling a Pick-Up for JACO

4.3.5 Conclusions

Cancellations are an issue for the program. About 20 percent of scheduled appointments are cancelled. In 2004-5 there were approximately 40,000 cancellations, of which 34,500 were not rescheduled. These cancellations represent missed opportunities because the units for the cancelled pick-ups are likely to remain on the grid and the effort to initially schedule and recover those units consumes valuable resources. Many of the units were transferred to someone else before they could be picked up. There is also evidence that logistics drivers delivering new appliances may have volunteered to remove some of the units. Such units are likely to be returned to the market. Some customers decided to keep their units.

Evidence indicated that customers who scheduled by telephone were less likely to cancel than persons scheduling over the Internet. It is not evident whether this is related to the more anonymous nature of the Internet, differences in the socio-demographics of customers who use the Internet who may prefer convenience, or some other factor. Orders that are placed with long lead times to pick-up are more likely to be cancelled that those with shorter lead times. This is consistent with other findings in this report that have pointed to convenience as an important motivation for participating.

4.4 OPPORTUNITIES FOR REFINING QUALITY OF TRACKING DATA

More then 165,000 refrigerators and freezers were disposed of through the 2004-2005 RARP. There are two contractors and three utilities involved in this process. In addition, there are subtle differences in programs and utility reporting requirements. Tracking these units is a routine but difficult task. Both recycling firms have developed extensive software systems for data tracking. As a result, there is more data available about this program than for many similar programs of this kind. However, for purposes of comparing across service territories, it is difficult to combine data from the different systems and to perform analysis using a combined database. Moreover, the consistency of some of the data collected and the consistency in methods of data collection can be improved, thereby providing significant gains that will increase the ability to effectively manage and evaluate the program.

The discussion in this section highlights specific problems that were found with the data and makes some recommendations for remedying these problems. The problems are categorized under four headings: refrigerator data, survey data, cancellation data, and pick-up release sheets.
Refrigerator Data

ARCA and JACO track different information about refrigerators and freezers they pick up. ARCA records age or year of manufacture, size, type, and electrical characteristics. JACO records size, type, and model number. A key problem is the electrical data. In the JACO approach the model numbers can be used to determine electrical characteristics, but data are only available to convert model numbers into capacity and consumption ratings for 60 to 70 percent of refrigerators.

In the absence of better information about model numbers, it is recommended that the model number as well as specific data about the machine be captured. The following information should be routinely collected:

- Estimated age
- Estimated size
- Name plate amperage
- Name plate voltage
- Refrigerant type
- Refrigerator brand
- Model number
- Style (single door, top freezer, etc.)

4.4.1 Survey Conducted When the Order Is Placed

Currently, the recycling contractors are collecting survey data for a random sample of customers. The mini-survey at sign-up is a fundamentally sound idea, representing a potentially important tool for continuous evaluation and particularly for tasks such as monitoring the effects of promotion.

However, as it is currently implemented it has marginal value. There are three basic problems with the survey data as now being collected:

- The content is not useful.
- There are inconsistencies in what is collected between contractors.
- The collection methodology is inconsistent.

At the time of the study, the following questions were being asked

1. How did you hear about the Refrigerator Recycling Program?
2. Which two aspects of the Refrigerator Recycling Program most influenced your decision to participate?
3. What is your gender?
4. Have you ever participated in other energy conservation programs?
5. Are you replacing this refrigerator with a new model?
6. Do you own or rent your home?
7. Approximately what year was this house built?
8. What building type describes your home?
9. How many square feet are in this home (Do not include garage)?
10. Do you have central air conditioning?
11. Who made the decision to recycle the refrigerator?
12. What is the age of the person who decided to recycle the appliance?
13. How many people reside in your home?

Many of these questions or the responses to them are not useful. Questions one, two and five or a variant of them should be retained. However, the remaining questions, which focus on demographics, are not useful for analysis purposes in the absence of other information. More importantly, critical information about some of the more important aspects of the recycling program is missing. The recycling companies also found that several questions such as the age and size of the home were very difficult for customers to answer.

When the information collected even for questions one, two and five was analyzed, a number of issues with the data collected became apparent. Table 4-6 shows JACO's results for question one, while Table 4-7 shows ARCA's. The responses displayed in bold show significant changes in response between 2004 and 2005 year. Further analysis showed that the shift in response for both sets of data occurred somewhat dramatically in the month of March 2005. Although some variance between years might be expected because of changes in marketing strategies, the shift seems quite abrupt. Neither JACO or ARCA personnel nor the program managers were able to shed light on why there should be such a radical shift in the data in March of 2005.

Table 4-6. JACO Survey Results: How Customers Heard of the RARP

How Customers Heard of RARP	*2004 (%)*	*2005 (%)*	*Total (%)*
Utility Rep	31.6	28.6	29.7
Direct Mail Piece	**1.2**	**21.3**	**14.2**
Friend/Neighbor	**30.8**	**3.4**	**13.0**
Truck Ad	**5.7**	**15.6**	**12.1**
TV	**3.4**	**14.5**	**10.6**
Appliance Dealer	**18.2**	**5.6**	**10.0**
Bill insert	1.7	5.7	4.3
Newspaper	2.9	4.6	4.0
Other	4.1	0.5	1.8
Radio Ad	0.2	0.2	0.2
No Response	0.1	0.0	0.1
Total Responses	1,264	2,333	3,597

Table 4-7. ARCA Survey Results: How Customers Heard of the RARP

How Customers Heard of RARP	*2004 (%)*	*2005 (%)*	*Total (%)*
Truck Ad	**43.6**	**5.8**	**23.1**
Bill Insert	**3.5**	**23.0**	**14.0**
Direct Mail Piece	**1.0**	**20.8**	**11.7**
Appliance Retailer/Store	**5.6**	**12.5**	**9.3**
Newspaper Ad	**16.7**	**2.0**	**8.7**
Utility Representative	**14.3**	**4.0**	**8.7**
Friend/Neighbor	**1.7**	**13.6**	**8.1**
Radio Ad	7.3	4.8	5.9
Other	2.7	3.3	3.0
Television Advertising	0.0	4.6	2.5
Web Site	0.6	2.9	1.9
Penny Saver	3.0	0.1	1.4
TV/News Story	0.0	1.0	0.6
Magnet Mailer	0.0	0.5	0.3
Movie Theater	0.1	0.3	0.2
ValPak	0.0	0.4	0.2
E-Mail	0.0	0.2	0.1
No Response	0.1	0.0	0.0
Total Responses	47,678	56,207	103,893

The question about "who most influenced your decision to participate" also presented issues. One of the recycling companies apparently recorded only the first response. The other recorded all responses, but in alphabetic order so that it was not possible to determine the first response. This points to the need to make sure that the questions are presented to the operator in a way that allows for proper recording of the data. The recommendation is that a standard set of questions and a protocol be developed and that after the survey is implemented by the recycling companies the implementation be reviewed to make sure that it will present the right data.

There is some inconsistency in how the survey is completed. At one recycling company, the operator can defer the survey up to five times before having to complete it. An operator interviewed said that they make judgments about whether a caller will be responsive before asking if the caller will complete the questions.

Thus, the following recommendations are made regarding the customer surveys conducted by the recycling contractors for RARP.

- That a new set of survey questions be implemented. A recommended set of questions is presented below.
- That a protocol for implementing the questions be developed and that once the questions are implemented, we recommend that the implementation be reviewed by someone familiar with computer aided questionnaire design so that the desired results are produced.
- That operators be trained to ask the questions and provide enter the data correctly.
- That calls be monitored periodically, once a month, to determine if the operators are handling the questions according to protocol.
- That the protocol should require that the questions be completed unless the respondent refuses.

With respect to the first recommendation, possible questions for the re-designed survey form are shown in Table 4-8.

Table 4-8. Questions for Re-Designed Survey Form

1. How did you first hear about the Appliance Recycling Program?
(Probe by saying: "Did you hear about it through a bill insert, appliance dealer, family, newspaper or some other way?"

- ❒ a. Bill insert/bill message
- ❒ b. Mailer
- ❒ c. Email blast
- ❒ d. Utility website
- ❒ e. Other website
- ❒ f. Appliance dealer
- ❒ g. Family or friends
- ❒ h. Community waste management service
- ❒ i. Newspaper ad
- ❒ j. Television ad
- ❒ k. Media story
- ❒ l. Movie theater ad
- ❒ m. Truck ad
- ❒ n. Other (specify) ___________________
- ❒ o. Don't know

2. People participate in the program for different reasons. Which aspect most influenced your decision to participate?

- ❒ a. $35/$50 incentive
- ❒ b. Free pick-up
- ❒ c. Simple one call procedure
- ❒ d. Electricity savings
- ❒ e. Help the environment by recycling
- ❒ f. Recommendation from friend or family
- ❒ g. Recommendation from appliance retailer/dealer
- ❒ h. Unaware of other options
- ❒ i. Other (specify) _________________
- ❒ j. Don't know

3. Was there something else that influenced your decision?

- ❒ a. No other reasons
- ❒ b. $35/$50 incentive
- ❒ c. Free pick-up
- ❒ d. Simple one call procedure
- ❒ e. Electricity savings from inefficient machine
- ❒ d. Recycle value for the environment

- ❒ e. Recommendation from friend or family
- ❒ f. Recommendation from appliance dealer
- ❒ g. Unaware of other options
- ❒ h. Other (specify) ________________
- ❒ I. Don't know

4. Is the unit you are discarding used as a main or secondary/spare unit?
   - ❒ a. Main
   - ❒ b. Spare

5. Are you replacing this refrigerator:
   - ❒ a. With a new model
   - ❒ b. With a used model
   - ❒ c. Not replacing (skip to question 8)
   - ❒ d. Don't know

6. Is the replacement unit likely to be:
   - ❒ a. Larger
   - ❒ b. Smaller
   - ❒ c. Same size
   - ❒ d. Don't know

7. Is the replacement unit Energy Star?
   - ❒ a. Yes
   - ❒ b. No
   - ❒ c. Don't know

8. Where was the appliance located when it was in use?
   - ❒ a. Kitchen
   - ❒ b. Garage
   - ❒ c. Carport/outside
   - ❒ d. Other interior room

9. In the last year, was the refrigerator or freezer running
   - ❒ a. All the time
   - ❒ b. Part of the time
   - ❒ c. For special occasions
   - ❒ d. Not at all

10. After you dispose of this unit, how many refrigerators will you have running in your house?

    Number of refrigerators:

11.Have you discarded any other refrigerators and/or freezers in the past year? How many?

- ❒ a. Yes, #:_____
- ❒ b. No

12. If so, how were they discarded? (check more then one if needed)

- ❒ a. Appliance Recycling Program
- ❒ b. Appliance dealer removed unit
- ❒ c. Gave to charity
- ❒ d. Gave to friend or family
- ❒ e. Sold to friend or family
- ❒ f. Sold through ad or garage/estate sale
- ❒ g. Sold/given to used appliance dealer
- ❒ h. Taken to landfill/community waste center
- ❒ i. Taken to/by a recycler
- ❒ j. Other (specify) _______________

13. If you hadn't called us, what do you think you would do with the unit you are discarding?

- ❒ a. Keep it
- ❒ b. Keep it but not used
- ❒ c. Have an appliance dealer remove unit
- ❒ d. Give it to charity
- ❒ e. Give it to friend or family
- ❒ f. Sell it to friend or family
- ❒ g. Sell it through ad or garage/estate sale
- ❒ h. Sell or give it to used appliance dealer
- ❒ i. Take or have it taken to landfill/community waste center
- ❒ j. Take or have it taken to a recycler
- ❒ k. Other (specify) _______________

4.4.2 Cancellation Data

As previously noted, RARP has a high percentage of cancellations. The recycling companies have not been asked to provide cancellation data, but they have collected the information for their own use. An analysis of cancellations was presented above. One recycling company systematically codes information into 23 different categories that could be combined into a more compact set of reasons. The other firm puts responses in a comment field with highly variable responses or does not collect the reasons.

It is recommended that cancellation data be a standard part of routine data collection activities. Cancellations typically occur through a call to the call centers, when customers are notified of an impending pick-up up to 24 hours in advance, or when the driver attempts a pick up and there is no appliance or no one is home.

A screen should be added that allows the operator to query for a reason for the cancellation. The reasons should be standardized and the operators should be trained to determine the reason for the cancellation. Likewise, staff placing calls to households in advance of a pick-up should have access to the same standardized screen and should initiate the question when told that the appointment should be cancelled. Finally, there should be a place on the pick-up order sheet where the crew can check a reason for not recovering a unit. These reasons should be the same as the reasons for the call center and the crews should be trained on how to record the data. If the crew is unable to determine a reason, they should check a box that will result in a follow-up call from the call center during low call volumes.

There should be a response field that the operators can initially check one of the following:

- Appliance does not qualify for the program
- Decided to keep the appliance
- Appliance was sold to a third party
- Appliance was given to a friend or neighbor
- Appliance was give to a charity
- The new appliance delivery crew volunteered to remove it
- Appliance was sold to a dealer who came and removed it
- Arrangements were made with the new appliance dealer to remove it
- Had a hauler or community waste program remove it
- Took it to a waste management center
- Customer was unable to meet schedule
- Recycling company (ARCA/JACO) unable to meet schedule
- Cancel for other reason (specify)

4.4.3 Correct Order Dates

In order to analyze marketing data, the recycling companies were asked for the elapsed time between the initial call, pickup and cancellation date. Within the data that JACO provided, there were inconsistencies in reporting the first contact date. An analysis of elapsed time between first contact and pick-up dates showed that about two percent (almost 450) of cases have an elapsed time of five or more months from the contact date. Furthermore, a large proportion of these have a one-year or greater elapsed time. Most of these appear to be cases in which the customer used the program a second or third time and the information from the first order was copied to certain fields including the call date. When the name of the respondent appears exactly as the name of an earlier order, the first order date is recorded. When the name is entered differently, even with the same customer id number, a new order date was recorded.

In order to accurately analyze the data, each individual order must have an order date. JACO needs to make sure that a date is entered for each order and make sure that field is not linked to an earlier start-up date.

4.4.4 Data on the Locations of Refrigerators in the Field

The location of a unit at a residence (e.g., in conditioned or unconditioned space) can be an important determinant of energy use. Whether a refrigerator or freezer is located in a controlled temperature environment can affect the amount of electricity used. On the pick-up routes observed, 28 of the 29 refrigerators were outside or in the garage when the driver arrived. Through conversations with the customers, it was determined that nearly all of these units were located inside when they were in operation. Both the ARCA and JACO drivers recorded these units as being in the garage. Only if the unit is pre-filled in, is accurate information obtained.

Largely, the drivers do not interact with the customers except to obtain a signature. In most cases the unit has been already moved so the driver cannot accurately determine where the unit was being used. It is recommended that this information be dropped from the order form and incorporated into the survey conducted at the time the pick-up order is placed.
Summary of Recommendations Regarding Data Issues

Although the recycling contractors have developed sophisticated data collection systems, there are a few issues that need to be addressed to make the data being collected more usable for both marketing and evaluation. The primary recommendations are:

- That the recycling contractors need to collect the same information about refrigerators and store it in a consistent manner. The utilities could set a standard and incorporate that into the contracts with the recycling companies.
- That that both the content and the method for collecting the information be standardized for the random survey that is made of households. A set of recommended questions with response sets was presented above, which could be incorporated into the contracts.
- That standardized data be collected for customers who cancel their orders. Suggested categories were presented above.
- That JACO fix the date problem when multiple pick-ups are made (if they have not already done so).
- That drivers no longer be asked to collect information about the location of the appliance and that the question be asked as part of the random survey completed when a pick-up is scheduled.

5. CUSTOMER AWARENESS OF, PARTICIPATION IN, AND SATISFACTION WITH RARP

This chapter discusses customer awareness of, participation in, and satisfaction with the 2004-2005 RARP. Section 5.1 discusses customer awareness of the program, Section 5.2 discusses customer motivations for participating in the program, and Section 5.3 addresses the satisfaction of customers who did participate in the program.

5.1 CUSTOMER AWARENESS OF PROGRAM

This section addresses program awareness and how customers reported that they became aware of the program. Four topics are discussed:

- Program awareness among acquirers/disposers
- Likelihood of future participation once acquirer/disposers are aware of the program
- How RARP customers became aware of the program
- Differences in awareness between utilities and across customers with different characteristics.

The discussion is based on RARP awareness data from three sources:

- Survey of RARP participants, conducted for this evaluation;
- Acquirer/disposer surveys conducted for this evaluation; and
- 2005 PG&E study of participants.

Although the recycling contractors also collect awareness data from a random sample of customers, those data were not used because analysis revealed some problems with consistency.

5.1.1 Program Awareness

Nearly 1,100 residents in the IOU service territories who either purchased or disposed of a refrigerator or freezer over the past 4 years were surveyed as part of the acquirer/disposer study. A set of filter questions was used to screen these residents from a much larger sample of all households in the IOU service territories. Thus, this sample of households is comprised of those that acquired or disposed of a refrigerator by any method including use of the RARP.

A tabulation of responses from the survey regarding awareness of RARP is provided in Table 5-1. Taken across all three utilities, 46 percent of the acquirer/disposer households were aware of the program. SCE customers appear to be more aware than customers of the other utilities. Fifty-eight percent of SCE customers have heard of the program compared to 35 percent of PG&E customers and 43 percent of SDG&E customers. (Differences among the utilities were statistically significant with a chi-square test of 54.503 at a p of .0001.) The differences probably result from several factors, including the history of the program, the relative amount of advertising, the historical quantities of the units that have been recycled, the visibility of the trucks in the service territory, and word-of-mouth. For example, the SCE version of RARP has been running for 12 years while the program is relatively new in the other two service territories.

Table 5-1. Knowledge of RARP among Non-Participants (Percentages)

Knowledge of RARP	***PG&E***	***SCE***	***SDG&E***	***Total***
Yes	35	58	43	46
No	63	39	55	52
Don't know/refused	1	2	3	2
Total %	100	100	100	100
N Totals	491	465	134	1,090

Whether or not a respondent had purchased or disposed of an appliance was not strongly associated with awareness. Forty-seven percent of those who disposed of an appliance stated that they were previously aware of the program and 45 percent of respondents who purchased a unit were previously aware of the program. One might have expected acquirers to be more aware, based on in-store promotions.

Respondents who were not aware of the RARP were given a short description of the program. Then all respondents were asked whether they would be likely to participate in the program in the future. Ninety percent of the disposer/acquirers who had participated in RARP indicated that they would be very likely to participate in the future. The remaining 10 percent indicated that they would be somewhat likely to participate. In other words, most RARP acquirers and disposers were certain that they would participate again.

The tabulations in Table 5-1 included RARP participants as well as non-participants. To gauge program awareness among those who had not participated in RARP, the RARP participants were removed from the data set and the remaining acquirer/disposers (non-participants) were sorted by whether they were previously aware of the program or not and by how likely they would be to participate in RARP in the future. The distribution of responses across these categories is shown in Table 5-2.

Table 5-2. Future Participation versus Prior Awareness of the Program among Non-participants (Percentages)

Future RARP Use	***Not Aware of RARP***				***Aware of RARP***				***Don't know/Refused***			
	PG&E	SCE	SDG&E	Total	PG&E	SCE	SDG&E	Total	PG&E	SCE	SDG&E	Total
Not at all likely	15	14	22	16	9	8	4	8	0	0	33	5
Somewhat likely	27	28	26	27	15	26	13	21	50	18	33	29
Very Likely	58	56	50	56	74	67	81	71	17	73	0	48
Don't know	1	2	1	1	2	0	2	1	33	9	33	19
Totals	100	100	100	100	100	100	100	100	100	100	100	100
N Total	302	180	72	554	166	254	53	473	6	11	3	20

*For only the program totals without don't knows and refusals, the chi-square value is 32.658 at .000

The results in Table 5-2 show the following.

- Of the unaware non-participants who had been read the description, 56 percent stated that they were very likely and 27 percent said that they were somewhat likely to participate in the future. Sixteen percent of customers said they were unlikely to use the RARP in the future. A smaller percentage of unaware non-participant SDG&E customers stated that they were very likely to participate in the future than did customers from the other two utilities.
- Seventy-one percent of RARP aware non-participant customers said they were very likely to participate in the future. A smaller percentage of RARP aware SCE customers indicated that they were very likely to participate than did PG&E customer who were are smaller percentage than SDG&E customers.

These findings indicate that there is an awareness gap among customers for whom the program is most salient. The gap is larger in the PG&E and SDG&E service territories where the current program has a much shorter history. There is substantial likelihood that awareness would lead to participation.

5.1.2 Participant Awareness

Data to examine how RARP participants became aware of the program was collected from two sources. The first was a PG&E study of 1,600 randomly selected PG&E RARP customers. The second was the responses from the slightly more than 1,000 RARP customers from the three utilities who participated in the 2004 or 2005 survey.

Table 5-3 tabulates the responses from the PG&E about how customers heard of RARP. Forty-one percent of the PG&E customers who participated in 2005 heard about the program from an appliance store. Another 20 percent heard about it through friends and family. About 14 percent of participants learned about the program through PG&E bills/bill inserts and newspaper advertisements.

Table 5-3. PG&E Customers Who Heard of RARP through Various Sources (Percentages)

How Heard About Program	***PG&E***
Appliance Store	41
Family or friends	20
PG&E bill or bill Insert	14
Newspaper Ad	14
PG&E website	11
Called PG&E	4
Other	5
Percent Total	100
N Total	1,632

In the 2004-5 RARP survey, the participant respondents were asked how they first heard of the program and then about other ways that they may have heard about the program. All but one respondent answered the first question, while 44 percent of the respondents replied with an answer to the second question. The responses to the first question are shown in Table 5-4.

Table 5-4 Percent of Customers Who Heard of RARP through Various Sources

	PG&E		***SCE***		***SDG&E***		***Total***	
	Item percent	***Category Percent***	***Item percent***	***Category Percent***	***Item percent***	***Category Percent***	***Item percent***	***Category Percent***
Direct utility broadcast		11		43		35		37
Utility bill insert/information with utility bill	10		38		30		32	
Separate mailing/brochure	1		5		6		4	
Word-of-mouth		45		26		23		29
From a friend, relative or neighbor	17		16		15		16	
Appliance retailer	29		10		8		13	
Media		20		16		22		18
TV advertisement	4		5		12		6	
Newspaper advertisement	14		5		7		6	
Radio advertisement	1		6		3		5	
Media stories about the program	1		1		1		1	
Customer initiated		10		5		4		5
Utility website	9		4		3		4	
Called the utility (e.g., 800 number)	1		1		2		1	
Other		14		11		16		12
Somewhere else	5		2		2		3	
Don't know	9		8		14		9	
Refused	1		0		0		0	
Total percent	100		100		100		100	
N of cases	162		735		122		1019	

Thirty-seven percent of the participants said that they learned about the program through direct contact with the utilities. Most customers learned about this from bill inserts and information on the utility bills. SCE and SDG&E customers were more likely to say that they learned through this vehicle than did PG&E customers. Only a small percentage of customers reported learning about RARP through separate mailings of mailings or brochures from utilities. There is an interesting anomaly here. Both SCE and SDG&E reported using bill inserts. An examination of

PG&E's bill inserts for 2004-5 found no references to the RARP in them. Thus, it is not surprising that more SCE and SDG&E customers reported getting information from bill inserts. It is a bit surprising that in the two surveys between 10 and 14 percent of PG&E customers reported getting information from a bill insert. It is not uncommon for a few percent of customers to mistakenly report an action in a survey but this is somewhat high from that perspective.

Customers reported the second most important way in which they learned about RARP was word-of-mouth. About 16 percent of customers reported that they got the information from friends and relatives. Customers also reported that they learned about this through appliance dealers. This occurred most frequently in the PG&E service territory (29 percent) and substantially less frequently in the other two service territories (10 percent of the time in the SCE territory and eight percent of the time in the SDG&E territory). Based on data that showed that SCE was the most active in approaching appliance dealers and that PG&E did none of this, this finding is somewhat surprising. A possible explanation is that historically there has been an appliance pick-up program in Northern California. Consumers wanting to get rid of an appliance could call an 800 number and JACO would remove the appliance for a fee. While the sponsor of the service has changed, it appears that appliance dealers are now telling customers about the utility program.

Media sources were mentioned third most often. In general about five percent of people in each of the utility service territories reported that they learned about the program from television, radio, and newspapers. There were two exceptions: about 14 percent of PG&E respondents reported that they heard through newspapers and 12 percent of SDG&E respondents heard through television. This is consistent with the data in the previous chapter, which indicated that PG&E marketing mainly revolved around the placement of advertisements in newspapers.

Another question addressed was if there were differences in awareness by customer characteristics, such as whether the customer recycled a refrigerator or freezer, or if the refrigerator was a primary unit or tertiary unit. Both of these characteristics are related to whether or not the customer replaces the disposed appliance. In fact, the survey results showed that customers who recycled a refrigerator replaced it 83 percent of the time, compared to 55 percent of the time for freezer disposals. Ninety-eight percent of customers disposing main refrigerators replace them, compared to only 61 percent of replacements among customers who disposed a spare refrigerator.

As can be seen in Table 5-5, there are some differences by appliance type in terms of how customers heard about programs. Direct utility broadcast methods and word-of-mouth were more important for refrigerators, while direct utility broadcast and media were more important sources of information for freezer. Participants who disposed of a freezer were more likely to have heard from a direct utility source such as a bill insert. This was more true in the SCE and SDG&E territories than in the PG&E territories. As reported in the previous chapter, SCE made heavy use of bill inserts and broadcast type contacts with customers and this may have been especially true for freezers. The smaller percentage of customers hearing by direct broadcast probably reflects the absence of the use of bill inserts in the PG&E service territory discussed above. Word-of-mouth was less likely to be a source of information for refrigerators than for freezers. As just discussed, appliance retailers do play a role in marketing for RARP, especially in the PG&E service territory. The appliance dealer is an important source of word-of-mouth information, but customers disposing of freezers or spare refrigerators are less likely to be engaged with an appliance dealer. Disposers of freezers say that they more commonly heard about the program from media sources.

Table 5-5. Customers Who Heard of RARP by Appliance Type (Percentages)

How Heard About Program	Refrigerator only				Freezer Only			
	PG&E	SCE	SDG&E	Total	PG&E	SCE	SDG&E	Total
Direct Utility Broadcast	12	39	33	34	9	49	40	42
Word-of-mouth	48	28	29	31	36	21	11	22
Media	19	14	21	15	25	21	24	22
Ambiguous	10	6	4	6	11	2	5	4
Other	13	13	14	13	18	7	21	11
Percent Total	100	100	100	100	100	100	100	100
N of cases	114	515	80	709	44	203	38	285

Table 5-6 shows the same distributions but for whether the participant was disposing of a main or secondary refrigerator. Word-of-mouth through dealers was clearly the source for persons disposing of main refrigerators, especially in the PG&E service territory. However, the percentage citing this source is somewhat smaller for those disposing of a spare refrigerator. Word-of-mouth was followed by direct utility broadcast methods and media. In the SCE and SDG&E service territories direct utility broadcast was most important. Once again, this was clearly more prevalent in the SCE and SDG&E territories than in the PG&E service territory. Clearly, awareness from word-of-mouth sources drops significantly for customers disposing of a freezer or a spare refrigerator, especially among PG&E customers.

Table 5-6. Customers Who Heard of RARP, by Refrigerator Use (Percentages)

How Heard About Program	Main Refrigerator				Spare Refrigerator			
	PG&E	SCE	SDG&E	Total	PG&E	SCE	SDG&E	Total
Direct Utility Broadcast	8	39	31	33	20	42	36	37
Word-of-mouth	59	31	33	35	32	22	18	23
Media	16	14	19	15	17	14	27	16
Ambiguous	8	6	3	6	10	6	4.5	6
Other	8	11	14	11	22	17	14	17
Total percent	100	100	100	100	100	100	100	100
N of cases	73	353	58	484	41	161	22	224

The PG&E survey was also analyzed for differences between customers' recycling a primary refrigerator versus a secondary or spare unit. Over half (53 percent) of the customers recycling a primary refrigerator heard about the program from an appliance store and 17 percent heard about it from family and friends. This is consistent with the results of overall awareness.

The differences occur with customers disposing of secondary refrigerators through the program as is seen in Table 5-7. Only 23 percent of these customers heard of the program through an appliance store, a significant decrease from primary customers. Newspaper ads and family or friends increased the most for customers disposing of spare units, although all other sources, besides the PG&E website, increased slightly. Once again this is consistent with what we know about PG&E's marketing efforts.

Table 5-7. PG&E Customers Who Heard of RARP, by Refrigerator Use (Percentages)

How Heard about Program	***Primary***	***Spare***
PG&E bill or bill insert	13	16
PG&E website	11	10
Newspaper ad	8	23
Appliance store	53	23
Family or friends	17	24
Called PG&E	3	5
Other	5	8
Total	100	100
N Total		

These characteristic differences are important to look at when devising a marketing strategy. If spare units or freezers are to be targeted, appliance retailers are important, but maybe not as important as other advertisements that would not bypass customers not looking to replace the disposed unit. Clearly, the bill insert, which reaches all customers, appears to be the most widely stated source, and likely the most cost effective.

5.1.3 Conclusions about Awareness

Awareness is important for participation in RARP. More then half (52 percent) of IOU service customers who recently (i.e., in past 4 years) acquired or disposed of a refrigerator or freezer were unaware of the program, with the percentage of unaware residents greater among PG&E and SDG&E customers. There is room for overall improvement in awareness with more emphasis in the PG&E and SDG&E service territories.

When asked if customers were likely to participate in the future, only 11 percent of acquirers and disposers who did not use the RARP said that they were not likely to do so. Nearly half of these respondents had previously been aware of the program, so clearly other factors (e.g., inconvenience, lack of eligibility) explained their lack of participation. Among customers who had not heard of the program, future participation was somewhat likely or very likely for 83 percent of respondents once they were told about the program. However, this number was much greater for residents who had already heard of the program and likely had more knowledge of the program (92 percent).

Awareness of the RARP varies among customers of the three utilities. In PG&E service areas, most participants learn of the program through word-of mouth, such as appliance dealers and from friends or relatives. In SCE and SDG&E service territories, the vast majority of participants learn of the program through direct utility broadcast means, such as bill inserts. Media networks, such as TV, radio and newspaper advertisements inform roughly a third of participants in each territory.

Awareness also differs across customer characteristics. Characteristics, such as appliance type (i.e., refrigerator versus freezer) and appliance use (i.e., primary unit versus secondary unit) affect the customer's likelihood of replacing their disposed unit. Customers who dispose of a freezer or a secondary unit are less likely to replace that unit. Thus, they are less likely to be influenced by appliance dealers. Marketing tools that reach everyone (e.g., bill inserts) are an effective way to reach this audience. SCE's use of bill inserts may partially explain why SCE customers are more aware of the program.

5.2 MOTIVATIONS OF CUSTOMERS TO PARTICIPATE IN PROGRAM

The issue addressed in this section is: What motivates households to use the appliance recycling program? Customers do have options in disposing of an old refrigerator or freezer: use the RARP, give the unit away, sell the unit, have a used appliance dealer take the unit, or haul the unit away oneself. The analysis discussed here addresses why participants use the program as well as why non-participants did not use the program. Included in this discussion of the factors that motivated customers to participate in RARP are the results of a conjoint analysis.

5.2.1 Motivations to Participate as Identified through a PG&E Survey

In 2005, PG&E surveyed more than 1,600 RARP customers. Customers were asked about their reasons for participating. Respondents could select multiple reasons. The results are tabulated in Table 5-8.

- The largest percentage of customers (61 percent) indicated convenience and free pickup as a reason for their participation. Customers who said that they participated to avoid disposal charges and that the program was a best possible option were included in the convenience category.
- Environmental concerns were the next most frequent reason for participants (34 percent of respondents). This included respondents who said they participated because of the recycling factor and energy savings.

Table 5-8. PG&E Customers' Citing Reasons for Participating in RARP (Percentages)
(Note that customers could provide more than one reason)

Reason for Participation	***Item Percentage***	***Category Percentage***
Convenience/free pickup		61
Good/best option/get rid of	29	
Convenience	13	
Free pickup	11	
Avoid dump/disposal charges	8	
Environment/recycling/energy savings		34
Recycling preferences	14	
Energy savings	12	
Environment	8	
Rebate	30	30
Other		18
Upgrading/remodeling/replacing	10	
Thought unit would be resold/donated/help others/reused	2	
Retailer referred	2	
JACO/PG&E recommended	1	
Friend/family recommendation	1	
Other	1	
Total Percent	144*	144
N of cases	1,632	

- The third most important reason cited was the rebate, which was the reason 30 percent of the respondents decided to participate. Of customers who indicated the rebate was their reason, 11 percent (one third) said they would not have participated without the rebate while the other 19 percent (approximately two-thirds) were unsure whether they would have participated without the monetary incentive. Thus for the PG&E sample, the rebate appears to have been important or necessary for 11 percent of the sample.

5.2.2 Motivations to Participate as Identified through RARP Participation Survey

In the survey of RARP participants conducted for this evaluation, customers were asked their main reason for participating in the program and if there was another reason. Ninety-seven percent of the respondents gave a first reason and 46 percent proffered a second. The first and second reasons are combined and summarized in Table 5-9.

Table 5-9 Customers' Motivational Reasons for Participating in RARP (Percentages)

Participation Reason for All	***PG&E***		***SCE***		***SDG&E***		***Total***	
	Item %	*Category %*	*Item %*	*Category %*	*Item %*	*Category %*	*Item %*	*Category %*
Convenient/Free pickup		68		65		69		66
Easy way/convenient	52		44		51		46	
Free pick-up service/others don't pick-up/don't have to take	16		21		18		20	
Incentive		37		46		46		45
Environmentally safe Disposal/recycled/good for environment		24		22		22		22
Other		10		9		7		9
Never heard of any others/only one I know of	4		3		2		3	
Utility sponsorship of the program	0		2		0		1	
Recommendation of a friend/relative	2		1		1		1	
Recommendation of retailer/dealer	1		1		1		1	
Other	5		4		4		4	
Don't Know/Refused		7		5		6		5
Total		146		147		150		147
N of cases		162		735		121		1018

Inspection of Table 5-9 shows the following.

- Convenience and free pick-up was the most frequently mentioned motivating factor. Approximately 66 percent of the respondents listed a response that would fall into this category. Along with "the convenience" and "the free pick-up service," responses such as "the easiest way", "don't have to take it anywhere", and "others don't take it" were also included in this category.
- The $35 incentive ($50 for freezers after May 1, 2005 in the SCE service territory) motivated 45 percent of the respondents. When asked if the incentive was essential to their participation, approximately 81 percent of the respondents said that they would have participated in the RARP without the incentive and 15 percent said that they would not.
- The environment (22 percent), which also included responses focusing on recycling, was the third most important motivation.
- The 'other' category in Table 5-9 included "utility sponsorship of the program", "recommendations from a friend", "neighbor or retailer", "no other options", and "other unspecified reasons".

Factors that might relate to motivation for participating in the RARP were also examined. For example, customers with more modest incomes might find the incentive more important than customers with higher incomes. Table 5-10 shows the percent of respondents identifying a reason by the respondent's income level.

Table 5-10 Customers' Motivational Reasons by Income Level (Percentages)

Reason for Participation	***Under $30k***	***$30k to $50k***	***$50k to $75k***	***$75k to $150k***	***Above $150k***	***DK/ Refused***	***Total***
Convenient/Free pickup	65	56	81	67	74	60	66
Incentive	40	54	44	41	40	48	45
Environment	15	21	17	29	23	23	22
Other	14	14	6	7	10	12	10
Don't Know/Refused	9	3	5	4	2	7	5
Total with two responses	143	148	153	148	149	150	148
N of cases	127	168	156	257	78	231	1,018

A working hypothesis was that as customer's income level rose, the incentive would become less important and convenience would become more important. The relationships trend in the hypothesized directions, but the relationship is neither strong nor linear. Convenience was least often cited among participants with household incomes between $30 and $50K. It was most important for those with incomes over $50K. It is possible that the sample of persons with household incomes under $30K may include households with older persons for whom convenience and the free pick-up are attractive. The incentive was about equally appealing across income groups except for households with incomes of $30 to $50K where it appeared to be substantially more important. These may be households where even a small incentive is a welcome addition to income.

Table 5-10 also shows that customers making more than $75,000 annually are more motivated by the environmental benefits of the program then those below that income level, especially those households with incomes of under $30K.

There were no significant relationships when correlations were examined between motivation for using the program and whether the unit was a refrigerator or a freezer, whether the unit was replaced or not, and whether the refrigerator was a main or a tertiary refrigerator.

The two surveys used for this analysis of the reasons for participation are not directly comparable because the questions and response sets were not quite the same. Even so, they demonstrate some common trends.

- Convenience is clearly the most important motivation for participants in the program. Sixty percent or more of the respondents listed convenience as their first or second motivation for participating.

- In the PG&E sample the incentive (34 percent) and the environment (30 percent) were cited nearly equally as being a first or second motivation. In the RARP sample, the incentive was more important. However, the incentive was somewhat less important for PG&E customers than for SDG&E and SCE customers suggesting that there are different motivations.
- PG&E customers showed an ever so slight preference for the environment compared to customers from the other utilities.

Perhaps the most important finding has to do with the percentage of customers for whom the incentive is necessary to participate in the program. In the RARP survey and the PG&E surveys 11 and 15 percent respectively said that the incentive was essential. This is a relatively small number of participants who feel the incentive is necessary. There is further confirmation of these findings later in this report.

5.2.3 Why Non-Participants Don't Participate

The survey of non-participants that was conducted for this evaluation provided some insight into what motivates customers who do not participate in the RARP. As stated in previous discussion, this survey represents households in the IOU service territory who either purchased or disposed of a refrigerator or freezer in the past 4 years.

Before starting, it is useful to briefly revisit how units were disposed of. As shown in Table 5-11, about 12 percent of units disposed of in 2005 went to RARP, a quarter of the units were removed by appliance dealers, and 24 and 22 percent were given away and discarded /recycled respectively. About 11 percent of disposed units were sold and it is unclear what happened to the other six percent.

Table 5-11 Disposal Method of Residents in the IOU Service Territories

Method of Disposal	***Percent Disposed***
RARP	12
Dealer Took it	25
Gave Away	24
Thrown out/ Recycled	22
Sold	11
Unknown	6
Total	100
N Total	703,000

Table 5-12 shows that approximately 51 percent of residents in the IOU service territory who disposed of a refrigerator or freezer were unaware of the RARP.

Table 5-12. Awareness of RARP among Disposers

Knowledge of RARP	***Total***
Yes	47
No	51
DK/Refused	2
Total	100
N Total	637

In the survey, non-participants were asked why they did not participate in the program. Of the nearly 296 respondents who disposed of a refrigerator or freezer and were aware of the program, 204 (67 percent) provided a reason for not using the RARP. Table 5-13 shows the reasons for not participating for all respondents.

Table 5-13. Reasons for Not Participating in RARP

Reason for Not Using RARP	***Percent***	***N Total***
Unaware of the program	60	374
Did not respond	15	92
Didn't have any appliances to recycle	9	56
Planned to give unit away to friend/relative/charity in the future	5	31
Dealer/ Retailer picked up/disposed of the old one	4	22
Unit was not working/did not qualify	1	9
Inconvenient (Misc.)	1	8
Planned to sell unit as used in the future	1	6
We rent/landlord decides/other decision maker	1	6
Program wasn't available	1	5
Forgot about program	0	2
Cannot be home as required when unit is picked up	0	1
Other	1	7
Total	100	622

Some of these respondents may have disposed of a unit more than two years ago, so the program may not have been an option as captured in the "program not available response." There is also a group of respondents who initially stated that they had heard of the program but then stated that their reason for not participating was lack of awareness. These respondents are included in the "not aware" category.

Clearly, lack of awareness is the overwhelming reason for not participating (60 percent). Another 15 percent did not respond, suggesting that they didn't have a reason. Planning on giving the unit away to a friend or relative in the future was the next greatest reason stated (5 percent), followed by the new appliance dealer taking the old unit (4 percent). The remaining responses, none of which were reported by more then one percent of the respondents, can be seen in Table 5-13.

Awareness is clearly the biggest obstacle to using the RARP. More importantly, only about 15 percent seemed to have an identifiable reason for not using the program. This suggests that many of the people who did not know about the program did not have any particular plan for the units.

5.2.4 Conjoint Analysis Addressing Customer Participation Decision

Data were also collected during the surveys of participants and non-participants that were used in choice-based conjoint (CBC) analysis of preferences among disposal options.

Disposal options (called product configurations in CBC) were based on combinations of distinct attributes that impact the consumer's preference for each option, including: (1) the cost (or payment) upon disposal, (2) the timing of when the appliance is removed, (3) the disposition of the unit once it is taken away (e.g., re-used, recycled, dumped), and (4) the hassle of disposal (defined as number of phone calls one needs to make). Each of the four attributes included between two to five "levels." Table 5-14 shows the attributes and levels used for both the participant and nonparticipant surveys:

Table 5-14. Conjoint Attributes and Levels

Attribute	***Levels Within Attributes***
Cost	Cost to you is $50
	Cost to you is $35
	No cost or payment to you
	Payment to you is $35
	Payment to you is $50
Timing	Pickup is same day you arrange it
	Pickup is within 3 days of when you arrange it
	Pickup is in 7 days of when you arrange it
	Pickup is in 14 days of when you arrange it
	You transport it yourself
Disposition	The appliance gets used by someone else
	The appliance goes into a landfill
	The appliance gets completely scrapped and recycled
Hassle	You make no more than one phone call
	You might have to make multiple phone calls

Attributes and levels were created to represent possible disposal options in the marketplace, including not only configurations that currently exist, but also configurations that might be created or offered in the future.

In the survey, two disposal options, chosen by randomly selecting attribute levels (one level for each attribute), were pitted against each other. The respondent chose between the two configurations, and an option of "Neither, I'd keep the appliance." Each respondent was given six distinct choice tasks – the number needed based on the total sample size to provide reliable results. An example of one possible choice task is shown in Table 5-15.

Table 5-15. Conjoint Choice Task Example

Option 1 is:	Option 2 is:	Or you could keep the appliance.
Cost to you is $50	Cost to you is $35	
Pickup is within 3 days of when you arrange it	You transport it yourself	
The appliance gets used by someone else	The appliance goes into landfill	
You make no more than one phone call	You might have to make multiple phone calls	

5.2.4.1 Calculating Conjoint Utility Values

The first step in analyzing conjoint data is to calculate conjoint utility values. Utility values (also called part worths) are interval-level data and the values within an attribute sum to zero. Utility values cannot be compared directly across attributes; utility values can only be compared within attributes. These data are primarily used to provide relative rankings of the preference (or "desirableness") of attribute levels within an attribute, and the strength of preference differences between the levels. Negative values merely indicate that a level is less preferred relative to the other levels and it does *not necessarily* indicate a negative valence (i.e., it is not preferred or it is disliked).

Table 5-16 shows the utility values from the participant and nonparticipant surveys.

For the attribute "cost," which is comprised of five levels ranging from "cost to you is $50" to "payment to you is $50," the utility values for participants range from –93.46 to 56.22. "Cost to you is $50" is the least desirable level and payment to you is $50 is the most desirable. By examining the numerical differences between the values, we can also interpret the relative desirability of each level compared to the others. The difference between "Payment to you is $35" (48.44) and "payment to you is $50" (56.22) is relatively small. This indicates that program participants prefer receiving $50 more than $35, but not by much. Participants have adverse preferences for having to pay for disposal, and $50 is far more negative than $35.

Table 5-16. Conjoint Utility Values

Attribute	***Levels Within Attributes***	***Participant***	***Nonparticipant***
Cost			
	Cost to you is $50	-93.46	-69.26
	Cost to you is $35	-34.95	-24.59
	No cost or payment to you	23.74	30.59
	Payment to you is $35	48.44	27.33
	Payment to you is $50	56.22	35.93
Timing			
	Pickup is same day you arrange it	30.72	42.23
	Pickup is within 3 days of when you arrange it	28.04	25.67
	Pickup is in 7 days of when you arrange it	7.87	8.30
	Pickup is in 14 days of when you arrange it	5.53	3.77
	You transport it yourself	-72.16	-79.96
Disposition			
	The appliance gets used by someone else	29.76	32.81
	The appliance goes into a landfill	-58.23	-70.68
	The appliance gets completely scrapped and recycled	28.46	37.87
Hassle			
	You make no more than one phone call	29.73	32.04
	You might have to make multiple phone calls	-29.73	-32.04
	None (Keep It) – Utility Value	-106.07	-94.49
	None (Keep It) – Percent Choosing This Option	12%	14%

Among nonparticipants for "cost," there are negative values for "cost to you is $50" (-69.26) and "cost to you is $35" (-24.59) indicating that nonparticipants also prefer not to pay for disposal. However, the utility values for "no cost or payment to you," "payment to you is $35," and "payment to you is $50" are nearly the same among nonparticipants, ranging between 27.33 and 35.93. This indicates that nonparticipants are generally indifferent between these three levels. Receiving a payment is not preferred much more than "no cost or payment to you."

A conclusion is that receiving a payment for their old appliance matters to participants, but not to nonparticipants. This might be one reason why some people choose to participate in the utility program – it provides them with a payment for the old unit.

For the attribute "timing," participants have equal utility values (and equal preference) for "pickup is same day you arrange it, and pickup is within 3 days of when you arrange it." Utility is lower but approximately equal for the next two levels: "pickup is in 7 days of when you arrange it" and "pickup is in 14 days of when you arrange it." Among participants, then, we conclude that they most prefer a quick pickup (within 3 days), followed by a 7-14 day pickup schedule. Having to transport the unit yourself is a large negative in comparison to having it picked up, regardless of the timing.

Among nonparticipants, the "timing" attribute levels have similar utility values as for participants, with the exception that nonparticipants value a same day pickup more than a 3-day pickup schedule.

From the "timing" results, it is clear that a fast pickup schedule is important for both participants and nonparticipants.

Regarding "disposition," participants and nonparticipants alike are generally indifferent between "the appliance gets used by someone else" and the "appliance gets completely scrapped and recycled." However, both groups are strongly opposed to "the appliance goes into a landfill." There are relatively few differences between customers in the three utility service territories, but PG&E customers preferred the recycling option while SCE and SDG&E customers preferred the re-use alternative. This might be indicative of two psychographic factors in California: Northern Californian's are more receptive and concerned about environmental issues, while Southern California has a higher proportion of lower income immigrants who are more frequent purchasers of used or second-hand items.

For the "hassle" attribute, both participants and nonparticipants prefer having to make just one phone call over more than one. Also, the large negative value of the "keep it" option indicates that most consumers, whether they are participants or nonparticipants in the RARP, do not want to keep the unit and will frequently choose less favorable disposal options rather than keep it.

5.2.4.2 Calculating Conjoint Importances

Calculating the conjoint importances is the next step in analyzing conjoint data. Conjoint importances are calculated based on the range of utility values for any individual attribute, then transformed to a common metric. Conjoint importances are ratio-level data and can be treated as such. They always sum to 100 and are always positive. Importances can be compared between all other attributes and even across the two surveys. Importances give us an overall understanding of how the attributes relate to one another. Table 5-17 includes the conjoint importances from the participant and nonparticipant surveys.

Table 5-17. Conjoint Importances

Attributes	*Participant*	*Nonparticipant*
Cost	37.42	26.30
Timing	25.72	30.55
Disposition	22.00	27.14
Hassle	14.86	16.02

Among the participants, the rank ordering of these attributes is very clear. "Cost" is the most important attribute, followed by "timing" and "disposition" which are relatively close in their importance, and then "hassle." Also, "cost" is about 1.5 times as important as either "timing" or "disposition," and it is more than twice as important as "hassle." Among nonparticipants, "cost" drops in importance compared to participants, so that "timing" is most important followed closely by "disposition" and then "cost," with "hassle" falling quite a bit lower on the scale.

5.2.4.3 Share of Preference

Conjoint utility values and importances help to describe the relative preferences of attributes and levels, but not the trade-offs that consumers make when choosing between real alternatives. These trade-offs can be described by using a market simulator, which combines utilities and importances to calculate the percent of respondents who would prefer a particular disposal option. The market simulator requires *a priori* specifications of configurations that could exist in the marketplace at a given point in time to determine the percentage of respondents who would prefer each particular configuration.

It is important to note that the share of preference calculations are not actual market share estimates because there are many other variables not measured that can affect market share, such as awareness, distribution availability, and other marketplace circumstances.

For the simulations, six different configurations were defined to represent actual marketplace disposal options, including the current utility program. Table 5-18 shows the six configurations and their definitions.

Table 5-18. Product Configurations Examined

Configuration	***Cost/Payment***	***Timing***	***Disposition***	***Hassle***
Current Utility Program	$35 Payment	7 Days	Recycled	1 Call
Dealer Hauls Away	$0	Same Day	Re-used	1 Call
Sell In Pennysaver	$50 Payment	7 Days	Re-used	Multiple Calls
Give to Neighbor	$0	3 Days	Re-used	1 Call
You Pay for Hauling	$50 Cost	3 Days	Re-used	1 Call
You Haul It	$0	You Haul	Landfill	1 Call

These configurations were analyzed in two ways: by share of preference simulations and by sensitivity analyses. Both of these types of analyses can be compared across samples and across studies because they are ratio-level data and have a common metric.

5.2.4.4 Share of Preference Simulations

Share of preference simulations pit various configurations against each other. The output is the predicted percent of respondents who would choose that configuration if all options were available to all consumers in the marketplace. The six configurations from Table 5-19 yield the following share of preference simulations for the participant and nonparticipant surveys.

Table 5-19. Share of Preference

Configuration	***Participants***	***Non-Participants***
Current Utility Program	34.27	28.75
Dealer Hauls Away	30.55	38.30
Sell In Pennysaver	17.86	12.79
Give to Neighbor	9.93	11.13
You Pay for Hauling	5.46	7.55
You Haul It	1.92	1.49

Based on the alternatives currently available in the marketplace, the simulator shows that the "Current Utility Program" among participants receives the highest share of preference, followed closely by "Dealer Hauls Away." "Sell in Pennysaver" is in third place, substantially behind the top two alternatives. Since this ranking is among participants, it is not surprising to find that the "Current Utility Program" receives the highest share of preference. Compared to the second place alternative, "Dealer Hauls Away," the "Current Utility Program" offers a strong positive of the incentive payment, but at the expense or trade-off of waiting longer for the pickup.

The relative shares also demonstrate that almost as many participants actually prefer the characteristics of the "Dealer Hauls Away" option (30.55 percent) as prefer the "Current Utility Program" (34.27 percent). This suggests that the utility program faces close competition with dealers, even among those who did choose the utility program for an actual disposal. The third option, "Sell In PennySaver," likely appeals to participants because they receive a payment for their old unit, though the additional inconvenience of the timing of the pickup and the added hassle of multiple phone calls drops the preference share of this option to about half that of the "Current Utility Program."

Among nonparticipants, "Dealer Hauls Away" is the most preferred with a preference share of 38.30percent. The "Current Program" is second at 28.75 percent. Third is nearly a tie between "Sell In PennySaver" and "Give to Neighbor." Nonparticipants have a lower utility score for receiving a payment and higher utility for fast pickup compared to participants, and the share of preference results among each group are consistent with these utilities.

The share of preference simulator was also used to determine the net change in preference when characteristics of one of the options are altered. Making changes to the "Current Utility Program" allowed evaluation of the affect of changing program characteristics on preference shares. These types of changes to the configurations can help determine what the optimal program configuration could be.

Two potential program changes were tested in this way.

- For Scenario 1, the program incentive payment is increased from $35 to $50 dollars.
- For Scenario 2, the timing of the pickup is decreased from 7 days to 3 days.

The shares of preference that result for Scenario 1 (i.e., when the incentive offered by the utility program is increased from $35 to $50) are shown in Table 5-20.

Table 5-20. Share of Preference: $50 Incentive

Configuration	***Participants***	***Nonparticipants***
Utility Program BUT $50 incentive	36.50	30.67
Dealer Hauls Away	31.28	38.74
Sell In PennySaver	14.01	9.70
Give to Neighbor	10.64	11.66
You Pay for Hauling	5.63	7.75
You Haul It	1.94	1.48

Increasing the program incentive from $35 to $50 boosts the share of preference for the utility program among participants from 34.27 percent to 36.50 percent. This gain in share of 2.23 percent appears to come primarily from "Sell in PennySaver," which drops from 17.86 to 14.01 percent. Among nonparticipants, there is a similar rise in share of preference for the utility program (from 28.75 to 30.67 percent) and a drop in share of preference for "Sell in PennySaver" (12.79 to 9.70 percent). This increase in share of preference as a percentage of the original preference share for the utility program is about 7% among both participants (2.23/34.27) and nonparticipants (1.92/28.75).

For Scenario 2, the incentive is left the same but the pickup timing is changed from 7 days to 3 days. The resulting shares of preference for Scenario 2 are shown in Table 5-21.

Table 5-21. Share of Preference: 3-Day Pickup

Configuration	***Participants***	***Nonparticipants***
Utility Program BUT 3-Day pickup	41.43	34.60
Dealer Hauls Away	25.14	33.46
Sell In PennySaver	17.48	12.89
Give to Neighbor	11.93	13.57
You Pay for Hauling	2.47	4.14
You Haul It	1.54	1.27

With Scenario 2, changing the pickup timing of the utility program from 7 days to 3 days boosts share of preference for the program among participants from 34.27 to 41.43 percent, which is a substantial 7.16 percent increase. As a percentage of the initial share of preference, this represents a 21 percent (7.16/34.27) boost. Among nonparticipants, the change in timing increases preference share from 28.75 to 34.60 percent. This increase as a percentage of the original preference share is 20 percent (5.85/28.75).

It can be concluded from these results that increasing the incentive and reducing the pickup timing can both lead to increased program utilization, but reducing the pickup timing from 7 days to 3 days yields a much greater boost in preference than does increasing the incentive from $35 to $50. Additional potential program changes could be evaluated in this same way.

5.2.4.5 Sensitivity Analyses

Sensitivity analyses use the same set of basic configurations as the share of preference simulations. However, sensitivity analyses change only one attribute systematically (on just one single configuration) while holding all other attributes and levels constant for all other options. This type of analysis shows how systematically changing one attribute of a given disposal option affects the share of preference for that option. Two examples of sensitivity analysis are given here.

In the first example, the "Cost" attribute is systematically varied for the "Current Utility Program." All other attributes for the "Current Utility Program" are held constant, as are the attributes for the other five options. Table 5-22 shows share of preference for the "Current Utility Program" when the levels of one of the attributes of the "Current Utility Program" are varied.

Table 5-22. Sensitivity Analysis: Current Utility Program Varied by Cost

Current Utility Program	*Participants*	*Nonparticipants*
Cost to you is $50	5.84	8.76
Cost to you is $35	14.37	16.71
No cost or payment to you	23.69	25.94
(Current Program) Payment to you is $35	34.27	28.75
Payment to you is $50	36.50	30.67

Among participants, increasing the incentive payment to $50 from $35 increases share of preference from 34.37% to 36.50%, a marginal gain that perhaps is not worth the additional cost. Dropping the incentive payment to "no cost or payment to you" reduces share of preference from 34.27% to 23.69%. Clearly, participants value the $35 payment since share of preference drops by about one-third when the $35 payment is taken away.

Among nonparticipants, share of preference is highest for a $50 payment at 30.67% and it drops incrementally to 28.75% and 25.94% for a $35 payment and no cost or payment, respectively. These changes are very modest, and further demonstrate that receiving payment is not too important to most nonparticipants. However, preference drops much more when a cost is imposed.

The second example for the sensitivity analysis was to change the "timing" attribute of the "Current Program." The resulting share of preference for this change is shown in Table 5-23.

Table 5-23. Sensitivity Analysis: Current Program Varied by Timing

Current Utility Program	***Participants***	***Nonparticipants***
Pickup is same day you arrange it	41.72	37.97
Pickup is within 3 days of when you arrange it	41.43	34.66
(Current Program): Pickup is in 7 days of when you arrange it	34.27	28.75
Pickup is in 14 days of when you arrange it	34.96	29.10
You transport it yourself	17.76	13.22

Among participants and nonparticipants alike, share of preference increases substantially for the "Current Utility Program" when the pickup timing is reduced from 7 days to 3 days. For nonparticipants, there is another boost in preference when pickup timing is further reduced to same day. Preference does not change for either group when pickup timing is increased to 14 days. Preference does drop substantially for the hypothetical scenario where the consumers must transport the unit by themselves.

5.2.4.6 Summary of Conjoint Analysis

In summary, the conjoint analysis provides additional insights about consumer preferences and program design.

- The payment matters to participants. Consumers who participate in the program choose this option primarily because they receive payment ($35) for their old appliance.
- Boosting the payment (to $50) does increase preference among this group.
- Secondary considerations for participants are the timing of the pickup and the disposition of their old unit. Timing and disposition are of equal importance although shortening the timing of the pickup (from 7 days to 3 days) increases preference considerably, whereas participants are generally indifferent between having their old unit completely recycled and having it used by someone else.
- Timing of the pickup is what matters most for nonparticipants, followed by cost and disposition.
- As with participants, shortening the pickup time from 7 days to 3 days boosts preference for the program. The program gets an additional boost among nonparticipants if pickup can be made same day.
- Nonparticipants are less interested in getting paid for their old unit. They still want to avoid having to pay for disposal but they are more willing than participants to give it up for free.
- Keeping the unit, hauling it yourself, and having the unit junked all provide very low marginal utility, which means that most consumers are seeking to avoid these things.

Consumers, then, are primarily seeking a convenient, no cost way for someone else to take the old unit off their hands. Receiving payment for the unit matters to some consumers (including those who have participated in the program), though is of little consequence to others.

5.2.5 Summary of Factors Motivating Customer Participation in RARP

Motivation for participating in the RARP can be broken down into three basic categories: convenience/free pick-up, incentive, and environment. It is clear from the analysis that convenience/free pick-up is the primary motivating factor. Nearly two-thirds of the respondents listed it as a reason for participating. Almost half of all respondents listed the incentive as a motivating factor. However, the incentive is a necessary condition for just 15 percent of the population. Roughly a quarter of the respondents listed the environment as a motivating factor.

Participation is related to income level. As a household's income rises, convenience and the environment become more important and the incentive becomes less important. The exception occurs with households with incomes under $30,000, at least some of whom may be mature households, who care more about convenience and the free pickup.

For those that participated in the RARP, promotions or information received through word-of mouth convinced them to offer their units to the program. It is important to look at what these individuals would have done without the program. Households that disposed of a freezer, a spare unit, or a unit that was not being replaced, were more likely to keep the unit without the program. As for specific methods, the majority of residents would have given away or donated their old appliance, followed by hauling or hiring someone to haul the old unit to the dump.

5.3 CUSTOMER SATISFACTION WITH PROGRAM

To gauge customer satisfaction with the RARP, satisfaction questions about the specific processes and the overall program were incorporated into a survey of participants. Information from similar questions that PG&E collected from participants in its program in 2005 were also analyzed, providing another perspective, albeit only for PG&E customers. Additional satisfaction surveys for SCE and SDG&E were not available.

5.3.1 Experiences of Respondents to RARP Participant Survey

In order to gain a better understanding of customer experiences with various aspects of the RARP process, respondents in the survey of participants were asked specific yes or no questions about the process. The responses to the questions are shown in Table 5-24 for four categories: information, scheduling, pick-up, and incentive.

Table 5-24. Responses to Specific RARP Satisfaction Questions (Percentages)

Process Satisfaction Yes/No Questions	***Percents***			
	Yes	***No***	***Don't know / Refused***	***N***
Information				
Did you learn everything you wanted to know about the program before participating?	84	14	2	1,018
Did you receive information or learn that older refrigerators and freezers are less efficient and use more energy than newer… ?	75	18	7	924
Did you learn the unit picked-up would be recycled?	63	28	9	924
Scheduling				
Was the representative you spoke to on the telephone polite and courteous?	97	0	3	665
Did the representative answer all your questions?	97	1	2	665
Were you able to schedule a pickup appointment for a convenient date and time?	96	3	1	665
Did you have to call more than once?	11	86	3	665
Pick-up				
Do you think the time between schedule and pick-up was too long?	16	84	0	492
Did they call in advance to confirm the appointment or let you know they were coming?	79	3	18	717
Did they arrive on time?	93	2	5	717
Was the representative polite and courteous?	99	0	1	717
Did the representative appear neat and professional?	94	2	4	717
Incentive				
Did you receive an incentive check?	88	5	7	1,018
Do you think the time between pick-up and receiving check was too long?	9	90	1	554
Would you have participated in the program without the incentive check?	81	16	3	895

Responses to the survey revealed some gaps in the information customers received. Customers were asked whether they learned what they needed to know before signing up for the program, whether they learned that old refrigerators used more energy, and whether they understood that the refrigerators were to be recycled. In all three cases there was a small minority of customers who indicated that they did not receive information. Fourteen percent of customers signed up but might have liked to have known more about the program, 18 percent did not know that older units are less efficient than newer units, and 28 percent did not know that units were to be recycled.

There were statistically significant differences between the utilities in the percentage of those knowing that older units were less efficient but not for the other two variables. As shown in Table 5-25, only 73 percent of PG&E customers knew this compared to 79 and 82 percent of SDG&E and SCE customers respectively. These findings are consistent with the observations about the comments made while the pick-ups were being observed.

Table 5-25. Customers Who Learned about Inefficiency of Old Refrigerators, by Utility (Percentages)

	PG&E	***SCE***	***SDG&E***	***Total***
Percent saying that they knew or learned that old refrigerators were less efficient and used more energy	73	82	79	80

Chi-square = 7.010 with p = .030

Customers were quite positive about the scheduling process. On average, 97 percent of the customers said that during the scheduling process the representative was polite and courteous, the representative was able to answer all their questions, and a convenient time for pick-up could be scheduled. There were statistically significant differences among the utilities with respect to finding a convenient time for pick-up. Table 5-26 shows that 98 percent of SCE participants said that a convenient time could be found compared to 96 and 92 percent for SDG&E and PG&E.

Table 5-26. Customers Who Said That They Were Able to Schedule a Convenient Date and Time, by Utility (Percentages)

	PG&E	***SCE***	***SDG&E***	***Total***
Percent saying that they were able to schedule a convenient date and time	92	98	96	97

Chi-square = 9.723 with p = .008

Table 5-27 tabulates the responses when customers were asked whether a second call was required. At first glance, the number of yes responses seems high (11 percent). However, it is not clear that a second call is necessarily an issue. It is likely that callbacks were due to the inability of the customer to provide information used to determine the eligibility of the refrigerator or indecision on the customer's part. If the issue is inability to provide eligibility information, then the eligibility requirement may be an issue and perhaps that eligibility requirements could be simplified. There were statistically significant differences by utility in the number of callbacks required. SCE had the fewest callbacks and SDG&E the most.

Table 5-27. Customers Who Said That They Had to Call the Utility More Than Once, by Utility (Percentages)

	PG&E	SCE	SDG&E	Total
Percent saying that they had to call the utility more than once	15	9	17	11

Chi-square = 7.686 with p = .021

With respect to pick-up, 93 percent of the customers said the representative arrived on time, was polite and courteous, and appeared neat and professional. More than 79 percent of the customers reported that they received a call in advance of the pick-up. However, 20 percent of the respondents did not know the answer to this question. Among those who responded with a yes or no, more than 90 percent said that they received a call in advance. However, there was a statistically significant difference among customers of the different utilities who reported receiving a call in advance (see Table 5-28). Perhaps a more important concern is the fact that 16 percent of customers stated that they thought the time between scheduling and pick-up was too long. There were no statistically significant differences between utilities on this score. We should keep in mind that this is directly linked to overall satisfaction.

Table 5-28. Customers Who Said That They Received a Call in Advance, by Utility (Percentages)

	PG&E	SCE	SDG&E	Total
Percent saying that they received a call in advance	91	97	99	11

Chi-square = 7.237 with p = .027

By the time that the RARP survey was completed, all customers should have received an incentive check. According to the survey, five percent of customers reported that they did not receive their incentive check. Whether a check was indeed cashed by those who said they had not received a check was not verified. However, it is has been found in other studies that people have received the check but do not remember having received it. A $35 check may not be memorable or may be handled by someone else in the household. Also customers were asked if they would have participated in the program without the incentive check. An overwhelming high number (81 percent) stated that they would have participated without the money.

Earlier discussion showed that convenience is one of the most important aspects of the RARP. For the RARP to be successful the process has to run smoothly and efficiently. These data show that for the most part customers are satisfied with their experiences with the program, although there is room for improvement in some areas, most notably with respect to educating customers and improving response time.

5.3.2 Customer Satisfaction per Respondents to RARP Participant Survey

As already noted, customers seemed to be highly satisfied with the program. On a one to five scale where one is “completely satisfied” and five is “not at all satisfied”, customers were asked how satisfied they were with the program sign-up and pick-up experience and the program overall. As shown in Table 5-29, more than 81 percent of customers were completely satisfied with these two aspects of the program and the program overall. The number of satisfied customers increases to 95 percent with the inclusion of the "somewhat satisfied" category. More customers were completely satisfied with the pick-up process than the sign-up process.

There were slight variations in satisfaction by utility. The SCE and SDG&E programs had slightly higher satisfaction scores than PG&E but there were no statistically significant differences. PG&E customers were slightly less satisfied, especially in regards to the sign up process where only 76 percent of customers were completely satisfied and four percent were not at all satisfied. Overall, 78 percent of PG&E customers were completely satisfied with the program and another 16 percent were somewhat satisfied, compared to 84 percent and 13 percent respectively for SCE customers.

Table 5-29. Responses to Overall RARP Satisfaction Questions (Percentages)

Satisfaction Questions	**Not at all satisfied**	**Somewhat dissatisfied**	**Indifferent**	**Somewhat satisfied**	**Completely satisfied**	**Don't know**	**N Total**
How satisfied were you with this sign up experience?	1	0	2	14	81	1	778
How satisfied were you with the actual pick up and removal experience?	1	1	2	6	90	0	717
How satisfied were you with the service overall?	0	1	3	13	83	0	1,018

While subpart satisfaction scores could be regressed on overall satisfaction to assess what contributes most to overall satisfaction, the satisfaction levels were so high that this procedure would not produce meaningful results.

How Complaints Are Handled

Some information was obtained in the survey of RARP participants about how complaints are handled. Complaints are handled on a customer-by-customer basis. If a customer is not pleased about some aspect of the program (e.g., a refrigerator not meeting eligibility requirements), the contractors usually tell the customer that the guidelines are imposed by the utility. That is usually the end of the discussion. If the customer wants to pursue such a complaint, it is referred to a line supervisor who explains that small refrigerators use less energy and that goal of the program is to get high-energy use refrigerators out of the market. If the customer is still not satisfied, the complaint is escalated to higher levels of management and may ultimately be referred to the utility program manager. This happens very rarely.

If there is a complaint with a pick-up, it is referred to the operations manager. In an extreme case, a call center manager, the operations manager and the program manager may get involved.

On rare occasions during the removal of a refrigerator, there may be some damage either at the customer's residence or to the property of someone who is not a customer. In such instances, a general manager, an insurance company representative, a contractor, and perhaps a program manager may become involved.

5.3.3 Satisfaction per Respondents to PG&E Survey

Table 5-30 tabulates the responses to several questions about program satisfaction that were asked in a 2005 survey that PG&E conducted of participants in its program. Sixty-five percent of the respondents in the 2005 PG&E study rated the program as excellent, while another 26 percent said it was very good. The rest of customers said it was good or fair (six and one percent respectively), with less than one percent saying it was poor.

Table 5-30. PG&E Customers' Program Satisfaction Level (Percentages)

Satisfaction Questions	*Excellent*	*Very Good*	*Good*	*Fair*	*Poor*
Overall Program	65	26	6	1	0
Recycling programs enrollment process	62	29	7	1	1
Appliance pick-up process	62	28	8	2	1
Length of time to have your appliance picked-up	44	32	15	6	2
Length of time to receive your rebate check from PG&E	41	34	18	4	2

The study also inquired about satisfaction levels for four aspects of the program as is shown in Table 5-30. Enrollment and pick-up processes had the highest levels of satisfaction. Both processes were rated as excellent by 62 percent of customers, and 28 to 29 percent as very good. Only one to three percent of customers rated those processes as fair or poor. Customers were less satisfied with the length of time until pick-up and length of time until the customer received the rebate. The number of "excellent" ratings dropped while the number of "good" ratings more than doubled in comparison the ratings for enrollment and pick-up. Also the number of ratings of "fair" increased.

These data suggest that overall satisfaction might be related to the length of time between pick-up and receipt of their incentive check. As can be seen in Table 5-31, there is almost a direct linear relationship between length of time between pick-up and receipt of the incentive check. Eighty percent of customers who received the check within two weeks rated the program as very satisfactory while 39 percent who received their incentive check more than eight weeks later gave the same rating.

Table 5-31. PG&E Customers' Overall Program Satisfaction by Length of Time It Took to Receive Their Rebate (Percentages)

Length of time between pick-up and receiving check	**Excellent**	**Very Good**	**Good**	**Fair**	**Poor**
Have not yet received a rebate check	34	50	11	3	3
8 weeks or longer	39	39	6	6	11
6 to 8 weeks	59	28	11	2	0
4 to 6 weeks	64	25	8	2	0
2 to 4 weeks	69	26	4	1	0
Less than 2 weeks	80	17	3	0	0

When asked how the program could be improved, most customers suggested that it be left as is (see Table 5-32). Of the participants that did give a suggestion, most wanted to see an aspect of the pick-up process enhanced, particularly in respect to the length of time it takes to have the refrigerator or freezer taken away after they call. Many also suggested increasing or adding more rebates. About four percent of customers suggested that they had communicating issues in dealing with the program, many of which included language barriers.

Table 5-32. Suggested Improvements From PG&E Customers (Percentages of Respondents)

Improvement Suggestion	**Percent of Participants Suggested**	**Category totals**
Don't change/Good		42.4
Don't change/Good	42.4	
Pick-up		15.3
Faster Pickup	15.3	
Shorten time frame and increase availability of pickup times	3.9	
Forgotten or missed pick-ups	1	
Removal/driver issues	0.6	
Remove old when receiving new	0.7	
Promote		15.7
Promote more	15.7	
Change rebates		10.4
Increase or add more rebates	6.3	
Don't offer the rebate	0.4	
Forgotten or slow issue of rebate	3.7	
Requirements		8.4
Apply to additional appliances	3.3	
Change age/year requirements	2.3	
Size Requirements	1.2	1.2
Take more than two per year	0.8	0.8
Shouldn't have to be working/running	0.8	0.8

Improvement Suggestion	***Percent of Participants Suggested***	***Category totals***
Communication		6.6
Communication Issues	4.1	
Call Center issues	2.1	
Inform better about post-pickup process	0.4	
Other	2.5	
Worried about hazards of leaving running/door removal	1.1	

Finally, suggested improvements given by customers who ranked the various aspects of the program as fair or poor were tabulated (see Table 5-33). Customers could provide more than one response. These results can be seen in Table 5-33. (Only values greater than two percent are listed in the table.)

Table 5-33. Suggested Improvements From PG&E Customers Who Rated an Aspect of the Process Fair or Poor (Percentages)

	Rated the Process Fair or Poor			
Suggested Improvements	***Enrollment process***	***Pick-up process***	***Length of time to pick-up***	***Length of time to receive rebate***
Communication issues	44	24	11	16
Faster pickup	15	43	61	33
Call center issues	15	-	-	6
Forgotten or slow issue of rebate	11	-	6	25
Shorten time frame and increase availability of pickup times	11	19	15	14
Forgotten or missed pick-ups	-	11	7	-
Removal/Driver issues	-	8	-	-
Shouldn't have to be working/running	-	-	5	-
Promote	-	-	3	10
Increase or add more rebates	-	-	-	5
Don't change/Good	-	-	-	13
Other responses under 2 percent	33	27	13	16

Of the customers that rated the enrollment process fair or poor, 45 percent gave communication, including language barriers, as part of the program that could be improved. Other popular suggestions included faster pick-up, call center improvements, speed and accuracy of rebate payments and shortening the time frames for pick-ups.

Of the customers that rated the appliance pick-up process and length of time to have the appliance picked up as fair or poor, both suggested strongly that faster pick-up would be an improvement to the program. They also recommended shorter pick-up time frames and communication improvements. The customers who rated the appliance pick-up process fair to poor also suggested issues with forgotten pick-ups and issues with the JACO driver. Customers who rated the length of time until the appliance was picked up poorly also mentioned being forgotten or slow pick-up and that they shouldn't be required to wait for the drivers to pick up the appliance.

Lastly, customers who rated the length of time to receive the rebate check from PG&E as being poor or fair mostly suggested that faster pick-up would be an improvement and 25 percent of them said their rebate check was forgotten or slow. On the other hand, 13 percent of them still indicated that the program shouldn't be changed and that there should be more or increased rebates.

5.3.4 Conclusions about Customer Satisfaction with RARP

Overall, customer satisfaction with the program is very high. More than 80 percent of customers reported that they were very satisfied and more than 95 percent reported that they were somewhat or very satisfied.

The one area where there appear to have been gaps is with information coverage. The survey data suggest that overall between 14 and 28 percent of the customers were not as well informed as they might be. Overall, about 14 percent indicated that they were not as well informed as they would like to be before they signed up for the program. About 18 percent said that they did not learn that older refrigerators used more energy than newer refrigerators. PG&E respondents were less likely to know this than SDG&E and SCE customers and the difference was statistically significant. Finally, 28 percent said that they did not know that refrigerators that were being removed were being recycled.

There were only a few areas where more than a small percentage of customers indicated the program didn't function quite as well as it might. These included:

- having to place more than one call to the call center;
- having too much time elapse between scheduling and pick-up;
- calling to confirm the appointment;
- receiving the incentive check; and
- having to wait too long for the incentive check.

It could be argued that having to call more than once is a function of the eligibility requirements and that having simple eligibility requirements is the best solution to this issue. About 20 percent of respondents did not know whether an attempt had been made to call them prior to delivery. When those who did not know were removed from the analysis, more than 90 percent said that they had received a call. SCE respondents were more likely than SDG&E respondents who were more likely than PG&E respondents to say that they had received a call. Perhaps the most important issue is that many people consider the elapsed time between scheduling and pick-up to be too long. Other analysis suggests that convenience is important and that people cancel participation when pick-ups are too far removed from scheduling. A small percentage of respondents suggested that they didn't receive an incentive check or that it could have been more prompt.

6. MARKET ASSESSMENT

An assessment of the market for recycling old refrigerators and freezers was also conducted as part of the evaluation of the 2004-2005 RARP. The objectives in making the market assessment included the following:

- To document customer knowledge and attitudes related to older refrigerators and freezers;
- To analyze the operation of used appliance market in order to determine impact on energy savings potential for RARP;
- To provide information with which to help refine the design of the program to achieve goals; and
- To increase the cost effectiveness of the program by providing market data and information that can be used to refine the program to better meet market requirements.

The major issues in making the market assessment pertained to (1) the apparent complexity of the market for used refrigerators and freezers, (2) the apparent localized nature of the market, and (3) the relative scarcity of information on that market. KEMA conducted a survey of used appliance dealers in their evaluation of SCE's 1994 program, and TecMarket Works performed a study of the market for used refrigerators in Wisconsin. These previous works were drawn on to guide data collection to better inform an assessment of the market in California and of the savings potential for RARP.

6.1 REFRIGERATORS, FREEZERS AND RARP ELIGIBLE UNITS IN CALIFORNIA

In order to set the context for the assessment of the market for recycling refrigerators and freezers, basic information is provided in this section on the markets for household refrigerators and freezers in California and the service territories of the Investor Owned Utilities (IOUs). Estimates are provided of the following:

- Numbers of refrigerators and freezers in California;
- Numbers of refrigerators and freezers in the IOU service territories;
- Numbers of new and used refrigerators purchased annually;
- Numbers of refrigerators and freezers transferred annually; and
- Distribution of physical characteristics of refrigerators in California and of those that are transferred.

The information presented in this section is synthesized from numerous sources, not all of which are consistent with each other.

6.1.1 Refrigerators and Freezers in California

Table 6-1 displays estimates of the California population, the number of households, the number of refrigerators, the number of primary and secondary refrigerators, the total number of refrigerators, the annual increase in the number of refrigerators, and the number of freezers for the years between 2000 and 2006. Focusing on 2005, the most recent RARP program year, there were more than 36.7 million persons living in nearly 12.2 million households in California.[1] Using the 2003 RASS data, the number of refrigerators was calculated by applying the ratio of primary and secondary refrigerators in households to the number of California households. Nearly 100 percent of California households have a primary refrigerator. There were 2.3 million secondary refrigerators, which when combined with the primary refrigerators, results in an estimated total of 14.5 million refrigerators statewide.[2] In addition, there were slightly more than 2.2 million freezers in California.

Assuming that the number of refrigerators increased in proportion to the total number of households, the number of refrigerators in California increased by about 1 million units between 2000 and 2006 or at an average annual rate of about 1.2 percent.

6.1.2 Number of Refrigerators in IOU Service Territories 2002

The Residential Appliance Recycling Program (RARP) is operated in the service territories of PG&E, SCE and SDG&E. Table 6-2 presents estimates of refrigerators and freezers for the PG&E, SCE and SDGE service territories based on the 2003 RASS Survey. From the data, which was collected in 2002, it is estimated that there were roughly 11.4 million refrigerators in 9.4 million homes.[3] There are about 1.9 million secondary or tertiary refrigerators. Eighty-one percent of households had one refrigerator, 17 percent had two, and one percent had three or more. A tenth of a percent either had no refrigerator or did not answer the question in the RASS Survey. A more recent study based on a much smaller sample produced very similar results: 80 percent of the respondents had one refrigerator, 18.9 percent had two, and 1.1 percent had three or more. All homes in that study had refrigerators.[4]

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[1] Population and household data are from State of California, Department of Finance, City/County Population and Housing Estimates, 1991-2000, with 1990 Census Counts. Sacramento, California, May 2000; and E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-2006, with 2000 Benchmark. Sacramento, California, May 2006.

[2] California Statewide Residential Appliance Saturation Study, KEMA Xenergy, 2002, 2003 www.calmac.org. The ratio of households to refrigerators is static across the years. The applicable ratios are shown in the last column of Table 6-1.

[3] LAWPD was included in the survey but the refrigerators for that service territory have been removed from this calculation.

[4] RLW Analytics, *2005 California Statewide Residential and Appliance Efficiency Saturation Study*, Sonoma, CA: RLW Analytics, 2005.

Table 6-1. Number of Refrigerators and Freezers in California Using Census Data and 2003 RASS Data

	2000	2001	2002	2003	2004	2005	2006	Ratio
Population*	33,873,086	34,441,561	35,088,671	35,691,472	36,245,016	36,728,196	37,172,015	
Households*	11,504,315	11,592,356	11,725,049	11,865,286	12,013,734	12,184,365	12,367,468	
Primary Refrigerators (est.)	11,489,788	11,577,719	11,710,244	11,850,304	11,998,564	12,168,980	12,351,852	0.999
Secondary Refrigerators** (est.)	2,185,679	2,202,406	2,227,616	2,254,259	2,282,463	2,314,881	2,349,668	0.190
Unknown (est.)	18,337	18,478	18,689	18,913	19,149	19,421	19,713	0.002
Total Refrigerators (est.)	13,693,805	13,798,602	13,956,549	14,123,476	14,300,177	14,503,282	14,721,233	1.190
Annual percent change in the number of refrigerators		0.8	1.1	1.2	1.3	1.4	1.5	
Freezers (est.)	2,119,140	2,135,358	2,159,800	2,185,633	2,212,977	2,244,408	2,278,137	0.184

Sources: Population and household data are from State of California, Department of Finance, City/County Population and Housing Estimates, 1991-2000, with 1990 Census Counts. Sacramento, California, May 2000; and E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-2006, with 2000 Benchmark. Sacramento, California, May 2006. California Statewide Residential Appliance Saturation Study, KEMA Xenergy, 2002, 2003 www.calmac.org. The ratio of households to refrigerators is static across the years. The applicable ratios are shown in the last column of

Table 6-2. 2003 RASS Data for Refrigerators and Freezers in IOU Service Territories

Major Household Appliance	RASS Estimate for 2002
Households	9,452,605
Households without refrigerators	6,887
Primary refrigerators	9,440,401
Secondary refrigerators*	1,899,506
Unknown refrigerators	15,951
Total refrigerators	11,355,858
Total freezers	1,861,432

Source: California Statewide Residential Appliance Saturation Study, KEMA Xenergy, 2002, 2003 www.calmac.org.

6.1.3 Utility-Specific Estimates of Refrigerators and Freezers in 2004 and 2005

To estimate the number of refrigerators by service territory (see Table 6-3), the number of households was estimated from utility data and then multiplied by the appropriate ratio from the RASS data.[5] The ratios are utility-specific and therefore vary slightly from the ratio used in Table 1. There were a little over 11.7 million refrigerators and 1.9 million freezers in 2004. In 2005 there were almost 12 million refrigerators and a little over 1.9 million freezers. In 2005, PG&E had 45.5 percent, SCE had 42.5 percent, and SDG&E had 12.5 percent of the refrigerators in the IOU service territories. In 2005, 82.6 percent of all refrigerators (11,975,940/14,503,282) and 87.6 percent of all freezers in California were located in the IOU Service Territories.

[5] These household estimates were developed from utility supplied data by John Peterson of Athens Research.

Table 6-3. Number of Refrigerators and Freezers in PG&E, SCE and SDGE Service Territories in 2004 and 2005.

	2004	**2005**	**Ratio**
PG&E			
Electric Customer Households	4,452,919	4,537,353	
Primary Refrigerators (est.)	4,447,848	4,532,186	0.999
Secondary Refrigerators* (est.)	900,595	917,672	0.202
Unknown Refrigerators (est.)	5,005	5,100	0.001
Total Refrigerators (est.)	5,353,448	5,454,958	1.202
Percent of Refrigerators in IOU Service Territory	45.4%	45.4%	
Freezers (est.)	1,063,371	1,083,534	0.239
Percent of Freezers in IOU Service Territory	55%	55%	
SCE			
Electric Customer Households	4,136,930	4,195,603	
Primary Refrigerators (est.)	4,131,022	4,189,611	0.999
Secondary Refrigerators* (est.)	822,704	834,372	0.199
Unknown Refrigerators (est.)	10,156	10,300	0.002
Total Refrigerators (est.)	4,963,882	5,034,283	1.2
Percent of Refrigerators in IOU Service Territory	42.1%	42.1%	
Freezers (est.)	655,217	664,510	0.158
Percent of Freezers in IOU Service Territory	33.1%	33.1%	
SDG&E			
Electric Customer Households	1,216,777	1,235,747	
Primary Refrigerators (est.)	1,215,107	1,234,050	0.999
Secondary Refrigerators* (est.)	247,411	251,269	0.203
Unknown Refrigerators (est.)	1,359	1,380	0.001
Total Refrigerators (est.)	1,463,877	1,486,699	1.203
Percent of Refrigerators in IOU Service Territory	12.4%	12.5%	
Freezers (est.)	215,646	219,008	0.177
Percent of Freezers in IOU Service Territory	11.9%	11.9%	
Totals			
Electric Customer Households	9,806,626	9,968,703	
Primary Refrigerators (est.)	9,793,976	9,955,847	
Secondary Refrigerators* (est.)	1,970,710	2,003,312	
Unknown Refrigerators (est.)	16,520	16,780	
Total Refrigerators (est.)	11,781,207	11,975,940	
Freezers (est.)	1,934,234	1,967,052	

6.1.4 Other Estimates of Refrigerators in California

There are other studies that provide estimates of the number of refrigerators in California. For reference purposes, these estimates are presented in the second through fifth rows of Table 6-4, along with the total IOU utility estimate from the 2003 RASS. Row six shows the RASS estimate after adjustment to a statewide estimate. Row seven shows the year adjusted 2005 estimates for each of the studies. The 1999 Appliance Magazine estimate for refrigerators appears to coincide most closely with the results of this study. The AHAM estimate is the next closest. It is worth noting that the RASS estimate for freezers is the lowest of all of the estimates. We did not adjust the freezer totals. If the freezer estimates were adjusted, the freezer totals would all exceed the RASS estimate in every case.

Table 6-4. Number of Refrigerators and Freezers in California From Past Studies

Appliance	*DOE Estimate*	*Appliance Magazine Estimate*	*AHAM Estimate*	*Total RASS Estimate***
Study year	1997	1999	2001	2002
Primary Refrigerators	9,660,000	11,477,000	10,706,500	10,334,741
Secondary Refrigerators*	1,840,000	1,667,500	1,805,500	1,952,891
Unknown Refrigerators				16,494
Total Refrigerators	11,500,000	13,144,500	12,512,000	12,317,192
Adjustment to Statewide				13,956,549
2005 Estimate (Escalated)	12,691,002	14,275,899	13,150,975	14,503,282
Total Freezers	2,300,000	4,933,500	4,715,000	1,906,107

* Represents Secondary and Tertiary Refrigerators.

** Includes refrigerators in LADWP Service Territory

6.1.5 Purchases of New and Used Refrigerators and Freezers

According to the Association of Home Appliance Manufactures (AHAM), manufacturers shipped 1.33 million refrigerators to California in 2005. Referring to Table 6-2, about 203,000 of these refrigerators were placed in new residential construction. From the 2003 Commercial Building Energy Consumption Survey (CBECS), there is a residential sized refrigerator for every 13,085 square feet in commercial buildings. If the square footage of commercial building space in California is divided by this number, there are roughly 316,012 residential-sized refrigerators in commercial building spaces in California. Assuming a lifetime of 14 years, an estimated 26,858 of the refrigerators shipped to California were placed into service in commercial buildings. Thus, an estimated approximately 1.1 million new refrigerators were shipped to California and placed in service in existing households. These estimates are shown in Table 6-5.

Table 6-5. Appliance Purchases in California in 2005

	Refrigerators	***Freezers***
Shipped to California*	1,333,182	170,806
New Construction	203,105	
Commercial Sales	26,858	
New Residential Sales	1,103,219	
Used Residential Sales	225,608	
Total Residential Sales	1,328,827	
Non tenant rental unit sales	385,281	
Householder transactions	943,546	
Total Sales	1,558,790	

*Source: AHAM, Sales by State — 2005. Spreadsheet obtained from AHAM.

Because the program targets household transactions, household transactions are distinguished from total residential sales. Total residential sales are the sum of household transactions and the quantity purchases of landlords replacing refrigerators in multifamily buildings.

Two methods were used to develop estimates of household refrigerator transactions in the IOU service territories.

The first method estimates household transactions from the survey of non-participant acquirers and applies the estimates to the number of households in the IOU Services territories. In the non-participant survey, households in the IOU service territories were called at random and asked if the household had acquired or disposed of a refrigerator in the last four years. In order to achieve the required quotas for acquirers and disposers, it was necessary to complete calls to slightly more than 800 households that acquired, disposed, or acquired and disposed of a refrigerator(s). A total 1,817 households were called to obtain the quota.

Of the slightly more than 800 households that said that they had acquired or disposed of a refrigerator, 487 said that they acquired a new refrigerator and 101 acquired a used refrigerator in the past four years. Because some households could have purchased more than one refrigerator in the period, the number of refrigerators reported by households when they indicated a refrigerator purchase was examined.

From the survey data, it was determined that purchasers of new refrigerators bought an average of 1.06 new refrigerators, and purchasers of used refrigerators bought an average of 1.05 used refrigerators. From the survey data, the revised estimate of new refrigerator purchases was 518 refrigerators (487 * 1.06). The revised estimate of used refrigerator purchases was 106 (101 * 1.05). Because this is the four year total of refrigerators, dividing by four gives the annual number of purchases, 130 new refrigerators and 26 used refrigerators.

To estimate household refrigerator transactions in the IOU service territories, the ratio of new and used refrigerators to IOU households was multiplied by the number of households. To estimate the number of refrigerator transactions, the 130 new refrigerators from the survey was divided by the number of qualified households contacted to obtain the eligible respondents (1,817). The resulting ratio of new refrigerators to IOU households is 0.07127. The ratio of used refrigerators to survey respondents that were contacted is 0.01458. Multiplying by the number of IOU households from Table 6-3 for 2005, the estimate is that in 2005 there were 710,469 new and 145,388 used residential refrigerator acquisitions by householders in the IOU service territories. This data is found in row one of Table 6-6.

In the second method, AHAM data were adjusted to arrive at the number of household transactions. Forty percent of households in California are renters, and 60 percent are owners. If it is assumed that refrigerator sales in California distribute in these proportions to households, the estimate is that 661,931 new refrigerators (60 percent of the 1,103,219 new refrigerators in column 5 of Table 6-5) went to owner households. If these are prorated to the IOU service territories, the result is 546,755 refrigerators. From the survey of non-participant acquirers, 84.5 percent of the refrigerator transactions were for owner households and 15.6 percent were for renter households. Thus, all householder transactions can be represented by dividing the 546,755 new refrigerators by .845 to give an estimate of 647,074 new refrigerators in the IOU service territories. Applying the ratio of used refrigerators to new refrigerators [(106/518) * 647,074] gives an estimate of used refrigerators of 132,412. By this method, there were 779,486 IOU household refrigerator transactions in 2005.

Table 6-6 Refrigerator Purchases By Households in Investor Owned Service Territories in California in 2005

Study	***New Sales***	***Used Sales***	***New/Used Total***
Nonparticipant survey for IOU service territory (acquirers - method one)	710,405	145,388	855,793
Estimates based on AHAM shipments data*	647,074	132,412	779,486
Average of the methods	678,739	138,900	816,140

6.1.6 Refrigerator Disposals

Refrigerator disposals were estimated by two methods.

From the non-participant survey, 445 households disposed of a refrigerator in the last four years. Dividing 445 by four, the number of households in the sample disposing of refrigerators annually is 111. The disposal rate for disposing households is 1.15. Thus, the estimated annual number of refrigerators disposed of in the sample is 128. Dividing the annual rate by 1,817 (i.e., the number of households screened to get the quota of disposers) yields an annual disposal rate per household of 0.07514. Multiplying that by the number of households in the IOU service territories suggests that the number of refrigerators disposed of by households in the IOU service territories was 702,939 in 2005. These numbers are reported in Table 6-7.

As an alternate method for estimating disposals, the estimated purchases can be adjusted for acquirers who didn't dispose of a refrigerator, program participants who disposed but didn't acquire a refrigerator, and disposers who disposed but did not acquire a refrigerator. To get the number of refrigerators that were disposed, the number of transactions needs to be reduced by the number of acquirers who didn't dispose of a refrigerator and increased by the number of participants and disposers who did not acquire a refrigerator. With this method, the number of refrigerators disposed is about four percent smaller than the more direct estimation method. In the subsequent discussion, the direct estimate of 702,939 is used to represent appliances that were discarded in 2005.

Table 6-7. Estimated Refrigerator Disposals
in IOU Service Territories in 2005 (Alternate Calculation)

Transaction Type	***Percent of Affected Transactions***	***Number of Transactions***	***Totals***
Total Refrigerator Transactions			855,793
Acquirers who did not dispose of a refrigerator	-29.9	816,140	-244,026
Disposers that did not replace a unit	+6.2	745,036	46,192
RARP Participants who did not replace a unit	+17.6	82,492	14,519
Total			672, 478

6.1.7 Discards of Working and Nonworking Units

AHAM reported that the average life expectancy of refrigerators is 14 years and that for freezers is 16 years.[6] The AHAM study also reported that 34 percent of people who replaced a refrigerator with a new one did so because their old one died or the repairs were too costly. Thirty-three percent of people who replaced a refrigerator with a used one did so for the same reason.

The AHAM study reports that 34 percent of people who replaced a freezer with a new one did so because their old freezers died, and 38 percent of people who replaced their freezer with a used one did so for the same reason.

In the RARP disposer's survey, customers were asked whether refrigerators that were discarded were working or not. (Discard meant that a unit was transferred from a household.) Discards may be sold, given away, taken away by a dealer, or taken to a disposal site. This is a slightly different question than the AHAM question, since the RARP survey deals with any unit that was discarded rather than with replacement units. Disposers reported that 22.6 percent of the units were not working.

[6] AHAM, May 2001, Final Report: Home Appliance Saturation And Length of First Ownership Study. NFO.

Customers surveyed were not asked specifically if an acquired refrigerator replaced a non-functioning unit. However, looking at acquirers who had disposed of a nonworking unit, the percentage of nonworking units was slightly higher, 24.6 percent.

Thus, slightly more than 77 percent of units being discarded in the IOU service territories appear to be working units. Table 6-8 shows that according to these estimates approximately 158,864 nonworking units and 544,075 working units were discarded in IOU Service territories in 2005. If not recycled, the working units could potentially be returned to the electrical grid. (The avenues that appliances disposed by households can follow to return to the electrical grid is discussed below.)

Table 6-8. 2005 Refrigerator Discards in the IOU service Territory, Based on the Nonparticipant Survey

Status of Refrigerator	***Number of Refrigerators***
Working	544,075
Dead	158,864
Total	702,939

6.1.8 Characteristics of Refrigerators and Freezers in California

RARP particularly targets older, less efficient refrigerators. This section provides a brief discussion of the age and size distributions of all refrigerators, of refrigerators that were removed by the program, and of refrigerators discarded outside the program.

Based on data from the 2002 RASS, Figure 6-1 shows the age distribution of the nearly 10 million primary and two million secondary refrigerators in the IOU services territories. Fifty-seven percent of primary refrigerators are seven years or less old. Twenty percent are eight to ten years old and 18 percent are more than 10 years old. The comparable percentages for secondary and tertiary refrigerators are 42 percent, 19 percent and 25 percent respectively. As might be expected, secondary refrigerators are older than primary refrigerators. For the RASS study year (2002), there were approximately 1.8 million primary and 0.5 million secondary refrigerators that were more than 10 years old. The age of about a half a million primary and secondary refrigerators is unknown.

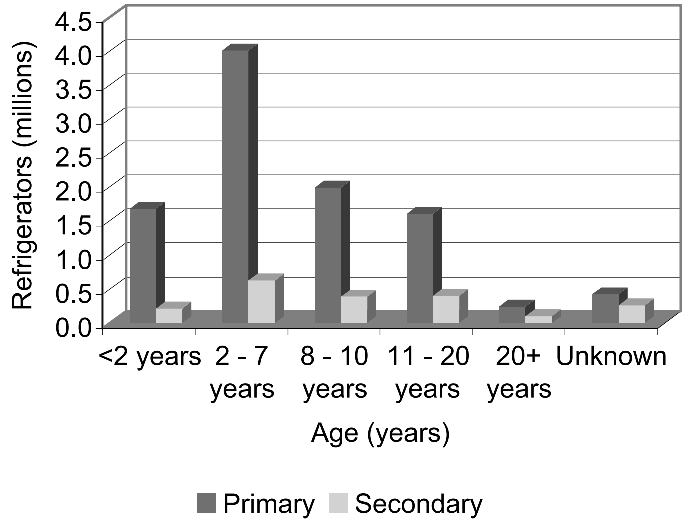

Figure 6-1. Age and Numbers of Refrigerators in the IOU Service Territories

According to RASS data, there were about 1.7 million primary freezers and 270,000 secondary freezers in 2002. Figure 6-2 displays the age distributions for the freezers in the IOU Services territories. A third of the primary freezers are of unknown age. Of the remainder, 36 percent are seven years or less, 16 percent are eight to ten years, 21 percent are 11 to 20 years, and 8 percent are more than 20 years. In general, the ages of secondary freezers are unknown. Freezers tend to be older than refrigerators.

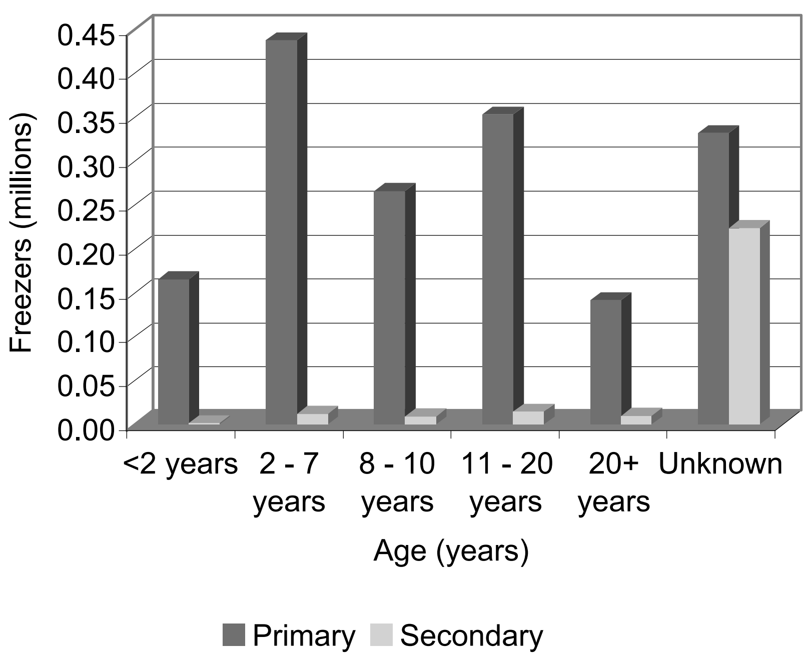

Figure 6-2. Age and Number of Freezers In the IOU Service Territories

Figure 6-3 displays the distribution of refrigerators by size. Seventy-nine percent of the primary and 53 percent of the secondary refrigerators, accounting for a combined total of approximately 9 million refrigerators, are between 17 and 23 cubic feet. Just 15 percent of the primary and secondary refrigerators, accounting for about a half a million units, are less than 13 cubic feet.

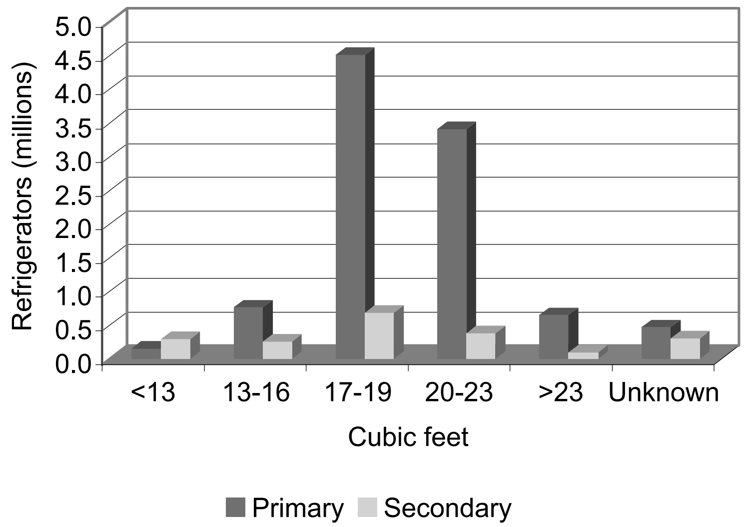

Figure 6-3. Size of Refrigerators

Figure 6-4 shows the same information for freezers. In general, freezers tend to be smaller than refrigerators. Just under a quarter of freezers are less than 13 cubic feet. Another 38 percent are between 13 and 16 cubic feet.

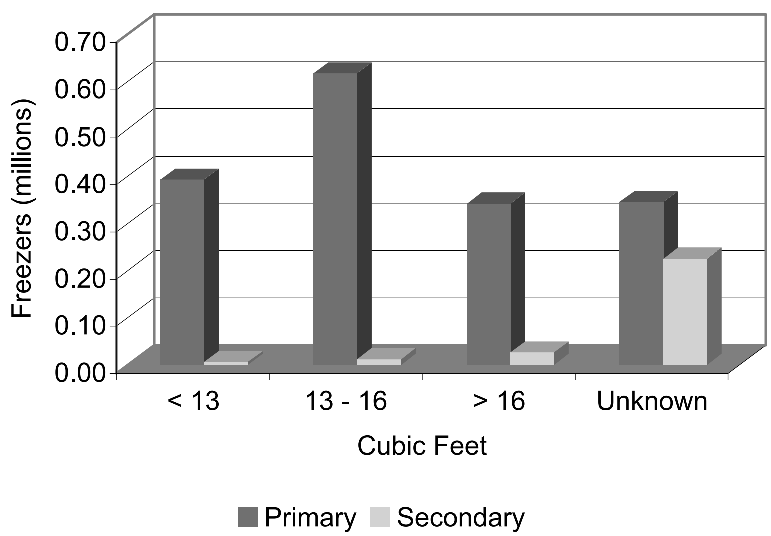

Figure 6-4. Size of Freezers

6.1.9 Characteristics of Refrigerators and Freezers Being Disposed in California

This section provides data comparing the characteristics of refrigerators removed by the program, refrigerators discarded by households without the benefit of the program, and the characteristics of refrigerators in the population. The program data are based on data received from the utilities for units taken by the RARP in 2004 and 2005. Data for age and size was available for approximately 88 percent of the units. Age and size data from households disposing of units without the benefit of the program were available for a bit more than half of the disposers in our survey. The population data are from RASS. The data for primary and secondary units is combined.

Figure 6-5 shows that the vast majority of refrigerators taken by the program were more than ten years old. This is not surprising since for most of 2004 and 2005 eligible units were limited to pre-1991 units. In fact, 98 percent of the units were 11 or more years old.

What is of more interest is the disposer data. The disposer data suggest that units being discarded outside of the program are generally somewhat younger than those disposed through the program, although somewhat older than units in the general population. Disposers reported that 59 percent of the units that were discarded were 10 years old or less. Forty-two percent were 11 or more years old. This suggests that disposers outside the program are changing units well before the units have reached their useful lives, perhaps because of the desire for a different type of unit, remodeling, or other reason.

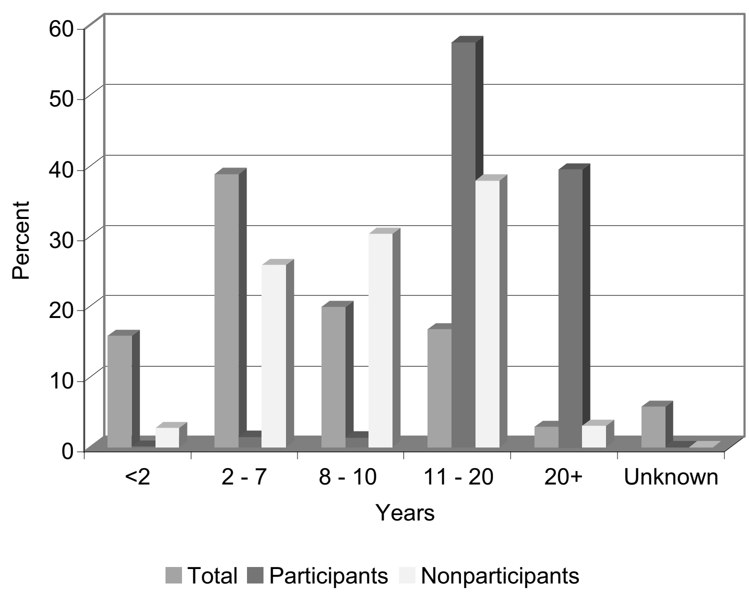

Figure 6-5. Percentage of Refrigerators by Age for All Refrigerators, For Those Removed by the Program, And For Disposers in the Population

6.1.10 Summary and Conclusions

This section has set the stage for the analysis of the used refrigerator market. Estimating the number of refrigerators and freezers in California and then in each IOU service territory establishes the groundwork for estimating the number of eligible units and the potential for RARP in the future.

The key numbers are as follows:

- In 2005, there were roughly 14.5 million refrigerators and more then 2.2 million stand alone freezers in nearly 12.2 million households in California.
- Between 2000 and 2006 we estimate that the number of refrigerators in California increased by about 1 million units or at an average annual rate of about 1.2 percent.
- In the IOU service territories in 2005, there were almost 12 million refrigerators and a little over 1.9 million freezers in about 10 million electric customer households.
- In 2005, 45 percent of refrigerators in the IOU service area were in PG&E service territory; 42 percent were in the SCE service territory; and 12 percent were in SDG&E service territory.
- AHAM shipped more that 1.3 million refrigerators and 170 thousand freezers to California in 2005. It was estimated that about 1.1 million new and 225,000 used refrigerators were placed into service in existing (as opposed to new) residences in California.
- About an estimated 385,000 refrigerators were purchased by the owners of multifamily housing to be used in their units. These refrigerators are not a target of the program.
- Approximately 816,000 new and used refrigerator transactions were estimated to occur in the IOU service territories in 2005. These transactions involved about 639,000 new units and 139,000 used units.
- Approximately 702,939 refrigerators were estimated to have been discarded (i.e., sold, given away, taken away by a dealer, or taken for disposal) in the IOU service territories. Approximately 159,000 of the refrigerators (22.6 percent) that were discarded were estimated to be non-working refrigerators. The remainder, 544,000 were working when they were discarded.
- Fifty-seven percent of the refrigerators in the IOU service territories are less than eight years old.
- As would be expected given the program requirements in 2004 and 2005, most of the refrigerators that were taken by the program were 11 or more years old.
- Fifty-nine percent of the units discarded by those who disposed of an appliance were less than 10 years old.

6.2 CALIFORNIA USED REFRIGERATOR MARKET

The used refrigerator market is extremely complex. Refrigerators that are removed from households may travel by numerous intersecting paths to their next destination. The players in the market may have a single role or may play multiple roles. For example, a refrigerator may go to a county waste management site where the refrigerant is removed and sold to a firm that deals in refrigerant. The carcass may be crushed and taken to a scrap metal dealer. A refrigerator might go to an appliance dealer who contracts with a used dealer to dispose of it. The appliance dealer screens the refrigerator and either decides to resell it, perhaps to another dealer, or to dispose of it. The used dealer might take the refrigerator to the firm that deals with refrigerant where the refrigerant is extracted and then the shell is taken to a scrap dealer who shreds it. Alternatively, the dealer might take the refrigerator to the scrap dealer who extracts the refrigerant, shreds the shell, and then sells the refrigerant to a dealer. There are literally tens of these different disposal pathways in California.

The complexity of the situation is further increased by the fact that the market place is very dynamic. The California market has undergone significant changes in recent years stemming from changes in safety and environmental laws concerned with refrigerator/freezer disposal and repair. Many businesses and organizations that formerly dealt with used refrigerators have gotten out of the business or have begun to steer away from it because the revenue stream has shrunk or has become a source of loss. Moreover, there is anecdotal evidence that there are businesses and organizations that are operating outside of the common paths, further increasing the complexity of the market.

The paths by which households dispose of refrigerators are discussed in this section. A flow diagram is presented to show how refrigerators leave households and their disposition. The information on which this flow diagram is based comes from a number of sources. A key source of data is the survey of non-participant acquirers and disposers that was conducted as part of this evaluation effort. Program records were examined to obtain some of the data. Other data came from interviews with charitable organizations, interviews with appliance dealers, a survey of used appliance dealers, and a survey of recycling organizations. Information was also gained from other interview activities such as those with RARP contractors.

In constructing the estimates of units flowing through various paths, an attempt was made to triangulate information. In some instances it was difficult to reconcile information from different sources. It should be emphasized that these are estimates. With the exception of the estimates for program units, most of the estimates are probably accurate to within a few thousand units. The numbers are rounded to thousands to emphasize this fact.

6.2.1 Refrigerator Transfers

In the discussion that follows, unit transfers refer to an existing unit changing hands. Ultimately there are two possible outcomes: a unit is placed into service or is stored, or a unit is de-manufactured and leaves the grid. If the unit is re-used, it is generally given away, sold directly to another household, or finds its way to a used appliance dealer who resells it. If the unit is de-manufactured, it is generally disposed of through a utility program such as RARP, a new appliance dealer who takes the unit and sells it to a used dealer who disposes of it, or is disposed through community waste systems.

Figure 6-6 provides a representation of paths that units take. The flow begins with the statewide California refrigerator and household information presented in Section 6.1. Of the 14.5 million refrigerators in 2005, approximately 12 million were located in the 10 million households in the IOU service territories. From the non-participant survey and the calculations described in Section 6.1, it is estimated that roughly 703,000 used refrigerators were transferred from 610,000 homes (i.e., total households transferring a refrigerator multiplied by the average number of units transferred per household).

Directly below the information about the transfers are two rows of cells representing transfer paths. Most cells contain an estimated number of units in the cell and a percentage of the total disposed units represented by that cell unless otherwise marked. In the second row of cells, percentages for units working are reported. The cells in the first row are categories describing the general type of transfer. The cells in the second row provide more specific information about paths that a refrigerator can take.

The first cell on the left in the first row is the number of refrigerators that were taken by RARP. In 2005, 79,094 households transferred 82,492 used refrigerators. It is estimated that this accounts for about 12 percent of all refrigerator transfers in the IOU service territory and about 15 percent of working refrigerator transfers. ARCA and JACO, the program contractors, recycled 100 percent of these units.

The remaining values in these two rows were largely derived from responses to two questions in the survey of non-participants, as shown in Table 6-9. Disposers of working and nonworking units were asked how they disposed of their units. The percentages for RARP and units given to charities did not come from the survey, but were derived from other sources. In order to include RARP and the charities in the table, it was calculated what the survey responses would have been if they had been included in the table.

The final figures were formed by separating the working and non-working units. The total number of households that disposed of a working refrigerator was multiplied by the percent working units and then multiplied by the ratio of working household disposers to obtain the total working units disposed. The working units and nonworking units were totaled to get the numbers in Table 6-9.

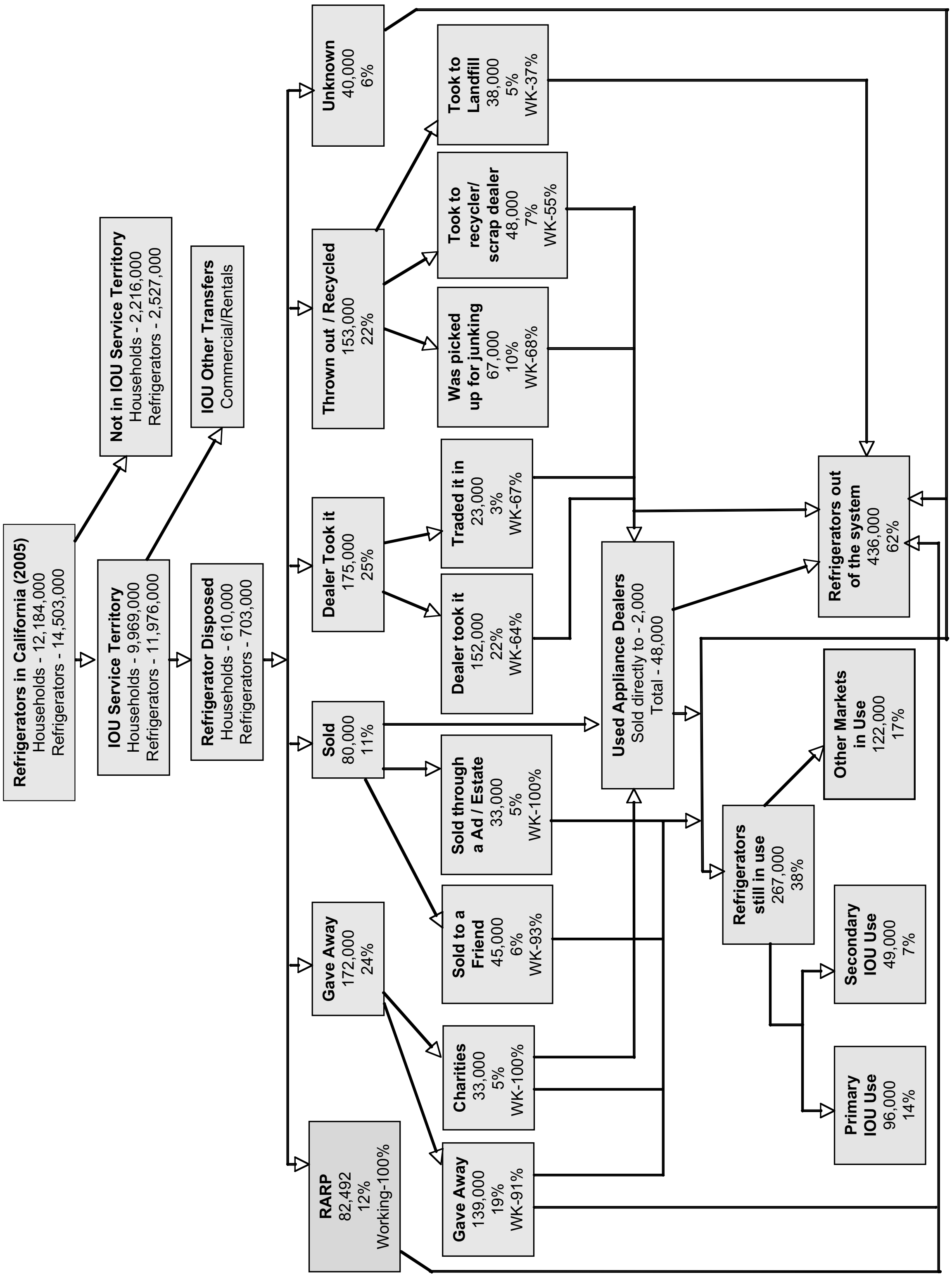

Figure 6-6. Used Refrigerator Transfers in California

Table 6-9. How Households That Transferred Refrigerators Dispose of Them.

How did you get rid of this refrigerator?	***Percent Working***	***Percent Nonworking***	***Percent Total***	***Category Totals***
RARP				12
RARP*	15.7	0	11.7	
Gave Away				24
Gave it away	23.2	7.2	20.3	
Charities*	7.0	0	4.7	
Sold it				11
Sold it to a friend, acquaintance or relative	8.0	1.8	6.6	
Sold it via garage sale, estate sale, or newspaper ad	6.2	0	4.8	
Sold it to a used refrigerator / freezer dealer	0.3	0	0.2	
Dealer took it				25
Dealer I bought a new one from took it away	18.4	31.5	21.3	
Traded it for a replacement unit	3.0	4.5	3.3	
Threw it our or recycled it				21
Hired someone to pick it up (for junking or dumping)	7.4	16.2	9.4	
Took it to a recycler or scrap dealer	5.0	12.6	6.7	
Took it to the landfill or threw it away	2.7	13.5	5.1	
Unknown				6
Other	.6	1.8	.9	
Don't know	2.6	10.8	4.6	
Total	100	100	100	100
Adjusted n total*	333	111	444	
Actual survey n	281	111	392	

* These values were obtained from sources other than the survey. The number of survey equivalents was used to calculate the percentages and are represented in the total at the bottom. The percents in the working column are adjusted to include the known value of RARP participants.

From the first row it can be seen that the two most common ways to transfer or dispose of a refrigerator were (1) to give it away or (2) to transfer it to a dealer who disposes of it. In 2005, it is estimated that about 172,000 used refrigerators (24 percent of transfers) were given away. From discussions with charities, it was learned that there is only a single charity in California that takes used refrigerators in substantial numbers. This charity receives about 40,000 units statewide, which when adjusted for the population of the IOU service territory, means that they receive about 33,000 units or about five percent of annual refrigerator transfers. The charity sells about 20 percent of these units directly to customers while the other 80 percent are sold at auction, with most going to used appliance dealers. This charity takes only working units.

Examination of the data suggests that about 91 percent of the remaining 110,000 units that are given away are working units and typically go to friends, relatives and others customers for reuse. It is unclear to whom the seven percent of units that are not working are given, but it is likely that most, if not all of the refrigerators that are not used are on the electric grid.

In 2005, households sold nearly 80,000 used refrigerators comprising 11 percent of all refrigerator transfers in the IOU service territories. Most (95 percent) of these are working units. It is unclear what happens to units that are sold that are not functioning. Some may be purchased with the intent to repair the unit. Of the household sales, approximately 56 percent went to a friend (six percent of all units), 41 percent went to an unknown user through an advertisement or estate sale (four percent of all units), and approximately three percent (less than one percent of all units) were sold directly to used appliance dealers.

Another common way for households to transfer a refrigerator is to have the appliance dealer remove it when delivering a replacement unit. Approximately 175,000 or 25 percent of used refrigerators were transferred this way. Roughly 64 percent of these transfers were working units, and 36 percent were nonworking units. (AHAM reported in their 2002 study that 34 percent of refrigerators that are purchased replace a failed unit.)

The dealer making the sale may take the machine with or without charging the customer. Some respondents (three percent) said that they traded a unit for a replacement unit. It is unclear, what is meant by "traded." Most of the largest new appliance dealers do not take "trade-ins" per se. In either event, units collected in this way most often go to a used appliance dealer that screens them and who typically sells the more desirable units (younger with more features) discarding the remainder or to a recycler where the unit is demanufactured.

The final path for a refrigerator being disposed of by a household is for it to be hauled away or to be transferred to the waste management system. Approximately 153,000 or 22 percent of refrigerators are transferred through this mechanism. Approximately 52 percent of these units were working and 48 percent were nonworking. Roughly 67,000 refrigerators in this category were picked up for junking by someone hired to haul the unit, 48,000 were taken to a recycler or a scrap dealer by the householder, and 38,000 were taken to the community waste facility. A small number of units that are picked up for junking or taken to a recycler or scrap dealer will return to the market through used appliance dealers. However, most units are sent to a non-program recycler and de-manufactured. It is assumed that almost all of the units taken to community waste facilities are removed from the system.

As can be seen in Figure 6-6, there is an unknown path. This represents respondents who indicated some other option or indicated that they didn't know what happened to the refrigerator. Where this remaining 6 percent of refrigerator transfers go is not known. Many of them may be distributed over the other categories.

One destination for refrigerators is used appliance dealers. From data collected through a survey of used appliance dealers, it is estimated that approximately 50,000 used refrigerators are sold annually in California through used dealers. Adjusting that number to IOU service territories suggests that the used dealers will sell about 42,000 units in the IOU service territories. From the dealer survey, these companies sell 86 percent of their refrigerator stock (78 percent to households and 8 percent to multifamily operators), which leaves 14 percent to be recycled or salvaged for parts. Therefore, used appliance dealers in the IOU service territories acquire approximately 48,000 used refrigerators a year (42,000 + 6,000 de-manufactured units). Used dealers receive about 26,000 units from charities and about 2,000 directly from consumers. The remaining 20,000 units are acquired through contracts with new dealers (59 percent of all units acquired), units being picked for junking (10 percent), units being taken to a recycler/scrap dealer (3 percent), multifamily operations (4 percent) and unknown (8 percent).

It is clear that the refrigerators that went through the RARP were recycled. The 38,000 units that were taken to the landfill are also out of the system, although not necessarily in an environmentally safe manor. From the data collected through the used appliance dealer's survey, it is estimated that 14,000 of the units taken by dealers, who remove a refrigerator when selling a replacement refrigerator, go to used appliance dealers. The remaining 161,000 units (92 percent of refrigerators taken by new dealers) end up being recycled or in the landfill. Through the same survey, it is also estimated that about 3000 units that were picked up or sent to be recycled end up at used appliance dealers. Therefore 112,000 or 97 percent of these refrigerators are actually recycled or sent to a landfill.

The survey of non-participants suggested that approximately 13,000 nonworking refrigerators are given away. It can be assumed that all of these units are de-manufactured. Finally, some of the refrigerators that end up with used appliance dealers cannot be resold and are sent to recycling companies or the landfill. From the survey of used appliance dealers, approximately 14 percent of refrigerators they acquire are taken to recyclers, landfills, or salvaged for parts. This accounts for about 6,000 units. Assuming that the unknown units are transferred in the same ratio as all known units, it can be concluded that approximately 436,000 out of the 703,000, or 62 percent of transferred refrigerators are no longer on the grid.

On the other end, units often stay on the system when a household gives away their used refrigerator, sells their old unit, or the unit goes to a used appliance dealer. It can be assumed that all working refrigerators that are given away, except to charities, remain in the market. This accounts for approximately 126,000 units. Charities also sell about 20 percent of their stock or 7,000 units directly to residents, which would mean they are probably still in the market. It can also be assumed that all units sold to a friend or through an ad/estate sale remain in the market. California residents receive about 80,000 used refrigerators through these means. Finally, refrigerators return to the market when used appliance dealers sell them. From the used dealers survey, it is estimated that used dealers sell 42,000 used units in the IOU service territories. Assuming again that the unknown refrigerators are transferred in the same ratio as the known units, it can be concluded that 267,000 or 38 percent of refrigerators that are transferred are still in use.

Finally, it is estimated that 145,000 of the 283,000 units are absorbed by residents of the IOU services territories. Ninety-six thousand of these units remaining in the market are used as primary refrigerators and 39,000 are used as secondary units. An estimated 122,000 units are working units that may be disposed or that flow into other markets. These may include the international market and/or the small rental market.

This analysis does not deal with the rental market, except for individual households that purchase units for use in rental housing. Refrigerators for rental units tend to be on the smaller end of the size spectrum (e.g., 14 cubic feet). Small rental property owners typically purchase units one-by -one as needed, usually in replacement situations. They may sometimes purchase units available through rental stores. Larger rental property owners typically deal with distributors or manufacturers as large national accounts. The larger owners replace defective units on an as- needed basis and mass replace refrigerators periodically when they want to update units or at the point where the existing stock of units becomes a maintenance issue. There are companies that specialize in large quantities of used units from rental housing. Because this was not a focus of this research, no one from those firms was interviewed. Units from these different markets and the rental market undoubtedly flow back and forth.

Based on this analysis, it can be estimated that the RARP is capturing about 23 percent of the market comprised of working, used refrigerators. Considering just those machines that remain in the IOU market, then the program is capturing approximately 36 percent of the eligible machines.

6.2.2 Refrigerators Given Away

Households within the IOU service territories gave away approximately 165,000 used refrigerators in 2005. About 20 percent (33,000) of these units are estimated to have gone to charities. The other 80 percent of units were likely given away to family, friends or neighbors.

In the past, charities have played a larger role in the used refrigerator/freezer market in California. Charities have chosen to become less active because of new rules that units being disposed of must be disposed of by a licensed firm. The primary thrust of these rules is to prevent CFCs from entering the atmosphere. If charities take units that have little or no commercial value, then they have to pay to dispose of them. Therefore, charities are increasingly selective about taking refrigerators and freezers to avoid having to pay to dispose of the units.

For example, St. Vincent DePaul and AmVets no longer take units. Four charities in California were identified as accepting used refrigerators: Habitat for Humanity, Rebuilding Together, Out of the Closet, and the Salvation Army. After interviews with representatives of each charity, it was determined that only the Salvation Army acquires and sells a significant number of refrigerators. The following is a quick breakdown of how each charity deals with used refrigerators and the method for obtaining the information.

- *Habitat For Humanity*. A call was placed to the organization's headquarters. According to a representative, branches in other parts of the country accept a limited number of used refrigerators but refrigerators are no longer accepted in California.
- *Rebuilding Together*. There are 27 chapters in California. Twenty-three were sent a short email survey. (Four chapters did not list an email address). Ten chapters replied. Three said that they accept used refrigerators. Two of the chapters received two to three units in the past year, while the other received about 30. To be accepted, the units have to be less than five years old and in "new" condition. Based on this information, it is estimated that Rebuilding Together obtains between 50 and 100 used refrigerators annually.
- *Out of the Closet*. There are 22 stores in California. A representative from headquarters was interviewed, but provided little usable information. Six stores were visited and the managers interviewed. Most stores do a limited business with large appliances such as refrigerators, primarily because of space issues. One store did not accept any units. Another store receives about five units and sells about two per year. Three stores received about one refrigerator per month or 12 annually. Another store, which had more floor space, receives and sells about 3 to 4 units per month or about 50 units per year. The only criterion is that the refrigerator works. If units cannot be resold, they are trashed or recycled. Based on this information, it is estimated estimate that between 275 and 315 used refrigerators are acquired and sold in Out of the Closet stores annually.
- *St. Vincent DePaul and Goodwill*. — According to their websites, neither of these charities accepts refrigerators.
- *Salvation Army*. An executive interviewed provided actual sales figures for recent month for Salvation Army stores. Based on that, he estimated that the Salvation Army receives about 40,000 units a year in California (33,000 in IOU service territory). Units are picked up from homeowners. The unit must be working and plugged in when the driver arrives. The driver determines whether to take the unit and may reject units on grounds of fitness or difficulty of removal. Approximately 20 percent of units obtained are sold through Salvation Army stores and 80 percent are sold at auctions held at Salvation Army distribution centers several times a week.

The charities covered in this review were identified through Internet searches and interviews with individuals with good knowledge of the used appliance market. Because an exhaustive search of charities was not performed, it is possible that other charities are receiving a small, probably insignificant number of units.

6.2.3 Refrigerators Sold

In 2005, households sold approximately 78,000 used refrigerators. Fifty-seven percent of these were sold to family or friends, and 40 percent were sold through ads or estate sales. Only information regarding units sold through ads was available.

The way in which households are selling used refrigerators through ads is changing. Internet advertising services, such as craigslist and the web version PennySaver, are growing in popularity and making it easier to sell used appliances.

In order to look at the scope of craigslist and PennySaver and the characteristics of used refrigerators sold through ads in general, postings on California craigslist and PennySaver sites for a one-week period were analyzed. During the week of June 23rd – June 29th approximately 550 advertisements were posted for used refrigerators on craigslist sites in California. In January 2007 the ads listed in the PennySaver for all of California were obtained. For a one-week period, 317 ads were listed. Adjusting the craigslist figure to annual numbers and for the IOU service territories results in about 24,000 craigslist postings for used refrigerators in 2006. Doing the same thing for PennySaver results in an annual total of about 13,500. There are several potential problems with these estimates.

- Refrigerators are more likely to be disposed of in the summer so that actual annual craigslist total may be lower.
- The figure represents units that are offered and not necessarily units that are transferred.
- There may be serial postings for the same unit.
- Some of the units are offered by businesses. Although screening for these was attempted, it was impossible to distinguish in every case if the advertisement came from a household or a used appliance dealer.

Based on the survey data collected during this study, it is estimated that approximately 31,000 refrigerators are sold through advertisements or estate sales. If the estimates from craigslist and the PennySaver are combined, the total estimate is near 37,500. For the reasons just stated, the estimates from craigslist and PennySaver are probably too high, and the true number is closer to 31,000. What these data do indicate is that a very high percentage of units sold through advertisements are sold through craigslist or the PennySaver.

More importantly, the craigslist and PennySaver studies allow obtaining some information about the prices, sizes, and ages of advertised appliances. The price of course is the asking price, not the selling price. Table 6-10 shows a distribution of prices for craigslist and the PennySaver. The asking prices for craigslist ranged from being free to $2,800, or an average of $267. The asking prices for refrigerators in the PennySaver mirror those of craigslist. Almost half of the units (46 percent for craigslist and 49 percent for PennySaver) ranged from $100 to $300.

Many advertisements do not state the size of the unit. Table 6-10 shows the distribution of sizes for units placed on the website. The average size in the craigslist advertisements was 21 cubic feet. It appears that 67 percent of craigslist households are disposing units larger than 20 cubic feet. There appear to be more smaller-sized refrigerators in the PennySaver, although the percentage of the large refrigerators is about the same. These differences may reflect the respective target audiences of the two websites, with craigslist tending to draw white-collar households and the PennySaver blue-collar households.

Table 6-10. Price, Size, and Age of Used Refrigerators Sold through Ads (by Percent)

Price	***craigslist***	***PennySaver***
Free	4	0
<50	3	3
50-99	14	16
100-199	28	31
200-299	18	18
300-399	12	9
400-499	8	8
500-799	7	9
800+	5	5
Total	100	99
N Total	1,010	

Size	***craigslist***	***PennySaver***
<13	3	15
13-16	8	13
17-19	23	15
20-23	32	21
>23	35	35
Total	100	99
N Total	317	

Age	***craigslist***	***PennySaver***
<1	5	0
1 to 4	61	80
5 to 8	19	20
9 to 12	9	0
13 to 16	2	0
17 to 20	2	0
>20	3	0
Total	100	100
N Total	287	

Finally, a few advertisements provided the age of the unit for sale. Table 6-10 shows the distribution of ages. The ages for units advertised on craigslist ranged from two months to 67 years, with an average of 6 years. More then half of the units (61 percent) were between one and four years. The PennySaver refrigerators were between one and eight years. Although one might question a 67 year-old refrigerator, there appears to be a small market for antique or vintage refrigerators. These units are upwards of 30 to 40 years old and tend to have high asking prices. Because these units are valued as antiques, it is unlikely that the RARP will have success targeting these units.

6.2.4 Used Refrigerators from Major Appliance Dealers

There are half a dozen major new appliance dealers in California: Sears, Lowes, Home Depot, Fry's, Best Buy and Howards. These stores have two streams of "used" refrigerators moving from their stores.

- One stream is scratch and dent and out-of-the box units. These are new refrigerators that were damaged in transit, were floor models, or were determined to be the wrong size, color, or feature set and returned by the purchaser to the store. Most of these units are sold to a dealer who sells them directly or more typically takes some or all of them to an auction where they are purchased by used appliance dealers.

- The second stream of refrigerators is comprised of units that come to the dealers when they sell a new refrigerator. The "deal" varies. When personnel at the stores of several major appliance dealers were interviewed, they indicated that with the purchase of a new refrigerator an existing refrigerator could be removed for a fee that ranges from free to as high as $65. The amount charged for a removal is often tied to the promotion for the sale of new appliances.

  This stream contains refrigerators and freezers that are typically older and refrigerators and freezers that are no longer working. The contractor typically separates the refrigerators with street value, usually those that are white and less than ten years old, from those with little street value. Those with street value may be sold at auction. Those with little street value are recycled. In some instances, the major appliance dealer may stipulate that all appliances be recycled whether they have street value or not.

The major appliance dealers contract with logistics services to actually manage the drop-off of new appliances and the pick-up of old appliances. Old appliances are usually taken to a staging area where the contractor picks them up. There is some evidence that logistics drivers may skim refrigerators. When a driver removes a refrigerator with resale value from a household, the driver may sometimes take the refrigerator to a location where the refrigerator is exchanged for a less saleable model that replaces the original in the load. There is anecdotal evidence that a driver delivering a unit may sometimes see a desirable unit that is not scheduled for removal and offer to remove the unit for "free." The householder may accept the offer because of the convenience.

One reason that RARP appointments get cancelled is because of the unscheduled removal of appliances. In interviews, the operators scheduling RARP pick-ups indicated that when householders call to cancel they sometimes tell them that the delivery person of their new refrigerator or freezer offered to take the appliance. For some smaller used appliance dealers, some of their used appliances come from the major appliance dealers. However, the majors do not usually deal with used dealers in this way. Some of these refrigerators are likely coming through this channel. Some of the refrigerators that appear in craigslist and the PennySaver may also be refrigerators that have been "recycled" through this informal channel.

6.2.5 Refrigerators in the Waste Management System

Refrigerators also find their way into community waste streams, but the community waste streams were not examined in detail. There appear to be a wide spectrum of practices with regard to how items such as refrigerators are handled. Some communities contract with private companies that deal with refrigerators and other large solid waste items. Some communities manage their own waste.

For example, a waste manager for a community facility in Northern California where they handle and disassemble refrigerators indicated that the community recycles 100 percent of the units. At that site, personnel collect refrigerant from refrigerators that are brought to the site. Other hazardous materials are removed. The refrigerator is then crushed. The refrigerant is sold to a company that recycles the material. The crushed shells are then hauled to a scrap yard near Richmond or to a site in Oregon.

6.2.6 Second Refrigerators – Not in the Used Market

The discussion in this section has addressed the used refrigerator market. The issue of second refrigerators that remain in customer homes has not been addressed. Second refrigerators represent the largest potential target for the program. It is estimated that there are about 1.9 to 2.0 million second refrigerators in the IOU service territories. About 40 percent of the refrigerators captured by the program were second refrigerators. Because this study was focused on program participants and households that acquired or discarded a refrigerator, the survey did not support an analysis of second refrigerators, the use of second refrigerators, or the potential for motivating customers to discard second refrigerators. This is a much needed study that should be pursued.

6.3 USED APPLIANCE DEALERS

In order to get an understanding of how used appliance dealers operate, a short telephone survey was completed with a sample of 46 firms. The main goal of the survey was to gain an understanding of used refrigerator dealers and their operations. A second purpose was to try and develop some estimates of market size. Because of the nature of the questions being asked, the focus for this survey effort was on dealers who sell more than 50 refrigerators a year. A short form was completed with dealers who sell less than that.

The used appliance dealers survey addressed the following topics:

- The number of used refrigerators sold annually
- How used appliance dealers acquire used refrigerators/freezers
- General characteristics of used refrigerators acquired by appliance dealers
- What used appliance dealers do with refrigerators/freezers
- What upgrade/repair dealers perform on used refrigerators
- Parts that used appliance dealers salvage from used units
- How customers find and contact used dealers
- RARP awareness and program effects on the used appliance business

For the survey of used appliance dealers, a sample of 150 firms was drawn from two sources: the BEAR list (60) and the Yellow Pages (90). The BEAR list represents all firms currently certified to repair appliances and/or electronics in California. When accessed in the summer of 2006, the list contained 2,849 firms certified to repair only appliances or both electronics and appliances. The list was reduced to 2,208 firms by removing duplicates and firms that only sold new units (e.g., Sears) or that clearly did not sell refrigerators (e.g., Suburban Propane). The working hypothesis was that if firms sold used refrigerators and/or freezers, they likely would also be certified to repair them. The intent was to locate smaller companies that might not have the resources to advertise in the yellow pages or have the focus of their business in other areas.

A sample of 60 firms was extracted from the revised list and a letter and call was placed to each. Thirteen (20 percent) of these firms could not be reached after numerous calls. Another 10 had disconnected or wrong numbers, suggesting that they were no longer in business. Twenty-eight firms said that they do not sell used refrigerators. That left nine of sixty firms, only three of which sold more than four refrigerators a month.

Another 163 used appliance dealers were identified through searches of the online Yellow Pages for California. A sample of 90 of these firms was selected and sent a letter explaining the survey. When called, twenty-four of these firms could not be reached after numerous calls and 15 appeared to be no longer in business. Twenty-one firms said that they do not sell used refrigerators. Thus, 37 of the 90 firms sold refrigerators; of these 25 sold more then four refrigerators.

Table 6-11 provides summary information on the sample of used appliance dealers surveyed.

Table 6-11. Sample of Used Appliance Dealers Surveyed

Used Appliance Dealers Status	***BEAR***	***BEAR Percent****	***Yellow Pages***	***YP Percent****	***All Firms***	***All Firms Percent****
Completed long or short survey	9	19	37	56	46	41
Firm does not sell used refrigerators	28	60	14	21	42	37
Appears firm is no longer in operation	10	21	15	23	25	22
Firm could not be reached	13		24		37	
Total	60	100	90	100	150	100

* Firms that could not be reached have been removed

Assuming that the BEAR list and the Yellow Pages represent a reasonably completed list of appliance dealers in California, the experience with this sample suggests that there are approximately 511 used refrigerator dealers in California.[7]

Another striking aspect of this effort to survey used appliance dealers was the number of firms whose number was disconnected or changed. Twenty percent of firms from the BEAR list and 21 percent of firms from the Yellow Pages had a wrong or disconnected number. The most logical conclusion to draw from this is that these firms are no longer in operation. Based on this

[7] Using figures in Table 6-11, 19 percent of the 2,208 BEAR firms (420) and 56 percent of the 163 Yellow Pages firms (91) sold used appliances. Therefore the total is 511.

information, nearly 500 firms can be estimated to have exited the market in the last year. The largest percentage of these firms (60 percent) probably did not sell used refrigerators or freezers in the first place. However, about an estimated 200 firms that sold used refrigerators or freezers in 2005 no longer do so. How many firms that sell used refrigerators that have been born is not known.

These data suggest that the used refrigerator market is highly transient. The strict rules that California State Government has put on refrigerator repair and disposal may have contributed to this. It may be that some of these firms still operate but have gone “underground” and use the PennySaver and craigslist.

Of the 150 firms that were in the sample frame, 28 completed the full survey and 18 completed the short survey. Firms that sell more then four refrigerators a month completed a full survey while firms that sell fewer than four units a month were given a shorter survey.

The sample included a mix of small and large firms, which varied in how important used refrigerator and freezer sales were to their business. Seventeen of the 28 used appliance dealers were able to provide an estimate of the percent of their total business that comes from reused refrigerators and freezers. On average 46 percent of each firm’s total business comes from this source and it ranged from a low of 3 percent to a high of 100 percent of their total business.

Seventy-five percent of the survey firms were small operations with one location. Several other dealers were much larger. One firm in particular, which is a subsidiary of a major new appliance dealer, sells only returned units that are nearly new. This firm sells about 4,800 units per year. It is the outlier shown in Figure 6-7. In the analysis for estimating the number of refrigerators, this firm has been removed as an outlier.

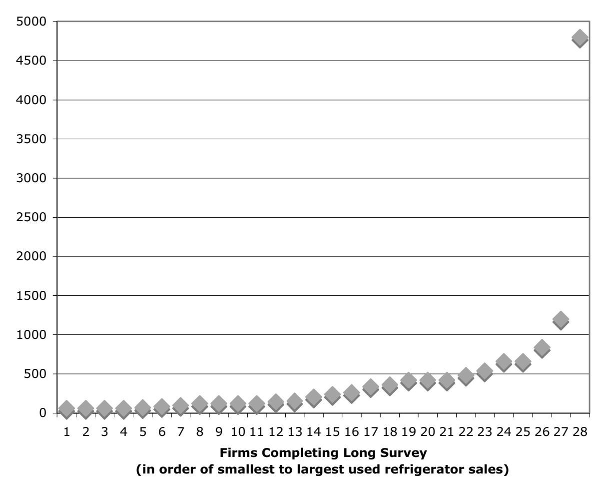

Figure 6-7. Used Appliance Dealers Annual Refrigerator Sales

6.3.1 Selling Used Refrigerators

For the 28 firms that sold more then four units a month, the number of annual sales ranged from a low of 60 refrigerators to a high of 4,800. The average was 468 refrigerators per firm and the median 222. There were also 18 firms surveyed who sold less then four refrigerators a month. It was assumed that each of these firms sold the median of two and a half units a month or 30 units annually.

These data, which are summarized in Table 6-12, suggest that that nearly 40 percent of businesses that sell used refrigerators sell less then 50 units annually. They are likely small firms who have other, more important, aspects of their business. Another 15 percent of used dealers sell between 50 and 100 units annually, 13 percent of dealers sell between 100 and 200 units annually, and 11 percent sell between 200 and 400 units annually. The majority of the "big players" in this market fall in the fifth category, where 15 percent of dealers sell between 400 and 700 units. Finally, six percent of used refrigerator dealers sell greater than 700 units a year, many of which are probably "scratch and dent" sales.

Table 6-12. Distribution of Annual Used Refrigerator Sales by Used Appliance Dealers

Annual Sales	***Count***	***Percent***
Less then 50	18	39
51-100	7	15
101-200	6	13
201-400	5	11
401-700	7	15
701-1200	2	4
More than 1200	1	2
Total	46	100

Finally, eighteen of the used appliance dealers provided an estimate of the price for a 10 year-old, 18 cubic foot, side-by-side refrigerator. The distribution of prices is summarized in Table 6-13. The average price was $183 with prices ranging from $50 to $400 per unit.

Table 6-13. Distribution of Prices
for a Standard 10 year-old, 18 Cubic Foot, Side-by-Side Used Refrigerator

Price Range	***Firms***
$50-$99	2
$100-$149	4
$150-$199	5
$200-$249	3
$250-$299	2
$300+	2
Total	18

6.3.2 Acquiring Used Refrigerators/Freezers

The 28 used appliance dealers that were given the long survey were asked where they obtained their used refrigerators and freezers. The responses are summarized in Table 6-14. Most of the dealers (61 percent) have contracts with new appliance dealers to receive the old units that are replaced with new ones. On average, these dealers obtain 64 percent of their stock through this means. This accounts for approximately 48 percent of all refrigerators obtained by used appliance dealers.

More then half of used appliance dealers (54 percent) also obtain units via direct pick-up from homeowners. They obtain about 26 percent of their stock this way, which accounts for 10 percent of all used appliance dealers' units. Another 39 percent of used appliance dealers acquire 21 percent of their units through customer drop-offs. This accounts for only three percent of all used appliance dealers' refrigerators.

Between 20 and 25 percent of used appliance dealers acquire refrigerators from other sources that include multifamily operations, sales of new refrigerators, other used appliance dealers, or appliance auctions. Only those firms that go to appliance auctions get the majority of their units through one of these means. These dealers receive two-thirds of their stock from auctions, which accounts for 11 percent of all units in the industry. Utility recycling programs, curbside pick-up, and scavenging are the least common means of obtaining used refrigerators, as only one of the 28 dealers (4 percent) use one of these methods.

Table 6-14. How Used Appliance Dealers Acquire Used Refrigerators/Freezers (Percent)

Means of Acquiring Used Refrigerators/Freezers	***Dealers***	***Average Percent of Dealers Business***	***Weighted Percent of Total Units***	***Weighted Percent of Total Units Adjusted***
Contracts with new appliance dealers	61	64	67	48
Direct pick-up from home	54	26	6	10
People drop them off at dealer location	39	21	2	3
Multifamily operations	25	19	3	4
Selling a new refrigerator	21	39	7	11
Other used appliance dealers	21	50	3	5
Appliance auctions	21	66	7	11
Curb-side/scavenging without contracts	4	5	0	0
Utility recycling programs	4	15	0	0
Contracts with communities	0	0	0	0
Unknown			5	8
N Total	28		13,116	8,316

6.3.3 Additional Information about Used Dealer Acquisitions

Used appliance dealers who obtained refrigerators and freezers from contracts with new appliance dealers had between zero and five contracts with dealers. Most of the dealers, however, said that they did not know how many contracts they had. The used dealers who were willing to comment split about equally whether they picked up used units from new appliance dealers, had the units brought to them, or receive them both ways.

Five out of the six dealers who responded to the question said that they pay the new appliance dealer to pick-up the used units. One dealer pays the new dealer an average of $10 per unit and another pays an average of $15. Two others said that the amount they pay varies by the unit. Three used dealers take all units from the new dealers under contract and two others only take certain ones. These two dealers only take units less than 5 years old and will take units of any size including extra large units and units under 10 cubic feet. Only one used dealer took non-working units under contract with the new appliance dealers.

Out of the 15 dealers that pick-up used refrigerators directly from homes, nine charge the homeowner for the pick-up while four paid the owner for the unit. Homeowners that get charged pay up to $50 and those that are paid receive up to $25. The remaining dealers pick-up units for their recycle value.

Five of the used dealers estimate the average number of workdays from the time dealer gets the call to pick-up, to be one day. Nine of the dealers said that the amount of time depends, and the remaining dealer could not estimate the time lag from customer call to pick-up.

Eleven of the 15 dealers who do direct pick-ups take all the refrigerators they are offered from the homeowner, while four only take certain units. One dealer said that they only take units that are less than 10 years old while another dealer only takes units less than 5 years old. Three out of the four dealers will take any size while one is selective. Two of the four dealers only take working units. One dealer said that the units have to look good cosmetically.

Three of the 11 dealers, who allow people to drop appliances off at the dealer’s location, charge the homeowners. The homeowner pays the dealer up to $30 per unit. Seven of the dealers pay the homeowner between $15 and $40 for units that are dropped off.

None of the seven dealers who said that they work with multifamily operators could estimate the number of multifamily operators. Three of the seven dealers assist multifamily operators stage removals and four do not help in this way.

Seventeen of the 28 used appliance dealers were able to provide estimates of the age of the used refrigerators they acquire. These responses are summarized in Table 6-15. The vast majority of used refrigerators obtained by used appliance dealers (84 percent) are less than 10 years old. It appears that only newer refrigerators have resale value in the secondary market.

*Table 6-15. Percentage Distribution for Ages of Used Refrigerators Acquired by Used Appliance Dealers**

Age of Used Refrigerators	*Used Refrigerators Acquired*
Less than 10 years old	84
10-14 years old	7
15-19 years old	5
Over 20 years old	2
Total	98
N Total	17

*Dealers could supply more than one response

Twelve used appliance dealers were able to provide an estimate of the average size of used refrigerators they obtain. The average size was 20 cubic feet, with a range from a low of 12 cubic feet to a high of 24 cubic feet.

6.3.4 What Happens to Used Refrigerators/Freezers

All of the used dealers but one sell used refrigerators in their stores. Table 6-16 summarizes the information on what used appliance dealers do with the refrigerators / freezers that they acquire. The 27 dealers sell on average 82 percent of the units in stores, which accounts for 71 percent of all used refrigerators and freezers transferred by used appliance dealers. Forty-six percent of the dealers take units to a recycler. These dealers take an average of 26 percent of their units to the recycler, which accounts for 13 percent of all units transferred by used dealers. Twenty-one percent of used dealers sell 29 percent of their units to multifamily operators, which accounts for about seven percent of all units. Eleven percent of dealers sell 14 percent of their units to other dealers, which accounts for four percent of units. Only two (7 percent) of the firms surveyed demanufacture units in house or salvage parts and then take them to a recycler, which accounts for less then one percent of all units.

Table 6-16. What Used Appliance Dealers Do with Refrigerators/Freezers (Percent)*

What Happens to Used Refrigerators/Freezers	Dealers	Average percent of dealers business	Weighted percent of total units	Weighted percent of total units adjusted
Sell used refrigerator/freezer in the store	96	82	82	71
Take used refrigerator to recycler	46	26	8	13
Sell used refrigerator to multifamily operators	21	29	4	7
Sell used refrigerator to other dealers	11	14	2	4
Demanufacture used refrigerators	7	7	0	0
Salvage parts from used refrigerator and take them to recycler	7	3	0	0
Take used refrigerator to community waste management site	0	0	0	0
Sell used refrigerator to broker/overseas broker	0	0	0	0
Unknown			4	5
N Total	28		13,116	8,316

*Dealers could supply more than one response

Twenty-nine percent of the used appliance dealers said that they are able to sell all the used refrigerators they obtain, while 43 percent said they could not. However, 46 percent said that they could sell more used refrigerators if they could obtain them. These respondents said that they could sell between 3 and 100 more units per month or an average of 36 more units per month.

Table 6-17 categorizes the upgrades / repairs that dealers make on used refrigerators / freezers that they acquire. Eighty-six percent of the dealers perform some sort of upgrade or repair and/or clean units before reselling them. Seventy-two percent of the used refrigerators that come from these dealers are repaired or upgraded, and 50 percent are cleaned. The most common repair or upgrade is to repair defrost controls. Sixty-four percent of all dealers perform this on an average of 29 percent of their units. Sixty-one percent of dealers check refrigerant levels on an average of 45 percent of their units. Several indicated that they only check refrigerant if the unit is not cooling. Fifty-four percent of dealers say that they repair door seals on 23 percent of their units and 43 percent say that they paint an average of 22 percent of the units. One respondent said they only do touch ups and never paint the whole outside of the machine. Finally, one dealer (4 percent) repairs the thermostats, timers and controls on 3 percent of their units.

Table 6-17. What Upgrades/Repairs Dealers Perform on Used Refrigerators After Obtaining Them (Percent)*

Type of Upgrade/Repair	***Dealers***	***Average Percent of Dealers Business***	***Weighted Percent of Total Units***	***Weighted Percent of Total Units Adjusted***
Some repair/upgrade to used machines	86	100	46	72
Cleans machines	86	90	32	50
Repairs defrost controls	64	29	8	12
Checks refrigerant charge levels	61	45	8	12
Repairs door seals	54	23	3	5
Paints outside of machines	43	22	5	8
Repairs thermostats, timers or controls	4	3	0	0
N Total	28		13,116	8,316

*Dealers could supply more than one response

Table 6-18 provides information on the parts that used appliance dealers salvage from used units. Overall, 57 percent of all used appliance dealers salvage parts from inoperable machines for reuse in other machines with low market value. Thirty-six percent salvage coils, condensers, and physical parts (such as shelves and handles), while thirty-two percent salvage compressors. Only one dealer (4 percent) salvages thermostats, timers or controls from inoperable or low-market units for reuse in other units.

Twenty-nine percent of used appliance dealers remove refrigerant from machines. Twenty-five percent reuse the refrigerant and 21 percent sell it on the secondary market.

Table 6-18. Parts That Used Appliance Dealers Salvage from Used Units (Percent)*

Type of parts salvaged for reuse	***Dealers***
Salvages parts from inoperable or low-market machines for reuse in others	57
Salvages coils	36
Salvages condensers from machines	36
Salvages physical parts such as shelves and handles	36
Salvages compressors from machines	32
Salvages thermostats, timers, or controls from machines	4
Salvages evaporator fans from machines	4
N Total	28

*Dealers could supply more than one response

6.3.5 How Customers Hear About and Contact Used Appliance Dealers

Table 6-19 provides information on how customers hear about and contact used appliance dealers. The majority of customers (61 percent) find out about the dealer via the yellow pages. Twenty-five percent hear about the used dealer from newspaper ads, 18 percent hear about the dealer through word-of-mouth, and seven percent are informed via the Internet. One dealer (4 percent) uses door-hangers to advertise their business.

Table 6-19. How Customers Find Out about Dealers Services (Percent)*

How Customers Find Out about Dealer	***Dealers***
Yellow pages	61
Newspaper/Penny Saver	25
Word-of-mouth	18
Internet	7
Door Hangers	4
Referral from community waste management/waste haulers	0
TV	0
Radio	0
New Appliance dealers	0
N Total	28

*Dealers could supply more than one response

Table 6-20 indicates how customers contact used appliance dealers. Three quarters of customers contact the dealer over the phone, 39 percent walk into the store, and seven percent use the Internet. Clearly, some customers use more then one of these sources.

Table 6-20 How Customers Contact Used Appliance Dealers (Percent)*

How Customer Contacts Dealer	***Dealers***
Phone	75
Store visit	39
Internet	7
N Total	28

*Dealers could supply more than one response

6.3.6 Used Appliance Dealer Awareness of RARP

The final goal of the survey was to gain an understanding of how used appliance dealers view the RARP. Thirty-six percent (10 firms) of the used dealers were aware of RARP. Of those dealers, three think the RARP is influencing their business. Even after the RARP was described, none of the dealers who were previously unaware felt that the program was affecting their company.

The survey also inquired about the possibility of the RARP partnering with used dealers. Four of the used appliance dealers think that there are ways for their business to cooperate with the program. Two suggested that if they received older units that could not be resold, the used dealer could refer the customer to the program. Another firm suggested that the program could offer the used dealer some of their newer units that are efficient and can be resold. Six used dealers felt that there was no way to cooperate, with the program with several saying that that they viewed the program as competition. Eighteen of the dealers were unsure if cooperation was possible or not.

6.4 MARKET ASSESSMENT CONCLUSIONS

There are roughly 10 million households in the IOU territories. In 2005, it is estimated that 703,000 refrigerators were transferred by households that were eligible to participate in the RARP Program. This excludes refrigerators transferred from multifamily rental properties owned by large companies.

RARP disposed of approximately 82,500 of these refrigerators. Of the remainder, it is estimated that 25 percent went to a dealer as part of a transaction for a new appliance, 24 percent were given away, 21 percent were thrown-out or recycled, 11 percent were sold, and the balance of 7 percent were disposed in unknown ways.

Of the refrigerators that were given away, nearly 80 percent were given to family, neighbors or friends. The balance went to charities. Of those that were sold approximately 60 percent were sold to a friend while the remainder were sold through advertisements or at estate sales. Of those that were thrown out or recycled just under half were picked-up for junking, slightly more than a third were taken to be recycled and the balance went directly to a landfill.

Of the 703,000 refrigerators, an estimated 269,000 are still in the market. Just about half are being used in households as primary or secondary refrigerators. About two-thirds are primary refrigerators and another third are secondary. The other half of the refrigerators have found other markets.

Of refrigerators that are given away, about 20 percent are given to charities. The Salvation Army is now the only charity that is handling large quantities of refrigerators. They transfer about an estimated 33,000 units within the IOU service territories. About 6,500 of these are sold directly to households through Salvation Army stores.

Households sold approximately 78,000 used refrigerators in 2005. As noted above about 60 percent of these go to family, friends, and neighbors. The balance is sold through advertisements or through estate sales, most likely through craigslist or the PennySaver. The median asking price for these refrigerators is about $200. More than half of these refrigerators are 20 cubic feet or more. Eighty-five percent or more of these refrigerators appear to be 10 or fewer years old.

Major appliance dealers generate two streams of refrigerators. One of the streams is new refrigerators that are out-of-the box. Most of the major appliance dealers have a contractor who removes these and auctions them or sells them direct. For the purposes of this assessment, this stream is of little interest.

The second of the streams is comprised of appliances that are removed by the logistics services when a major appliance dealer sells a new appliance. It is estimated that about a quarter of used appliances are generated in this manner. The major appliance dealers typically have a contract with a used dealer or recycler who removes the units from the major appliance dealer's site and resells or recycles the appliances. There appears to be a fair amount of leakage of these units back into the market. There is evidence that personnel at the logistics companies may skim these units and may also skim units from homes where a removal was not scheduled. The latter practice may account for a quarter to a half of the 20 percent of cancellations in the RARP program.

It has been suggested the programs may want to work with the major appliance dealers to remove refrigerators. Skimming appears to be a problem that is difficult to control and would result in a significant reduction in the net-to-gross ratio of the program. The program may not want to consider this option because of this problem and the difficulty in establishing a disciplined process.

Based on an effort to survey dealers in used appliances, it is estimated that there are about 500 used appliance dealers in California. These dealers appear to represent a fairly transient group, based on the number of disconnected telephone numbers. It is estimated that used appliance dealers transfer approximately 50,000 units annually. They prefer to deal in units that are white, of most sizes, and generally less than ten years old. The largest percentage of units they obtain (48 percent) came from contracts with appliance dealers. The next three most common sources at approximately 10 percent each are: appliance auctions, direct pick-up from homes, and recovery of a unit as a result of selling a new unit. A typical dealer sells a median of 222 refrigerators per year. About 40 percent of the units are sold by dealers who sell fewer than 50 refrigerators annually. The median price of the units they sell is just under $200. Seventy percent of the units are sold in a store and about 10 percent are taken to recyclers.

The dealers say that they do some repair on approximately 72 percent of all units and that they clean about half of them. Sixty-one percent of the dealers say that they check the refrigerant on about 45 percent of units.

Only 36 percent of the used dealers were aware of RARP. Only three of these dealers think that RARP is influencing their business. When told about RARP, dealers who were not aware of it and didn't think it was influencing their business.

Finally, about 43 percent of the used dealers say that they cannot sell all of the units that they have. Forty-six percent say that they could sell an average of 36 more units per month if they could obtain them.

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APPENDICES

LIST OF APPENDICES

APPENDIX A
CPUC IMPACT REPORTING TABLES

This appendix contains the impact reporting tables for the 2004-2005 RARP, as prescribed by the CPUC for evaluations of 2004-2005 programs.

SCE Program Energy Impact Reporting for 2004-2005 Programs

Program ID*:	1232-04					
Program Name:	Residential Appliance Recycling (PGC)					
	Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Net Peak MW Savings
	1	2004				
	2	2005	154,718	77,976	26.4	18.0
	3	2006	154,718	77,976	26.4	18.0
	4	2007	154,718	77,976	26.4	18.0
	5	2008	154,718	77,976	26.4	18.0
	6	2009	154,718	77,976	26.4	18.0
	7	2010	154,718	77,976	26.4	18.0
	8	2011				
	9	2012				
	10	2013				
	11	2014				
	12	2015				
	13	2016				
	14	2017				
	15	2018				
	16	2019				
	17	2020				
	18	2021				
	19	2022				
	20	2023				
	TOTAL	**2004-2023**	928,309	467,854	158.2	108.0

SCE Program Energy Impact Reporting for 2004-2005 Programs

Program ID*:	1157-04					
Program Name:	Residential Appliance Recycling (Procurement)					
	Year	**Calendar Year**	**Gross Program-Projected MWh Savings**	**Net Evaluation Confirmed Program MWh Savings**	**Gross Program-Projected Peak MW Savings**	**Evaluation Projected Net Peak MW Savings**
	1	2004				
	2	2005	134,221	16,566	22.9	3.8
	3	2006	134,221	16,566	22.9	3.8
	4	2007	134,221	16,566	22.9	3.8
	5	2008	134,221	16,566	22.9	3.8
	6	2009	134,221	16,566	22.9	3.8
	7	2010	134,221	16,566	22.9	3.8
	8	2011				
	9	2012				
	10	2013				
	11	2014				
	12	2015				
	13	2016				
	14	2017				
	15	2018				
	16	2019				
	17	2020				
	18	2021				
	19	2022				
	20	2023				
	TOTAL	**2004-2023**	805,325	99,397	137.3	22.9

SCE Program Energy Impact Reporting for 2004-2005 Programs

Program ID*:						
Program Name:	Residential Appliance Recycling (2005 Summer Initiative)					
	Year	**Calendar Year**	**Gross Program-Projected MWh Savings**	**Net Evaluation Confirmed Program MWh Savings**	**Gross Program-Projected Peak MW Savings**	**Evaluation Projected Net Peak MW Savings**
	1	2004				
	2	2005	18,246	26,409	3.1	6.0
	3	2006	18,246	26,409	3.1	6.0
	4	2007	18,246	26,409	3.1	6.0
	5	2008	18,246	26,409	3.1	6.0
	6	2009	18,246	26,409	3.1	6.0
	7	2010	18,246	26,409	3.1	6.0
	8	2011				
	9	2012				
	10	2013				
	11	2014				
	12	2015				
	13	2016				
	14	2017				
	15	2018				
	16	2019				
	17	2020				
	18	2021				
	19	2022				
	20	2023				
	TOTAL	**2004-2023**	109,476	158,454	18.9	36.0

PG&E Program Energy Impact Reporting for 2004-2005 Programs

Program ID*: 1114-04
Program Name: Residential Appliance Recycling

Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Net Peak MW Savings
1	2004				
2	2005	42,965	25,732	7.7	6.3
3	2006	42,965	25,732	7.7	6.3
4	2007	42,965	25,732	7.7	6.3
5	2008	42,965	25,732	7.7	6.3
6	2009	42,965	25,732	7.7	6.3
7	2010	42,965	25,732	7.7	6.3
8	2011				
9	2012				
10	2013				
11	2014				
12	2015				
13	2016				
14	2017				
15	2018				
16	2019				
17	2020				
18	2021				
19	2022				
20	2023				
TOTAL	**2004-2023**	257,791	154,394	46.2	37.5

SDG&E Program Energy Impact Reporting for 2004-2005 Programs

Program ID*: 1348-04
Program Name: Residential Appliance Recycling

Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Net Peak MW Savings
1	2004				
2	2005	28,648	19,390	4.8	4.4
3	2006	28,648	19,390	4.8	4.4
4	2007	28,648	19,390	4.8	4.4
5	2008	28,648	19,390	4.8	4.4
6	2009	28,648	19,390	4.8	4.4
7	2010	28,648	19,390	4.8	4.4
8	2011				
9	2012				
10	2013				
11	2014				
12	2015				
13	2016				
14	2017				
15	2018				
16	2019				
17	2020				
18	2021				
19	2022				
20	2023				
TOTAL	**2004-2023**	171,888	116,337	28.9	26.5

Sum Of Energy Impacts for This 2004-2005 Program

Program IDs*:
Program Name: Residential Appliance Recycling

Year	Calendar Year	Gross Program-Projected MWh Savings	Net Evaluation Confirmed Program MWh Savings	Gross Program-Projected Peak MW Savings	Evaluation Projected Peak MW Savings
1	2004				
2	2005	378,798	166,073	64.9	38.5
3	2006	378,798	166,073	64.9	38.5
4	2007	378,798	166,073	64.9	38.5
5	2008	378,798	166,073	64.9	38.5
6	2009	378,798	166,073	64.9	38.5
7	2010	378,798	166,073	64.9	38.5
8	2011				
9	2012				
10	2013				
11	2014				
12	2015				
13	2016				
14	2017				
15	2018				
16	2019				
17	2020				
18	2021				
19	2022				
20	2023				
TOTAL	**2004-2023**	2,272,790	996,436	389.5	231.0

APPENDIX B
RARP HISTORY AND THEORY

The Residential Appliance Recycling Program (RARP) is available to eligible customers on a first come first served basis in the service territories of the California Investor Owned Utilities (IOUs): Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E). Each utility manages its own program while adhering to agreed upon common elements.

In 2004-5, the program targeted residential customers for removal of inefficient but functioning (meaning still cooling) pre-1991 14 to 27 cubic foot refrigerators and/or freezers. For the SCE program the age restriction was removed May 1st 2005. The goal of the program is to reduce energy consumption and coincident peak demand by accelerating the removal of less efficient refrigerators and freezers from the grid. Additional goals of the program are to educate customers about the energy efficiency benefits of recycling older refrigerators and freezers and the non-energy benefits from recycling in an environmentally friendly manner.

The program accepts a maximum of two refrigerators and/or freezers annually from a household that have either been displaced by another refrigerator or freezer and/or represent a second, third and even fourth refrigerator that is being disposed by a household. The program offers free pick-up of the appliance and a cash incentive for participation. Program contractors pick-up and dispose of the refrigerators in an environmentally safe manner.

B.1 BRIEF HISTORY OF THE REFRIGERATOR RECYCLING PROGRAMS

Refrigerator recycling programs have been around since the inception of demand-side management programs in the late 1970s. PG&E, partnering with the Salvation Army, started a refrigerator recycling program in the late 1970s. Initially that program would accept any refrigerator whether working on not. That early program was refined and emulated by utilities in other parts of the country, for example, by Wisconsin Electric Power Company. Early on, PG&E realized that accepting nonworking refrigerators reduced net savings and resulted in a low benefit-to-cost ratio. For this and other reasons, PG&E decided to terminate the program in the1980s.

In 1994, SCE implemented its first full year of refrigerator and freezer recycling. SCE's program accepted only working tertiary refrigerators. Participants received $25 or $50 savings bond for participating in the program. A report from the 1994 program year reported 48,000 recycled refrigerators with net savings of 31.1 GWh per year and net savings of 674 kWh and 473 kWh per refrigerator or freezer respectively. A report for the 1996 program year stated that 25,000 refrigerators were recycled with utility level net savings of 29.1 GWh and net savings per unit of 1141 and 1182 kWh per unit for refrigerators and freezers respectively. In 2002 the utilities collected 38,409 refrigerators and 4,761 freezers resulting in a net savings of 30.8 GWh.

The program changed starting in 1999, when program rules were relaxed to allow for the pick-up of primary as well as secondary units. Primary units became the dominant units removed by the program. A cash incentive replaced the savings bond and participants could opt to select a package of five CFLs instead of the incentive. The CFLs were not a wildly popular option. Starting in 2002, the CPUC offered the program through third party contractor arrangements in the SDG&E and PG&E service territories. PG&E and SDG&E took over the administration of the program in their service territories in 2004.

Concerns about net-to-gross savings led the CPUC to impose restrictions on the eligibility of refrigerators in the 2004-5 program years. Refrigerators manufactured after 1990 and refrigerators smaller than 14 cubic feet were not eligible for the program. Refrigerators newer than 1990 were perceived to be more efficient than earlier refrigerators and were assumed to reduce the net-to-gross savings and the overall benefit-to-cost ratio. The age restriction was removed during the 2005 program year and refrigerators of 10 cubic feet or more were once again eligible for the program. The 2004-5 program offered a $35 dollar incentive for refrigerators and freezers. SCE petitioned and was granted permission to increase the incentive for freezers from $35 to $50 after May 1st, 2005. The SCE refrigerator incentive has remained at $35 as did the refrigerator and freezer incentives at the other utilities.

The market has changed in various ways. Over the years a market for used refrigerators developed in Mexico. That market was for smaller refrigerators, such as 14 cubic foot units. At least one or more of our informants told us that particular market is now in decline.

New appliance dealers have gotten out of the business of selling used refrigerators and now contract with recyclers to take the units that are removed from households. New appliance dealers also contract with many of these same dealers to take out-of-box and scratch and dent units. Used dealers who sell appliances are primarily interested in clean full-featured units that are less than 10 years old.

Another major factor in the market has been the changes in environmental law. Firms servicing or dealing with refrigerators must now be licensed. The refrigerant in the refrigerators and freezers must be removed before the appliances can be recycled. Because of the cost of safe removal of refrigerant from all units, not just working units, firms and organizations that previously had been taking used units have gotten out of this activity. As we shall see later, there is only one major charity that continues to take refrigerators in large numbers and then only if the refrigerator is working.

B.2 GENERAL LOGIC MODEL FOR RARP

This section presents a general logic model for RARP.

B.2.1 Overview of Logic Models

Typically a logic model includes a graphic and a written description of the program. A logic model represents two interrelated logics (or two causal sequences) associated with a program in a two dimensional space. A sequence of key program activities is presented in one dimension. For instance, the development of the program infrastructure must occur before the program is marketed; the program must be marketed before customers can be recruited, etc. It is implicitly assumed, if not always stated, that there is feedback from later to earlier activities. In other words, if marketing activities are unsuccessful, program managers or evaluators will observe this and the marketing activities and or content will be changed.

The second dimension, sometimes called the performance spectrum, is the logic associated with activities. This logic says that resources are required for an activity to occur; the activity occurs and produces outputs; partners and target audiences react to the outputs producing outcomes (short-term outcomes), and the outcomes produce additional outcomes and long-term outcomes or impacts (energy savings, demand reductions, etc.). Like the sequence of activities, there is an implicit assumption that there is feedback between the later and earlier elements in the spectrum. The long-term outcomes (impacts) reflect the goals of the program. Logic models that are complete identify partners, target audiences, and external factors that influence the program. Examples of external factors are changes in refrigerator prices or the marketing and disposal practices of large retailers that may influence the market for used appliances.

Program logic models have numerous uses. They can:

- Provide a brief but powerful description of a program.
- Assist in developing a credible theory for how a program works
- Assist in identifying gaps in existing programs
- Assist in identifying program elements that may not be useful
- Provide a systematic basis for developing evaluation questions
- Provide a systematic basis for identifying metrics
- Help to track the development of a program, i.e., are the necessary elements of the program falling into place.

B.2.2 Logic Model for RARP

Figure B-1 is the general logic model for the Residential Appliance Recycling Program. In this logic model, the activities are oriented in the horizontal direction and the performance spectrum in the vertical. This is a generic program model. In reality, there are variations in how the three utilities run their programs. These are discussed in Section B.3. For the customer, these differences are largely unseen.

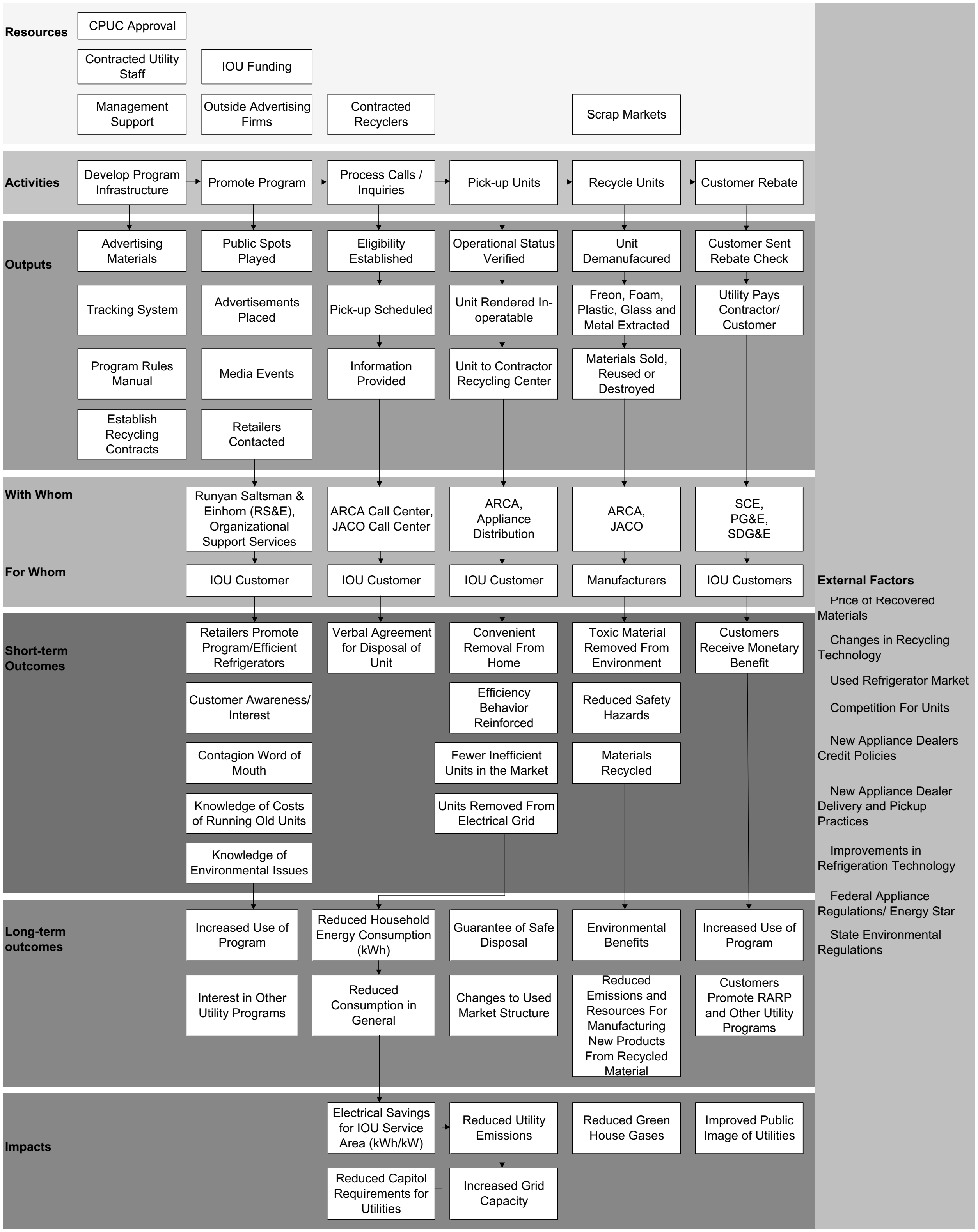

Figure B-1. General Logic Model for the California Residential Appliance Recycling Program

B.2.2.1 Activities and Outputs

Because they are so closely intertwined, activities and outputs are discussed at the same time. The blue area (second from the top) displays the main program activities:

- Develop program infrastructure
- Promote or market the program
- Process inquiries and requests for appliance removal
- Pick-up the appliances
- Recycle the units
- Process the incentives

These activities produce the program outputs shown in the darker blue area, the third section from the top.

Program infrastructure development activities involve such things as gathering market knowledge, setting the goals for the program, designing the program, establishing the rules, developing the marketing approaches and content, and establishing the institutional and operating structures that are needed. The outputs associated with infrastructure development activities include tracking systems, the contracts for the recycling firms and marketing materials, including print advertisements and public service announcements, and a functioning program operation.

Program promotions draw targeted customers into the program. The outputs of program promotions are bill inserts, direct mailings, advertising placed in print media, television and radio advertisements, public spots that are placed or played on radio or television, news releases, media events that attract the news media, information provided to appliance retailers who make it available to customers, e-mail blasts and utility/program websites. The program also leverages other statewide and outreach campaigns such as those that offer information and education, e.g., Flex Your Power Statewide Marketing and Outreach Campaign, Univision.

Another key activity is *processing inquiries and requests for appliance removal*. Customers place a call to the recycling contractors' call centers to arrange for the disposal of appliances. In 2004 and 2005, customers could also sign-up for removal of refrigerators or freezers via the utility / contractor website in the SCE service territory. Upon receiving a call, the contractors verify that the customer is a utility customer, that the unit is operable, that the unit is within the specifications of the program, and that the customer has not reached the limit of two units for the current year. The contractors then schedule the soonest possible day and time for appliance removal that is convenient for the customer based on a pre-established routing schedule. The customers are informed that they will receive a reminder call 24 hours in advance and are told that the unit must be plugged in and operating so that the driver can verify that the unit is functional. The call centers also handle calls from customers who call to cancel or reschedule the appointment and customers seeking information.

The key outputs of this activity are:

- Establishing customer eligibility
- Establishing the eligibility of the appliance
- A schedule for removing the unit from the customer's residence
- Providing information to the customers / potential customers about the service.

Contractors *complete the pick-up of the units*. The contractors call the customer 24 hours in advance to give them a four-hour pick-up window. The four-hour window is required by law in California. The customers are reminded that the units must be plugged in to verify that they are operable. The operators usually try to speak directly with a person but will leave a message on an answering machine.

Drivers are given a list of locations for appliance removal. ARCA drivers receive their lists at the end of the previous day and are responsible for their own routing. JACO drivers are given a list and a computer generated routing.

The pick-up crews go to the household to retrieve the refrigerators. The crew verifies that the unit is cooling and that it meets other requirements. They then cut the cord and smash the controls. The crews have found that some customers become emotional about this procedure so they will typically cut the cord but wait until they are on the truck to disable the controls. The crews bypass households where no one is home even if a refrigerator is sitting outside of the home. JACO will remove a unit if there is a note left on the machine specifically identifying it for removal. If they miss the householder on the first pass and the route is fairly compact, drivers may swing by a household a second time. Approximately 20-25units will be collected on a route on a given day, although this number can vary widely based on geographic location and time of the year. It is not unusual to have a few missed appointments (i.e., "last minute" cancellations, requests to reschedule, "no shows"). Units are taken to the recycling center for de-manufacturing.

Recycling units involves removing glass and plastic components, parts with PCBs and mercury from units that have them, the refrigerant and oil, opening the case to remove the foam insulation, disposing of the foam insulation, and then selling the refrigerant and other materials to appropriate dealers. There are variations in the processes of the two contractors that are discussed later in this report.

ARCA sends an incentive check to the customer and provides participation data to SCE and SDG&E. JACO provides participant data to PG&E which processes it and mails the rebate checks.

B.2.2.2 With Whom and for Whom

The primary targets of this program are residential customers that own refrigerators and/or freezers. There is a cast of partners with which the program works. In terms of program promotion, SCE works with its marketing department, which in turn works with a contractor(s) to do the promotion. JACO partners with Runyon, Saltzman, & Einhorn, Inc to do the promotion for PG&E. On occasion, there are marketing activities at the corporate utility level that may include mention of the RARP. In addition, the "Flex Your Power Program," also promotes RARP in some of its work. In addition to the utility websites, there are a number of other non-utility websites that link to one or more of the utility websites. SCE uses Organizational Support Services to do outreach with major new appliance dealers in the SCE service territory.

JACO subcontracts with Appliance Distribution Inc to collect refrigerators in the PG&E service territory.

ARCA and JACO partner with other firms to dispose of the materials that are recovered from the refrigerators.

B.2.2.3 Outcomes

Outcomes are the result of partners and target audiences responding to the outputs of the programs. In response to a visit from the circuit rider, retailers may respond by placing information on the sales floor. They may also respond as a result of inquiries by customers.

The remaining outcomes are primarily customer outcomes. The promotional aspects of the program result in customer awareness of the program. The promotion may also induce contagion as customers who have heard about the program tell others about it whether or not they have actually used the program. Promotion may also increase customer awareness of the amount of energy consumed by refrigerators and freezers, especially older units.

Another outcome is the commitment or agreement to have a refrigerator removed when the customer places a call to the call center or visits the website. As we shall see, it's not unusual for customers to change their minds and dispose of their refrigerator(s) in some other way.

Other short-term outcomes are the convenient removal from the home and the receipt of the incentive. The household is likely to feel good about the removal of the unit and their efficiency behaviors may be reinforced for their participation. In this optimal case, the unit is no longer connected to the electrical grid and there is one less unit that may appear in the used appliance market.

Other short-term outcomes from recycling the unit are a reduction in toxic materials in the environment, a reduction in safety hazards, and the safe recycling of materials.

This program has a number of intermediate outcomes. Knowledge of the program may spread by word-of-mouth leading to greater interest and use of the program. Knowledge of the program may also lead households to seek information about other efficiency programs and to use them. The removal of a unit or units reduces household energy consumption and may reduce demand as well. The program reduces energy costs for the household.

The program may also lead to changes in the structure of the used refrigerator market. For example, the program may lead to fewer units available to used refrigerator dealers or may reduce the demand for used refrigerators as people learn about their consumption. The program may also lead to increased availability of recycled raw materials.

The long-term outcomes or impacts include a reduction in energy and demand at the grid level. In turn this may reduce the need for capital expenditures at the distribution or the grid level. The program also serves to reduce emissions from power plants. The embedded energy in new products is reduced when the copper and steel in refrigerators is recycled and reused and environmental hazards associated with producing copper and steel from raw materials is reduced as well.

B.2.2.4 External Factors

External factors are those forces at work outside the program that can influence program results. There are a number of examples of how such factors have influenced this program in recent years. For example, the price of CFCs, which the recyclers resell in the market, is declining as the demand for CFCs decline in response to the phase-out of these materials. Countering this trend are the prices of copper and steel. Copper prices have increased rapidly recently. Steel prices have increased in response to demand in Asia and elsewhere. As we shall see later, copper prices are sufficient enough to make it worthwhile to ship compressors to India to have the copper stripped from them.

Changes in recycling technology may influence the market as well. For example, the giant shredders in use at some scrap metal companies are fully capable of shredding multiple refrigerators at once, reducing them to small pieces, and destroying the toxic gases from plastics and other items due to the high heat generated by the friction within the shredder. According to a representative from a scrap processing firm, the shredder passes emissions tests.

As noted previously there have been changes in the used refrigerator market during the last ten years. The competition for used units may have changed as well. New appliance dealers have changed their patterns of behavior and contracted with firms to recycle used units they have collected. These firms disassemble the units that have little utility value. These recycling firms contract with used dealers to sell the desirable used units. The way in which firms handle out-of-box units may tend to displace the demand for some used units. The availability of credit at large appliance dealers may make low-end new units reasonably competitive with units re-entering the market. We have previously noted that changes in state regulations have led to changes in the market. Changes in refrigeration technology may reduce or increase the life span of refrigerators and/or cause a further reduction in the consumptions of units.

B.3 VARIATIONS IN THE UTILITY PROGRAMS IN 2004-5

There are variations in the way in which the programs are operated by the utilities. It is unclear how much effect these differences may have on participation. Some of these are totally transparent to the customer.

One variation during the period of the study was the use of websites for customer sign-ups. SCE was doing this in 2004-5. PG&E's contractor had implemented this at the beginning of 2006. Another difference is in the way that media were being handled. SCE and SDG&E were handling these chores in-house with implementation support from outside contractors. ARCA was not directly involved in program promotion. On the other hand JACO was responsible for program promotion and was using its contractor to deliver those services. SCE and SDG&E reported using circuit riders to visit appliance dealers but PG&E through JACO did not. There were no readily apparent differences in outputs or outcomes that were traceable to responsibility for program promotion.

ARCA was responsible for mailing incentive checks to customers, while JACO presented a list of recipients to PG&E for payment. There appear to be few ramifications resulting from this difference as well.

As part of its 2005 Summer Initiative, SCE did increase its incentive for freezers from $35 to $50 in an attempt to increase the number of freezers entering the program. The other utilities did not.

APPENDIX C
APPLIANCE RECYCLING AND DEMANUFACTURING

Refrigerators and freezers can be recycled in a number of different ways. It is useful to describe these paths because in the longer-term one or two of these paths may represent more cost-effective methods for disposing of refrigerators and freezers than the methods in current use by the program. It is also helpful to understand how units that are not part of the program make their way out of the system.

The information in this appendix is based on interviews with staff of ARCA and JACO, findings from a questionnaire sent to recyclers, and telephone interviews with recyclers and community waste programs.

C.1 RARP RECYCLING PROCESSES

There were differences between the recycling contractors (ARCA and JACO) in the methods by which materials were recycled. These differences are summarized in Table C-1. The main differences in recycling methods had to do with the way in which the refrigerant and compressor oils were removed, the way in which the shells were disassembled to remove the foam insulation, and the disposal of the foam insulation. There were also some differences in how the materials were recycled.

Table C-1. Disposition of Materials from the Demanufacturing of Refrigerators

Demanufacturing End Results	***ARCA***	***JACO***
Cables		Shredded and recycled
Fiber and tempered glass	Shredded and recycled	Sold to be shredded to be used in potting soil for aerations
Capacitors containing CFC and mercury switches	Disposed of as hazardous waste	Disposed of as hazardous waste
Refrigerants	Sold and reclaimed	Sold and reclaimed
Compressor oil	Refined and reused	Reclaimed
Compressors	Sent to scrap dealers	Sold in Indian market for copper recovery
Plastics and metals	Sent to be shredded and recycled	Sent to be shredded and recycled
CFCs in foam insulation	CFCs extracted with solids made into bricks. Bricks can be ground up and spread on landfills to control dust	Sent to be burned in environmentally safe manner. Energy used to produce electricity and sold back to the grid.

C.1.1 JACO Recycling Process

When program refrigerators reach JACO's recycling facility, cables, glass shelving, capacitors, and mercury switches are extracted, and the door is removed. The capacitors and mercury switches are stored for later shipment to a firm that disposes of them in an environmentally safe manner.

The refrigerators are then sent to a vacuum extraction machine (SEG) to have the refrigerant/oil removed from the cooling circuit. A machine lifts the refrigerator using a hydraulic hoist automatically positioning the refrigerator so that the cooling circuit is at its lowest position. An extraction tool is used to punch a hole and insert a nipple with an external seal in the refrigerator line to prevent the escape of CFC's. A gauge measuring the pressure indicates the cooling system is intact. The SEG machine then extracts the refrigerant and oil through a vacuum line. This process is entirely computerized eliminating manipulation from the operator and assuring that no residual fluid remains in the compressor.

The vacuum unit separates the CFC's from the oil through a process that heats the mixture to drive off the CFC's. The CFCs are removed and stored in large compressed gas cylinders. The refrigerants (R134 and R12) are sent to Total Reclaim Inc., a firm specializing in environmental management, to be recycled and reused. JACO indicated that they believe that R12, like R11, will soon be destroyed rather than recycled because the equipment in which it is used is becoming obsolete and the recycle value is diminishing.

After the extraction is completed, the supports for the compressor are cut and it is removed. JACO sells the compressors to the Indian market where it is still economical to separate the copper components in the compressor from other elements. At the time of the interviews, the value of the compressors was estimated at about seven dollars.

JACO uses Sawzall hand tools to cut the refrigerator/freezer body open and the workers use shovels or similar tools to chip the polyurethane foam containing CFCs from the refrigerator shell. JACO has a band saw that is capable of doing the cutting but at the time we observed the process they believed the Sawzall method was more productive. The foam from each refrigerator is placed in clear bags. Each bag represents the foam from one refrigerator. Each refrigerator yields from zero to eleven pounds of polyurethane foam containing one pound of CFCs. The bagged foam is sent to a firm that burns the foam in a way that prevents the CFCs from being released to the atmosphere and in the process uses the released energy to produce electricity that is returned to the grid. According to JACO each bag of foam yields about 7 kWh of electricity.

The plastics, aluminum, and tempered glass are recycled. The tempered glass is sold to a company that puts it in potting soil to aid in aeration. At the time of the interview ten pound bags fetched about ten dollars. It is also being used on dirt roads to reduce dust.

C.1.2 ARCA Recycling Process

At ARCA, refrigerators and freezers are removed from trucks and the door, the plastics and aluminum or glass shelving is removed. These products are either recycled or sent to landfills.

Workers separate refrigerators with foam insulation from those with fiberglass. In most instances the workers know from experience the type of insulation in the refrigerator. They can determine what it is by knocking on the side. When they are unsure they drill a hole in the side of the unit to verify the type of insulation. Refrigerators are then placed on a carrier and moved along a conveyor belt.

At the first station, a worker removes the capacitor and mercury switches when they are present. The worker in this area wears special safety equipment, including safety boots that never leave the designated area because the capacitors can be laden with PCBs. The worker locates the nameplate, separates the refrigerators by type of refrigerant, and then moves them further along the assembly line. Capacitors and mercury switches are taken in bulk to a secure room where they are stored until they can be sent to be destroyed through high temperature incineration at a licensed and permitted hazardous waste facility.

At the next station, a modified vice grip like tool with a punch surrounded by a pad to for a seal (similar to the one used by JACO) is connected to the refrigerant line. After several refrigerators are connected, a vacuum pump extracts the refrigerant from the group of refrigerators. We were told that it takes about one minute to hook up each refrigerator. Once the refrigerant is removed, the machines are sent to a drill station where a hole about a three quarters of an inch in diameter is drilled in the compressor hosing. The refrigerator then moves along the line to a frame that tips three refrigerators at a time onto their backs allowing the oil in the compressor to be drained into a trough. Minimal residue is left in the compressor. The oil is collected and sent to a recycler to be refined and reused. The CFCs are transported to Coolgas, CFC Refimax, LLC, or another facility for reclamation and reuse.

The units with polyurethane foam insulation move forward to the saw room. The saw room is an acoustically isolated from the rest of the work area. There are two operators in the room. Two refrigerators are placed on the band saw table in such a way that their face can be cut and removed. The band saws cut the refrigerators into pieces that are then transported from the band saw room by conveyer. Because of the way in which they are cut, experienced workers can separate the foam from the refrigerator shell by peeling the metal from the foam. On some units, the foam adheres firmly to the metal and needs to be scraped from the shell. The method used by ARCA appears to require less scraping than the method employed by JACO.

The foam is taken to an A-55 machine manufactured by Adelmann, a German company. Water is mixed with foam and the mixture is heated to drive the CFCs from the liquid. The CFC's are captured and the foam comes out in the form of a cylindrical CFC free brick known as hydroscopic polyurethane.

ARCA has come up with several possible uses for these bricks, including utilizing of the substance for insulation in buildings. While they have identified several uses, the small production runs limits the demand for the product. Currently it's used as cover for landfills to minimize dust.

About 98 percent of the CFCs are recovered using the A-55 machine and resold into the market. However, as stated previously the market for CFCs is declining and as it does, it is likely that the CFC's will be incinerated.

The metal shell is compacted and sent to a wholesale recycler to be shredded. The non-PCB containing compressors, motors, shelving and wiring are also sent for recycling.

C.2 OTHER RECYCLING AND DEMANUFACTURING FIRMS

Another path for refrigerators is through non-program related appliance recyclers. The appliance recycling market has been greatly affected by recent California regulations dealing with repairing, recycling, and destroying refrigerators and freezers. Locations that repair appliances must be registered with the Bureau of Electronic and Appliance Repair. There are approximately 2,850 firms listed on this registry.

Firms are required to obtain licenses and follow regulations when demanufacturing or recycling refrigerators and other similar devices such as air-conditioners including automobile air conditioners. In early 2006, the Certified Appliance Recyclers (CAR) list that is posted on a California State website, listed 68 recycling firms with 86 sites in California. Most of these deal scrap including automobiles and other large objects. After attempts to contact each firm, it was determined that as many of as 84 percent or 72 of these sites may actually demanufacture or recycle the materials form refrigerators and/or freezers.

C.2.1 Small Metal Recyclers

Based on our analysis of the CARS list and our survey, we believe that the there are somewhere between 25 and 30 nonprogram related recyclers. From the data that we collected we believe that these operators recycle between 250 and 5,000 units annually. The average number of units for the ten firms who responded to the survey was around 1900 units annually. At an average of 1,900 units annually, this group would account for 55,000 to 60,000 units. This group includes firms that recycle to capture refrigerant. With the decline in demand and the price of refrigerant, the number of firms recycling refrigerators to capture refrigerant is likely to decline.

Some of the firms obtain units from new dealers, some may deal with local communities, and some may receive units directly from the public. The units from dealers may include out-of-box units that are nearly new but that cannot be sold as new units. These recyclers sort the refrigerators into those with resale value and those to be recycled. Refrigerators with value may be sent to auction or sold to used appliance dealers. Like ARCA and JACO, these firms process the appliances to be taken to recycle to some degree. This involves the removal of the refrigerant and capacitors and mercury switches. In a case where we were able to observe the operation of a firm, the refrigerant, capacitors, and mercury switches were removed and the refrigerators were taken to the wholesale scrap dealer without further processing. The refrigerant is sold to a firm specializing in refrigerant. According to our recyclers' questionnaire, 25 percent of the foam is destroyed, 50 percent is sold or recycled, and 25 percent is disposed of through another method.

Refrigerant recycling companies that process refrigerators are very much like small recyclers. In this case the refrigerant is captured for reuse. Units are received and processed in a manner similar to smaller metal recyclers. We were unsuccessful in getting one of the refrigerant recyclers to talk with us so the methods of managing the refrigerant are unclear.

C.2.2 Wholesale Recyclers

Wholesale recyclers are large operations at the end of the recycling chain. These are the companies that deal in the materials markets. The steel and copper often go to Asia. The wholesale recyclers typically have multiple sites in California. Many of these sites have been acquired through acquisition of small pre-existing firms. Wholesale recyclers typically deal with automobiles and therefore have to deal with the refrigerants in automobile air-conditioning units as well. Wholesale recyclers may process 100,000 or more refrigerators and freezers annually. These units may or may not previously have been partially disassembled.

Refrigerators or materials from refrigerators typically come to wholesale recyclers in one of three ways. The may come as scrap from firms that recycle refrigerators such as ARCA and JACO. They may come from licensed recyclers that have extracted the refrigerant and brought the refrigerator to the recycler. Or, they may come as "intact" units where there has been no attempt to remove the refrigerant.

Units received from licensed firms from which the refrigerant has been removed are dealt with as scrap. Units that are received intact must have the refrigerant removed. The wholesale recyclers remove the refrigerant from intact units in much the same way as other refrigerator recyclers. One of our respondents reported that refrigerators received "intact" are frequently non-working and have often lost their refrigerant. Even when it is obvious that there is no refrigerant, for example, the coil is disconnected, punctured, broken, or snapped off, the evacuation procedure is supposed to be followed. The refrigerant that is recovered is sold to a firm licensed to deal in refrigerant. Once the refrigerant is removed, the refrigerators are shredded.

The shredders are capable of dealing with whole objects such as refrigerators, cars or other large metal objects. The friction from the shredding causes very high temperatures. These temperatures are sufficiently high to cause the destruction of CFCs, for example, the CFC's in the foam. As a result, units are taken directly to the shredder as soon as the refrigerant is removed and no attempt is made to recover materials such as foam from the units. According to an operator of a shredding unit with whom we spoke, measured emissions at the stack of the shredder are within regulatory limits. He indicated that his unit has passed a number of EPA inspections.

C.3 COMMUNITY WASTE DISPOSAL

We did not do a comprehensive survey of community waste disposal systems. Some communities directly dispose of refrigerators, others contract with an external firms to remove refrigerators and freezers, and others may refer households to firms that provide the service. Waste Management Inc is an example of a firm that disposes of refrigerators for communities. Our data suggest that most of these refrigerators are non-working units.

A community manager whose community takes and disposes of refrigerators says that they charge a $20 fee for disposal. The manager anticipated that the fee would rise to $25 - $30 in the next budget year.

This community removes environmentally toxic components such as mercury switches and capacitors. They also remove the refrigerant and drain the waste oil that they sell to a recycling company. One reason for the fee increase is that revenues from refrigerant are declining.

This community has an automobile crusher that it uses to compact the refrigerator bodies. The compacted units are sent, along with other kinds of compacted scrap, to wholesale scrap dealers in Richmond CA or to Portland Oregon where the units are shredded and the shredded materials sent over seas.

C.4 SUMMARY

The evidence we have suggests that refrigerator recycling is changing somewhat rapidly. There is increased regulation designed to prevent harmful substances from entering the environment. The market for materials is changing rapidly as well. The market for R12 refrigerant is declining as the number of older appliances using R12 declines. On the other hand, the value of steel and copper has increased in recent years and may continue or increase based on demand in Asian markets. With the decline of the market for CFCs, their recovery from foam may no longer be advantageous and the incineration of foam either directly in incinerators or as a byproduct of shredding may represent a more economical method of disposal.

Shredding is potentially a very economical method for disposing of refrigerators. However, shredding requires a substantial stream of raw materials. It is not likely that the RARP can generate enough materials to sustain a shredding operation. However, contract shredding is potentially a cost-effective alternative to currently disassembly methods.

APPENDIX D
SURVEY DATA COLLECTION

This appendix describes the survey data collection that was used to collect data from program participants and non-participants that were used in the net savings estimation and market assessment.

D.1 DESIGN FOR SURVEY OF PARTICIPANTS

There was interest in this evaluation to disaggregate net-to-gross estimates by utility service territory, by primary/secondary refrigerator, and by refrigerator/freezer to better understand the factors underlying the one overall net-to-gross estimate prepared in previous evaluations. Toward satisfying this interest, the sample design had to balance the goal of achieving good precision for statewide estimates of savings with other goals of comparing program results between utilities, between primary and secondary refrigerators, etc.. To facilitate this disaggregated analysis, a sample design was prepared that involved some over-sampling in the less active utility territories and in the less active appliance categories (secondary refrigerator, freezer), but with a minimum allocation per cell.

The design of the participant survey was as follows.

- A minimum number of participants per utility/year was specified for the sample, to be drawn from the tracking system data.
- Within utility and year, minimum contributions to the sample were set for secondary refrigerator recyclers and for freezer recyclers.
- Remaining sample points were allocated in proportion to expected savings.

Table D-1 shows the numbers of RARP participants surveyed, classified by utility, year of participation and type of appliance.

Table D-1. Numbers of Participants Surveyed by Utility, Year and Type of Appliance

Utility	Type of Appliance	Year 2004	Year 2005	Totals
PGE	Freezers	28	45	73
	Refrigerators	71	105	176
	Both	3	2	5
PG&E Totals		102	152	254
SCE	Freezers only	48	95	143
	Refrigerator only	120	239	359
	Both	3	7	10
SCE Totals		171	341	512
SDG&E	Freezers only	29	41	70
	Refrigerators only	68	106	174
	Both	6	2	8
SDG&E Totals		103	149	252
Overall Totals		376	642	1,018

D.2 DESIGN FOR SURVEY OF NON-PARTICIPANTS

The non-participant survey was conducted to obtain information on recent acquirers or disposers of refrigerators and freezers. The sample size for the non-participant survey was set at 800, to be entirely focused on customers who had disposed of and/or acquired a used appliance in the last four years. In order to have an adequate survey of acquirers, the sample size was allocated to ensure obtaining data from 250 used appliance acquirers and from 550 appliance disposers. Sample allocation was also oriented to adequately representing each utility as well. Table D-2 shows the designed allocation of sample points.

Table D-2. Design Allocation for Survey of Non-Participant Acquirers and Disposers by Utility and Type of Appliance

Type of Appliance	Utility PG&E	Utility SCE	Utility SDG&E	Totals
	Acquirers			
Refrigerator	45	85	45	175
Freezer	20	35	20	75
Totals	65	120	65	250
	Disposers			
Primary refrigerator	55	110	55	220
Secondary refrigerator	40	85	40	165
Freezer	40	85	40	165
Totals	135	280	135	550

In conducting the survey, the surveying was continued until the quotas specified in Table D-2 were achieved. A total of 1,081 interviews were completed for the survey of non-participants.

The first 800 interviews were done without regard to any quota structure other than utility (where the breakdown was 200 each for PG&E and SDG&E and 400 for SCE. An additional 281 interviews were then used to satisfy the design quotas.

Within the 1,081 households surveyed, there were a total of 1,044 decisions to either acquire or dispose of a refrigerator or freezer in the past four years. (Note that some households could have made more than one decision.) Table D-3 shows the distribution of these acquisition and disposal decisions by utility and type of appliance.

Table D-3. Distribution of Acquisition and Disposal Decisions by Surveyed Non-Participants by Utility and Type of Appliance

Type of Appliance	***Utility***			***Totals***
	PG&E	***SCE***	***SDG&E***	
Acquisition Decisions				
Refrigerator	48	99	63	210
Freezer	14	34	21	69
Totals	62	133	84	279
Disposal Decisions				
Primary refrigerator	106	226	98	430
Secondary refrigerator	41	85	36	162
Freezer	46	87	40	173
Totals	193	398	174	765

APPENDIX E
SURVEY QUESTIONNAIRES

This appendix contains copies of the questionnaires used for the surveys of participants and non-participants. These instruments provided here were modified from the instruments used by KEMA in their evaluation of the 2002 RARP. The questionnaires in this appendix are annotated to facilitate comparison to the questionnaire used by KEMA. Notation is provided for questions as added new, as revised, or as removed.

RARP PARTICIPANT QUESTIONNAIRE FINAL (v6)

INTRODUCTION

May I please speak with (INSERT: pufname pulname)?

INTRODUCTION: Hello, my name is _____ calling on behalf of (INSERT: based on sample … Pacific Gas & Electric Company, Southern California Edison, San Diego Gas & Electric). We are contacting customers who had refrigerators or freezers removed through an appliance pick-up and recycling program offered by (INSERT: based on sample … Pacific Gas & Electric Company, Southern California Edison, San Diego Gas & Electric). Are you the person who was most involved and most familiar with having (INSERT: what) picked up on [INSERT: pickupdt]?

IF NO, NOT RIGHT PERSON: May I please speak to the person who would know the most about the removal? REPEAT INTRODUCTION AND CONTINUE

IF NO, NO REFRIGERATOR OR FREEZER PICKED UP: THANK AND TERM

IF YES, RIGHT PERSON: We are conducting a study to evaluate (INSERT: based on sample … Pacific Gas & Electric Company, Southern California Edison, San Diego Gas & Electric)'s appliance pick up and recycling program and would like to include your opinions. This is required by the California Public Utilities Commission and will be used to verify the effectiveness of the program and to make improvements.

IF NEEDED: It takes about 15 minutes.

IF NEEDED: I'm calling from Hiner & Partners, an independent research firm.

This call may be monitored or recorded for quality purposes.

SCREEN SECTION: This section confirms the number of appliances that were picked up. If more than one appliance was picked up, one is selected at random for the following section.

SECTION A: This section describes the unit and how it was used: main or spare, replaced or disposed, part-use if a spare, description of unit (size, age, etc.), description of replacement (size, age, etc.), and other details.

SECTION Z: This section provides the same information as Section A, but for a freezer unit.

SECTION C: This section asks respondents to consider alternative methods of disposal.

SECTION T: This section includes a conjoint trade-off to derive preference weights (utilities).

SECTION P: This is the process verification and evaluation section. It focuses on participant satisfaction wit their program experiences.

SECTION D: These are demographic questions.

SCREEN1

Our records show that (INSERT: what) (WAS/WERE) picked up. Is this correct?

Yes, correct	01	CONT
No, it was one refrigerator	02	CONT
No, it was two refrigerators	03	CONT
No, it was one refrigerator and one freezer	04	CONT
No, it was one freezer	05	CONT
Don't know/Don't remember	98	TERM
Refused	99	TERM

SCREEN2 (DELETED)

SCREEN3a (IF ONE APPLIANCE…e.g., APTYPE2 = blank)

Now I'm going to ask you some specific questions about the (size1) cubic feet (apmanuf1/apbrand1, DO NOT READ "do not know") (aptype1 where RE=Refrigerator and FR=Freezer) that was picked up.

SCREEN3b (IF MORE THAN ONE APPLIANCE … e.g., APTYPE2=RE or FR) (USE APPLIANCE 1 IF PICKONE=1, USE APPLIANCE 2 IF PICKONE=2)

Now I'm going to ask you some specific questions about one of the appliances that were picked up.

Let's talk only about the…(size1 or 2) cubic feet (apmanuf1 or 2/apbrand1 or 2, if "do not know" don't read) (aptype1 or 2 where RE=Refrigerator and FR=Freezer)

PROGRAMMER NOTE: FOR THE FOLLOWING QUESTIONS IN SECTIONS A AND Z, TRACK FOR "refrigerator" OR "freezer" DEPENDING ON SELECTION FROM SAMPLE. IF aptype1 (or aptype2) = RE, ask SECTION A. If aptype1 (or aptype2) = FR, ask SECTION Z.

SECTION A: APPLIANCE DESCRIPTIONS

A2b (A2 revised)

During the time just before you decided to get rid of it, was the refrigerator you got rid of being used as your main refrigerator, or had it been a secondary or spare? (Interviewer: a main refrigerator is typically in the kitchen, a secondary or spare is usually kept someplace else and might or might not be running. If the person recently bought a new main refrigerator and was just waiting for the old one to be picked up, it should be classified as "main.")

*Main	01	A5
*Secondary or Spare	02	
Don't know	98	A5
Refused	99	A5

QUOTA CHECK … IF QUOTA FOR MAIN OR SECONDARY IS FULL THANKS AND TERMINATE

A2c (A2B revised)

How long had it been a secondary or spare? GET MONTHS/YEARS (If respondent is confused, reinforce that "how long had it been a spare when you decided to get rid of it.")

MONTHS _____ (1-11)	01
YEARS ______(1-50, HALF = .5))	02
Don't know/Don't remember	98
Refused	99

A3 (A3/A4/A4b revised)

Thinking about the (last 12 months (IF 1 YEAR OR MORE)/months (ALL OTHER)) you had it as a spare prior to getting it picked up, was it plugged in and running …

All the time	01
For special occasions only	02
During certain months of the year only, or	03
Never plugged in or running	04
Don't know/Don't remember	98
Refused	99

ASK A4 ONLY IF A3=02 OR 03

A4 (A3/A4/A4b revised)

If you were to add up the total time it was running as a spare (in the last 12 months (IF 1 YEAR OR MORE)), how many months would that be? Your best estimate is okay. (GET NEAREST MONTH OR HALF MONTH)

MONTHS _____ (1-11, half = 0.5)	01
All the time	96
Don't know/Don't remember	98
Refused	99

A5 (A5)
Where was it located?

Kitchen	01	
Garage	02	
Porch/Patio	03	
Basement	04	
Other (SPECIFY:)	05	
Don't know	98	
Refused	99	

A5B (A5B)
Was the space heated?

Yes	01
No	02
Don't know	98
Refused	99

A5C (A5C)
Was the space air-conditioned?

Yes	01
No	02
Don't know	98
Refused	99

A1 (A1)
At the time of the pick-up, how old was the refrigerator? RECORD MONTHS OR YEARS, 12 MONTHS = 1 YEAR

MONTHS _____ (1-11)	01	A2
YEARS ______(1-50, HALF = .5))	02	A2
Don't remember	97	A1b
Don't know	98	A1b
Refused	99	A1b

A1b (NEW)
When did you acquire it? ACCEPT YEAR, OR NUMBER OF MONTHS OR YEARS AGO

YEAR _____ (1950-2004)	01
MONTHS AGO ______(1-11)	02
YEARS AGO ______(1-50, HALF = .5)	03
Don't know/Don't remember	98
Refused	99

A2 (A6 and A6C revised)

Did you decide to get rid of it because you …(READ)

Got a brand new refrigerator to replace it 01
Got a used refrigerator to replace it 02
Or to get rid of a refrigerator you no longer wanted
without replacing it 03
(DO NOT READ) Don't know 98
(DO NOT READ) Refused 99

ASK A6A-A6L ONLY IF A2=01 OR 02, OTHERWISE SKIP TO A7

A6 (REPLACED)

A6B (DELETED)

A6C (REPLACED)

A6D (A6D)

Does the replacement refrigerator that you got have … (READ)

A single door, with freezer compartment inside........................... 01

2 doors, side by side 02

A Top freezer 03

Or a Bottom freezer? 04

(DO NOT READ) Other (SPECIFY:___)...................................... 96

(DO NOT READ) Don't know 98

(DO NOT READ) Refused 99

A6E (A6E)
Is the replacement frost free or manual defrost?

Frost free 01

Manual defrost 02

Other (SPECIFY: ___) 03

Don't know........ 98

Refused 99

A6F (A6F)
(IF A2=2) How old is the replacement refrigerator? (LESS THAN 1 YEAR=1, GET NEAREST YEAR)

YEARS ______(1-50) 01
Don't know 98

Refused........ 99

A6G (A6G)
What size is it in cubic feet? IF NEEDED: Your best estimate is fine. CLARIFY FRACTIONS TO GET TO NEAREST NUMBER.

Less than Ten 9
Ten 10
Eleven 11
Twelve........ 12
Thirteen 13
Fourteen........ 14
Fifteen 15
Sixteen 16
Seventeen 17
Eighteen 18
Nineteen........ 19
Twenty 20
Twenty One........ 21
Twenty Two........ 22
Twenty Three 23
Twenty Four 24
Twenty Five........ 25
Twenty Six 26
More than 26........ 27
Other (SPECIFY___) 97
Don't know 98
Refused........ 99

ASK A6G2 ONLY IF A6G IS 98 (DK) OR 99 (REF)

A6G2 (NEW)

Is it larger, smaller or the same size as the one it replaced?

Larger.. 01
Smaller 02
Same Size.. 03
Don't know 98
Refused.. 99

(NOTE: ANALYSIS OF SIZE OF REPLACEMENT (QA6G) VS. SIZE OF RECYCLED UNIT (FROM DATABASE) CAN DETERMINE ACTUAL SIZE DIFFERENCE)

ASK A6H THRU A6L IF A2 = 2 (USED)

A6H (DELETED)

A6I (DELETED)

A6H (NEW)

You indicated that the replacement refrigerator was actually a previously used one.
Where did you get it? (PROBE IF NEEDED: Did you purchase it or was it given to you?)

Bought it from a friend or relative.. 01
Bought it from a used appliance dealer 02
Bought it at garage sale, estate sale, or from a newspaper ad. 03
Given to me by a friend/neighbor/person 04
Previous occupant of this left it behind 05
Given to me by an organization 06
(DO NOT READ) Other (SPECIFY:___) 97
(DO NOT READ) Don't know/Don't remember.......................... 98
(DO NOT READ) Refused 99

A6I (NEW)

How much did you pay for this used replacement?

Free / Nothing / Didn’t Pay... 00
DOLLARS ($____)($1 - $3000).. 01
Don't know 98
Refused.. 99

A6J (NEW)

Is it currently being used as your main refrigerator or as a secondary or spare?

Main... 01
Secondary or Spare 02
No longer have it 03
Not working 04
Don't know.. 98
Refused 99

A6K (NEW)
Where was it located?

Kitchen 01
Garage 02
Porch/Patio 03
Basement 04
Other (SPECIFY:) 05
Don't know 98
Refused 99

A6L (NEW)
At the time that you acquired this used refrigerator, if this specific refrigerator had not been available, which of the following would you most likely have done... (READ) (ONE ANSWER)

Bought a similar used refrigerator somewhere else 01
Not purchased a refrigerator at that time 02
Purchased a lower quality or less expensive used refrigerator. 03
Purchased a higher quality or more expensive used refrigerator06
Purchased a new refrigerator 04
Repaired an old, non-working refrigerator 05
(DO NOT READ) Don't Know 98
(DO NOT READ) Refused 99

Now lets get back to the refrigerator that you had disposed of.

A7 (DELETED)

A7 (A7 ALTERNATE)
Had you already considered discarding this refrigerator before hearing about (UTILITY)'s Appliance Recycling Program? By discard we mean getting rid of it either by selling it, giving it away, having someone pick it up, or taking it to the dump or a recycling center.

Yes 01
No 02
Don't know 98
Refused 99

A8 (A8 REVISED)
If you had not used this service to discard the refrigerator when you did, would you have still gotten rid of it, or would you have kept it?

Gotten rid of it 01 C1
Kept it 02 C1

Don't know 98 C1
Refused 99 C1

ALL B SERIES QUESTIONS (DELETED)

SECTION Z: FREEZER SECTION
ONLY APPLIES IF APPLIANCE IS AS A FREEZER.

Z2b (NEW)
During the time just before you decided to get rid of it, was the freezer you got rid of being used as your main freezer, or had it been a secondary or spare?

Main	01	Z5
Secondary or Spare	02	
Don't know	98	Z5
Refused	99	Z5

Z2c (NEW)
How long had it been a secondary or spare? GET MONTHS/YEARS (If respondent is confused, reinforce that “how long had it been a spare <u>when you decided to get rid of it</u>.”)

MONTHS _____ (1-11)	01
YEARS ______(1-50, HALF = .5))	02
Don't know/Don't remember	98
Refused	99

Z3 (Z10 REVISED)
Thinking about the (last 12 months (IF 1 YEAR OR MORE)/months (ALL OTHER)) you had it as a spare prior to getting it picked up, was it plugged in and running …

All the time	01
For special occasions only	02
During certain months of the year only, or	03
Never plugged in or running	04
Don't know/Don't remember	98
Refused	99

ASK Z4 ONLY IF Z3=02 OR 03
Z4 (Z10 REVISED)
If you were to add up the total time it was running as a spare (in the last 12 months (IF 1 YEAR OR MORE)), how many months would that be? Your best estimate is okay. (GET NEAREST MONTH OR HALF MONTH)

MONTHS _____ (1-11, half = 0.5)	01
All the time	96
Don't know/Don't remember	98
Refused	99

Z5 (NEW)
Where was it located?

Kitchen	01
Garage	02
Porch/Patio	03
Basement	04
Other (SPECIFY:)	05

Don't know 98
Refused 99

Z5B (NEW)

Was the space heated?

Yes 01
No 02
Don't know 98
Refused 99

Z5C (NEW)

Was the space air-conditioned?

Yes 01
No 02
Don't know 98
Refused 99

Z1 (NEW)

At the time of the pick-up, how old was the freezer? RECORD MONTHS OR YEARS, 12 MONTHS = 1 YEAR

MONTHS _____ (1-11)	01	Z2
YEARS ______(1-50, HALF = .5))	02	Z2
Don't remember	97	Z1b
Don't know	98	Z1b
Refused	99	Z1b

Z1b (NEW)

When did you acquire it? ACCEPT YEAR, OR NUMBER OF MONTHS OR YEARS AGO

YEAR _____ (1950-2004) 01

MONTHS AGO ______(1-11) 02

YEARS AGO ______(1-50, HALF = .5) 03
Don't know/Don't remember 98
Refused 99

Z2 (Z1/Z2 REVISED)

Did you decide to get rid of it because you …(READ)

Got a brand new freezer to replace it 01
Got a used freezer to replace it 02
Or to get rid of a freezer you no longer wanted
without replacing it 03
(DO NOT READ) Don't know 98
(DO NOT READ) Refused 99

ASK Z6-Z6L ONLY IF Z2=01 OR 02, OTHERWISE SKIP TO Z7

Z6 (DELETED)

Z6D (Z3)
Is the replacement an upright or chest freezer?

Upright freezer 01

Chest freezer 02

Other (SPECIFY:) 03

Don't know 98

Refused... 99

Z6E (NEW)
Is the replacement frost free or manual defrost?

Frost free 01

Manual defrost 02

Other (SPECIFY: ___) 03

Don't know... 98

Refused 99

Z6F (Z4)
(IF A2=2) How old is the replacement freezer? (LESS THAN 1 YEAR=1, GET NEAREST YEAR)

YEARS ______(1-50) 01
Don't know 98

Refused... 99

Z6G (Z5)

What size is the replacement in cubic feet? IF NEEDED: Your best estimate is fine. CLARIFY FRACTIONS TO GET TO NEAREST NUMBER.

Less than Five	4
Five	5
Six	6
Seven	7
Eight	8
Nine	9
Ten	10
Eleven	11
Twelve	12
Thirteen	13
Fourteen	14
Fifteen	15
Sixteen	16
Seventeen	17
Eighteen	18
Nineteen	19
Twenty	20
Twenty One	21
Twenty Two	22
Twenty Three	23
Twenty Four	24
Twenty Five	25
Twenty Six	26
More than 26	27
Don't know	98
Refused	99

ASK Z6G2 ONLY IF Z6G IS 98 (DK) OR 99 (REF)

Z6G2 (NEW)

Is it larger, smaller or the same size as the one it replaced?

Larger	01
Smaller	02
Same Size	03
Don't know	98
Refused	99

(NOTE: ANALYSIS OF SIZE OF REPLACEMENT (QZ6G) VS. SIZE OF RECYCLED UNIT (FROM DATABASE) CAN DETERMINE ACTUAL SIZE DIFFERENCE)

ASK Z6H THRU Z6L IF Z2 = 2 (USED)

Z6H (NEW)

You indicated that the replacement freezer was actually a previously used one.
Where did you get it? (PROBE IF NEEDED: Did you purchase it or was it given to you?)

- Bought it from a friend or relative.. 01
- Bought it from a used appliance dealer.................................... 02
- Bought it at garage sale, estate sale, or from a newspaper ad. 03
- Given to me by a friend/neighbor/person 04
- Previous occupant of this left it behind..................................... 05
- Given to me by an organization... 06
- (DO NOT READ) Other (SPECIFY:___) 97
- (DO NOT READ) Don't know/Don't remember.......................... 98
- (DO NOT READ) Refused.. 99

Z6I (NEW)

How much did you pay for this used replacement?

- Free / Nothing / Didn't Pay.. 00
- DOLLARS ($____)($1 - $3000).. 01
- Don't know 98
- Refused.. 99

Z6J (NEW)

Is it currently being used as your main freezer or as a secondary or spare?

- Main.. 01
- Secondary or Spare 02
- No longer have it... 03
- Not working 04
- Don't know... 98
- Refused... 99

Z6K (NEW)

Where is it located?

- Kitchen 01
- Garage 02
- Porch/Patio.. 03
- Basement 04
- Other (SPECIFY:) 05
- Don't know... 98
- Refused... 99

Z6L (NEW)

At the time that you acquired this used freezer, if this specific freezer had not been available, which of the following would you most likely have done... (READ) (ONE ANSWER)

Bought a similar used freezer somewhere else	01
Not purchased a freezer at that time	02
Purchased a lower quality or less expensive used freezer	03
Purchased a higher quality or more expensive used freezer	06
Purchased a new freezer	04
Repaired an old, non-working freezer	05
(DO NOT READ) Don't Know	98
(DO NOT READ) Refused	99

Now lets get back to the freezer that you had disposed of.

Z7 (Z7 REVISED)

Had you already considered discarding this freezer before hearing about (UTILITY)'s Appliance Recycling Program? By discard we mean getting rid of it either by selling it, giving it away, having someone pick it up, or taking it to the dump or a recycling center.

Yes	01
No	02
Don't know	98
Refused	99

Z8 (Z8)

If you had not used this service to discard the freezer when you did, would you have still gotten rid of it, or would you have kept it?

Gotten rid of it	01	C1
Kept it	02	C1
Don't know	98	C1
Refused	99	C1

SECTION C: CONSIDERATION OF ALTERNATIVES SECTION

C1 (NEW)

I am now going to read a list of alternative ways that you could have disposed of this appliance. For each, tell me if this is a method you had **considered using or doing**. (PROGRAMMER: ITEMS E AND F ONLY IF A2 = 01 OR 02. RANDOMIZE a-i, j and k ALWAYS LAST.)

a. Sell it to a private party, either by running an ad or to someone you know
b. Sell it to an ~~used~~ appliance dealer
c. Give it away to a private party, such as a friend, relative, or neighbor
d. Give it away to a charity organization, such as Goodwill Industries or a church
e. Have it removed by the dealer you got your new or replacement appliance from
f. ~~Trade it in for the new appliance or replacement appliance~~
g. Haul it to the dump yourself
h. Haul it to a recycling center yourself
i. Hire someone else haul it away for junking or dumping

j. Keep it
k. Or something else I've not mentioned

FOR EACH:

Yes – considered using/doing 01
No – did not consider or did not know about 02
Don't know 98
Refused.. 99

C2 (NEW)

Now suppose that the (from sample: UTILITY) service that you used to dispose of this appliance had not been available, which one of these other alternatives that we've just discussed would you have been most likely to do? (DO NOT READ) IF NEEDED: Your best estimate is okay.

Sell it to a private party, either by running an ad or to someone you know 01
Sell it to an ~~used~~ appliance dealer... 02
Give it away to a private party, such as a friend or neighbor 03
Give it away to a charity organization, such as Goodwill Industries or a church 04
Have it removed by the dealer you got your new or replacement appliance from 05
~~Trade it in for the new appliance or replacement appliance~~...... 06
Haul it to the dump yourself.. 07
Haul it to a recycling center yourself... 08
Hire someone else haul it away for junking or dumping............ 09
Keep it... 10
Some Other Way (SPECIFIY:___) 11
(DO NOT READ) Don't know... 98
(DO NOT READ) Refused 99

C3 (NEW)

Which alternative would have been your second choice? (DO NOT READ)

Sold it to a private party, either by running an ad or to someone you know 01
Sold it to an ~~used~~ appliance dealer 02
Given it away to a private party, such as a friend, relative or neighbor 03
Given it away to a charity organization, such as Goodwill Industries or a church 04
Had it removed by the dealer you got your new or replacement appliance from 05
~~Traded it in for the new appliance or replacement appliance~~.... 06
Hauled it to the dump yourself.. 07
Hauled it to a recycling center yourself..................................... 08
Hire someone else haul it away for junking or dumping............ 09
Keep it... 10
Some Other Way (SPECIFIY:___) 11
None – No Second Choice 12
Don't know 98
Refused.. 99

C4A (NEW)

If you had sold this appliance to someone, how much money do you think you would have received for it?

DOLLARS _____($1 - $2000) 01
Don't know 98
Refused... 99

C4B (NEW)

If an appliance dealer were to take it away, how much, if anything, do you think you would have to pay for this service?

Nothing / Free Service 00
DOLLARS _____($1 - $2000) 01
Don't know 98
Refused... 99

C4C (NEW)

What was the condition of this appliance? Would you say …

It worked and was in good physical condition 01
It worked but needed minor repairs like a door seal or handle . 02
It worked but had some problems like it wouldn't defrost.......... 03
Or, it didn't work 04
(DO NOT READ) Don't know.. 98
(DO NOT READ) Refused 99

C4D (NEW)

One factor in disposing of an appliance is being able to physically move and transport it. Do you have the ability to do this yourself, or would you need assistance such as renting or borrowing a truck or having someone other than your immediate family help you?

Yes, could do it myself... 01
Would need assistance... 02
(DO NOT READ) Don't know... 98
(DO NOT READ) Refused 99

C4E (A9F OR Z9F REVISED)

How much money do you think it would cost each month to run the (if aptype1 (or 2) = RE than insert “refrigerator” or if aptype1 (or 2) =FR than insert “freezer”) that was picked-up, if it were running full-time? For example, if you kept it plugged in.

Nothing 01
$1 to $5 per month 02
$6 to $10 03
$11 to $15 04
$16 to $20 05
$21 to $25 06
$26 to $30 07
$31 to $35 08
$36 to $40 09
More than $40 10
Don't pay electric bill 97
Don't know 98
Refused 99

C5 (NEW)

Now that you have considered some additional factors involved in keeping or disposing of your (if aptype1 (or 2) = RE than insert “refrigerator” or if aptype1 (or 2) =FR than insert “freezer”), I’d like you to reconsider which of these other methods we had talked about would you have been most likely to use if the (UTILITY) service that picked up this appliance had not been available. You said you would have (INSERT MOST LIKELY METHOD ANSWER FROM C2). Is this still what you would have been most likely to do, or something else? (PROBE IF SOMETHING ELSE: What would you have done?)(READ LIST ONLY IF NEEDED)

Sold it to a private party, either by running an ad or to someone you know 01
Sold it to an ~~used~~ appliance dealer 02
Given it away to a private party, such as a friend or neighbor 03
Given it away to a charity organization, such as Goodwill Industries or a church 04
Had it removed by the dealer you got your new or replacement appliance from 05
~~Traded it in for the new appliance or replacement appliance~~ 06
Hauled it to the dump yourself 07
Hauled to a recycling center yourself 08
Had someone else pick it up for junking or dumping 09
Kept it 10
Some Other Way (SPECIFIY:___) 11
Don't know 98
Refused 99

ASK A9A THRU A9E IF C5=10 KEPT IT. OTHERWISE, SKIP TO A10

A9A (A9A OR Z9A REVISED)

You mentioned you would have kept this (if aptype1 (or 2) = RE than insert “refrigerator” or if aptype1 (or 2) =FR than insert “freezer”) if it hadn’t been picked up by the service. If you had kept it, would it have been stored unplugged, or used as a spare? (DO NOT READ) IF NEEDED: Your best estimate is fine.

Store it unplugged	01	T1
Use it as a spare	02	
Both-store it and use it	03	
No/Would not keep	04	T1
Don't know	98	T1
Refused	99	T1

A9B (A9B OR Z9B)

For how many years might it have kept running as a spare? IF NEEDED: Your best estimate is fine.

YEARS ______(1-50)	01
(DO NOT READ) Until it broke, indefinitely	96
(DO NOT READ) Don't know	98
(DO NOT READ) Refused	99

A9C (A9C OR Z9C)

Where would it have been located? IF NEEDED, CLARIFY: What room? IF NEEDED: Your best estimate is fine.

Kitchen	01
Garage	02
Porch	03
Basement	04
Other (SPECIFY:___)	05
Don't know	98
Refused	99

A9D (A9D OR Z9D)

Would this have been a heated space?

Yes	01
No	02
Don't know	98
Refused	99

A9E (A9E OR Z9E)

Would this have been an air-conditioned space?

Yes 01
No 02
Don't know 98
Refused... 99

ASK A10 IF C5 NOT 10 "KEPT IT," OTHERWISE SKIP TO T1.

A10 (NEW)

Is the cost of running this (if aptype1 (or 2) = RE than insert "refrigerator" or if aptype1 (or 2) =FR than insert "freezer") we have been talking about a reason that you did not want to keep it?

Yes 01
No 02
Don't know 98
Refused... 99

ASK A11 IF A2=01 OR 02 (AND C5 NOT 10), OTHERWISE SKIP TO T1

A11 (NEW)

And is the cost of running this (if aptype1 (or 2) = RE than insert "refrigerator" or if aptype1 (or 2) =FR than insert "freezer") we have been talking about a reason that you replaced it with a different unit?

Yes 01
No 02
Don't know 98
Refused... 99

SECTION T: PREFERENCES TRADE-OFF SECTION (PROGRAMMER: INTERVIEWERS WILL HAVE OPTIONS LISTED ON PAPER)

T1 (NEW)

I'm going to read to you some alternatives to the appliance recycling program that you used to dispose of your (if aptype1 (or 2) = RE than insert "refrigerator" or if aptype1 (or 2) =FR than insert "freezer"). For each pair of alternatives, tell me which one you most prefer, and your best guess is okay. If you would not choose either alternative but would keep the appliance instead, you can choose that.

Option 1 is … Option 2 is … Or you could keep the appliance. Which do you most prefer?

- Option 1 01
- Option 2 02
- Keep it 03
- Don't know 98
- Refused 99

T2 (NEW)

Option 1 is … Option 2 is … Or you can keep the appliance. Which do you most prefer?

- Option 1 01
- Option 2 02
- Keep it 03
- Don't know 98
- Refused 99

REPEAT WITH SIX DIFFERENT PAIRS, E.G., T1 through T6

NOTE THAT THIS IS A FULL PROFILE CONJOINT ANALYSIS. ATTRIBUTES (AND LEVELS OF EACH ATTRIBUTE) INCLUDE:

COST/INCENTIVE: (5 levels)

Cost to you is $50, Cost to you is $35, No Cost or Payment to you, Payment to you is $35, Payment to you is $50

TIMING: (5 levels)

Pickup is same day you arrange it, Pickup is in 3 days of when you arrange it, Pickup is in 7 days of when you arrange it, Pickup is in 14 days of when you arrange it, you transport it yourself

DISPOSITION: (3 levels)

Appliance gets used by someone else, appliance goes into landfill, appliance gets scrapped and completely recycled

HASSLE: (2 levels)

You make no more than one phone call, you might have to make multiple calls

Option 1 is: The cost to you is $25 dollars, pickup is the same day you arrange it, the appliance gets used by someone else, and you make no more than one phone call

OR

Option 2 is: Payment to you is $25, pick up is within 7 days of when you arrange it, the appliance goes into landfill, and you might have to make multiple calls

SECTION P: PROCESS EVALUATION AND VERIFICATION SECTION (SECTION IS RENUMBERED – QUESTIONS NEW TO 2006 ARE INDICATED)

This next section is about your experiences with (UTILITY)'s appliance recycling program.

P1A (M1)

How did you FIRST learn about this program? (CLARIFY IF NEEDED: Was that your utility's web site? Was that a TV ad? Etc.)

Newspaper advertisement	01	
TV advertisement	02	
Radio advertisement	03	
Utility website	04	
Utility bill insert/information with utility bill	05	
Separate mailing/Brochure	06	
Called the Utility Co. (e.g., 800 number)	07	
Media stories about the program	08	
From a friend, relative or neighbor	09	
Appliance retailer	10	
Somewhere else (SPECIFY:___)	97	
Don't know	98	P2A
Refused	99	P2A

P1B (M2)

Have you heard about this program through any other sources? IF YES: Where else?

No/None/No other sources	00
Newspaper advertisement	01
TV advertisement	02
Radio advertisement	03
Utility website	04
Utility bill insert/information with utility bill	05
Separate mailing/Brochure	06
Called the Utility Co. (e.g., 800 number)	07
Media stories about the program	08
From a friend, relative or neighbor	09
Appliance retailer	10
Somewhere else (SPECIFY:___)	97
Don't know	98
Refused	99

P1Ca (NEW)

The appliance recycling program includes not only the pick-up service, but also consumer education. Did you receive information or learn that older refrigerators and freezers are less efficient and use more energy than newer ones, at the time that you found out about the pick-up service?

Yes, received information 01
No 02
Don't know 98
Refused.. 99

P1Cb (NEW)
ASK P1Cb ONLY IF P1Ca – 1 (YES)

From where did you get this information?

Newspaper advertisement... 01
TV advertisement... 02
Radio advertisement.. 03
Utility website 04
Utility bill insert/information with utility bill 05
Separate mailing/Brochure/Flyer 06
Called the Utility Co. (e.g., 800 number) 07
Media stories about the program... 08
From a friend, relative or neighbor 09
Appliance retailer 10
Some other way (SPECIFY___).. 11
Don't know 98
Refused.. 99

P1D (NEW)

And did you learn that the refrigerator or freezer that is picked up by the program would be recycled, which means that the coolant in the unit would be safely removed and the materials that the unit is made of would be reused?

Yes, received information 01
No 02
Don't know 98
Refused.. 99

P2A (Y1)

What is the MAIN reason you chose <u>this service</u> over <u>other methods</u> of disposing of your appliance? IF MULTIPLE ARE MENTIONED: Of those, which is the main reason? (DO NOT READ) (ACCEPT ONE ANSWER ONLY)

(IF RESPONDENT SAYS SOMETHING LIKE: “I didn’t need or want the refrigerator” REASK THE QUESTION)

$35 cash / Incentive payment.. 01
DELETED 02
Free pick-up service/Others don’t pick up/Don’t have to take it myself . 03
Environmentally safe disposal /Recycled/Good for Environment........... 04
Recommendation of a friend/relative 05

Recommendation of retailer/dealer	06	
Utility sponsorship of the program	07	
Easy way/convenient	08	
Never heard of any others/only one I know of	09	
Other (SPECIFY:___)	10	
Don't know	98	P3
Refused	99	P3

P2B (Y2)

Were there any other reasons? IF YES: What were they? (MULTIPLE RESPONSE)

No/None/No other reasons	00
$35 cash / Incentive payment	01
DELETED	02
Free pick-up service/Others don't pick up/Don't have to take it myself	03
Environmentally safe disposal /Recycled/Good for Environment	04
Recommendation of a friend/relative	05
Recommendation of retailer/dealer	06
Utility sponsorship of the program	07
Easy way/convenient	08
Never heard of any others/only one I know of	09
Other (SPECIFY:___)	10
Don't know	98
Refused	99

P3 (NEW)

Did you learn everything you wanted to know about the program before participating, or did you still have unanswered questions but signed up anyway?

Yes, learned all needed to know	01
No, but signed up anyway	02
Don't know	98
Refused	99

P4 (E1 REVISED)

Once you decided to participate, the first step was signing up and pre-qualifying. Are you the one who took care of this, or did someone else in your household?

Yes, I did it	01	
No, someone else	02	P9
Don't know	98	P9
Refused	99	P9

P5 (E1 REVISED)

Did you sign up online or on the telephone? (CAN BE MULTIPLE RESPONSE)

Telephone	01	
Online	02	
Other (SPECIFY:___)	03	
Don't know	98	P9
Refused	99	P9

P6 (E2)
How satisfied were you with this sign up experience? Use a 5-point scale where "5" means "completely satisfied" and "1" means "not at all satisfied."

Not at all satisfied 1

2 2

3 3

4 4

Completely satisfied... 5

Don't know 98

Refused... 99

P7A (NEW)
(IF P5 = 02 Online)
Was it easy to find the sign up screen on the website?

Yes 01
No 02
Not Applicable... 97
Don't know 98
Refused... 99

P7B (NEW)
(IF P5 = 02 Online)
Did the website answer all your questions about the appliance recycling program?
Yes 01
No 02
Not Applicable... 97
Don't know 98
Refused... 99

P7C (NEW)
(IF P5 = 02 Online)
Were you able to schedule a pickup appointment for a convenient date and time?
Yes 01
No 02
Not Applicable... 97
Don't know 98
Refused... 99

P7D (NEW)

(IF P5 = 02 Online)

Did you receive confirmation that your sign up had been successful?

Yes 01
No 02
Not Applicable 97
Don't know 98
Refused 99

P8A (NEW)

(IF P5 = 01 Telephone)

Was the representative you spoke to on the telephone polite and courteous?

Yes 01
No 02
Not Applicable 97
Don't know 98
Refused 99

P8B (NEW)

(IF P5 = 01 Telephone)

Did the representative answer all your questions?

Yes 01
No 02
Not Applicable 97
Don't know 98
Refused 99

P8C (S1 AND S2 REVISED)

(IF P5 = 01 Telephone)

Were you able to schedule a pickup appointment for a convenient date and time?

Yes 01
No 02
Not Applicable 97
Don't know 98
Refused 99

P8D (NEW)

(IF P5 = 01 Telephone)

Did you have to call more than once?

Yes 01
No 02
Not Applicable 97
Don't know 98
Refused 99

P9 (S3)
The next step is the pickup appointment. Were you present at the time of the pickup or are you familiar enough with the pick-up to answer some questions about it?

Yes	01	
No	02	P13
Don't know	98	P13
Refused	99	P13

P10 (S4)
How satisfied were you with the actual pick up and removal experience. Use a 5-point scale where "5" means "completely satisfied" and "1" means "not satisfied at all."

Not at all satisfied	01
2	02
3	03
4	04
Completely satisfied	05
Don't know	98
Refused	99

P11A (NEW)
How much time did it take from when you scheduled the appointment until your appliance was picked up? (RECORD IN DAYS IF LESS THAN 1 WEEK OR BETWEEN WEEKS, IE, 10 DAYS)

1 Week	01	
2 weeks	02	
3 weeks	03	
4 weeks	04	
5 weeks	05	
6 weeks	06	
7 weeks	07	
8 weeks or more	08	
____(RECORD DAYS)	09	
Not Applicable	97	P12A
Don't know	98	P12A
Refused	99	P12A

P11B (NEW)
Do you think this was too long?

Yes	01
No	02
Don't know	98
Refused	99

P12A (NEW)

(IF P9 = 01 YES)
Did they call in advance to confirm the appointment or let you know they were coming?

Yes	01
No	02
Not Applicable	97
Don't know	98
Refused	99

P12B (NEW)

(IF P9 = 01 YES)
Did they arrive on time?

Yes	01
No	02
Not Applicable	97
Don't know	98
Refused	99

P12C (NEW)

(IF P9 = 01 YES)
Was the representative polite and courteous?

Yes	01
No	02
Not Applicable	97
Don't know	98
Refused	99

P12D (NEW)

(IF P9 = 01 YES)
Did the representative appear neat and professional?

Yes	01
No	02
Not Applicable	97
Don't know	98
Refused	99

I1 AND I2 AND I2A (DELETED)

P13A (I1A REVISED)

Did you receive an incentive check?

Yes	01	
No	02	P14
Not Applicable	97	P14
Don't know	98	P14
Refused	99	P14

P13B (I1A REVISED)
For how much?

$35	01	
____(OTHER $ AMOUNT)	02	
Don't know	98	
Refused	99	

P13C (I3 REVISED)
How long did it take to get the check after they picked up your appliance?

1 Week or less	01	
2 weeks	02	
3 weeks	03	
4 weeks	04	
5 weeks	05	
6 weeks	06	
7 weeks	07	
8 weeks or more	08	
____(RECORD DAYS)	09	
Don't know	98	P13E
Refused	99	P13E

P13D (I4)
Do you think this was too long?

Yes	01	
No	02	
Don't know	98	
Refused	99	

P13E (I4B REVISED)
Would you have participated in the program without the incentive check?

Yes	01	
No	02	
Don't know	98	
Refused	99	

P14 (S7 REVISED)

Did you encounter any other problems with the program that you have not mentioned yet? (INTERVIEWER: IF RESPONDENT MENTIONED OTHER PROBLEMS EARLIER, RECORD THEM HERE. PROBE FOR CLARITY ONLY.)

RECORD COMMENTS 00

No other problems 01

Don't know 98

Refused 99

P15 (O5)

Thinking about your experiences throughout the whole process, How satisfied were you with the service OVERALL? Use a 5 point scale where "5" means you were "completely satisfied" and "1" means you were "not at all satisfied."

Not at all satisfied 01
2 02
3 03
4 04
Completely satisfied 05
Don't know 98
Refused 99

I5, I5A, I5B, I5C, AW1, AW2, C1, C2, C3, C4, C5, C6, AW3, AW4, C7, C7A, C7B< C8, C9, C9A, C9B, C10, P1, M3, Y4, M4, AW5, AW7 DELETED

SECTION D: DEMOGRAPHICS SECTION

D1 (D1)

My last few questions are for statistical purposes only. Including yourself and children, how many people live in your household at least six months of the year?

One/Just myself/Live alone.. 01
Two 02
Three... 03
Four... 04
Five 05
Six 06
Seven... 07
Eight.. 08
Nine... 09
Ten or more 10
Don't Know... 98
Refused.. 99

D2 (D2)

What is your age? Are you … (READ)

18-25... 01
26-35... 02
36-45... 03
46-55... 04
56-65... 05
65 or older?.. 06
Refused.. 99

D3 (D3)

(IF D1 = 2 OR MORE)
Of the people who live in your household, how many are under 18 years of age?

None 00
One 01
Two 02
Three... 03
Four... 04
Five 05
Six 06
Seven... 07
Eight.. 08
Nine... 09
Ten or more 10
Refused.. 99

D4, D5, D6, D7, D8, D9, SUM1 (DELETED)

D4 (D10)
Please stop me when I reach the category that best describes your household's total annual income before taxes.

Under $10,000 01
$10,000 to just under $20,000 02
$20,000 to just under $30,000 03
$30,000 to just under $40,000 04
$40,000 to just under $50,000 05
$50,000 to just under $75,000 06
$75,000 to just under $100,000 07
$100,000 to just under $150,000 08
$150,000 or above? 09
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

D5 (NEW)
What language do you speak in your home most often?

English 01
Spanish 02
Mandarin 03
Cantonese 04
Other Chinese 05
Japanese 06
Tagalog 07
Korean 08
Vietnamese 09
Other (SPECIFY: ___) 10
Don't know 98
Refused 99

D6 (NEW)
How would you describe your ethnicity? (READ)

White or Caucasian 01
Hispanic 02
African-American 03
Asian 04
American Indian 05
Some other background (SPECIFY:___) 06
(DO NOT READ) Don't know 98
(DO NOT READ) Refused 99

RECORD GENDER

Male 1

Female 2

LANG

THE INTERVIEW WAS DONE IN:

English 1

Spanish 2

That concludes my questions. Thank you very much for your time and cooperation.

VERSION (NEW)

RECORD VERSION NUMBER FROM PAPER SURVEY. ALSO, WRITE RESPONENT ID ON THE PAPER COPY.

VERSION: __ __ __ (3 DIGIT: 1-100)

RARP NON-PARTICIPANT QUESTIONNAIRE

INTRODUCTION

~~May I please speak with (INSERT: CONTACT)?~~

INTRODUCTION: Hello, my name is _____ calling on behalf of (INSERT: UTILITY). We are conducting a survey about refrigerators and freezers. I am not selling anything. Could I speak to someone who could answer some questions about your household's refrigerators or freezers?

IF NEEDED: The survey takes about 10 to 15 minutes.

IF NEEDED: I'm calling from Hiner & Partners, an independent research firm.

ONCE DECISION MAKER IS ON PHONE, REPEAT INTRODUCTION IF NEEDED AND CONTINUE.

SCREEN1a (NEW)

Has your household obtained a refrigerator or stand-alone freezer in the past 4 years? By obtained, we mean that you either purchased it from a dealer or some other firm or individual or it was given to you, but not rented or borrowed. Going back four years would be since January 1, 2002. (NOTE: OBTAIN CAN MEAN PURCHASED NEW, PURCHASED USED, GOT FROM A FRIEND OR NEIGHBOR, ETC. RESPONDENT IS NOW THE OWNER OF IT. NOT RENTED OR BORROWED.)

Yes 01
No 02 SCREEN2
Don't know 98 SCREEN2
Refused.. 99 SCREEN2

SCREEN1b (NEW)

Were any of these "used" refrigerators or freezers when you obtained them?

Yes 01
No 02
Don't know 98
Refused.. 99

SCREEN2 (NEW)

Has your household discarded a refrigerator or stand-alone freezer that you owned in the past 4 years? By discard, we mean selling it, giving it away, or having it hauled away, and going back four years is since January 1, 2002. (NOTE: DISCARD MEANS GOT RID OF IT AND CAN INCLUDE SELLING IT, GIVING IT AWAY, HAULING TO THE DUMP, HAVING SOMEONE ELSE TAKE IT AWAY, ETC. DO NOT COUNT IF RENTED OR BORROWED.)

Yes 01
No 02
Don't know 98
Refused.. 99

SCREEN3 (NEW)

Do you currently have more than one refrigerator or more than one freezer in your home, not counting any bar-sized or countertop refrigerator or wine coolers, and not counting any that are borrowed or rented?

Yes 01
No 02
Don't know 98
Refused.. 99

CALCULATE QUALIFICATION: SCREEN1b OR SCREEN2 OR SCREEN3 MUST BE 01. MUST HAVE ACQUIRED A USED UNTI OR DISCARDED AT LEAST ONE REFRIGERATOR OR FREEZER, OR MUST HAVE MULTIPLE UNITS.

IF NOT QUALIFIED: THANK AND TERMINATE.

IF QUALIFIED: CONTINUE.

This call may be monitored or recorded for quality purposes.

1. PARTICIPANT SURVEY INSTRUMENT

SECTION IR: IDENTIFICATION OF REFRIGERATORS OWNED

IR1 (NEW)

How many refrigerators do you currently have at your home, including any that don't work?

None .... 00 SEC IF
_____(RECORD NUMBER: 1-9) 01
Don't know 98
Refused 99

IR2 (NEW)

Can you tell me the location (of the/for each of the (number of refrigerators from IR1)) refrigerator(s) in your household, for example, in the kitchen, on the porch, in the garage, or in the basement?

FIRST UNIT MENTIONED
In the Kitchen 01
In the Garage 02
On the Porch or Patio 03
In the Basement 04
Other (SPECIFY:) 05
Don't know.. 98
Refused 99

SECOND UNIT MENTIONED
In the Kitchen 01
In the Garage 02
On the Porch or Patio 03
In the Basement 04
Other (SPECIFY:) 05
Don't know.. 98
Refused 99

(PROGRAMMER: NEED TO RECORD FOR EACH UNIT … MIGHT BE UP TO FIVE UNITS) (IF DK/REF FOR FIRST UNIT IN IR2 SKIP TO SECTION IF)
REPEAT QUESTIONS IR3 THROUGH IR8 FOR EACH LOCATION NAMED.

IR3 (NEW)

Does the refrigerator you mentioned (first/second/third/fourth/fifth) that is (name of location in IR2) work, that is, does it keep things cold? (IF NOT PLUGGED IN: Would it work if plugged in?)

Yes 01
No 02
Don't know 98
Refused 99

IR4 (NEW)

What size is this refrigerator (name of location in IR2) in cubic feet?

CUBIC FEET _____ (1-30, half=.5).. 01
Don't know/Not sure.. 98
Refused... 99

IR5 (New)

When you first obtained this refrigerator (name of location in IR2) was it new or used?

New.. 00
Used... 01
Don't know/Not sure/Can't remember....................................... 98
Refused... 99

IR6 (NEW)

Do you recall the month and year that you got this refrigerator?

January 01
February.. 02
March 03
April.. 04
May 05
June 06
July... 07
August... 08
September 09
October 10
November 11
December 12
_____(RECORD YEAR, E.G. 2003).. 21
Don't know/Not sure/Can't remember....................................... 98
Refused... 99

IR7 (NEW)

ASK IF DON'T KNOW OR REFUSED IN IR6, ELSE SKIP TO IR8

How long have you had this refrigerator that is (name of location in IR2)? (TOTAL TIME OWNED)

Less than one year 00
YEARS ____ (1-50) 01
Don't know/Not sure/Can't remember....................................... 98
Refused... 99

IR8 (NEW)

ASK IF IR5 = USED

How old is this refrigerator? Your best guess is okay.

Less than one year old 00
YEARS ____ (1-50) 01
Don't know/Not sure/Can't remember...................................... 98
Refused.. 99

SECTION IF: IDENTIFICATION OF FREEZERS OWNED

IF1 (NEW)

How many stand-alone freezers do you currently have at your home, including any that don't work?

None 00
_____(RECORD NUMBER: 1-9)... 01
Don't know 98
Refused.. 99

IF2 (NEW)

Can you tell me the location (of the/for each of the (number of refrigerators from IR1)) stand-alone freezers in your household, for example, in the kitchen, on the porch, in the garage, or in the basement?

FIRST UNIT MENTIONED

In the Kitchen 01
In the Garage 02
On the Porch or Patio 03
In the Basement... 04
Other (SPECIFY:) 05
Don't know.. 98
Refused.. 99

SECOND UNIT MENTIONED

In the Kitchen 01
In the Garage 02
On the Porch or Patio 03
In the Basement... 04
Other (SPECIFY:) 05
Don't know.. 98
Refused.. 99

(PROGRAMMER: NEED TO RECORD FOR EACH UNIT … MIGHT BE UP TO THREE UNITS)
REPEAT QUESTIONS IF3 THROUGH IF7 FOR EACH LOCATION NAMED.

IF3 (NEW)
Does the freezer you mentioned (first/second/third/fourth/fifth) that is (name of location in IF2) work, that is, does it keep things frozen? (IF NOT PLUGGED IN: Would it work if plugged in?)

Yes.......... 01
No.......... 02
Don't know.......... 98
Refused.......... 99

IF4 (NEW)
What size is this freezer (name of location in IF2) in cubic feet?

CUBIC FEET _____ (1-30, half=.5).......... 01
Don't know/Not sure.......... 98
Refused.......... 99

IF5 (New)
When you first obtained this freezer (name of location in IF2) was it new or used?

New.......... 00
Used.......... 01
Don't know/Not sure/Can't remember.......... 98
Refused.......... 99

IF6 (NEW)
Do you recall the month and year that you got this freezer?

January.......... 01
February.......... 02
March.......... 03
April.......... 04
May.......... 05
June.......... 06
July.......... 07
August.......... 08
September.......... 09
October.......... 10
November.......... 11
December.......... 12
_____(RECORD YEAR, E.G. 2003).......... 21
Don't know/Not sure/Can't remember.......... 98
Refused.......... 99

IF7 (NEW)

ASK IF DON'T KNOW OR REFUSED IN IF6, ELSE SKIP TO IF8

How long have you had this freezer that is (name of location in IF2)? (TOTAL TIME OWNED)

Less than one year	00
YEARS ____ (1-50)	01
Don't know/Not sure/Can't remember	98
Refused	99

IF8 (NEW)

ASK IF IF5 = USED

How old is this freezer? Your best guess is okay.

Less than one year old	00
YEARS ____ (1-50)	01
Don't know/Not sure/Can't remember	98
Refused	99

SECTION A: ACQUIRED USED REFRIGERATOR CHARACTERISTICS

BENA1

IF ANY IR5=USED AND (IR6=2002, 2003, 2004, 2005 OR IR7=4 YEARS OR LESS) CONTINUE. ELSE GO TO BENB1

Now I'm going to ask you some questions about the used refrigerator you acquired most recently.

A1

Does the used refrigerator you acquired most recently have a. . .(READ)

Single door with a freezer compartment inside 01
A 2 door, side-by-side 02
Top freezer.. 03
Or bottom freezer... 04
(DO NOT READ) Other (SPECIFY:___) 97
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

A2a (NEW)

Does the refrigerator have an icemaker?

Yes 01
No 02
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

A2b (NEW)

(ASK A2b IF A2a=01 (YES))
Does the refrigerator dispense ice through the door?

Yes – dispenses ice through the door 01
No 02
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

A3

Is it frost-free or manual defrost? (IF NEEDED: manual means that frost and ice builds up in the freezer and it must be turned off and thawed)

Frost free.. 01
Manual defrost 02
Other (SPECIFY:___) 03
Don't know 98
Refused.. 99

A4

Where did you get the refrigerator? (PROBE IF NEEDED: Did you purchase it or was it given to you?)

Bought it from a friend, neighbor or relative	01	
Bought it from a used appliance dealer	02	
Bought it at garage sale, estate sale, or from a newspaper ad	03	
Refrigerator was given to me by a friend/neighbor/person	04	
Previous occupant left it behind	05	
Refrigerator was given to me by an organization	06	NEW
(DO NOT READ) Other (SPECIFY:___)	97	
(DO NOT READ) Don't know/Don't remember	98	
(DO NOT READ) Refused	99	

A5

(IF A4=01, 02, 03, 97, 98, 99)
How much did you pay for the refrigerator?

None/Nothing/Didn't pay	00
DOLLARS____ ($1 TO $3,000)	01
Don't know	98
Refused	99

A6

When you got the refrigerator was it working, working but in need of repair, or not working?

Working	1
Working but needed repair	2
Not working	3
Don't know	8
Refused	9

A7

Did you get this refrigerator. . . (READ)

Because you didn't have a refrigerator before getting this one	01
To replace your main refrigerator	02
To replace a spare or backup refrigerator	03
To use as an additional refrigerator to give you more refrigerator capacity	04
It came with the house or was there when we moved in	05
Or for some other reason (SPECIFY:___)	06
(DO NOT READ) Don't know	98
(DO NOT READ) Refused	99

A8 (NEW)

And is it currently . . . (READ)

Your main refrigerator	01	A9
Or a secondary or spare refrigerator	02	A9
(DO NOT READ) No longer have it	03	A12
(DO NOT READ) Not used/Not working	04	A12
(DO NOT READ) Don't know	98	A12
(DO NOT READ) Refused	99	A12

A9

Which of the following best describes how you have used the refrigerator in the past 12 months? Was it … (READ)

Plugged in and running all the time	1	A11
Plugged in most of the time and unplugged when not in use	2	
Used only during certain months or seasons	3	
Kept as a spare; but wasn't plugged in and operating at all	4	A11
(DO NOT READ) Unit doesn't work	5	A11
(DO NOT READ) Don't know	8	A11
(DO NOT READ) Refused	9	A11

A10

During the past 12 months, how many total months was it plugged in and running?

None/Never use it	00
MONTHS _____(1-12, half = .5)	01
Don't know/Don't remember	98
Refused	99

A11

Where was the refrigerator located during this time?

Kitchen	01
Garage	02
Porch	03
Basement	04
Other (SPECIFY:)	05
Don't know	98
Refused	99

A12

(SKIP IF A9=05)

Regarding its condition now, or when you last used it, does it cool effectively, or does it not cool as well as it should?

Yes, cools effectively	1
No, works but does not cool well	2
Don't know	8
Refused	9

A13

(SKIP IF A9=05)

Does it cycle on and off correctly, or does it seem like the motor is always running?

Cycles correctly	1
Motor always running / not cycling	2
Don't know	8
Refused	9

A14

(SKIP IF A9=05
Are the door seals in good condition, or do they leak cold air?

In good condition 1
Leak cold air... 2
Don't know 8
Refused... 9

A15

At the time you acquired it, if this specific refrigerator had not been available, which of the following would you most likely have done... (READ)

Bought a similar used refrigerator somewhere else 01
Not purchased or acquired a refrigerator at that time................ 02
Purchased a lower quality used refrigerator 03
Purchased a new refrigerator 04
Fixed or repaired the old refrigerator 05
(DO NOT READ) Something else (Spec:______)..................... 06 (NEW)
(DO NOT READ) Don't Know 98
(DO NOT READ) Refused.. 99

A16

(IF A8A=02 OR 03)
What did you do with the refrigerator you replaced? Did you...

Discard or get rid of it.. 01
Still have it unused and unplugged.. 02
Or use it as a spare or back up refrigerator and it runs occasionally 03
(DO NOT READ) Don't know.. 98
(DO NOT READ) Refused.. 99

SECTION B: ACQUIRED USED FREEZER CHARACTERISTICS

BENB1

IF ANY IF5=USED AND (IF6=2002, 2003, 2004, 2005 OR IF7=4 YEARS OR LESS) CONTINUE. ELSE GO TO ID1

Now I'm going to ask you some questions about the used freezer you acquired most recently.

B1

Is this an upright or a chest freezer? (IF NEEDED: A chest freezer is about waist height with a door or lid on the top)

Upright 1
Chest... 2
Don't know 8
Refused... 9

B2

Is it frost-free or manual defrost? (IF NEEDED: manual means that frost and ice builds up in the freezer and it must be turned off and thawed)

Frost free...................................... 1
Manual defrost 2
Other (SPECIFY:___) 3
Don't know 8
Refused... 9

B3

Where did you get the freezer? (PROBE IF NEEDED: Did you purchase it or was it given to you?)

Bought it from a friend or relative........................ 01
Bought it from a used appliance dealer 02
Bought it at garage sale, estate sale, or from a newspaper ad . 03
Freezer was given to me by a friend/neighbor/person 04
Previous occupant of this left it behind 05
Freezer was given to me by an organization.............. 06 NEW
(DO NOT READ) Other (SPECIFY:___) 97
(DO NOT READ) Don't know/Don't remember............ 98
(DO NOT READ) Refuse 99

B4

(IF B3=01, 02, 03, 97, 98, 99)
How much did you pay for the freezer?

None/Nothing/Didn't pay 00
DOLLARS____ ($1 TO $3,000) 01
Don't know 98
Refused... 99

B5
When you got the freezer was it working, working but in need of repair, or not working?

Working	1	
Working but in needed repair	2	
Not working	3	
Don't know	8	
Refused	9	

B6
Did you get this freezer. . .

Because you didn't have a freezer before getting this one	01	
To replace your main freezer	02	
To replace your spare or backup freezer	03	
To use as a spare or backup to give you more freezer capacity	04	
Came with the house/was there when we moved in	05	
Or for some other reason (SPECIFY:___)	06	
(DO NOT READ) Don't know	98	
(DO NOT READ) Refused	99	

B7
Which of the following best describes how you currently use the freezer? Is it. . .

Plugged in and running all the time	1	B9
Plugged in most of the time and unplugged when not in use	2	
Used only during certain months or seasons	3	
Kept as a spare; but it isn't plugged in and operating at all	4	B9
Unit doesn't work	5	B9
(DO NOT READ) Don't know	8	B9
(DO NOT READ) Refused	9	B9

B8
During the past 12 months, how many total months was it plugged in and running?

None/Never use it	00	
MONTHS _____(1-12, half = .5)	01	
Don't know/Don’t remember	98	
Refused	99	

B9
Where was the freezer located during this time?

Kitchen	01	
Garage	02	
Porch	03	
Basement	04	
Other (SPECIFY:)	05	
Don't know	98	
Refused	99	

B10

(SKIP IF B7=05 (NOT WORKING))
Regarding its condition now, or when you last used it, does it freeze effectively, or does it not freeze as well as it should?

Yes, freezes effectively 1
No, works but does not freeze well... 2
Don't know 8
Refused... 9

B11

(SKIP IF B7=05 (NOT WORKING))
Does it cycle on and off correctly, or does it seem like the motor is always running?

Cycles correctly 1
Motor always running / not cycling 2
Don't know 8
Refused... 9

B12

(SKIP IF B7=05 (NOT WORKING))
Are the door seals in good condition, or do they leak cold air?

In good condition 1
Leak cold air.. 2
Don't know 8
Refused... 9

B13

At the time you acquired it, if this specific freezer had not been available, which of the following would you most likely have done... (READ)

Bought a similar used freezer somewhere else 01
Not purchased a freezer at that time 02
Purchased a lower quality used freezer 03
Purchased a new freezer.. 04
Fixed or repaired the old freezer 05
(DO NOT READ) Something else (Spec:______)..................... 06 (NEW)
(DO NOT READ) Don't Know 98
(DO NOT READ) Refused 99

B14

(IF B6=02 OR 03)
What did you do with the freezer you replaced? Did you...

Discard or get rid of it.. 01
Still have it unused and unplugged.. 02
Or use it as a spare or back up freezer and it runs occasionally03
(DO NOT READ) Don't know.. 98
(DO NOT READ) Refused 99

SECTION ID: IDENTIFICATION OF DISCARDS

ID1

Have you ever gotten rid of a working refrigerator or freezer, including any units that were replaced? (IF NEEDED: This includes any that would work if plugged in.)

Yes	01	
No	02	N
Don't know	98	N
Refused	99	N

ID2

Have you gotten rid of any working refrigerators or stand-alone freezers in the last four years, that is since January 1, 2002?

Yes	01	
No	02	N
Don't know	98	N
Refused	99	N

ID3

How many working refrigerators have you gotten rid of since January 1, 2002?

None	00	ID5
_____(RECORD NUMBER: 1-9)	01	
Don't know	98	ID5
Refused	99	ID5

ID4

Just to confirm, (this unit was working, not broken when you got rid of it/ these units were working, not broken when you got rid of them). Is this correct?

Yes (at least one of them)	01	
No	02	ID5
Don't know	98	ID5
Refused	99	ID5

ID5

How many working freezers have you gotten rid of in the last four years, that is since January 1, 2002?

None	00	BENC1
_____(RECORD NUMBER: 1-9)	01	
Don't know	98	BENC1
Refused	99	BENC1

ID6

Just to confirm, (this unit was working, not broken when you got rid of it/ these units were working, not broken when you got rid of them). Is this correct?

Yes (at least one of them)	01	
No	02	BENC1
Don't know	98	BENC1
Refused	99	BENC1

SECTION C: DISCARDED REFRIGERATOR CHARACTERISTICS

BENC1

CONTINUE TO C1 IF ID4=01 (YES). OTHERWISE, SKIP TO BEND1
Now I'm going to ask you some questions about the working refrigerator you disposed of most recently.

C0

Was this a refrigerator you replaced with another, meaning you got another refrigerator about the same time as you got rid of this one, or was it one you got rid of without replacing it?

Replaced 01
Not replaced 02
Don't know/Not sure 98
Refused 99

C1

What type of refrigerator was it? Did it have a …

Single door with a freezer compartment inside 01
A 2 door, side-by-side 02
Top freezer 03
Or bottom freezer 04
(DO NOT READ) Other (SPECIFY:___) 97
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

C2a (NEW)

Did the refrigerator have an icemaker?

Yes 01
No 02
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

C2b (NEW)

(ASK A2b IF A2a=01 (YES))
Did the refrigerator dispense ice through the door. . .

Yes – dispensed ice through the door 01
No 02
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

C3
Was it frost-free or manual defrost? (IF NEEDED: manual means that frost and ice builds up in the freezer and it must be turned off and thawed)

Frost free.. 01
Manual defrost 02
Other (SPECIFY:___) 03
Don't know 98
Refused.. 99

C4
About how old was it when you got rid of it? RECORD IN YEARS IF MORE THAN 1 YEAR OLD. IF NEEDED: Your best estimate is fine.

Less than one year old 00
YEARS ____ (1-50) 01
Don't know/Not sure/Can't remember.................................. 98
Refused.. 99

C5
What size was it in cubic feet? Your best estimate is fine.

CUBIC FEET _____ (1-30, half=.5)...................................... 01
Don't know/Not sure.. 98
Refused.. 99

C6
Where was the refrigerator located?

Kitchen 01
Garage 02
Porch.. 03
Basement... 04
Other (SPECIFY:) 05
Don't know 98
Refused.. 99

C7
Was the space heated? [IF NEEDED: where the refrigerator was located]

Yes... 01
No 02
Don't know 98
Refused.. 99

C8

Was the space air-conditioned? [IF NEEDED: where the refrigerator was located]

Yes 01
No 02
Don't know 98
Refused 99

C9

Did you use the refrigerator as your main refrigerator or as an extra or spare refrigerator?

Main 01
Extra/Spare 02
Other (SPECIFY:___) 03
Don't know 98
Refused 99

C10

When you got rid of the refrigerator was it working well or working but in need of repair?

Working 01
Working but needed repair 02
Don't know 98
Refused 99

C11 (NEW)

Did it cool effectively, or did it not cool as well as it should?

Yes, cooled effectively 1
No, worked but did not cool well 2
Don't know 8
Refused 9

C12 (NEW)

Did it cycle on and off correctly, or did it seem like the motor was always running?

Cycled correctly 1
Motor always running / not cycling 2
Don't know 8
Refused 9

C13 (NEW)

Were the door seals in good condition, or did they leak cold air?

In good condition 1
Leaked cold air 2
Don't know 8
Refused 9

C14

When did you get rid of it? BEST GUESS OKAY. ANSWER REQUIRES MONTH AND YEAR.

January	01
February	02
March	03
April	04
May	05
June	06
July	07
August	08
September	09
October	10
November	11
December	12
2003	21
2004	22
2005	23
2006	24
Don't know/Not sure/Can't remember	98
Refused	99

C15

How did you get rid of this refrigerator? (CLARIFY IF NEEDED TO FIT LIST BELOW. FOR EXAMPLE: Did you give it away or sell it?)

HAULED IT AWAY YOURSELF	
Took it to a recycler or scrap dealer	01
Took it to the landfill or threw it away	02
SOLD IT	
Sold it to a friend, acquaintance or relative	03
Sold it to a used refrigerator / freezer dealer	04
Sold it via garage sale, estate sale, or newspaper ad	05
Sold it when you moved to new occupant	13
SOMEONE ELSE HAULED IT AWAY	
Hired someone to pick it up (for junking or dumping)	06
Called utility's appliance recycling program	12
DEALER TOOK IT	
Traded it for a replacement unit	07
Dealer I bought a new one from took it away	08
GAVE IT AWAY (NOT SOLD)	
Gave it away	09
Left it behind when moved (for new occupant)	11
STILL HAVE IT	
Still have it, and using	00
Still have it; store it unused	10
SOME OTHER WAY	
Other (SPECIFY:___)	97
Don't know	98
Refused	99

C16
(IF C11 = 03, 04, 05, 07, 12, 13)
How much did you get for it?

None/Nothing/Didn't pay 00
DOLLARS ____ ($1-$3,000) 01
Don't know 98
Refused........ 99

C17
(IF C11 = 01, 02, 06, 08, 09)
How much did you pay to get rid of it?

None/Nothing/Didn't pay 00
DOLLARS ____ ($1-$500) 01
Don't know 98
Refused........ 99

C18
What other options for getting rid of this refrigerator did you seriously consider? CLARIFY IF NEEDED TO FIT LIST BELOW. FOR EXAMPLE: Would you have given it away or sold it? To whom? (MULTIPLE RESPONSE OKAY)

HAUL IT AWAY YOURSELF
Take it to a recycler or scrap dealer 01
Take it to landfill or throw it away........ 02

SELL IT
Sell it to a friend, acquaintance or relative........ 03
Sell it to a used refrigerator / freezer dealer 04
Sell it via garage sale, estate sale, or newspaper ad 05
Sell it when you moved to new occupant 13

SOMEONE ELSE HAUL IT AWAY
Hire someone to pick it up (for junking or dumping)........ 06
Call utility's appliance recycling program........ 12

DEALER TAKE IT
Trade it for a replacement unit........ 07
Dealer I bought a new one from take it away 08

GIVE IT AWAY (NOT SOLD)
Give it away 09
Leave it behind when we moved 11

KEEP IT
Keep and use it........ 00
Keep and store it, not used........ 10

NO OTHER OPTIONS CONSIDERED 96
Other (SPECIFY:___) 97
Don't know 98
Refused........ 99

SECTION D: DISCARDED FREEZER CHARACTERISTICS

BEND1

CONTINUE TO D1 IF ID6=01 (YES). OTHERWISE, SKIP TO N
The next few questions are about the working freezer you disposed of most recently.

D0

Was this a freezer you replaced with another, meaning you got another freezer about the same time as you got rid of this one, or one you got rid of without replacing it?

Replaced 01
Not replaced 02
Don't know/Not sure 98
Refused 99

D1

Was the freezer you got rid of most recently an upright or chest freezer? (IF NEEDED: A chest freezer is about waist height with a door or lid on the top. It is sometimes called a coffin freezer.)

Upright 1
Chest 2
Don't know 8
Refused 9

D2

Was it frost-free or manual defrost?

Frost free 01
Manual defrost 02
Other (SPECIFY:___) 03
Don't know 98
Refused 99

D3

About how old was it when you got rid of it? RECORD IN YEARS IF MORE THAN 1 YEAR OLD. IF NEEDED: Your best estimate is fine.

Less than one year old 00
YEARS ____ (1-50) 01
Don't know/Not sure/Can't remember 98
Refused 99

D4

What size was it in cubic feet? Your best estimate is fine.

CUBIC FEET _____ (1-30, half=.5) 01
Don't know/Not sure 98
Refused 99

D5
Where was the freezer located?

Kitchen 01
Garage 02
Porch.. 03
Basement.. 04
Other (SPECIFY:) 05
Don't know 98
Refused... 99
....

D6
Was the space heated? [IF NEEDED: where the freezer was located]

Yes 01
No 02
Don't know 98
Refused... 99

D7
Was the space air-conditioned? [IF NEEDED: where the freezer was located]

Yes 01
No 02
Don't know 98
Refused... 99

D8
Did you use the freezer as your main freezer or as an extra or spare freezer?

Main 01
Extra/spare... 02
Other (SPECIFY:___) 03
Don't know 98
Refused... 99

D9
When you got rid of the freezer, was it working well or working but in need of repair?

Working.. 01
Working but needed repair 02
Don't know 98
Refused... 99

D10 (NEW)
Did it freeze effectively, or did it not freeze as well as it should?

Yes, freezed effectively ... 1
No, worked but did not freeze well ... 2
Don't know ... 8
. ...Refused 9

D11 (NEW)
Did it cycle on and off correctly, or did it seem like the motor was always running?

Cycled correctly ... 1
Motor always running / not cycling ... 2
Don't know ... 8
Refused ... 9

D12 (NEW)
Were the door seals in good condition, or did they leak cold air?

In good condition ... 1
Leaked cold air ... 2
Don't know ... 8
Refused ... 9

D13
When did you get rid of it? BEST GUESS OKAY. ANSWER REQUIRES MONTH AND YEAR.

January ... 01
February ... 02
March ... 03
April ... 04
May ... 05
June ... 06
July ... 07
August ... 08
September ... 09
October ... 10
November ... 11
December ... 12
2003 ... 21
2004 ... 22
2005 ... 23
2006 ... 24
Don't know/Not sure/Can't remember ... 98
Refused ... 99

D14

How did you get rid of this freezer? (CLARIFY IF NEEDED TO FIT LIST BELOW. FOR EXAMPLE: Did you give it away or sell it?)

HAULED IT AWAY YOURSELF
Took it to a recycler or scrap dealer 01
Took it to the landfill or threw it away 02

SOLD IT
Sold it to a friend, acquaintance or relative 03
Sold it to a used refrigerator / freezer dealer 04
Sold it via garage sale, estate sale, or newspaper ad 05
Sold it when you moved to new occupant 13

SOMEONE ELSE HAULED IT AWAY
Hired someone to pick it up (for junking or dumping)................ 06
Called utility's appliance recycling program.............................. 12

DEALER TOOK IT
Traded it for a replacement unit.. 07
Dealer I bought a new one from took it away 08

GAVE IT AWAY (NOT SOLD)
Gave it away 09
Left it behind when moved (for new occupant)......................... 11

STILL HAVE IT
Still have it, and using 00
Still have it; store it unused 10

SOME OTHER WAY
Other (SPECIFY:___) 97
Don't know 98
Refused... 99

D15

(IF C11 = 03, 04, 05, 07, 12, 13)
How much did you sell it for?

None/Nothing/Didn't pay 00
DOLLARS ____ ($1-$3,000) 01
Don't know 98
Refused... 99

D16

(IF C11 = 01, 02, 06, 08, 09)
How much did you pay to get rid of it?

None/Nothing/Didn't pay 00
DOLLARS ____ ($1-$500) 01
Don't know 98
Refused... 99

D17

What other options for getting rid of this freezer did you seriously consider? CLARIFY IF NEEDED TO FIT LIST BELOW. FOR EXAMPLE: Would you have given it away or sold it? To whom? (MULTIPLE RESPONSE OKAY)

HAUL IT AWAY YOURSELF
Take it to a recycler or scrap dealer 01
Take it to landfill or throw it away... 02

SELL IT
Sell it to a friend, acquaintance or relative................................. 03
Sell it to a used refrigerator / freezer dealer 04
Sell it via garage sale, estate sale, or newspaper ad 05
Sell it when you moved to new occupant 13

SOMEONE ELSE HAUL IT AWAY
Hire someone to pick it up (for junking or dumping).................. 06
Call utility's appliance recycling program................................... 12

DEALER TAKE IT
Trade it for a replacement unit... 07
Dealer I bought a new one from take it away 08

GIVE IT AWAY (NOT SOLD)
Give it away 09
Leave it behind when we moved 11

KEEP IT
Keep and use it... 00
Keep and store it, not used.. 10

NO OTHER OPTIONS CONSIDERED 96
Other (SPECIFY:___) 97
Don't know 98
Refused... 99

SECTION NW: NON-WORKING APPLIANCE DISPOSAL

NW1

Have you gotten rid of any non-working refrigerators or stand-alone freezers in the last four years, that is since January 1, 2002?

Yes	01	
No	02	T
Don't know	98	T
Refused	99	T

NW2

How many non-working refrigerators have you gotten rid of since January 1, 2002?

None	00	NW4
_____(RECORD NUMBER: 1-9)	01	
Don't know	98	NW4
Refused	99	NW4

NW3

How did you dispose of it/them? (MULTIPLE RESPONSE OKAY IF MORE THAN 1 IN NW2)

HAULED IT AWAY YOURSELF	
Took it to a recycler or scrap dealer	01
Took it to the landfill or threw it away	02
SOLD IT	
Sold it to a friend, acquaintance or relative	03
Sold it to a used refrigerator / freezer dealer	04
Sold it via garage sale, estate sale, or newspaper ad	05
Sold it when you moved to new occupant	13
SOMEONE ELSE HAULED IT AWAY	
Hired someone to pick it up (for junking or dumping)	06
Called utility's appliance recycling program	12
DEALER TOOK IT	
Traded it for a replacement unit	07
Dealer I bought a new one from took it away	08
GAVE IT AWAY (NOT SOLD)	
Gave it away	09
Left it behind when moved (for new occupant)	11
SOME OTHER WAY	
Other (SPECIFY:___)	97
Don't know	98

NW4

How many non-working freezers have you gotten rid of since January 1, 2002?

None	00	T
_____(RECORD NUMBER: 1-9)	01	
Don't know	98	T
Refused	99	T

NW5

How did you dispose of it/them? (MULTIPLE RESPONSE OKAY IF MORE THAN 1 IN NW4)

HAULED IT AWAY YOURSELF
Took it to a recycler or scrap dealer 01
Took it to the landfill or threw it away 02

SOLD IT
Sold it to a friend, acquaintance or relative 03
Sold it to a used refrigerator / freezer dealer 04
Sold it via garage sale, estate sale, or newspaper ad 05
Sold it when you moved to new occupant 13

SOMEONE ELSE HAULED IT AWAY
Hired someone to pick it up (for junking or dumping) 06
Called utility's appliance recycling program 12

DEALER TOOK IT
Traded it for a replacement unit 07
Dealer I bought a new one from took it away 08

GAVE IT AWAY (NOT SOLD)
Gave it away 09
Left it behind when moved (for new occupant) 11

SOME OTHER WAY
Other (SPECIFY:___) 97
Don't know 98

SECTION T: PREFERENCES TRADE-OFF SECTION

T1 (NEW)

I'm going to read to you some hypothetical alternatives for disposing of a refrigerator or freezer. For each pair of alternatives, tell me which one you most prefer. If you would not consider either alternative but would keep the appliance instead, you can choose that. (IF NEEDED: Your best guess is okay)

Option 1 is … Option 2 is … Or you can keep it. Which do you most prefer?

Option 1 01
Option 2 02
Keep it 03
Don't know 98
Refused 99

T2 (NEW)

Option 1 is … Option 2 is … Or you can keep it. Which do you most prefer?

Option 1 01
Option 2 02
Keep it 03
Don't know 98
Refused 99

REPEAT WITH SIX DIFFERENT PAIRS … T1 through T6

NOTE THAT THIS IS A FULL PROFILE CONJOINT ANALYSIS. ATTRIBUTES (AND LEVELS OF EACH ATTRIBUTE) INCLUDE:

COST/INCENTIVE: (5 levels)

Cost to you is $50, Cost to you is $35, No Cost or Payment to you, Payment to you is $35, Payment to you is $50

TIMING: (5 levels)

Pickup is same day you arrange it, Pickup is within 3 days of when you arrange it, Pickup is within 7 days of when you arrange it, Pickup is within 14 days of when you arrange it, you transport it yourself

DISPOSITION: (3 levels)

Appliance gets used by someone else, appliance goes into landfill, appliance gets scrapped and completely recycled

HASSLE: (2 levels)

You make no more than one phone call, you might have to make multiple phone calls

Option 1 is: The cost to you is $25 dollars, pickup is the same day you arrange it, the appliance gets used by someone else, and you make no more than one phone call … OR

Option 2 is: Payment to you is $25, pick up is within 7 days of when you arrange it, the appliance goes into landfill, and you might have to make multiple phone calls

SECTION E: APPLIANCE RECYCLING PROGRAM

BEGNE

Now I have just a few general questions about a program offered by your electric utility.

E1

(UTILITY) provides a refrigerator and freezer removal service called the Residential Appliance Recycling Program. This program helps save energy by removing and recycling unwanted or out of date appliances. Do recall hearing about this program?

Yes	01	E2
No	02	
Don't know	98	
Refused	99	

(IF E1=02, 98, 99: READ THE FOLLOWING, THEN SKIP TO E6)
The program will pay you $35 and pick up your used, working refrigerator or freezer. You would call or go online to schedule the pick-up. It can take up to 2 to 3 weeks for the pick-up appointment, and you have to be present at the time of the pick-up. (SKIP TO E6)

E2

How did you hear about this program? [DO NOT READ]

Newspaper advertisement	01
TV advertisement	02
Radio advertisement	03
Utility website	04
Utility bill insert / information with utility bill	05
Separate mailing from your utility	06
News stories about the program	07
From a friend, neighbor, or co-worker	08
Appliance retailer	09
Ad or sign on a truck	10
Other (SPECIFY:)	97
Don't know	98
Refused	99

E3

(SKIP IF I09 = 02, 98, 99)
Have you ever had an appliance picked up by this program in the past?

Yes	1	
No	2	E5
Don't know	8	E6
Refused	9	E6

E4

How long ago did you use the Appliance Recycling Program?

Less than 1 month 01
1-3 months 02
4-6 months 03
7-9 months 04
10-12 months (1 year) 05
2 years 06
3 years 07
More than 3 years 08
Don't know/Not sure/Can't remember 98
Refused 99

E5

(SKIP IF E3 = 1 OR IF I09 = 02, 98, 99)
Why didn't you use this recycling program before?

Didn't have any appliances to recycle 01
Incentive is too low 02
Wait time is too long 03
Cannot be home as required when unit is picked up 04
Unit was not working 05
Need secondary unit for food/beverage storage at certain times of the year 06
Wanted to retain secondary unit for future use 07
Planned to give unit away to friend/relative in the future 08
Planned to sell unit as used in the future 09
Have not heard of the program until now 10
We rent/landlord decides 11
Signed up /but no one ever came to pick it up 12
Dealer/ Retailer picked up/Disposed of the old one 13
Inconvenient (Misc.) 14
Other (SPECIFY:___) 15
Don't know 98
Refused 99

E6 (NEW)

How likely would you be to use this program the next time you have an extra refrigerator or freezer? (READ)

Not at all likely 01
Somewhat likely 02
Very Likely 03
(DO NOT READ) Don't know 98
(DO NOT READ) Refused 99

E6X
How likely would you be to use this program to discard a working room or window-mount air conditioner? (READ)

Not at all likely 01
Somewhat likely 02
Very Likely 03
(DO NOT READ) Don't know 98
(DO NOT READ) Refused 99

E6Y
Your utility is considering changing several features to the appliance recycling program. I am going to read you a list of the changes they are considering. For each one, please tell me if it would make you more likely to use this program, or would it make no difference?

E6A
If the program offered more than the current $35 incentive?

More likely to use the program 01
No difference 02
Don't know 98
Refused 99

E6A1
(IF E6 = 01 or 02)
How much would you need to be offered so that you would be very likely to use this program?

DOLLARS ____ ($1-$500) 01
Don't know 98
Refused 99

E6B
If the wait time between when you call to schedule and when the appliance is picked up was shorter than 2 to 3 weeks?

More likely to use the program 01
No difference 02
Don't know 98
Refused 99

E6B1
What is the maximum number of days you would wait?

Less than a day/Same day 01
DAYS ___ (1-30) 02
Don't know 98
Refused 99

E6C

If they change the requirement that someone has to be home when the unit is picked up, so that no one has to be home?

More likely to use the program 1
No difference.. 2
Don't know 8
Refused... 9

E6D

If your old unit could be picked up by the appliance dealer at the time the new unit is being delivered?

More likely to use the program 1
No difference.. 2
Don't know 8
Refused... 9

E6E (DELETED)

E6F

Is there anything else that would make you more likely to use the appliance recycling program in the future?

RECORD COMMENTS 00
Nothing/Can't think of anything.. 01
Don't know 98
Refused... 99

SECTION DEMO: DEMOGRAPHICS QUESTIONS

DEMO1

My last few questions are for statistical purposes only. Including yourself and children, how many people live in your household at least six months of the year?

One/Just myself/Live alone	01
Two	02
Three	03
Four	04
Five	05
Six	06
Seven	07
Eight	08
Nine	09
Ten or more	10
Don't Know	98
Refused	99

DEMO2

What is your age? Are you. . .

18 to 25	01
26 to 35	02
36 to 45	03
46 to 55	04
56 to 65	05
Or 65 or older	06
(DO NOT READ) Refused	99

DEMO3

(IF DEMO1 = 2 OR MORE)
Of the people who live in your household, how many are under 18 years of age?

None	00
One	01
Two	02
Three	03
Four	04
Five	05
Six	06
Seven	07
Eight	08
Nine	09
Ten or more	10
Refused	99

DEMO4 (EX-DEMO3)

Please stop me when I reach the category that best describes your household's total annual income before taxes.

Under $10,000	01

$10,000 to just under $20,000 02
$20,000 to just under $30,000 03
$30,000 to just under $40,000 04
$40,000 to just under $50,000 05
$50,000 to just under $75,000 06
$75,000 to just under $100,000 07
$100,000 to just under $150,000 08
$150,000 or above 09
(DO NOT READ) Don't know/Not sure 98
(DO NOT READ) Refused 99

DEMO5 (NEW)

Do you own your home or rent?

Own.. 01
Rent/Lease... 02
Don't know/Not sure.. 98
Refused... 99

DEMO6 (NEW)

How long have you lived there?

Less than a year 01
YEARS _____ (1-99) 02
Don't know/Not sure.. 98
Refused... 99

DEMO7 (NEW)

Do you live in a …

Single family detached home.. 01
Condominium, townhouse, or duplex 02
Apartment 03
Or mobile home 04
Other (SPECIFY:___) 05
Don't know/Not sure.. 98
Refused... 99

DEMO8 (NEW)

What language do you speak in your home most often?

English 01
Spanish 02
Mandarin 03
Cantonese 04
Other Chinese 05
Japanese 06
Tagalog 07
Korean 08
Vietnamese 09
Other (SPECIFY: ___) 10
Don't know 98
Refused 99

DEMO9 (NEW)

How would you describe your ethnicity? (READ)

White or Caucasian 01
Hispanic 02
African-American 03
Asian 04
American Indian 05
Some other background (SPECIFY:___) 06
(DO NOT READ) Don't know 98
(DO NOT READ) Refused 99

RECORD GENDER

Male 01
Female 02

RECORD LANGUAGE OF INTERVIEW

English 01
Spanish 02

SECTION NP: READ THE NAMEPLATE

NP1 (NEW)

**(ASK IF ACQUIRED A USED REFRIGERATOR. E.G. SAME FILTER AS FOR SECTION A…
IF ANY IR5=USED AND (IR6=2002, 2003, 2004, 2005 OR IR7=4 YEARS OR LESS))**
One last thing about the used refrigerator we had been talking about, would you be able to look inside and read to me some information from the small nameplate or sticker on the inside of the refrigerator section? (IF NEEDED:) The plate has the manufacturer, model number, and other information. (IF NEEDED) The plate might be located on the inside sidewall about eye level near the front, or on the inside roof, or near the floor in the front. It is usually silver with black writing, or black with silver or white writing.

INTERVIEWER: Model number is different from the serial number. Ask for and record model number.
IF RESPONDENT CAN'T FIND THE PLATE AND IS TIRED OF LOOKING, RECORD AS 97.

Please tell me …

The manufacturer's name __________________ 01
The model number ____________________ 02
(DO NOT READ) Not able to provide information 97
(DO NOT READ) Refused 99

NP2 (NEW)

**(ASK IF ACQUIRED A USED FREEZER. E.G. SAME FILTER AS FOR SECTION B…
IF ANY IF5=USED AND (IF6=2002, 2003, 2004, 2005 OR IF7=4 YEARS OR LESS))**
One last thing about the used freezer we had been talking about, would you be able to look inside and read to me some information from the small nameplate or sticker on the inside of the freezer? (IF NEEDED:) The plate has the manufacturer, model number, and other information. (IF NEEDED) The plate is usually inside the freezer near the front or top when you open the door. It might sometimes be on the inside of the door itself. . It is usually silver with black writing, or black with silver or white writing.

INTERVIEWER: Model number is different from the serial number. Ask for and record model number.
IF RESPONDENT CAN'T FIND THE PLATE AND IS TIRED OF LOOKING, RECORD AS 97.

Please tell me …

The manufacturer's name __________________ 01
The model number ____________________ 02
(DO NOT READ) Not able to provide information 97
(DO NOT READ) Refused 99

CONCLUSION

Those are all the questions I have. Thank you very much for your time and cooperation.

APPENDIX F
VERIFICATION OF PROGRAM REPORTING

The objective for the program verification work was to verify the accomplishments of the 2004-2005 RARP as reported by each utility in their end-of-year reports to the CPUC. The verification was made for the program overall in each service territory and for the hard-to-reach aspects of the program.

F.1 VERIFYING PROGRAM RESULTS

Verifying program results entailed comparing the accomplishments for the 2004-2005 RARP as reported by each utility in their end-of-year reports to the CPUC against utility tracking data.

- Utility reports for the 2004-2005 RARP were downloaded from the CPUC Energy Efficiency Groupware Public Access website (http://eega.cpuc.ca.gov/).
- Full extracts from each utility's RARP tracking system were obtained both early in the evaluation period and later after utility refinement of their tracking data. These extracts were used not only for the verification work but also in developing sampling frames for various aspects of the study.

The verification of utility filings against the tracking data was based on the "settled" tracking data. The verification effort involved tabulating, by IOU and by program year, reported recycled units based on final IOU filings against tracking system total units and units with various potential program rule exceptions (unverified units). This effort verified that the total number of units reported as recycled in each of the utilities' fourth quarter filing matched the actual quantities of units shown in the tracking system database.

As a second aspect of the verification effort, verification questions were embedded within the overall participant telephone interview. As part of the interview, a participant was asked to confirm whether or not that the information contained on the tracking system concerning the appliances picked up from that participant was correct. The responses to this question, which are tabulated in Table F-1, showed that the tracking system data were generally correct.

Table F-1. Participants Responses to Question Whether Tracking System Data on Appliances Picked-Up Was Correct

Utility	***Was tracking system information correct as to what appliances were picked up?***			***% Correct***
	Yes	***No***	***Total***	
PG&E	243	11	254	95.7%
SCE	511	1	512	99.8%
SDG&E	250	2	252	99.2%
Totals	1,004	14	1,018	98.6%

F.2 RESULTS OF HTR VERIFICATION

The second major aspect of the verification effort was to confirm that the utilities' goals for participation of hard-to-reach (HTR) customers in the RARP were achieved. For 2004 and 2005, HTR goals were 37% of customers served for PG&E, 53% for SDG&E and 57% for SCE.

Staff from each utility were consulted with to confirm the definitions of HTR customers that they were using for their reporting. These definitions were then applied to data in the program tracking databases to determine the percentages of customers served by RARP in 2004-2005 that were hard-to-reach. These percentages are reported in Table F-2.

Table F-2. Percentages of RARP Customers Classified as Hard-to-Reach, by Utility and Type of Appliance (As Calculated from Tracking System Data)

Type of Appliance	***Utility***		
	PG&E	***SCE***	***SDG&E***
Refrigerators	23.9%	52.4%	68.0%
Freezers	30.2%	47.5%	70.5%
All Appliances	24.7%	51.8%	68.4%

APPENDIX G
DESCRIPTION OF DUAL MONITORING STUDY

This appendix provides descriptions of (1) the sampling design used for the dual monitoring study and (2) the characteristics on the refrigerators and freezers that were monitored. A more complete description of the dual monitoring study is provided in the following report.

> ADM Associates, 2006. "Dual Metering Study to Support 2003 EM&V of Statewide Residential Appliance Recycling Program: Final Report." June, 2006.

G.1 SAMPLING DESIGN

The sampling design for the Dual Metering Project had to support the collection of data that represents the diversity of participation in the Statewide Residential Appliance Recycling Program and allow estimation of a two-equation model. As KEMA-Xenergy concluded on the basis of their review of the literature on *in situ* monitoring of refrigerator energy use:

> … the basis for the adjustment between lab and in situ metering must rely on a carefully developed in situ sample that includes wide variation in climate, seasonality, household size, appliance configuration, appliance age and appliance status as secondary/primary. Such a sample can then be used to model the relationship between appliance use in a controlled situation versus appliance use in kitchens or garages as in a program like RARP. [KEMA-Xenergy (2004)]

The sample size for the monitoring effort was set by budgeting considerations. Funding was available for monitoring a sample of 220 appliance units during 2004 and 2005. The actual sample size desired was 200 units for which separate energy use measurements could be made at BR Laboratories using the DOE testing procedures. Under the adopted budget, *in situ* monitoring was conducted for 220 units to accommodate any attrition in the sample because of damages, loss of data, etc. (Assuming an attrition rate of 10%, monitoring only 200 units would result in attrition of 20 units. Monitoring 220 units will provide 20 additional units beyond 200 to account for such attrition.)

For purposes of sample design and selection, a frame was used that was constructed from program tracking data collected by ARCA and JACO for refrigerators and freezers recycled through the RARP during 2003. Full-year program tracking data were available for SCE, SDG&E and PG&E.

The working hypothesis in using the 2003 program tracking data for preparing the sampling design was that the types of refrigerators recycled through the program in 2004-2005 would, except for age, likely be distributed similarly to those recycled during 2003. The age distributions will differ because an age restriction was imposed for the 2004-2005 program such that only refrigerators manufactured before 1991 can be recycled through the program.

The frame of refrigerators and freezers recycled in 2003 was used to examine different approaches to stratifying the population of refrigerators and freezers and to allocating sample points across strata. The stratification scheme and the allocation plan are discussed in turn.

G.1.1 Stratification Scheme

A starting point for considering the definition of a stratification scheme was the sampling design that was used for the evaluation of the 2002 RARP. That sampling design stratified the population of recycled refrigerators/freezers by the following variables:

- Unit type (refrigerator or freezer);
- Defrost type (manual, automatic, partial);
- Configuration (single door, side by side, top freezer, bottom freezer; chest freezer, upright freezer);
- Age; and
- Size (cubic feet category).

A total of 19 strata were defined using these variables, 15 strata for refrigerators and 4 for freezers. The definitions of these strata are shown in Table G-1.

Table G-1. Definitions of Strata for Xenergy's Evaluation of 2002 RARP

Refrigerator Group	***Type***	***Age (Years)***	***Size (Cubic feet)***
1	Frost-Free with Bottom Freezer	Any	Any
2	Frost-Free with Single Door	Any	Any
3	Frost-Free with Side-by-Side Doors	≤19	10–20
4		>20	10–20
5		≤19	21+
6		>20	21+
7	Frost-Free with Top Freezer	≤19	10–17
8		>20	10–17
9		≤19	18–20
10		>20	18–20
11		≤19	21+
12		>20	21+
13	Manual defrost with single door	Any	Any
14	Manual defrost with two doors (all types)	Any	Any
15	Partial defrost (all types)	Any	Any
Freezer Group	***Type***	***Age (Years)***	***Size (Cubic feet)***
1	Frost-free (chest or upright)	Any	10-17
2	Frost-free (chest or upright)	Any	18+
3	Manual or partial defrost (chest or upright)	Any	10-17
4	Manual or partial defrost (chest or upright)	Any	18+

Maintaining the deep stratification scheme for refrigerators/freezers shown in Table G-1 would complicate the sampling design if stratification by other variables (e.g., geographical location, primary or secondary unit, etc.) were also to be considered. In particular, creating a large number of strata with only 200 sample points to allocate could result in some strata receiving small numbers of or even no sample points, making statistical analysis and estimation unstable. Accordingly, the refrigerator/freezer stratification was collapsed so that fewer strata were defined.

One way to collapse the refrigerator/freezer stratification was to remove stratification by age and size. There are several reasons for this.

- Both age and size are continuous variables whose effects on energy use can be controlled for in the statistical analysis (e.g., by entering them as variables in regression analysis). As has been noted: "…the relationship between age [and size] and consumption in the DOE model is likely to be better estimated when age, like any other X, is free to roam rather than truncated."[1]
- Because of the restriction placed on the age of refrigerators and freezers that can be recycled through RARP, the variation in age would be reduced, thereby making it less useful to stratify by age *a priori.*
- Refrigerator size is one of the explanatory variables in the equation used to explain variations in energy use as measured through DOE test procedure. Much of the effect of size is therefore already captured.

Refrigerators and freezers could still be stratified according to style and type of defrost, but with models having similar energy use combined into a stratum. The scheme that was used for stratifying refrigerators and freezers by style and type of defrost is shown in Table G-2. Also shown in Table G-2 are mean annual kWh usage estimates for the different models, as derived from information in the database of refrigerators and freezers that the Weatherization Assistance Program Technical Assistance Center (WAPTAC) has made available.[2]

Three strata for refrigerators and two strata for freezers were defined on the basis of similarities in energy use. The major distinction among strata was with respect to the type of defrost; units with automatic or frost-free defrost use more energy.

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1 John Peterson, Athens Research, personal communication, August 17, 2004.

2 The WAPTAC database includes energy use and other information on over 40,000 models of refrigerators, refrigerator/freezers, and freezers that were manufactured from 1979 through 1992. This database has been compiled from the *Directory of Certified Refrigerators, Freezers, and Refrigerator Freezers* published by the California Energy Commission (CEC) from 1979 to 1992. The information for each model includes manufacture (for years available), brand, year of manufacture, model number, style (e.g., side-by-side, top freezer), defrost type, volume (fresh food compartment, freezer, and total), dimensions, kWh/year (low, high, and mean), date of the CEC directory, and the effective date of the appliance efficiency standard with which it complies. Note that the energy use in this database is essentially DOE test data for when a unit is new.

Table G-2. Definitions of Strata for Dual Metering Study

Refrigerator Group	Type	Mean Annual kWh
A	Top freezer, frost-free Single door, frost-free	1,111 1,068
B	Side-by-side, frost-free Bottom freezer, frost-free	1,547 1,445
C	Top Freezer, Partial frost-free Top Freezer, Manual defrost Side-by-Side, Partial frost-free Side-by-Side, Manual defrost Bottom Freezer, Partial frost-free Bottom Freezer, Manual defrost Single Door, Partial frost-free Single Door, Manual defrost	868 759 613 708 671 948 500 468
Freezer Group	**Type**	
D	Frost-free, (chest or upright)	1,256
E	Manual or partial defrost , (chest or upright)	814

Table G-3 shows how refrigerators and freezers recycled through the program in PY2003 were distributed across the strata defined in Table G-2.

- Nearly two-thirds of the refrigerators recycled were in Stratum A, primarily top freezer, frost-free refrigerators. Refrigerators recycled in Stratum B were primarily side-by-side, frost-free refrigerators. Although Stratum C contains eight different models, these units accounted for less than ten percent of the units recycled.
- For freezers, just over three-fourths of the units recycled in PY2003 were either manual or partial defrost.

Table G-3. Distribution of Recycled Refrigerators and Freezers for Proposed Strata for Program Year 2003

Stratum*	PG&E	SCE	SDG&E	All
		Refrigerators		
	N = 10,358	N = 31,051	N = 4,681	N = 46,090
A	67.6%	63.2%	63.8%	64.3%
B	24.1%	28.2%	28.8%	27.3%
C	8.1%	8.6%	7.3%	8.4%
		Freezers		
	N = 1,972	N = 3,092	N = 614	N = 5,678
D	19.8%	28.2%	20.0%	24.4%
E	80.2%	71.8%	80.0%	75.6%

*See definitions of refrigerator and freezer groups in Table G-2.
Numbers of units are from utilities 4th Quarter 2003 Energy Efficiency Reports.

Besides the stratification by type of refrigerator or freezer shown in Table G-2, additional stratification needed to be considered for this study to ensure representation of factors that the literature review pointed to as influencing *in situ* energy use and hence the relationship between refrigerator or freezer energy use measured *in situ* and through DOE laboratory testing.

One type of additional stratification was by geographic location. There were several reasons for such stratification.

- Stratification by geographic location allowed representation of all three utility service areas in the data collection effort.
- The literature review showed that several studies have identified outdoor temperature as significant in affecting the *in situ* energy use of refrigerators. Stratifying by geographic location allowed account to be taken of variations in temperature and other climatic conditions that can affect energy use of refrigerators and freezers.
- Stratification by geographic location could also provide for some representation of variations in household characteristics (e.g., number of occupants, age, income, education, etc.). That is, it is known that there can be "clustering effects" if sample units are selected only from a restricted area. Choosing several different areas from which to select units could mitigate this problem.

Aggregations of 3-digit zip code areas were used to provide geographic stratification. Appendix A shows the number of refrigerators and freezers recycled in PY2003 in 3-digit zip code areas, as well as the average income and cooling degree days and heating degree days for these zip code areas. (Average income and CDD65 and HDD65 were calculated from data collected for the 2002 Residential Appliance Saturation Survey (RASS.)

From these data, it was possible to define geographical areas that differ in income and climatic conditions and that have sufficient numbers of recycled refrigerators and freezers to facilitate selecting a sample of units according to the stratification shown in Table G-1. These geographical areas, which are aggregations of 3-digit zip code areas, are defined in Table G-4. Three areas are in SCE's service territory, one in PG&E's service territory, and one in SDG&E's service territory. As can be seen, the areas span different levels of average income and different climatic conditions.

The five areas specified in Table G-4 account for just under half of the refrigerators recycled through RARP in 2003. If similar levels of recycling occur in 2004-2005, the required sample size for the metering can be reached through a sampling rate of roughly one in a hundred from among units recycled in these areas.

Table G-4. Proposed Geographical Areas for Recruiting Households for Sample

Area	ZipCode3	Refrigerators Recycled	Freezers Recycled	Average Income	CDD65	HDD65
SCE-1	902	2,154	130	54,367	605	1,367
	906	2,051	188	50,153	892	1,421
	907	1,017	99	41,621	548	1,374
	908	1,195	65	40,422	375	1,401
Subtotal		*6,417*	*482*			
SCE-2	917	4,886	436	62,512	1,264	1,531
Subtotal		*4,886*	*436*			
SCE-3	926	2,917	230	82,336	416	1,393
	927	1,478	119	64,998	580	1,362
	928	2,324	242	69,891	799	1,374
	930	1,791	217	74,936	598	1,503
Subtotal		*8,510*	*808*			
PG&E-1	945	3,261	436	76,950	766	2,665
	946	487	45	52,697	123	2,824
	947	225	24	68,045	123	2,824
	948	215	34	64,033	123	2,824
Subtotal		*4,188*	*539*			
SDG&E-1	920	2,032	304	68,889	480	1,531
	921	1,546	169	62,521	373	1,394
Subtotal		*3,578*	*473*			
Total		*27,579*	*2,738*			

A third level of stratification pertained to whether a recycled unit was a primary or secondary unit or whether it was being operated in conditioned or unconditioned space. The *in situ* metering conducted for the ICF study of the RARP program suggested that refrigerators in unconditioned space used less energy than those in conditioned space. To control for this effect, two strata that are of interest were defined:

- Primary units that are in conditioned space.
- Secondary units that are in unconditioned space.

The assumption being made was that the prevalence of primary units in unconditioned space or of secondary units in conditioned space would be too low to warrant the effort to bring such units into the sample.

In summary, the stratification scheme was as follows:

- 5 strata defined for different types of refrigerators and freezers;
- 5 geographic areas, 3 of which are in SCE's service area and 1 each in the service areas of PG&E and SDG&E; and
- 2 strata defined as (1) primary units in conditioned space and (2) secondary units in unconditioned space.

G.1.2 Allocation of Sample Points

Having defined a stratification scheme, the next step in preparing the sampling design was to determine the allocation of the 200 sample points across the strata in the scheme. This allocation could result in some strata being collapsed with other strata or receiving no sample points.

To guide the allocation, use was made of RARP tracking data for PY2003. Table G-5 shows that the distributions of recycled units by type of refrigerator were relatively similar between PY2002 and PY2003. Although distributions may be different in future years, they were the only source of quantitative information on which to base sample allocation decisions.

Table G-5. Distribution of Recycled Refrigerators across KEMA-Xenergy Sampling Strata for Program Years 2002 and 2003

Group*	PY 2002		PY 2003	
	Number	Percent of Total	Number	Percent of Total
	Refrigerators			
0			1,438	3.52
1	965	2.50	617	1.51
2	618	1.60	486	1.19
3	1,226	3.20	1,213	2.97
4	1,446	3.80	652	1.59
5	2,938	7.70	4,821	11.79
6	3,466	9.10	2,627	6.43
7	4,246	11.10	5,658	13.84
8	3,583	9.40	2,404	5.88
9	7,034	18.40	10,791	26.4
10	7,023	18.40	4,598	11.25
11	1,166	3.10	1,670	4.09
12	848	2.20	490	1.20
13	1,526	4.00	1,929	4.72
14	1,469	3.80	961	2.35
15	656	1.70	526	1.29
Totals	38,210	100%	40,881	100%

*See definitions of refrigerator groups in Table 4-1.

G.1.2.1 Allocation of Sample Points between Refrigerators and Freezers

The first step in the allocation of sample points was to determine how many sample points should be allocated for refrigerators and how many for freezers. Table G-6 shows the percentages of units recycled in PY2003 that were refrigerators or freezers in the different utility service areas and overall. As can be seen, nearly 90% of the units recycled were refrigerators. Accordingly, 90% of the 200 sample points for the metering study were allocated to refrigerators. On this allocation, there would be 180 sample points for refrigerators and 20 sample points for freezers.

Table G-6. Percentages of Units Recycled in PY2003 That Were Refrigerators or Freezers

	Utility Service Area			***Totals***
	PG&E	***SCE***	***SDG&E***	
Units recycled	12,330	34,143	5,295	51,768
% Refrigerators	84.0%	90.9%	88.4%	89.0%
% Freezers	16.0%	9.1%	11.6%	11.0%

The next step in the allocation of sample points was to determine the separate allocations of the points for refrigerators and for freezers. Allocation of refrigerator sample points is addressed first.

G.1.2.2 Allocation of Sample Points for Refrigerators

There were three considerations in allocating the 180 sample points for refrigerators.

- How should sample points be allocated to Refrigerator Type Strata A, B, and C?
- How should sample points be allocated to the five geographic strata?
- How should sample points be allocated between the primary conditioned stratum and the secondary unconditioned stratum?

One argument made with respect to allocation of sample points across Refrigerator Type Strata was that consideration be given to the relative variability of energy use values across types of refrigerators. In particular, an "optimal" (i.e., Neyman) allocation would take into account both the numbers of units and the variance of energy use in the different strata. Note, however, that if the variability of energy use is similar among strata, then optimal allocation reduces to an allocation in proportion to the number of units.

There was evidence that suggested that the variability of energy use was similar for the two types of refrigerators that accounted for most of the recycled units (i.e., top freezer, frost-free refrigerators in Stratum A and side-by-side, frost-free refrigerators in Stratum B). Table G-7 shows data on means, standard deviations, and coefficients of variation for these two types of refrigerators as calculated from the WAPTAC database. The coefficients of variation are similar for the two types, suggesting little difference in variability of energy use between the two types.

Table G-7. Means and Standard Deviations for kWh Use for Top Freezer and Side-by-Side Refrigerators with Frost-Free Defrosting

Type of Refrigerator	***Number of Models***	***Mean kWh***	***Standard Deviation***	***Coefficient of Variation***
Top freezer, frost-free	14,198	1,111	238	21.4%
Side-by-side, frost-free	4,229	1,547	316	20.5%

With no significant differences in the variability of energy use between strata, sample points could be allocated across the three Refrigerator Type strata in proportion to the numbers of units recycled. Table G-3 provided the information used for making this allocation. The distributions of recycled refrigerators across the three strata were relatively similar for the three utility service areas. For the allocation, a split of 60:30:10 was made for the three strata defined by refrigerator types, giving the following allocation across Refrigerator Type strata:

- 105 sample points for Stratum A
- 55 sample points for Stratum B
- 20 sample points for Stratum C

These sample points needed to be allocated across the five geographical areas that had been designated as the areas from which units would be recruited for the metering. The data on the numbers of refrigerators recycled in PY2003 showed that the three utility service areas accounted for the following percentages of all recycled refrigerators:

- PG&E: 22.5%
- SCE: 67.4%
- SDG&E: 10.4%

Within SCE's service area, Table G-4 showed that the three geographical areas selected for recruitment of households differed in the magnitude of recycling. SCE-1 accounted for about 30% of refrigerator recycling among the three areas, SCE-2 for about 25%, and SCE-3 for about 45%. Applying these percentages to the 180 sample points allocated to refrigerators gave the following allocation of sample points to the five geographical areas.

- PG&E 40
- SCE-1 36
- SCE-2 30
- SCE-3 54
- SDG&E 20

The final allocation of sample points was between primary units coming from conditioned space and secondary units coming from unconditioned space. Using program tracking data for PY2003, the percentages of recycled refrigerators in each utility service area that were secondary units were calculated. These percentages, which are reported in Table G-8, were applied to determine the allocation of sample points between primary and secondary units for each allocation cell defined by refrigerator type and geographical area.

Table G-8. Percentages of Recycled Refrigerators in PY2003 That Were Secondary Units by Utility Service Area

*Stratum**	*PG&E*	*SCE*	*SDG&E*	*All*
A	23.1%	23.5%	21.3%	23.2%
B	22.8%	21.1%	17.8%	20.9%
C	33.6%	31.0%	26.2%	30.8%

The allocation of sample points for refrigerators that resulted from these steps is shown in Table G-9.

Table G-9. Allocation of Sample Points for Refrigerators

*Stratum**	*PG&E*	*SCE-1*	*SCE-2*	*SCE-3*	*SDG&E*	*Totals*
A-P	18	16	13	24	9	80
A-S	6	4	4	8	3	25
B-P	10	9	7	13	5	44
B-S	3	2	2	3	1	11
C-P	2	4	3	4	1	14
C-S	1	1	1	2	1	6
Totals	40	36	30	54	20	180

*Defined by combination of refrigerator type stratum and primary/secondary stratum.
E.g., A-P is Refrigerator Type stratum A for primary units.

G.1.2.3 Allocation of Sample Points for Freezers

The considerations in allocating the 20 sample points for freezers were as follows:

- How should sample points be allocated to the five geographic strata?
- How should sample points be allocated to Freezer Type Strata D and E?

The data for answering these questions and making the allocation of sample points for freezers are reported in Table G-10. Of 5,678 freezers that were recycled, 34.7% were from PG&E service area. Of the freezers recycled in PG&E's service area, 19.8% were frost-free (i.e., in Freezer Stratum D).

Table G-10. Distribution of Recycled Refrigerators and Freezers for Proposed Strata for Program Year 2003

	PG&E	*SCE*	*SDG&E*	*All*
% of all recycled freezers	34.7%	54.5%	10.8%	N=5,678
% of recycled freezers that were frost-free	19.8%	28.2%	20.0%	24.4%

Applying the percentages in Table G-10 produced the allocation of sample points for freezers shown in Table G-11.

Table G-11. Allocation of Sample Points for Freezers

Stratum*	PG&E	SCE-1	SCE-2	SCE-3	SDG&E	Totals
D	1	1	1	1	1	5
E	5	3	3	3	1	15
Totals	6	4	4	4	2	20

G.1.3 Summary of Sampling Design

The stratification scheme for the sampling design defined the following strata.

- Three refrigerator type strata and two freezer type strata were defined.
- Five geographical areas were designated as the areas from which the refrigerators and freezers would be selected for the sample. These areas provided variation in climatic conditions, provided representation of each service area in the sample, and allowed some representation of households from areas with different income levels.
- Two strata were defined for whether a unit was a primary or secondary unit. The assumption was made that most primary units come from conditioned spaces, while most secondary units come from unconditioned spaces.

The proposed allocation of the 200 sample points across the defined strata is summarized in Table G-12. The cell numbers represent quotas that were to be met by the end of the project.

Table G-12. Allocation of Sample Points for Refrigerators and Freezers

Stratum*	PG&E	SCE-1	SCE-2	SCE-3	SDG&E	Totals
			Refrigerators			
A-P	18	16	13	24	9	80
A-S	6	4	4	8	3	25
B-P	10	9	7	13	5	44
B-S	3	2	2	3	1	11
C-P	2	4	3	4	1	14
C-S	1	1	1	2	1	6
Totals	40	36	30	54	20	180
			Freezers			
D	1	1	1	1	1	5
E	5	3	3	3	1	15
Totals	6	4	4	4	2	20

G.2 CHARACTERISTICS OF DUAL MONITORED UNITS

Data on the characteristics of households where monitoring was conducted and of the refrigerators and freezers that were monitored were collected for each household. (A copy of the data collection instrument is provided in Appendix C.) Summary data on the characteristics of the households and the monitored units are presented in this chapter.

G.2.1 Numbers of Refrigerators and Freezers Monitored

As shown in Table G-13, there were 221 refrigerators and 21 freezers for which *in-situ* monitoring was conducted. The number of units actually monitored was greater than 220 to accommodate for the loss of some monitored units during their being transported to BR Labs for the DOE lab testing. Table G-13 shows how the units monitored were distributed according to the stratum definitions discussed in Section G.1.

Table G-13. Numbers of Refrigerators and Freezers Monitored In-Situ

Refrigerators Monitored In-Situ						
Stratum*	***PG&E***	***SCE -1***	***SCE -2***	***SCE -3***	***SDG&E***	***Totals***
A-P	18	16	20	34	10	98
A-S	7	9	6	12	5	39
B-P	13	14	5	19	7	58
B-S	3	2	5	7	2	19
C-P	2	2	2	0	0	6
C-S	1	0	0	0	0	1
Totals	44	43	38	72	24	221
Freezers Monitored In-Situ						
Stratum*	***PG&E***	***SCE -1***	***SCE -2***	***SCE -3***	***SDG&E***	***Totals***
D	1	1	1	2	1	6
E	6	3	2	3	1	15
Totals	7	4	3	5	2	21
Totals	**51**	**47**	**41**	**77**	**26**	**242**

Table G-14 shows the distribution of monitored units according to the method of recruitment: through lists provided by the recyclers or through a customer's direct call.

Table G-14. Distribution of Monitored Refrigerators and Freezers by Method of Recruitment

Recruitment Procedure	***Refrigerators***	***Freezers***	***Totals***
Recycler lists	91	11	102
Customer direct call	130	10	140
Totals	221	21	242

G.2.2 Numbers of Monitored Units Receiving DOE Testing

Table G-15 shows that of the 242 units monitored *in situ,* 203 units (i.e., 183 refrigerators and 20 freezers) received the DOE lab testing at BR Labs.

Table G-15. Numbers of Refrigerators and Freezers Tested with DOE Lab Test Protocol at BR Labs

Refrigerators Tested at BR Labs with DOE Lab Test Protocol						
Stratum*	***PG&E***	***SCE -1***	***SCE -2***	***SCE -3***	***SDG&E***	***Totals***
A-P	18	14	14	25	9	80
A-S	7	8	6	10	5	36
B-P	11	13	3	16	5	48
B-S	2	1	3	5	2	13
C-P	2	1	2	0	0	5
C-S	1	0	0	0	0	1
Totals	41	37	28	56	21	183
Freezers Tested at BR Labs with DOE Lab Test Protocol						
Stratum*	***PG&E***	***SCE -1***	***SCE -2***	***SCE -3***	***SDG&E***	***Totals***
D	0	1	1	2	1	5
E	6	3	2	3	1	15
Totals	6	4	3	5	2	20
Totals	**47**	**42**	**31**	**61**	**23**	**204**

G.2.3 Characteristics of Households with Dual Monitored Units

Information was obtained on the numbers of persons and on the levels of education and of income for the households where the dual monitored units were located. Table G-16 shows the distributions of the households according to the number of persons in the household.

Table G-16. Distributions of Dual Monitored Households by Number of Persons in Household

Number of Persons in Household	***Number of Freezers Monitored***	***Number of Refrigerators Monitored***
One	2	21
Two	10	77
Three	2	38
Four	5	23
Five		11
More than five		8
Not reported	1	5
Totals	20	183

Table G-17 shows the distributions of households according to the level of education of the head of the household.

Table G-17. Distributions of Dual Monitored Households by Level of Education for Head of Household

Highest Level of Education Attained by Head of Household	*Number of Freezers Monitored*	*Number of Refrigerators Monitored*
Elementary school		1
High school graduate	3	21
Some college or trade/vocational school	3	34
College graduate	12	82
Post-graduate	2	41
Not reported		4
Totals	20	183

Table G-18 shows the distributions of the households with dual monitored units according to the level of household income. Only about 30 percent of the households with dual monitored refrigerators reported on their annual household income.

Table G-18. Distributions of Dual Monitored Households by Level of Household Income

Annual Household Income	*Number of Freezers Monitored*	*Number of Refrigerators Monitored*
Less than $25,000		2
$25,000 – $49,999	1	16
$50,000 – $74,999	6	14
$75,000 – $99,999	3	11
$100,000 – $149,999	2	7
$150,000 or more		3
Not reported	8	130
Totals	20	183

G.2.4 Characteristics of Dual Monitored Units

Data were collected on the characteristics of the 203 dual monitored refrigerators and freezers. Those data are summarized in this section.

The configuration types represented among the 183 dual monitored refrigerators included 6 with bottom freezers, 5 with single doors, 58 with side-by-side doors, and 114 with top freezers. There were 44 refrigerators with through-the-door water or ice dispensers. With respect to type of defrost, 179 refrigerators were frost-free, and 4 were manual defrost.

Among the 20 dual monitored freezers, there were 4 chest freezers and 16 upright freezers. With respect to type of defrost, 5 of the freezers were frost-free, and 15 were manual defrost.

A variety of brands were represented among the 203 dual monitored refrigerators and freezers. This variety is shown in Table G-19. The most common brands were Sears (both Kenmore and Coldspot), General Electric, Whirlpool, and Amana.

Table G-19. Brands Represented among Dual Monitored Freezers and Refrigerators

Brand	***Freezers***	***Refrigerators***
Admiral	3	1
Amana		27
Frigidaire		3
General Electric	1	33
Gibson	1	3
Hot Point		10
J.C. Penneys	1	2
Kelvinator	1	1
Kenmore (Sears)	5	27
Kitchenaid		1
Magic Chef		1
Marquette	1	
Maytag		2
Montgomery Ward	1	10
Norge		1
Philco (Ford)		1
Roper		1
Sears		1
Sears Coldspot	3	5
Westinghouse		4
Whirlpool	3	31
White Westinghouse		1
Totals	20	183

The distributions of the dual monitored units by year of manufacture is shown in Table G-20. The majority of the monitored units were manufactured during the period 1984 through 1989.

Table G-21 shows the distributions of the dual monitored units by cubic feet of capacity. The average capacity for the 183 dual monitored refrigerators was 19.98 cubic feet (with a standard deviation of 3.11 cubic feet). The average capacity of the 20 dual monitored freezers was 16.91 cubic feet (with a standard deviation of 2.50 cubic feet).

Table G-20. Distribution of Dual Monitored Units by Year of Manufacture

Year Manufactured	***Freezers***	***Refrigerators***
1962		1
1965		1
1968	1	
1970	1	
1971		3
1973		1
1974	1	1
1975	1	3
1976	2	5
1977	1	1
1978	1	9
1979		7
1980		3
1981	2	5
1982	3	8
1983	1	5
1984		11
1985	1	13
1986	1	31
1987	1	18
1988	10	18
1989		28
1990		1
1991		1
1992		1
Estimated '50-'60	1	
Estimated '68-'72		1
Estimated '70s	1	5
Unknown		2
Totals	20	183

Table G-21. Distributions of Dual Monitored Units by Cubic Feet of Capacity

Cubic Feet of Capacity	Freezers	Refrigerators
14.0		6
14.1		2
14.2		1
14.5	2	
15.0	2	2
15.1	1	
15.5	1	2
16.0	7	7
16.5		1
17.0	2	15
17.5		1
18.0	1	26
18.5	1	
18.6		1
19.0		26
19.3		1
19.6		1
19.7		1
20.0	1	20
21.0		11
21.6		2
22.0		13
22.1		1
22.2		2
22.5		1
23.0	1	3
23.1	1	
23.5		2
24.0		9
25.0		22
26.0		3
Not reported		1
Totals	20	183

G.2.5 Energy-Using Characteristics of Dual Monitored Units

Information was collected during the installation visits that pertained to the energy-using characteristics of the dual monitored units. This information included one-time measurements for the following items for each unit monitored:

- Amperage
- Power factor
- Wattage

The information for these measurements are summarized for the dual monitored refrigerators in the tables in this section.

G.2.5.1 Measurements of Energy-Us Parameters for Dual Monitored Refrigerators

One-time measurements were made for several energy-use parameters (i.e., amps, power factor, watts) for the dual monitored refrigerators. These averages of these measurements are reported in Table G-22 for all monitored refrigerators and for different types of refrigerators.

Table G-22. One-Time Measurements of Energy-Use Parameters for Dual Monitored Refrigerators

Type of Refrigerator	*Number of Units*	*Average*	*Standard Deviation*
	Capacity (cubic feet		
Bottom freezer	6	19.50	0.55
Single door	5	16.70	0.97
Side-by-side	58	23.31	2.10
Top freezer	114	18.49	2.22
Totals	183	19.98	3.11
	OTM Amps		
Bottom freezer	6	3.25	0.52
Single door	5	2.71	0.50
Side-by-side	58	3.59	0.97
Top freezer	114	3.07	1.18
Totals	183	3.23	1.11
	OTM Power Factor		
Bottom freezer	6	0.72	0.08
Single door	5	0.67	0.11
Side-by-side	58	0.76	0.09
Top freezer	114	0.76	0.11
Totals	183	0.76	0.10
	OTM Watts		
Bottom freezer	6	272.17	42.81
Single door	5	223.80	71.68
Side-by-side	58	316.98	69.20
Top freezer	114	269.34	88.96
Totals	183	283.29	84.62

G.2.5.2 Energy-Use Parameters for Dual Monitored Freezers

One-time measurements were also made for energy-use parameters for the dual monitored freezers. Averages and standard deviations for these measurements are reported in Table G-23.

Table G-23. One-Time Measurements of Energy-Use Parameters for Dual Monitored Freezers

Type of Freezer	*Number of Units*	*Average*	*Standard Deviation*
	Capacity (cubic feet)		
Chest	4	19.05	4.62
Upright	16	16.38	1.45
Totals	20	16.91	2.50
	OTM Amps		
Chest	4	2.42	0.95
Upright	16	3.48	0.78
Totals	20	3.27	0.90
	OTM Power Factor		
Chest	4	0.75	0.08
Upright	16	0.65	0.08
Totals	20	0.67	0.09
	OTM Watts		
Chest	4	208.75	53.04
Upright	16	267.13	65.01
Totals	20	255.45	65.99

G.2.6 Operating Information for Dual Monitored Units

Information on the conditions under which the dual monitored units were operated was collected during the on-site installation visits. This information is summarized in this section.

Table G-24 shows the distributions of the dual monitored units according to the locations where they were usually operated.

Table G-24. Distributions of Dual Monitored Units According to Locations Where Usually Operated

Location Where Usually Operated	Freezers	Refrigerators
Basement	1	1
Dining Room		5
Kitchen	1	129
Laundry	1	
Porch	1	
Utility Room	1	
Garage	15	45
Outside		1
Outside Patio		2
Totals	20	183

Table G-25 shows how the dual monitored units were distributed according to the length of time the unit had been in the location where it was usually operated (as reported in Table G-24).

Table G-25. Distributions of Dual Monitored Units According to Length of Time in Location Where Usually Operated

Length of Time in Location?	Freezers	Refrigerators
5 days		1
1 week	2	7
2 weeks		4
1 month	2	3
2 months		2
3 months		1
4 months		1
6 months		2
7 months		1
8 months		1
1 year		2
2 years		8
3 years	1	2
4 years		1
5 years		16
6 years		8
7 years		5
8 years		3
9 years		4
10 years	3	15
11 years		4
12 years		4
13 years		3
14 years		3
15 years	2	3
16 years	1	17
17 years	1	10

Length of Time in Location?	Freezers	Refrigerators
18 years	1	8
19 years		12
20 years	1	12
21 years		1
22 years	1	
23 years	1	4
24 years		3
25 years	1	1
26 years		3
27 years	2	
29 years		2
31 years		1
33 years	1	1
35 years		1
Not reported		3
Totals	20	183

Table G-26 shows the distributions of the dual monitored units according to whether the location where the unit was usually operated was conditioned.

Table G-26. Distributions of Dual Monitored Units According to Whether Locations Where Usually Operated Were Conditioned

Was Location Where Usually Operated Conditioned?	Freezers	Refrigerators
Yes	2	133
No	18	50
Totals	20	183

At the time of the installation visit, the field staff observed the level of food storage in the dual monitored units. The results of these observations are reported in Table G-27.

Table G-27. Distributions of Dual Monitored Units According to Level of Food Storage

Level of Food Storage	Freezers	Refrigerators
Full	3	79
Moderate	12	62
Sparse	5	37
Not reported		5
Totals	20	183

Data were collected over the monitoring period for each unit that allowed estimation of the number of refrigerator door openings per day and the number of minutes per day that the door of a refrigerator was open. Table G-28 reports the average number of door openings for refrigerators of different types in either conditioned or unconditioned space, while Table G-29 shows the average number of minutes per day that refrigerator doors were open.

Table G-28. Average Number of Refrigerator Door Openings per Day for Different Types of Refrigerators Located in Conditioned and Unconditioned Space

Type of Refrigerator	Number of Units	Average Number of Door Openings per Day	Standard Deviation for Door Openings per Day Door
Units Located in Conditioned Space			
Bottom freezer	5	26.69	6.47
Single door	4	17.13	13.58
Side-by-side	45	28.55	14.63
Top freezer	79	23.52	14.96
Total	133	25.16	14.70
Units Located in Unconditioned Spaces			
Bottom freezer	1	1.72	Not applicable
Single door	1	1.72	Not applicable
Side-by-side	13	6.87	7.40
Top freezer	35	3.81	2.76
Total	50	4.60	4.72

Table G-29. Average Number of Minutes per Day Refrigerator Door Was Open for Different Types of Refrigerators Located in Conditioned and Unconditioned Space

Type of Refrigerator	Number of Units	Average Number of Minutes per Day Door Was Open	Standard Deviation for Minutes per Day Door Was Open
Units Located in Conditioned Space			
Bottom freezer	5	6:34	1:22
Single door	4	3:34	1:42
Side-by-side	45	6:38	3:51
Top freezer	79	5:43	5:06
Total	133		
Units Located in Unconditioned Spaces			
Bottom freezer	1	0:18	Not applicable
Single door	1	0:27	Not applicable
Side-by-side	13	1:22	1:23
Top freezer	35	0:54	0:52
Total	50	1:02	1:02

Data were collected during the monitoring periods on ambient room temperatures. These data were averaged for each unit to estimate the average room temperature. Table G-30 reports the room temperatures when averaged across units located in conditioned spaces that monitored in a given month during 2005 and in different locations. The locations represent different climate areas: coastal climate, inland-moderate climate, and inland-hot climate.

Figures G-1, G-2, and G-3 plot the average room temperatures for the different months for the three climate areas (as shown in Table G-30) against the average hourly temperatures for those months during 2005 in those areas. The correlations between average room temperatures and outdoor temperatures for the three climate areas are relatively high: 0.93 for the coastal area, 0.94 for the inland-moderate area, and 0.77 for the inland-hot area.

Table G-30. Room Temperatures in Conditioned Spaces as Averaged across Monitored Refrigerator for Different Months in Different Locations

Month of Monitoring during 2005	Number of Units	Average Room Temperature	Standard Deviation
Coastal			
January	5	68.44	4.07
February	8	66.17	3.26
March	2	67.21	2.59
April	6	70.69	3.90
May	4	73.27	1.86
June	4	75.73	1.69
July	5	76.78	2.48
August	2	75.81	1.06
September	2	77.85	3.67
October	3	73.55	2.66
Inland-Moderate			
February	5	66.66	5.52
March	10	67.23	3.08
April	10	71.37	2.73
May	7	73.65	3.83
June	6	77.08	6.58
July	8	78.07	3.62
August	13	78.81	2.42
September	9	76.88	3.16
October	7	75.37	2.71
Inland-Hot			
April	1	67.68	Not applicable
May	1	71.83	Not applicable
June	5	74.25	2.12
July	6	76.81	3.39
August	2	82.43	3.16
September	3	80.76	4.26
October	1	76.51	Not applicable

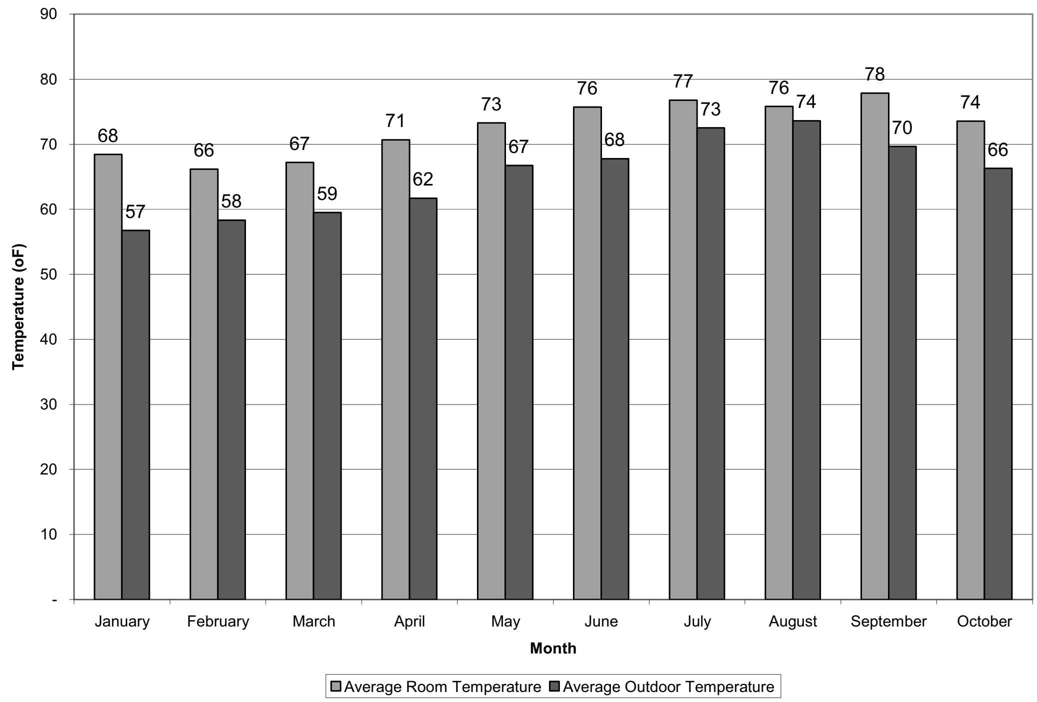

Figure G-1. Average Room Temperature in Conditioned Space versus Outdoor Average Temperature by Month for Coastal Climate Area

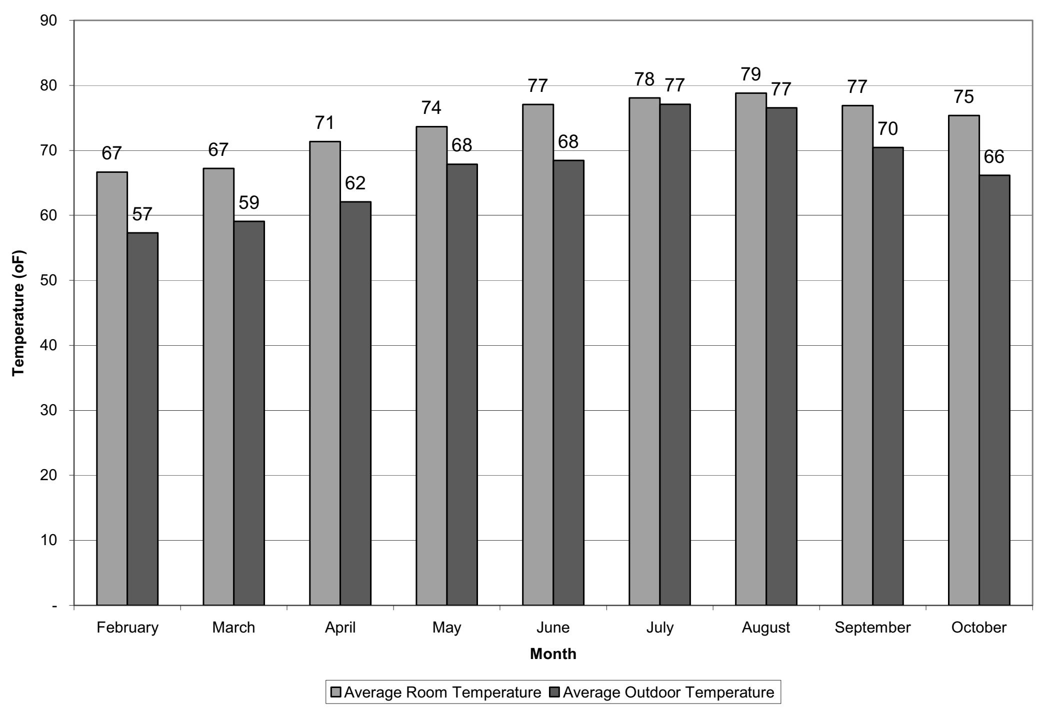

Figure G-2. Average Room Temperature in Conditioned Space versus Outdoor Average Temperature by Month for Inland-Moderate Climate Area

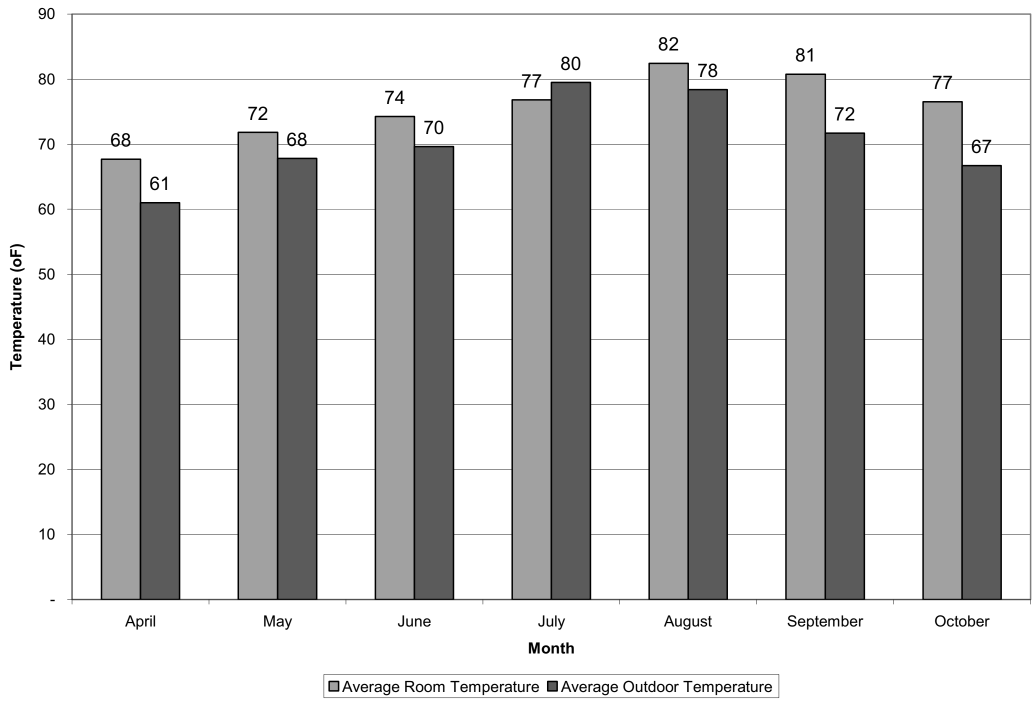

Figure G-3. Average Room Temperature in Conditioned Space versus Outdoor Average Temperature by Month for Inland-Hot Climate Area

APPENDIX H
SUPPORTING MATERIALS FOR GROSS SAVINGS ESTIMATION

This appendix provides supporting materials for the gross savings estimation. Materials are included that pertain to the following:

- Hourly regression solutions supporting extrapolation from metered to full year in situ consumption;
- Regression work for developing gross savings estimates using DOE test lab data; and
- Summary results for a set of 384 scenarios in which *in situ* data on energy use were compared to DOE test laboratory results.

H.1 HOURLY REGRESSION SOLUTIONS SUPPORTING EXTRAPOLATION FROM METERED TO FULL YEAR IN SITU CONSUMPTION

NOTE:

Regressions based on long term monitoring data.

Regressions are for:

Freezers (FZ)
Second refrigerators (RS)
Side by side primary refrigerators (SS)
Top freezers (TF)

Type B regressions include additive terms for month
Type A regressions don’t

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN RUN (TYPE A) FOR FZ ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 998367


 NOTE: Due to missing values, only 996831 observations can be used in this analysis.
```

```
1EXTRAP09-- extrapolation regressions
 ==============================================================
 --- WHMEAN RUN (TYPE A) FOR FZ ----

 General Linear Models Procedure

 Dependent Variable: WH

 Source                  DF          Sum of Squares             Mean Square        F Value           Pr > F

 Model                   24       2773777816.78197000      115574075.69924900       45832.35           0.0001

 Error               996806       2513615919.98116000           2521.67013439

 Corrected Total     996830       5287393736.76314000

                   R-Square                    C.V.                Root MSE                          WH Mean

                   0.524602                43.04741             50.21623377                     116.65333366


 Source                  DF               Type I SS             Mean Square        F Value           Pr > F

 WHMEAN                   1       2447928026.99984000     2447928026.99984000       99999.99           0.0001
 MONTH                   11        231654186.72947700       21059471.52086160        8351.40           0.0001
 AMBT                     1         89066112.74249960       89066112.74249960       35320.29           0.0001
 AMBT*MONTH              11          5129490.31015241         466317.30092295         184.92           0.0001

 Source                  DF             Type III SS             Mean Square        F Value           Pr > F

 WHMEAN                   1       2397639965.98268000     2397639965.98268000       99999.99           0.0001
 MONTH                   11          2913779.75093688         264889.06826699         105.05           0.0001
 AMBT                     1         85842494.42132160       85842494.42132160       34041.92           0.0001
 AMBT*MONTH              11          5129490.31015209         466317.30092292         184.92           0.0001


                                                          T for H0:            Pr > |T|           Std Error of
 Parameter                           Estimate            Parameter=0                                  Estimate

 INTERCEPT                     -42.38619946 B                 -42.13              0.0001             1.00597089
 WHMEAN                          0.99336423                  975.10              0.0001             0.00101873
 MONTH        1                -12.97912149 B                  -8.78              0.0001             1.47793618
              2                -24.81748549 B                 -16.22              0.0001             1.53017644
              3                -28.64114144 B                 -18.29              0.0001             1.56602276
```

```
1EXTRAP09-- extrapolation regressions
 ==============================================================
 --- WHMEAN RUN (TYPE A) FOR FZ ----

 General Linear Models Procedure

 Dependent Variable: WH

                                                      T for H0:            Pr > |T|           Std Error of
 Parameter                          Estimate         Parameter=0                                Estimate

 MONTH      4                  -12.90823332 B              -8.87             0.0001             1.45553765
            5                  -34.30915798 B             -21.12             0.0001             1.62440515
            6                  -12.90234567 B              -8.47             0.0001             1.52274411
            7                  -10.12865481 B              -6.48             0.0001             1.56270775
            8                  -17.23827252 B             -10.78             0.0001             1.59980879
            9                  -30.19317172 B             -17.62             0.0001             1.71404492
            10                 -41.30584180 B             -26.47             0.0001             1.56031012
            11                 -18.26661718 B             -12.50             0.0001             1.46141726
            12                   0.00000000 B                .                 .                 .
 AMBT                            0.41891356 B              22.22             0.0001             0.01884935
 AMBT*MONTH 1                    0.31366175 B              11.48             0.0001             0.02732528
            2                    0.55863047 B              19.99             0.0001             0.02795148
            3                    0.65048166 B              23.37             0.0001             0.02783618
            4                    0.44012101 B              17.33             0.0001             0.02539988
            5                    0.81645956 B              29.75             0.0001             0.02744036
            6                    0.56915027 B              22.98             0.0001             0.02476892
            7                    0.58266273 B              23.60             0.0001             0.02469394
            8                    0.69578647 B              28.03             0.0001             0.02482601
            9                    0.85767958 B              31.87             0.0001             0.02691171
            10                   0.92003094 B              34.93             0.0001             0.02633798
            11                   0.40455969 B              15.32             0.0001             0.02640588
            12                   0.00000000 B                .                 .                 .

 NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal
       equations.   Estimates followed by the letter 'B' are biased, and are not unique estimators of the
       parameters.
```

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR FZ ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 998367


 NOTE: Due to missing values, only 996831 observations can be used in this analysis.
```

```
1EXTRAP09-- extrapolation regressions
==============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR FZ ----

 General Linear Models Procedure

 Dependent Variable: WH
```

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	24	2773777816.78197000	115574075.69924900	45832.35	0.0001
Error	996806	2513615919.98116000	2521.67013439		
Corrected Total	996830	5287393736.76314000			

R-Square	C.V.	Root MSE	WH Mean
0.524602	43.04741	50.21623377	116.65333366

Source	DF	Type I SS	Mean Square	F Value	Pr > F
WHMEAN	1	2447928026.99984000	2447928026.99984000	99999.99	0.0001
MONTH	11	231654186.72947700	21059471.52086160	8351.40	0.0001
AMBT	1	89066112.74249960	89066112.74249960	35320.29	0.0001
AMBT*MONTH	11	5129490.31015241	466317.30092295	184.92	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
WHMEAN	1	2397639965.98268000	2397639965.98268000	99999.99	0.0001
MONTH	11	2913779.75093688	264889.06826699	105.05	0.0001
AMBT	1	85842494.42132160	85842494.42132160	34041.92	0.0001
AMBT*MONTH	11	5129490.31015209	466317.30092292	184.92	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-42.38619946 B	-42.13	0.0001	1.00597089
WHMEAN		0.99336423	975.10	0.0001	0.00101873
MONTH	1	-12.97912149 B	-8.78	0.0001	1.47793618
	2	-24.81748549 B	-16.22	0.0001	1.53017644
	3	-28.64114144 B	-18.29	0.0001	1.56602276

1EXTRAP09-- extrapolation regressions
===
--- WHMEAN (TYPE B, plus additive) RUN FOR FZ ----

General Linear Models Procedure

Dependent Variable: WH

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
MONTH	4	-12.90823332 B	-8.87	0.0001	1.45553765
	5	-34.30915798 B	-21.12	0.0001	1.62440515
	6	-12.90234567 B	-8.47	0.0001	1.52274411
	7	-10.12865481 B	-6.48	0.0001	1.56270775
	8	-17.23827252 B	-10.78	0.0001	1.59980879
	9	-30.19317172 B	-17.62	0.0001	1.71404492
	10	-41.30584180 B	-26.47	0.0001	1.56031012
	11	-18.26661718 B	-12.50	0.0001	1.46141726
	12	0.00000000 B	.	.	.
AMBT		0.41891356 B	22.22	0.0001	0.01884935
AMBT*MONTH	1	0.31366175 B	11.48	0.0001	0.02732528
	2	0.55863047 B	19.99	0.0001	0.02795148
	3	0.65048166 B	23.37	0.0001	0.02783618
	4	0.44012101 B	17.33	0.0001	0.02539988
	5	0.81645956 B	29.75	0.0001	0.02744036
	6	0.56915027 B	22.98	0.0001	0.02476892
	7	0.58266273 B	23.60	0.0001	0.02469394
	8	0.69578647 B	28.03	0.0001	0.02482601
	9	0.85767958 B	31.87	0.0001	0.02691171
	10	0.92003094 B	34.93	0.0001	0.02633798
	11	0.40455969 B	15.32	0.0001	0.02640588
	12	0.00000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN RUN (TYPE A) FOR RS ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 250340


 NOTE: Due to missing values, only 241635 observations can be used in this analysis.
```

1EXTRAP09-- extrapolation regressions
==
--- WHMEAN RUN (TYPE A) FOR RS ----

General Linear Models Procedure

Dependent Variable: WH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	598384658.51203500	23935386.34048140	7629.49	0.0001
Error	241609	757980441.67535700	3137.21939860		
Corrected Total	241634	1356365100.18739000			

R-Square	C.V.	Root MSE	WH Mean
0.441168	52.28328	56.01088643	107.12963179

Source	DF	Type I SS	Mean Square	F Value	Pr > F
WHMEAN	1	543473211.29853800	543473211.29853800	99999.99	0.0001
APPL_VOL*MONTH	12	48529898.91368020	4044158.24280668	1289.09	0.0001
APPL_VOL*AMBT	1	2745391.12075996	2745391.12075996	875.10	0.0001
APPL_VOL*AMBT*MONTH	11	3636157.17905712	330559.74355065	105.37	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
WHMEAN	1	537264976.18326600	537264976.18326600	99999.99	0.0001
APPL_VOL*MONTH	12	8294201.61169206	691183.46764101	220.32	0.0001
APPL_VOL*AMBT	1	3510598.00512262	3510598.00512262	1119.02	0.0001
APPL_VOL*AMBT*MONTH	11	3636157.17905681	330559.74355062	105.37	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		1.357833787	2.46	0.0139	0.55226381
WHMEAN		1.001513483	413.83	0.0001	0.00242011
APPL_VOL*MONTH	1	-2.108506988	-13.79	0.0001	0.15286458
	2	-3.449934668	-22.04	0.0001	0.15651649
	3	-3.573408387	-19.95	0.0001	0.17913531

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN RUN (TYPE A) FOR RS ----

 General Linear Models Procedure

 Dependent Variable: WH
```

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
APPL_VOL*MONTH	4	-2.906709567	-22.49	0.0001	0.12927089
	5	-2.605303614	-14.93	0.0001	0.17446919
	6	-0.440214685	-2.90	0.0037	0.15182361
	7	2.593130279	16.91	0.0001	0.15336256
	8	1.357476993	9.50	0.0001	0.14286087
	9	-0.887156615	-5.20	0.0001	0.17076120
	10	-2.443955170	-14.91	0.0001	0.16386003
	11	-2.823695053	-19.08	0.0001	0.14798972
	12	-1.031820691	-7.69	0.0001	0.13426292
APPL_VOL*AMBT		0.001098662 B	0.45	0.6493	0.00241639
APPL_VOL*AMBT*MONTH	1	0.017455590 B	4.80	0.0001	0.00363281
	2	0.042540918 B	11.79	0.0001	0.00360798
	3	0.049335430 B	12.79	0.0001	0.00385677
	4	0.043747623 B	13.76	0.0001	0.00317984
	5	0.038273781 B	10.42	0.0001	0.00367146
	6	0.013968643 B	4.28	0.0001	0.00326565
	7	-0.027553873 B	-8.57	0.0001	0.00321437
	8	-0.002459814 B	-0.80	0.4231	0.00307054
	9	0.021795762 B	6.42	0.0001	0.00339741
	10	0.038675385 B	11.12	0.0001	0.00347915
	11	0.036272875 B	10.41	0.0001	0.00348459
	12	0.000000000 B	.	.	.

```
 NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal
       equations.   Estimates followed by the letter 'B' are biased, and are not unique estimators of the
       parameters.
```

```
1EXTRAP09-- extrapolation regressions
==============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR RS ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 250340


 NOTE: Due to missing values, only 241635 observations can be used in this analysis.
```

1EXTRAP09-- extrapolation regressions
==
--- WHMEAN (TYPE B, plus additive) RUN FOR RS ----

General Linear Models Procedure

Dependent Variable: WH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	37	598988169.74574300	16188869.45258760	5164.12	0.0001
Error	241597	757376930.44164900	3134.87721471		
Corrected Total	241634	1356365100.18739000			

	R-Square	C.V.	Root MSE	WH Mean
	0.441613	52.26376	55.98997423	107.12963179

Source	DF	Type I SS	Mean Square	F Value	Pr > F
WHMEAN	1	543473211.29853800	543473211.29853800	99999.99	0.0001
MONTH	11	47101897.06731640	4281990.64248332	1365.92	0.0001
AMBT	1	2626321.01951110	2626321.01951110	837.77	0.0001
APPL_VOL	1	39286.00723100	39286.00723100	12.53	0.0004
APPL_VOL*MONTH	11	1993418.70021009	181219.88183728	57.81	0.0001
AMBT*APPL_VOL	1	104234.04545587	104234.04545587	33.25	0.0001
AMBT*APPL_VOL*MONTH	11	3649801.60748041	331800.14613458	105.84	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
WHMEAN	1	531419331.29175100	531419331.29175100	99999.99	0.0001
MONTH	11	566442.05510418	51494.73228220	16.43	0.0001
AMBT	1	966.69989416	966.69989416	0.31	0.5787
APPL_VOL	1	206715.59462838	206715.59462838	65.94	0.0001
APPL_VOL*MONTH	11	3976633.21407949	361512.11037086	115.32	0.0001
AMBT*APPL_VOL	1	200158.51216339	200158.51216339	63.85	0.0001
AMBT*APPL_VOL*MONTH	11	3649801.60748018	331800.14613456	105.84	0.0001

1EXTRAP09-- extraploation regressions
==
--- WHMEAN (TYPE B, plus additive) RUN FOR RS ----

General Linear Models Procedure

Dependent Variable: WH

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-8.63433454 B	-2.25	0.0247	3.84504931
WHMEAN		1.00133675	411.73	0.0001	0.00243205
MONTH	1	3.71997977 B	1.49	0.1358	2.49413759
	2	18.56938692 B	7.35	0.0001	2.52496809
	3	21.37394518 B	8.48	0.0001	2.52139460
	4	8.64715038 B	3.37	0.0007	2.56449441
	5	6.29601491 B	2.47	0.0135	2.54864036
	6	9.99666097 B	3.67	0.0002	2.72685263
	7	15.11129573 B	5.62	0.0001	2.68840244
	8	23.89796412 B	8.61	0.0001	2.77566132
	9	10.76193151 B	4.04	0.0001	2.66194595
	10	19.55585928 B	7.69	0.0001	2.54261481
	11	7.72783243 B	3.09	0.0020	2.49915110
	12	0.00000000 B	.	.	.
AMBT		-0.03439937	-0.56	0.5787	0.06194624
APPL_VOL		-0.56123413 B	-2.45	0.0142	0.22895982
APPL_VOL*MONTH	1	-1.25521282 B	-5.39	0.0001	0.23280911
	2	-3.35512948 B	-13.91	0.0001	0.24122852
	3	-3.58751347 B	-14.15	0.0001	0.25358323
	4	-2.27590605 B	-10.16	0.0001	0.22404025
	5	-1.89495106 B	-7.67	0.0001	0.24706731
	6	0.11221609 B	0.47	0.6363	0.23727096
	7	2.90587876 B	12.16	0.0001	0.23900445
	8	1.25821530 B	5.37	0.0001	0.23450946
	9	-0.37329715 B	-1.51	0.1321	0.24791826
	10	-2.33758426 B	-9.68	0.0001	0.24150065
	11	-2.16399912 B	-9.43	0.0001	0.22949521
	12	0.00000000 B	.	.	.
AMBT*APPL_VOL		0.00395850 B	1.01	0.3109	0.00390604
AMBT*APPL_VOL*MONTH	1	0.01707046 B	4.69	0.0001	0.00364014
	2	0.04187236 B	11.59	0.0001	0.00361216
	3	0.04785965 B	12.39	0.0001	0.00386312
	4	0.04275837 B	13.41	0.0001	0.00318882

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR RS ----

 General Linear Models Procedure

 Dependent Variable: WH

                                                     T for H0:            Pr > |T|           Std Error of
 Parameter                          Estimate        Parameter=0                                Estimate

 AMBT*APPL_VOL*MONTH 5            0.03785715 B            10.29              0.0001             0.00368079
                     6            0.01300765 B             3.97              0.0001             0.00327248
                     7           -0.02883471 B            -8.95              0.0001             0.00322026
                     8           -0.00427370 B            -1.39              0.1648             0.00307634
                     9            0.02084085 B             6.12              0.0001             0.00340602
                     10           0.03698408 B            10.61              0.0001             0.00348508
                     11           0.03556025 B            10.18              0.0001             0.00349245
                     12           0.00000000 B              .                  .                  .

 NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal
       equations.   Estimates followed by the letter 'B' are biased, and are not unique estimators of the
       parameters.
```

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN RUN (TYPE A) FOR SS ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 1231710


 NOTE: Due to missing values, only 1067111 observations can be used in this analysis.
```

1EXTRAP09-- extrapolation regressions
==
--- WHMEAN RUN (TYPE A) FOR SS ----

General Linear Models Procedure

Dependent Variable: WH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	3776777777.43336000	151071111.09733400	48978.20	0.0001
Error	1067085	3291376636.02575000	3084.45591122		
Corrected Total	1067110	7068154413.45911000			

R-Square	C.V.	Root MSE	WH Mean
0.534337	33.44171	55.53787817	166.07370190

Source	DF	Type I SS	Mean Square	F Value	Pr > F
WHMEAN	1	3351588687.49313000	3351588687.49313000	99999.99	0.0001
APPL_VOL*MONTH	12	316523790.12702300	26376982.51058520	8551.58	0.0001
APPL_VOL*AMBT	1	105580931.70872600	105580931.70872600	34230.00	0.0001
APPL_VOL*AMBT*MONTH	11	3084368.10447872	280397.10040716	90.91	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
WHMEAN	1	3266027706.29748000	3266027706.29748000	99999.99	0.0001
APPL_VOL*MONTH	12	34999019.07831160	2916584.92319264	945.58	0.0001
APPL_VOL*AMBT	1	98348636.92354560	98348636.92354560	31885.25	0.0001
APPL_VOL*AMBT*MONTH	11	3084368.10447847	280397.10040713	90.91	0.0001

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-1.237396106	-2.30	0.0212	0.53689691
WHMEAN		0.991571733	1029.01	0.0001	0.00096361
APPL_VOL*MONTH	1	-2.400620114	-47.12	0.0001	0.05095211
	2	-2.869128736	-51.66	0.0001	0.05554276
	3	-3.152210152	-53.78	0.0001	0.05860812

1EXTRAP09-- extrapolation regressions
==
--- WHMEAN RUN (TYPE A) FOR SS ----

General Linear Models Procedure

Dependent Variable: WH

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
APPL_VOL*MONTH	4	-3.221153460	-61.07	0.0001	0.05274438
	5	-3.475187339	-61.71	0.0001	0.05631619
	6	-2.851378363	-51.96	0.0001	0.05487213
	7	-1.747344588	-31.48	0.0001	0.05550355
	8	-2.148210814	-37.09	0.0001	0.05791164
	9	-2.298636904	-36.36	0.0001	0.06321951
	10	-2.602468964	-44.98	0.0001	0.05785818
	11	-2.336109707	-43.19	0.0001	0.05409501
	12	-2.117307051	-39.45	0.0001	0.05366546
APPL_VOL*AMBT		0.027559101 B	29.86	0.0001	0.00092300
APPL_VOL*AMBT*MONTH	1	0.004778993 B	3.79	0.0001	0.00126037
	2	0.015401899 B	11.83	0.0001	0.00130208
	3	0.019188992 B	14.56	0.0001	0.00131750
	4	0.021314993 B	17.57	0.0001	0.00121332
	5	0.027444877 B	22.27	0.0001	0.00123251
	6	0.023487831 B	20.09	0.0001	0.00116927
	7	0.013882774 B	12.03	0.0001	0.00115395
	8	0.018785589 B	16.16	0.0001	0.00116224
	9	0.016208544 B	13.10	0.0001	0.00123749
	10	0.015080161 B	12.18	0.0001	0.00123819
	11	0.005600162 B	4.43	0.0001	0.00126532
	12	0.000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

```
1EXTRAP09-- extrapolation regressions
==============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR SS ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 1231710


 NOTE: Due to missing values, only 1067111 observations can be used in this analysis.
```

1EXTRAP09-- extrapolation regressions
==
--- WHMEAN (TYPE B, plus additive) RUN FOR SS ----

General Linear Models Procedure

Dependent Variable: WH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	37	3798031242.50331000	102649493.04063000	33495.53	0.0001
Error	1067073	3270123170.95579000	3064.57306197		
Corrected Total	1067110	7068154413.45911000			

	R-Square	C.V.	Root MSE	WH Mean
	0.537344	33.33375	55.35858616	166.07370190

Source	DF	Type I SS	Mean Square	F Value	Pr > F
WHMEAN	1	3351588687.49313000	3351588687.49313000	99999.99	0.0001
MONTH	11	327916741.47599700	29810612.86145430	9727.49	0.0001
AMBT	1	101862340.58648900	101862340.58648900	33238.67	0.0001
APPL_VOL	1	7033.50563574	7033.50563574	2.30	0.1298
APPL_VOL*MONTH	11	12371529.45566920	1124684.49596993	367.00	0.0001
AMBT*APPL_VOL	1	848817.04005814	848817.04005814	276.98	0.0001
AMBT*APPL_VOL*MONTH	11	3436092.94633317	312372.08603029	101.93	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
WHMEAN	1	3260077474.53239000	3260077474.53239000	99999.99	0.0001
MONTH	11	16822051.31485970	1529277.39225998	499.02	0.0001
AMBT	1	24506.60853210	24506.60853210	8.00	0.0047
APPL_VOL	1	728622.60647424	728622.60647424	237.76	0.0001
APPL_VOL*MONTH	11	13336886.05320840	1212444.18665531	395.63	0.0001
AMBT*APPL_VOL	1	825058.24682342	825058.24682342	269.22	0.0001
AMBT*APPL_VOL*MONTH	11	3436092.94633278	312372.08603025	101.93	0.0001

```
1EXTRAP09-- extraplation regressions
=============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR SS ----

 General Linear Models Procedure

 Dependent Variable: WH
```

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-60.8369260 B	-19.40	0.0001	3.13516983
WHMEAN		0.9910134	1031.40	0.0001	0.00096084
MONTH	1	42.3418249 B	17.48	0.0001	2.42211709
	2	62.8310354 B	25.66	0.0001	2.44869184
	3	41.8495433 B	17.32	0.0001	2.41649957
	4	58.3417937 B	23.22	0.0001	2.51267304
	5	73.2672747 B	28.73	0.0001	2.55048377
	6	79.7802447 B	29.61	0.0001	2.69408587
	7	117.7533536 B	42.74	0.0001	2.75501407
	8	106.9141381 B	37.95	0.0001	2.81719751
	9	47.3686927 B	16.74	0.0001	2.83032519
	10	-0.0081397 B	-0.00	0.9975	2.62090611
	11	-29.4737659 B	-11.52	0.0001	2.55918227
	12	0.0000000 B	.	.	.
AMBT		0.1416014	2.83	0.0047	0.05007385
APPL_VOL		0.6011845 B	4.10	0.0001	0.14650758
APPL_VOL*MONTH	1	-2.2335172 B	-17.34	0.0001	0.12879069
	2	-3.6174671 B	-27.72	0.0001	0.13049878
	3	-2.9902837 B	-23.07	0.0001	0.12959983
	4	-3.7538833 B	-29.06	0.0001	0.12916003
	5	-4.5718452 B	-35.01	0.0001	0.13059738
	6	-4.2321832 B	-31.26	0.0001	0.13538012
	7	-4.5745224 B	-33.49	0.0001	0.13661274
	8	-4.5591112 B	-32.62	0.0001	0.13975266
	9	-2.3785578 B	-16.62	0.0001	0.14313159
	10	-0.7015866 B	-5.18	0.0001	0.13549306
	11	0.9592702 B	7.17	0.0001	0.13373732
	12	0.0000000 B	.	.	.
AMBT*APPL_VOL		0.0183060 B	7.77	0.0001	0.00235531
AMBT*APPL_VOL*MONTH	1	0.0074660 B	5.91	0.0001	0.00126355
	2	0.0188268 B	14.45	0.0001	0.00130278
	3	0.0223909 B	17.00	0.0001	0.00131731
	4	0.0243394 B	20.04	0.0001	0.00121428

```
1EXTRAP09-- extrapolation regressions
==============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR SS ----

 General Linear Models Procedure

 Dependent Variable: WH

                                                   T for H0:           Pr > |T|           Std Error of
 Parameter                          Estimate       Parameter=0                              Estimate

 AMBT*APPL_VOL*MONTH 5            0.0293407 B            23.75             0.0001             0.00123524
                     6            0.0255776 B            21.84             0.0001             0.00117126
                     7            0.0136646 B            11.81             0.0001             0.00115748
                     8            0.0192796 B            16.54             0.0001             0.00116550
                     9            0.0194732 B            15.71             0.0001             0.00123921
                     10           0.0190032 B            15.34             0.0001             0.00123861
                     11           0.0072091 B             5.69             0.0001             0.00126622
                     12           0.0000000 B              .                  .                  .

 NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal
       equations.   Estimates followed by the letter 'B' are biased, and are not unique estimators of the
       parameters.
```

```
1EXTRAP09-- extrapolation regressions
==============================================================
 --- WHMEAN RUN (TYPE A) FOR TF ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 3710845


 NOTE: Due to missing values, only 3684251 observations can be used in this analysis.
```

```
1EXTRAP09-- extrapolation regressions
==============================================================
 --- WHMEAN RUN (TYPE A) FOR TF ----

 General Linear Models Procedure

 Dependent Variable: WH

 Source                 DF        Sum of Squares          Mean Square      F Value        Pr > F

 Model                  25   11685693980.02810000   467427759.20112700    99999.99        0.0001

 Error             3684225   10916067221.84650000       2962.92089160

 Corrected Total   3684250   22601761201.87470000

                  R-Square                  C.V.             Root MSE                    WH Mean

                  0.517026              50.52264          54.43271894               107.73926174


 Source                 DF             Type I SS          Mean Square      F Value        Pr > F

 WHMEAN                  1   10735958776.41230000  10735958776.41230000    99999.99        0.0001
 APPL_VOL*MONTH         12     673956278.36073800     56163023.19672820    18955.29        0.0001
 APPL_VOL*AMBT           1     257133710.45536000    257133710.45536000    86783.86        0.0001
 APPL_VOL*AMBT*MONTH    11      18645214.79971310      1695019.52724665      572.08        0.0001

 Source                 DF           Type III SS          Mean Square      F Value        Pr > F

 WHMEAN                  1   10064906007.84580000  10064906007.84580000    99999.99        0.0001
 APPL_VOL*MONTH         12     105132572.17909400      8761047.68159122     2956.90        0.0001
 APPL_VOL*AMBT           1     211225998.01982600    211225998.01982600    71289.79        0.0001
 APPL_VOL*AMBT*MONTH    11      18645214.79970880      1695019.52724626      572.08        0.0001


                                                       T for H0:          Pr > |T|         Std Error of
 Parameter                          Estimate          Parameter=0                            Estimate

 INTERCEPT                      -0.946224551                -4.58            0.0001          0.20643802
 WHMEAN                          0.981996222              1843.08            0.0001          0.00053280
 APPL_VOL*MONTH       1         -1.776873976               -64.44            0.0001          0.02757518
                      2         -2.011576304               -61.07            0.0001          0.03293639
                      3         -2.231992612               -65.49            0.0001          0.03408115
```

1EXTRAP09-- extrapolation regressions
===
--- WHMEAN RUN (TYPE A) FOR TF ----

General Linear Models Procedure

Dependent Variable: WH

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
APPL_VOL*MONTH	4	-2.727359905	-83.87	0.0001	0.03251700
	5	-3.024731884	-93.65	0.0001	0.03229779
	6	-2.739702016	-91.43	0.0001	0.02996503
	7	-2.601678714	-81.25	0.0001	0.03202078
	8	-2.621650063	-75.03	0.0001	0.03494058
	9	-2.184534115	-65.22	0.0001	0.03349476
	10	-3.394620932	-73.15	0.0001	0.04640779
	11	-2.211940431	-67.80	0.0001	0.03262325
	12	-1.414438358	-53.08	0.0001	0.02664637
APPL_VOL*AMBT		0.016112360 B	31.51	0.0001	0.00051129
APPL_VOL*AMBT*MONTH	1	0.008389682 B	11.52	0.0001	0.00072823
	2	0.011946328 B	15.37	0.0001	0.00077724
	3	0.018448129 B	24.71	0.0001	0.00074662
	4	0.027227557 B	38.22	0.0001	0.00071240
	5	0.033902175 B	49.78	0.0001	0.00068100
	6	0.033451842 B	52.62	0.0001	0.00063570
	7	0.033222308 B	51.65	0.0001	0.00064319
	8	0.032987840 B	49.29	0.0001	0.00066931
	9	0.023897971 B	35.75	0.0001	0.00066840
	10	0.036435555 B	42.67	0.0001	0.00085381
	11	0.015572662 B	20.56	0.0001	0.00075749
	12	0.000000000 B	.	.	.

NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal equations. Estimates followed by the letter 'B' are biased, and are not unique estimators of the parameters.

```
1EXTRAP09-- extrapolation regressions
==============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR TF ----

 General Linear Models Procedure
 Class Level Information

 Class    Levels    Values

 MONTH        13    1 2 3 4 5 6 7 8 9 10 11 12 13


 Number of observations in data set = 3710845


 NOTE: Due to missing values, only 3684251 observations can be used in this analysis.
```

1EXTRAP09-- extrapolation regressions
==
--- WHMEAN (TYPE B, plus additive) RUN FOR TF ----

General Linear Models Procedure

Dependent Variable: WH

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	37	11727654869.79700000	316963645.12965000	99999.99	0.0001
Error	3684213	10874106332.07760000	2951.54116553		
Corrected Total	3684250	22601761201.87470000			

R-Square	C.V.	Root MSE	WH Mean
0.518882	50.42552	54.32808818	107.73926174

Source	DF	Type I SS	Mean Square	F Value	Pr > F
WHMEAN	1	10735958776.41230000	10735958776.41230000	99999.99	0.0001
MONTH	11	690496912.62262700	62772446.60205700	21267.68	0.0001
AMBT	1	277616598.49975800	277616598.49975800	94058.18	0.0001
APPL_VOL	1	1773087.51120567	1773087.51120567	600.73	0.0001
APPL_VOL*MONTH	11	3944921.09240437	358629.19021858	121.51	0.0001
AMBT*APPL_VOL	1	2832566.83705425	2832566.83705425	959.69	0.0001
AMBT*APPL_VOL*MONTH	11	15032006.82163230	1366546.07469385	462.99	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
WHMEAN	1	10021910743.57370000	10021910743.57370000	99999.99	0.0001
MONTH	11	1582409.72700909	143855.42972810	48.74	0.0001
AMBT	1	17206884.77087810	17206884.77087810	5829.80	0.0001
APPL_VOL	1	3125504.71738746	3125504.71738746	1058.94	0.0001
APPL_VOL*MONTH	11	5774840.55034891	524985.50457717	177.87	0.0001
AMBT*APPL_VOL	1	3016103.25937255	3016103.25937255	1021.87	0.0001
AMBT*APPL_VOL*MONTH	11	15032006.82162800	1366546.07469346	462.99	0.0001

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR TF ----

 General Linear Models Procedure

 Dependent Variable: WH
```

Parameter		Estimate	T for H0: Parameter=0	Pr > |T|	Std Error of Estimate
INTERCEPT		-98.38249967 B	-86.91	0.0001	1.13197104
WHMEAN		0.98146055	1842.68	0.0001	0.00053263
MONTH	1	3.86388203 B	4.23	0.0001	0.91288135
	2	-0.10990490 B	-0.12	0.9036	0.90762827
	3	5.69517924 B	6.32	0.0001	0.90173336
	4	12.95906948 B	13.86	0.0001	0.93492211
	5	7.61506348 B	7.95	0.0001	0.95844456
	6	9.61761544 B	9.48	0.0001	1.01500048
	7	16.13112876 B	15.62	0.0001	1.03289110
	8	6.43868313 B	6.02	0.0001	1.06899772
	9	6.81078279 B	6.68	0.0001	1.01929922
	10	15.15387544 B	13.51	0.0001	1.12152407
	11	4.49124943 B	4.80	0.0001	0.93494299
	12	0.00000000 B	.	.	.
AMBT		1.41716717	76.35	0.0001	0.01856070
APPL_VOL		3.08809639 B	53.41	0.0001	0.05781494
APPL_VOL*MONTH	1	-0.52383990 B	-9.99	0.0001	0.05241339
	2	-0.46858877 B	-8.39	0.0001	0.05586181
	3	-0.85960601 B	-14.61	0.0001	0.05883849
	4	-1.67524599 B	-28.74	0.0001	0.05829459
	5	-1.78525325 B	-29.37	0.0001	0.06079045
	6	-1.64703323 B	-26.99	0.0001	0.06102169
	7	-1.79129990 B	-28.65	0.0001	0.06251374
	8	-1.21611793 B	-18.92	0.0001	0.06426834
	9	-0.93146185 B	-14.95	0.0001	0.06228828
	10	-2.12626568 B	-27.69	0.0001	0.07679008
	11	-0.80151647 B	-14.03	0.0001	0.05711400
	12	0.00000000 B	.	.	.
AMBT*APPL_VOL		-0.04880316 B	-47.27	0.0001	0.00103238
AMBT*APPL_VOL*MONTH	1	0.00785591 B	10.67	0.0001	0.00073639
	2	0.00962164 B	12.30	0.0001	0.00078236
	3	0.01450291 B	19.35	0.0001	0.00074963
	4	0.02275869 B	31.81	0.0001	0.00071550

```
1EXTRAP09-- extrapolation regressions
=============================================================
 --- WHMEAN (TYPE B, plus additive) RUN FOR TF ----

 General Linear Models Procedure

 Dependent Variable: WH

                                                T for H0:          Pr > |T|         Std Error of
 Parameter                          Estimate     Parameter=0                            Estimate

 AMBT*APPL_VOL*MONTH 5          0.03073738 B           44.86            0.0001          0.00068523
                     6          0.03090553 B           48.33            0.0001          0.00063947
                     7          0.03013801 B           46.60            0.0001          0.00064668
                     8          0.02788574 B           41.40            0.0001          0.00067355
                     9          0.02089238 B           31.11            0.0001          0.00067162
                     10         0.02643117 B           30.73            0.0001          0.00086014
                     11         0.01179558 B           15.48            0.0001          0.00076207
                     12         0.00000000 B             .                .                 .

 NOTE: The X'X matrix has been found to be singular and a generalized inverse was used to solve the normal
       equations.   Estimates followed by the letter 'B' are biased, and are not unique estimators of the
       parameters.
```

H.2 DOE LAB TEST UEC REGRESSION WORK

```
NOTE:

Contents:

Solution prints for ..

Reg3A: Inclusive of age(logged)-by-"sample cohort" terms.
Reg3A1: Reg3A trimmed of influential observations ("DFFITS" criterion
of 1.2814, as in Athens/KEMA analyses since 1998).

Reg3B: Eliminate family of age-by-"sample cohort" terms.
Reg3B1: Reg3B trimmed of influential observations ("DFFITS" = 1.2814).

Collinearity diagnostics for Reg3B1.

Examination of correlation of regression residuals for
reg3A1, Reg3B1 with regressors and other variables considered in
development.
```

1REG3A: INCLUSIVE OF AGE BY SAMPLE COHORT INTERACTIONS

Model: SIMPLE1
Dependent Variable: ANNKWH DOE RESULT

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	21	684733179.43	32606341.878	58.176	0.0001
Error	1561	874909809.73	560480.33935		
C Total	1582	1559642989.2			

Root MSE	748.65235	R-square	0.4390
Dep Mean	1943.64031	Adj R-sq	0.4315
C.V.	38.51805		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|
INTERCEP	1	-482.470588	549.68185062	-0.878	0.3802
ZFZR	1	144.948956	91.78520696	1.579	0.1145
ZD_BF	1	558.053885	205.55929384	2.715	0.0067
ZD_SS	1	-163.830682	375.33124978	-0.436	0.6625
ZD_SD	1	-396.165339	88.07892037	-4.498	0.0001
ZDFF	1	-304.377048	450.54430404	-0.676	0.4994
ZAGEL	1	458.929152	189.46120479	2.422	0.0155
SIZE	1	43.415035	9.49450988	4.573	0.0001
AMPS	1	102.028836	21.51968091	4.741	0.0001
ZIFF_FZ	1	383.299273	164.63081460	2.328	0.0200
ZIFF_BF	1	-261.912011	236.32766035	-1.108	0.2679
ZIFF_SS	1	1421.647677	380.85091633	3.733	0.0002
ZISS_D	1	-117.854266	43.84045303	-2.688	0.0073
ZSAMP98	1	-1603.456479	616.05929387	-2.603	0.0093
ZSAMP03	1	-1821.298689	721.69662352	-2.524	0.0117
ZSAMP05	1	-2037.508751	520.65827379	-3.913	0.0001
ZIFF_CL	1	245.032291	145.44249550	1.685	0.0922
I98AGEL	1	518.460026	203.78882300	2.544	0.0111
I03AGEL	1	474.815167	246.72592063	1.924	0.0545
I05AGEL	1	468.552416	174.10116971	2.691	0.0072
ZAGE15UP	1	1588.248794	470.47213431	3.376	0.0008
IA15AGEL	1	-678.704095	174.97255520	-3.879	0.0001

1REG3A: INCLUSIVE OF AGE BY SAMPLE COHORT INTERACTIONS

```
INTERCEP   1  Intercept
ZFZR       1  Freezer dummy, TRKG
ZD_BF      1  Bottom fzr dummy, TRKG
ZD_SS      1  Side by side dummy, TRKG
ZD_SD      1  Single door dummy, TRKG
ZDFF       1  Frost free dummy, TRKG
ZAGEL      1  Age nat log
SIZE       1  TRKG CU FT
AMPS       1  LABEL AMPS
ZIFF_FZ    1
ZIFF_BF    1  Bottom fzr x frost free
ZIFF_SS    1  Side by side x frost free
ZISS_D     1  Side-side x amps
ZSAMP98    1  Lovelace/KEMA/BRLABS sample, 1998
ZSAMP03    1  Samiullah/KEMA/BRLABS sample, 2003
ZSAMP05    1  Samiullah/ADM/BRLABS dualmtr, 2005
ZIFF_CL    1  Frost free x ln(age)
I98AGEL    1  Ln age x sample98
I03AGEL    1  Ln age x sample03
I05AGEL    1  Ln age x sample05
ZAGE15UP   1  Age 15 up (direct)
IA15AGEL   1  Ln age x age 15 up
```

1REG3A1: INCLUSIVE OF AGE BY SAMPLE COHORT INTERACTIONS
--- after trimming influentials ----

Model: MODEL1
Dependent Variable: ANNKWH2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	21	684733179.43	32606341.878	58.176	0.0001
Error	1561	874909809.73	560480.33935		
C Total	1582	1559642989.2			

Root MSE	748.65235	R-square	0.4390
Dep Mean	1943.64031	Adj R-sq	0.4315
C.V.	38.51805		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Tolerance	Variance Inflation
INTERCEP	1	-482.470588	549.68185062	-0.878	0.3802	.	0.00000000
ZFZR	1	144.948956	91.78520696	1.579	0.1145	0.47581268	2.10166742
ZD_BF	1	558.053885	205.55929384	2.715	0.0067	0.23739372	4.21241134
ZD_SS	1	-163.830682	375.33124978	-0.436	0.6625	0.01830959	54.61618290
ZD_SD	1	-396.165339	88.07892037	-4.498	0.0001	0.37018873	2.70132482
ZDFF	1	-304.377048	450.54430404	-0.676	0.4994	0.00794672	125.83811120
ZAGEL	1	458.929152	189.46120479	2.422	0.0155	0.05286573	18.91584694
SIZE	1	43.415035	9.49450988	4.573	0.0001	0.33140875	3.01742188
AMPS	1	102.028836	21.51968091	4.741	0.0001	0.28307387	3.53264683
ZIFF_FZ	1	383.299273	164.63081460	2.328	0.0200	0.65956449	1.51615196
ZIFF_BF	1	-261.912011	236.32766035	-1.108	0.2679	0.23989600	4.16847297
ZIFF_SS	1	1421.647677	380.85091633	3.733	0.0002	0.01806313	55.36138766
ZISS_D	1	-117.854266	43.84045303	-2.688	0.0073	0.02530071	39.52457618
ZSAMP98	1	-1603.456479	616.05929387	-2.603	0.0093	0.01187924	84.18043568
ZSAMP03	1	-1821.298689	721.69662352	-2.524	0.0117	0.01148658	87.05810310
ZSAMP05	1	-2037.508751	520.65827379	-3.913	0.0001	0.01163433	85.95253387
ZIFF_CL	1	245.032291	145.44249550	1.685	0.0922	0.00881591	113.43122080
I98AGEL	1	518.460026	203.78882300	2.544	0.0111	0.01187560	84.20627513
I03AGEL	1	474.815167	246.72592063	1.924	0.0545	0.01149690	86.97996025
I05AGEL	1	468.552416	174.10116971	2.691	0.0072	0.01159165	86.26903012
ZAGE15UP	1	1588.248794	470.47213431	3.376	0.0008	0.01060513	94.29395331
IA15AGEL	1	-678.704095	174.97255520	-3.879	0.0001	0.00734880	136.07663351

1REG3A1: INCLUSIVE OF AGE BY SAMPLE COHORT INTERACTIONS
--- after trimming influentials ----

Variable	DF	Variable Label
INTERCEP	1	Intercept
ZFZR	1	Freezer dummy, TRKG
ZD_BF	1	Bottom fzr dummy, TRKG
ZD_SS	1	Side by side dummy, TRKG
ZD_SD	1	Single door dummy, TRKG
ZDFF	1	Frost free dummy, TRKG
ZAGEL	1	Age nat log
SIZE	1	TRKG CU FT
AMPS	1	LABEL AMPS
ZIFF_FZ	1	
ZIFF_BF	1	Bottom fzr x frost free
ZIFF_SS	1	Side by side x frost free
ZISS_D	1	Side-side x amps
ZSAMP98	1	Lovelace/KEMA/BRLABS sample, 1998
ZSAMP03	1	Samiullah/KEMA/BRLABS sample, 2003
ZSAMP05	1	Samiullah/ADM/BRLABS dualmtr, 2005
ZIFF_CL	1	Frost free x ln(age)
I98AGEL	1	Ln age x sample98
I03AGEL	1	Ln age x sample03
I05AGEL	1	Ln age x sample05
ZAGE15UP	1	Age 15 up (direct)
IA15AGEL	1	Ln age x age 15 up

1REG3B: DROPPING AGE BY SAMPLE COHORT INTERACTIONS

Model: SIMPLE1
Dependent Variable: ANNKWH DOE RESULT

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	18	676365039.94	37575835.552	66.535	0.0001
Error	1564	883277949.23	564755.72201		
C Total	1582	1559642989.2			

Root MSE	751.50231	R-square	0.4337
Dep Mean	1943.64031	Adj R-sq	0.4271
C.V.	38.66468		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Variable
INTERCEP	1	-422.410623	548.49725352	-0.770	0.4413	
ZFZR	1	169.053578	91.86246434	1.840	0.0659	
ZD_BF	1	595.379358	204.95360648	2.905	0.0037	
ZD_SS	1	-129.355323	376.65011648	-0.343	0.7313	
ZD_SD	1	-417.102580	88.22724104	-4.728	0.0001	
ZDFF	1	-445.034826	445.21989066	-1.000	0.3177	
ZAGEL	1	405.213449	188.39968786	2.151	0.0316	
SIZE	1	43.647799	9.50690191	4.591	0.0001	
AMPS	1	104.101844	21.57049504	4.826	0.0001	
ZIFF_FZ	1	319.109662	164.27657464	1.943	0.0523	
ZIFF_BF	1	-302.048423	236.37701091	-1.278	0.2015	
ZIFF_SS	1	1451.320647	382.20950899	3.797	0.0002	
ZISS_D	1	-126.433239	43.93924942	-2.877	0.0041	
ZSAMP98	1	-48.945967	71.46625569	-0.685	0.4935	
ZSAMP03	1	-435.897800	81.07056510	-5.377	0.0001	
ZSAMP05	1	-649.207285	63.02247618	-10.301	0.0001	
ZIFF_CL	1	299.820612	143.39003847	2.091	0.0367	
ZAGE15UP	1	1197.834930	459.01504652	2.610	0.0092	
IA15AGEL	1	-524.978166	170.19944466	-3.084	0.0021	

1REG3B: DROPPING AGE BY SAMPLE COHORT INTERACTIONS

Variable	DF	Variable Label
INTERCEP	1	Intercept
ZFZR	1	Freezer dummy, TRKG
ZD_BF	1	Bottom fzr dummy, TRKG
ZD_SS	1	Side by side dummy, TRKG
ZD_SD	1	Single door dummy, TRKG
ZDFF	1	Frost free dummy, TRKG
ZAGEL	1	Age nat log
SIZE	1	TRKG CU FT
AMPS	1	LABEL AMPS
ZIFF_FZ	1	
ZIFF_BF	1	Bottom fzr x frost free
ZIFF_SS	1	Side by side x frost free
ZISS_D	1	Side-side x amps
ZSAMP98	1	Lovelace/KEMA/BRLABS sample, 1998
ZSAMP03	1	Samiullah/KEMA/BRLABS sample, 2003
ZSAMP05	1	Samiullah/ADM/BRLABS dualmtr, 2005
ZIFF_CL	1	Frost free x ln(age)
ZAGE15UP	1	Age 15 up (direct)
IA15AGEL	1	Ln age x age 15 up

1REG3B1: DROPPING AGE BY SAMPLE COHORT INTERACTIONS
--- after trimming influentials ----

Model: MODEL1
Dependent Variable: ANNKWH2

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Prob>F
Model	18	676365039.94	37575835.552	66.535	0.0001
Error	1564	883277949.23	564755.72201		
C Total	1582	1559642989.2			

Root MSE	751.50231	R-square	0.4337
Dep Mean	1943.64031	Adj R-sq	0.4271
C.V.	38.66468		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	T for H0: Parameter=0	Prob > |T|	Tolerance	Variance Inflation
INTERCEP	1	-422.410623	548.49725352	-0.770	0.4413	.	0.00000000
ZFZR	1	169.053578	91.86246434	1.840	0.0659	0.47863612	2.08926984
ZD_BF	1	595.379358	204.95360648	2.905	0.0037	0.24062048	4.15592223
ZD_SS	1	-129.355323	376.65011648	-0.343	0.7313	0.01832028	54.58431313
ZD_SD	1	-417.102580	88.22724104	-4.728	0.0001	0.37175945	2.68991146
ZDFF	1	-445.034826	445.21989066	-1.000	0.3177	0.00820000	121.95119052
ZAGEL	1	405.213449	188.39968786	2.151	0.0316	0.05387096	18.56287767
SIZE	1	43.647799	9.50690191	4.591	0.0001	0.33306676	3.00240105
AMPS	1	104.101844	21.57049504	4.826	0.0001	0.28389090	3.52247999
ZIFF_FZ	1	319.109662	164.27657464	1.943	0.0523	0.66746501	1.49820589
ZIFF_BF	1	-302.048423	236.37701091	-1.278	0.2015	0.24162502	4.13864423
ZIFF_SS	1	1451.320647	382.20950899	3.797	0.0002	0.01807175	55.33496965
ZISS_D	1	-126.433239	43.93924942	-2.877	0.0041	0.02537919	39.40235379
ZSAMP98	1	-48.945967	71.46625569	-0.685	0.4935	0.88947154	1.12426306
ZSAMP03	1	-435.897800	81.07056510	-5.377	0.0001	0.91722103	1.09024975
ZSAMP05	1	-649.207285	63.02247618	-10.301	0.0001	0.80012197	1.24980945
ZIFF_CL	1	299.820612	143.39003847	2.091	0.0367	0.00913929	109.41772399
ZAGE15UP	1	1197.834930	459.01504652	2.610	0.0092	0.01122614	89.07782818
IA15AGEL	1	-524.978166	170.19944466	-3.084	0.0021	0.00782601	127.77906586

1REG3B1: DROPPING AGE BY SAMPLE COHORT INTERACTIONS
--- after trimming influentials ----

Variable	DF	Variable Label
INTERCEP	1	Intercept
ZFZR	1	Freezer dummy, TRKG
ZD_BF	1	Bottom fzr dummy, TRKG
ZD_SS	1	Side by side dummy, TRKG
ZD_SD	1	Single door dummy, TRKG
ZDFF	1	Frost free dummy, TRKG
ZAGEL	1	Age nat log
SIZE	1	TRKG CU FT
AMPS	1	LABEL AMPS
ZIFF_FZ	1	
ZIFF_BF	1	Bottom fzr x frost free
ZIFF_SS	1	Side by side x frost free
ZISS_D	1	Side-side x amps
ZSAMP98	1	Lovelace/KEMA/BRLABS sample, 1998
ZSAMP03	1	Samiullah/KEMA/BRLABS sample, 2003
ZSAMP05	1	Samiullah/ADM/BRLABS dualmtr, 2005
ZIFF_CL	1	Frost free x ln(age)
ZAGE15UP	1	Age 15 up (direct)
IA15AGEL	1	Ln age x age 15 up

1REG3B1: DROPPING AGE BY SAMPLE COHORT INTERACTIONS
--- after trimming influentials ----

Collinearity Diagnostics

Number	Eigenvalue	Condition Index	Var Prop INTERCEP	Var Prop ZFZR	Var Prop ZD_BF	Var Prop ZD_SS	Var Prop ZD_SD	Var Prop ZDFF	Var Prop ZAGEL	Var Prop SIZE
1	8.52241	1.00000	0.0000	0.0005	0.0002	0.0001	0.0003	0.0000	0.0000	0.0002
2	2.50350	1.84505	0.0000	0.0076	0.0042	0.0014	0.0051	0.0000	0.0000	0.0000
3	1.79970	2.17611	0.0000	0.0131	0.0518	0.0000	0.0075	0.0000	0.0000	0.0000
4	1.40781	2.46042	0.0000	0.0815	0.0003	0.0000	0.0419	0.0000	0.0000	0.0000
5	1.09499	2.78982	0.0000	0.0128	0.0045	0.0007	0.0759	0.0003	0.0000	0.0000
6	0.99994	2.91941	0.0000	0.0013	0.0002	0.0000	0.0052	0.0000	0.0000	0.0000
7	0.86918	3.13131	0.0000	0.0441	0.0057	0.0001	0.0153	0.0001	0.0000	0.0000
8	0.65723	3.60099	0.0000	0.0893	0.0001	0.0000	0.0217	0.0002	0.0000	0.0000
9	0.58954	3.80211	0.0000	0.1246	0.0001	0.0000	0.0717	0.0000	0.0000	0.0001
10	0.24430	5.90641	0.0001	0.1893	0.0134	0.0001	0.1836	0.0006	0.0000	0.0016
11	0.15403	7.43838	0.0004	0.0426	0.5075	0.0000	0.0176	0.0003	0.0001	0.0041
12	0.08526	9.99796	0.0010	0.3713	0.4073	0.0000	0.2394	0.0032	0.0005	0.0109
13	0.03026	16.78306	0.0025	0.0074	0.0003	0.0491	0.0628	0.0002	0.0024	0.0128
14	0.01320	25.40984	0.0022	0.0000	0.0001	0.0121	0.0934	0.0040	0.0269	0.3445
15	0.01109	27.71917	0.0005	0.0000	0.0011	0.1230	0.0160	0.0018	0.0000	0.1697
16	0.00917	30.48924	0.0004	0.0135	0.0031	0.7318	0.0401	0.0057	0.0067	0.0020
17	0.00609	37.41641	0.0576	0.0010	0.0002	0.0757	0.0660	0.0752	0.0045	0.4499
18	0.00196	65.92407	0.0318	0.0002	0.0001	0.0044	0.0286	0.3145	0.0016	0.0025
19	0.0003432	157.58400	0.9034	0.0000	0.0000	0.0014	0.0080	0.5939	0.9571	0.0016

1REG3B1: DROPPING AGE BY SAMPLE COHORT INTERACTIONS
--- after trimming influentials ----

Collinearity Diagnostics

Number	Var Prop AMPS	Var Prop ZIFF_FZ	Var Prop ZIFF_BF	Var Prop ZIFF_SS	Var Prop ZISS_D	Var Prop ZSAMP98	Var Prop ZSAMP03	Var Prop ZSAMP05	Var Prop ZIFF_CL	Var Prop ZAGE15UP
1	0.0003	0.0003	0.0001	0.0001	0.0001	0.0011	0.0010	0.0019	0.0000	0.0000
2	0.0000	0.0048	0.0038	0.0014	0.0019	0.0051	0.0008	0.0007	0.0000	0.0000
3	0.0000	0.0097	0.0540	0.0000	0.0000	0.0007	0.0000	0.0001	0.0000	0.0000
4	0.0000	0.1689	0.0004	0.0000	0.0001	0.0634	0.0032	0.0015	0.0000	0.0000
5	0.0003	0.0003	0.0028	0.0007	0.0010	0.0905	0.0572	0.0420	0.0003	0.0000
6	0.0000	0.0000	0.0001	0.0000	0.0000	0.0009	0.5490	0.2352	0.0000	0.0000
7	0.0002	0.0498	0.0070	0.0001	0.0002	0.4243	0.0502	0.1229	0.0001	0.0000
8	0.0000	0.3525	0.0009	0.0000	0.0000	0.1262	0.1592	0.1563	0.0002	0.0000
9	0.0003	0.1158	0.0003	0.0000	0.0000	0.2483	0.1384	0.3133	0.0000	0.0000
10	0.0025	0.0876	0.0217	0.0000	0.0001	0.0015	0.0071	0.0002	0.0001	0.0023
11	0.0054	0.0319	0.5013	0.0001	0.0000	0.0085	0.0020	0.0000	0.0013	0.0005
12	0.0145	0.1703	0.3995	0.0007	0.0002	0.0014	0.0011	0.0041	0.0068	0.0002
13	0.3354	0.0014	0.0008	0.0224	0.1672	0.0000	0.0001	0.0117	0.0001	0.0005
14	0.0023	0.0013	0.0013	0.0895	0.0837	0.0094	0.0044	0.0345	0.0117	0.0129
15	0.6082	0.0003	0.0002	0.1213	0.7162	0.0034	0.0048	0.0336	0.0000	0.0000
16	0.0024	0.0034	0.0013	0.7169	0.0003	0.0000	0.0001	0.0005	0.0045	0.0057
17	0.0225	0.0012	0.0015	0.0453	0.0246	0.0077	0.0153	0.0395	0.0726	0.0231
18	0.0046	0.0002	0.0001	0.0016	0.0021	0.0068	0.0058	0.0020	0.2872	0.2225
19	0.0013	0.0004	0.0029	0.0000	0.0023	0.0007	0.0002	0.0001	0.6151	0.7322

1REG3B1: DROPPING AGE BY SAMPLE COHORT INTERACTIONS
--- after trimming influentials ----

Collinearity Diagnostics

Number	Var Prop IA15AGEL
1	0.0000
2	0.0000
3	0.0000
4	0.0000
5	0.0000
6	0.0000
7	0.0000
8	0.0000
9	0.0000
10	0.0016
11	0.0003
12	0.0001
13	0.0000
14	0.0007
15	0.0000
16	0.0010
17	0.0064
18	0.2444
19	0.7454

1REG3B1: CORRELATION OF RESIDUALS
CORRELATION OF REG3A, 3A1, 3B, 3B1 RESIDUALS WITH REGRESSORS AND CANDIDATES

Correlation Analysis

Pearson Correlation Coefficients / Prob > |R| under Ho: Rho=0
/ Number of Observations

		R_REG3A	R_REG3A1	R_REG3B	R_REG3B1
SIZE		0.00000	0.00000	0.00000	0.00000
TRKG CU FT		1.0000	1.0000	1.0000	1.0000
		1583	1583	1583	1583
AGE		-0.01844	-0.00246	-0.01495	-0.00182
TRKG AGE		0.4634	0.9222	0.5522	0.9422
		1583	1583	1583	1583
AMPS		-0.00000	0.00000	-0.00000	0.00000
LABEL AMPS		1.0000	1.0000	1.0000	1.0000
		1583	1583	1583	1583
ZDMD		-0.02099	-0.02120	-0.02114	-0.02144
Manual def dummy, TRKG		0.4040	0.3992	0.4007	0.3940
		1583	1583	1583	1583
ZDPD		0.02983	0.03014	0.03004	0.03047
Partial def dummy, TRKG		0.2355	0.2308	0.2322	0.2256
		1583	1583	1583	1583
ZDFFJ		0.00734	0.00787	0.00713	0.00749
Frost free dummy, TRKG (JP-no CF)		0.7704	0.7545	0.7769	0.7659
		1583	1583	1583	1583
ZD_UF		0.00367	0.00636	0.00109	0.00229
Upright fzr dummy, TRKG		0.8840	0.8004	0.9654	0.9275
		1583	1583	1583	1583
ZD_CF		-0.00893	-0.01548	-0.00266	-0.00557
Chest fzr dummy, TRKG		0.7226	0.5384	0.9159	0.8249
		1583	1583	1583	1583
KAGE30UP		0.00305	0.01279	0.00593	0.01279
Age 30 up (KEMA style)		0.9034	0.6112	0.8137	0.6111
		1583	1583	1583	1583
KAGE25UP		-0.01373	0.01079	-0.00924	0.00925
Age 25 up (KEMA style)		0.5852	0.6680	0.7135	0.7129
		1583	1583	1583	1583
KAGE20UP		-0.04901	-0.01193	-0.04189	-0.01024
Age 20 up (KEMA style)		0.0512	0.6354	0.0957	0.6839
		1583	1583	1583	1583
KAGE15UP		-0.04931	-0.03506	-0.04711	-0.03009
Age 15 up (KEMA style)		0.0498	0.1633	0.0610	0.2316
		1583	1583	1583	1583
KAGE10UP		0.09389	0.02571	0.08553	0.02737
Age 10 up (KEMA style)		0.0002	0.3066	0.0007	0.2765
		1583	1583	1583	1583
KAGE30		0.00305	0.01279	0.00593	0.01279
Age 30 up (KEMA style)		0.9034	0.6112	0.8137	0.6111
		1583	1583	1583	1583

KAGE25	-0.02155	-0.00006	-0.01884	-0.00209
Age 25 (KEMA style)	0.3915	0.9982	0.4539	0.9339
	1583	1583	1583	1583
KAGE20	-0.04043	-0.02584	-0.03738	-0.02218
Age 20 (KEMA style)	0.1078	0.3041	0.1371	0.3779
	1583	1583	1583	1583
KAGE15	0.01524	-0.01518	0.00896	-0.01302
Age 15 (KEMA style)	0.5445	0.5462	0.7217	0.6046
	1583	1583	1583	1583
KAGE10	0.09258	0.04832	0.08666	0.04373
Age 10 (KEMA style)	0.0002	0.0546	0.0006	0.0820
	1583	1583	1583	1583
	R_REG3A	R_REG3A1	R_REG3B	R_REG3B1
KAGE05	-0.09389	-0.02571	-0.08553	-0.02737
Age 05 (KEMA style)	0.0002	0.3066	0.0007	0.2765
	1583	1583	1583	1583
ZAGE30UP	0.00498	0.01337	0.00732	0.01305
Age 30 up (direct)	0.8431	0.5951	0.7711	0.6038
	1583	1583	1583	1583
ZAGE25UP	-0.01793	0.00533	-0.01453	0.00272
Age 25 up (direct)	0.4760	0.8321	0.5636	0.9138
	1583	1583	1583	1583
ZAGE20UP	-0.05248	-0.01761	-0.04514	-0.01579
Age 20 up (direct)	0.0368	0.4837	0.0726	0.5301
	1583	1583	1583	1583
ZAGE15UP	-0.04699	0.00000	-0.04460	0.00000
Age 15 up (direct)	0.0616	1.0000	0.0761	1.0000
	1583	1583	1583	1583
ZAGE10UP	0.03276	-0.01093	0.02069	-0.01793
Age 10 up (direct)	0.1927	0.6640	0.4108	0.4759
	1583	1583	1583	1583
ZAGE05UP	0.10154	0.02806	0.08882	0.02485
Age 05 up (direct)	0.0001	0.2645	0.0004	0.3232
	1583	1583	1583	1583
ZAGE30	0.00498	0.01337	0.00732	0.01305
Age 30 up (direct)	0.8431	0.5951	0.7711	0.6038
	1583	1583	1583	1583
ZAGE25	-0.02884	-0.00748	-0.02692	-0.01055
Age 25-29 (direct)	0.2514	0.7663	0.2844	0.6748
	1583	1583	1583	1583
ZAGE20	-0.04213	-0.02723	-0.03727	-0.02204
Age 20-24 (direct)	0.0938	0.2789	0.1383	0.3809
	1583	1583	1583	1583
ZAGE15	0.01798	0.02027	0.01169	0.01817
Age 15-19 (direct)	0.4747	0.4202	0.6421	0.4699
	1583	1583	1583	1583
ZAGE10	0.07049	-0.00618	0.06102	-0.01013
Age 10-14 (direct)	0.0050	0.8061	0.0152	0.6870

	1583	1583	1583	1583
ZAGE05	0.02513	0.03030	0.03130	0.03648
Age 05-09 (direct)	0.3177	0.2282	0.2133	0.1468
	1583	1583	1583	1583
ZAGER	-0.01171	-0.00190	-0.00969	-0.00154
Age sqrt	0.6414	0.9397	0.7001	0.9512
	1583	1583	1583	1583
ZAGEQ	-0.01834	-0.00129	-0.01371	-0.00010
Age squared	0.4658	0.9592	0.5858	0.9969
	1583	1583	1583	1583
ZAGEL	-0.00000	0.00000	-0.00000	-0.00000
Age nat log	1.0000	1.0000	1.0000	1.0000
	1583	1583	1583	1583
ZAGET	-0.02899	-0.01528	-0.02726	-0.01379
Age trunc at 20	0.2491	0.5435	0.2785	0.5834
	1583	1583	1583	1583
ZAGERT	-0.01223	-0.01095	-0.01271	-0.00996
Age trunc at 20-sqrt	0.6268	0.6634	0.6133	0.6921
	1583	1583	1583	1583
ZAGEQT	-0.04580	-0.01829	-0.04159	-0.01649
Age trunc at 20-squared	0.0685	0.4672	0.0981	0.5121
	1583	1583	1583	1583
ZAGELT	0.00578	-0.00575	0.00303	-0.00538
Age trunc at 20-nat log	0.8181	0.8192	0.9041	0.8307
	1583	1583	1583	1583
ZIFF_TF	-0.00332	-0.00322	-0.00334	-0.00319
Top freezer x frost free	0.8950	0.8980	0.8943	0.8992
	1583	1583	1583	1583
ZIFF_SD	0.02694	0.02615	0.02711	0.02586
Single door x frost free	0.2841	0.2984	0.2811	0.3038
	1583	1583	1583	1583
ZIFF_UF	0.02714	0.02908	0.02635	0.02768
Upright fzr x frost free	0.2805	0.2475	0.2947	0.2710
	1583	1583	1583	1583
ZIFF_CF	-0.05614	-0.06015	-0.05451	-0.05726
Chest fzr x frost free	0.0255	0.0167	0.0301	0.0227
	1583	1583	1583	1583
ZIMD_BF	0.01869	0.01963	0.01405	0.01335
Bottom fzr x manl def	0.4575	0.4351	0.5766	0.5956
	1583	1583	1583	1583
ZIMD_SS	0.00000	0.00000	0.00000	0.00000
Side by side x manl def	1.0000	1.0000	1.0000	1.0000
	1583	1583	1583	1583
ZIMD_TF	-0.03844	-0.03970	-0.03747	-0.03894
Top freezer x manl def	0.1264	0.1144	0.1361	0.1215
	1583	1583	1583	1583
ZIMD_SD	-0.01697	-0.01699	-0.01676	-0.01659
Single door x manl def	0.4998	0.4993	0.5052	0.5095
	1583	1583	1583	1583

ZIMD_UF	-0.00963	-0.00764	-0.01208	-0.01143
Upright fzr x manl def	0.7018	0.7614	0.6311	0.6495
	1583	1583	1583	1583
ZIMD_CF	0.02506	0.01988	0.03144	0.02975
Chest fzr x manl def	0.3190	0.4294	0.2113	0.2369
	1583	1583	1583	1583
ZIPD_BF	-0.01129	-0.01186	-0.00849	-0.00807
Bottom fzr x part def	0.6534	0.6372	0.7358	0.7484
	1583	1583	1583	1583
ZIPD_TF	0.02025	0.02054	0.01993	0.02019
Top freezer x part def	0.4208	0.4140	0.4282	0.4220
	1583	1583	1583	1583
ZIPD_SD	0.05502	0.05574	0.05392	0.05416
Single door x part def	0.0286	0.0266	0.0320	0.0312
	1583	1583	1583	1583
ZIFFJTF	-0.00332	-0.00322	-0.00334	-0.00319
Top freezer x frost free(JP re CF)	0.8950	0.8980	0.8943	0.8992
	1583	1583	1583	1583
ZIFFJSD	0.02694	0.02615	0.02711	0.02586
Single door x frost free(JP re CF)	0.2841	0.2984	0.2811	0.3038
	1583	1583	1583	1583
ZIFFJUF	0.02714	0.02908	0.02635	0.02768
Upright fzr x frost free(JP re CF)	0.2805	0.2475	0.2947	0.2710
	1583	1583	1583	1583
ZIFF_C	-0.01484	-0.00085	-0.01105	0.00087
Frost free x age	0.5552	0.9730	0.6604	0.9725
	1583	1583	1583	1583
ZIFF_CR	-0.00503	-0.00052	-0.00392	-0.00006
Frost free x sqrt(age)	0.8414	0.9836	0.8762	0.9981
	1583	1583	1583	1583
ZIFF_CQ	-0.02549	0.00140	-0.01568	0.00714
Frost free x age**2	0.3108	0.9556	0.5331	0.7765
	1583	1583	1583	1583
ZIFF_CT	-0.01282	-0.00624	-0.01266	-0.00667
Frost free x trunc_age	0.6104	0.8040	0.6147	0.7909
	1583	1583	1583	1583
ZIFF_CRT	-0.00334	-0.00287	-0.00385	-0.00325
Frost free x sqrt(trunc_age)	0.8944	0.9093	0.8782	0.8973
	1583	1583	1583	1583
ZIFF_CLT	0.00113	-0.00130	0.00025	-0.00171
Frost free x ln(trunc_age)	0.9642	0.9587	0.9921	0.9459
	1583	1583	1583	1583
ZIFF_CQT	-0.02910	-0.00986	-0.02715	-0.01025
Frost free x trunc_age**2	0.2473	0.6950	0.2804	0.6837
	1583	1583	1583	1583
ZIFFJC	-0.00880	0.00553	-0.00527	0.00684
Frost free(JP) x age	0.7266	0.8259	0.8339	0.7858
	1583	1583	1583	1583

ZIFFJCR	0.00194	0.00691	0.00281	0.00695
Frost free(JP) x sqrt(age)	0.9385	0.7836	0.9112	0.7823
	1583	1583	1583	1583
ZIFFJCL	0.00721	0.00770	0.00697	0.00730
Frost free(JP) x ln(age)	0.7743	0.7594	0.7816	0.7718
	1583	1583	1583	1583
ZIFFJCQ	-0.02172	0.00535	-0.01214	0.01074
Frost free(JP) x age**2	0.3879	0.8316	0.6292	0.6694
	1583	1583	1583	1583
ZIFFJCT	-0.00572	0.00128	-0.00582	0.00043
Frost free(JP) x trunc_age	0.8201	0.9595	0.8171	0.9863
	1583	1583	1583	1583
ZIFFJCRT	0.00404	0.00501	0.00329	0.00422
Frost free(JP) x sqrt(trunc_age)	0.8722	0.8422	0.8958	0.8668
	1583	1583	1583	1583
ZIFFJCLT	0.00855	0.00663	0.00744	0.00583
Frost free(JP) x ln(trunc_age)	0.7339	0.7920	0.7673	0.8167
	1583	1583	1583	1583
ZIFFJCQT	-0.02285	-0.00331	-0.02117	-0.00411
Frost free(JP) x trunc_age**2	0.3637	0.8954	0.4000	0.8701
	1583	1583	1583	1583
ZIFF_D	0.00262	0.00263	0.00234	0.00222
Frost free x amps	0.9169	0.9167	0.9258	0.9295
	1583	1583	1583	1583
ZIFFJD	0.00962	0.01013	0.00918	0.00941
Frost free(JP) x amps	0.7020	0.6872	0.7151	0.7085
	1583	1583	1583	1583
ZIRF_D	-0.00088	-0.00110	-0.00059	-0.00071
Refrig x amps	0.9722	0.9650	0.9814	0.9774
	1583	1583	1583	1583
ZIFZ_D	0.00139	0.00174	0.00093	0.00113
Freezer x amps	0.9561	0.9448	0.9706	0.9642
	1583	1583	1583	1583
ZIBF_D	0.00039	0.00024	0.00044	0.00041
Bottom fzr x amps	0.9876	0.9924	0.9859	0.9870
	1583	1583	1583	1583
ZITF_D	0.00211	0.00211	0.00205	0.00201
Top freezer x amps	0.9331	0.9333	0.9349	0.9364
	1583	1583	1583	1583
ZISD_D	-0.00751	-0.00778	-0.00684	-0.00694
Single door x amps	0.7654	0.7570	0.7857	0.7827
	1583	1583	1583	1583
ZIUF_D	0.00985	0.01270	0.00766	0.00913
Upright fzr x amps	0.6955	0.6136	0.7607	0.7167
	1583	1583	1583	1583
ZICF_D	-0.02061	-0.02670	-0.01642	-0.01952
Chest fzr x amps	0.4126	0.2884	0.5137	0.4378
	1583	1583	1583	1583
I94RF	0.01046	0.00788	0.01399	0.01299

Refrig x sample94	0.6775	0.7539	0.5780	0.6055
	1583	1583	1583	1583
I94FZ	-0.02122	-0.01599	-0.02838	-0.02635
Freezr x sample94	0.3989	0.5249	0.2591	0.2947
	1583	1583	1583	1583
I94FF	0.01697	0.01412	0.02377	0.02324
Frost free x sample94	0.5000	0.5745	0.3447	0.3556
	1583	1583	1583	1583
I94FFJ	0.01697	0.01412	0.02377	0.02324
Frost free (JP) x sample94	0.5000	0.5745	0.3447	0.3556
	1583	1583	1583	1583
I94AGE	-0.01582	-0.00492	-0.03120	-0.02761
Age x sample94	0.5295	0.8448	0.2147	0.2723
	1583	1583	1583	1583
I94AGER	-0.00606	-0.00194	-0.01649	-0.01655
Sqrt age x sample94	0.8097	0.9387	0.5120	0.5105
	1583	1583	1583	1583
I94AGEQ	-0.02264	-0.00665	-0.03995	-0.03331
Square age x sample94	0.3681	0.7913	0.1121	0.1853
	1583	1583	1583	1583
I94AGEL	0.00000	0.00000	-0.00782	-0.01027
Ln age x sample94	1.0000	1.0000	0.7558	0.6830
	1583	1583	1583	1583
I94AGET	-0.01105	-0.00587	-0.02232	-0.02120
Trnc_age x sample94	0.6604	0.8155	0.3748	0.3994
	1583	1583	1583	1583
I94AGERT	-0.00166	-0.00177	-0.00885	-0.01088
Sqrt trnc_age x sample94	0.9475	0.9440	0.7250	0.6654
	1583	1583	1583	1583
I94AGEQT	-0.02857	-0.01268	-0.04376	-0.03520
Square trnc_age x sample94	0.2559	0.6142	0.0818	0.1615
	1583	1583	1583	1583
I94AGELT	0.00297	0.00020	-0.00276	-0.00655
Ln trnc_age x sample94	0.9060	0.9938	0.9125	0.7945
	1583	1583	1583	1583
I98RF	-0.00678	-0.00477	-0.01087	-0.01062
Refrig x sample98	0.7876	0.8496	0.6655	0.6730
	1583	1583	1583	1583
I98FZ	0.01106	0.00778	0.01774	0.01732
Freezr x sample98	0.6602	0.7570	0.4805	0.4909
	1583	1583	1583	1583
I98FF	0.03320	0.03509	0.02500	0.02441
Frost free x sample98	0.1867	0.1629	0.3202	0.3318
	1583	1583	1583	1583
I98FFJ	0.03308	0.03492	0.02446	0.02373
Frost free (JP) x sample98	0.1884	0.1649	0.3307	0.3453
	1583	1583	1583	1583
I98AGE	-0.00354	-0.00401	0.01020	0.01344
Age x sample98	0.8881	0.8733	0.6850	0.5932

	1583	1583	1583	1583
I98AGER	-0.00091	-0.00102	0.00647	0.00835
Sqrt age x sample98	0.9710	0.9675	0.7972	0.7399
	1583	1583	1583	1583
I98AGEQ	-0.01101	-0.01280	0.01136	0.01564
Square age x sample98	0.6617	0.6108	0.6515	0.5339
	1583	1583	1583	1583
I98AGEL	0.00000	0.00000	0.00482	0.00613
Ln age x sample98	1.0000	1.0000	0.8481	0.8075
	1583	1583	1583	1583
I98AGET	0.00473	0.00559	0.01242	0.01532
Trnc_age x sample98	0.8509	0.8241	0.6214	0.5424
	1583	1583	1583	1583
I98AGERT	0.00277	0.00323	0.00704	0.00863
Sqrt trnc_age x sample98	0.9122	0.8979	0.7796	0.7314
	1583	1583	1583	1583
I98AGEQT	0.00683	0.00831	0.01930	0.02401
Square trnc_age x sample98	0.7859	0.7411	0.4428	0.3397
	1583	1583	1583	1583
I98AGELT	0.00205	0.00235	0.00506	0.00617
Ln trnc_age x sample98	0.9350	0.9256	0.8407	0.8062
	1583	1583	1583	1583
I03RF	-0.00133	0.00031	-0.00154	-0.00034
Refrig x sample03	0.9578	0.9902	0.9511	0.9892
	1583	1583	1583	1583
I03FZ	0.00389	-0.00090	0.00451	0.00100
Freezr x sample03	0.8772	0.9713	0.8578	0.9683
	1583	1583	1583	1583
I03FF	-0.01905	-0.01706	-0.01980	-0.01884
Frost free x sample03	0.4487	0.4975	0.4311	0.4539
	1583	1583	1583	1583
I03FFJ	-0.01600	-0.01320	-0.01674	-0.01501
Frost free (JP) x sample03	0.5246	0.5997	0.5057	0.5506
	1583	1583	1583	1583
I03AGE	0.00223	0.00178	0.00809	0.01399
Age x sample03	0.9294	0.9436	0.7476	0.5781
	1583	1583	1583	1583
I03AGER	0.00054	0.00045	0.00357	0.00674
Sqrt age x sample03	0.9827	0.9857	0.8873	0.7887
	1583	1583	1583	1583
I03AGEQ	0.00736	0.00540	0.01727	0.02608
Square age x sample03	0.7697	0.8300	0.4924	0.2997
	1583	1583	1583	1583
I03AGET	-0.00258	-0.00183	0.00089	0.00538
Trnc_age x sample03	0.9184	0.9420	0.9717	0.8307
	1583	1583	1583	1583
I03AGERT	-0.00150	-0.00114	0.00035	0.00272
Sqrt trnc_age x sample03	0.9523	0.9639	0.9890	0.9139
	1583	1583	1583	1583

I03AGEQT	-0.00358	-0.00212	0.00237	0.01015
Square trnc_age x sample03	0.8868	0.9327	0.9249	0.6865
	1583	1583	1583	1583

I03AGELT	-0.00111	-0.00088	0.00016	0.00179
Ln trnc_age x sample03	0.9647	0.9720	0.9948	0.9434
	1583	1583	1583	1583
I05RF	-0.00926	-0.00818	-0.01119	-0.01078
Refrig x sample05	0.7127	0.7450	0.6564	0.6681
	1583	1583	1583	1583
I05FZ	0.02813	0.02485	0.03399	0.03275
Freezr x sample05	0.2633	0.3232	0.1765	0.1928
	1583	1583	1583	1583
I05FF	-0.03706	-0.03542	-0.04120	-0.04064
Frost free x sample05	0.1405	0.1589	0.1013	0.1060
	1583	1583	1583	1583
I05FFJ	-0.02850	-0.02660	-0.03274	-0.03207
Frost free (JP) x sample05	0.2570	0.2901	0.1930	0.2021
	1583	1583	1583	1583
I05AGE	0.00674	0.00795	0.02281	0.02603
Age x sample05	0.7887	0.7518	0.3645	0.3007
	1583	1583	1583	1583
I05AGER	0.00184	0.00221	0.01032	0.01185
Sqrt age x sample05	0.9416	0.9301	0.6817	0.6375
	1583	1583	1583	1583
I05AGEQ	0.01675	0.01951	0.04314	0.04871
Square age x sample05	0.5055	0.4379	0.0862	0.0527
	1583	1583	1583	1583
I05AGEL	0.00000	0.00000	0.00557	0.00642
Ln age x sample05	1.0000	1.0000	0.8249	0.7986
	1583	1583	1583	1583
I05AGET	-0.00580	-0.00530	0.00245	0.00425
Trnc_age x sample05	0.8176	0.8330	0.9224	0.8658
	1583	1583	1583	1583
I05AGERT	-0.00383	-0.00381	0.00088	0.00170
Sqrt trnc_age x sample05	0.8791	0.8796	0.9722	0.9460
	1583	1583	1583	1583
I05AGEQT	-0.00684	-0.00512	0.00640	0.00994
Square trnc_age x sample05	0.7857	0.8386	0.7991	0.6927
	1583	1583	1583	1583
I05AGELT	-0.00316	-0.00336	0.00029	0.00074
Ln trnc_age x sample05	0.8999	0.8937	0.9907	0.9765
	1583	1583	1583	1583
IFF_30UP	0.00738	0.02432	0.01556	0.02962
Frost free by age 30 up	0.7691	0.3336	0.5362	0.2389
	1583	1583	1583	1583
IFF_25UP	-0.02512	0.00670	-0.01919	0.00530
Frost free by age 25 up	0.3180	0.7899	0.4455	0.8330
	1583	1583	1583	1583
IFF_20UP	-0.04722	-0.00947	-0.04058	-0.00941
Frost free by age 20 up	0.0603	0.7066	0.1065	0.7084
	1583	1583	1583	1583

IFF_15UP Frost free by age 15 up	-0.03929 0.1182 1583	-0.00367 0.8839 1583	-0.03833 0.1274 1583	-0.00536 0.8313 1583
IFF_10UP Frost free by age 10 up	0.01107 0.6600 1583	-0.00585 0.8161 1583	0.00573 0.8199 1583	-0.00949 0.7059 1583
IFF_05UP Frost free by age 05 up	0.02278 0.3651 1583	0.00630 0.8024 1583	0.01993 0.4282 1583	0.00557 0.8246 1583
IA30AGE Age x age 30 up	0.00273 0.9137 1583	0.01030 0.6823 1583	0.00514 0.8380 1583	0.01018 0.6857 1583
IA25AGE Age x age 25 up	-0.01499 0.5511 1583	0.00506 0.8404 1583	-0.01147 0.6483 1583	0.00321 0.8985 1583
IA20AGE Age x age 20 up	-0.03960 0.1152 1583	-0.00947 0.7066 1583	-0.03287 0.1912 1583	-0.00823 0.7436 1583
IA15AGE Age x age 15 up	-0.03846 0.1261 1583	0.00061 0.9807 1583	-0.03384 0.1784 1583	0.00078 0.9754 1583
IA10AGE Age x age 10 up	-0.02000 0.4264 1583	-0.00700 0.7807 1583	-0.01796 0.4752 1583	-0.00752 0.7649 1583
IA05AGE Age x age 05 up	-0.01576 0.5308 1583	-0.00185 0.9414 1583	-0.01260 0.6164 1583	-0.00126 0.9600 1583
IA30AGER Sqrt age x age 30 up	0.00388 0.8775 1583	0.01187 0.6369 1583	0.00622 0.8047 1583	0.01161 0.6444 1583
IA25AGER Sqrt age x age 25 up	-0.01648 0.5123 1583	0.00534 0.8320 1583	-0.01303 0.6043 1583	0.00305 0.9035 1583
IA20AGER Sqrt age x age 20 up	-0.04658 0.0639 1583	-0.01343 0.5935 1583	-0.03946 0.1166 1583	-0.01194 0.6349 1583
IA15AGER Sqrt age x age 15 up	-0.04525 0.0719 1583	0.00020 0.9936 1583	-0.04140 0.0997 1583	0.00023 0.9926 1583
IA10AGER Sqrt age x age 10 up	-0.00804 0.7492 1583	-0.01103 0.6610 1583	-0.01045 0.6777 1583	-0.01366 0.5870 1583
IA05AGER Sqrt age x age 05 up	0.00414 0.8692 1583	0.00208 0.9340 1583	0.00420 0.8675 1583	0.00206 0.9349 1583
IA30AGEL Ln age x age 30 up	0.00439 0.8614 1583	0.01257 0.6172 1583	0.00671 0.7895 1583	0.01226 0.6259 1583

IA25AGEL	-0.01711	0.00539	-0.01369	0.00294
Ln age x age 25 up	0.4964	0.8302	0.5864	0.9068
	1583	1583	1583	1583
IA20AGEL	-0.04920	-0.01512	-0.04197	-0.01352
Ln age x age 20 up	0.0503	0.5477	0.0951	0.5910
	1583	1583	1583	1583
IA15AGEL	-0.04698	0.00000	-0.04362	0.00000
Ln age x age 15 up	0.0617	1.0000	0.0828	1.0000
	1583	1583	1583	1583
IA10AGEL	0.00181	-0.01299	-0.00364	-0.01693
Ln age x age 10 up	0.9426	0.6055	0.8849	0.5008
	1583	1583	1583	1583
IA05AGEL	0.02411	0.00608	0.02118	0.00553
Ln age x age 05 up	0.3377	0.8089	0.3996	0.8260
	1583	1583	1583	1583

H.3 FULL SET OF 384 SCENARIOS EVALUATED: LABORATORY RESULTS AND IN_SITU PREDICTION.

NOTE:

SCENE=APPL TYPE, COND/UNCOND, COOLER/HOTTER CLIMATE ZONE, DEFROST, HOUSEHOLD SIZE, LAB UEC
PCT=IN SITU AS PCT OF LAB ESTIMATE
PCT_LOW=IN_SITU MINUS STD ERROR OF PREDICTION AS PCT OF LAB ESTIMATE
PCT_HI=IN_SITU MINUS STD ERROR OF PREDICTION AS PCT OF LAB ESTIMATE

1GANAL15A: ANALYSIS OF MULTIPLE SCENARIOS - LAB VS. IN SITU

OBS	SCENE	KWH_INSITU	PCT_LOW	PCT	PCT_HIGH
1	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1300	1096	74.42	84.27	94.13
2	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1500	1317	79.61	87.80	95.99
3	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1700	1538	83.14	90.50	97.85
4	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1900	1760	85.57	92.62	99.68
5	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2100	1981	87.26	94.35	101.44
6	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2300	2203	88.47	95.77	103.07
7	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2500	2424	89.37	96.97	104.56
8	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2700	2646	90.07	97.99	105.90
9	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1300	1355	94.09	104.20	114.32
10	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1500	1576	96.44	105.07	113.71
11	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1700	1798	97.82	105.74	113.65
12	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1900	2019	98.59	106.26	113.94
13	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2100	2240	98.97	106.69	114.40
14	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2300	2462	99.13	107.04	114.94
15	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2500	2683	99.16	107.33	115.50
16	FREEZER ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2700	2905	99.12	107.58	116.04
17	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1300	1275	86.11	98.07	110.03
18	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1500	1383	81.89	92.18	102.46
19	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1700	1490	78.63	87.67	96.71
20	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1900	1598	76.01	84.11	92.22
21	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2100	1706	73.85	81.24	88.62
22	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2300	1814	72.04	78.86	85.67
23	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2500	1921	70.49	76.86	83.23
24	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2700	2029	69.14	75.16	81.17
25	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1300	1534	106.14	118.00	129.85
26	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1500	1642	99.22	109.45	119.68
27	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1700	1749	93.88	102.91	111.95
28	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1900	1857	89.62	97.75	105.88
29	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2100	1965	86.14	93.57	101.01
30	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2300	2073	83.23	90.12	97.01
31	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2500	2181	80.76	87.22	93.68
32	FREEZER ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2700	2288	78.64	84.75	90.87
33	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1300	1240	84.97	95.42	105.87
34	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1500	1462	88.81	97.46	106.11
35	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1700	1683	91.34	99.02	106.70
36	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1900	1905	92.98	100.25	107.52
37	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2100	2126	94.04	101.25	108.46
38	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2300	2348	94.71	102.07	109.43
39	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2500	2569	95.16	102.76	110.37
40	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2700	2790	95.45	103.35	111.25
41	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1300	1500	104.73	115.35	125.97
42	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1500	1721	105.73	114.73	123.73
43	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1700	1942	106.10	114.26	122.42
44	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1900	2164	106.07	113.89	121.70
45	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2100	2385	105.80	113.58	121.37
46	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2300	2607	105.41	113.33	121.26
47	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2500	2828	104.97	113.13	121.28
48	FREEZER ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2700	3050	104.53	112.95	121.37
49	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1300	1420	97.22	109.21	121.20
50	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1500	1527	91.54	101.83	112.13

51	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1700	1635	87.15	96.19	105.24
52	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1900	1743	83.64	91.74	99.84
53	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2100	1851	80.77	88.13	95.50
54	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2300	1959	78.36	85.16	91.95
55	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2500	2066	76.31	82.65	88.99
56	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2700	2174	74.54	80.52	86.50
57	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1300	1679	117.32	129.14	140.96
58	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1500	1787	108.92	119.11	129.29
59	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1700	1894	102.45	111.43	120.42
60	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1900	2002	97.30	105.37	113.45
61	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2100	2110	93.10	100.47	107.84
62	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2300	2218	89.59	96.42	103.25
63	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2500	2325	86.62	93.02	99.41
64	FREEZER ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2700	2433	84.07	90.12	96.17
65	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1300	871	57.69	67.02	76.35
66	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1500	1093	65.37	72.84	80.32
67	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1700	1314	70.78	77.30	83.82
68	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1900	1536	74.63	80.82	87.00
69	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2100	1757	77.43	83.67	89.90
70	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2300	1978	79.52	86.02	92.52
71	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2500	2200	81.14	87.99	94.85
72	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2700	2421	82.44	89.68	96.92
73	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1300	1130	77.73	86.95	96.17
74	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1500	1352	82.50	90.12	97.73
75	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1700	1573	85.70	92.54	99.39
76	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1900	1795	87.82	94.45	101.08
77	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2100	2016	89.26	96.00	102.74
78	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2300	2237	90.27	97.28	104.30
79	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2500	2459	91.00	98.36	105.71
80	FREEZER ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2700	2680	91.55	99.27	107.00
81	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,13	1051	69.17	80.81	92.44
82	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,15	1158	67.19	77.22	87.25
83	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,17	1266	65.62	74.47	83.33
84	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,19	1374	64.34	72.31	80.27
85	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,21	1482	63.27	70.55	77.83
86	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,23	1589	62.35	69.10	75.85
87	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,25	1697	61.56	67.89	74.22
88	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,27	1805	60.85	66.85	72.84
89	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,13	1310	89.53	100.74	111.95
90	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,15	1417	84.78	94.49	104.20
91	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,17	1525	81.11	89.71	98.32
92	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,19	1633	78.17	85.94	93.72
93	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,21	1741	75.75	82.89	90.03
94	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,23	1848	73.72	80.37	87.02
95	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,25	1956	71.98	78.25	84.52
96	FREEZER ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,27	2064	70.48	76.44	82.41
97	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1300	1016	68.07	78.16	88.26
98	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1500	1238	74.40	82.50	90.60
99	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1700	1459	78.83	85.82	92.82
100	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1900	1680	81.92	88.44	94.96
101	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2100	1902	84.11	90.56	97.02
102	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2300	2123	85.69	92.32	98.94
103	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2500	2345	86.87	93.79	100.71
104	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2700	2566	87.78	95.04	102.30
105	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1300	1275	88.18	98.09	108.00
106	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1500	1497	91.63	99.78	107.93
107	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1700	1718	93.83	101.06	108.29
108	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1900	1939	95.19	102.08	108.97
109	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2100	2161	96.01	102.90	109.79
110	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2300	2382	96.49	103.58	110.67
111	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2500	2604	96.76	104.15	111.54
112	FREEZER ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2700	2825	96.92	104.64	112.36
113	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,13	1195	80.17	91.95	103.73
114	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,15	1303	76.73	86.88	97.02
115	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,17	1411	74.05	83.00	91.94
116	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,19	1519	71.90	79.93	87.97
117	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,21	1626	70.12	77.45	84.78
118	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,23	1734	68.62	75.40	82.19
119	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,25	1842	67.33	73.68	80.04
120	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,27	1950	66.20	72.21	78.23
121	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,13	1454	100.60	111.88	123.17
122	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,15	1562	94.39	104.15	113.91
123	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,17	1670	89.60	98.24	106.88
124	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,19	1778	85.77	93.57	101.37
125	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,21	1886	82.64	89.79	96.94

126	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,23	1993	80.02	86.67	93.32
127	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,25	2101	77.79	84.04	90.30
128	FREEZER ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,27	2209	75.86	81.81	87.76
129	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1300	982	66.40	75.56	84.72
130	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1500	1204	72.53	80.25	87.97
131	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1700	1425	76.76	83.83	90.91
132	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1900	1647	79.73	86.66	93.59
133	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2100	1868	81.88	88.95	96.03
134	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2300	2089	83.49	90.85	98.20
135	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2500	2311	84.74	92.44	100.13
136	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2700	2532	85.75	93.79	101.83
137	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1300	1241	85.82	95.49	105.16
138	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1500	1463	89.13	97.52	105.91
139	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1700	1684	91.25	99.07	106.89
140	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1900	1906	92.61	100.30	107.99
141	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2100	2127	93.48	101.29	109.10
142	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2300	2349	94.07	102.11	110.15
143	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2500	2570	94.47	102.80	111.13
144	SECOND ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2700	2791	94.75	103.39	112.02
145	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1300	1162	84.27	89.35	94.43
146	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1500	1269	80.53	84.62	88.71
147	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1700	1377	77.57	81.01	84.44
148	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1900	1485	75.14	78.15	81.16
149	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2100	1593	73.07	75.84	78.61
150	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2300	1700	71.28	73.93	76.58
151	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2500	1808	69.71	72.33	74.95
152	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2700	1916	68.32	70.96	73.60
153	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1300	1421	104.02	109.28	114.54
154	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1500	1528	97.54	101.90	106.25
155	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1700	1636	92.48	96.25	100.01
156	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1900	1744	88.39	91.79	95.18
157	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2100	1852	85.00	88.18	91.36
158	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2300	1960	82.13	85.20	88.27
159	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2500	2067	79.66	82.69	85.72
160	SECOND ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2700	2175	77.52	80.56	83.60
161	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1300	1127	76.55	86.70	96.86
162	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1500	1349	81.39	89.91	98.43
163	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1700	1570	84.67	92.35	100.04
164	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1900	1791	86.91	94.29	101.66
165	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2100	2013	88.47	95.85	103.23
166	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2300	2234	89.59	97.14	104.70
167	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2500	2456	90.40	98.23	106.06
168	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2700	2677	91.03	99.16	107.28
169	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1300	1386	96.09	106.63	117.18
170	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1500	1608	98.12	107.18	116.24
171	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1700	1829	99.28	107.59	115.91
172	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1900	2051	99.88	107.92	115.97
173	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2100	2272	100.14	108.19	116.23
174	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2300	2493	100.21	108.41	116.61
175	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2500	2715	100.16	108.59	117.02
176	SECOND ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2700	2936	100.06	108.75	117.44
177	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1300	1306	94.69	100.50	106.30
178	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1500	1414	89.55	94.28	99.01
179	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1700	1522	85.54	89.53	93.52
180	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1900	1630	82.28	85.78	89.27
181	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2100	1738	79.56	82.74	85.92
182	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2300	1845	77.24	80.23	83.22
183	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2500	1953	75.23	78.12	81.02
184	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2700	2061	73.46	76.33	79.19
185	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1300	1566	114.61	120.43	126.24
186	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1500	1673	106.72	111.55	116.38
187	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1700	1781	100.60	104.77	108.94
188	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1900	1889	95.68	99.41	103.14
189	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2100	1997	91.63	95.08	98.53
190	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2300	2104	88.21	91.49	94.78
191	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2500	2212	85.28	88.49	91.69
192	SECOND ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2700	2320	82.75	85.92	89.10
193	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1300	758	48.55	58.30	68.05
194	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1500	979	57.28	65.29	73.31
195	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1700	1201	63.51	70.64	77.76
196	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1900	1422	68.05	74.86	81.67
197	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2100	1644	71.43	78.27	85.11
198	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2300	1865	74.04	81.09	88.15
199	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2500	2087	76.10	83.46	90.83
200	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2700	2308	77.78	85.48	93.18

201	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1300	1017	68.36	78.23	88.11
202	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1500	1238	74.22	82.56	90.91
203	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1700	1460	78.28	85.88	93.48
204	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1900	1681	81.13	88.49	95.85
205	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2100	1903	83.20	90.61	98.02
206	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2300	2124	84.73	92.36	99.98
207	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2500	2346	85.92	93.83	101.73
208	SECOND ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2700	2567	86.86	95.08	103.30
209	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,130	937	65.83	72.10	78.36
210	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,150	1045	64.42	69.67	74.92
211	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,170	1153	63.25	67.81	72.37
212	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,190	1261	62.25	66.34	70.43
213	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,210	1368	61.38	65.16	68.94
214	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,230	1476	60.59	64.18	67.76
215	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,250	1584	59.88	63.35	66.83
216	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,270	1692	59.24	62.65	66.07
217	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,130	1196	86.20	92.03	97.85
218	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,150	1304	82.00	86.94	91.88
219	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,170	1412	78.69	83.05	87.41
220	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,190	1520	76.00	79.98	83.96
221	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,210	1627	73.76	77.50	81.24
222	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,230	1735	71.84	75.44	79.04
223	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,250	1843	70.19	73.72	77.25
224	SECOND ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,270	1951	68.75	72.25	75.75
225	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1300	903	58.63	69.45	80.26
226	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1500	1124	66.05	74.95	83.85
227	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1700	1346	71.32	79.16	86.99
228	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1900	1567	75.14	82.48	89.82
229	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2100	1789	77.94	85.17	92.39
230	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2300	2010	80.06	87.39	94.72
231	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2500	2231	81.71	89.26	96.81
232	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2700	2453	83.02	90.85	98.68
233	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1300	1162	78.53	89.38	100.23
234	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1500	1383	83.09	92.22	101.35
235	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1700	1605	86.19	94.40	102.60
236	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1900	1826	88.31	96.12	103.92
237	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2100	2048	89.78	97.51	105.24
238	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2300	2269	90.81	98.66	106.50
239	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2500	2491	91.56	99.62	107.68
240	SECOND ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2700	2712	92.13	100.44	108.76
241	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,130	1082	76.18	83.24	90.29
242	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,150	1190	73.39	79.32	85.26
243	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,170	1298	71.19	76.33	81.48
244	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,190	1405	69.37	73.97	78.56
245	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,210	1513	67.84	72.06	76.27
246	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,230	1621	66.52	70.48	74.43
247	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,250	1729	65.37	69.15	72.93
248	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,270	1836	64.35	68.02	71.69
249	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,130	1341	96.63	103.17	109.71
250	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,150	1449	91.05	96.60	102.14
251	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,170	1557	86.70	91.57	96.44
252	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,190	1665	83.20	87.61	92.01
253	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,210	1772	80.30	84.39	88.49
254	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,230	1880	77.84	81.74	85.64
255	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,250	1988	75.74	79.51	83.29
256	SECOND ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,270	2096	73.91	77.61	81.32
257	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1300	967	65.21	74.36	83.51
258	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1500	1188	71.50	79.21	86.92
259	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1700	1410	75.85	82.91	89.98
260	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1900	1631	78.91	85.84	92.77
261	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2100	1852	81.14	88.21	95.28
262	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2300	2074	82.81	90.17	97.52
263	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2500	2295	84.12	91.81	99.51
264	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2700	2517	85.16	93.21	101.26
265	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1300	1226	84.64	94.29	103.93
266	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1500	1447	88.11	96.48	104.85
267	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1700	1669	90.34	98.15	105.96
268	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1900	1890	91.79	99.48	107.16
269	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2100	2111	92.74	100.55	108.35
270	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2300	2333	93.39	101.43	109.47
271	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2500	2554	93.84	102.17	110.51
272	REFRIG ,COND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2700	2776	94.17	102.81	111.45
273	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1300	1146	83.04	88.15	93.27
274	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1500	1254	79.46	83.58	87.70
275	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1700	1361	76.63	80.09	83.54

276	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,1900	1469	74.30	77.33	80.36
277	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2100	1577	72.31	75.10	77.88
278	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2300	1685	70.59	73.25	75.91
279	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2500	1793	69.08	71.70	74.33
280	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,2700	1900	67.74	70.38	73.03
281	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1300	1405	102.81	108.08	113.35
282	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1500	1513	96.49	100.85	105.22
283	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1700	1621	91.56	95.33	99.10
284	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,1900	1728	87.57	90.97	94.36
285	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2100	1836	84.26	87.43	90.61
286	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2300	1944	81.45	84.52	87.59
287	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2500	2052	79.04	82.07	85.10
288	REFRIG ,COND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,2700	2159	76.94	79.98	83.02
289	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1300	1112	75.37	85.50	95.64
290	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1500	1333	80.36	88.86	97.37
291	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1700	1554	83.76	91.44	99.11
292	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1900	1776	86.10	93.47	100.83
293	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2100	1997	87.73	95.11	102.48
294	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2300	2219	88.91	96.47	104.02
295	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2500	2440	89.78	97.61	105.43
296	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2700	2662	90.45	98.58	106.71
297	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1300	1371	94.92	105.43	115.94
298	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1500	1592	97.10	106.14	115.17
299	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1700	1813	98.37	106.68	114.98
300	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1900	2035	99.07	107.10	115.13
301	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2100	2256	99.41	107.45	115.48
302	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2300	2478	99.54	107.73	115.92
303	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2500	2699	99.54	107.97	116.40
304	REFRIG ,COND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2700	2921	99.48	108.17	116.86
305	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1300	1291	93.48	99.29	105.11
306	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1500	1399	88.50	93.24	97.98
307	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1700	1506	84.61	88.61	92.61
308	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,1900	1614	81.46	84.95	88.45
309	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2100	1722	78.82	82.00	85.17
310	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2300	1830	76.56	79.55	82.54
311	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2500	1937	74.61	77.50	80.39
312	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,2700	2045	72.89	75.75	78.61
313	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1300	1550	113.41	119.22	125.04
314	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1500	1658	105.69	110.51	115.34
315	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1700	1765	99.69	103.85	108.01
316	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,1900	1873	94.87	98.59	102.31
317	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2100	1981	90.89	94.33	97.77
318	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2300	2089	87.54	90.82	94.09
319	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2500	2197	84.67	87.86	91.05
320	REFRIG ,COND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,2700	2304	82.18	85.34	88.51
321	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1300	742	47.35	57.10	66.86
322	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1500	964	56.22	64.25	72.28
323	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1700	1185	62.58	69.72	76.86
324	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,1900	1407	67.21	74.03	80.86
325	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2100	1628	70.67	77.53	84.38
326	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2300	1850	73.34	80.41	87.48
327	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2500	2071	75.46	82.84	90.21
328	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE<3 ,2700	2292	77.19	84.90	92.62
329	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1300	1001	67.16	77.03	86.90
330	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1500	1223	73.18	81.52	89.87
331	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1700	1444	77.36	84.96	92.56
332	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,1900	1666	80.31	87.67	95.03
333	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2100	1887	82.45	89.86	97.28
334	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2300	2109	84.05	91.68	99.31
335	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2500	2330	85.28	93.20	101.12
336	REFRIG ,UNCOND ,COOLER CZ ,MANUAL ,HHSIZE3+ ,2700	2551	86.27	94.50	102.73
337	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,130	922	64.57	70.89	77.22
338	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,150	1029	63.32	68.63	73.93
339	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,170	1137	62.29	66.89	71.49
340	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,190	1245	61.40	65.52	69.65
341	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,210	1353	60.60	64.41	68.23
342	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,230	1460	59.89	63.50	67.11
343	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,250	1568	59.24	62.73	66.22
344	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE<3 ,270	1676	58.64	62.07	65.51
345	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,130	1181	84.95	90.82	96.70
346	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,150	1288	80.92	85.90	90.88
347	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,170	1396	77.74	82.13	86.52
348	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,190	1504	75.16	79.16	83.16
349	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,210	1612	72.99	76.75	80.51
350	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,230	1720	71.15	74.76	78.38

351	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,250	1827	69.55	73.09	76.63
352	REFRIG ,UNCOND ,COOLER CZ ,FROST FR ,HHSIZE3+ ,270	1935	68.16	71.67	75.18
353	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1300	887	57.44	68.25	79.06
354	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1500	1109	65.01	73.91	82.81
355	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1700	1330	70.40	78.24	86.08
356	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,1900	1552	74.31	81.66	89.01
357	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2100	1773	77.19	84.43	91.66
358	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2300	1994	79.38	86.71	94.05
359	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2500	2216	81.07	88.63	96.19
360	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE<3 ,2700	2437	82.43	90.27	98.11
361	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1300	1146	77.34	88.18	99.01
362	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1500	1368	82.06	91.18	100.30
363	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1700	1589	85.28	93.48	101.68
364	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,1900	1811	87.49	95.29	103.10
365	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2100	2032	89.03	96.76	104.49
366	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2300	2253	90.13	97.98	105.82
367	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2500	2475	90.94	99.00	107.06
368	REFRIG ,UNCOND ,HOTTER CZ ,MANUAL ,HHSIZE3+ ,2700	2696	91.54	99.86	108.18
369	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,130	1066	74.95	82.04	89.13
370	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,150	1174	72.32	78.28	84.25
371	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,170	1282	70.24	75.41	80.59
372	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,190	1390	68.53	73.15	77.76
373	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,210	1498	67.08	71.31	75.54
374	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,230	1605	65.83	69.80	73.76
375	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,250	1713	64.73	68.52	72.32
376	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE<3 ,270	1821	63.76	67.44	71.12
377	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,130	1326	95.40	101.97	108.53
378	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,150	1433	89.99	95.56	101.12
379	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,170	1541	85.77	90.65	95.54
380	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,190	1649	82.36	86.78	91.20
381	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,210	1757	79.54	83.65	87.76
382	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,230	1864	77.16	81.06	84.97
383	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,250	1972	75.11	78.89	82.67
384	REFRIG ,UNCOND ,HOTTER CZ ,FROST FR ,HHSIZE3+ ,270	2080	73.33	77.04	80.74

Exhibit J-2

Analysis of Energy Efficiency Market Participation Potential for LG&E and KU DSM Programs

for:

E.ON U.S.

by:

FRONTIER ASSOCIATES
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October 9, 2009

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Executive Summary

Frontier Associates has developed market participation projections for 11 energy efficiency programs planned for inclusion in E.ON U.S.'s filing before the Kentucky Public Service Commission on behalf of its two Kentucky companies, Louisville Gas & Electric (LG&E) and Kentucky Utilities (KU). For each program, Frontier has produced high end, low end, and best estimates of the levels of participation in the proposed programs that we believe E.ON can expect in the two companies' service regions.

Because of the similarities of the two service territories, it is Frontier's assessment that E.ON U.S. can expect similar participation rates from the target markets in each service territory. Table ES-1 provides a summary of Frontier's findings.

Table ES-1. Projected First Year Market Participation Rates, LG&E and KU *

Program	High	Low	Best Estimate
Home Performance with Energy Star	0.30%	0.04%	0.15%
Residential Appliance Rebates	19.8%	6.6%	13.2%
Refrigerator Removal Program	4.00%	1.25%	2.00%
Residential Window/Door Replacement & Window Film Rebates	1.0010%	0.0202%	0.0293%
Energy Star Manufactured Homes	14.0%	7.0%	10.0%
Commercial Customized Rebates	0.070%	0.013%	0.020%
Commercial Refrigeration Rebates	0.0350%	0.0002%	0.0150%
Commercial Cool Roof Rebates	0.010%	0.003%	0.007%
Residential HVAC Rebates	0.755%	0.130%	0.450%
Geothermal Rebates - Residential	0.3900%	0.0020%	0.0065%
Geothermal Rebates - Commercial	0.0013%	0.0001%	0.0007%
Solar Thermal Rebates - Res	0.0071%	0.0000%	0.0022%
PV Rebates - Residential	0.0036%	0.0000%	0.0011%
PV Rebates - Commercial	0.0036%	0.0000%	0.0011%

* Typically, percentages presented are as a percentage of the number of customers in the program's target customer class. A participant in a residential PV rebate program is one typical residential PV installation. However, for certain programs (e.g. residential appliance rebates), the presented first-year participation level estimates are percentages of a specifically-defined subset of customers (e.g. the expected number of new manufactured homes to be built in the coming year).

Frontier applied customer counts by rate class provided by E.ON to the percent participation best estimates in Table ES-1 to estimate first year participation in each program in LG&E and KU's service territories. Projected participant counts for each program are presented in Table ES-2.

Table ES-2. Best Estimate of First Year Participants, E.ON Utilities*

Program	KU	LG&E	Total
Home Performance with Energy Star	240	290	530
Residential Appliance Rebates	9,245	11,187	20,432
Refrigerator Removal Program	1,028	1,243	2,271
Residential Window/Door Replacement & Window Film Rebates	99	120	220
Energy Star Manufactured Homes	68	82	150
Commercial Customized Rebates	6.6	15.9	22.5
Commercial Refrigeration Rebates	4.4	10.6	15.0
Commercial Cool Roof Rebates	2.2	5.3	7.5
Residential HVAC Rebates	1,028	1,243	2,271
Geothermal Heat Pump Rebates - Residential	2.6	3.1	5.7
Geothermal Heat Pump Rebates - Commercial	0.2	0.5	0.7
Solar Thermal	19.7	23.9	43.6
Residential PV	9.9	11.9	21.8
Commercial PV	0.1	0.3	0.4

* The table includes fractional estimates of participation for some programs. These fractions are not intended to imply a level of precision that is not possible for estimates of this nature; rather, they represent the fact that program participation is not necessarily even from one year to the next. Particularly in programs for which anticipated participation levels are low, fractional participation rates are appropriate to convey expected participation levels over time.

Frontier has provided participation estimates for each program for seven years. These estimates are provided by program in the body of the report. The participation levels presented in this report are gross participation rates: program by program estimates of free-ridership are not incorporated into the provided participation estimates. A table of applicable net-to-gross ratios is provided in the appendix.

Introduction

Frontier Associates (Frontier) was contracted by E.ON US (E.ON) to develop market participation level projections for a set of programs proposed for implementation by E.ON's two companies in Kentucky: Louisville Gas & Electric (LG&E) and Kentucky Utilities (KU). The programs with which Frontier is tasked with producing projections are listed in Table 1.

Table 1. Proposed Programs Reviewed by Frontier

Market	Program Name
Residential	
	Home Performance with Energy Star
	Residential Appliance Rebates
	Refrigerator Removal Program
	Residential Window/Door Replacement & Window Film Rebates
	Energy Star Manufactured Homes
	HVAC Rebates
Commercial	
	Commercial Customized Rebates
	Commercial Refrigeration Rebates
	Commercial Cool Roof Rebates
Cross-Cutting (Residential & Commercial)	
	Geothermal Heat Pump Rebates
	Solar Thermal & Photovoltaic Rebates

The commercial market excludes industrial customers, as E.ON anticipates no industrial sector participation in its program offerings.

Methods

Frontier used a mixture of methods to develop participation estimates for each program. Once E.ON's target list of programs was defined, Frontier staff undertook primary research to identify comparable programs implemented by other utilities around the country. Relying on our direct experience designing and implementing energy efficiency programs, we developed information from primary sources (e.g. Frontier's online program tracking systems deployed for utilities around the country, as well as publicly-available filings of energy efficiency plans and energy efficiency plan implementation annual reports) and secondary sources (e.g. the 2004 National Energy Efficiency Best Practices Study performed for the

California Best Practices Project Advisory Committee).[1] In some cases Frontier staff contacted utility program managers directly to gather additional information about their programs.

Frontier has prepared a measure-by-measure "database" of the information compiled in preparing this report. This database, consisting of an Excel spreadsheet with individual tabs for each program, along with this report, represents the final product of this project.

Characteristics of LG&E and KU and Assumptions

Louisville Gas and Electric and Kentucky Utilities provide electricity to Kentucky's two largest urban centers, Louisville and Lexington, respectively, as well as to rural populations and smaller to mid size towns across in the state. According to EIA, the state of Kentucky has just over 1.9 million residential and over 290,000 commercial customers,[2] meaning that E.ON's customers in these two customer classes represent approximately 39 and 47 percent of the residential and commercial markets, respectively, in Kentucky.

Table 2. Electric Customers by Customer Class

Customer Class	LG&E	KU	TOTAL
Residential	342,511	414,456	756,967
Commercial	41,532	96,929	138,461
Public Authority *	2,294	9,708	12,002

* For KU, *Public Authority* includes 401 "Municipal Pumping" customers.

The mix of urban and rural customers makes the E.ON utilities' service territories similar to those of many large utilities across the country. Throughout this analysis, Frontier has made a number of assumptions of similarity between the E.ON utilities' customers and those of other utilities, or with typical national or regional averages. For instance, for the proposed Residential Appliance Rebate program, Frontier based its estimate of the market for appliances on the assumption that the overall rate of replacement of household appliances in Kentucky is similar to the national average.

Defining "Participation" and Other Challenges

Among the most significant challenges associated with developing participation projections is defining "participation." For its commercial HVAC program, for instance, E.ON may define a participant according to the number of AC units to be installed via the program (whereby a single customer replacing four rooftop units (RTUs) is counted as having participated four times). Data from other programs obtained by Frontier for comparison may include participant counts by customer (in which the customer changing out four RTUs is counted only once). It is Frontier's experience that these issues are not always handled consistently, even within a given utility's program filing and reporting.

[1] Available online: http://www.eebestpractices.com/index.asp

[2] Number of Customers (Bundled and Unbundled) by Sector, Census Division, and State, 2007. *Energy Information Administration*. Online. Available: http://www.eia.doe.gov/cneaf/electricity/esr/table1.xls.

A multitude of factors influence the rates at which customers participate in energy efficiency program offerings. Customers such as those served by E.ON, whose average energy rates are low, have much a weak incentive to invest in energy-saving technologies than those who pay higher rates for energy. While this lack of motivation can be overcome by providing more generous incentives, cost-effectiveness criteria become a challenge for implementing utilities. Differences in the size of offered incentives, as well as the structure of incentives (payments per kW and kWh versus rebates paid per unit of a measure installed) also may greatly affect participation.

Finally, a number of factors influence program participation over time. The current state of the domestic economy may depress participation, though emphases on energy efficiency in federal government spending may offset this tendency, at least in certain market segments (in particular, public facilities through American Recovery and Reinvestment Act funds, as well as favored technologies/programs). In particular, utilities modify their programs from year to year as they identify what does and does not work. Further complicating matters, all utilities advertise their programs at different times, and with differing degrees of effectiveness. We expect the E.ON utilities will also adjust programs mid-course. The combination of these factors makes it difficult to extend participation projections past 1 to 3 years. At E.ON's request, we are providing seven year projections. For the most part, these projections involve an intial participation estimate based on the experience of other utilities with similar offerings, followed by two to three years of growth as customers become familiar with the programs, and, hopefully, as economic conditions improve. It is Frontier's general assessment that participation in most of the programs E.ON plans to offer will reach its sustainable level by about the third year; projections for most programs are for constant participation rates from years three to seven.

Net Participation vs. Gross Participation

The participation levels presented in this report are gross participation rates: program by program estimates of free-ridership are not incorporated into the provided participation estimates. A table of applicable net-to-gross ratios is provided in the appendix.

Program Market Participation Assessment

Frontier has developed participation estimates for 11 programs. Five programs target the residential market, and three target the commercial market. The remaining three programs – the HVAC Rebate program, the Geothermal Heat Pump Rebate program, and the Solar Thermal and Photovoltaic Rebate program - target both the commercial and residential markets. For these three programs, participation projections are broken down by target market (residential/commercial).

Residential Programs

E.ON U.S. has identified six programs that are residential only for inclusion in its upcoming filing with the Kentucky Public Service Commission (PSC). The geothermal heat pump rebate program and the solar thermal and photovoltaic programs, which both have residential as well as commercial dimensions, are included in the final section of this document, *Cross-Cutting Programs*.

Home Performance with Energy Star

Home Performance with Energy Star programs vary greatly in their implementation around the country. Because of the high threshold set by the Energy Star program for qualification, utilities choose encouragE customers to participate in their related offerings in different ways: despite being named "Home Performance with Energy Star," the degree to which the program reaches Energy Star's objectives, and the point at which a utility considers a customer a participant, vary widely. As such, it is difficult to reliably compare participation estimates from one program to the next.

Despite these challenges, Frontier has identified comparable programs of a number of utilities, including major Midwestern utilities. Using this information, we have estimated the market for participation in the proposed Home Performance with Energy Star program as a percentage of the E.ON utilities' entire residential customer class.

Table 3. Expected Participation, Home Performance with Energy Star (%)

	High End	Low End	Best Estimate
Year 1	0.20%	0.02%	0.07%
Year 2	0.30%	0.04%	0.15%
Year 3	0.35%	0.05%	0.17%
Year 4	0.35%	0.05%	0.17%
Year 5	0.35%	0.05%	0.17%
Year 6	0.35%	0.05%	0.17%
Year 7	0.35%	0.05%	0.17%

Table 4. Expected Participants, Home Performance with Energy Star (#)

	LG&E	KU	Total
Year 1	240	290	530
Year 2	514	622	1,135
Year 3	582	705	1,287
Year 4	582	705	1,287
Year 5	582	705	1,287
Year 6	582	705	1,287
Year 7	582	705	1,287

High end participation estimates reflect the typical rates of participation in the service territories of directly comparable regional utilities with higher base rates, and whose participants do not necessarily meet all the criteria for a true "Home Performance with Energy Star" designation. Low end participation estimates reflect the kind of participation that can be expected if E.ON chooses to only provide rebates through its Home Performance with Energy Star program to customers who meet the minimum threshold for the Energy Star program. Frontier's best estimate is that 0.07 percent of customers participate in the first year of the program, rising to 0.17 percent by the program's third year and holding steady. This estimate is based on Frontier's expectation that E.ON will implement this program in a manner that allows customers to participate without necessarily implementing the full complement of measures required to reach the actual EnergyStar program threshold.

HVAC Rebates

E.ON staff has indicated that only residential HVAC rebates will be addressed in the pending filing, as a commercial rebate program is already in place. As such, Frontier has prepared estimates of participation from the residential customer class only. However, given that E.ON's existing commercial rebate program only provides HVAC rebates for chillers, E.ON could consider extending the contemplated rebate offering to small commercial customers as well.

Frontier has estimated the market for participation in the proposed HVAC Rebate program as a percentage of the E.ON utilities' entire residential customer class.

Table 5. Expected Participation, Residential HVAC Rebates (%)

	High End	Low End	Best Estimate
Year 1	0.50%	0.10%	0.30%
Year 2	0.75%	0.13%	0.45%
Year 3	1.13%	0.17%	0.7%
Year 4	1.13%	0.17%	0.7%
Year 5	1.13%	0.17%	0.7%
Year 6	1.13%	0.17%	0.7%
Year 7	1.13%	0.17%	0.7%

Table 6. Expected Participants, Residential HVAC Rebates (#)

	LG&E	KU	Total
Year 1	1,028	1,243	2,271
Year 2	1,541	1,865	3,406
Year 3	2,312	2,798	5,110
Year 4	2,312	2,798	5,110
Year 5	2,312	2,798	5,110
Year 6	2,312	2,798	5,110
Year 7	2,312	2,798	5,110

Examples of residential HVAC rebates are abundant, as they are among the most frequently offered utility programs. Frontier used information from the programs of a number of Midwestern utilities, including Duke Energy's Smart Saver program in Indiana, as well as information reported by Florida and Texas utilities, among others, in preparing these estimates. The *best estimate* for the E.ON Utilities is based on the more recent experience of the identified comparable programs, and is similar to the level of participation Commonwealth Edison projected for its residential HVAC program in its recent filing before the Illinois Commerce Commission. First year participation in Duke Energy's Indiana Smart Saver program represents an upper bound on what we expect E.ON might experience: based on conversations with program managers, the high early program participation level (0.5%) was driven by a temporary spike in energy rates.

Residential Appliance Rebates

Frontier has estimated the market for participation in the proposed Residential Appliance Rebate program as a percentage of the E.ON utilities' residential customers who, in a given year, are likely to be replacing an appliance for which E.ON proposes to offer a rebate. We estimated the rate of replacement of home appliances in E.ON's service territory by comparing national appliance shipping data from manufacturers, as published by Appliance Magazine, to the national population. We have assumed that appliances are replaced in Kentucky at about the same rate as in the rest of the country; according to census data, Kentucky has about 1.5 percent of US households, so 1.5 percent of the annual total appliances of a given type shipped represents the Kentucky market for that appliance. These data are provided in Table 7.

Table 7. Estimated Annual Appliances Shipped to Kentucky

	US Total Appliances Shipped	KY Share	Estimated KY Purchases
Dishwashers	7,251,500	1.50%	108,773
Refrigerators	11,077,600	1.50%	166,164
Freezers	2,147,800	1.50%	32,217
Clothes Washer	9,499,900	1.50%	142,499
Total	29,976,800	1.50%	449,653

The existing market for Energy Star appliances must also be taken into account when considering the market for a residential appliance rebate program. The Energy Star program tracks its market share using sales data from Energy Star national retail partners by census region. Market share estimates for the Energy Star appliances for which E.ON is considering providing rebates[3] are provided in Table 8.

Table 8. Lower Midwest Region Energy Star Appliance Market Share

Appliance Type	Percent ENERGY STAR
Clothes Washer	22.3%
Dishwasher	61.0%
Refrigerator	34.6%
Weighted Average	**37.3%**

Weighted by the number of appliances shipped nationally, the average market share of these Energy Star appliances is about 37 percent. Using this percentage, E.ON's estimated share of the residential market in Kentucky (about 46 percent) and the estimated number of appliances for which shipping data are available (plus our own estimate of electric water heaters, for which data were not available), Frontier estimates the market for Energy Star appliances in the E.ON utilities' combined service territories at about 200,000 appliances annually. Frontier developed its best estimate of the percentage of Energy Star appliances that the E.ON utilities should be able to rebate annually by comparing AmerenUE's projected number of rebated dishwashers (the only appliance common to their program and E.ON's proposed program) to the expected number of Energy Star appliances to be purchased in its service territory in the coming years.

We estimate that 10.2 percent of the E.ON utilities' customers purchasing Energy Star appliances in the first year of the program will participate in the program. This number is 75 percent of the AmerenUE reported dishwasher participation. We applied this factor to account for the lower popularity of the Energy Star appliances under consideration: it may be more difficult for E.ON to induce customers to purchase an Energy Star refrigerator with its rebate than it was for AmerenUE to induce participation in its dishwasher program.

High end, low end, and best estimates of participation in this program are presented in Table 9 as percentages of the 200,000 Energy Star appliances projected to be purchased annually by E.ON customers.

Table 9. Expected Participation, Residential Appliance Rebates (%)

	High End	Low End	Best Estimate
Year 1	15.3%	5.1%	10.2%
Year 2	19.8%	6.6%	13.2%
Year 3	24.9%	8.3%	16.6%
Year 4	24.9%	8.3%	16.6%
Year 5	24.9%	8.3%	16.6%
Year 6	24.9%	8.3%	16.6%
Year 7	24.9%	8.3%	16.6%

[3] In E.ON-provided materials, additional appliances were listed as under consideration including freezers, dryers, and electric water heaters. Frontier has not identified market share data for these three appliances. In the case of clothes dryers, there is no Energy Star labeling offered as there is little opportunity to improve efficiency.

Table 10. Expected Participants, Residential Appliance Rebates (#)

	LG&E	KU	Total
Year 1	9,245	11,187	20,432
Year 2	11,956	14,467	26,423
Year 3	15,029	18,186	33,216
Year 4	15,029	18,186	33,216
Year 5	15,029	18,186	33,216
Year 6	15,029	18,186	33,216
Year 7	15,029	18,186	33,216

While these estimates indicate that the E.ON utilities would be providing a significant number of rebates through this program (over 20,000 rebates in the first year and 33,000 appliance rebates per year by the program's third year), these numbers are in line with those reported by other programs. We recommend that the E.ON utilities take into account that free ridership may be more of an issue than the 0.9 net-to-gross ratio provided in the appendix would indicate, particularly for appliances like dishwashers for which the market saturation of Energy Star appliances is already high.

Refrigerator Removal Program

Estimates of expected participation in a refrigerator removal program were obtained using Frontier's extensive experience implementing these programs in diverse states and by interviewing representatives of the Appliance Recycling Centers of America, one of the two major providers of appliance recycling services. The typical participant in a refrigerator removal programs is a household with more than one refrigerator: Frontier estimates that about 20 percent of residential customers in the E.ON utilities' service territories are likely to have multiple refrigerators.[4] The participation estimates provided in Table 11 are presented as the percent of the estimated number of customers with more than one refrigerator.

Table 11. Expected Participation, Refrigerator Removal Program (%)

	High End	Low End	Best Estimate
Year 1	3.0%	1.0%	1.5%
Year 2	4.0%	1.3%	2.0%
Year 3	5.0%	1.5%	2.5%
Year 4	5.0%	1.5%	2.5%
Year 5	5.0%	1.5%	2.5%
Year 6	5.0%	1.5%	2.5%
Year 7	5.0%	1.5%	2.5%

[4] RECS data suggest that 17% of customers in the region served by the E.ON utilities have multiple refrigerators. Given the wealth effect associated with serving the two largest metropolitan areas in Kentucky, Frontier is comfortable estimating at least 20 percent of households in E.ON's service territories have multiple refrigerators.

Table 12. Expected Participants, Refrigerator Removal Program (#)

	High End	Low End	Best Estimate
Year 1	LG&E	KU	Total
Year 2	1,028	1,243	2,271
Year 3	1,370	1,658	3,028
Year 4	1,713	2,072	3,785
Year 5	1,713	2,072	3,785
Year 6	1,713	2,072	3,785
Year 7	1,713	2,072	3,785

Frontier's assembled database for this program includes a Public Service Company of Colorado (Xcel) projection of 5.6 percent participation for 2009, as compared with actual participation of 1.6 percent in an Oncor (North Central and West Texas, including Dallas/Fort Worth) program. We believe the Oncor program actual performance provides a more reasonable expectation level for E.ON's proposed program.

Residential Window/Door Replacement & Window Film Rebates

This proposed program includes residential envelope measures, including window and door replacement. The majority of the residential envelope programs that the Frontier team has encountered in its research, as well as in its experience designing and evaluating programs, have focused on insulation and weatherization approaches that typically involve lower costs and faster returns on investment. The identified programs having the most in common with the proposed program are those that provide rebates for solar screens and/or films.

Other efforts that have met some success in the energy efficient window market are programs like the Texas Window Initiative, a manufacturer-driven market transformation program. However, its experience is not directly comparable to the proposed rebate program. The estimates provided in Table 13 are provided as a percentage of E.ON's total residential customer base.

Table 13. Expected Participation, Window/Door Replacement & Window Film Rebates (%)

	High End	Low End	Best Estimate
Year 1	1.000%	0.010%	0.029%
Year 2	1.001%	0.010%	0.029%
Year 3	1.001%	0.010%	0.030%
Year 4	1.001%	0.010%	0.030%
Year 5	1.001%	0.010%	0.030%
Year 6	1.001%	0.010%	0.030%
Year 7	1.001%	0.010%	0.030%

Table 14. Expected Participants, Window/Door Replacement & Window Film Rebates (#)

	LG&E	KU	Total
Year 1	99	120	220
Year 2	100	121	222
Year 3	101	123	224
Year 4	101	123	224
Year 5	101	123	224
Year 6	101	123	224
Year 7	101	123	224

In the database, the *Windows and Doors* efficiency program implemented by Iowa IOUs is the most regionally appropriate comparison; however, their reported participation rate appears to be a major outlier. Frontier has estimated that E.ON customer participation will be more in line with that of other programs in the database. We believe that the majority of participants in the proposed program will be with window films. If E.ON decides to emphasize window and door replacement at the expense of window films, it should expect participation closer to the low end estimate. The fundamental challenge of window and door replacement is that there is a very high capital cost, and, particularly for E.ON customers with long payback periods due to low energy costs. Rebates would have to be very generous to induce participation, which would inhibit cost-effectiveness.

Energy Star Manufactured Homes

Existing programs targeting manufactured homes against which to compare the proposed Energy Star Manufactured Homes program are limited. Frontier identified the programs of Progress Energy in the Carolinas and the Tennessee Valley Authority as potential comparables, but was not able to obtain relevant data for these programs. As such, we estimated the market for the E.ON utilities' Energy Star Manufactured Homes program based on typical participation rates for Energy Star New Homes programs (which are not specifically manufactured homes programs).

The market for an Energy Star Manufactured Homes program is set by the annual number of manufactured homes being built. We estimate that there will be approximately 2,500 new manufactured homes per year in the E.ON utilities' service territories in the coming years. This estimate assumes that new manufactured homes will be 14 percent of expected new homes (manufactured homes are currently about 14 percent of homes in Kentucky based on 2007 census data), and that annual population growth in Kentucky will continue at a rate similar to that of the last decade (about 2.4 percent per year, according to comparison of 2000 and 2007 census data).

Table 15. Expected Participation, Energy Star Manufactured Homes (%)

	High End	Low End	Best Estimate
Year 1	8.0%	4.0%	6.0%
Year 2	14.0%	7.0%	10.0%
Year 3	20.0%	10.0%	15.0%
Year 4	20.0%	10.0%	15.0%
Year 5	20.0%	10.0%	15.0%
Year 6	20.0%	10.0%	15.0%
Year 7	20.0%	10.0%	15.0%

Table 16. Expected Participants, Energy Star Manufactured Homes (#)

	LG&E	KU	Total
Year 1	68	82	150
Year 2	113	137	250
Year 3	170	205	375
Year 4	170	205	375
Year 5	170	205	375
Year 6	170	205	375
Year 7	170	205	375

Our estimates of high, low and expected (best estimate) participation are based on the share of new manufactured homes being built to the Energy Star new manufactured homes standard. We estimated a minimum participation of those customers who would have purchased the Energy Star new home absent the program (and participate in the program to obtain a rebate – the free riders) and the number of additional customers that E.ON could induce to buy up to the Energy Star standard by offering a rebate. The estimates are expressed as a percentage of the market for new manufactured homes in E.ON's service territories.

Commercial Programs

E.ON requested that Frontier provide participation estimates for three commercial programs (not including cross-cutting programs): Customized Rebates, Refrigeration Rebates, and Cool Roof Rebates.

Commercial Customized Rebates

Development of participation projections for E.ON's Custom Rebate program is complicated by the fact that some custom programs are C&I programs, targeting heavily the industrial process type efficiency improvements that E.ON's programs will not include, due to the non-participation of the industrial sector. However, the industrial sector also chooses to take advantage of opt-out clauses in many states, allowing more direct comparison.

Because a custom rebate program can have a broad range of modes of participation, producing anywhere from little savings to a lot, participation estimates for this program are only meaningful if they are associated with an average load reduction. For these estimates, we assume the typical project saves 25 kW.

Table 17. Expected Participation, Commercial Customized Rebates (%)

	High End	Low End	Best Estimate
Year 1	0.04%	0.010%	0.015%
Year 2	0.07%	0.013%	0.02%
Year 3	0.10%	0.015%	0.03%
Year 4	0.10%	0.015%	0.03%
Year 5	0.10%	0.015%	0.03%
Year 6	0.10%	0.015%	0.03%
Year 7	0.10%	0.015%	0.03%

Table 18. Expected Participants, Commercial Customized Rebates (#)

	LG&E	KU	Total
Year 1	7	16	23
Year 2	9	21	30
Year 3	13	32	45
Year 4	13	32	45
Year 5	13	32	45
Year 6	13	32	45
Year 7	13	32	45

Our participation estimates are presented as a percentage of the E.ON utilities entire commercial customer class. The best estimate of 0.015 percent lies between participation levels observed in programs compiled into the database; the high end estimate comes from one Midwestern utility whose program results are not yet public.

Commercial Refrigeration Rebates

Refrigeration upgrades typically rebated through utility programs can vary greatly in size. For the purpose of projecting participation in the E.ON utilities' programs, Frontier has assumed that the refrigeration upgrade projects rebated through the program will provide about 1.4 kW of coincident peak demand reduction. The participation rates provided in Table 19 are as a percentage of the E.ON Utilities' total commercial class.

Table 19. Expected Participation, Commercial Refrigeration Rebates (%)

	High End	Low End	Best Estimate
Year 1	0.020%	0.0001%	0.010%
Year 2	0.035%	0.0002%	0.015%
Year 3	0.050%	0.002%	0.020%
Year 4	0.050%	0.002%	0.020%
Year 5	0.050%	0.002%	0.020%
Year 6	0.050%	0.002%	0.020%
Year 7	0.050%	0.002%	0.020%

Table 20. Expected Participants, Commercial Refrigeration Rebates (#)

	LG&E	KU	Total
Year 1	4.4	10.6	15
Year 2	6.6	15.9	22.5
Year 3	8.8	21.2	30
Year 4	8.8	21.2	30
Year 5	8.8	21.2	30
Year 6	8.8	21.2	30
Year 7	8.8	21.2	30

Frontier has identified a number of similar programs across the country, including one Midwestern utility whose program results are not yet public, a couple of mid-Atlantic utilities (Progress Energy and Duke Energy), as well as utilities in New York, California, and Colorado. Participation rates in San Diego Gas &

Electric's Small Business Super Saver program were high enough to be considered an outlier – California programs typically enjoy higher participation rates than programs in other parts of the country. As such, Frontier believes that the XCEL Colorado program participation rate of 0.2 percent provides an effective higher bound; the best estimate is a participation rate commensurate with that being achieved by the comparable Midwestern utility.

Commercial Cool Roof Rebates

Cool Roof programs have grown in popularity in recent years; Frontier has seen a recent increase in inquiries about cool roofs. However, examples of programs explicitly oriented towards cool roofs do not abound; typically, cool roofs are part of a standard offer program (e.g. Texas utilities Centerpoint Energy or part of envelope programs oriented towards the residential market (e.g. Progress Energy's building envelope program). Frontier did identify programs directly targeting cool roofs/reflective roof coatings in Florida (City of Gainesville, though a residential program), the mid-Atlantic (Progress Energy again), and in Texas (in Austin, Bryan, and San Antonio). Data were available for the programs in Bryan, Houston, Gainesville, and from Progress Energy's residential building envelope program.

Frontier's participation estimates for the E.ON utilities are provided in Table 21. They are presented as a percentage of the total commercial customer market sector.

Table 21. Expected Participation, Commercial Cool Roof Rebates (%)

	High End	Low End	Best Estimate
Year 1	0.008%	0.002%	0.0035%
Year 2	0.012%	0.003%	0.005%
Year 3	0.018%	0.005%	0.008%
Year 4	0.018%	0.005%	0.008%
Year 5	0.018%	0.005%	0.008%
Year 6	0.018%	0.005%	0.008%
Year 7	0.018%	0.005%	0.008%

Table 22. Expected Participants, Commercial Cool Roof Rebates (#)

	LG&E	KU	Total
Year 1	1.5	3.7	5.3
Year 2	2.3	5.6	7.9
Year 3	3.5	8.4	12
Year 4	3.5	8.4	12
Year 5	3.5	8.4	12
Year 6	3.5	8.4	12
Year 7	3.5	8.4	12

We believe the 0.002 percent participation achieved by Centerpoint through its standard offer program represents a low-end estimate of participation E.ON can expect. Participation in Centerpoint's program with cool roofs is depressed by the fact that cool roofs must compete with other measures for limited program dollars: through Centerpoint's program, contractors are rebated on a $/kW and $/kWh basis (calculated using a deemed savings approach), and other measures provide a greater return on investment. Frontier's best estimate is that participation among E.ON commercial customers will be slightly better than Centerpoint's has been, as participation will not be constrained by the same competition for funds.

Cross-Cutting Programs

E.ON U.S. included two programs with both residential and commercial target markets in the list of programs to be reviewed by Frontier: Geothermal Heat Pump Rebates and Solar Thermal and Photovoltaic Rebates.

Geothermal Heat Pump Rebates

Utility experience with geothermal heat pump rebate programs is limited as compared to other programs. Investment in geothermal heating and cooling has been limited by the high upfront costs, but the increased attractiveness of developing the geothermal resource has pushed development of the technology. A rebate program can help overcome the high up-front costs, but results of programs implemented to date have been mixed.

Residential Market

Frontier has estimated the market for participation in a proposed residential geothermal heat pump rebate program as a percentage of the E.ON utilities' entire residential customer class. While a significant percentage of LG&E and KU's customers may not be likely candidates for participation in a geothermal heat pump rebate program, participation in the programs of comparable utilities were available on this same basis; it is reasonable to assume that the demographics of the E.ON utilities residential customer classes are similar to those of utilities in Indiana, Oklahoma, and Arkansas.

Table 23. Expected Participation, Residential Geothermal Heat Pump Rebates (%)

	High End	Low End	Best Estimate
Year 1	0.002%	0.0003%	0.0005%
Year 2	0.002%	0.0003%	0.0007%
Year 3	0.003%	0.0004%	0.0008%
Year 4	0.003%	0.0004%	0.0008%
Year 5	0.003%	0.0004%	0.0008%
Year 6	0.003%	0.0004%	0.0008%
Year 7	0.003%	0.0004%	0.0008%

Table 24. Expected Participants, Residential Geothermal Heat Pump Rebates (#)

	High End	Low End	Best Estimate
Year 1	1.7	2.1	3.8
Year 2	2.2	2.7	4.9
Year 3	2.9	3.5	6.4
Year 4	2.9	3.5	6.4
Year 5	2.9	3.5	6.4
Year 6	2.9	3.5	6.4
Year 7	2.9	3.5	6.4

The database of comparable programs includes the highly successful first year of a geothermal heat pump rebate program implemented by the Central Indiana Power Cooperative. It appears that their success may have been influenced by the coincidence of their program with a very generous rebate from the state of Indiana.[5] They also are a comparatively small utility, and may also be able to attribute their success to a number of factors related to implementation strategies. We treat it as an outlier, and derive our high-end estimate from the first year results of a program implemented by Connecticut Light & Power. Even so, the economics of ground source heat pumps can make them more attractive for climates with significant winter loads. As such, we believe it highly unlikely that the E.ON utilities could replicate the success of Connecticut L&P.

The participation rates projected by Oklahoma Gas and Electric for its most recent program filing (about 0.085 percent participation) would appear to be a more reasonable comparison. However, because Oklahoma State University has a research center focused on geothermal heat pumps, and because Oklahoma is home to one of the country's major geothermal heat pump manufacturers, it is reasonable to expect consumers may be more aware of the technology and that additional state-level incentives may be available. As such, participation will likely be higher in Oklahoma than in Kentucky. We present our best estimate based on the expectation that, absent additional incentives from third party sources, annual participation in this program will be limited to a handful of customers.

Commercial Market

While the payback typically improves for geothermal heat pumps as system size increases, Frontier does not find significant evidence of great success in commercial geothermal heat pump programs implemented around the country. Frontier has identified six geothermal heat pump programs with at least a commercial component, but none have provided data indicating significant levels of participation. Table 25 provides estimates of participation as a percentage of the E.ON utilities' entire commercial customer classes.

Table 25. Expected Participation, Commercial Geothermal Heat Pump Rebates (%)

	High End	Low End	Best Estimate
Year 1	0.001%	0.0001%	0.0005%
Year 2	0.001%	0.0001%	0.0007%
Year 3	0.002%	0.0002%	0.0008%
Year 4	0.002%	0.0002%	0.0008%
Year 5	0.002%	0.0002%	0.0008%
Year 6	0.002%	0.0002%	0.0008%
Year 7	0.002%	0.0002%	0.0008%

Table 26. Expected Participants, Commercial Geothermal Heat Pump Rebates (#)

	LG&E	KU	Total
Year 1	0.2	0.5	0.8
Year 2	0.3	0.7	1.0
Year 3	0.4	0.9	1.3
Year 4	0.4	0.9	1.3
Year 5	0.4	0.9	1.3
Year 6	0.4	0.9	1.3
Year 7	0.4	0.9	1.3

[5] Indiana Residential Geothermal Heat Pump Rebate: Program Review. *Indiana Office of Energy and Defense Development.* Online. Available: http://www.in.gov/oed/files/GHPProgramreport.pdf, Accessed: October 2, 2009.

Participation rates have been selected to indicate, on average, one to two projects per year, which seems reasonable for the first years of this program.

Solar Thermal & Photovoltaics

Frontier has assessed the market for this program in both the commercial and residential sectors. In our judgment, the potential for participation in solar programs in Kentucky is limited, primarily due to the extremely long payback on investments in solar technology, which in turn is due to a number of factors:

- Low energy costs
- Low amounts of sunlight for energy production[6]

Furthermore, we have assumed that the solar thermal program will be more oriented towards the residential market, while the PV program would be offered to both residential and commercial customers.

Residential Market - Solar Thermal

Frontier estimates that it would cost around $5,500 to install a typical solar water heating unit for a family of four in Kentucky. A 30 percent federal tax credit and a $500 rebate from the state of Kentucky would bring this cost down to $3,350. Frontier estimates annual savings in energy costs of about $173 associated with using solar water heating; simple payback analysis indicates that a solar water heater would have about a 19 year payback period. As such, participation is likely to be relatively limited.

Table 27. Expected Participation, Residential Solar Thermal (%)

	High End	Low End	Best Estimate
Year 1	0.013%	0.001%	0.003%
Year 2	0.019%	0.002%	0.005%
Year 3	0.025%	0.003%	0.006%
Year 4	0.025%	0.003%	0.006%
Year 5	0.025%	0.003%	0.006%
Year 6	0.025%	0.003%	0.006%
Year 7	0.025%	0.003%	0.006%

Table 28. Expected Participants, Residential Solar Thermal (#)

	LG&E	KU	Total
Year 1	10.3	12.4	22.7
Year 2	15.4	18.7	34.1
Year 3	20.0	24.2	44.3
Year 4	20.0	24.2	44.3
Year 5	20.0	24.2	44.3
Year 6	20.0	24.2	44.3
Year 7	20.0	24.2	44.3

Participation estimates in Table 27 are presented as a percentage of the total residential customer classes of the E.ON utilities. While Frontier has identified some existing solar thermal programs, they are mostly

[6] According to the National Renewable Energy Laboratory, on average there are 4.5 hours of sunlight/day in KY, as compared with 5.5 hours in Texas.

from Texas utilities, which are of limited relevance, given the difference in the solar resource between Texas and Kentucky. To develop participation estimates for the solar thermal program, we took the estimated participation rate for the PV program (as developed below), and doubled it, based on our estimate that the payback period for solar thermal water heating is about half that of PV (19 years versus 38 years).

Residential Market - PV

The majority of Frontier's experience with residential PV programs is in the Texas market, although we have also participated in the implementation of PV projects in adjacent states and Colorado. All of these states have better conditions for PV programs than LG&E and KU: higher rates and more sun. Typical residential projects implemented so far in Texas combining utility incentives (typically around $2.50/watt) with state and federal tax credits to induce customers to install PV systems. Participants tend to be larger; the average installation in 2008/09 programs in Texas is estimated to be a 5 kW system.

Participation estimates are provided as a percentage of the entire residential market in Table 29. High end rates are comparable to those achieved by some of the better-performing Texas programs, and are not likely to be attained in E.ON's programs. The Year 1 best estimate is an average of participation in the lower-performing Texas programs. While experience in Texas has been that programs are taking off – some growing by 1000 percent between 2008 and 2009 - Frontier expects that growth will be moderated in Kentucky. In part, the growth in Texas programs can be explained by improvement of offerings and, perhaps most importantly, by the removal in the size cap on the 30% federal tax credit.

Table 29. Expected Participation, Residential Photovoltaic (%)

	High End	Low End	Best Estimate
Year 1	0.0064%	0.0007%	0.0015%
Year 2	0.0096%	0.0010%	0.0023%
Year 3	0.0124%	0.0013%	0.0029%
Year 4	0.0124%	0.0013%	0.0029%
Year 5	0.0124%	0.0013%	0.0029%
Year 6	0.0124%	0.0013%	0.0029%
Year 7	0.0124%	0.0013%	0.0029%

Table 30. Expected Participants, Residential Photovoltaic (#)

	LG&E	KU	Total
Year 1	5.1	6.2	11.4
Year 2	7.7	9.3	17.0
Year 3	10.0	12.1	22.1
Year 4	10.0	12.1	22.1
Year 5	10.0	12.1	22.1
Year 6	10.0	12.1	22.1
Year 7	10.0	12.1	22.1

With an estimate of 22.5 kWh generated daily from a typical solar installation in Kentucky (based on the typical Texas installation of 5 kW and 4.5 peak sun hours/day in Lousville, according to the National Renewable Energy Laboratory), and a per watt installed cost after applying the currently available 30 percent federal tax credit of seven dollars, a simple payback analysis suggests that the payback period is around 38 years for a PV system. Any E.ON rebate would have to cut significantly into the $7/watt installation cost to overcome this significant barrier to installing PV systems in Kentucky.

Commercial Market - PV

The economics of PV in Kentucky's commercial market are similar to those in the residential market. Having broken out participation in the commercial and residential Texas (and other) PV programs that Frontier helps manage into their respective markets, we estimated participation for the E.ON utilities' programs based on the expectation that the program will garner less participation than the Texas programs due to the much less favorable nature of the economics of solar energy in Kentucky.

Table 31. Expected Participation, Commercial Photovoltaic (%)

	High End	Low End	Best Estimate
Year 1	0.0029%	0.0009%	0.0019%
Year 2	0.0043%	0.0014%	0.0028%
Year 3	0.0056%	0.0018%	0.0037%
Year 4	0.0056%	0.0018%	0.0037%
Year 5	0.0056%	0.0018%	0.0037%
Year 6	0.0056%	0.0018%	0.0037%
Year 7	0.0056%	0.0018%	0.0037%

Table 32. Expected Participants, Commercial Photovoltaic (#)

	LG&E	KU	Total
Year 1	0.8	2.0	2.8
Year 2	1.2	3.0	4.2
Year 3	1.6	3.9	5.5
Year 4	1.6	3.9	5.5
Year 5	1.6	3.9	5.5
Year 6	1.6	3.9	5.5
Year 7	1.6	3.9	5.5

Conclusions and Recommendations

Within the constraints of the time and budget available for this report, the information contained herein represents Frontier's best estimates of participation in E.ON's proposed programs.

We welcome E.ON's comments and questions about this report, and look forward to providing E.ON staff any additional assistance they might require in the design of its programs in preparation for your pending filing.

Appendix. Net to Gross Ratios

Table 33. Net-to-Gross Value Assumptions and Sources

Program	Market	Net-to-Gross * (%)	Source for NTG
Commercial New Construction	C&I	70%	EE Best Practices range from 0.65 to 0.93. BP_NR8, page NR8-42.
Recommissioning/Retrocommissioning and other major/comprehensive facility retrofits	C&I	Use upper end (~95%) for new program. 80% after 3 or 4 years	EE Best Practices for comprehensive programs range from 0.7 to 1.06. Apply to EMS and Recommissioning. BP_NR5, page NR5-63.
Large Lighting	C&I	98%	EE Best Practices ranges from 0.96 to 1.0. BP_NR1, page NR1-52. Applies to all Lighting entries.
Small/Medium Lighting	C&I	98%	
Energy Management Systems	C&I	80%	EE Best Practices for comprehensive programs range from 0.7 to 1.06. Apply to EMS and Recommissioning. BP_NR5, page NR5-63.
Motors	C&I	85%	Within range reported for cooling and "large comprehensive" values used from Best Practices study.
Large Cooling Replacement	C&I	90%	EE Best Practices ranges from 0.85 to 1.0. BP_NR2, page NR2-38. Applies to all cooling equipment replacement entries.
Medium Cooling	C&I	90%	
Small Cooling	C&I	90%	
Thermal Energy Storage	C&I	90%	
Residential Lighting	Residential	90%	EE Best Practices range BP_R1 pg R1-37
ENERGY STAR Appliances	Residential	90%	No source identified; averaged other NTGs
Refrigerator Recycling	Residential	90%	No source identified; averaged other NTGs

Program	Market	Net-to-Gross * (%)	Source for NTG
Residential Home Efficiency	Residential	80%	BP_R7 ranged from 72 to 100% NTG for audit programs Page R7-47; Contrast with "weatherization" for a different view.
HVAC Tune-Up; applies to single-family only	Residential	80%	Res AC programs were not well reported, one was 0.80 NTG. BP_R2, page R2-42.
Comprehensive Weatherization/ Residential Solutions	Residential	95% (100% for income qualified)	Comprehensive weatherization for all customer classes reported at about 90% (NTG BP_R4, page R4-44). Low-income are assigned 100% NTG..
Load Control	Residential	100%	
Res New Constr.	Residential	95%	New construction programs ranged from 0.8 to 1.16 NTG. BP_R8, page R8-56.

*** The estimated Net to Gross ratios as presented represent the free riders net of free drivers.**

Exhibit J-3

Fundamentals of Starting an Appliance Recycling Program

AESP Brown Bag March 20, 2008

JACO Environmental

Agenda

- Program Design Elements – Sam Sirkin
- Program Implementation – Michael Dunham

JACO Environmental

Key Features/Benefits

- Cost Effective
    - Exceeded only by lighting
- Huge Environmental Upside
    - GHG, toxics and materials
- Customer Service "Home Run"

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Design - Cost Effectiveness

- Measure metrics
  - Net savings: 700 - >1,000 kWh/year
  - Measure life: 8-10 years
  - Cost: ~$150 (increase/decrease for scale)
- Results
  - Levelized cost - ~3 cents or less per lifetime kWh
  - Benefit:Cost Ratio – 1.5-2.5 or higher

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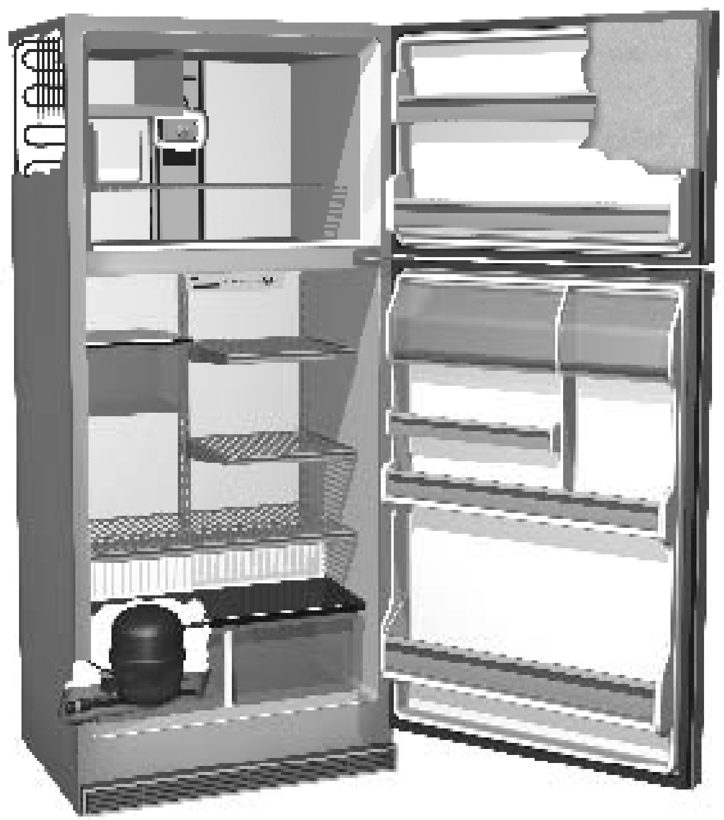
Design – Environmental Benefits



- GHG/ODS capture
- Other hazardous waste – oil, PCBs, mercury
- Other – glass, plastic, metals
- Become EPA RAD Partner

JACO Environmental

Program Design -Target Audience

- Secondary refrigerators; freezers
  - Households with 2+ refrigerators or a stand-alone freezer; disproportionately:
    - Homeowners aged 35-60
    - Middle income
    - Living in detached or single family dwelling
    - 2+ persons in household
- Primary refrigerators
  - Households replacing their existing refrigerator

JACO Environmental

Program Design – How Many Units Are Out There?

JACO Environmental

Program Design – Inventory

- Primary units – 1 per residential customer
  - Disposed approximately every 14 years (0.07/year)
- Second units - .15-.34 per residential customer
  - Use territory appliance saturation or IEA RECs data
- Total available for "harvest" formula

  Primaries displaced (res account x 0.07)

  \+ Seconds (res account x % second fridge/freezer saturation)
- Scope – Annual Harvest Rate (AHR) Approach
  - 1 unit from 1% - 3% residential customers/yr = full-scale program

JACO Environmental

Program Design – Qualifying Units

- Program Unit Qualification
  - Location – in territory
  - Status – working/cooling
  - Vintage – older units
  - Size matters – 10-30 cubic feet
- Customer Qualifications – no vintage restriction
  - Reduces/simplifies program requirements
  - Reduces customer service issues
  - Delivers older units

JACO Environmental

Typical Vintage and Size Harvested

- Average age, all programs - 21 years
- Average size, all programs - 19.5 Cubic Feet
- Harvest Oldest Units First – sample program

Table 1. 2004-2006 Program Comparison

	2004	2005	2006
Total Number of Units	2604	3766	3739
- Refrigerators	68%	67%	68%
- Freezers	32%	33%	32%
Average Unit Size (cubic feet)	18.75	17.3	17.5
Average Vintage	1976	1978	1979
Average Age (years)	28	27	26

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Program Design – Incentive Levels

- Per-unit incentive or "bounty" levels
  - Range between $30 and $50
  - Recommend starting $30-$35/unit
- Purpose - offset perceived customer convenience of keeping the unit
  - customer payback considerations not applicable, since there are no customer costs involved
  - program service involves free collection and recycling to overcome customer inertia and/or change behavior
- Incentive set based on desired number of units to be harvested
  - can be raised over time, if necessary

JACO Environmental

Implementation – Program Elements

- Turnkey provisioning of:
  - Marketing
  - Call center operation (inbound 800 #)
  - Web site (program details, reservation requests)
  - Onsite verification of unit working condition
  - Unit collection / transportation
  - Recycling processing
    - Including CFC-11 (foam) incineration or recycling
  - Incentive check processing
  - Reporting

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Implementation – Timing

- Preferred launch in spring (March-May timeframe)
  - Synergy with spring cleaning, home improvement/ remodeling, and upcoming summer moves (all drivers of program demand)
  - Year-round programs see average daily volume in summer is typically 2X average daily volume in winter
    - Slowest season is mid November – early January
- Key events (ahead of initial pickups)
  - Call center and web site activated: 2 weeks prior
  - Newspaper & TV ads: 2 weeks prior
  - Retail POS placements: 1 week prior

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Implementation – Marketing

- Primary Elements
  - Customer pamphlets (“extended” bill insert materials)
  - General market newspapers
- Secondary Elements
  - Retail point of sale (POS) flyers
  - Signage on collection trucks
  - Public relations event
  - Cable TV or broadcast TV
- Tertiary Elements
  - Web links (to/from utility web site and JACO web site)
  - Internet banners (newspaper websites)
  - Email “blasts” to selected PNM customers

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Implementation – Marketing

- Sample public relations event/activities
  - Program launch: TV and newspaper press invited to ceremonial 1st unit collection pickup
    - Usually extremely effective in jump-starting call center volumes
  - Press support / press releases
  - Web site [for newspapers and TV stations] containing downloadable broadcast-quality footage of refrigerators being picked up and recycled

Implementation – Marketing

- Sample customer pamphlet bill insert (Nevada Power, 12/07)

2007 December

NEVADAPOWER.COM

Recycle for Cash

We'll pick up your old fridge and you pickup 30 bucks.

Refrigerator Recycling

If you're like most folks, chances are you have an old refrigerator or freezer in your garage. Did you know that these units could consume up to three times as much energy as the newer, more energy-efficient models? Not only do they use more energy, if you have them in a hot garage during the summer they have to work a lot harder to keep food at the correct temperature, which draws a great deal more power.

But there's an easy solution. You can pick up $30 in cold cash and reduce your monthly power bill all year long when you recycle your older working refrigerator or freezer with Nevada Power. We'll even pick it up for free.

When you recycle your old unit, over 95 percent of the materials used in manufacturing it are recycled in an environmentally friendly and United States Environmental Protection Agency approved manner. So do something good for yourself, good for the environment and lower your energy bills too.

Call toll-free at (877) 289-8260 and schedule your free pickup today (limit of two units per residence). The Refrigerator Recycling program is offered on a first come, first served basis while funding lasts.

Call toll-free at (877) 289-8260 to schedule your free pickup.

Conservation Corner

Temperature Control

Thermostats in many homes are usually thought of exclusively as a means of turning heating systems on and off. The truth is, your thermostat is the control center of your home comfort system. When it is not performing properly, it will not only cause you considerable discomfort, it can increase your heating expense as well.

Is your thermostat level or do you have lint build-up inside the unit? Some thermostats need to be level and lint-free in order to work properly. Is your programmable thermostat set for different times of the day and night? Thermostat settings for the winter months should be at 68 degrees when you are home and lower when your home or business is not occupied or when you are sleeping. Every degree above 70 degrees can increase your heating cost by two and a half percent.

For more energy saving tips visit nevadapower.com.


Recycling that old fridge will save more than energy.
Save energy, save some money and help the environment.
While it's true, older refrigerators may not be spoiling your food, they are spoiling the environment. In fact, recycling a single older refrigerator is like taking ten tons of carbon dioxide out of the air. What's more, they use up to four times more energy than newer models, eating up hundreds of dollars a year in utility bills. So give us a call and recycle that old fridge or freezer. We'll pick it up for free, plus you'll get $30 back. See ya later, refrigerator.
$30 BACK
For a pickup call 1-866-899-5539 or visit www.pacificpower.net
PACIFIC POWER
*No age restrictions. Refrigerators and freezers must be in working condition and must be a minimum of 10 cubic feet in size, utilizing inside measurements. Pacific Power contracts with JACO Environmental, an appliance recycler, to pick up and recycle refrigerators and freezers that are in working condition. This program is funded by Pacific Power and is available to its residential customers in Washington on a first-come, first-served basis until funding is expended. Customers must own the unit(s) being recycled. Limit two units per residential address. A check will be mailed to the Pacific Power customer within 4-6 weeks after the appliance collection. Some restrictions apply. © 2007 Pacific Power

WANTED
$40 REWARD

CRIME:

Stealing energy, costing innocent homeowners hundreds of dollars.

DESCRIPTION:

15+ yrs old,* medium build, flat top, 5-6 feet tall, no prior arrests.
Last seen running in a neighborhood just like yours.

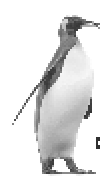
If spotted, do the bright thing. Rocky Mountain Power customers should call 1-866-899-5539 or visit rockymtnpower.net. We'll pick it up for FREE and you'll pick up a $40 reward.

ROCKY MOUNTAIN POWER

PacifiCorp Print 2008
Rocky Mountain Power
(5col x 10")
5.75 x 10
BW

Is that old fridge a little power hungry?

Turns out, that old refrigerator or freezer could be sucking the life out of your everyday life. In fact, a single older refrigerator actually does as much damage to the environment as two cars can do in a year. What's more, older appliances can use three to four times more electricity than newer models, eating up hundreds of dollars a year in high utility bills. So give us a call and recycle that old fridge or freezer. We'll pick it up for free, plus we'll give you a $50 rebate.



$50

For a pickup call 1-800-299-7573 or visit www.smud.org

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT
The Power To Do More.

Sac Bee
3 col. (5.6875) x 10

Implementation – Recycling

- Initial processing steps
  - Catalog units (type, size, vintage, etc.)
  - Remove doors, crispers, and shelves
  - Place on line conveyor belt
  - Evacuate oils and refrigerant simultaneously
  - Remove possible hazmats
    - PCB starting devices
    - Mercury switches and thermostats
  - Discern type of insulation (drill core sample)
  - Record harvested materials (refrigerant type and quantity, oils quantity, presence of hazmats)
- Units not containing CFC-11: "hull" is transported to nearby recycler/scrap yard for shredding and materials management

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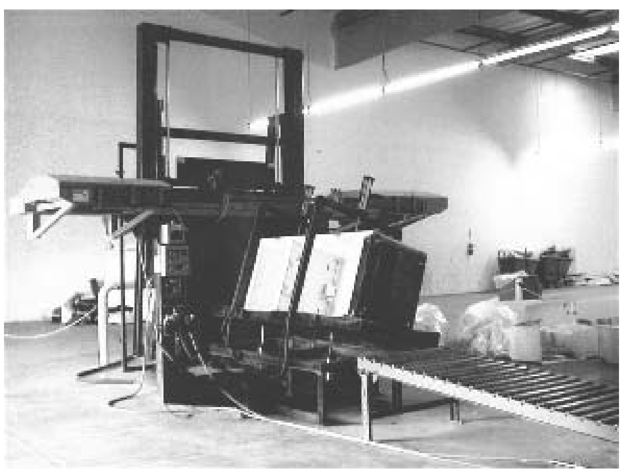
Implementation – Recycling

- CFC-11 units at SEG "Stage 1" facility
  - Cut chassis into pieces manually (using saws)
  - Separate foam, metals, and plastic
    - Metals and plastic then sold to nearby recyclers
  - Seal CFC-11 foam in bags
  - Ship foam to WTE or hazmat incinerator for destruction
- Environmental permitting and recycling process certifications needed



Implementation – Data

- Units tracked from initial call -> pick-up -> recycling
- Program managers track progress in real-time
- Reports include all recycled materials
- EPA RAD Program reporting requirements

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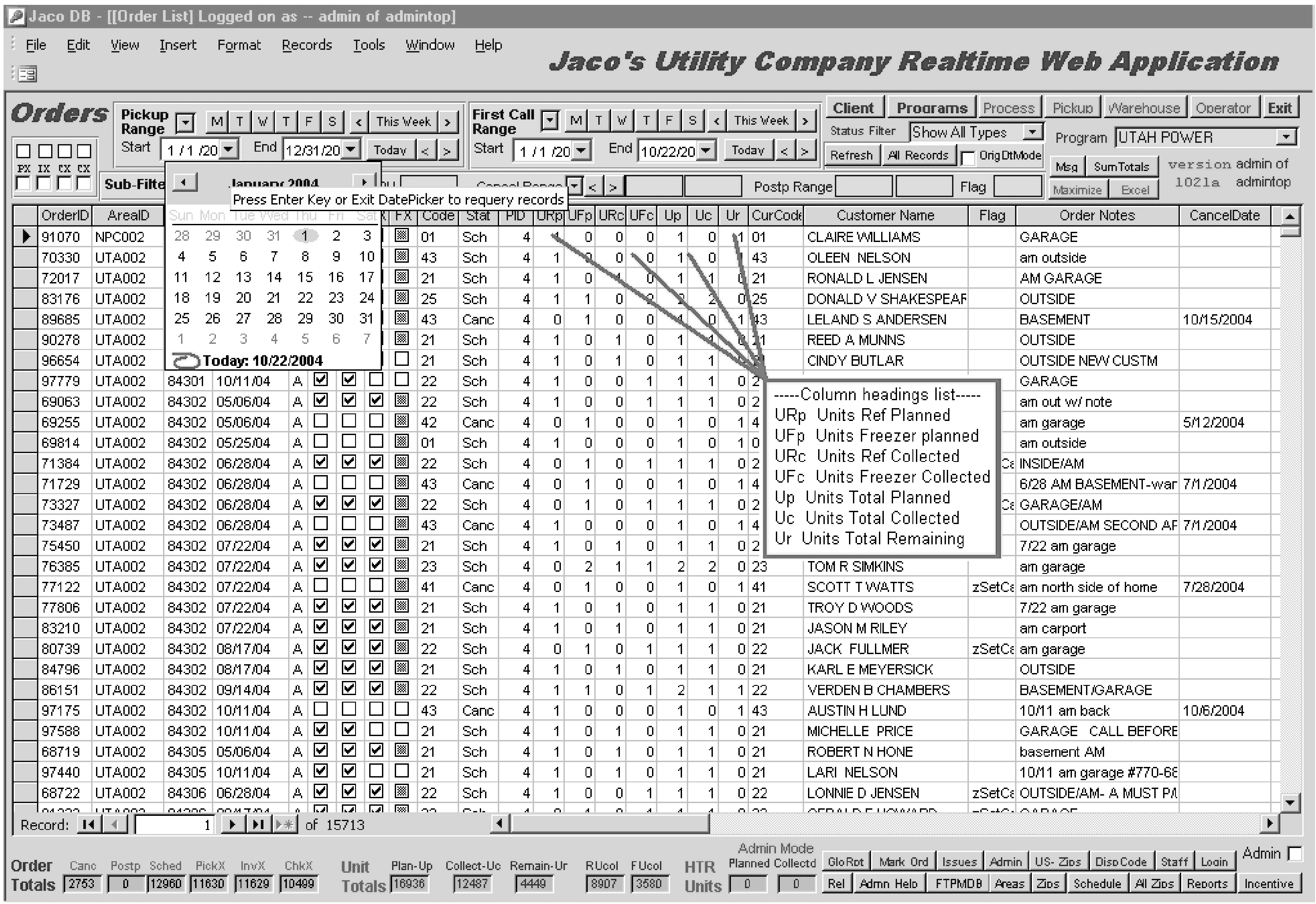
Implementation – Data

Sample screenshot of customer order records in database



Conclusion

- Cost Effective
- Huge Environmental Upside
- Customer Service “Home Run”

J A C O
Environmental

Thank You

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J A C O Environmental

Exhibit J-4

That Old Fridge: Where Does It Go?

AESP Spring Implementation Conference

April 29, 2009
Charlotte NC

John H. Reed
Charles Bailey
Moria Morrissey

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Rockville, MD 20850
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INNOVOLOGIE

The Authors Are Responsible For the Opinions and Facts Expressed Here

We would have neither opinions nor facts without the collaboration and cooperation of the following

- Don Dohrmann, ADM
- Steven Westberg, Hiner and Associates
- John Peterson, Athens Research
- Shahana Samiallah, SCE
- Tom Schober, SCE
- ARCA
- JACO

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Looking to Replace A CFL Program???

323 kWh Savings Annually

with 5 bulbs in a dwelling
running 3 hours a day
365 days a year at
59 watts per hour savings
per bulb

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Try a refrigerator recycling program!!!

1271 kWh annually if you remove a 16 year old 19 cubic foot top freezer

862 kWh annually if you remove a 16 year old 19 cubic foot top freezer and replace it

1955 kWh annually if you remove a 16 year old 25 cubic foot side-by-side

1355 kWh annually if you remove a 16 year old 25 cubic foot side-by-side and replace it with a new one

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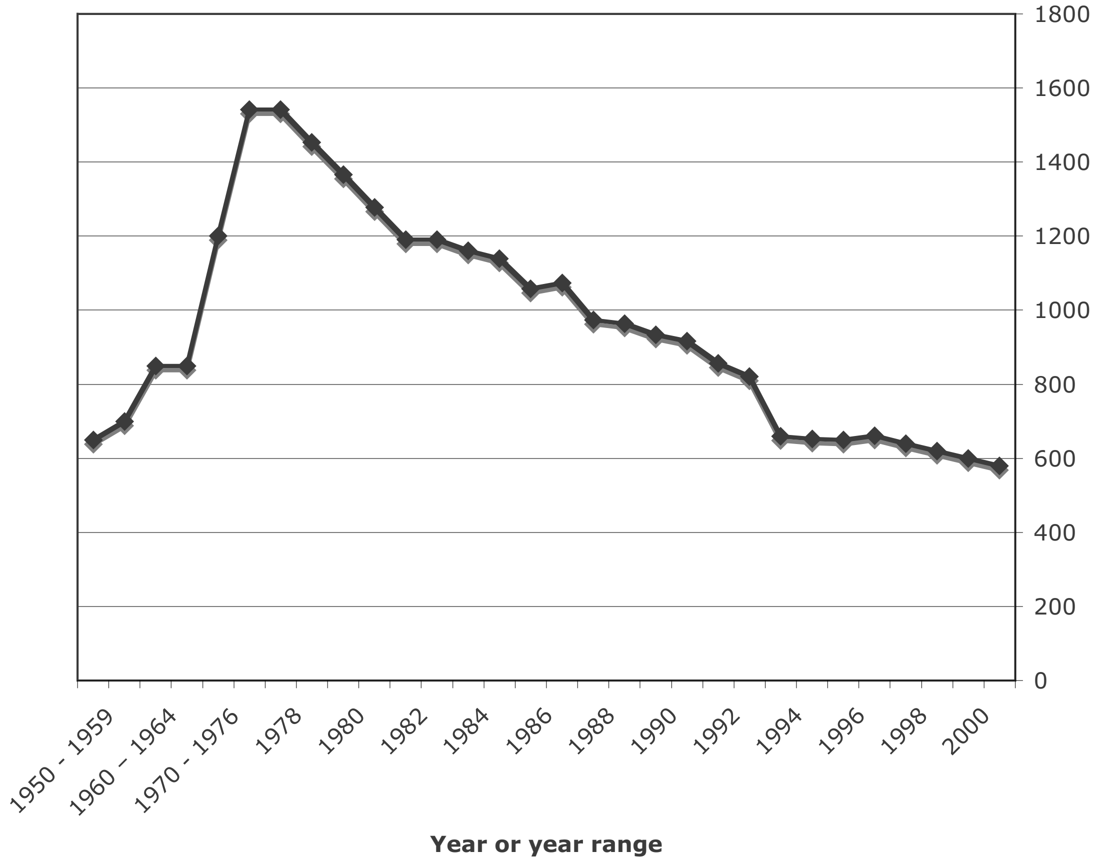
Shipment Weighted Average Energy Consumption of Refrigerators (kWh)



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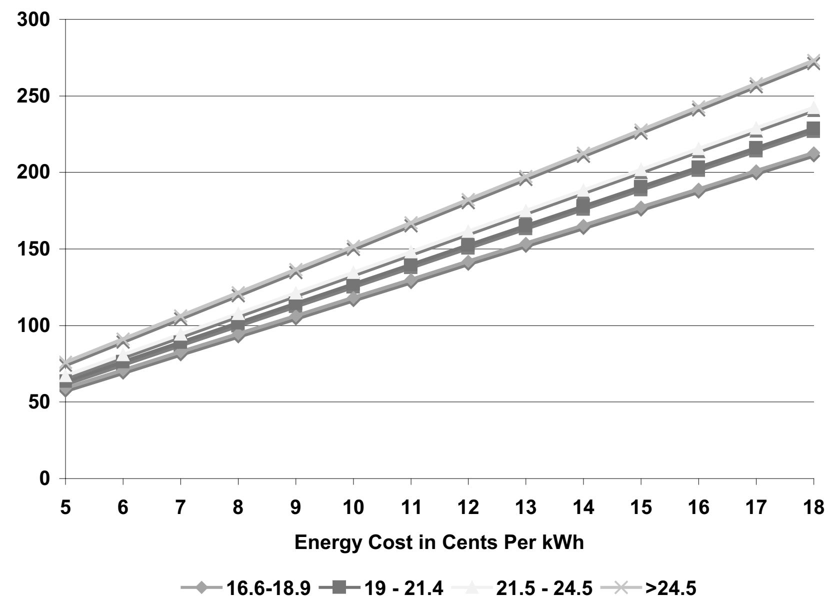
Why Recycle Old Refrigerators

- Save energy
- Save customers $
- Reduce demand
- Reduce emissions

Customer Savings by kWh Cost for Four Sizes of 16 Year Old Top Freezer Refrigerator



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Some Interesting Approximations Relating Households and Refrigerators

Households	Percent	In the US	Per 100,000 customers	Per million customers
With a second refrigerator	20	22.7 million	20,000	200,000
That transfer* a refrigerator annually	7	8 million	7,000	70,000

* That get rid of a refrigerator because they bought a new one or because they got rid of an existing one.

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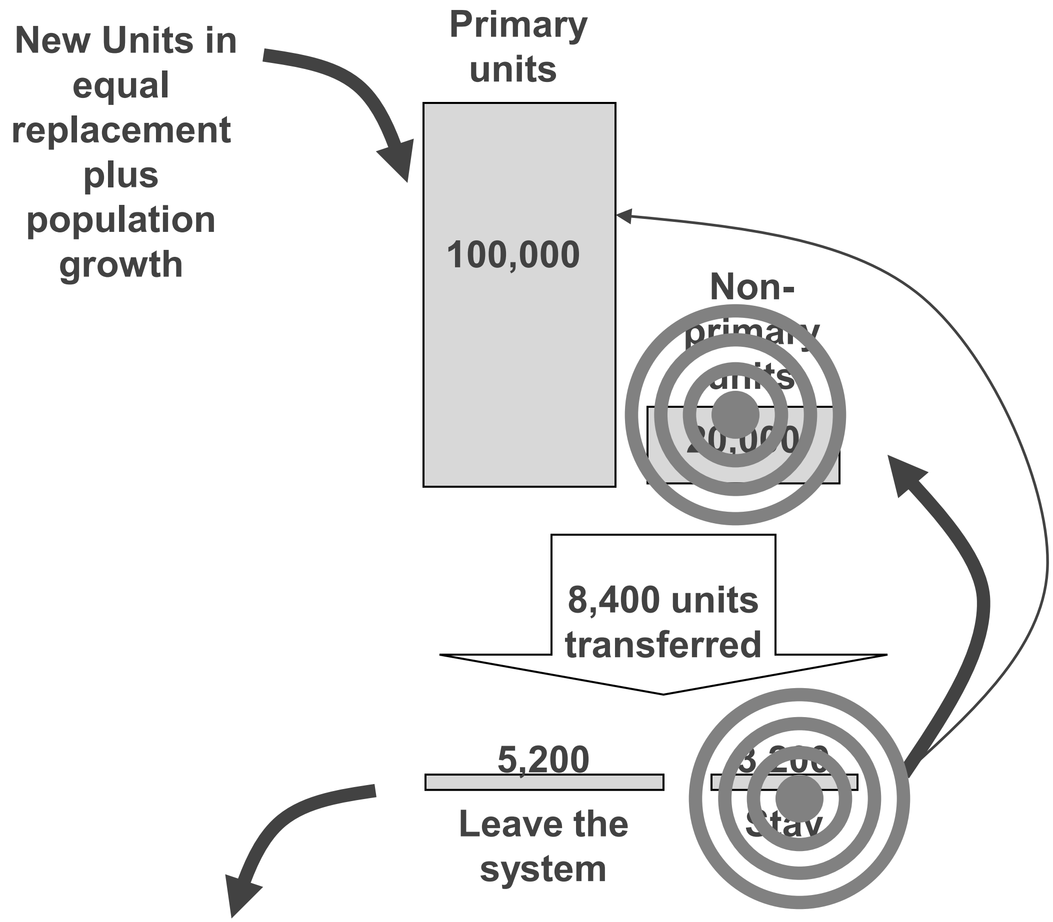
A Year in the Life of the Refrigerators in 100,000 Homes



Second Refrigerator Questions

- What are the characteristics of second refrigerator households?
- How essential is the second refrigerator in those households?
- What messages would it take to get the household to give a unit up?
  - Annual operating cost
  - Rebate
  - Convenience
  - Environment
- What message channels should be used?

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Households with a Second Refrigerator Are More Likely to Have

- An area greater than 2000 square feet
- Electricity consumption greater than 6,000 kWh and especially greater than 8,000 kWh
- The same residents for more than 10 years
- Two adults with no children in their 50s and 60s
- Recent remodel
- Income greater than $75,000

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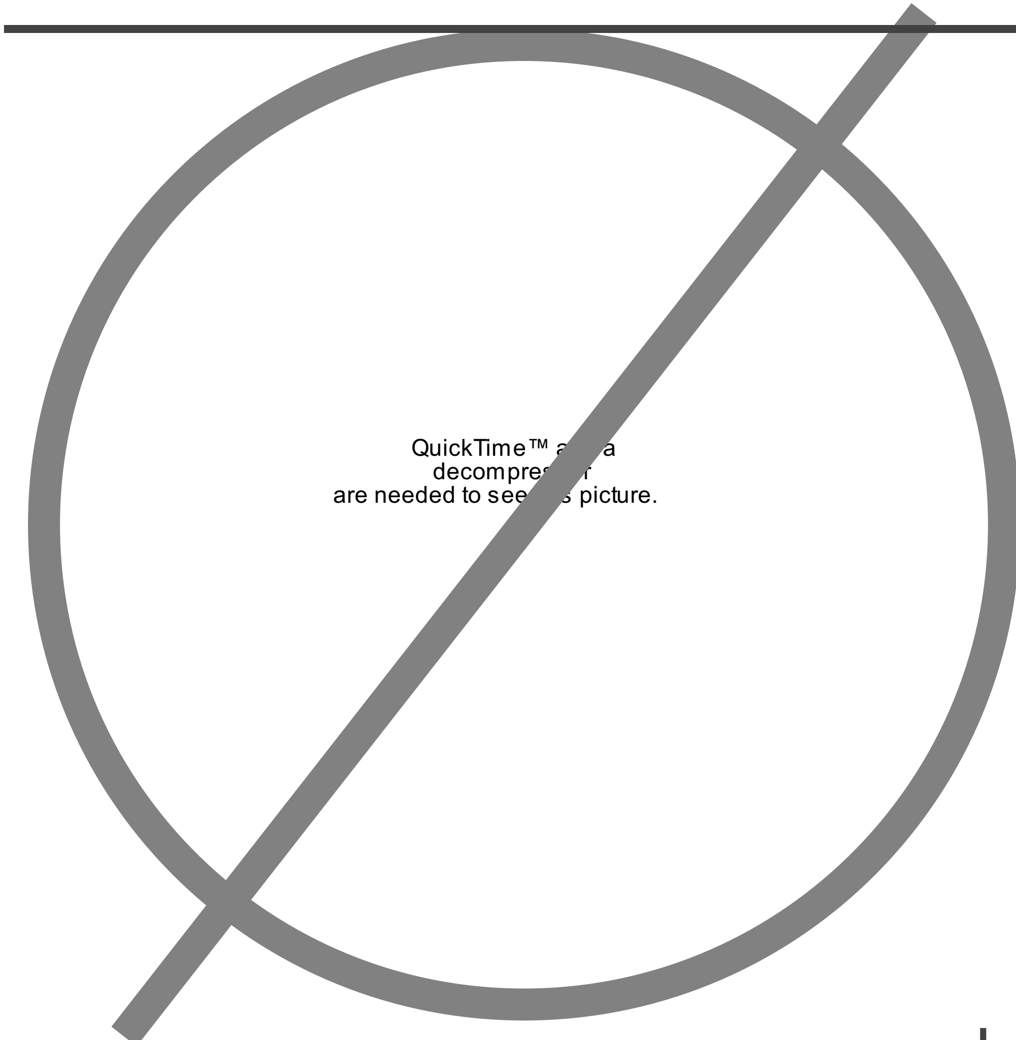
You Don’t Need a Pilot Program



QuickTime™ and a
decompressor
are needed to see this picture.

Just a Good Turnkey Program

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There is a lot of wailing and gnashing of teeth about net-to-gross

Many studies suggest that the net-to-gross is about:

~~.35~~

They are wrong, it is really around

.60

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Although the Calculations from Older Studies Appear Correct, the Assumptions that Underlie Them Are Wrong

- Past studies and more recent studies that have copied the older methodology assume, for example, that a household replacing a used unit with a used unit will have zero savings (i.e. they are considered free-riders)
- The fact is that households replacing old units with relatively new used units produce nearly as many savings as old units replaced by brand new units.
- Assumptions in past studies produce a higher free rider rate than is warranted
- It is also worth noting that any under utilized second refrigerator, regardless of age, is probably worth removing from a home

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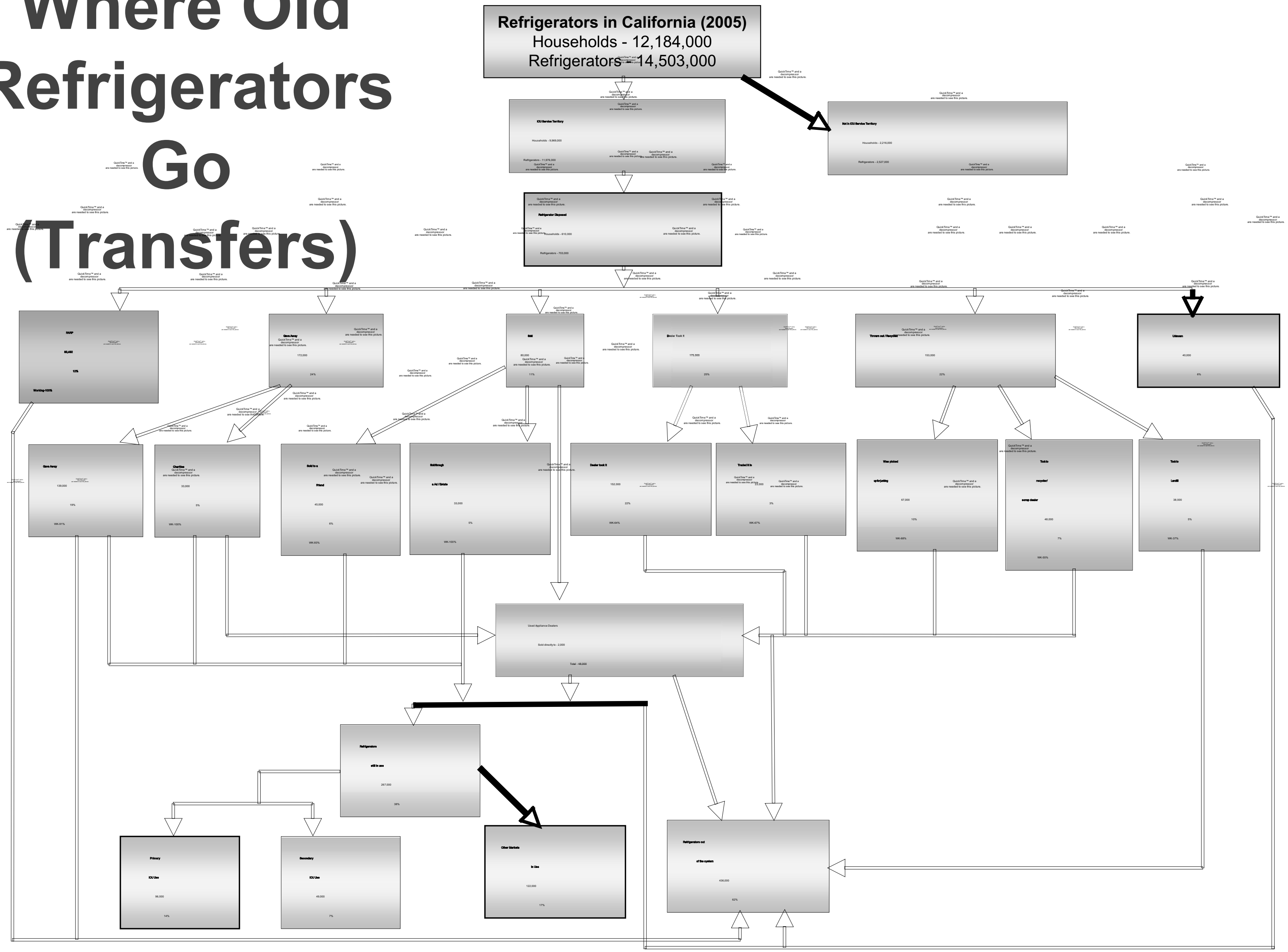
Where Old Refrigerators Go (Transfers)



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Giveaways to friends and neighbors (19 percent)

- The givers, and presumably the receivers, see units as having value
- Probably 100 percent working units
- Average age is 9.7 years older
- The gift is often a lump of coal
- Should be priority targets
- When marketing recycling program
  - Operational costs (Do your friends and neighbors a favor)
  - The benefits of removal and recycling

Charities (5 percent)

- Customers preferred option in absence of program but not a very realistic one
- Altruism is a basic customer motivator (this old machine is valuable to someone)
- Except for one, charities in California were no longer accepting refrigerators
  - Only working units (100 percent working)
  - Environmental disposal costs
- The one charity collected about 40,000 units
  - These units were typically older units
  - Sold about 20 percent through their stores
  - Auctioned the rest, usually to appliance dealers, so the returned to the street

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Sold (11 percent)

- Average age of these units is 6.7 years
- 100 percent working
- Half sold to friends
- Other half to strangers (advertisements on craigslist penny savers)
- Average asking price about $200
- Because people are seeking value these units are likely hard to retrieve and because of their relative youth are probably not worth the effort to market the customers very hard
- These units can remain on the grid with minimal consequences

INNOVOLOGIE

New Appliance Dealers (25 percent)

- About 25 percent of old units go to dealers
- The new appliance dealers sell them to recyclers (usually for less than $10)
- Around 36 percent are not working
- A high percentage of units are more than 10 years old and have little commercial value so they are scrapped
- Saleable units are sold to used appliance dealers
- Some units in certain areas may find there way out of the country
- Tempting to work with dealers but these units are likely to have low NTG without careful program design

A Quarter of the Units go to Waste Disposal

- About 50 percent of these units are non-working and many are damaged.
- In California, these units have the remaining refrigerant pumped regardless of whether there is any refrigerant in them
- They are liberated of PCBs and mercury which are recycled
- The compressor oil is recycled
- The carcass and (maybe) the compressor may be compacted or sent whole to a materials recycler who likely shreds it and ships it to be recycled

Used Appliance Dealers

- With a few exceptions they deal in very small volumes (under 50 units a year)
- Because of environmental regulations, availability of credit at large retailers, and other factors, used appliance dealers are a dying breed
- Many aren’t even aware of the utility recycling programs
- They basically market units that are ten years or less and may salvage parts from some units
- The myth is that they serve a need for lower income households but they may not be doing those households any favors

If the Units Make It to a Recycler

- The plastic and glass are removed and recycled
- The PCBs and mercury (if any are sent) to recyclers
- The refrigerant is withdrawn and recycled or burned
- The CFCs in the foam are removed or the foam is burned

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The Recycled Refrigerator Top Ten

1. The program has good energy and demand savings
2. You can do a turn key program and get lots of units — you don't need a pilot and don't set your goals low
3. The net-to-gross ratio on this program is 0.6. Beware of purveyors of other information
4. Second refrigerators should be a high priority target (a not so old second refrigerator is worth removing)
5. We need more good research on households with second refrigerators
6. Target households that are likely to give away refrigerators
7. Be very cautious about designing a program around new appliance dealers — without careful design the net-to-gross is likely to be very low
8. Don't overemphasize incentives
9. Emphasize convenience
10. Tell customers why they should recycle and include reduced annual energy costs, convenience, the environment

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Where to get more information

- Contact:
  John H. Reed
  301 340-8701
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- Read more on the CALMAC website:
  ADM, Athens Research, Innovologie LLC, Hiner and Partners. Evaluation Study of the 2004-05 Statewide Residential Appliance Recycling Program.
  http://www.calmac.org/publications/EM&V_Study_for_2004-2005_Statewide_RARP_-_Final_Report.pdf

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