PERSISTENCE STUDY OF SOUTHERN CALIFORNIA EDISON'S 1994 through 1997 APPLIANCE RECYCLING PROGRAMS

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1 INTRODUCTION

1.1 BACKGROUND

This report provides the results of the fourth-year retention study of Southern California Edison's (SCE's) 1994 through 1997 Appliance Recycling Programs. Periodic retention studies are required by the Measurement and Evaluation Protocols of the California DSM Measurement Advisory Committee (CADMAC).[1]

Under this program, incentives are offered to customers to turn in their old appliances for destruction, with ecologically responsible recycling of components and materials. The goals are:
(a) to eliminate second appliance use at participating residences; and
(b) to prevent the transfer of older, inefficient appliances into the secondary market.

The program has been evaluated twice for first-year load impacts, first of the 1994 program (XENERGY, Study #515) and then of the 1996 program(XENERGY, Study #537). In these studies, energy savings were attributed to both phenomena (a) and (b) above – removing auxiliary appliances that would have been kept otherwise, and preventing operable but inefficient appliances from continuing to circulate in the territory, thereby increasing the use of more efficient appliances.

1.1.1 Protocol Requirements

The CADMAC Protocols require that retention studies be performed periodically for utility Demand-Side Management Programs, with an explicit schedule covering the majority of programs. However, there is no Protocol specifically governing this program. Edison has obtained a waiver to conduct one fourth-year (and one ninth-year) retention study to be applied to four program years, 1994-1997. The results of the combined analysis will be used in the third earnings claims filed for each program year.

This report presents the fourth-year retention study. This study has many features in common with retention studies being conducted for other measures under the terms of the Protocols. However, special considerations were required because of the type of measure—appliance removal rather than appliance efficiency—and because the savings identified in the first-year

[1] California Public Utilities Commission, *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings from Demand-Side Management Programs*, Decision 93-05-063. Revised March, 1998., pursuant to Decisions 94-05-063, 94-10-059, 94-12-021, 95-12-054, 96-12-079, and 98-03-063.

impact studies include not only the direct effects on participating households but also secondary market effects.

Estimating Effective Useful Life (EUL)

As defined in the Protocols (p. A-9), the goals of the measure retention study are to determine

> (a) the length of time the measure(s) installed during the program year are maintained in operating condition; and (b) the extent to which there has been a significant reduction in the effectiveness of the measures.

The CADMAC Persistence Subcommittee has agreed that the first question (a) should be addressed by estimating each measure's Effective Useful Life (EUL). The EUL is defined as the median survival time, that is, as the time until half the units are no longer in place and operable. Estimating the EUL is the primary focus of this report. The question of reduced measure effectiveness is not addressed for this measure.

Each measure has an *ex ante* estimate of the EUL, which has been used in the first and second earnings claims. If the *ex post* EUL determined by the retention study for a particular measure is statistically significantly different from the *ex ante* EUL at the 20 percent significance (80 percent confidence) level, the *ex post* EUL will be used for future earnings claims. If there is not such a statistically significant difference, the *ex ante* EUL will be retained. Whether or not the EUL is revised as a result of this study, the EUL may be revised in the future based on the ninth-year retention study results. For Edison's Appliance Recycling Program, the *ex ante* EUL is 6 years.

This study provides an estimate of the *ex post* EUL for the Appliance Recycling Program. This EUL is for the combined effect of the eliminated spare appliance and prevented transfer "measures," for refrigerators and freezers combined.

1.2 STUDY METHODS

The general method employed in measure retention studies is to collect measure retention data from a sample of participants, and fit a parametric survival function to those data. This approach is applied here to the appliance removal measure. However, what constitutes failure of the measure must first be defined. This definition is different for the savings component due to the direct effect of removing units and that due to avoided transfers to the secondary market. As a result, the approach to measuring the median time until failure is also different for these two components.

1.2.1 Measure Retention for Units That Would Have Been Kept

For the direct effect of removing the unit from the home, measure failure is defined as the home's acquiring another unit to replace the removed unit. This definition of failure applies to the participating homes where the unit would have been kept if not picked up by the program. Thus, the time until failure for such homes is the time until the home added another unit. This time to failure can be observed explicitly for participating homes.

Participant surveys were used to determine if the number of units in use at the home had increased over the study period, and if so, at what date. The surveys were conducted with homes that had been previously surveyed as part of the first-year impact studies for the 1994 and 1996 program. The number of refrigerators and freezers in use as of the time of that survey was known, providing more reliable information on changes.

Failure times based on these survey data were analyzed by standard statistical survival analysis methods. The techniques are described in more detail in Section 2.

1.2.2 Measure Retention for Units That Would Have Been Transferred to Another User

For units that would otherwise have been transferred to the secondary market, the removal of the unit from the market has a lifetime equal to the remaining life of the unit if it had been transferred. That is, the savings due to preventing this unit from being transferred to a new user last for as long as that unit would have continued in use.

This hypothetical remaining life of the appliance not transferred is not directly observable. For this component of program savings, a different approach was taken to estimating the measure life. A life table of the age at final disposal of working refrigerators was developed. The basis for this table was data collected as part of Edison's 1995 Residential Appliance Saturation Study. Combining these data with the ages at pick-up of units in the program gave the distribution of remaining life for these units. The median of this distribution is the Effective Useful Life for the avoided transfer component of the program.

1.3 SUMMARY OF RESULTS

The results of this study are summarized in Table 1-1. The median life of the direct measure removal—i.e., the time until half the removed units have been replaced—is estimated at 6.3 years, with an 80 percent confidence interval of 5.0 to 7.5 years. This result is based on the combined analysis of retention data from 1994 and 1996 participants.

For units whose transfer to another user has been avoided by the program, the median avoided remaining life in the hands of the new user ranges from 4.1 to 6.2 years over the four program years, with 80 percent confidence intervals spanning a range from 1.9 to 6.6 years. The estimates vary by program year, based on the ages at turn-in of the units collected in each year.

Combining the EUL's for the two components of program savings two, the median lifetime of an arbitrary unit of savings in the program ranges from 6.0 years (for the 1996 program) to 6.3 years (for the 1994 program). The 80 percent confidence interval for each program year includes the *ex ante* estimate of 6 years. That is, the *ex ante* estimate is accepted. Thus, the EUL to be used for the third earnings claim is the *ex ante* value of 6 years.

Table 1-1
Summary of EUL Findings
(years)

Program Year	EUL	80% Confidence Interval Lower	Upper	
Direct Effect of Measure Removal				
All	6.3	5.0	7.5	
Avoided Transfers				
1994	6.2	4.0	6.6	
1995	6.1	3.6	6.6	
1996	4.1	1.9	5.9	*
1997	4.6	2.3	6.0	
Combined				
1994	6.3	5.5	6.9	
1995	6.2	5.5	6.9	
1996	6.0	5.3	6.8	
1997	6.1	5.3	6.7	

* The *ex ante* EUL of 6 years does not fall within the 80 percent confidence interval. Formally, the *ex ante* EUL is rejected.

1.4 REPORT ORGANIZATION

Details on the data collection and estimation methods are provided in Section 2. The results are presented in Section 3. Survey instruments are included in Appendix A. Tables meeting the requirements of Table 6B of the CADMAC Protocols are given in Appendix B. The documentation required by Table 7B of the Protocols is given in Appendix C. A copy of the approved waiver for the study methods is included in Appendix D.

2 METHODS

2.1 OVERVIEW

As described in Section 1, the retention study addressed the effective useful life of two components of savings identified in the first-year impact analysis. The structure of the first-year impact analysis is reviewed below. The corresponding structure of the retention study is then described.

2.2 REVIEW OF FIRST-YEAR IMPACT ANALYSIS

As approved in a previous waiver, the first-year impact analysis for the 1994 and 1996 program was based on the idea that, in the absence of the program a unit may have been:

1. kept by the participants at the premise,
2. transferred to a new owner within SCE territory,
3. transferred to a new owner outside SCE territory, or
4. destroyed.

Program impacts are based on the units that would have been kept or transferred to another user within SCE territory in the absence of the program. The fraction that would have otherwise been kept by the participants was determined from a survey of program participants. The fraction of those that would not have been kept that would have otherwise been transferred within SCE territory was determined by surveying customers who disposed of refrigerators and freezers outside the program.

For units that would have otherwise been kept by the participants at the premise, the gross savings is defined as the full-year unit energy consumption (UEC) of recycled units, based on metering tests conducted by SCE. For units that would have otherwise been transferred within SCE territory, the gross savings is the UEC of the old unit as described above minus the UEC of a unit that the recipient would presumably have had to buy instead. For each group, the gross savings is based on a full-year UEC adjusted by a part-use factor. This methodology provided a manageable approach to looking at the first-year impacts.

The analysis for the retention study builds on the first-year impact analysis previously approved. Separate analysis methods are used for units that would have otherwise been kept and for units that would have otherwise been transferred within SCE territory in the absence of the program. This simplified retention analysis approach does not account for changing usage of the unit over time, nor for the changing UEC of the unit that was purchased because the recycled unit was unavailable.

2.3 DEFINITION OF EUL FOR THE RECYCLING PROGRAM

The first year impact analysis identified two sources of savings from the program.
1. Direct savings resulting from removing a unit from a participating household.
2. Indirect savings resulting from avoiding the transfer of a used unit to another household.

2.3.1 EUL Definition for Direct Savings from Avoided Use in Participant Households

For units that would have otherwise been kept at the premise, retention is defined as the premise's continuing not to have an extra refrigerator. Non-retention occurs when the premise has acquired another unit. Therefore, measure life for a particular participant and premise is the time until another unit was added. The EUL is the median time for all premises until another unit was added.

Unlike positive measures, the lack of a refrigerator or freezer does not necessarily ever "wear out." For would-be keepers, retention is defined as persistence of the type of measure (lack of an additional unit), not as persistence of the particular "anti-unit." Defining retention at premise level, not at the customer or household level removes the need to try to track participants who moved out of Southern California Edison territory.

2.3.2 EUL Definition for Indirect Savings from Avoided Transfers

For indirect savings, no specific households are identified where the program resulted in a more efficient unit (or none at all) being acquired. Therefore it is impossible to contact such households to determine if the more efficient unit is still in place or has been replaced by a less efficient unit. For this portion of the program, EUL is defined as remaining useful life in the refrigerator that would have otherwise been transferred within SCE territory.

2.4 DATA COLLECTION

Units that would have otherwise been kept

The primary data collection consisted of two surveys.
1. A survey of participants who have not moved.
2. A survey of current residents in households where the participant has moved.

Because moving may be a major reason why refrigerator ownership changes, retention cannot be assumed to be the same for movers as for non-movers. For this reason, the data collection and analysis must address both groups of participants. The information collected on each of the surveys is described below.

Both surveys were targeted to the premises for which responses were obtained to the 1994 and 1996 first-year impact study participant surveys. As part of these surveys, participants were asked the number of refrigerators and freezers in use at that time. Any replacement of removed

units to that time would in principle have been reflected in the first-year impact analysis. Thus, the retention study addresses measure "removals" or reversals since that time.

For both nonmoving participants and current occupants of homes from which the participant moved, the survey asked the number of refrigerators and of freezers in use in the home. The survey also asked the dates of each acquisition or discard of a unit since the participation date, or since the new occupant moved into the home.

In cases where the number of units currently in place was greater than the number in place as of the previous survey, the reported acquisition and discard dates were used to determine the date when the prior number was first exceeded. That date was set as the measure failure date. For new occupants of premises from which the participant had moved, if the number of units in place as of the new occupancy date exceeded the prior number, that date was set as the failure date. That is, it was assumed that measure reversal or failure occurred for that premise on the date the new occupant moved in.

Only those households that would otherwise have kept the unit if it had not been picked up by the program contributed to the savings component for the direct effect of measure removal. Households that would otherwise have discarded the unit contribute only to the savings related to the avoided transfer to the secondary market. The EUL estimate associated with replacement of removed units therefore applies only to the "would-be keeper" savings component, and should be based only on these households. Replacement rates are likely to be different for those households where the unit would otherwise have been kept than for those where the unit would have been discarded by some other means. For this reason, the follow-up surveys were targeted only to those premises classified as "would-be keepers" in the first-year impact analysis.

The number of respondents to the original and follow-up surveys are indicated in Table 2-1. Across the two program years total of 572 participant households were targeted for the follow-up survey, and surveys were completed with 353 of these.

Table 2-1
Follow-Up Retention Survey Sample

	1994			1996			Total		
	Nonmovers	Movers	Total	Nonmovers	Movers	Total	Nonmovers	Movers	Total
Respondents to first year impact evaluation			484			501			985
Classified as "would-be keeper"	232	46	278	281	13	294	513	59	572
Respondents to follow-up retention survey	124	23	147	197	9	206	321	32	353

2.5 1995 RASS DATA USED FOR REMAINING USEFUL LIFE CALCULATION

As noted, the EUL is the effective useful life. Age at disposal is known from the tracking system for all units. For units that would have otherwise been transferred within Edison's service territory, the effective useful life is the remaining useful life as a function of the age at disposition, assuming the unit was working when it was discarded.

Information on the remaining life of existing working units was developed from Edison's 1995 Residential Appliance Saturation Survey (RASS). This survey collected data on refrigerators that were disposed of by the survey respondents. The respondents were asked if the unit was working when they disposed of it and the age of the unit at disposition.

Also asked on the survey was the means by which the unit had been discarded. Units were considered to have come to the end of their working life if they were hauled away for disposal. Only these units were included in the construction of the life table used to determine the remaining useful life of units in the program. Units that were picked up by an appliance retailer, or given away or sold were assumed not to be at the end of their useful lives, and were not used in the analysis.

Clearly some units hauled away for disposal may have been refurbished and resold by the hauler. Conversely, some units picked up by the appliance retailer may have been junked after pick-up. These two errors in classifying units as failed based on the limited response options work in opposite directions. On balance, the classification scheme should provide a reasonable basis for estimating the distribution of ages at final disposal.

The disposal data set used for the calculation of remaining useful life also was limited to units that were working at the time of disposal. This restriction eliminated units that may have broken down a long time before they were finally discarded. Inclusion of such units would tend to overstate the age at failure, since the age at discard, not the age at failure, was obtained on the survey. On the other hand, the restriction to working units also eliminated units that broke down just before being discarded. This exclusion would be expected to understate somewhat the distribution of ages at the time of "death," where death is either the final breakdown or the final disposal not to another user.

The units included in the remaining useful life analysis are summarized in Table 2-2.

Table 2-2
Units Included in Remaining Useful Life Analysis from 1995 RASS

	Refrigerators		Freezers		Total	
	Respondents	Units	Respondents	Units	Respondents	Units
Total RASS respondents					10626	
Disposed of a unit	1704	1834	372	402	2076	2236
Unit working when discarded *	1309	1309	295	295	1604	1604
Hauled away for disposal *	508	508	121	121	629	629

* Asked only for last unit discarded.

2.6 SURVIVAL ANALYSIS FOR UNITS THAT WOULD HAVE BEEN KEPT

2.6.1 The General Survival Function

The survival function is a function $S(t;\theta)$ that gives the probability S of surviving to any positive time t, given the parameters θ. These parameters are estimated from the retention data. Once the

survival function parameters are estimated, median lifetime or EUL is determined as the time t^* such that $S(t;\theta) = 0.5$.

The estimation and application of the survival function requires the specification of the function's parametric form. This form is typically specified in terms of the *hazard function* $h(t;\theta)$. Roughly, the hazard function can be thought of as the instantaneous probability that of failing at time t, given that a unit has survived up to that time.

The survival probability $S(t;\theta)$ is one minus the probability $F(t;\theta)$ that a unit will die by time t. Formally, the hazard function is the ratio of the probability density function of the distribution $F(t,q)$ to the survival probability $S(t;\theta)$:

$$h(t;\theta) = (dF/dt)/S(t;\theta).$$

2.6.2 Choices of Parametric Forms for the Survival Function

Several parametric forms are in common use as hazard functions. Those explored in this study include the following:

- Gamma
- Weibull
- Exponential
- Log-normal
- Log-logistic

The Gamma function is the most general of these, and includes the Weibull, Exponential, and Log-normal as special cases. In essence, the Gamma function allows certain parameters to be determined by the data that are constrained by each of the other specifications. As a result, the Gamma function will be able to follow the empirical data most closely. If one of the other forms is a good description of the data, its results will be similar to those of the less constrained Gamma fit. If the other form is not a good match to the data, its results will be at odds with those of the Gamma fit. This "goodness-of-fit" can be formally tested by the log-likelihood test.

Similarly, the Weibull also includes the Exponential as a special case. The goodness of fit for the exponential form can be tested against the Weibull results, again using the log likelihood test.

The log-normal and log-logistic forms have decreasing hazard function, with an initial peak. This structure could make sense for unit replacement, if it's assumed that the chance of replacing the unit is relatively high after it's first discarded, because the participants discover they miss it after all. If the unit isn't replaced in the early period, the chance of replacement drops off.

The exponential form represents a constant hazard function. That is, the chance that a unit will fail in the next time increment, given that it's already survived to the current time, is the same no matter what the current time. This form is often used in survival analysis. In the context of this

program, the assumption of a constant chance of failure, i.e., of acquiring an additional unit, is plausible.

The Weibull form has an increasing hazard function. That is, the failure rate increases over time. This basic assumption is very reasonable for "positive" measures whose failure is associated with equipment breakdown, but is less compelling for measure replacement.

As noted, the Gamma form is the most general. Depending on the empirical data and the resulting parameters estimated, this form may produce an increasing, decreasing, or essentially constant hazard function.

2.6.3 Application of Survival Analysis to the Would-Be Keeper Retention Data

The participant follow-up sample provided data on whether the removed unit had been replaced, and the date of the replacement. The data were collected for both refrigerators and freezers.

A single survival model was fit for the combined data, including refrigerators and freezers for both program years. Model fits were attempted with each of the five hazard function forms indicated above. Outputs from each model fit included

- the estimated survival probability $S(t)$ for each time t from one to 50 years
- the estimated median survival time
- an 80 percent confidence interval for the median survival time.

Weighting for the Would-Be Keeper Measure Survival Analysis

The survival model combines premise retention data from four groups:

- 1994 participants who have not moved (nonmovers)
- 1994 participating premises from which the participant has moved since participating (movers)
- 1996 nonmovers
- 1996 movers.

It is possible that measure retention rates are different for movers than for nonmovers. If so, then it is important that each group be represented in the sample in proportion to its presence in the population. Otherwise the survival analysis results would be biased toward which ever group was proportionately over-represented.

To avoid such potential for bias, the sample was weighted according to the proportions of movers and nonmovers in the participating population for each program year. Specifically, for each year the weight for each group (mover, nonmover) was calculated as the ratio of the population proportion to the sample proportion. That is, the weight w_{yg} for each unit in group g in year y was calculated as

$$w_{gy} = (N_{gy}/N_y)/(n_{gy}/n_y)$$

where

N_{gy} = population total number of units turned in by participants in group g in year y
N_y = population total number of units turned in for year y
n_{gy} = number of units in the sample from group g in year y
n_y = total number of units in the sample for year y

With this weighting, the sum of the weights over all units in the sample is equal to the number of units in the sample for each year. As a result, the standard errors provided by a standard package are approximately correct.

Weighting the sample separately for each program year means that the information from each time period is valued equally in the estimation. The alternative would be to weight the units in each of the four groups according to its proportion of the combined population—1994 and 1996 participants. This approach would give more weight in the analysis to the 1994 units, because there were nearly 50 percent more units collected in 1994 than in 1996. That is, the fitted curve would tend to follow the failure pattern in the 1994 data more closely than that in the 1996 data.

However, the premise of the joint analysis of the two program years is that, in terms of measure failure rates, they can be treated as if they come from a single population. As far as the analysis is concerned, the only difference between the two groups is that they are observed at different lengths of time since participation. Information from these two time periods is equally important in determining the pattern of failure rates over time. Thus, observations from each time period are given the same weight in the analysis, adjusted only for differences between movers and nonmovers.

2.7 ESTIMATING REMAINING USEFUL LIFE FOR AVOIDED TRANSFERS

2.7.1 Estimated Life Table

The RASS data on age at final disposal was used to develop a life table, that is, the that a unit would survive to any given age. Only noncensored values—that is, units with known ages at the end of their life—were included in the analysis. The life table was estimated using the SAS LIFETEST procedure. This procedure provides a nonparametric fit of a survival curve to the data. The result is an estimated survival function value $S(t)$ for each time t, along with a confidence interval (at any specified confidence level).

In particular, an 80 percent confidence interval was obtained around the estimated survival curve $S(t)$. That is, for each value of t, corresponding to the estimated survival function value $S(t)$ were estimated lower and upper 80 percent confidence bounds $S^{-}(t)$ and $S^{+}(t)$.

A single survival function was estimated from the 1995 disposal data, and applied to all program years. The survival function combined refrigerator and freezer data on the age at disposal. An attempt was made to develop a separate survival function for freezers. However, there were

relatively few observations on freezers in the RASS disposal data set. The refrigerator survival function curve fell well inside the upper and lower confidence bounds of the freezer curve. On this basis, the two curves were considered to be not significantly different, and a single combined curve was estimted.

2.7.2 Estimated Remaining Useful Life Distribution for Each Program Year

The empirical survival function $S(t)$ was used to develop the distribution $R(t)$ of remaining useful life. For each value of elapsed time t, $R(t)$ is the probability that the unit will survive another t years from the time it was turned in. This distribution was developed separately for each program year, as follows.

For a unit whose current age is a, the distribution of remaining life is given by

$$R(t|a) = S(a+t|a) = S(a+t)/S(a)$$

That is, the chance of surviving an additional t years, given that a unit has already survived a years, is the chance that it will survive to a total age of $a+t$, given that it will survive to age a. This probability is simply the ratio of the chance of surviving to time $a+t$ to the chance of surviving to time a. For example, if there is a 30 percent overall probability of surviving to age 15, and a 10 percent overall probability of surviving to age 20, then 10/30 or 1/3 of the units that survive to age 15 will survive to age 20. That is,

$$R(5|15) = S(15+5|15) = S(15+5)/S(15) = S(20)/S(15) = 0.10/0.30 = 1/3.$$

For each program year, the number N_a of units turned in at age a was determined from the program tracking data. For a unit selected at random, of unspecified age at turn-in, the probability that the unit would survive an additional t years from the time of turn-in is given by

$$R(t) = \Sigma_a R(t|a) P(a) = \Sigma_a R(t|a) N_a/N$$

where

$P(a)$ = probability a unit selected at random had age a at the time it was turned in
N = total number of units in the program year.

In practice, some units did not have age at turn-in recorded in the tracking data. These units were excluded from the totals in determining the counts N_a and the total count N for purposes of this calculation. Implicitly, these units were assumed to have the same age distribution as those whose ages were reported.

The possibility was considered that the age distribution of units that would have been transferred may be different from that for units that would otherwise have been kept. The hypothetical disposition of units in the absence of the program is known only for the participants surveyed from the 1994 and 1996 programs. The keeper and discarder age distributions were compared

for the combined survey samples, and found to be almost identical. Based on this result, identifying a separate distribution for discarders alone was determined to be unnecessary. As a result, the age distribution could be based not just on the survey samples, but on the entire population data base. With this approach, it was possible to develop the age distribution separately for each program year.

Once the remaining useful life distribution was calculated for each time t, its median was found as the value t^* such that

$$R(t^*) = 0.5.$$

Repeating the above calculation using the lower and upper bound survival curves $S^-(t)$ and $S^+(t)$ in place of the estimate itself $S(t)$ in the formula for the remaining life distribution $R(t|a)$ provided corresponding bounds $R^-(t)$ and $R^+(t)$ for the remaining life distribution. The lower and upper confidence bounds for the median remaining life were calculated as the values t^- and t^+ such that

$$R^-(t^-) = 0.5$$
$$R^+(t^+) = 0.5.$$

This procedure attributes all the uncertainty in the estimated remaining life distribution to the uncertainty in the estimated life table $S(t)$. The distribution of ages at turn-in for each year is assumed to be known. This assumption is close to correct, since the great majority of units in the tracking system have ages reported. While there are likely to be reporting errors in these ages, the effect of such errors cannot be reflected in the confidence interval calculation unless some explicit assumption is made about their distribution. Lacking any information on these errors, they are assumed to be negligible in terms of the final estimate of median remaining useful life.

2.8 COMBINED EUL FOR THE TWO SAVINGS COMPONENTS

The survival analysis of the participant follow-up retention data provides the survival probabilities $S(t)$ and the median survival time t_k^* for the component of savings associated with units that would otherwise have been kept in the home. The remaining useful life analysis for each year provides the remaining-life probabilities $R(t)$ and the median remaining life t_D^* for the savings associated with avoided transfers to the secondary market. The combined effective useful life for the program must combine these two median lives.

The simplest way to combine the EUL's for the two program components would be to compute their savings-weighted average. This approach may give an approximately correct result, but is not strictly appropriate. In general, the median of an average is not the same as the average of corresponding medians. In this case, the median life of a measure that is an average of two savings components is not the same as the average of the median lives for those two components.

2.8.1 Combined Survival Curve for the Two Program Components

The approach used to develop an appropriate esitmate of the median life for the combined program effects is to develop a combined survival curve $S_c(t)$, and determine the median value on this curve. Consider an arbitrary kWh of savings associated with the program. If that kWh of savings came from a unit that would otherwise have been kept, its chance of surviving to time t is the "keepers" survival probability $S_k(t)$. If the savings came from a unit that would otherwise have been discarded, the chance that those savings will last at least t years is the remaining useful life probability $R(t)$. Thus, the overall chance that the kWh of savings will survive to time t is

$$S_c(t) = p_k S_k(t) + p_D R(t)$$

where

p_k = probability that a given kWh of savings came from a unit that would have been kept
p_D = probability that a given kWh of savings came from a unit that would have been discarded.

The EUL or median life of the combined program savings—i.e. the time when half the savings will be gone—is the time t_c^* such that

$$S_c(t_c^*) = 0.5.$$

The probabilities p_k and p_D are calculated as the fractions of first-year savings in each year attributed to would-be keepers and to would-be discarders, respectively. These calculations are based on the *ex post* savings determined from the first-year impact analysis. The evaluation of the 1994 program is used for program years 1994 and 1995, and the evaluation of the 1996 program for program years 1996 and 1997.

This mixing of the two probability curves can be understood as follows. For units that would otherwise have been kept, the survival curve $S_k(t)$ gives the probability that the effect of the program's picking up a particular unit will last until time t. This function can also be thought of as the fraction of the would-be keeper component of program savings that will still be in effect at time t. Likewise, for units otherwise discarded, the remaining useful life curve $R(t)$ is the chance that the effect of picking up a particular unit will last until time t. This function can also be thought of as the fraction of the avoided transfer component of program savings that will still be in effect at time t. Considering both program savings components, the combined fraction of savings still in effect at time t is the weighted average of the would-be keeper fraction $S_k(t)$ and the avoided transfer fraction $R(t)$, with weights equal to the proportions of program savings contributed by each component, as indicated above.

2.8.2 Confidence Interval for the Combined EUL

As discussed above, the separate analysis of the two program components provides an 80 percent confidence interval (t^-, t^+) for each component's EUL t^*. The corresponding approximate confidence bounds for the combined EUL are calculated as

$$t_c^- = t_c^* - \sqrt{p_k^2 (t_k^- - t_k^*)^2 + p_D^2 (t_D^- - t_D^*)^2}$$

$$t_c^+ = t_c^* + \sqrt{p_k^2 (t_k^+ - t_k^*)^2 + p_D^2 (t_D^+ - t_D^*)^2} \ .$$

3 RESULTS

3.1 OVERVIEW

The results of the analysis described in Section 2 are presented below. First, the estimation of the survival function and corresponding EUL for the direct effect of appliance removal is presented. Next, the remaining useful life curves and corresponding EUL's for the avoided discards in each program year are presented. Finally, the combined savings survival function and EUL are presented.

3.2 SAVINGS FROM UNITS OTHERWISE KEPT: SURVIVAL ANALYSIS OF THE DIRECT EFFECT OF APPLIANCE REMOVAL

For units that would otherwise have been kept, the participant premise follow-up surveys determined if the removed unit has been replaced, and if so the date when that replacement occurred. A standard survival analysis was applied to these measure retention data, with measure failure defined as replacement of the removed unit. Details of the data collection and classification rules were provided in Section 2.

Table 3-1 shows the fraction of premises where the removed appliance was replaced between the time of the first-year evaluation and the time of the follow-up survey, for each program year.

Table 3-1
Measure Failure Rates for Removed Appliances That Would Have Been Kept

	Replaced		Retained		Total	
Respondent Type	Number	Percent	Number	Percent	Number	Percent
1994 Nonmover	22	19.1%	93	80.9%	115	100%
1994 Mover	18	47.4%	20	52.6%	38	100%
1996 Nonmover	19	10.0%	171	90.0%	190	100%
1996 Mover	6	40.0%	9	60.0%	15	100%

Table 3-2 gives the weights assigned to each component of the sample. The weight is the ratio of the population proportion to the sample proportion for each program year. The sum of the weights over all units in the analysis is equal to the actual number of units in the sample for each program year. This method of weighting adjusts for disproportionate representation of movers and nonmovers in the responding sample, while ensuring that the standard errors produced by a packaged program using these weights are approximately correct.

Table 3-2
Relative Weights for the Analysis

Sample Group	Population Count of Units	Percent of Program Year	Sample Count of Units	Percent of Program Year	Weight
1994 Nonmovers	36,504	80.7%	115	75.2%	1.07
1994 Movers	8,744	19.3%	38	24.8%	0.78
1996 Nonmovers	28,057	78.0%	190	92.7%	0.84
1996 Movers	7,904	22.0%	15	7.3%	3.00

Table 3-3 shows the estimated EUL's or median lifetimes and corresponding 80 percent confidence bounds for each of the hazard function distributional forms explored. For all but the exponential form, the *ex ante* EUL of 6 years is within the estimated 80 percent confidence bounds. Thus, the *ex ante* EUL would be accepted by three of the four distributions.

Table 3-3
Estimated EUL for Direct Effect of Appliance Removal
(years)

	EUL	80% Confidence Interval		
Weibull	6.3	(5.0 ,	7.5)	
Gamma				
Exponential	10.2	(8.7 ,	11.8)	*
Log-normal	6.8	(5.8 ,	7.8)	
Log-logistic	6.6	(5.7 ,	7.4)	

* The *ex ante* EUL of 6 years does not fall within the 80 percent confidence interval. Formally, the *ex ante* EUL is rejected.

For the gamma function, the most general of the forms explored, the model did not converge. That is, there are too few failures at this point for the parameters of this form to be specified.

As described in Section 2, the exponential form can be tested against the Weibull when that form converges. This test rejects the exponential. That is, the more restrictive exponential form is inconsistent with the pattern in the data as indicated by the fitted Weibull distribution.

There is no firm basis for accepting or rejecting any of the other hazard function forms. All yield roughly similar EUL estimates and standard errors. The log-normal and log-logistic forms both have an initially high failure rate followed by a declining rate. In broad terms, this pattern makes sense. A certain fraction of customers find out in the early period after removal that they miss having the unit that was removed, and replace it. After that early period, replacements are more sporadic. The problem with attempting to fit a model of this form is that the fitted model may be

a reasonable description of the replacement rates within the period studied, but its projection to a time period twice as long as what was studied is of unknown validity. In particular, the extension of the declining failure rate over time may not be a good description of the failure patterns after several years.

The Weibull, which allows a steadily increasing failure rate over time, avoids this problem. For this reasons, the Weibull result was taken as the final estimate for this component of program savings. The other two forms give slightly higher EUL's, but none gives a value significantly different from the *ex ante* EUL, at the 20 percent significance (80 percent confidence) level.

With the Weibull distribution, the EUL is estimated at 6.3 years. This value and the associated survival function are used in the calculation of the EUL for the combined program. Before the combined EUL can be developed, however, the persistence of savings due to avoided transfers must be studied.

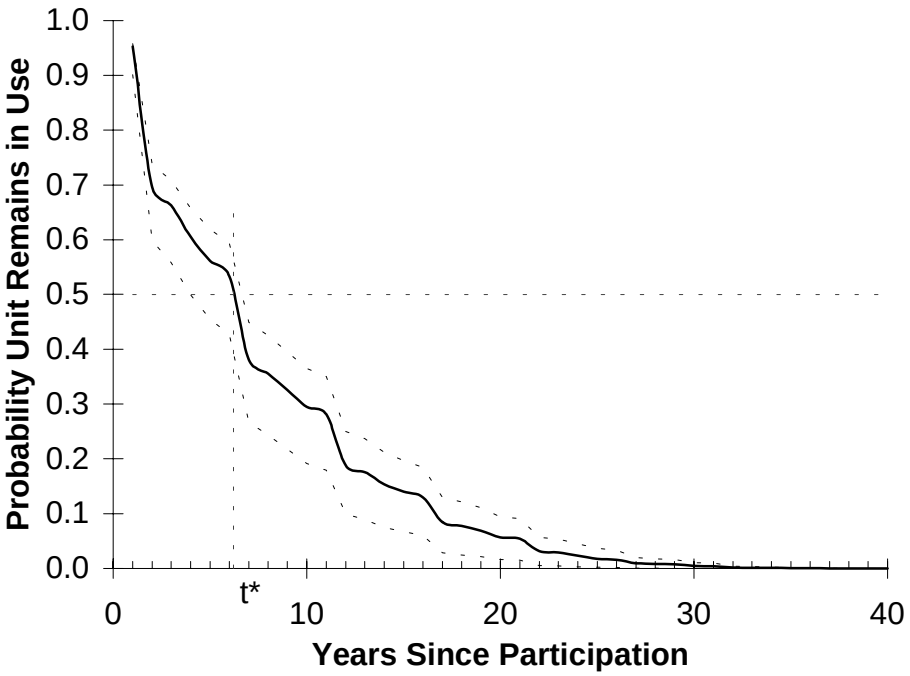
3.3 SAVINGS FROM UNITS OTHERWISE DISCARDED: REMAINING USEFUL LIFE ANALYSIS FOR AVOIDED TRANSFERS

Figure 3-1 shows the empirical survival curve *S(t)* based on the RASS data on ages of units at final disposal. For each time *t* the figure shows the probability that a unit will survive to age *t*. Also shown in the figure are the upper and lower bounds $S^{+}(t)$ and $S^{-}(t)$ of an 80 percent confidence interval around the survival probability at each time *t*.

Figure 3-2 shows the remaining useful life curve *R(t)* based on applying the tracking-system distribution of ages at disposal to the survival curve *S(t)*. For each time *t*, the figure shows the probability that a unit picked up by the program would have remained in use an additional *t* years if transferred to another user instead. Also shown in Figure 3-2 are upper and lower bounds for an 80 percent confidence interval around the probability of remaining in use an additional *t* years. The construction of the remaining useful life curve $R(t)$ and corresponding upper and lower bounds from the survival curve $S(t)$ and its bounds is described in Section 2.7 above.

Figure 3-1
Empirical Survival Curve for Age at Final Disposal
Based on 1995 RASS

Figure 3-2
Remaining Useful Life Curve for Avoided Transfers, 1994 Program



As can be seen from Figure 3-2, the median remaining useful life—that is, the time when the probability of remaining in use an additional *t* years is equal to 50 percent—is 6.2 years. The corresponding points on the lower and upper bound curves give the lower and upper bounds for the estimated median.

The curve shown in Figure 3-2 is for program year 1994. A similar shape was found for the other years. Table 3-4 shows the median remaining useful life and 80 percent confidence bounds for each program year. These are the EUL estimates for the portion of savings due to avoiding transfers to the secondary market.

Table 3-4
EUL for Avoided Transfers, by Program Year
(years)

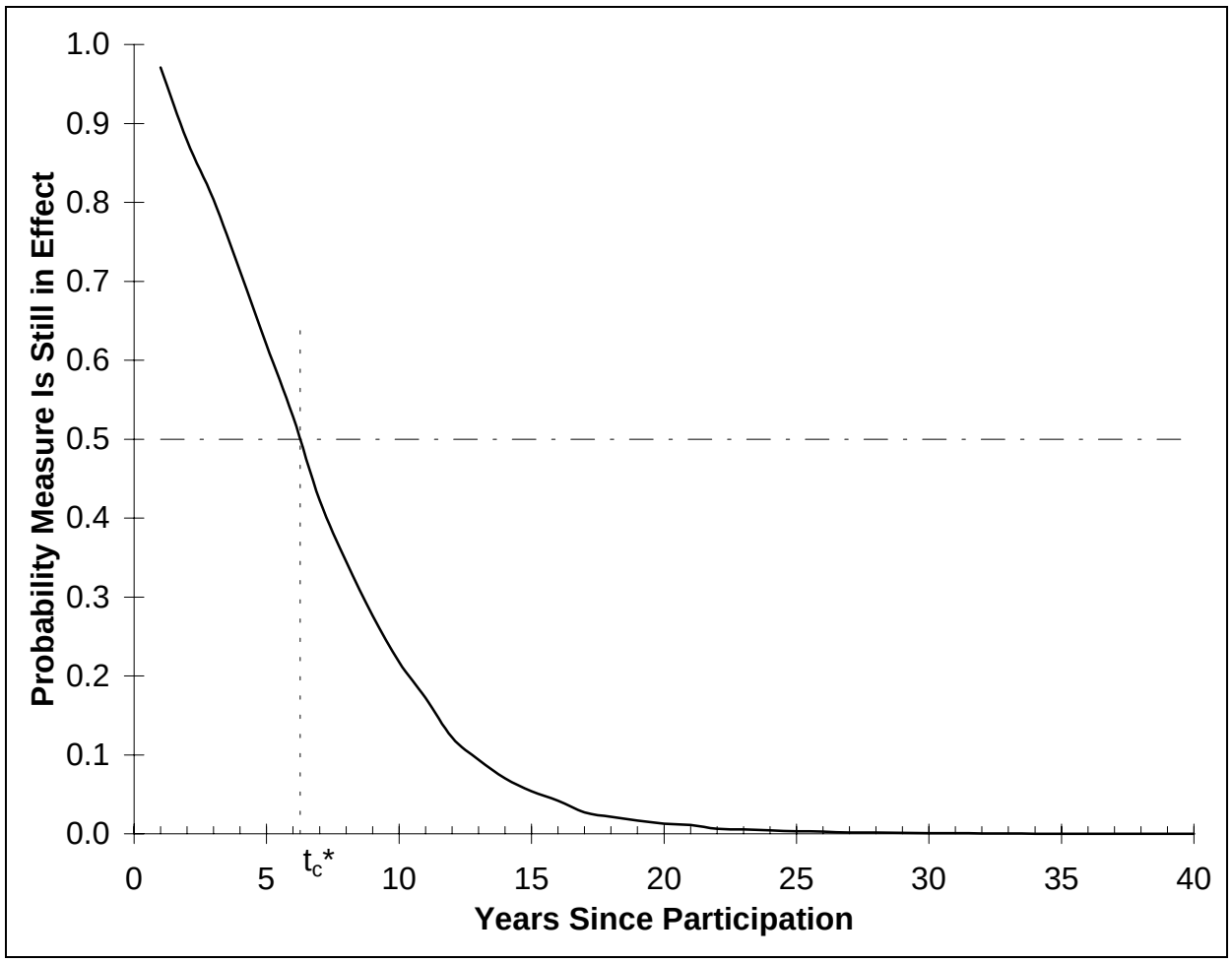
Program Year	EUL	80% Confidence Interval Lower	Upper	
1994	6.2	4.0	6.6	
1995	6.1	3.6	6.6	
1996	4.1	1.9	5.9	*
1997	4.6	2.3	6.0	

*80 percent confidence bound does not include the *ex ante* EUL of 6 years. The *ex ante* value is rejected.

3.4 COMBINED EUL FOR THE TWO PROGRAM SAVINGS COMPONENTS

Figure 3-3 shows the combined survival curve for the two program savings components. As described in Section 2-8 above, this curve is a weighted average of the survival curve $S_k(t)$ for the would-be keeper component and the remaining useful life curve $R(t)$ for the avoided transfer component. The weights are the proportions of program *ex post* savings attributable to the two components.

Figure 3-3
Combined Survival Curve for Direct Effects of Appliance Removal and Avoided Transfers
1994 Program



The median survival time on this curve is 6.3 years. This curve is for the 1994 program year. Table 3-5 summarizes the results for all program years. Included in the table are the 80 percent confidence bounds obtained by combining the confidence bounds for the two program components, as described in Section 2.

Table 3-5
EUL for the Combined Program Effects
(years)

Program Year	EUL	80 Percent Confidence Lower	80 Percent Confidence Upper
1994	6.3	5.5	6.9
1995	6.2	5.5	6.9
1996	6.0	5.3	6.8
1997	6.1	5.3	6.7

*80 percent confidence bound does not include the *ex ante* EUL of 6 years. The *ex ante* value is rejected.

The estimated EUL's for the combined program range from 6.0 to 6.3 across the four program years. None of these *ex post* EUL estimates is significantly different from the *ex ante* value of 6 years at the 20 percent significance (80 percent confidence) level. That is, the 80 percent confidence interval includes the *ex ante* value. Thus, the *ex ante* EUL of 6 years is retained for all four years. Indeed, the results of this study appear to provide good confirmation of that value.

A

SURVEY INSTRUMENTS

A.1 PARTICIPANT & NEW OCCUPANT SURVEY

A.2 1995 RESIDENTIAL APPLIANCE SATURATION SURVEY

DRAFT
Telephone Survey

Prepared by
XENERGY Inc.

I. INTRODUCTION SECTION

Good morning/afternoon/evening. I'm _____ calling from Luth Research, an independent research company, on behalf of Southern California Edison. We are conducting a brief follow-up to a survey conducted a couple of years ago to learn about refrigerators and freezers in Southern California Edison territory. (IF ASKED) This will only take about 5 minutes of your time.

SC1 First, I want to make sure that I reached you at [*ADDRESS*]. Is this your correct address?
Yes [*SKIP TO REM1*] 1
No 2
Don't know 99

SC2 Is that an address that you are responsible for, or were in [*PROGRAM YEAR*]?
Yes 1
No (THANK AND TERMINATE) 2
Don't know (THANK AND TERMINATE) 99

[*IF SC2=1 THEN* READ]: The following questions are about the home you are/were responsible for in [*PROGRAM YEAR*]. Please answer these questions for [*ADDRESS*] to the best of your ability.

REM1 [*IF MOVER* READ] To the best of your knowledge [*ALL*]Was there any major remodeling or renovation performed at [*ADDRESS*] since [*THE YEAR BEFORE PROGRAM YEAR*]?
Yes 1
No 2
Don't Know *[SKIP TO R1]* 99

REM2 [IF REM1=YES] Was this a remodeling of the kitchen?
Yes 1
No 2
Don't Know 99

R. *ASK IF PREMISE HAD REFRIGERATOR RECYCLED*

READ: I would now like to ask you some questions about the refrigerators you have in your home

R1 How many refrigerators do you have in your home?

Zero.....0
One.....1
Two.....2
Three.....3
Four.....4
Five.....5
Other (SPECIFY_____).....6
Don't Know/Refused.....99

READ: First I would like to ask you a few questions about your main refrigerator.

R2_a1 [*FIRST REFRIGERATOR*] About how many months of the year is this refrigerator plugged in and running? (READ LIST IF NECESSARY.)

None	1
Less than one month	2
1 - 3 months	3
4 - 6 months	4
7 - 9 months	5
10 - 11 months	6
All year/12 months[*SKIP TO R2_c1]*	7
Don't know	99

R2_b1 [*FIRST REFRIGERATOR*] Is the refrigerator plugged in and running only during certain seasons, holiday times or special events?

Yes (SPECIFY):_____	1
No	2
Don't know	99

R2_c1 [*FIRST REFRIGERATOR STAYERS*] Did your household acquire this unit before or after [*PREVIOUS SURVEY DATE*]? (IF DON'T KNOW PROBE WITH: This was the date when last spoke to someone at this address.)

Before.....1
After.....2
Don't know.....99

R2_d1 [*FIRST REFRIGERATOR MOVERS*] When did you get that unit? Was it--

In the home when you moved in.....1
One you brought with you when you moved in.....2
One you acquired after you moved in.....3
Don't Know.....99

R2_e1m and R2e1_y [or R2e1_s] FIRST REFRIGERATOR[*IF R2_d1=3*] Approximately when did your household acquire the unit? Month ____ Year_____ Season _____
(IF UNSURE OF MONTH PROBE FOR SEASON)

READ *IF R1 IS MORE THAN ONE*: Now I would like to ask you some questions about your first spare refrigerator [then second...] [CODING *NOTE: SECOND REFRIGERATOR WILL HAVE SAME CODES FOR QUESTION 2 BUT A "2" ON THE END, THIRD UNIT WILL HAVE A "3" ON THE END, ETC.]*

ONCE R2s ARE ANSWERED FOR EACH REFRIGERATORS CONTINUE WITH R3

R3 [*STAYERS ONLY*] Our records from the last time we talked to your household indicate that you had [*READ #*] of operating refrigerators on [*PREVIOUS SURVEY DATE*]. Does that sound right?

Yes [*SKIP TO R5*].....1
No.....2
Don't Know.....99

R4 [*IF R3 = NO or R3=Don't Know*] How many refrigerators do you think you had at that time?

Zero.....0
One.....1
Two.....2
Three.....3
Four.....4
Five.....5
Other (SPECIFY_____).....6
Don't Know.....99

R5 [*IF ANY OF R2C_1, R2C_2...= 2 OR ANY R2D_1 R2D_2...=3*] You just told me that your household acquired [a] refrigerator[s] *at [READ DATES FROM R2_e1m...R2_e...*] Is that the complete and correct list of all the refrigerators your household has acquired since [*STAYERS-PREVIOUS SURVEY DATE, MOVERS-ESTABDT*]? (IF NO CORRECT LIST AND DATES OF CURRENT HOLDINGS. ALSO LIST AS OPEN ADDITIONAL UNITS ACQUIRED BUT NO LONGER IN THE HOUSEHOLD.)

R6 Has your household [*IF Q5 NOT ASKED*] acquired or [*ALL*] discarded any refrigerators since [*STAYERS-LAST SURVEY DATE; MOVERS-ESTABDT*]?

Yes 1
No 2
Don't Know 99

R7 [*IF R6 = YES AND R5 NOT ASKED*] How many refrigerators has your household acquired since that time, and what was the approximate date of each? [*CODE AS Q7_R1_m, Q7_R1_y...]*

R8 [*IF R6 = YES*] How many refrigerators has your household discarded since that time, and what was the approximate date of each? [*CODE AS Q8_R1_m, Q8_R1_y...*]

CHECKS:

a. *IS NUMBER CURRENTLY IN HOUSEHOLD = # FROM PREVIOUS SURVEY + # ACQUIRED SINCE - # DISCARDED SINCE?*
b. *IS NUMBER CURRENTLY IN HOUSEHOLD = # FROM R4 + # ACQUIRED SINCE - # DISCARDED SINCE?*

IF NEITHER A NOR B IS TRUE, PROBE TO CORRECT.

R9. (IF MOVER) If there would have been (if only one of r2_d1=1 or R2_d2=1 or...)a (if at least two of the r2_d questions=1) an additional refrigerator left in the home when you moved in, do you think you would have done anything differently in terms of the refrigerators you moved with you, the refrigerators you acquired since you moved in, or the refrigerators you discarded since you moved in?

Probably Yes 1
Probably No 2
Don't Know 22
Refused 23

R10 (IF R9=1 and MOVER) What would you have done differently? (NOTE TO INTERVIEWER : WE ARE LOOKING FOR DIFFERENCES IN NUMBERS AS WELL AS WHEN THEY WOULD HAVE DONE SOMETHING)

Open Response(SPECIFY) 20
Don't Know 22
Refused 23

[END OF SECTION]

F. *ASK IF PREMISE HAD FREEZER RECYCLED*

READ: I would now like to ask you some questions about the freezers you have in your home

F1 How many freezers do you have in your home?

Zero....0
One....1
Two....2
Three....3
Four....4
Five....5
Other [*SPECIFY_____]*....6
Don't Know....99

IF F1 IS MORE THAN ONE READ: I would like to ask you some questions about the first of these freezers

F2_a1 [*FIRST FREEZER*] About how many months of the year is this freezer plugged in and running? (READ LIST IF NECESSARY.)

None	1
Less than one month	2
1 - 3 months	3
4 - 6 months	4
7 - 9 months	5
10 - 11 months	6
All year/12 months [*SKIP TO F2_C1*]	7
Don't know	99

F2_b1 [*FIRST FREEZER*] Is the freezer plugged in and running only during certain seasons, holiday times or special events?

Yes (SPECIFY):_____	1
No	2
Don't know	99

F2_c1 [*FIRST FREEZER STAYERS*] Did your household acquire that unit before or after [*PREVIOUS SURVEY DATE*]?

Before....1
After....2
Don't Know....99

F2_d1 [*FIRST FREEZER MOVERS*] When did you get that unit. Was it--

In the home when you moved in.....1
One you brought with you when you moved in.....2
One you acquired after you moved in.....3
Don't Know.....99

F2_e1m and F2e1_y [or F2e1_s] *FIRST FREEZER* [IF F2_d1=3] Approximately when did your household acquire the unit? Month _____ Year _____ Season _____
(IF UNSURE OF MONTH PROBE FOR SEASON)

IF MORE THAN ONE FREEZER IN F1 READ: Now I would like to ask you some questions about the second freezer. [CODING *NOTE: SECOND FREEZER WILL HAVE SAME CODES BUT A "2" ON THE END, THIRD FREEZER WILL HAVE A "3" ETC.]*

ONCE F2s ARE ANSWERED FOR EACH FREEZER CONTINUE WITH F3

F3 [*STAYERS ONLY*] Our records from the last time we talked to your household indicate that you had [*READ #*] of operating freezers in [*PREVIOUS SURVEY DATE*]. Does that sound right?

Yes.....1
No.....2
Don't Know.....99

F4 [*IF F3 = NO OR F3=DON'T KNOW*] How many freezers do you think you had at that time?

Zero.....0
One.....1
Two.....2
Three.....3
Four.....4
Five.....5
Other [*SPECIFY*_____].....6
Don't Know.....99

F5 [*IF ANY Of F2C_1, F2C_2...= 2 OR ANY F2D_1 F2D_2...=3*] You just told me that your household acquired [a] freezer[s] at [READ DATES FROM F2_e1m...F2_e...] Is that the complete and correct list of all the freezers your household has acquired since [STAYERS-DATE OF LAST SURVEY, MOVERS-ESTABDT]? [*IF NO CORRECT LIST AND DATES OF CURRENT HOLDINGS. ALSO LIST AS OPEN ADDITIONAL UNITS ACQUIRED BUT NO LONGER IN THE HOUSEHOLD*.]

F6 Has your household [*IF F5 NOT ASKED*] acquired or [*ALL*] discarded any freezers since [*FOR STAYERS-DATE OF LAST SURVEY; FOR MOVERS-ESTABDT*]?

Yes 1
No 2
Don't Know 99

F7 [*IF F6 = YES AND F5 NOT ASKED*] How many freezers has your household acquired since that time, and what was the approximate date of each? [*CODE AS Q7_F1_m, Q7_F1_y...*]

F8 [*IF F6 = YES*] How many freezers has your household discarded since that time, and what was the approximate date of each? [*CODE AS Q8_F1_m, Q8_F1_y...]*

CHECKS:

a. IS NUMBER CURRENTLY IN HOUSEHOLD = # FROM PREVIOUS SURVEY + # ACQUIRED SINCE - # DISCARDED SINCE?
b. IS NUMBER CURRENTLY IN HOUSEHOLD = # FROM F4 + # ACQUIRED SINCE - # DISCARDED SINCE?

IF NEITHER A NOR B IS TRUE, PROBE TO CORRECT.

F9. (IF MOVER) If there would have been (if only one of f2_d1=1 or f2_d2=1 or...)a (if at least two of the f2_d questions=1) an additional freezer left in the home when you moved in, do you think you would have done anything differently in terms of the freezers you moved with you, the freezers you acquired since you moved in, or the freezers you discarded since you moved in?

Yes 1
No 2
Don't Know 22
Refused 23

F10 (IF F9=1 AND MOVER) What would you have done differently? (NOTE TO INTERVIEWER : WE ARE LOOKING FOR DIFFERENCES IN NUMBERS AS WELL AS WHEN THEY WOULD HAVE DONE SOMETHING)

Open Response(SPECIFY) 20
Don't Know 22
Refused 23

[END OF SECTION]

ASK OF ALL

READ: These final questions are for comparison purposes only.

HH. HOUSEHOLD CHARACTERISTICS AND DEMOGRAPHICS SECTION

D1 How long have you lived at this address (IF NECESSARY, READ LIST) Has it been ..?

- Less than one year 1
- One to two years 2
- Two to three years 3
- Three to five years 4
- Five to ten years 5
- More than ten years 6
- Don't know 999

D2 Including yourself, how many people live in your home at least six months of the year?

- Number of persons ..... _____

D3 What is the highest level of education you have completed?

- Eighth grade or less 1
- Some high school 2
- Graduated high school 3
- Some college or technical school 4
- Graduated college or technical school 5
- Post graduate work 6
- Refused 888

D4 Which of the following categories best describes your total household income during 1997, before taxes?

- Less than $10,000 1
- $10,000 to under $20,000 2
- $20,000 to under $30,000 3
- $30,000 to under $40,000 4
- $40,000 to under $50,000 5
- $50,000 to under $75,000 6
- $75,000 to under $100,000 7
- Over $100,000 8
- Refused 888

READ: Those are all of my questions. Thank you very much for taking the time to participate in this study.

SOUTHERN CALIFORNIA EDISON <<LOGO>>

1995 RESIDENTIAL APPLIANCE SURVEY

Please complete the survey and return it in the enclosed postage paid envelope to the address below:

Southern California Edison
c/o XENERGY
492 9th Street, Suite 220
Oakland, California 94607-4048

When answering the survey questions, please put a check mark (√ or X) in the oval that best represents your answer for each question. Several questions ask you to check all of the answers that apply to this home. For some questions, you are asked to write your answer in a box. Instructions appear throughout the survey in red.

Do your best to answer all of the questions. If you do not know the answer to one of the questions, please move on to the next one. If you would like help in completing the survey, you can call 1-800-362-7413 from 9 a.m. to 5 p.m. Monday through Friday.

Si usted gusta completar su formulario en Espanol por telefono, por favor llame al 1-800-362-7413.

Service Address Label TRACKN
Name & mail address label

Please fill out the survey for the home at the address to the left.
←

XENERGY

THE HOME

DWLTYPE

1. What type of building is this home?

- 1 ❍ Single Family Home--One story
- 2 ❍ Single Family Home--Two or more stories or split level
- 3 ❍ Townhouse
- 4 ❍ Duplex, Triplex, or Quadplex
- 5 ❍ Low Rise Apartment/Condo with more than 4 units-- *(1 to 2 stories)*
- 6 ❍ High Rise Apartment/Condo with more than 4 units-- *(3 or more stories)*
- 7 ❍ Mobile Home
- 8 ❍ Other (PLEASE DESCRIBE):_____ DWLOTRD

OWNRENT

2. Is this home occupied by an owner or by a renter?

1 ❍ Owner-occupied 2 ❍ Renters live in this home

BUILTYR

3. Approximately what year was this home built? (*If you don't know, please provide your best guess.)*

- 1 ❍ After 1990
- 2 ❍ 1987 - 1990
- 3 ❍ 1983 - 1986
- 4 ❍ 1979 - 1982
- 5 ❍ 1975 - 1978
- 6 ❍ 1970 - 1974
- 7 ❍ 1965 - 1969
- 8 ❍ 1960 - 1964
- 9 ❍ 1950 - 1959
- 10 ❍ 1940 - 1949
- 11 ❍ Before 1940

YRS_RES

4. How many years have you owned or lived in this home?

- 1 ❍ Less than one year
- 2 ❍ 1 - 5 years
- 3 ❍ 6 - 10 years
- 4 ❍ 11 - 15 years
- 5 ❍ 16 - 30 years
- 6 ❍ More than 30 years

NGSERV

5. Is there natural gas (piped) service at this home?

1 ❍ Yes 2 ❍ No

6. Does this home have any of the following? *(Please mark ALL that apply.)*

ATTIC 1 ❍ An attic space between the ceiling and the roof

VAULT 1 ❍ Vaulted or cathedral ceilings

WOODFRM 1 ❍ Woodframe construction with wood or stucco exterior walls

MASONRY 1 ❍ Masonry construction (block or brick exterior walls)

CRAWL 1 ❍ A basement or crawl space beneath the ground floor

NUMROOM

7. How many <u>rooms</u> are in this home? (Do not count bathrooms, garages, and halls.) ☐

BEDROOM

8. How many <u>bedrooms</u> are in this home? ☐

SQFT

9. How many square feet of living space are in this home? (Do not include garage area.)

If you know the square footage of this home, please write it here: ➔ ☐

OR

If you are unsure of the square footage of this home, please check the square foot category in which you think this home belongs.

1 ❍ less than 500	5 ❍ 1,250 to 1,499	9 ❍ 2,250 to 2,499
2 ❍ 500 to 749	6 ❍ 1,500 to 1,749	10 ❍ 2,500 to 2,749
3 ❍ 750 to 999	7 ❍ 1,750 to 1,999	11 ❍ 2,750 to 2,999
4 ❍ 1,000 to 1,249	8 ❍ 2,000 to 2,249	12 ❍ 3,000 or more

ALS_J93

10. Have you added more living space to this home since January 1, 1993?

1 ❍ Yes ➔ When was it added? ➔ Month: ALSMN / Year: ALSYR

2 ❍ No

How many square feet were added? ☐ ALSSQFT

11. Which of the following energy conservation measures are in the home?

		Yes, throughout the house	Yes, in parts of the house	No	Don't Know
SMCINS	Ceiling insulation	1 ❍	2 ❍	3 ❍	4 ❍
SMWINS	Wall insulation	1 ❍	2 ❍	3 ❍	4 ❍
SMFINS	Floor insulation	1 ❍	2 ❍	3 ❍	4 ❍
SMIWS	Interior window shades or blinds	1 ❍	2 ❍	3 ❍	4 ❍
SMEWS	Exterior window shading	1 ❍	2 ❍	3 ❍	4 ❍
SMTWD	Thermal Windows (double paned or greater)	1 ❍	2 ❍	3 ❍	4 ❍

ASUMDAY

12. Generally speaking, how often does a member of this household use electrical appliances or equipment on summer weekdays (Monday-Friday) between 12 noon and 4 p.m.?

1 ❍ Very Often (3-5 weekdays per week)

2 ❍ Occasionally (1-2 weekdays per week)

3 ❍ Rarely or Never (less than 1 weekday per week)

ELWIRRP

13. Within the last 2 years, have you required the services of an electrician to repair or install electrical wiring in your home?

1 ❍ Yes 2 ❍ No

HEATING

HTSYSTYP

14. Does the heating system serve only this home or does it serve more than one home or apartment?

- 1 ❍ Heating system serves only this home
- 2 ❍ Heating system serves more than one home or apartment ➔ Go to Question #19
- 3 ❍ No heating system at this home ➔ Go to Question #19

15. Which of the following heating systems are used at this home?

Type of Heating System(s)	All Systems: Check all heating systems that are used at this home.	Primary System: Check the one system used the most at this home.
Natural Gas Heating	⬇	⬇
Central furnace with ducts to more than one room	HTNGCNT 1 ❍	PHTNGCNT 1 ❍
Floor or wall furnace with no ducts	HTNGFLR 1 ❍	PHTNGFLR 2 ❍
Hot water or steam (upright radiators or baseboards)	HTNGH2O 1 ❍	PHTNGH2O 3 ❍
Don't know type	HTNGDK 1 ❍	PHTNGDK 4 ❍
Electric Heating		
Central heat pump with ducts to more than one room	HTELCHP 1 ❍	PHTELCHP 5 ❍
Window/wall heat pump	HTELWHP 1 ❍	PHTELWHP 6 ❍
Central resistance heater with ducts to more than one room	HTELCRH 1 ❍	PHTELCRH 7 ❍
Floor or wall resistance heaters with no ducts	HTELFLR 1 ❍	PHTELFLR 8 ❍
Baseboard heaters	HTELBSB 1 ❍	PHTELBSB 9 ❍
Portable heaters	HTELPTH 1 ❍	PHTELPTH 10 ❍
Radiant ceiling	HTELRCL 1 ❍	PHTELRCL 11 ❍
Don't know type	HTELDK 1 ❍	PHTELDK 12 ❍
Wood Heat		
Wood stove	HTWDWS 1 ❍	PHTWDWS 13 ❍
Fireplace	HTWDFP 1 ❍	PHTWDFP 14 ❍
Don't know type	HTWDDK 1 ❍	PHTWDDK 15 ❍
Bottled Gas Heat: propane, butane, or kerosene		
Central furnace with ducts to more than one room	HTBGCNT 1 ❍	PHTBGCNT 16 ❍
Floor or wall furnace with no ducts	HTBGFLR 1 ❍	PHTBGFLR 17 ❍
Portable heaters	HTBGPTH 1 ❍	PHTBGPTH 18 ❍
Don't know type	HTBGDK 1 ❍	PHTBGDK 19 ❍
Solar Heating with Collector Panels		
Solar with Gas back-up	HTSLGB 1 ❍	PHTSLGB 20 ❍
Solar with Electric back-up	HTSLEB 1 ❍	PHTSLEB 21 ❍
Other solar (please describe): HTSLOTRD	HTSLOTR 1 ❍	PHTSLOTR 22 ❍
Other System (please describe): HTOTSYSD	HTOTSYS 1 ❍	PHTOTSYS 23 ❍

Please answer Questions 16 - 18 for the primary heating system. (The primary system is the one used the most.)

HTCTLTYP

16. What type of temperature control is on the primary heating system? (Mark ONE answer only.)

- 1 ❍ Regular thermostat(s) with temperature settings
- 2 ❍ Clock or programmable thermostat(s)
- 3 ❍ Dial control without temperature settings
- 4 ❍ Simple on/off switch or no temperature control
- 5 ❍ Other: _____ HTCTLTPO

HTCTLBEV

17. Which of the following statements best describes how the primary system is used when someone is home?

- 1 ❍ The thermostat(s) is kept at a constant setting or temperature
- 2 ❍ The thermostat setting changes based on the time of day
- 3 ❍ The heater is turned on only when someone is cold
- 4 ❍ We rarely use this heating system

HTSYSAGE

18. How old is the primary heating system?

- 1 ❍ New (Purchased after January 1, 1993) ➔
- 2 ❍ 2 - 4 years old
- 3 ❍ 5 - 9 years old
- 4 ❍ 10 - 19 years old
- 5 ❍ 20 - 29 years old
- 6 ❍ 30 or more years

If new, when was it installed?	
Month:	HTSPMN
Year:	HTSPYR

↓

What type of energy was used by the old heater?	
1 ❍ Natural Gas	HTSPOLD
2 ❍ Electric	
3 ❍ Propane	
4 ❍ Other: _____	HTSPODOD

COOLING

CLWWNUM

19. How many wall or window air conditioners are in this home?

0 ❍ None ➔ **Go to Question #21** 1 ❍ One 2 ❍ Two 3 ❍ Three or more

20. What are the ages of these wall/window air conditioners?

	Unit #1	Unit #2	Unit #3
New (Purchased after January 1, 1993)	1 ❍	1 ❍	1 ❍
2 - 4 years	2 ❍	2 ❍	2 ❍
5 - 9 years	3 ❍	3 ❍	3 ❍
10 - 19 years	4 ❍	4 ❍	4 ❍
20 years or more	5 ❍	5 ❍	5 ❍
	CLW1AGE	CLW2AGE	CLW3AGE

➔

If new, when was the new unit installed?	
Month:	CLPWMN
Year:	CLPWYR

↓

Did it replace an older unit?	
1 ❍ Replacement	CLPWRA
2 ❍ New addition	

CLEVNUM

21. How many <u>evaporative coolers</u> (swamp coolers) are in this home?

0❍ None 1❍ One 2❍ Two 3❍ Three or more

22. Are any of the following fans used in this home?

		Yes	No
FNATTIC	Attic (power ventilator)	1❍	2❍
FNCEIL	Ceiling	1❍	2❍
FNPORT	Portable	1❍	2❍
FNWHOLE	Whole house	1❍	2❍

CLCSYTYP

23. Is there a <u>central</u> air conditioning system (other than fans) in this home?

1❍ Yes, and it serves this home only
2❍ Yes, but it serves more than one home or apartment ➔ **Go to Question #28**
3❍ No ➔ **Go to Question #28**

CLCNTTYP

24. What type of central air conditioning system is in this home?

1❍ Electric central system
2❍ Natural gas central system **(This is a very rare system - please verify.)**

CLCNTAGE

25. How old is your central air conditioning system?

1❍ New (Purchased after January 1, 1993) ➔
2❍ 2 - 4 years old
3❍ 5 - 9 years old
4❍ 10 - 19 years old
5❍ 20 - 29 years old
6❍ 30 or more years

If new, when was it installed?	
Month:	CLPCLMN
Year:	CLPCLYR

⬇

Did it replace an older air conditioner?	
1❍ Replacement	CLPCLRA
2❍ New addition	

CLCTLBEV

26. Which of the following statements best describes how the home is cooled when someone is home?

1❍ The thermostat(s) is kept at a constant setting or temperature
2❍ The thermostat setting changes based on the time of day
3❍ The air conditioner is turned on only when someone is hot
4❍ We rarely use the air conditioner(s): ➔ **Go to Question #28**

CLSUMDAY

27. During hot summer <u>weekdays</u> between 12 noon and 4 p.m., how often is air conditioning used?

1❍ Rarely or Never 3❍ 3-5 weekdays per week
2❍ 1-2 weekdays per week

HTCLMNT

28. Have you had a service professional repair or perform routine maintenance on your heating or cooling system within the last two years?

3❍ No 1❍ Yes, repair work was performed within the last 2 years
2❍ Yes, routine maintenance was performed within the last 2 years

COOKING

CKTYPE

29. What type of cooking equipment is in this home?

1 ❍ Combination stove-top/oven
2 ❍ Separate stove-top and oven

CKRNTYP

30. What type of stove-top is in this home?

1 ❍ Electric
2 ❍ Natural gas
3 ❍ Bottled gas (LP, propane, butane)
4 ❍ Other
5 ❍ None

CKOVTYP

31. What type of oven is in this home? (Do not include microwave ovens.)

1 ❍ Electric
2 ❍ Natural gas
3 ❍ Bottled gas (LP, propane, butane)
4 ❍ Other
5 ❍ None

CKMEAL

32. How often are hot meals typically prepared at this home?

1 ❍ Twice or more per day
2 ❍ Once per day
3 ❍ A few times a week
4 ❍ Once a week or less

CKRN_J93

33. Have you installed a new stove-top in this home since January 1, 1993?

1 ❍ Yes →
2 ❍ No

If yes, when was it installed?
Month: CKRNPMN
Year: CKRNPYR

↓

What type of energy was used by the old stove-top?
1 ❍ Natural Gas CKRNPOLD
2 ❍ Electric
3 ❍ Other: _____ CKRNODOD

CKOV_J93

34. Have you installed a new oven in this home since January 1, 1993? (Do not include microwave ovens.)

1 ❍ Yes →
2 ❍ No

If yes, when was it installed?
Month: CKOVPMN
Year: CKOVPYR

↓

What type of energy was used by the old oven?
1 ❍ Natural Gas CKOVPOLD
2 ❍ Electric
3 ❍ Other: _____ CKOVODOD

WATER HEATING

WHSYSTYP

35. Does the water heating system serve only this home or does it serve more than one home or apartment?

1 ❍ Water heater(s) serves only this home
2 ❍ Water heater(s) serves more than one home or apartment ➔ Go to Question #39
3 ❍ This home has no hot water ➔ Go to Question #39

WHSYSNUM

36. How many water heaters are at this home?

1 ❍ One 2 ❍ Two 3 ❍ Three or more

Please answer Questions 37 and 38 for the primary water heater (the one that is used the most).

37. What type(s) of energy is used to operate this water heater? (Mark ALL that apply.)

WHFEL 1 ❍ Electricity
WHFNG 1 ❍ Natural gas
WHFBG 1 ❍ Bottled gas (LP, propane, butane)
WHFSL 1 ❍ Solar

WHAGE

38. Approximately how old is this water heater?

1 ❍ New (Purchased after January 1, 1993) ➔
2 ❍ 2 - 4 years old
3 ❍ 5 - 9 years old
4 ❍ 10 - 15 years old
5 ❍ 16 or more years

If new, when was it installed?	
Month:	WHPMN
Year:	WHPYR

What type of energy was used by the old heater?	
1 ❍ Natural Gas	WHPOLD
2 ❍ Electric	
3 ❍ Other: _____	WHPODOD

LAUNDRY

CWPRIV

39. Is there a clothes washer at this home?

1 ❍ Yes, it is for the private use of this home
2 ❍ Yes, but it is in a common area and can be used by more than one home
3 ❍ No

CDPRIV

40. Is there a clothes dryer at this home?

1 ❍ Yes, it is for the private use of this home
2 ❍ Yes, but it is in a common area and can be used by more than one home ➔ Go to Question #43
3 ❍ No ➔ Go to Question #43

CDTYP

41. What type of clothes dryer is at this home?

- 1 ○ Electric
- 2 ○ Natural Gas
- 3 ○ Propane

CD_J93

42. Has a new clothes dryer been purchased for this home since January 1, 1993?

- 1 ○ Yes →
- 2 ○ No

If yes, when was it installed?	
Month:	CDPMN
Year:	CDPYR

↓

What type of energy was used by the old dryer?	
1 ○ Natural Gas	CDPOLD
2 ○ Electric	
3 ○ Propane	
4 ○ Did not have a dryer	

REFRIGERATORS

RFNUM

43. How many refrigerators are plugged in and operating at this home?

0 ○ None 1 ○ One 2 ○ Two 3 ○ Three or more

If you do not have a refrigerator, go to Question #50.
For questions 44 - 48, the primary refrigerator is the one used most.

44. What style best describes your refrigerator(s)?

		Side-by-side doors	Top/bottom doors	Single door
RF1STY	Primary refrigerator	1 ○	2 ○	3 ○
RF2STY	Second refrigerator	1 ○	2 ○	3 ○
RF3STY	Third refrigerator	1 ○	2 ○	3 ○

45. What size, in cubic feet, best describes the above refrigerator(s)?

		Mini: < 10 cu. ft.	Small: 10-14 cu. ft.	Medium: 15-18 cu. ft.	Large: 19-22 cu. ft.	Very large: >22 cu. ft.
RF1SZ	Primary refrigerator	1 ○	2 ○	3 ○	4 ○	5 ○
RF2SZ	Second refrigerator	1 ○	2 ○	3 ○	4 ○	5 ○
RF3SZ	Third refrigerator	1 ○	2 ○	3 ○	4 ○	5 ○

46. What type of defrost do the above refrigerator(s) have?

		Automatic (frost-free)	Manual
RF1DEF	Primary refrigerator	1 ❍	2 ❍
RF2DEF	Second refrigerator	1 ❍	2 ❍
RF3DEF	Third refrigerator	1 ❍	2 ❍

47. Do the refrigerators have automatic ice maker(s)?

		Automatic Ice Maker	No Automatic Ice Maker
RF1ICE	Primary refrigerator	1 ❍	2 ❍
RF2ICE	Second refrigerator	1 ❍	2 ❍
RF3ICE	Third refrigerator	1 ❍	2 ❍

48. How old are the refrigerator(s)?

		<2 yrs	2 - 5 yrs	6 - 10 yrs	11 - 15 yrs	> 15 yrs
RF1AGE	Primary refrigerator	1 ❍	2 ❍	3 ❍	4 ❍	5 ❍
RF2AGE	Second refrigerator	1 ❍	2 ❍	3 ❍	4 ❍	5 ❍
RF3AGE	Third refrigerator	1 ❍	2 ❍	3 ❍	4 ❍	5 ❍

49. If you purchased or acquired a refrigerator <u>after</u> January 1, 1993, please tell us: (a) whether it was new or used, (b) how many, and (c) when it was acquired.

New or Used	How many?	When was it acquired?
New refrigerator(s)	RFPN_J93	Month_____RFPNMN1 Year____ RFPNYR1 Month_____RFPNMN2 Year____ RFPNYR2
Used refrigerator(s)	RFPU_J93	Month_____RFPUMN1 Year____ RFPUYR1 Month_____RFPUMN2 Year____ RFPUYR2

RFDS_J93

50. How many refrigerators did you stop using or discard at this home after January 1, 1993? ☐

If zero, go to Question #52.

51. Please tell us about the <u>last</u> refrigerator you stopped using or discarded after January 1, 1993.

When did you stop using it?	How old was it?	Was it working?	RFDSDSP How was it discarded?
Month: RFDSMN Year: RFDSYR	RFDSAGE Years	1 ❍ Yes 2 ❍ No RFDSWC	1 ❍ Hauled away for disposal 2 ❍ Picked up by an appliance retailer 3 ❍ Gave away or sold 4 ❍ Still have it

STAND-ALONE FREEZERS

FZNUM

52. How many "stand-alone" freezers are plugged in at this house? (Do not count freezers that are part of a refrigerator.)

1 ❍ None 1 ❍ One 2 ❍ Two or more

If you do not have a stand-alone freezer, go to Question #56.
For Questions 53 and 54, the primary freezer is the one used most.

53. What style best describes your freezer(s)?

		Upright, Automatic Defrost	Upright, Manual Defrost	Chest
FZ1STY	Primary freezer	1 ❍	2 ❍	3 ❍
FZ2STY	Second freezer	1 ❍	2 ❍	3 ❍

54. What is the age(s) of your freezer(s)?

		<2 yrs	2 - 5 yrs	6 - 10 yrs	11 - 15 yrs	> 15 yrs
FZ1AGE	Primary freezer	1 ❍	2 ❍	3 ❍	4 ❍	5 ❍
FZ2AGE	Second freezer	1 ❍	2 ❍	3 ❍	4 ❍	5 ❍

55. If you purchased or acquired a freezer <u>after</u> January 1, 1993, please tell us: (a) whether it was new or used, (b) how many, and (c) when it was acquired.

New or Used	How many?	When was it acquired?
New freezer(s)	FZPN_J93	Month_____FZPNMN1 Year____ FZPNYR1 Month_____FZPNMN2 Year____ FZPNYR2
Used freezer(s)	FZPU_J93	Month_____FZPUMN1 Year____ FZPUYR1 Month_____FZPUMN2 Year____ FZPUYR2

FZDS_J93

56. How many freezers did you stop using or discard at this home after January 1, 1993? ☐

If zero, go to Question #58.

57. Please tell us about the <u>last</u> freezer you stopped using or discarded after January 1, 1993.

When did you stop using it?	How old was it?	Was it working?	FZDSDSP How was it discarded?
Month: FZDSMN Year: FZDSYR	FZDSAGE Years	1 ❍ Yes 2 ❍ No FZDSWC	1 ❍ Hauled away for disposal 2 ❍ Picked up by an appliance retailer 3 ❍ Gave away or sold 4 ❍ Still have it

SPAS

SPTYP

58. Is there a spa or hot tub at this home? (Do not include whirlpools in bath tubs.)

- 1 ❍ Yes, for private use by this home only
- 2 ❍ Yes, but in a common area for use by more than one home or apartment → Go to Question #63
- 3 ❍ No → Go to Question #63

SPLOC

59. Where is the spa or hot tub located?

1 ❍ Indoors 2 ❍ Outdoors, above ground 3 ❍ Outdoors, in ground

SPHTF

60. How is the spa or hot tub heated?

- 1 ❍ Electricity
- 2 ❍ Natural gas
- 3 ❍ Bottled gas (LP, propane, butane)
- 4 ❍ Solar with gas backup
- 5 ❍ Solar with electric backup

SPHTBEV

61. Which of the following best describes the way the spa or hot tub is heated?

- 1 ❍ We keep the spa fully heated so that it is available for immediate use
- 2 ❍ We keep the spa warm and heat it to full temperature before using it
- 3 ❍ We heat the spa only before using it
- 4 ❍ We rarely or never heat the spa

SPP_J93

62. Was the spa or hot tub obtained or purchased after January 1, 1993?

- 1 ❍ Yes →
- 2 ❍ No

When was it installed? Month:	SPPMN
Year:	SPPYR

POOLS

PLTYP

63. Does this home have a swimming pool?

- 1 ❍ Yes, for private use by this home only
- 2 ❍ Yes, but in a common area for use by more than one home or apartment → Go to Question #67
- 3 ❍ No → Go to Question #67

PLFTIM

64. Is the pool filter on a timer?

1 ❍ Yes 2 ❍ No

PLHRS

65. How many hours does the pool filter operate each day? → ____

Write in the hours per day

PLP_J93

66. Was the pool installed after January 1, 1993?

- 1 ❍ Yes →
- 2 ❍ No

When was it installed? Month:	PLPMN
Year:	PLPYR

APPLIANCES

67. How many of the following appliances are used at this home?

	How many are used at this home?	Were any purchased after January 1, 1993?	If purchased after January 1, 1993: What was the month and year of the purchase?	If purchased after January 1, 1993: Did it replace an older appliance? (See Explanatory Note)	
Microwave Oven	MICRO	1 Yes → 2 No MOP_J93	Month: MOP93MN Year: MOP93YR	1 Yes, Replacement 2 No, New Addition	MOP93RA
Automatic Dishwasher	DISH	1 Yes → 2 No DWP_J93	Month: DWP93MN Year: DWP93YR	1 Yes, Replacement 2 No, New Addition	DWP93RA
Big Screen Television (35 inches or more)	BSTV	1 Yes → 2 No BTP_J93	Month: BTP93MN Year: BTP93YR	1 Yes, Replacement 2 No, New Addition	BTP93RA
Color Television (34 inches or less)	CLTV	1 Yes → 2 No CTP_J93	Month: CTP93MN Year: CTP93YR	1 Yes, Replacement 2 No, New Addition	CTP93RA
B/W Television	BWTV	1 Yes → 2 No BWP_J93	Month: BWP93MN Year: BWP93YR	1 Yes, Replacement 2 No, New Addition	BWP93RA
Stereo System	MUSIC	1 Yes → 2 No MUP_J93	Month: MUP93MN Year: MUP93YR	1 Yes, Replacement 2 No, New Addition	MUP93RA
VCR	VCR	1 Yes → 2 No VRP_J93	Month: VRP93MN Year: VRP93YR	1 Yes, Replacement 2 No, New Addition	VRP93RA
Humidifier	HUM	1 Yes → 2 No HUP_J93	Month: HUP93MN Year: HUP93YR	1 Yes, Replacement 2 No, New Addition	HUP93RA
Dehumidifier	DEH	1 Yes → 2 No DHP_J93	Month: DHP93MN Year: DHP93YR	1 Yes, Replacement 2 No, New Addition	DHP93RA
Air filter/cleaner	AIRCL	1 Yes → 2 No ACP_J93	Month: ACP93MN Year: ACP93YR	1 Yes, Replacement 2 No, New Addition	ACP93RA
Heated waterbed	WBED	1 Yes → 2 No WBP_J93	Month: WBP93MN Year: WBP93YR	1 Yes, Replacement 2 No, New Addition	WBP93RA
Well pump	WELL	1 Yes → 2 No WPP_J93	Month: WPP93MN Year: WPP93YR	1 Yes, Replacement 2 No, New Addition	WPP93RA

NOTE: A Replacement means that the older appliance was discarded.
A New Addition means there was no older appliance, or the older appliance was kept and is still used in this home.

68. Do you currently have an extended warranty or service contract for any of your major appliances, heating equipment or cooling equipment?

HTCLWAR Heating or cooling equipment 1 Yes 2 No

MAPPWAR Major appliances 1 Yes 2 No

69. How many lighting fixtures in the interior or exterior of this home have the following equipment?

		None	1 fixture	2 fixtures	3 or more fixtures
LTFLUOR	Fluorescent tubes	0 ❍	1 ❍	2 ❍	3 ❍
LTCFL	Compact fluorescent lights	0 ❍	1 ❍	2 ❍	3 ❍
LTHAL	Halogen lights	0 ❍	1 ❍	2 ❍	3 ❍
LTHID	Sodium or mercury vapor lights	0 ❍	1 ❍	2 ❍	3 ❍
LTTIM	Timers	0 ❍	1 ❍	2 ❍	3 ❍
LTDIM	Dimmers	0 ❍	1 ❍	2 ❍	3 ❍
LTMOT	Motion detectors	0 ❍	1 ❍	2 ❍	3 ❍
LTPHO	Photo-electric sensors	0 ❍	1 ❍	2 ❍	3 ❍

LTSCRTY

70. Do you use outdoor security lighting other than a porch light at this home?

1 ❍ No
2 ❍ Yes, for about 1 hour or less per night
3 ❍ Yes, for about 2 to 4 hours per night
4 ❍ Yes, for more than 4 hours per night

71. Which of the following equipment or services are used in this home?

		Yes	No
CABLE	Cable television	1 ❍	2 ❍
TELESRV	Telecommunications services (such as call waiting, call forwarding, automatic call back)	1 ❍	2 ❍
PC	Personal computer	1 ❍	2 ❍
PCMD	Computer modem	1 ❍	2 ❍
CDROM	CD-ROM for the computer	1 ❍	2 ❍
PRTLAS	Computer printer (Laser)	1 ❍	2 ❍
PRTNLAS	Computer printer (Non-Laser)	1 ❍	2 ❍
ONLINE	Computer on-line services	1 ❍	2 ❍
FAX	Fax machine	1 ❍	2 ❍
COPIER	Copier	1 ❍	2 ❍

HOMEOFF

72. Is there a "Home Office" in this home?

1 ❍ Yes ➔
2 ❍ No

If yes, is this home office used for one of the following activities?
1 ❍ Home-based business HOMEBUS
1 ❍ Telecommuting to regular workplace TELECOM

OTREQPD

73. Is there any other large equipment that uses a lot of electricity in this home?

(Please specify): _____

THE HOUSEHOLD

Please provide answers to the following questions. Your responses will be kept confidential and no data will be used on an individual basis.

74. How many people, including yourself, live in this home? NUMRES

75. How many people in each of the following age groups live in this home?

	How many?		How many?
12 years of age or younger	NR0_12	25 - 44 years of age	NR25_44
13 - 17 years of age	NR13_17	45 - 59 years of age	NR45_59
18 - 24 years of age	NR18_24	60 years or more	NR60_99

NRCHG

76. Has the number of residents in this home changed since January 1, 1993?

1 ❍ Number of residents has remained the same
2 ❍ Number of residents has increased since January 1, 1993
3 ❍ Number of residents has decreased since January 1, 1993

SEASOCC

77. What portion of the year does someone live in this home?

1 ❍ Year-Round ↓

or

2 ❍ Winter only
3 ❍ Summer only
4 ❍ Other seasonal use

UNOC_J93

If year-round, has there been any time after January 1, 1993 that this home was unoccupied for a month or more?

0 ❍ No
1 ❍ Yes → From: Month_____, UNOCFMN
Year_____ UNOCFYR
To: Month_____, UNOCTMN
Year_____ UNOCTYR

INCOME

78. Please check the range that best describes your household's total annual income. (Please include all sources of taxable and non-taxable income including wages, pensions, social security, public assistance, etc.)

1 ❍ Less than $7,500
2 ❍ $7,500 - $9,999
3 ❍ $10,000 - $14,999
4 ❍ $15,000 - $19,999
5 ❍ $20,000 - $24,999
6 ❍ $25,000 - $29,999
7 ❍ $30,000 - $34,999
8 ❍ $35,000 - $49,999
9 ❍ $50,000 - $74,999
10 ❍ $75,000 - $99,999
11 ❍ $100,000 or more

EDUC

79. What was the highest level of education completed by any primary wage earner in the home?

1 ❍ Elementary 1-8
2 ❍ Some High School
3 ❍ High School graduate
4 ❍ Trade or vocational school
5 ❍ Some college
6 ❍ Junior college graduate
7 ❍ College graduate
8 ❍ Graduate school courses
9 ❍ Graduate degree

ETHNIC

80. In which of the following groups do you consider yourself?

1 ❍ Asian or Pacific Islander
2 ❍ Black
3 ❍ Hispanic/Latin American
4 ❍ White, non-Hispanic
5 ❍ Other_____ ETHOD

LANGPRI

81. What is the primary language spoken in this home?

1 ❍ English 2 ❍ Spanish 3 ❍ Other _____ LANGOD

82. What type of work does the primary wage earner(s) in this household do? (Mark ALL that apply.)

PROTECH 1 ❍ Professional, technical, or managerial
SALES 1 ❍ Sales
LABOR 1 ❍ Skilled labor and craftsman
SERVICE 1 ❍ Service and domestic worker
FARMER 1 ❍ Farmer
MILITARY 1 ❍ Military
STUDENT 1 ❍ Student
RETIRED 1 ❍ Retired

We may need to contact you to verify some of the information you have provided in the survey.
Please provide your telephone number and the times that would be most convenient for you to be contacted.
Your phone number will not be given out to anyone and will be used only for this research project.
You will only be called if we need to verify some of the information in the survey.

Telephone Number_____ Best Time to call _____ a.m. _____ p.m.

THANK YOU VERY MUCH FOR YOUR COOPERATION AND ASSISTANCE!

B REPORTING FOR CADMAC PROTOCOLS TABLE 6B

B.1 REFRIGERATION

Item 1		Item 2		Item 3	Item 4	Item 5	Item 6		Item 7	Item 8	Item 9
Studied Measure Description	**Refrigeration**	***ex ante* EUL**	**Source of *ex ante* EUL (ref. Ftnote)**	***ex post* EUL from Study**	***ex post* EUL to be used in Claim**	***ex post* EUL Standard Error**	**80% Conf. Interval Lower Bound**	**80% Conf. Interval Upper Bound**	**p-Value for *ex post* EUL**	**EUL Realizat'n Rate (*ex post/ex ante*)**	**"Like" Measures Associated with Studied Measure**
Recycled refrigerators and freezers: 1994		6.0		6.3	6.3	0.53	5.5	6.9	0.612	1.05	
Recycled refrigerators and freezers: 1995		6.0		6.2	6.2	0.54	5.5	6.9	0.646	1.04	
Recycled refrigerators and freezers: 1996		6.0		6.0	6.0	0.58	5.3	6.8	0.932	1.00	
Recycled refrigerators and freezers: 1997		6.0		6.1	6.0	0.57	5.3	6.7	0.913	1.00	

ex ante Source References: 1 Table C, SCE Regulatory Reporting, Analysis, and Policy staff.

C PROTOCOL TABLE 7B DOCUMENTATION

C.1 OVERVIEW INFORMATION

C.1.a Study Title and Study ID Number

Study Title: *Persistence Study of Southern California Edison's 1994 through 1997 Appliance Recycling Programs*

Study ID No: 525B

C.1.b Program Years and Program Description

Program years: 1994, 1995, 1996, 1997

Under this program, incentives are offered to customers to turn in their old appliances for destruction, with ecologically responsible recycling of components and materials. The goals are:

(a) to eliminate second appliance use at participating residences; and

(b) to prevent the transfer of older, inefficient appliances into the secondary market.

C.1.c End Uses and Measures Covered

Refrigeration

C.1.d Methods and Models Used

The general method employed in measure retention studies is to collect measure retention data from a sample of participants, and fit a parametric survival function to those data. This approach is applied here to the appliance removal measure.

For the direct effect of removing the unit from the home, measure failure is defined as the home's acquiring another unit to replace the removed unit. This definition of failure applies to the participating homes where the unit would have been kept if not picked up by the program. Thus, the time until failure for such homes is the time until the home added another unit. This time to failure can be observed explicitly for participating homes.

Participant surveys were used to determine if the number of units in use at the home had increased over the study period, and if so, at what date. The surveys were conducted with homes that had been previously surveyed as part of the first-year impact studies for the 1994 and 1996 program. The number of refrigerators and freezers in use as of the time of that survey was known, providing more reliable information on changes.

Failure times based on these survey data were analyzed by standard statistical survival analysis methods. The techniques are described in more detail in Section 2.

For units that would otherwise have been transferred to the secondary market, the removal of the unit from the market has a lifetime equal to the remaining life of the unit if it had been transferred. That is, the savings due to preventing this unit from being transferred to a new user last for as long as that unit would have continued in use.

This hypothetical remaining life of the appliance not transferred is not directly observable. For this component of program savings, a different approach was taken to estimating the measure life. A life table of the age at final disposal of working refrigerators was developed. The basis for this table was data collected as part of Edison's 1995 Residential Appliance Saturation Study. Combining these data with the ages at pick-up of units in the program gave the distribution of remaining life for these units. The median of this distribution is the Effective Useful Life for the avoided transfer component of the program.

The EUL for the program as a whole was estimated by combining the survival curve estimated for units that would otherwise have been kept with the remaining life curve for the units that would have been transferred. The two curves were combined in proportion to the first-year savings contributed by each of these program components. The median for the combined curve—that is, the time at which half the estimated savings from the program would be gone—was taken as the combined EUL.

C.1.e Analysis Sample Size

Survival analysis for direct effects of measure removal (units that would have been kept if not picked up by the program:

Number of customers: 295
Number of measures: 358 units

Remaining useful life curve for avoided transfers based on 1995 RASS data:

Number of customers: 102
Number of measures: 111 units

C.2 DATABASE MANAGEMENT

C.2.a Specific Data Sources

Tracking Data:

RECY93.xpt, RECY94.xpt, RECY95.xpt, RECY96.xpt, RECY97.xpt, RECY98.xpt

First-year impact study participant survey data:

1995 Survey FRID1206.sd2
1997 Survey SCE1c.sd2

Persistence survey data:

Sta_Mov.sd2

1995 RASS survey data:
Survey3.sd2

C.2.b Data Attrition

Table C-1
Follow-Up Retention Survey Sample

	1994			1996			Total		
	Nonmovers	Movers	Total	Nonmovers	Movers	Total	Nonmovers	Movers	Total
Respondents to first year impact evaluation			484			501			985
Classified as "would-be keeper"	232	46	278	281	13	294	513	59	572
Respondents to follow-up retention survey	124	23	147	197	9	206	321	32	353

Table C-2
Units Included in Remaining Useful Life Analysis from 1995 RASS

	Refrigerators		Freezers		Total	
	Respondents	Units	Respondents	Units	Respondents	Units
Total RASS respondents					10626	
Disposed of a unit	1704	1834	372	402	2076	2236
Unit working when discarded *	1309	1309	295	295	1604	1604
Hauled away for disposal *	508	508	121	121	629	629

* Asked only for last unit discarded.

C.2.c Data Quality
The SCE assigned premise number was used to link the survey data to the tracking system data.

C.2.d Data Collected Specifically for the Analysis but Not Used
Data on household characteristics and demographics (survey questions D1-D4) were collected but not used. These data were collected to provide a basis for modeling the probability of replacing the refrigerator was a function of any of these parameters. However, because the incidence of measure failure in the sample was low, modeling failure rates as a function of participant characteristics was not practical.

C.3 SAMPLING

C.3.a Sampling Procedures and Protocols
The participant follow-up survey was targeted to all participants who indicated on the first year impact survey that they would have kept the unit in the absence of the program. The sampling is described in the table below.

	1994			1996			Total		
	Nonmovers	Movers	Total	Nonmovers	Movers	Total	Nonmovers	Movers	Total
Respondents to first year impact evaluation			484			501			985
Classified as "would-be keeper"	232	46	278	281	13	294	513	59	572
Respondents to follow-up retention survey	124	23	147	197	9	206	321	32	353

C.3.b Survey Information

The survey instruments are provided in Appendix A of this report. The survey disposition is provided in the table below.

	Stayers		Movers	
	Number	Percent	Number	Percent
No answer/Answering machine	492	38.5%	46	41.1%
Phone busy	104	8.1%	4	3.6%
Disconnected phone	58	4.5%	8	7.1%
Business/Government phone	8	0.6%	0	0.0%
Respondent not available	194	15.2%	17	15.2%
Initial refusal	55	4.3%	0	0.0%
Computer tone	1	0.1%	0	0.0%
Language problems	2	0.2%	1	0.9%
Schedule callback	9	0.7%	2	1.8%
Call substitute phone number	21	1.6%	0	0.0%
Other	11	0.9%	2	1.8%
Number over maximum attempts	2	0.2%	0	0.0%
Completed interviews	321	25.1%	32	28.6%

To account for non-response bias, the sample was weighted to the proportion of movers and nonmovers in each program year.

C.3.c Statistical Descriptions

The key information collected was on the number of units that had been replaced. See table below.

	Replaced		Retained		Total	
Respondent Type	Number	Percent	Number	Percent	Number	Percent
1994 Nonmover	22	19.1%	93	80.9%	115	100%
1994 Mover	18	47.4%	20	52.6%	38	100%
1996 Nonmover	19	10.0%	171	90.0%	190	100%
1996 Mover	6	40.0%	9	60.0%	15	100%

C.4 DATA SCREENING AND ANALYSIS

C.4.a Procedures for Missing Dates

Missing recidivism dates were considered left censored with the survey date as the left censoring endpoint.

C.4.b Background Variables

n/a

C.4.c Screening Procedures

All survey responses were used in the analysis of the direct effect of measure removal, for "would-be keepers." In the analysis of avoided transfers, only those units that were thrown away after failure were considered in the analysis. See table below:

	Refrigerators		Freezers		Total	
	Respondents	Units	Respondents	Units	Respondents	Units
Total RASS respondents					10626	
Disposed of a unit	1704	1834	372	402	2076	2236
Unit working when discarded *	1309	1309	295	295	1604	1604
Hauled away for disposal *	508	508	121	121	629	629

* Asked only for last unit discarded.

C.4.d Model Statistics

			80% Confidence Interval							
Program Year	EUL/RUL	SE	Lower	Upper	Intercept	SE	Scale	SE	Number of Units in Analysis	Number of Independant Observations
Direct Effect of Measure Removal										
All	6.3	5.0	7.5	7.5	7.9	0.1	0.6	0.1	358	358
Avoided Transfers										
1994	6.2	1.0	4.0	6.6	0.0				45439	42865
1995	6.1	1.2	3.6	6.6	0.0				31879	28547
1996	4.1	1.6	1.9	5.9	0.0				26752	23608
1997	4.6	1.4	2.3	6.0	0.0				36106	32043
Combined										
1994	6.3	0.5	5.5	6.9	0.0					
1995	6.2	0.5	5.5	6.9	0.0					
1996	6.0	0.6	5.3	6.8	0.0					
1997	6.1	0.6	5.3	6.7	0.0					

C.4.e Specification

Would-Be Keepers—Direct Effect of Measure Removal

For the would-be keepers, several hazard function distributions were explored: Gamma, Weibull, exponential, log-normal, and log-logistic. The Gamma form did not converge. That is, the failure incidence at this date is sufficiently low that with the available sample sizes there was not enough information to fit this most general model form. The exponential result was rejected by the log-likelihood test against the Weibull result. That is, the more constrained exponential form does not match the pattern in the data as identified by the more general Weibull form; the Weibull would give a result close to the exponential if the latter form were a good description of the data.

There is no firm basis for accepting or rejecting any of the other hazard function forms. All yield roughly similar EUL estimates and standard errors. The log-normal and log-logistic forms both have an initially high failure rate followed by a declining rate. In broad terms, this pattern makes sense. A certain fraction of customers find out in the early period after removal that they miss having the unit that was removed, and replace it. After that early period, replacements are more sporadic. The problem with attempting to fit a model of this form is that the fitted model may be a reasonable description of the replacement rates within the period studied, but its projection to a time period twice as long as what was studied is of unknown validity. In particular, the extension of the declining failure rate over time may not be a good description of the failure patterns after several years.

The Weibull, which allows a steadily increasing failure rate over time, avoids this problem. For these reasons, the Weibull result was taken as the final estimate for this component of program savings. The other two forms give slightly higher EUL's, but none gives a value significantly different from the *ex ante* EUL, at the 20 percent significance (80 percent confidence) level.

1) ***Addressing Customer Heterogeneity***

The difference in measure retention between customers who would have kept a unit and those who would have discarded it was addressed by developing separate measure survival curves for these two program savings components. The possible difference in measure retention between customers who move after participating and those who stay in place was addressed in for the subset of customers who would have kept the unit. Survey were data for both types of customers. The analysis was done at the premise level, rather than tracking the "retention" of absent units with the original customer. In the analysis of retention data for would-be keepers, the movers and nonmovers in the responding sample were weighted according to the corresponding proportions in the participant sample.

2) Omitted Factors

No covariates were included in the model. With the limited instances of measure failure, estimation of effects of covariates was considered impractical.

Avoided Transfers

The life table used for the distribution of ages at final disposal, applied to avoided transfers, was estimated using nonparametric procedure, based on the empirical distribution found in the RASS data. The procedure used is the SAS LIFETEST procedure.

1) ***Addressing Customer Heterogeneity***

The possibility was explored that the age distribution at pick-up of units that would have been kept could be different from that of units that would have been discarded. The age distributions for these two groups were compared for those customers who responded to the 1994 and 1996 first-year impact evaluation surveys. The two distributions were found to be almost identical. Based on this finding, it was determined that the remaining useful life curve for avoided transfers could be calculated using the distribution of all collected units in each program year.

2) Omitted Factors

No covariates were included in the model. The model was to be applied to the universe of all collected units for each program year. Covariates were not available on these units to apply any fitted model form that may have been developed using the RASS data.

C.4.f Error in Measuring Variables

Units that were replaced but for which the date of recidivism was unknown were considered left censored with the survey date as the censoring endpoint.

C.4.g Influential Data Points

See 4a.

C.4.h Missing Data

Units that were replaced, but for which the date of recidivism was unknown were considered left censored with the survey date as the censoring endpoint.

C.4.i Precision

For would-be keepers, the weights were assigned so that the standard errors from the statistical package are correct.

For the avoided transfers, the confidence interval for the median EUL is derived from the confidence interval on the survival curve generated from the RASS data on median age at disposal.

For the combined analysis, the separate analysis of the two program components provides an 80 percent confidence interval (t^-, t^+) for each component's EUL t^*. The corresponding approximate confidence bounds for the combined EUL are calculated as

$$t_c^- = t_c^* - \sqrt{p_k^2 (t_k^- - t_k^*)^2 + p_D^2 (t_D^- - t_D^*)^2}$$

$$t_c^+ = t_c^* + \sqrt{p_k^2 (t_k^+ - t_k^*)^2 + p_D^2 (t_D^+ - t_D^*)^2} \ .$$

D

APPROVED WAIVER FOR STUDY METHODS

SOUTHERN CALIFORNIA EDISON COMPANY
RETROACTIVE WAIVER FOR 1994-1997
REFRIGERATOR RECYCLING MEASURE RETENTION STUDY
(Study ID #525B)
Approved by CADMAC on January 20, 1999

Background/Introduction

Southern California Edison conducts a residential refrigerator/freezer turn-in program in which incentives are offered to customers to turn in their old appliances for destruction, with ecologically responsible recycling of components and materials. The goals are:
(a) to eliminate second appliance use at participating residences; and
(b) to prevent the transfer of older, inefficient appliances into the secondary market.

The program has been evaluated twice for first year load impacts, first of the 1994 program (XENERGY, Study #515) and then of the 1996 program(XENERGY, Study #537). In these studies, energy savings were attributed to both phenomena (a) and (b) above – removing auxiliary appliances that would have been kept otherwise, and preventing operable but inefficient appliances from continuing to circulate in the territory, thereby increasing the use of more efficient appliances. Critical to these evaluations were timely survey self reports on alternative actions (including keeping and transferring) that would have taken place if participant respondents had not been able to avail themselves of the program.

There is no M&E Protocol specifically governing this program. Edison proposes to conduct one fourth and one ninth year retention study to be applied to the four program years, 1994-1997. The participants sampled in the impact studies of program years 1994 and 1996 will form the sample for these studies, in order to make use of crucial survey information indicating which phenomenon (eliminated second appliance, or prevented transfer) is the savings-generating "measure" whose retention should be studied.
The goal of the study is to provide survival analysis data (estimated survival tables, including median useful life) for both the eliminated spare appliance and prevented transfer "measures," as they apply to refrigerator and freezer recycling taken singly and together.

Based on the final reports, the impact analysis samples for 1994 and 1996 followed similar distributions on self-reported alternative actions, absent the program, as shown in Table 1, below.

Table 1
Reported Alternative Appliance Dispositions
From Studies 515 and 537

Alternative Disposition:		1994 Refrig.	1994 Freezer	1994 All	1996 Refrig.	1996 Freezer	1996 All
Keep:	number	205	34	239	250	47	297
	percent	51%	40%	49%	59%	60%	59%
Transfers, intra-SCE:	number	150	32	182	133	25	158
	percent	38%	38%	38%	31%	32%	31%
Transfers, extra-SCE:	number	12	9	21	27	4	31
	percent	3%	11%	4%	6%	5%	6%
Destroy:	number	32	10	42	16	2	18
	percent	8%	11%	9%	4%	3%	4%
Total respondents		399	85	484	426	78	504

The current proposal is to conduct a telephone survey at the premises at which analysis of original survey respondents indicated that the alternative disposition, absent the program, would have been keeping the appliance that was in fact recycled. Interviews will be attempted at all such premises. The current occupant, whether or not the original participant, will be asked about the number of appliances currently in use, and when additional appliances (if any) were acquired. This will fuel a survival analysis of the retention of "eliminated second appliances" – the first component of program savings in the original impact surveys. Note that more than 500 premises form the "proximate frame" for the reuse of the initial panels.

For prevented transfers, the proposal is to estimate the remaining operating life for appliances which would have been transferred intra-territorially absent the program. Where respondents have reported that the inefficient appliance picked up by the program would have been transferred into the secondary market, the savings are enjoyed during the remaining operating life of the hypothetically transferred appliance; these are the years which constitute retention of prevented transfers. This will be estimated by referring the recorded age of each appliance when picked up by the program to a refrigerator life table, which will provide survival parameters; e.g., probabilities of survival *n* more years and the number of years of continued life at which continued operation and failure become actuarially equiprobable for that appliance – the remaining operating life.

The refrigerator life table for use in the prevented transfers exercise may well be a synthesis from various sources, and the vendor assigned this study is carefully reviewing resources and the calculations required for their use.

Summary of Edison Request

This waiver request is in fact a proposal for a retention study on a program not specifically addressed by the Protocols. The proposal is to:

(a) Base survival research on follow-up use of original first year impact analysis survey panels.
(b) Estimate retention of the "measure" constituting prevention of second appliance use, using standard survival analysis techniques on re-survey data indicating self reported "reversion" to use of a spare appliance.
(c) Estimate retention of the "measure" constituting prevention of transfer to the secondary market using "actuarial" techniques predicting the remaining operating life of a hypothetically transferred appliance of the age at which transfer was actually prevented (at pickup date).
(d) Provide survival estimates for refrigerators and freezers, singly and combined.
(e) Generalize these estimates to the 1994-1997 recycling program years.

Program Summary

The following tables report on program costs, energy savings, and resource benefits, plus numbers of pickups in the program, by pickup year and appliance type. The energy savings data are based on the completed load impact studies for program years 1994 through 1996.

Table 2
Program Summary Data
(Costs and Resource Benefits in $1000's)

	1994	1995	1996	1997
Incentive Costs	$1,189	$4,640	$3,839	$5,251
Administrative Costs	$8,500	$ 448	$ 958	$1,182
Total Costs	$9,689	$5,088	$4,797	$6,433
Gross MWH savings	77,550	50,002	56,023	50,653
Gross MW reductions	10.244	6.601	8.565	11.293
Resource Benefit, net	$9,894	$7,029	$5,263	$5,809
Shareholder Earnings				

Table 3
Program Summary: Pickup Totals

Program Year	Refrigerator Pickups	Freezer Pickups	Total Pickups
1994	38,552	6,887	45,439
1995	26,395	5,484	31,879
1996	21,212	5,540	26,752
1997	29,087	7,019	36,106
Total	115,246	24,930	140,176

Parameter

No Protocol parameters apply directly. However, it may be inferred that the recycling program is understood to be governed by Protocol Table 9A (Residential AEI: Refrigeration) as applied to frequency of data collection, retention study due dates, and estimates obtained (per Table 9A, item 3).

Protocol Requirement

The retention study protocol requirement for the residential efficient refrigerator incentive program ("RES. AEI"), which may or may not be the intent of the Protocols for non-covered programs like the recycling program, is as follows:

(a) Fourth and ninth year retention studies, for program years 1994 and 1996 (Protocol Table 8A).
(b) Participant data from sequential program years are to be combined in order to provide a more "robust" retention sample (Table 9A, Item 3; silent on what is to be done if retention study depends upon data from first year impact study, and impact studies are not carried out annually).

Waiver Alternative

Edison proposes minor modifications of the Protocol requirements given above (which may or may not be deemed applicable anyway), and goes on to propose a methodology adapted to the unique circumstances of the recycling program:

(a) A "first round" retention study, generalized to 1994-1997 participating populations, building upon extant survey data from the 1994 and 1996 program years' first year impact studies.
(b) For premises at which participants would have kept using the appliance which was in fact recycled in the program, conceptualize "failure" as the re-entry of a second appliance into the premise's connected load, and attempt to conduct telephone interviews and survival analysis over all premises participating in the earlier impact evaluation surveys.
(c) For premises at which participants' stated alternative action involved transfer into the secondary market, conceptualize "failure" as the hypothetically transferred appliance's operational death, at which point savings from its prevented transfer also expire, and calculate survival parameters by referring the age at pickup to an appliance life table synthesized for this project.
(d) Calculate survival parameters, including effective useful life and other more informative estimates, for both "keeper" and "transfer" scenarios, and their aggregate counterparts; also calculate these for

refrigerators, freezers, and appliances combined; test hypothesis that combined measure EUL is equal to the ex ante value of six years.

Rationale

We include supporting arguments for facets of this proposal which are not deviations from the Protocols but are key features of the unique approach suggested.

Combining the 1994 and 1996 survey data provides some of the "robustness" which the Protocols now support, although 1994 and 1996 are not "sequential" in the apparent sense of the current Protocols.

Developing estimates from data based on re-contacting the first year impact studies' participant samples is both consistent with what may have been the original intent of the Protocols first year sample size requirements (Protocol Table 5's requirement of large samples sizes to allow for panel attrition), and necessary given that the analyst is only able to identify which program savings phenomenon applies -- preventing continued use at participating residence, vs. preventing transfer to secondary market -- based on the relatively timely original survey responses.

It will be noted that only the "prevented continued use" or "keeper" aspect of program savings requires actual re-contact with original survey participants (to elicit information on the timing of any reversion to spare appliance use). The "prevented transfer" aspect corresponds to a retention definition in which savings would accrue throughout the operational life of the appliance had it been transferred. For appliances whose participant owners indicated a transfer was the alternative disposition, the remaining operating life is calculable from a combination of the program tracking system's estimate of age at pickup, and an "actuarial" table for refrigerators or freezers.

Finally, the study will cast its re-survey of "would-be keeper" retention at the premise rather than household level. This is consistent with a conceptualization of the program at a system or utility territory level (the approach to savings taken in the original impact studies of the program), and makes any post-program movements of participating households moot.

Summary of Retroactive Waiver for Study 525B

Possibly Relevant

Retention Measurement Requirements - Tables 8A, 9A

Parameter	Protocol Requirements	Waiver Alternative	Rationale
Table 8A	For RES. AEI, perform distinct retention studies for 1994 and 1996 program years.	Combine 1994 and 1996 impact samples for retention study to be conducted in late 1998.	Current Protocols' robustness-of-combined-years rationale; need for survey information to determine which type of program savings is undergoing retention study, in the individual case.
Table 9A.3	Combine years 1994 and 1995, 1996 and 1997 in retention studies.	See above	See above