SOUTHERN CALIFORNIA EDISON
1994 RESIDENTIAL
APPLIANCE EFFICIENCY
INCENTIVE PROGRAM
FOURTH YEAR
RETENTION STUDY

CEC Study ID #525A

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EXECUTIVE SUMMARY

This report provides the results of a study of the fourth-year retention of space cooling appliances and refrigerators installed by customers of Southern California Edison (SCE) in 1994 under SCE's Residential Appliance Efficiency Incentive (RAEI) Program. The following four (4) types of appliances covered in the 1994 RAEI Program have been studied:

- Central air conditioning (A/C) units
- Central and through-the-wall heat pumps
- Evaporative coolers
- Refrigerators

Data for the study were collected through a two-phase mail and telephone survey effort. The data collected through the mail and telephone survey effort were used to determine the percent retention for each appliance. Based on the data collected, the retention rates for the various appliances are as shown in Table ES-1.

Table ES-1. Retention Rates for RAEI Appliances

Type of Appliance	*Percentage of Appliances Removed, Failed or Replaced since 1994*	*Percentage of Appliance Retained to 1998*
Central Air Conditioners	1.8%	98.2%
Heat Pumps	2.9%	97.1%
Evaporative Coolers	6.3%	93.7%
Refrigerators	3.0%	97.0%
Households that had not moved	3.5%	96.5%
Households that had moved	1.8%	98.2%

Another objective of the study was to estimate effective useful life (EUL) for each appliance and to determine if the estimated EULs were different from expected EULs. Because of the limited time span that the collected data cover and because the early retention rates for the different appliances were relatively high, direct estimation of effective useful lives from the collected data was not possible. However, hazard functions and corresponding survival functions for refrigerators and central air conditioners were developed using data from SCE's 1995 Residential Appliance Saturation Survey (RASS). (The RASS did not have the data needed to develop survival functions for heat pumps and evaporative coolers.) Assuming that these survival functions represent the general survival behavior for these types of appliances,

then the survival patterns for high efficiency refrigerators and central air conditioners installed by households under the 1994 RAEI Program were expected to be similar.

The estimates of effective useful lives determined through this study were as follows.

- For refrigerators, two estimates of useful life for refrigerators were derived in this study. Under the more realistic scenario, the estimated effective useful life of refrigerators was 21.8 years. SCE's *ex ante* estimate for the effective useful lives of refrigerators was 18 years. Accordingly, SCE's *ex ante* estimate of effective useful life for refrigerators appears appropriate.
- For central air conditioners, the effective useful life estimated in this study was 22.04 years. SCE's *ex ante* estimate for the effective useful live of central air conditioners was 18 years. Accordingly, SCE's *ex ante* estimate of effective useful life for central air conditioning appears appropriate.
- For heat pumps and evaporative coolers, estimates of effective useful lives could not be developed from either the data collected for this study or through alternative methods. Thus, SCE's *ex ante* estimates of effective useful lives for these appliances can be maintained. For heat pumps, the *ex ante* estimate is 18 years. For evaporative coolers, the *ex ante* estimate is 15 years.

1. INTRODUCTION

Under the DSM Measurement Protocols[1] adopted by the California Public Utilities Commission, Southern California Edison (SCE) is required to conduct studies to better understand the typical modes of savings erosion associated with energy-efficient measures. In line with this requirement, ADM Associates, Inc. (ADM) has performed a study of the retention of space cooling appliances and refrigerators installed by SCE customers in 1994 under SCE's Residential Appliance Efficiency Incentive (RAEI) Program. This RAEI fourth-year retention study has been performed under SCE's Purchase Order No. K107801.

The objective of this RAEI retention study has been to determine the extent to which space cooling appliances and refrigerators installed under SCE's 1994 RAEI Program are still in place and operational. The following four (4) types of appliances covered in the 1994 RAEI Program have been studied::

- Central air conditioning (A/C) units
- Central and through-the-wall heat pumps
- Evaporative coolers
- Refrigerators

Data for the study were collected through a two-phase mail and telephone survey effort. The mail survey was used as the most cost-effective means to screen a large population to identify those households where an appliance had been removed or had failed. Telephone interviews were then conducted with households that indicated in the mail survey that an appliance had been removed or failed. The telephone interviews were used to identify when the appliance had been removed or had failed and the reasons for the removal/failure.

The data collected through the mail and telephone survey effort were used to determine the following:

- Historic percent retention for each appliance, as a function of time
- Effective useful life (EUL) for each appliance

[1] See *Protocols and Procedures for the Verification of Costs, Benefits, and Shareholder Earnings for Demand-Side Management Programs*, as adopted by California Public Utilities Commission Decision 93-05-063, with subsequent revisions.

- If the estimated EULs are different from expected EULs at an 80% level of statistical significance

The retention rates for the appliances were determined through tabulation of the data collected through the survey effort. To develop estimates of effective useful lives for refrigerators and central air conditioners, hazard functions and survival functions were developed for these appliances using data from SCE's 1995 Residential Appliance Saturation Survey.

This final report presents and discusses the methodology used and results achieved through this study. The report is organized into the following sections.

- Section 2 contains a discussion of the methods used for the study.
- Section 3 presents and discusses the results of the analysis and reporting of the data collected.
- Appendix A contains copies of the forms used for the data collection.

2. STUDY METHODS

This section discusses the design used for the 1994 Residential Appliance Efficiency Incentive Program Fourth-Year Retention Study. Section 2.1 discusses the survey design. Section 2.2 discusses the data collection methodology. Section 2.3 discusses sample allocation and selection. Section 2.4 discusses the survey instruments. Section 2.5 reports the survey response rates.

2.1 SURVEY DESIGN

As noted in Section 1, there were several objectives to be met with the data collected through the survey. In terms of survey design, the most stringent requirement was that the effective useful life of a program appliance be estimated with 20% precision at 80% confidence. That is, it was necessary to design a plan for the data collection survey such that sufficient sample points would be obtained for each type of appliance to meet the specified precision/confidence requirements.

The analytical framework for the development of the survey design for the study was provided by survival analysis techniques. Survival analysis pertains to the analysis of data that correspond to the time from a well-defined time origin until the occurrence of some particular event or end-point. For this study, the time origin was defined by the installation of an appliance under the 1994 RAEI Program, while the end-point was defined by the removal or failure of the measure or the discontinuance of its use.

The survival data for appliances have several features that warranted special treatment in preparing the sample design.

- The measure survival data would probably not be symmetrically distributed and cannot be reasonably represented by a normal distribution.
- The survival data would be *right-censored* in that the end points for removals, failures, or discontinuance would not be observable for some of the installed measures.

The sample design addressed these and other features of the data that were collected. The sample design was developed through the following steps.

- First, the number of removals/failures required to meet the precision and confidence specifications for each type of measure was determined.
- Second, the probability of removal/failure for each type of measure over the period of the study was determined and applied to the required number of removals/failures to determine the number of points required in the sample.
- Third, sample points for an appliance were allocated among households.

2.1.1 Determining Number of Required Removals/Failures

The first step in preparing the sample design was to arrive at quantitative estimates of the required sample sizes for the various types of appliances. To do this, it was necessary to use a parametric representation for the appliance survival data. For the sample design, it was assumed that the survivor function for an appliance's life data could be represented with the exponential distribution:

$$S(t) = e^{-\lambda t}$$

For this function, the mean survival time is given by $\mu = 1/\lambda$, with its standard error given by $\frac{m}{\sqrt{r}}$, where r is the number of appliances within a sample that have been removed or failed. Thus, with an exponential survivor function, the standard error for the estimated mean from a sample depends on the number of removals/failures that are observed.

The precision/confidence requirements for the sample were that the estimate of mean effective useful life for a measure must have relative precision of ±20 percent at the 80 percent confidence level. This implied the following:

$$.0.2\,m = \frac{zm}{\sqrt{r}}$$

where μ and r are defined as above and z is the upper point of the standard normal distribution defining the desired level of confidence. For the 80 percent confidence level, z = 1.28. Thus, the number of removals/failures required to estimate mean life for a particular type of appliance at the specified precision/confidence is r = 41.

2.1.2 Accounting for "Right Censoring"

Based on using an exponential survival function, it appeared that about 41 removals/failures would be required for each type of appliance to satisfy the 80/20 confidence/precision requirement. However, the number of sample points needed to identify 41 removals/failures depends on the probability of "failure". The sample size needed to provide the required number of removals was determined as follows:

$$\text{Sample Size} = \frac{\text{Number of required removals / failures}}{\text{Probability of removal / failure}}$$

As shown by Collett[1], the probability of removal/failure with an assumed survival function can be calculated as a function of (1) specified values for the survival function,

1 Collett, D. *Modelling Survival Data in Medical Research*, Chapman & Hall, 1994, pp. 260-264.

(2) the study accrual time (i.e., the period when measure occurrences take place) and (3) the study follow-up time (i.e., the period when occurrences are tracked to see whether they are removed or fail). For this study, the accrual period was 12 months (i.e., the year 1994 for the 1994 RAEI Program), and the follow-up period was 48 months (i.e., the four years 1995-1998).

Given that the length of the study was fixed, the probability of removal/failure within a specified time span was determined primarily by the expected mean life of an appliance. As Table 2-1 shows, the longer the mean life of an appliance, the lower the probability of removal or failure within the time span specified for this study.

Table 2-1. Sample Sizes Required for Different Probabilities of Removal/Failure and Different Response Rates

Mean Life (In Years)	*Probability of Failure*	*Sample Size Required to Identify 41 Removals/Failures*	*Sample Size Adjusted for Response Rate*		
			40%	*50%*	*60%*
20	0.171	240	599	480	400
15	0.220	186	465	372	310
10	0.310	132	331	265	221
5	0.514	80	199	159	133

Table 2-1 illustrates that the number of households that had to be contacted to identify 41 where an appliance had been removed or had failed depends on the mean life of the appliance and on the rate of response to the survey. Moreover, if the precision/confidence requirements were to be met for *each* type of appliance, the total sample size required would be a multiple of the individual sample sizes. For example, if each of the four types of appliances had an expected life of 20 years and the response rate was 60%, the total sample required would be 1,600 (i.e., 400 x 4).

2.2 DATA COLLECTION METHODOLOGY

Based on the preceding analysis, using a telephone survey to screen households to identify those that had an appliance that had failed or that had been removed would have been relatively costly. Instead, a two-phase mail-telephone data collection methodology was used for each of the four types of appliances.

- In the first phase of the data collection, a mail survey was conducted of samples of participants in the 1994 RAEI Program. The primary purpose of this mail survey was to screen customers to identify those who may have had appliances that were removed or that failed.

- In the second phase of the data collection, telephone interviews were conducted with those households identified through the mail survey as having had appliances that were removed or that failed.

A mail survey was used in the first phase of the data collection because it allowed a relatively large number of households to be reached at less cost than a telephone survey. It is generally true that the depth of information that can be collected through a mail survey is less than that collected through a telephone survey. However, because the purpose of the first phase of data collection was only to identify households where an appliance may have been removed or failed, this was not a problem for the mail survey. Indeed, there was a single central question for the mail survey:

- Is the program-installed appliance still in place and operable?

This question was printed on a postcard that the respondent returned.

For those households that indicated that a program-installed appliance had been removed or had failed, follow-up telephone interviews were conducted to determine the reason for the removal/failure and the date when the removal/failure occurred.

2.3 SAMPLE ALLOCATION AND SELECTION

The sample allocation and selection work made use of files that SCE staff had prepared that contain information on the participants in the 1994 RAEI Program. Sampling frames for selecting the sample sites for the different types of appliances were created by extracting various items of data from three major files.

- The first file was a customer-based file that contained information on the *customers* who were 1994 RAEI Program participants.
- The second file was a customer-based follow-up file that contained information on current occupants of the residences that participated in the 1994 RAEI Program.

The population for the mail survey for each appliance was divided randomly into waves of the size desired for the mail out. For example, if the population of households numbered 4,000 and the number desired for a mail out was 400, then there would be ten waves of 400 households each. By creating waves, it was possible to stagger the mail survey to field more than one wave if the first wave did not result in the required number of households that had an appliance that had been removed or that had failed.

Households that received a rebate for a refrigerator needed to be treated somewhat differently from those that had received a rebate for a space cooling appliance. Essentially, households that received a rebate for a refrigerator in 1994 could be classified into four groups:

- Households in the same house who still had the refrigerator

- Households in the same house but who did not have the refrigerator
- Households who had moved but who still had the refrigerator
- Households who had moved and who did not have the refrigerator

Out of the 23,008 residences where an energy efficient refrigerator had been installed in 1994, 7,897 residences now had new households residing there. In other words, just over a third of the 1994 households receiving a rebate for a refrigerator had moved.

For households who had stayed in the same house, their current address was used for the mail survey. However, because households who had moved could have taken the refrigerator with them or otherwise disposed of it, it would have been necessary to find the new address of these households to use for the mailing. Thus, a questionnaire was mailed to these households at their old address to determine whether it could be forwarded to the new address.

While the household was the sampling unit for the refrigerator survey, the residence address was the sampling unit for the mail survey pertaining to space conditioning appliances. For these appliances, it is unlikely that a household would have taken the appliance when the household moved. The interest for this study was in finding whether the appliance was still in place at the house where it had originally been installed. If the program participant no longer lived in the house where the program appliance was installed (e.g., as indicated in SCE's customer information databases), information from SCE's customer databases that showed a name for the household now living in the house was used to direct the mail survey to that household. This approach was used because not including in the survey houses from which the original program participants had moved could impart a bias to the survey results.

The second phase telephone survey was directed only at those households who reported in the first phase mail survey that an RAEI Program appliance had been removed or had failed. Information was collected pertaining to basic household demographic and socio-economic characteristics.

2.4 SURVEY INSTRUMENTS

The types of survey instruments used for the 1994 RAEI Program retention study included the following:

- Survey letter and postcard questionnaire used to screen for presence of installed appliances
- Telephone survey form for interview of households where appliances have failed or been removed

Four sets of these materials were prepared, one set for each of the four types of appliances being studied. (For households who received rebates for refrigerators, there were two different questionnaires: one for the households that had not moved and another for households that had moved.) These materials are included in Appendix A.

The mail out letter to a customer was printed on SCE stationery and was mailed out in an envelope with SCE's logo.

2.5 SURVEY RESPONSES

Table 2-2 summarizes the data on the number of customers contacted through the mail survey and the number of customers who responded to the mail survey.

Table 2-2. Response Rates for Mail Survey Effort

Type of Appliance	*Number in Mail Survey Sample*	*Number of Respondents to Mail Survey*	*Percentage Responding to Mail Survey*
Central Air Conditioners	2,000	1,277	63.9%
Heat Pumps	940	481	51.2%
Evaporative Coolers	1,328	583	43.9%
Refrigerators: All	1,801	858	47.6%
For households that had not moved	1,201	631	52.5%
For households that had moved	600	227	37.8%

3. ANALYSIS AND RESULTS

This chapter presents and discusses the results of analyzing the data collected on the retention of appliances installed through the 1994 RAEI Program. Section 3.1 addresses the observed rates of retention for the various appliances. Section 3.2 presents and discusses the results of analyses used to derive estimates of effective useful lives for the appliances.

3.1 RETENTION DATA FOR EACH TYPE OF APPLIANCE

Retention rates for the various types of appliances were calculated using the information on the postcards returned by the respondents to the mail survey part of the data collection survey. In particular, Table 3-1 shows the percentage of households responding to the mail survey who reported that appliances installed in 1994 were no longer in place at the time of the survey. The implied retention rates are also shown. As would be expected for these types of appliances, the rates of retention for the various appliances are relatively high.

Table 3-1. Retention Rates for RAEI Appliances

Type of Appliance	*Number of Mail Survey Respondents*	*Number of Respondents Reporting Appliance Had Been Removed, Failed or Replaced since 1994*	*Percentage of All Respondents Reporting Appliance Removed, Failed or Replaced since 1994*	*Percentage of Respondents Retaining Appliance in 1998*
Central Air Conditioners	1,277	23	1.8%	98.2%
Heat Pumps	481	14	2.9%	97.1%
Evaporative Coolers	583	37	6.3%	93.7%
Refrigerators: All	858	26	3.0%	97.0%
For households that had not moved	631	22	3.5%	96.5%
For households that had moved	227	4	1.8%	98.2%

3.2 ESTIMATES OF EFFECTIVE USEFUL LIFE FOR APPLIANCES

Under the DSM Measurement Protocols, a utility recovers 25% of the earnings in the third and fourth earnings claims based on the following equation:

Net resource benefits = first year impacts x EUL x TDF

where EUL is the effective useful life of a measure and TDF is a technical degradation factor used to account for time-and-use related change in the energy savings of a high

efficiency measure or practice relative to a standard efficiency measure or practice. The first year impacts are developed in the first year impact evaluation studies, while the technical degradation factors have been developed from a statewide study sponsored by the California DSM Measurement Advisory Committee (CADMAC). Estimates of EUL are to be developed through retention studies, such as this one.

Under the Protocols, effective useful life of a measure is defined as the median number of years that the measure installed under the program is still in place and operable. In effect, the median age is the number of years that pass until 50% of the installed measures are no longer in place and operable. Determining the effective useful life according to this definition requires deriving a survival function for a measure, where a survival function shows the fraction of installed measures still in place and operable as time passes.

The analytical difficulty that arises in trying to derive a survival function for a program measure is that the amount of data available are relatively limited. It can be assumed that 100% of the measures are in place and operable when they are installed. Moreover, estimates of the percentage of measures still in place after three or four years are shown by the retention rates determined from the data collected in a retention study. However, no actual data on which to base the survival function are available for the particular measures beyond the third or fourth year.

Because the retention rates for the first four years after installation are high for the measures considered in this study, non-parametric methods of estimating survival functions are not appropriate. Non-parametric methods can give an accurate estimate of median survival time only if more than 50% of the measures are no longer in place and operable.

With parametric methods for estimating a median survival time, a survival function is estimated using the available data and the estimated function is then used to project survival rates at future points in time. The difficulty with the parametric approach for this study is that the high early retention rates for the different appliances mean that there is little information with which to distinguish between different functional forms for the survival function. Because of the limited time span that the collected data cover, a variety of survival functions that imply significantly different median lives can be fitted through the data.[1]

[1] For discussion of this problem, see Hahn, G.J. and Meeker, W.Q, Jr., "Pitfalls and Practical Considerations in Product Life Analysis—Part I: Basic Concepts and Dangers of Extrapolation", *Journal of Quality Technology*, Vol. 14, July 1982, pp. 144-152.

To overcome these difficulties, survival functions for refrigerators and central air conditioners were developed during this study using data from SCE's 1995 Residential Appliance Saturation Survey. (The RASS did not have the data needed to develop survival functions for heat pumps and evaporative coolers.) Assuming that these survival functions represent the general survival behavior for these types of appliances, then the survival patterns for high efficiency refrigerators and central air conditioners installed by households under the 1994 RAEI Program would be expected to be similar.

The steps in the procedure for estimating the survival functions were as follows:

- Prepare data for calculation of hazard rate function
- Calculate hazard rate function
- Use hazard rate function to determine survival function
- Estimate effective useful life of refrigerators or central air conditioners from survival function
- Determine whether there is reason to believe that high efficiency refrigerators or central air conditioners would have survival patterns different from those estimated from the RASS data

The following subsections present and discuss the results from applying this procedure to analyze the effective useful lives for refrigerators and for central air conditioners.

3.2.1 Analysis of Effective Useful Lives for Refrigerators

Data that could be used for estimating the effective useful lives of refrigerators was collected in SCE's 1995 Residential Appliance Saturation Survey. Respondents to that survey provided information about various aspects of their refrigerators, including the ages of those in use and of those that had been discarded after January 1, 1993 and the time of the survey (July through November of 1995). These RASS data were used to develop the data needed to estimate hazard functions for refrigerators being discarded and taken out of the stock.

A hazard function defines the probability that an item will fail in the next unit of time, given that it has survived to the present. The hazard rate at time t is the ratio of the number of units failing in that interval to the number surviving to that time:

$$h(t) = \frac{f(t)}{1-F(t)}$$

where h(t) is the hazard rate at time t; f(t) is the probability of failure during an increment of time at time t; and F(t) is the cumulative probability of failure up to time t. Given an estimated hazard function, a corresponding survival function can be determined.[2]

For the analysis here, the percentage of refrigerators discarded per year was taken to represent the hazard for a refrigerator being discarded. Table 3-2 provides the data that were developed from the 1995 RASS and used to estimate a hazard function for refrigerator discards. These data were developed through the following steps.

- On the RASS questionnaire, respondents were asked to classify the ages of their refrigerators according to the age categories shown in Column (1). The stock of refrigerators in each age category, as determined from the weighted RASS data, is shown in Column (2).
- RASS respondents were asked to provide information about the number of refrigerators that they had stopped using or had discarded after January 1, 1993. They were also asked to provide information on the age of the *last* refrigerator discarded. Using the age data, the distribution of last discards across the age categories in Column (1) could be determined. Because last discards did not fully represent the entire number of discards, the ratio of total discards to last discards was used to ratio up the number of discards by age category, as reported in Column (3).
- Refrigerator discards as a percentage of the stock are shown in Column (4). Because the reported discards cover a span of two years, the percentage of discards on an annual basis was determined by dividing the percentages in Column (4) by 2. The resulting percentages for refrigerators discarded per year are reported in Column (5).
- The percentages for discards reported in Column (5) in effect represent first discards by a household, but may not represent refrigerator discards that result in the refrigerator actually being taken out of the stock. To determine the percentage of discards taken out of stock, information from RASS on how refrigerators were discarded was used. If a respondent reported that a refrigerator was hauled away for disposal or was picked up by an appliance retailer, then that discarded refrigerator was assumed to have been taken out of the stock. The percentages of discards taken out of stock that were calculated from the RASS data are reported in Column (6). These percentages were applied to the percentages in Column (5) to arrive at the annual percentages of discards taken out of stock, as reported in Column (7).

[2] Collett, *op. cit.*, pp. 10-13.

Table 3-2. Data from 1995 Residential Appliance Saturation Survey Used for Calculation of Hazard Function for Refrigerators

(1) *Age of Refrigerator*	*(2)* *Stock of Refrigerators*	*(3)* *Estimated Discards between 1/1/93 and 1/1/95*	*(4)* *Percentage Discarded*	*(5)* *Annual Percentage Discarded*	*(6)* *Percentage of Discards Taken Out of Stock*	*(7)* *Annual Percentage of Discards Taken Out of Stock*
Under 2 years	523,023	3,803	0.73%	0.36%	21.83%	0.08%
2-5 years	1,289,249	54,211	4.20%	2.10%	16.38%	0.34%
6-10 years	1,362,156	116,019	8.52%	4.26%	38.13%	1.62%
11-15 years	570,443	109,737	19.24%	9.62%	50.93%	4.90%
Over 15 years	464,174	125,358	27.01%	13.50%	51.52%	6.96%

The percentages reported in Columns (5) and (7) in Table 3-2 can be interpreted as hazard rates for refrigerator discards under two different scenarios. Scenario 1, which uses the percentages in Column (5), implicitly assumes that a refrigerator's useful life ends when the first household to own it discards it. Scenario 2, which uses the percentages in Column (7), accounts for the fact that a refrigerator discarded by the first household to own it does not necessarily exit from the stock. Some of the discarded refrigerators are either given away or sold and therefore remain in operation.

The following functional form was used to derive empirical hazard functions for refrigerator discards for the two scenarios.

Percent discarded = a - b exp (-c x Age)

where Age is the age of the refrigerator. This function, which is known as the Mitscherlich curve, is appropriate for the situation where the hazard rate is expected to increase over the early period of time but to approach an asymptotic level as age increases.[3] The discard rates shown in Columns (5) and (7) do show the increase over time. However, data were not available on the actual ages of refrigerators more than 15 years old. Rather than assuming that the hazard rates would continue to increase, the Mitscherlich curve was used to impose an upper bound on the discard rate.

The hazard functions for refrigerator discards estimated for the data in Columns (5) and (7) in Table 3-2 were as follows:

Scenario 1: Percent discarded = 0.223598 - 0.232185 exp (-0.039582 x Age)

Scenario 2: Percent discarded = 0.145177 - 0.153128 exp (-0.029173 x Age)

[3] Collett, D. *op. cit.*, pp. 201-202

The midpoint for each age category was used as the age estimate for the estimation. The parameters were estimated through non-linear regression, using the PROC NLIN procedure in SAS.

Table 3-3 compares the values predicted using these estimated functions against the actual values for the two scenarios. As can be seen, the correspondence between predicted and actual is close for both scenarios.

Table 3-3. Comparison of Predicted versus Actual for Estimated Hazard Functions for Refrigerators

Scenario 1		*Scenario 2*	
Actual	*Predicted*	*Actual*	*Predicted*
0.36%	0.04%	0.08%	-0.35%
2.10%	2.15%	0.34%	0.69%
4.26%	5.44%	1.62%	2.39%
9.62%	8.48%	4.90%	4.04%
13.50%	13.73%	6.96%	7.13%

The estimated hazard functions for refrigerator discards imply survival functions of the form known as the Gompertz-Makeham distribution.[4] This distribution gives a survival function that is S-shaped, but which is non-symmetric in that it has a relatively longer tail.

Figure 3-1 compares the survival functions for Scenario 1 and Scenario 2. As can be seen, the assumption of Scenario 2 that some of first-discard refrigerators continue in the stock results in higher survival percentages at each point in time. The survival functions plotted in Figure 3-1 permit the computation of the effective useful lives for refrigerators, defined as the point in time when 50% of the refrigerators installed as a cohort have gone out of the stock. For Scenario 1 the estimated median age is about 14.6 years, while the estimated median age for Scenario 2 is about 21.8 years.

[4] See Collett, *ibid.* See also Chiang, Chin Long *The Life Table and Its Applications*, Robert E. Krieger Publishing Company, 1984, p. 199.

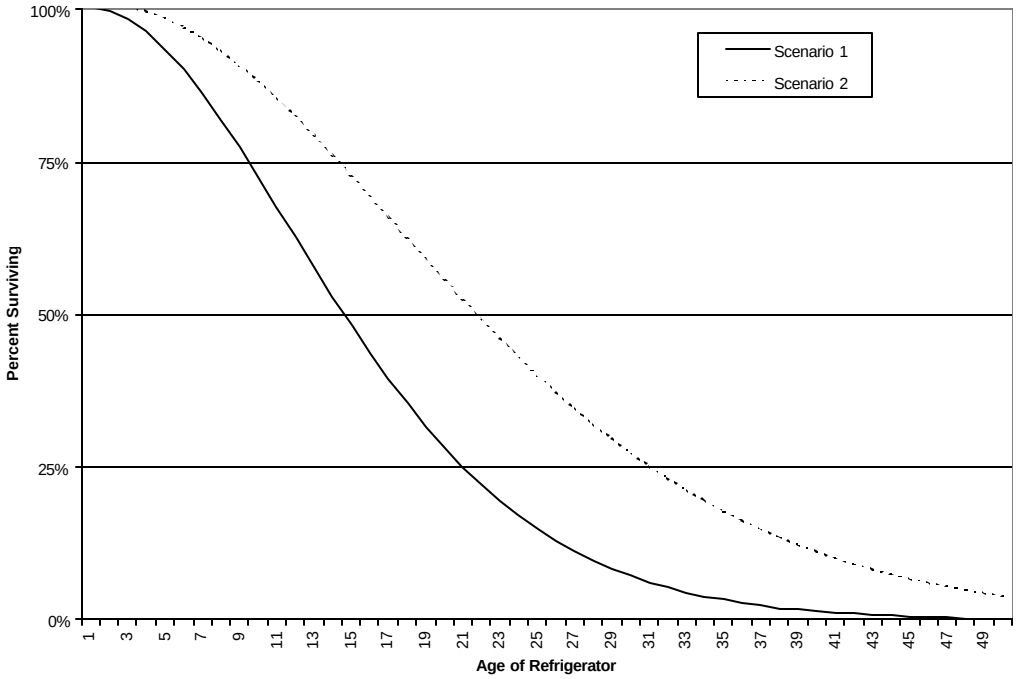

Figure 3-1. Estimated Survival Functions for Refrigerators

These estimates of median lives can be compared to other estimates of median lives for refrigerators that can be developed from other data SCE has collected.

- As one of the questions on the RASS survey, respondents who had discarded a refrigerator since January 1, 1993 were asked to estimate the age of the discarded refrigerator. Figure 3-2 provides a histogram summarizing the ages that RASS respondents reported for their discarded refrigerators. These data on ages of discarded refrigerators imply a median life of about 13 years. Conceptually, this estimate can be compared to the estimate derived for Scenario 1. That is, these estimates essentially address the time at which a household first discards a refrigerator. However, because a discarded refrigerator can be sold, the age at first discard will underestimate the effective useful life of the refrigerator.

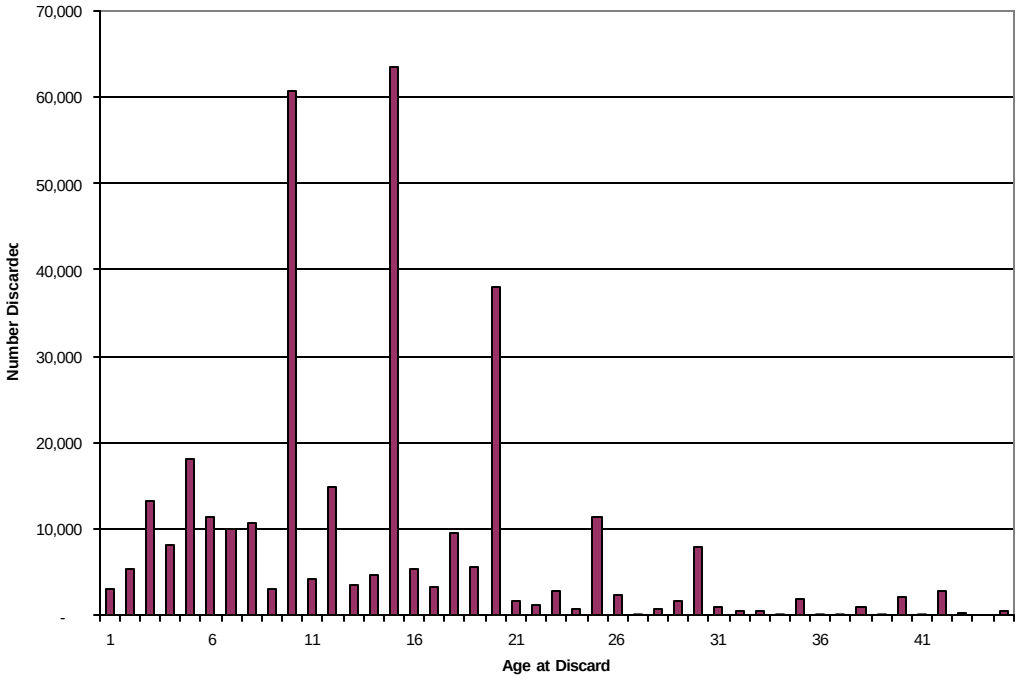

Figure 3-2. Distribution by Age for Discarded Refrigerators, per 1995 RASS

- Data on ages of discarded refrigerators were also collected by SCE for refrigerators that were disposed of through SCE's Refrigerator Recycling Program. The data on the ages of refrigerators disposed of through that program showed a median age of about 19.3 years. This estimate can be compared to the estimate developed for Scenario 2, in that both estimates address the age of a refrigerator when it is finally taken out of use. The estimated effective life of 21.8 years for Scenario 2 is higher than the age estimated from the refrigerator recycling data. However, the estimates are close, particularly when consideration is given to the probability that the recycling program induced households to dispose of refrigerators before their full useful life had been reached.

The estimates of effective useful lives for refrigerators reported here were developed from the substantial data collected by SCE in the 1995 Residential Appliance Saturation Survey. That survey was necessarily retrospective, looking at refrigerators already in existence. However, these estimates should apply equally as well to the high-efficiency refrigerators installed by households participating in SCE's 1994 RAEI Program. That is, there is no evidence at this point to indicate that the high efficiency refrigerators will have life spans that are not governed by the same forces as determined discard rates for refrigerators as shown by the RASS data. The fourth-year retention rates for the high efficiency refrigerators reported in Table 3-1 accord with the survival rates indicated for this time span in the survival curves shown in Figure 3-1.

SCE's *ex ante* estimate for the effective useful lives of refrigerators was 18 years. That estimate lies between the two estimates of useful life for refrigerators derived in this study: 14.6 years for Scenario 1 and 21.8 for Scenario 2. Accordingly, SCE's *ex ante* estimate of effective useful life for refrigerators appears appropriate.

3.2.2 Analysis of Effective Useful Lives for Central Air Conditioners

An analysis similar to that for refrigerators was conducted for central air conditioners, but with modifications to account for differences between the two types of appliances and the data available for the analysis.

For the analysis of central air conditioners, the percentage of new central air conditioners being installed per year *for existing houses with central air conditioning* was taken to represent the hazard for the air conditioner being replaced. That is, it was assumed that if new air conditioning equipment was installed for an existing house, that installation was made by and large to replace failed equipment. Moreover, the market for secondary sales of central air conditioning equipment is smaller than that for refrigerators, so that there was no need to account for replacements for which the equipment was not taken out of stock.

Table 3-4 provides the data that were developed from the 1995 RASS and used to estimate a hazard function for replacement of central air conditioners.

- On the RASS questionnaire, respondents were asked to classify their central air conditioning systems by age categories. However, there were no data collected in RASS by which to categorize air conditioner replacements by these age categories. Accordingly, a proxy method was used whereby the age of a house with central air conditioning was used as a measure of the age of the central air conditioning equipment. This method is based on the fact that most central air conditioning systems are installed when the house is built and that new additions of central air conditioning to existing houses occurs infrequently. This accords with RASS data that show that 71% of the households living in houses with central air conditioning built between 1940 and 1990 who reported having installed new air conditioning equipment reported that the installation was made to replace an older air conditioner. Following this method, the stock of houses with central air conditioning was distributed across house age categories as shown in Columns (1) and (2) of Table 3-4.
- Existing houses with central air conditioning equipment who installed replacement air conditioning were identified as those RASS respondents who reported having purchased new central air conditioning equipment after January 1, 1993. These households as a percentage of the stock of households are reported for each age category in Column (3) of Table 3-4.

Table 3-4. Data from 1995 Residential Appliance Saturation Survey Used for Calculation of Hazard Function for Central Air Conditioners

(1) *Year House Was Built*	*(2)* *Houses with CAC*	*(3)* *Percent of CAC Houses with New CAC Equipment*
1987-1990'	211,286	1.01%
1983-1986'	152,198	3.79%
1979-1982'	176,932	4.45%
1975-1978'	146,745	4.59%
1970-1974'	79,774	8.09%
1965-1969'	92,907	8.99%
1960-1964'	112,057	7.10%
1950-1959'	32,459	9.16%
1940-1949'	16,637	13.36%

The percentages reported in Column (3) in Table 3-4 can be interpreted as hazard rates for replacement of central air conditioning equipment. As with the refrigerator analysis, the Mitscherlich curve was used as the functional form to derive an empirical hazard function for air conditioning replacements.

The hazard function for air conditioner replacement estimated for the data in Column (3) in Table 3-4 was as follows:

Percent replaced = 0.242347 - 0.245961 exp(- 0.014337 x Age)

The midpoint for each age category was used as the age estimate for the estimation. The parameters were estimated through non-linear regression, using the PROC NLIN procedure in SAS.

Table 3-5 compares the values predicted using this estimated function against the actual values. As can be seen, the correspondence between predicted and actual is close.

Table 3-5. Comparison of Predicted versus Actual for Estimated Hazard Function for Air Conditioning Replacement

Actual	*Predicted*
1.01%	1.83%
3.79%	3.08%
4.45%	4.26%
4.59%	5.37%
8.09%	6.55%
8.99%	7.77%
7.10%	8.91%
9.16%	10.47%
13.36%	12.31%

The estimated hazard function for air conditioning replacement implies a survival function taking the form of the Gompertz-Makeham distribution. Figure 3-3 shows the survival function that results from the fitted hazard function. The survival function plotted in Figure 3-3 permits the computation of the effective useful lives for central air conditioners, defined as the point in time when 50% of the air conditioners installed have gone out of the stock. The estimated median age for central air conditioners based on this analysis is 22.04 years.

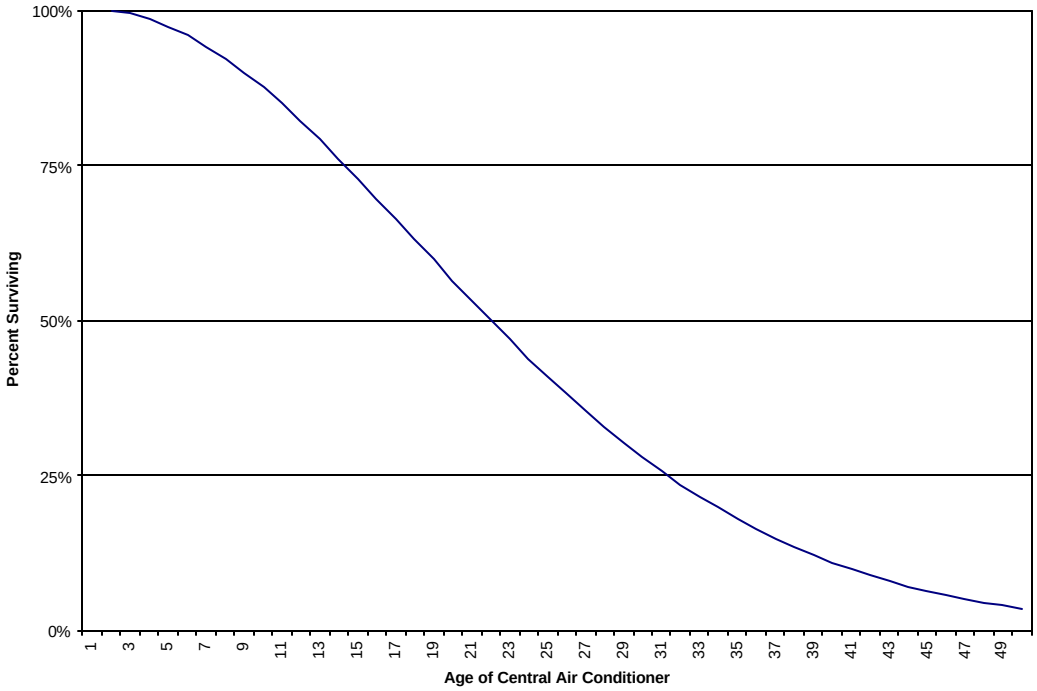

Figure 3-3. Estimated Survival Function for Central Air Conditioners

As with refrigerators, the estimate of effective useful life for central air conditioners that has been developed from the RASS data should apply equally as well to the high-efficiency central air conditioners installed by households participating in SCE's 1994 RAEI Program. That is, there is no evidence at this point to indicate that the high efficiency central air conditioners will have life spans that are not governed by the same forces as determined replacement rates for central air conditioners as shown by the RASS data. The fourth-year retention rates for the high efficiency central air conditioners reported in Table 3-1 accord with the survival rates indicated for this time span in the survival curve shown in Figure 3-3.

SCE's *ex ante* estimate for the effective useful live of central air conditioners was 18 years. That estimate is somewhat more conservative than the estimate of 22.04 years derived in this study. Accordingly, SCE's *ex ante* estimate of effective useful life for central air conditioning appears appropriate.

3.2.3 Analysis of Effective Useful Lives for Heat Pumps and Evaporative Coolers

Because of the relatively high retention rates in the first four years for heat pumps and evaporative coolers installed under the 1994 RAEI Program, the data collected through the mail/telephone survey could not support estimation of hazard functions and corresponding survival functions. Moreover, the procedure used to derive survival functions for refrigerators and central air conditioners from the 1995 RASS data could not be accomplished for heat pumps and evaporative coolers, but for different reasons.

For heat pumps, data were collected in the 1995 RASS pertaining to whether heat pumps served as the primary heating system of a house and the age of the primary heating system. The RASS data for central heat pumps were used to prepare Table 3-6, which is similar to Table 3-4 for central air conditioners.

Table 3-6. Data from 1995 Residential Appliance Saturation Survey for Houses with Central Heat Pumps

(1) *Year House Was Built*	*(2)* *Houses with Central Heat Pumps*	*(3)* *Percent of Houses with New Heat Pumps*
1987-1990'	30,431	0.13%
1983-1986'	30,270	0.15%
1979-1982'	27,436	0.28%
1975-1978'	22,792	2.75%
1970-1974'	17,814	0.70%
1965-1969'	5,245	1.17%
1960-1964'	7,827	0.38%
1950-1959'	12,308	9.82%
1940-1949'	14,134	4.15%

Although an attempt was made to use the RASS data to derive a hazard function for heat pumps, the non-linear regression procedure could not converge to provide estimates of the hazard function parameters. Further inspection of the percentages reported in Column (3) of Table 3-4 shows why the data were not sufficient to support development of a hazard function for heat pumps.

- First, some of the percentages for houses with new heat pumps imply very low probabilities of replacing a heat pump, particularly for the first three age categories. Table 3-1 showed that 2.9% of the heat pumps installed under the 1994 RAEI Program had been removed or had failed by 1998, implying a removal rate of about 0.7% per year. It would be expected that the replacement rates for older heat pumps would have been similar or higher. Moreover, there is no apparent reason why replacements of heat pumps should be significantly lower than the replacement rates for central air conditioners, as shown in Table 3-4.
- Second, the pattern of percentages across age categories is markedly jagged, rather than showing a trend toward increasing with higher ages (as would be expected).

For evaporative coolers, data were collected in the 1995 RASS that pertained to whether and how many coolers were present in a residence, but no data were collected pertaining to the age of the coolers. Lacking any age data for evaporative coolers, the procedure applied to estimate effective useful lives for refrigerators and central air conditioners could not be applied for evaporative coolers.

Because alternative estimates of effective useful lives could not be developed for heat pumps and evaporative coolers, SCE's *ex ante* estimates of effective useful lives for

these appliances can be maintained. For heat pumps, the *ex ante* estimate is 18 years. For evaporative coolers, the *ex ante* estimate is 15 years.

Appendix A

DATA COLLECTION FORMS

The types of survey instruments used for the 1994 RAEI Program retention study include the following:

- Survey letter and postcard questionnaire used to screen for presence of installed appliances
- Telephone survey form for interview of households where appliances have failed or been removed

Sets of these materials have been prepared for the following types of appliances:

- Central air conditioners
- Heat pumps (both central and through-the-wall)
- Evaporative coolers
- Refrigerators
  - One set for households that have not moved
  - Another set for households that have moved

Copies of these survey instruments are included in this appendix.

Mail Out Letter for Central Air Conditioner Households

[Date]

[Inside Address]

[Salutation]

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient central air conditioners. We are now conducting a follow-up survey to determine how many of the central air conditioners installed under that program are still installed and being used.

SCE's records show that an energy efficient central air conditioner was installed at this residence in 1994 under the RAEI Program. We would appreciate your filling out and returning the enclosed postcard. On the postcard, please check the appropriate box to indicate whether the central air conditioner installed in 1994 is still installed or whether that air conditioner has failed, has been replaced, or has been removed.

If you have any questions regarding this survey, please feel free to call ?? at ??.

Very truly yours,

[Signee]

Postcard Questionnaire to Return for Central Air Conditioner Households

Is the central air conditioner installed in your residence in 1994 under Southern California Edison's Residential Appliance Efficiency Incentive Program still in place and being used to air condition the residence?

- ❑ Yes, air conditioner is still in place and being used.
- ❑ No, air conditioner has been removed or disconnected.

Instrument for Telephone Survey Interview of Central Air Conditioner Households

Southern California Edison

1994 RAEI Program Retention Study

Telephone Survey:
Central Air Conditioners

Draft Version: 9/21/98

Instructions to Interviewer:

Hello, my name is _____ from ADM Associates. I am calling on behalf of Southern California Edison. May I speak to _____*(Customer Name*)?

If customer is not available, schedule a callback.

Once the contact has been made, make survey introduction:

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient central air conditioners. Edison's records show that an energy efficient central air conditioner was installed at your residence in 1994 under the RAEI Program.

We are conducting a survey to see how long the energy efficient central air conditioners installed through Edison's program in 1994 remain in use. We would be grateful for your cooperation in answering a few questions regarding the energy efficient central air conditioner installed at this residence.

1. Is the central air conditioner installed at this residence in 1994 through Edison's program still in place?

   Yes
   ↓
   Is that central air conditioner in a good state of repair?

   ❑ Yes *Go to Question 4.*

   ❑ No *Go to Question 2.*

   ❑ No *Go to Question 2.*

2. Has the air conditioner installed in 1994 been broken or damaged?

   ❑ No, it has not been broken or damaged. *Go to Question 3.*

   ❑ Yes, it has been broken or damaged.
   ↓

   a. How was the air conditioner broken or damaged?

      (*Explain)* _____
      _____
      _____
      _____

   b. When was the air conditioner broken/damaged? _____ *(Month/Year)*

3. Has the air conditioner installed in 1994 been removed or disconnected?

   ❑ No, it has not been removed or disconnected. *Go to Question 4.*

   ❑ Yes, it has been removed or disconnected.
   ↓

   a. Why was the air conditioner removed or disconnected?

      ❑ Air conditioner needed major repair.
      ❑ Renovation of house required change to air conditioning system.
      ❑ Cooling requirements changed.
      ❑ Other (*Specify*) _____
      _____
      _____
      _____

   b. When was the air conditioner removed/disconnected? _____ *(Month/Year)*

   c. Was the removal of the air conditioner part of a larger change?

      ❑ No

      ❑ Yes
      ↓

What change was that? _____
_____
_____

d. What, if anything, replaced the central air conditioner?
   - ❑ Air conditioner was removed but not replaced.
   - ❑ Air conditioner was replaced with a different type of cooling equipment.
     ↓
     What was the air conditioner replaced with?
     (*Specify*) _____
     _____
     _____
   - ❑ Other (*Specify*) _____

4. Were you living in this residence in 1994?
   - ❑ Yes
   - ❑ No
     ↓
     When did you move into this residence? _____ *(Month/Year)*

5. Do you own or rent this residence?
   - ❑ Own residence
   - ❑ Rent residence
   - ❑ Don't know

6. How many stories does this residence have?
   - ❑ One story
   - ❑ One-and-a-half stories
   - ❑ Two stories
   - ❑ Three or more stories

7. How many rooms does this residence have? _____ *(Number of rooms)*

8. What is the approximate size of the residence in square feet?
   _____(*Square Feet)*
   - ❑ Don't know

9. How many people live at this residence? _____ *(Number of people)*

That concludes my questions. Thank you for your cooperation.

Mail Out Letter for Heat Pump Households

[Date]

[Inside Address]

[Salutation]

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient heat pumps. We are now conducting a follow-up survey to determine how many of the heat pumps installed under that program are still installed and being used.

Edison's records show that an energy efficient heat pump was installed at this residence in 1994 under the RAEI Program. We would appreciate your filling out and returning the enclosed postcard. On the postcard, please check the appropriate box to indicate whether the heat pump installed in 1994 is still in place or whether that heat pump has failed, has been replaced, or has been removed.

If you have any questions regarding this survey, please feel free to call ?? at ??.

Very truly yours,

[Signee]

Postcard Questionnaire to Return for Heat Pump Households

Is the heat pump installed in your residence in 1994 under Southern California Edison's Residential Appliance Efficiency Incentive Program still in place and being used to air condition the residence?

- ❑ Yes, heat pump is still in place and being used.
- ❑ No, heat pump has been removed or disconnected.

Instrument for Telephone Survey Interview of Heat Pump Households

Southern California Edison

1994 RAEI Program Retention Study

Telephone Survey:
Central and Through-the-Wall Heat Pumps

Draft Version: 9/21/98

Instructions to Interviewer:

Hello, my name is _____ from ADM Associates. I am calling on behalf of Southern California Edison. May I speak to _____*(Customer Name*)?

If customer is not available, schedule a callback.

Once the contact has been made, make survey introduction:

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient heat pumps. Edison's records show that an energy efficient heat pump was installed at your residence in 1994 under the RAEI Program.

We are conducting a survey to see how long the energy efficient heat pumps installed through Edison's program in 1994 remain in use. We would be grateful for your cooperation in answering a few questions regarding the energy efficient heat pump installed at this residence.

1. Is the heat pump installed at this residence in 1994 through Edison's program still in place?
   - ❑ Yes
     ↓
     Is that heat pump in a good state of repair?
     - ❑ Yes *Go to Question 4.*
     - ❑ No *Go to Question 2.*
   - ❑ No *Go to Question 2.*

2. Has the heat pump installed in 1994 been broken or damaged?
   - ❑ No, it has not been broken or damaged. *Go to Question 3.*
   - ❑ Yes, it has been broken or damaged.
     ↓
     a. How was the heat pump broken or damaged?

     (*Explain)* _____
     _____
     _____
     _____

     b. When was the heat pump broken/damaged? _____ *(Month/Year)*

3. Has the heat pump installed in 1994 been removed or disconnected?
   - ❑ No, it has not been removed or disconnected. *Go to Question 4.*
   - ❑ Yes, it has been removed or disconnected.
     ↓
     a. Why was the heat pump removed or disconnected?
     - ❑ Heat pump needed major repair.
     - ❑ Renovation of house required change to air conditioning system.
     - ❑ Cooling requirements changed.
     - ❑ Other (*Specify*) _____
       _____
       _____
       _____

     b. When was the heat pump removed/disconnected? _____ *(Month/Year)*

     e. Was the removal of the heat pump part of a larger change?
     - ❑ No
     - ❑ Yes
       ↓

What change was that? _____
_____
_____

f. What, if anything, replaced the heat pump?

❑ Heat pump was removed but not replaced.

❑ Heat pump was replaced with a different type of cooling equipment.

↓

What was the heat pump replaced with?
(*Specify*) _____
_____
_____

❑ Other (*Specify*) _____

4. Were you living in this residence in 1994?

❑ Yes

❑ No

↓

When did you move into this residence? _____ *(Month/Year)*

5. Do you own or rent this residence?

❑ Own residence

❑ Rent residence

❑ Don't know

6. How many stories does this residence have?

❑ One story

❑ One-and-a-half stories

❑ Two stories

❑ Three or more stories

7. How many rooms does this residence have? _____ *(Number of rooms)*

8. What is the approximate size of the residence in square feet?
_____(*Square Feet)*

❑ Don't know

9. How many people live at this residence? _____ *(Number of people)*

That concludes my questions. Thank you for your cooperation.

Mail Out Letter for Evaporative Cooler Households

[Date]

[Inside Address]

[Salutation]

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive (RAEI) Program through which it paid rebates to customers who installed evaporative coolers. We are now conducting a follow-up survey to determine how many of the evaporative coolers installed under that program are still installed and being used.

Edison's records show that an evaporative cooler was installed at this residence in 1994 under the RAEI Program. We would appreciate your filling out and returning the enclosed postcard. On the postcard, please check the appropriate box to indicate whether the evaporative cooler installed in 1994 is still in place or whether that evaporative cooler has failed, has been replaced, or has been removed.

If you have any questions regarding this survey, please feel free to call ?? at ??.

Very truly yours,

[Signee]

Postcard Questionnaire to Return for Evaporative Cooler Households

Is the evaporative cooler installed in your residence in 1994 under Southern California Edison's Residential Appliance Efficiency Incentive Program still in place and being used to air condition the residence?

- ❑ Yes, evaporative cooler is still in place and being used.
- ❑ No, evaporative cooler has been removed or disconnected.

Instrument for Telephone Survey Interview of Evaporative Cooler Households

Southern California Edison

1994 RAEI Program Retention Study

Telephone Survey:
Evaporative Coolers

Draft Version: 9/21/98

Instructions to Interviewer:

Hello, my name is _____ from ADM Associates. I am calling on behalf of Southern California Edison. May I speak to _____*(Customer Name*)?

If customer is not available, schedule a callback.

Once the contact has been made, make survey introduction:

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient evaporative coolers. Edison's records show that an energy efficient evaporative cooler was installed at your residence in 1994 under the RAEI Program.

We are conducting a survey to see how long the energy efficient evaporative coolers installed through Edison's program in 1994 remain in use. We would be grateful for your cooperation in answering a few questions regarding the energy efficient evaporative cooler installed at this residence.

1. Is the evaporative cooler installed at this residence in 1994 through Edison's program still in place?
   - ❑ Yes
     ↓
     Is that evaporative cooler in a good state of repair?
     - ❑ Yes *Go to Question 4.*
     - ❑ No *Go to Question 2.*
   - ❑ No *Go to Question 2.*

2. Has the evaporative cooler installed in 1994 been broken or damaged?
   - ❑ No, it has not been broken or damaged. *Go to Question 3.*
   - ❑ Yes, it has been broken or damaged.
     ↓
     a. How was the evaporative cooler broken or damaged?

        (*Explain)* _____
        _____
        _____
        _____

     b. When was the evaporative cooler broken/damaged? _____ *(Month/Year)*

3. Has the evaporative cooler installed in 1994 been removed or disconnected?
   - ❑ No, it has not been removed or disconnected. *Go to Question 4.*
   - ❑ Yes, it has been removed or disconnected.
     ↓
     a. Why was the evaporative cooler removed or disconnected?
        - ❑ Evaporative cooler needed major repair.
        - ❑ Renovation of house required change to air conditioning system.
        - ❑ Cooling requirements changed.
        - ❑ Other (*Specify*) _____
          _____
          _____
          _____

     b. When was the evaporative cooler removed/disconnected? _____ *(Month/Year)*

     g. Was the removal of the evaporative cooler part of a larger change?
        - ❑ No
        - ❑ Yes
          ↓

What change was that? _____
_____
_____

h. What, if anything, replaced the evaporative cooler?

- ❑ Evaporative cooler was removed but not replaced.
- ❑ Evaporative cooler was replaced with a different type of cooling equipment.

  ↓

  What was the evaporative cooler replaced with?
  (*Specify*) _____
  _____
  _____
- ❑ Other (*Specify*) _____

4. Were you living in this residence in 1994?
   - ❑ Yes
   - ❑ No

     ↓

     When did you move into this residence? _____ *(Month/Year)*

5. Do you own or rent this residence?
   - ❑ Own residence
   - ❑ Rent residence
   - ❑ Don't know

6. How many stories does this residence have?
   - ❑ One story
   - ❑ One-and-a-half stories
   - ❑ Two stories
   - ❑ Three or more stories

7. How many rooms does this residence have? _____ *(Number of rooms)*

8. What is the approximate size of the residence in square feet?
   _____(*Square Feet)*
   - ❑ Don't know

9. How many people live at this residence? _____ *(Number of people)*

That concludes my questions. Thank you for your cooperation.

Mail Out Letter for Refrigerator Households That Have Not Moved

[Date]

[Inside Address]

[Salutation]

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient refrigerators. We are now conducting a follow-up survey to determine how many of the refrigerators installed under that program are still installed and being used.

Edison's records show that an energy efficient refrigerator was purchased for this residence in 1994 under the RAEI Program. We would appreciate your filling out and returning the enclosed postcard. On the postcard, please check the appropriate box to indicate whether the refrigerator installed in 1994 is still in place or whether that refrigerator has failed, has been replaced, or has been removed.

If you have any questions regarding this survey, please feel free to call ?? at ??.

Very truly yours,

[Signee]

Postcard Questionnaire to Return for Refrigerator Households That Had Not Moved

Is the refrigerator purchased for your residence in 1994 under Southern California Edison's Residential Appliance Efficiency Incentive Program still in place and being used?

- ❑ Yes, refrigerator is still in place and being used.
- ❑ No, refrigerator has been removed or disconnected.

Instrument for Telephone Survey Interview of Refrigerator Households That Have Not Moved

Southern California Edison

1994 RAEI Program Retention Study

Telephone Survey:
Refrigerators: Stayers

Draft Version: 9/21/98

Instructions to Interviewer:

Hello, my name is _____ from ADM Associates. I am calling on behalf of Southern California Edison. May I speak to _____*(Customer Name*)?

If customer is not available, schedule a callback.

Once the contact has been made, make survey introduction:

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient refrigerators. Edison's records show that an energy efficient refrigerator was installed at your residence in 1994 under the RAEI Program.

We are conducting a survey to see how long the energy efficient refrigerators installed through Edison's program in 1994 remain in use. We would be grateful for your cooperation in answering a few questions regarding the energy efficient refrigerator installed at this residence.

1. Is the refrigerator installed at this residence in 1994 through Edison's program still in place?
   - ❑ Yes
     ↓
     Is that refrigerator in a good state of repair?
     - ❑ Yes *Go to Question 4.*
     - ❑ No *Go to Question 2.*
   - ❑ No *Go to Question 2.*

2. Has the refrigerator installed in 1994 been broken or damaged?
   - ❑ No, it has not been broken or damaged. *Go to Question 3.*
   - ❑ Yes, it has been broken or damaged.
     ↓
     a. How was the refrigerator broken or damaged?

        (*Explain)* _____
        _____
        _____
        _____

     b. When was the refrigerator broken/damaged? _____ *(Month/Year)*

3. Has the refrigerator installed in 1994 been removed or disconnected?
   - ❑ No, it has not been removed or disconnected. *Go to Question 4.*
   - ❑ Yes, it has been removed or disconnected.
     ↓
     a. Why was the refrigerator removed or disconnected?
        - ❑ Refrigerator needed major repair.
        - ❑ Renovation of house required change to air conditioning system.
        - ❑ Cooling requirements changed.
        - ❑ Other (*Specify*) _____
          _____
          _____
          _____

     b. When was the refrigerator removed/disconnected? _____ *(Month/Year)*

     c. Was the removal of the refrigerator part of a larger change?
        - ❑ No
        - ❑ Yes
          ↓

What change was that? _____
_____
_____

d. What, if anything, replaced the refrigerator?
   - ❑ Refrigerator was removed but not replaced.
   - ❑ Refrigerator was replaced with a different type of cooling equipment.

     ↓

     What was the refrigerator replaced with?
     (*Specify*) _____
     _____
     _____
   - ❑ Other (*Specify*) _____

4. Were you living in this residence in 1994?
   - ❑ Yes
   - ❑ No

     ↓

     When did you move into this residence? _____ *(Month/Year)*

5. Do you own or rent this residence?
   - ❑ Own residence
   - ❑ Rent residence
   - ❑ Don't know

6. How many stories does this residence have?
   - ❑ One story
   - ❑ One-and-a-half stories
   - ❑ Two stories
   - ❑ Three or more stories

7. How many rooms does this residence have? _____ *(Number of rooms)*

8. What is the approximate size of the residence in square feet?
   _____(*Square Feet)*
   - ❑ Don't know

9. How many people live at this residence? _____ *(Number of people)*

That concludes my questions. Thank you for your cooperation.

Mail Out Letter for Refrigerator Households That Had Moved

[Date]

[Inside Address]

[Salutation]

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who installed energy efficient refrigerators. We are now conducting a follow-up survey to determine how many of the refrigerators purchased under that program are still being used.

Edison's records show that you received a rebate for purchasing an energy efficient refrigerator in 1994 while living at a previous residence. We would appreciate your filling out and returning the enclosed postcard. On the postcard, please check the appropriate box to indicate whether you are still using the refrigerator you bought in 1994, you left the refrigerator at your previous residence, or have otherwise disposed of that refrigerator.

If you have any questions regarding this survey, please feel free to call ?? at ??.

Very truly yours,

[Signee]

Postcard Questionnaire to Return for Refrigerator Households That Had Moved

How is the refrigerator you purchased in 1994 under Southern California Edison's Residential Appliance Efficiency Incentive Program now being used?

- ❑ Left that refrigerator at old residence when we moved.
- ❑ Took that refrigerator with us to new residence and are still using.
- ❑ Sold or gave away that refrigerator.
- ❑ Had to get rid of that refrigerator when it stopped working.

Instrument for Telephone Survey Interview of Refrigerator Households That Have Moved

Southern California Edison

1994 RAEI Program Retention Study

Telephone Survey:
Refrigerators: Moved Out

Draft Version: 9/21/98

Instructions to Interviewer:

Hello, my name is _____ from ADM Associates. I am calling on behalf of Southern California Edison. May I speak to _____*(Customer Name*)?

If customer is not available, schedule a callback.

Once the contact has been made, make survey introduction:

In 1994 Southern California Edison conducted a Residential Appliance Efficiency Incentive Program through which it paid rebates to customers who bought energy efficient refrigerators. Edison's records show that you purchased an energy efficient refrigerator and received a rebate for that refrigerator while living at your previous residence.

We are conducting a survey to see how long the energy efficient refrigerators purchased with Edison's rebate in 1994 remain in use. We would be grateful for your cooperation in answering a few questions regarding the energy efficient refrigerator you purchased.

1. When did you move into this residence? _____ *(Month/Year)*

2. Did you bring the refrigerator you bought in 1994 with a rebate from Southern California Edison to this residence?
   - ❑ Yes, we brought that refrigerator from our previous residence. *Go to Question 3.*
   - ❑ No, there was no refrigerator here but we bought a new refrigerator. *Go to Question 4.*
   - ❑ No, there was a refrigerator here when we moved in. *Go to Question 4.*

3. Is the refrigerator you bought in 1994 still in a good state of repair?
   - ❑ Yes *Go to Question 5.*
   - ❑ No
     ↓
     a. Has the refrigerator you bought in 1994 been broken or damaged?
        - ❑ No, it has not been broken or damaged. *Go to Question 5.*
        - ❑ Yes, it has been broken or damaged.
          ↓
          a. How was the refrigerator broken or damaged?
          (*Explain)* _____
          _____
          _____
          _____

          b. When was the refrigerator broken/damaged? _____ *(Month/Year)*

4. What did you do with the refrigerator you bought in 1994??
   - ❑ Left it at old residence. *Go to Question 5.*
   - ❑ Sold or gave that refrigerator away.
   - ❑ That refrigerator had stopped working and we got rid of it.
     ↓
     a. When did the refrigerator stop working? _____ *(Month/Year)*

5. Do you own or rent the residence you now live in?
   - ❑ Own residence
   - ❑ Rent residence
   - ❑ Don't know

6. How many stories does this residence have?
   - ❑ One story
   - ❑ One-and-a-half stories
   - ❑ Two stories

❑ Three or more stories

7. How many rooms does this residence have? _____ *(Number of rooms)*

8. What is the approximate size of the residence in square feet?
_____*(Square Feet)*

❑ Don't know

9. How many people live at this residence? _____ *(Number of people)*

That concludes my questions. Thank you for your cooperation.