

How Electric Customers Dispose of Used Refrigerators and Why They Choose a Utility Program

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Abstract

Many utilities are operating appliance recycling programs as part of their demand-side management programs. While there have been many evaluations of these programs, there is generally a lack of information about used appliance markets and the disposal choices that are available to customers that can directly inform both program planning and evaluation for these programs. Based on evaluation data (Dohrmann 2007) from the Residential Appliance Recycling Program (RARP) that was implemented statewide by California investor-owned utilities (IOUs), this paper presents a description of the paths that used refrigerators take when they leave customer's homes and provides an analysis of how customers choose among disposal options. Approximately 12 percent of refrigerators pass through the RARP. About 11 percent are sold and another 24 percent are given away. Dealers receive about 25 percent. Twenty-two percent are taken to recycle. The destination of 6 percent is unknown. When refrigerators are given away they are mostly given away to family and friends (19 out of 24 percent) with the remainder going to charities. Many charities no longer take refrigerators. More than half of the used refrigerators that are sold are sold to friends or family. We estimate that about five percent are for sale through advertisements. The percentage of refrigerators going to dealers that are actually resold appears to be less than five percent. A percentage is being shipped out of the US. Approximately, a third of used refrigerators are non-working.

When choosing between the utility program and other alternatives, consumers are primarily seeking a convenient, no cost method of disposal. Hauling a refrigerator or freezer to a landfill or keeping it are methods of last resort. Receiving a payment for their unit matters to some consumers (this is a key reason to choose the utility program), though others are relatively indifferent to receiving payment as long as they do not have to pay for disposal. What happens to the unit is another consideration. Some consumers prefer that their unit gets used by someone else (e.g., a friend or neighbor) while others find recycling more appealing. Fast pickup is what matters most. Same day pickup is most appealing, followed by 3 days, and then 7-14 days.

Introduction

Using extensive primary and secondary data from an evaluation of the California IOUs State-wide Residential Appliance Recycling Program, this paper attempts to answer two questions

0. How do customers dispose of unused or unwanted refrigerators?
0. Why do customers choose one option rather than another for disposing of unwanted refrigerators?

The answers to these two questions may potentially lead to a better understanding of the customer needs in this market and how to design better and more cost effective appliance recycling programs.

Historical Context

Refrigerator recycling programs have been around since the inception of demand-side management programs in the late 1970s. We have located 53 publications describing evaluations of appliance recycling programs (For example see: Naidu, 1986; Keating, 1995; Xenergy, 1995; Nicholas, 2005). Most of these evaluations have focused on the operation of the recycling programs, reasons why customers participated in them, satisfaction with the programs, and the results of the programs in terms of the number of refrigerators recycled, kW and kWh reduced, and sometimes the non-energy environmental benefits. For the most part, these evaluations have not placed the operation of these programs in the larger context of the used appliance market. Using a small sample of used dealers, Hall (2003) examined the market mainly focusing on used appliance dealers. A more recent study by Nexus Market Research and RLW (2005) provided a broader description of the market based on interviews and visits to used appliance dealers as well as some information from a survey of how nonparticipants disposed of refrigerators.

Consumer Disposal Options

A customer buying a replacement refrigerator or a customer with multiple refrigerators has multiple disposal options. They can decide to keep the refrigerator. They can use a utility program. They can give the unit to a friend, neighbor, or possibly a charity. They can sell the unit to a friend, neighbor, or through an advertisement. If the household is buying a new unit, the new appliance dealer may remove it for free or for a fee. Or, they may dispose of the unit through a local contract hauler or community waste management system. The option the customer chooses affects what is available in the market and influences energy demand on the grid.

The disposal option that a consumer chooses is a function of a number of factors such as:

- Whether the unit is working
- The customer's perception of the:
 - Monetary value of the unit
 - Functional value or utility of the unit
- The amount of effort the customer is willing to expend disposing of the unit
 - Time
 - Physical effort
- Awareness of a utility program and/or other options
- The cost or lack of cost associated with the disposal option,
- Whether the customer has space to keep the unit
- The environmental consequences of the disposal option
- Energy savings and energy cost savings associated with the unit

The Residential Appliance Recycling Program

The California Investor Owned Utilities (IOUs): Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E) offer a Residential Appliance Recycling Program (RARP) to eligible customers in their service territories on a first come first served ba-

sis. In 2004-05, the program targeted residential customers for removal of inefficient but functioning (meaning still cooling), pre-1991, 14 to 27 cubic foot refrigerators and/or freezers. The goal of the program was to reduce energy consumption and coincident peak demand by removing older less efficient residential refrigerators and freezers and reducing the incidence and operation of tertiary refrigerators freezers and keeping refrigerators from the resale market. Additional goals of the program were to educate customers about the energy efficiency benefits of getting rid of and recycling older refrigerators and the non-energy environmental benefits from careful recycling.

The program accepts a maximum of two refrigerators and/or freezers annually from a household. The program offers free pick-up of the appliance and a \$35 incentive for participation (starting in the summer of 2005, a \$50 incentive was offered for freezers in the SCE service territory and the age limitation was removed). Program contractors pick-up and dispose of the refrigerators in an environmentally safe manner. The program recycled a total of 71,264 refrigerators and freezers in 2004 and 95,254 units in 2005.

How Customers Dispose of Used Refrigerators

The analysis of how used refrigerators are disposed is based on multiple sources of primary and secondary data. These data include census data (State of California, 2006), housing data, refrigerator sales data (AHAM, 2007), information from utilities about the number of customers in their service territories, the 2002 Residential Appliance Saturation Survey (KEMA, 2003), program records, a telephone survey of a random sample of 800 participants from the appliance recycling programs, a sample of 1,018 respondents who identified themselves as having acquired or disposed of a refrigerator between 2002 and 2005 who were screened from a random sample of 1,817 households, approximately 50 in-depth interviews with used appliance dealers, additional surveys and interviews with 20 recyclers, 10 interviews with new appliance dealers, more than a dozen interviews with charities, and others involved in the used refrigerator market.

Using the qualitative information we developed an analysis of how customers disposed of refrigerators. The surveys asked acquirers and disposers what they did with refrigerators. Using the survey data and quantitative data from other sources, we estimated the magnitude of the flows. In constructing the estimates of used units flowing through various paths, we attempted to triangulate information although sometimes it was difficult to reconcile information from different sources. It should be emphasized that these are estimates. With the exception of the estimates for program units, most of the estimates are probably accurate to within a few thousand units. We have rounded the numbers to thousands to emphasize this fact.

The used refrigerator market is extremely complex and dynamic. Refrigerators removed from households may travel by numerous intersecting paths to their destination. The complexity of the situation is further increased by the fact that the market place is changing rapidly. The California used refrigerator market has undergone significant changes in recent years due to changes in safety and environmental laws concerned with refrigerator/freezer disposal and repair. Changes in the business models of new appliance dealers, especially the way in which they deliver new refrigerators and dispose of used ones, have also influenced the market. As a result of these changes, many businesses and organizations that formerly dealt with used refrigerators have gotten out of the business or have begun to steer away from it because the revenue stream has shrunk or has become a source of loss. The methods for dismantling refrigerators are influenced by materials markets such as the demand for steel and copper scrap in Asia and the decline in the prices of recycled refrigerant.

Figure 1 represents our best estimates for the paths units take. From Census data and the 2003 Residential Appliance Saturation Study (RASS 2003), we estimate that approximately 12 million California households had 14.5 million refrigerators in service in 2005. From utility data, we estimate that 10 million households in the IOU service territories had approximately 12 million refrigerators. From

this, we removed household sized refrigerators found in commercial spaces and our estimate of households and refrigerators in rental units where the owner supplies refrigerators. From our interviews we know that refrigerators removed from owner-supplied rental units are frequently taken by firms that specialize in large-scale removals. From our non-participant survey and other related data, we estimated that 610,000 households disposed of roughly 703,000 used refrigerators in 2005 in the IOU service territories.

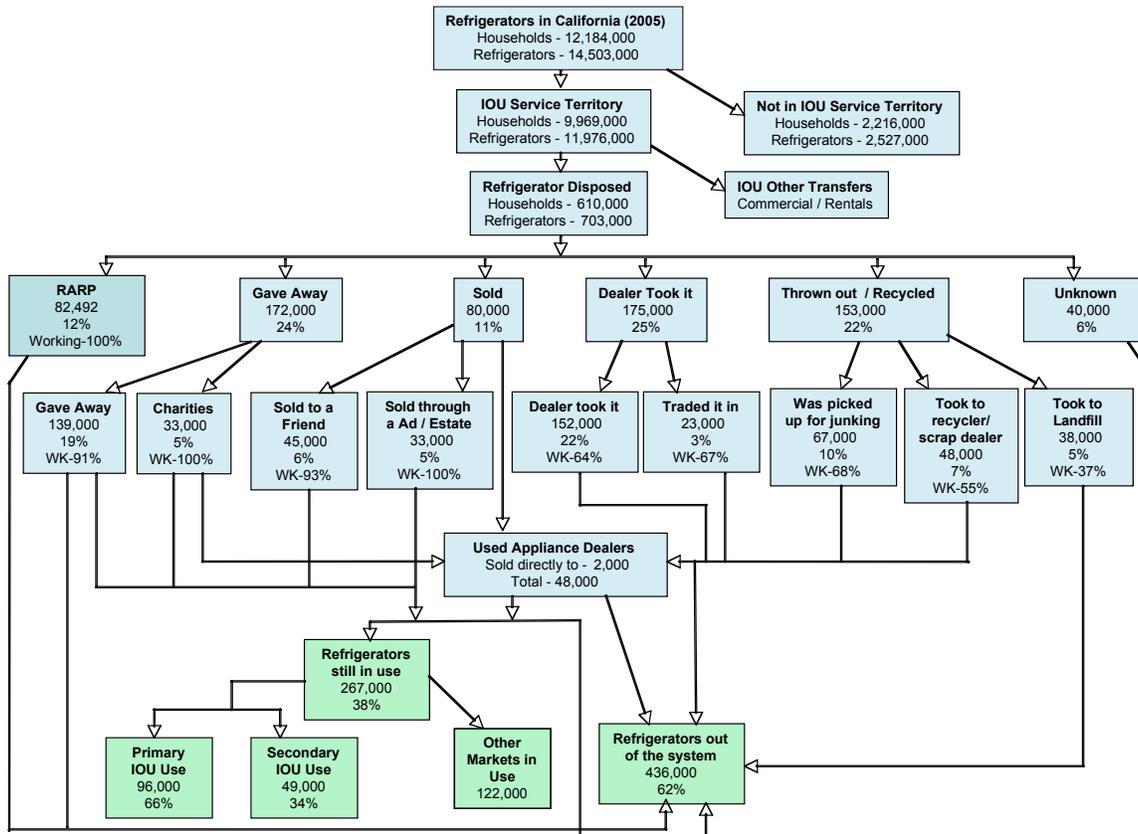


Figure 1 Used Refrigerator Disposed in California

Directly below the information about disposals in the IOU Service territories are two rows of cells representing disposal paths. The cells in the first row are the general categories of disposals. The cells in the second row provide more specific information about disposal paths that refrigerators can take. Cells contain an estimated number of units in the cell and a percentage of the total disposed units represented by that cell. In the second row of cells we also report estimated percentages of working units.

The first cell on the left in the first row is the number of refrigerators that were taken by RARP. In 2005, 79,094 households disposed of 82,492 used refrigerators. We estimate that this accounts for about 12 percent of all used refrigerator transfers in the IOU service territory and about 15 percent of working used refrigerator transfers. ARCA and JACO, the program contractors, recycled 100 percent of these units

Refrigerators Given Away

The two most common ways to transfer or dispose of an old refrigerator was to give it away or to transfer it to a dealer who disposes of it. In 2005, we estimate that about 165,000 used refrigerators (24 percent of transfers) were given away. From our discussions with charities and investigation of charity

websites, we know that there is a single charity, the Salvation Army, that takes used refrigerators in substantial numbers and that they receive about 40,000 units statewide, which when adjusted for the population of the IOU Service territory, means that they receive about 33,000 units or about five percent of annual refrigerator transfers in the IOU service territories. The charity sells about 20 percent of these units directly to customers while the other 80 percent are sold at auction with most going to used appliance dealers. The Salvation Army takes only working units. The Salvation Army requires that the units be plugged in and cooling when their truck arrives to take them to verify that they are working units.

Charities have chosen to become less active in the used refrigerator and freezer market because of recent rules that only licensed firms can dispose of units. One purpose of these rules is to prevent CFCs from entering the atmosphere. If charities take nonworking units or units with little or no commercial value, they have to pay to dispose of them. As a result charities have become increasingly selective about taking refrigerators and freezers.

Our data suggests that about 93 percent of the remaining 110,000 units that are given away are working units and typically go to friends, relatives and others customers for reuse. It is unclear to whom the seven percent of units that are not working are given, but it is likely that most, if not all of those refrigerators, are not used on the electric grid. Some people may take units with the intent to repair them.

Refrigerators Sold by Residents

In 2005, households sold nearly 78,000 used refrigerators comprising 11 percent of all refrigerator transfers in the IOU service territories. Most (95 percent) of those were working units. It is unclear what happens to units that are sold that are not functioning. Some may be purchased with the intent to repair the unit. Of the household sales, approximately 57 percent went to a friend (six percent of all units), 40 percent went to another user through an advertisement or estate sale (four percent of all units), and approximately three percent (less than one percent of all units) were sold directly to used appliance dealers.

Refrigerators Picked up by New Dealer

Another common disposal method is to transfer a refrigerator or freezer to a new appliance dealer when the dealer is delivering a new unit. Approximately 174,000 or 25 percent of used refrigerators were transferred this way. Roughly 64 percent of these transfers were working units and 36 percent were nonworking units. These figures are consistent with a 2002 study by AHAM (2002) that reported that 34 percent of refrigerators that are purchased replace a failed unit.

There are half a dozen major new appliance dealers in California: Sears, Lowes, Home Depot, Fry's, Best Buy and Howards. We called the stores of several major appliance dealers and were told that with the purchase of a new refrigerator an existing refrigerator could be removed for a fee that ranges from free to as high as \$65. The amount charged for a removal is often tied to the promotion for the sale of new appliances or the value of the sale. Many dealers told us that they would remove a unit for free if the value of the new unit exceeded \$250 – \$300.

The major appliance dealers contract with logistics services to manage the drop-off of new appliances and the pick-up of old appliances. Old appliances are usually taken to a staging area where a recycling contractor picks them up.

This stream contains refrigerators and freezers that are typically older and refrigerators and freezers that are no longer working. The contractor typically separates the refrigerators with street value, usually those that are white and less than ten years old, from those with little street value. Those with street value (maybe 20 percent) may reenter the market through auctions or through dealer contacts. Those with little street value are recycled. In some instances the major appliance dealer may stipulate that all appliances be recycled whether they have street value or not.

Some respondents (three percent) said that they traded a unit for a replacement unit. It is unclear, what is meant by “traded.” Most of the largest new appliance dealers do not take “trade-ins” per se.

There is a fair amount of leakage from this system into the used market. We have been told that refrigerators with high resale value may be replaced with a lower value refrigerator before they reach the recycling contractor. Also, householders with high value units not scheduled for removal are sometimes offered “free” removals. Not infrequently “free” removals result in a cancellation for the Residential Appliance Recycling Program.

Refrigerators Thrown Out/Recycled

The final path is for a refrigerator to be removed or transferred to the waste management system. Approximately 146,000 or 21 percent of refrigerators are transferred through this mechanism. Approximately 54 percent of these units were working and 46 percent are non-working. Roughly 46,000 refrigerators in this category were picked up for junking by someone hired to haul the unit, 40,000 were taken to a recycler or a scrap dealer by the householder, and 30,000 were taken to the community waste facility. A small number of units that are picked up for junking or taken to a recycler or scrap dealer will return to the market through used appliance dealers. However, most units are sent to a non-program recycler and de-manufactured. We assume that almost all of the units taken to community waste facilities are removed from the system.

Unknown

As can be seen in Figure 1, there is an unknown path. This represents respondents who indicated some other option or indicated that they didn’t know what happened to the refrigerator. We do not know where this remaining seven percent of refrigerator transfers go. Many of them may be distributed across the other categories.

Used Appliance Dealers

Some of the used refrigerators find their way to used appliance dealers. We estimate that used appliance dealers sell approximately 50,000 used refrigerators annually in California. Adjusting for IOU service territories implies that the used dealers sell about 42,000 units. From our dealers survey, we also know that these companies sell 86 percent of their refrigerator stock (78 percent to individual households and 8 percent to multifamily operators), which leaves 14 percent to be recycled or salvaged for parts. Therefore, used appliance dealers in the IOU service territory acquire approximately 48,000 used refrigerators a year (42,000 +6,000 de-manufactured units). Used dealers receive about 26,000 units from charities and about 2,000 directly from consumers. The remaining 20,000 units are acquired through contracts with new dealers (59 percent of all units acquired), units being picked for junking (10 percent), units being taken to a recycler/scrap dealer (3 percent), multifamily operations (4 percent) and unknown (8 percent).

We estimate that there are approximately 500 used appliance dealers in California. Very few these firms deal only in refrigerators and most of these firms sell less than 50 units annually. The large firms that sell up to 5000 units annually work with new dealers or agents for new dealers and sell out-of-box units or scratch and dent units. With the restrictions put on disposing of old refrigerators, the small used appliance dealers are only interested in newer and attractive units. These dealers told us that more than 84 percent of their stock is less than 10 years old.

Where Refrigerators End Up (De-manufactured vs. still in use)

RARP recycles the units it obtains. We are also confident that the 36,000 units that were taken to the landfill are out of the system. Through our used appliance dealers survey, we estimate that 14,000 of the units taken by new appliance dealers, who remove a refrigerator when selling a replacement refrigerator, go to used appliance dealers. The remaining 160,000 units (92 percent of refrigerators taken by new dealers) end up being recycled or in the landfill. Through the same survey, we also estimate that about 3000 units that were picked up or sent to be recycled end up at used appliance dealers. Therefore 107,000 or 97 percent of these refrigerators are actually recycled or sent to a landfill.

Finally, some of the refrigerators that end up with used appliance dealers cannot be resold and are sent to recycling companies or the landfill. From our survey of used appliance dealers we found that approximately 14 percent of refrigerators they acquire are taken to recyclers, landfills, or salvaged for parts. This accounts for about 6,000 units. Assuming that the unknown units are transferred in the same ratio as all known units, we conclude that approximately 434,000 out of the 703,000, or 62 percent of transferred refrigerators are no longer on the grid.

On the other end, units often stay on the system when a household gives away their used refrigerator, sells their old unit, or the unit goes to a used appliance dealer. We assume that all working refrigerators that are given away, except to charities, remain in the market. This accounts for approximately 123,000 units. Charities also sell about 20 percent of their stock or 7,000 units directly to residents, which would mean they are likely still in on the grid. We also assume that all units sold to a friend or through an ad/estate sale remain in the market. California residents receive about 76,000 used refrigerators through these means. Finally, refrigerators return to the market when used appliance dealers sell them. From our used dealers survey, we estimate that used dealers sell 42,000 used units in the IOU service territory. Assuming again that the unknown refrigerators are transferred in the same ratio as the known units, we conclude that 269,000 or 38 percent of refrigerators that are transferred are still in use.

Finally, we estimate that residents of the IOU services territories absorb 145,000 of the 283,000 used units. Ninety-six thousand of these units remaining in the market are used as primary refrigerators and 39,000 are used as secondary units. We estimate that 124,000 units are working units that may be disposed or that flow into other markets. These may include the international market and/or the small rental market.

As noted previously, we have not dealt with the rental markets except for individual households that purchase units for use in rental housing. Refrigerators for rental units tend to be on the smaller end of the size spectrum, for example, 14 cubic feet. Small rental property owners typically purchase units one by one as needed usually in replacement situations. Larger rental property owners typically deal with distributors or manufacturers as large national accounts. The larger owners replace defective units on an as needed basis and mass replace refrigerators periodically when they want to update units or at the point where the existing stock of units becomes a maintenance issue. There are companies that specialize in large quantities of used units from rental housing. Because this was not a focus of this research we did not interview anyone from those firms. Units, from the market we have been discussing and the rental market, undoubtedly flow back and forth.

If for the moment we assume that the goal is to capture all working used refrigerators, then the RARP program is capturing about 23 percent of all working used refrigerators in the market on annual basis. If we consider just those machines that remain in the IOU market, then the program is capturing approximate 36 percent of the eligible machines.

What Motivates Customers to Participate in Appliance Recycling Programs

Now we turn to the issue of what motivates households to use the appliance recycling program. As noted above, customers do have some disposal options: the program, giving a unit away, selling a unit, having a used appliance dealer take the unit, hauling the unit away oneself, and even keeping the unit. To address this, we used a survey research technique called conjoint analysis.

Conjoint Analysis Background

In addition to providing descriptive information about refrigerators and freezers that utility customers have disposed of recently, respondents to the participant and non-participant surveys completed a choice-based conjoint (CBC) exercise in which they indicated their preference between disposal options.

Disposal options (called product configurations in CBC) were based on combinations of distinct attributes that impact the consumer’s preference for each option, including: (1) the cost (or payment) upon disposal, (2) the timing of when the appliance is removed, (3) the disposition of the unit once it is taken away (e.g., re-used, recycled, dumped), and (4) the hassle of disposal (defined as number of phone calls one needs to make). Each of the four attributes included between two to five “levels.”

Attributes and levels (Table 1) were created to represent possible disposal options in the marketplace, including not only configurations that currently exist, but also configurations that might be created or offered in the future.

In the survey, two disposal options, chosen by randomly selecting attribute levels (one level for each attribute), were pitted against each other. The respondent chose between the two configurations, and an option of “Neither, I’d keep the appliance.” Each respondent was given six distinct choice tasks – the number needed based on the total sample size to provide reliable results. An example of one possible choice task is found in Table 2.

Table 1 Conjoint Attributes and Levels

Attribute	Levels Within Attributes
Cost	Cost to you is \$50
	Cost to you is \$35
	No cost or payment to you
	Payment to you is \$35
Timing	Payment to you is \$50
	Pickup is same day you arrange it
	Pickup is within 3 days of when you arrange it
	Pickup is in 7 days of when you arrange it
	Pickup is in 14 days of when you arrange it
Disposition	You transport it yourself
	The appliance gets used by someone else
	The appliance goes into a landfill
Hassle	The appliance gets completely scrapped and recycled
	You make no more than one phone call
	You might have to make multiple phone calls

Table 2 Conjoint Choice Task Example

Option 1	Option 2	Option 3
Cost to you is \$50	Cost to you is \$35	Wouldn't do either of these.
Pickup is within 3 days of when you arrange it	You transport it yourself	
The appliance gets used by someone else	The appliance goes into landfill	

Analysis of Conjoint Data

Conjoint Utility Values. The first step in analyzing conjoint data is to calculate conjoint utility values. Utility values (also called part-worth) are interval-level data and the values within an attribute sum to zero. We cannot directly compare utility values across attributes—we can only compare utility values within attributes. These data are primarily used to provide relative rankings of the preference (or “desirableness”) of attribute levels within an attribute, and the strength of preference differences between the levels. Negative values merely indicate that that level is less preferred relative to the other levels and it does *not necessarily* indicate a negative valence (i.e., it is not preferred or it is disliked).

For the attribute “cost,” (Table 3) which is comprised of five levels ranging from “cost to you is \$50” to “payment to you is \$50,” the utility values for participants range from -93 to 56. “Cost to you is \$50” is the least desirable level and payment to you is \$50 is the most desirable. By examining the numerical differences between the values, we can also interpret the relative desirability of each level compared to the other levels for the attribute (but again, not between attributes). The difference between “Payment to you is \$35” (48) and “payment to you is \$50” (56) is relatively small. This indicates that program participants prefer receiving \$50 more than \$35, but not by much. Participants have adverse preferences for having to pay for disposal, and \$50 is far more negative than \$35.

Among nonparticipants for “cost,” we see negative values for “cost to you is \$50” (-69) and “cost to you is \$35” (-25) indicating that non-participants also prefer not to pay for disposal. However, the utility values for “no cost or payment to you,” “payment to you is \$35,” and “payment to you is \$50” are nearly the same among non-participants, ranging between 27 and 36. This indicates that non-

Table 3 Conjoint Utility Values

		Participant	Non-Participant
Cost	Cost to you is \$50	-93	-69
	Cost to you is \$35	-35	-25
	No cost or payment to you	24	31
	Payment to you is \$35	48	27
	Payment to you is \$50	56	36
	Timing	Pickup is same day you arrange it	31
Pickup is within 3 days of when you arrange it		28	26
Pickup is in 7 days of when you arrange it		8	8
Pickup is in 14 days of when you arrange it		6	4
You transport it yourself		-72	-80
Disposition	The appliance gets used by someone else	30	33
	The appliance goes into a landfill	-58	-71
	The appliance gets completely scrapped and recycled	28	38
Hassle	You make no more than one phone call	30	32
	You might have to make multiple phone calls	-30	-32
	None (Keep It) – Utility Value	-106	-94
	None (Keep It) – Percent Choosing This Option	12	14

participants are generally indifferent between these three levels. Receiving a payment is not preferred much more than “no cost or payment to you.”

Receiving a payment for their old appliance matters to participants but not to non-participants. This might be why some people choose to participate in the utility program – it provides them with a payment for the old unit.

For the attribute “timing,” participants have equal utility values (and equal preference) for “pickup is same day you arrange it and pickup is within 3 days of when you arrange it.” Utility is lower but approximately equal for the next two levels: “pickup is in 7 days of when you arrange it” and “pickup is in 14 days of when you arrange it.” Among participants, then, we conclude that they most prefer a quick pickup (within 3 days), followed by a 7-14 day pickup schedule. Having to transport the unit yourself is a large negative in comparison to having it picked up regardless of the timing.

Among non-participants, the “timing” attribute levels have similar utility values as for participants. The exception is that non-participants value a same day pickup more than a 3-day pickup schedule. It is clear that a fast pickup schedule is important for both participants and non-participants, and is likely a reason why some consumers do not use the utility program – alternatives can be superior in this respect.

Participants and non-participants alike are generally indifferent between “the appliance gets used by someone else” and the “appliance gets completely scrapped and recycled.” However, both groups are strongly opposed to “the appliance goes into a landfill.” There are relatively few differences between customers in each of the three utility service territories although PG&E customers preferred the recycling option while SCE and SDG&E customers preferred the re-use alternative. This might be indicative of two psychographic factors in California: Northern Californian’s are more receptive and concerned about environmental issues while Southern Californian’s have a higher proportion of lower income immigrants who are more frequent purchasers of used or second-hand items.

Both participants and non-participants prefer having to make just one phone call over more than one. Also, the large negative value of the “keep it” option indicates that most consumers, whether they are participants or non-participants in the RARP, do not want to keep the unit and will frequently choose less favorable disposal options rather than keep it.

Conjoint Importances. Conjoint importances are calculated based on the range of utility values for any individual attribute and then transformed to a common metric. Conjoint importances are ratio-level data and can be treated as such. They always sum to 100 and are always positive. Importances can be compared between all other attributes and even across the two surveys. Importances give us an overall understanding of how the attributes relate to one another. Table 4 includes the conjoint importances from the participant and non-participant surveys.

Among the participants, the rank ordering of these attributes is very clear. “Cost” is the most important attribute, followed by “timing” and “disposition” which are relatively close in their importance, and then “hassle.” Also, we can say that “cost” is about 1.5 times as important as either “timing” or “disposition,” and it is more than twice as important as “hassle.” Among non-participants, “cost” drops in importance compared to participants, so that “timing” is most important followed closely by “disposition” and then “cost,” with “hassle” falling quite a bit lower on the scale.

Table 4 Conjoint Importances

Attributes	Participant	Non-Participant
Cost	37	26
Timing	26	31
Disposition	22	27
Hassle	15	16

Share of Preference. Conjoint utility values and importances help to describe the relative preferences of attributes and levels, but not the trade-offs that consumers make when choosing between real alternatives. To describe these trade-offs, we use a market simulator. The market simulator combines utilities and importances to calculate the percent of respondents who would prefer a particular disposal

option. The market simulator requires *a priori* specifications of configurations that could exist in the marketplace at a given point in time to determine the percentage of respondents who would prefer each particular configuration (Table 5.)

It is important to note that the share of preference calculations are not actual market share estimates because there are many other variables we have not measured that we know can affect market share, such as awareness, distribution availability, and other marketplace circumstances.

Table 5 Product Configurations

Configuration	Cost/Payment	Timing	Disposition	Hassle
Current Utility Program	\$35 Payment	7 Days	Recycled	1 Call
Dealer Hauls Away	\$0	Same Day	Re-used	1 Call
Sell In Pennysaver	\$50 Payment	7 Days	Re-used	Multiple Calls
Give to Neighbor	\$0	3 Days	Re-used	1 Call
You Pay for Hauling	\$50 Cost	3 Days	Re-used	1 Call
You Haul It	\$0	You Haul	Landfill	1 Call

For the simulations, we have defined six different configurations to represent actual marketplace disposal options, including the current utility program. Below is a table of the six configurations and their definitions.

We analyze these configurations in two ways: share of preference simulations and sensitivity analyses. Both of these types of analyses can be compared across samples and across studies because they are ratio-level data and have a common metric.

Share of Preference Simulations. Share of preference simulations pit various configurations against each other. The output is the predicted percent of respondents who would choose that configuration if all options were available to all consumers in the marketplace. The above six configurations yield the following share of preference simulations for the participant and non-participant surveys (Table 6).

Based on the alternatives currently available in the marketplace, the simulator shows that the “Current Utility Program” among participants receives the highest share of preference, followed closely by “Dealer Hauls Away.” “Sell in Pennysaver” is in third place, substantially behind the top two alternatives. Since this ranking is among participants, we are not surprised to find that the “Current Utility Program” receives the highest share of preference. Compared to the second place alternative, “Dealer Hauls Away,” the “Current Utility Program” offers a strong positive of the incentive payment, but at the expense or trade-off of waiting longer for the pickup.

Table 6 Share of Preference

Configuration	Participants	Non-Participants
Current Utility Program	34	29
Dealer Hauls Away	31	38
Sell In Pennysaver	18	13
Give to Neighbor	10	11
You Pay for Hauling	5	8
You Haul It	2	1

The relative shares also demonstrate that almost as many participants actually prefer the characteristics of the “Dealer Hauls Away” option (31percent) as prefer the “Current Utility Program” (34 percent). This suggests that the utility program faces close competition with dealers even among those who did choose the utility program for an actual disposal. The third option, “Sell In Pennysaver,” likely appeals to participants because they receive a payment for their old unit, though the additional inconvenience of the timing of the pickup and the added hassle of multiple phone calls drops the preference share of this option to about half that of the “Current Utility Program.”

Among non-participants, “Dealer Hauls Away” is the most preferred with a preference share of 38 percent. The “Current Program” is second at 29 percent. Third is nearly a tie between “Sell In Pennysaver” and “Give to Neighbor.” Non-participants have a lower utility score for receiving a payment

and higher utility for fast pickup compared to participants, and the share of preference results among each group are consistent with these utilities.

The share of preference simulator allows us to determine the net change in preference when we alter characteristics of one of the options. Making changes to the “Current Utility Program” allows us to evaluate the affect of changing program characteristics on preference shares. These types of changes to the configurations can help us determine what the optimal program configuration could be.

Two potential program changes that we tested in this way are: (1) increasing the program incentive payment from \$35 to \$50 dollars, and (2) decreasing the timing of the pickup from 7 days to 3 days. In Table 7, we increase the incentive offered by the utility program from \$35 to \$50.

Increasing the program incentive from \$35 to \$50 boosts the share of preference for the utility program among participants from 34 percent to 36 percent. This gain in share of 2 percent appears to come primarily from “Sell in Pennysaver,” which drops from 18 to 14 percent. Among non-participants, we see a similar rise in share of preference for the utility program (from 29 to 31 percent) and a drop in share of preference for “Sell in Pennysaver” (13 to 10 percent). This increase in share of preference as a percentage of the original preference share for the utility program is about 7% among both participants (2/34) and non-participants (2/29).

Table 7 Share of Preference: \$50 Incentive

Configuration	Participants	Non-Participants
Utility Program BUT \$50 incentive	36	31
Dealer Hauls Away	31	39
Sell In Pennysaver	14	10
Give to Neighbor	11	26
You Pay for Hauling	6	8
You Haul It	2	1

If we compare Table 8 to Table 6, the incentive stays the same but the timing of the pick-up changes from 7 days to 3 days. Changing the pickup timing of the utility program from 7 days to 3 days boosts share of preference for the program among participants from 34 percent to 41 percent, a substantial 7 percent increase. As a percentage of the initial share of preference, this represents a 21 percent (7/34) boost. Among non-participants, the change in timing increases preference share from 29 to 35 percent. This increase as a percentage of the original preference share is 20 percent (6/29).

Table 8 Share of Preference: 3-Day Pickup

Configuration	Participants	Non-Participants
Utility Program BUT 3-Day pickup	41	35
Dealer Hauls Away	25	33
Sell In Pennysaver	17	13
Give to Neighbor	12	14
You Pay for Hauling	2	4
You Haul It	2	1

From these results, we conclude that increasing the incentive and reducing the pickup timing can both lead to increased program utilization, but reducing the pickup timing from 7 days to 3 days yields a much greater boost in preference than does increasing the incentive from \$35 to \$50. Additional potential program changes can be evaluated in this same way.

Sensitivity analyses. Sensitivity analyses use the same set of basic configurations as the share of preference simulations. However, sensitivity analyses change only one attribute systematically (on just one single configuration) while holding all other attributes and levels constant for all other options. This type of analysis shows how systematically changing one attribute of a given disposal option affects the share of preference for that option.

Below are two examples of sensitivity analysis. In the first (Table 9), the “Cost” attribute is systematically varied for the “Current Utility Program.” All other attributes for the “Current Utility Pro-

gram” are held constant, as are the attributes for the other five options. The numbers shown are share of preference for the “Current Utility Program” when the levels of one of the attributes of the “Current Utility Program” are varied.

Table 9 Sensitivity Analysis: Current Utility Program Varied by Cost

Current Utility Program	Participants	Non-Participants
Cost to you is \$50	6	9
Cost to you is \$35	14	17
No cost or payment to you	24	26
(Current Program) Payment to you is \$35	34	29
Payment to you is \$50	36	31

Among participants, increasing the incentive payment to \$50 from \$35 increases share of preference from 34 to 36 percent - a marginal gain though perhaps not worth the additional cost. Dropping the incentive payment to “no cost or payment to you” reduces share of preference from 34 to 24 percent. Clearly, participants value the \$35 payment since share of preference drops by about one-third when the \$35 payment is taken away.

Among non-participants, share of preference is highest for a \$50 payment at 31 percent and it drops incrementally to 29 and 26 percent for a \$35 payment and no cost or payment, respectively. These changes are very modest, and further demonstrate that receiving payment is not too important to most non-participants. However, preference drops much more when a cost is imposed.

Table 10 is a sensitivity analysis for the “timing” attribute of the “Current Program.” Among

participants and non-participants alike, share of preference increases substantially for the “Current Utility Program” when the pickup timing is reduced from 7 days to 3 days. For non-participants, there is another boost in preference when pickup timing is further reduced to same day.

Table 10 Sensitivity Analysis: Current Program Varied by Timing

Current Utility Program	Participants	Non-Participants
Pickup is same day you arrange it	42	38
Pickup is within 3 days of when you arrange it	42	35
(Current Program)		
Pickup is in 7 days of when you arrange it	34	29
Pickup is in 14 days of when you arrange it	34	29
You transport it yourself	18	13

Preference does not change for either group when pickup timing is increased to 14 days. Preference does drop substantially for the hypothetical scenario where consumers must transport the unit themselves.

Cancellations

In order to find supporting data that reinforces the findings in the conjoint analysis, we looked at cancellation data. For the 2004-05 program years, approximately 34,500 pick-up orders were canceled. Cancellation data was received for approximately 40,000 customers. By matching those records against our pickup data, we determined that about 14 percent (roughly 5,500) of these cancellations were eventually picked-up by the program. The exact results can be seen in Table 11, along with a broad reason for cancellation. The importance of the cancellations is that they represent units that the program had captured but subsequently lost. In at least some instances the removal workers actually stopped at the household. Capturing a greater percentage of these units would improve the yield of the program.

Table 11 Broad Cancellation Descriptions for ARCA and JACO

Reason	ARCA		JACO		
	Total	Reason Percent	Total	Reason Percent	Total Percent
Appliance does not qualify	2,458	8.8	231	13.1	2.4
Customer disposed of unit before pickup	16,288	58.3	750	42.4	7.8
Likely still being used	13,329	47.7	205	11.6	2.1
Disposed through another source	2,847	10.2	538	30.4	5.6
Took to landfill	112	0.4	7	0.4	0.1
Scheduling issues	9,205	32.9	789	44.6	8.2
Canceled for unknown reason	2,626	NA	7,801	NA	81.5
Total with a reason	30,577	100	2,039	100.0	21.3
Total	NA	NA	9,571	NA	100.0
Canceled but picked up	3,426	11.2	2,064	NA	21.6
Total canceled	27,151	18.0*	7,507	NA	23.5*
Total orders picked up	123,491	82.0*	24,444	NA	76.5*
Total orders scheduled	150,642	100.0*	31,951	NA	100.0*

* Percent out of Total Orders Scheduled

There are two sets of percentages for the JACO data – reason percent and total percent. Only about 20 percent of JACO's data included reasons for cancellations.

As the conjoint analysis showed, speed of removal is extremely important to customers. Approximately 58 and 42 percent of the cancellations for ARCA and JACO respectively occurred because the unit was transferred before it could be picked-up. Many of these units will remain on the electrical grid. It is unclear how these transfers occurred. The logistics contractor for a new appliance dealer may have hauled it away or the customer may have found someone who wanted to use it. These represent a quicker removal option for customers. Scheduling issues were also cited for a large portion of cancellations (33 percent for ARCA, and 45 percent for JACO). Improving the speed and efficiency of pickups, along with educating customers on the importance removing used units from the grid might greatly assist in reducing cancellations.

Summary and Conclusions

In this paper we have described how California customers in the investor owned service territories dispose of existing used refrigerators once they decide to get rid of them. Because customers have disposal options, we have also examined why customers choose one option rather than another for disposing of unwanted refrigerators and how the program option fares vis-à-vis the other available options.

Approximately, a third of used refrigerators are non-working. Approximately 12 percent of refrigerators pass through the program. About 11 percent are sold and another 24 percent are given away. Dealers receive about 25 percent. Twenty-two percent are taken to recycle. The destination of 6 percent is unknown. When refrigerators are given away they are mostly given away to family and friends (19 out of 24 percent) with the remainder being given to charity. Many charities no longer take refrigerators. More than half of the refrigerators that are sold are sold to friends or family. We estimate that about five percent are for sale through advertisements. The percentage of refrigerators going to dealers for resale appears to be less than five percent. A percentage is being shipped out of the US.

When choosing the utility program over other alternatives, consumers are primarily seeking a convenient, no cost method of disposal. Hauling it to landfill or keeping it are methods of last resort. Receiving a payment for their unit matters to some consumers (this is a key reason to choose the utility program), though others are relatively indifferent to receiving payment as long as they do not have to

pay for disposal. Fast pickup is what matters most. Same day pickup is most appealing, followed by 3 days, and then 7-14 days.

Consumers who participate in the program choose this option primarily because they receive payment (\$35) for their old appliance. Boosting the payment (to \$50) does increase preference among this group but by a relatively small amount.

Secondary considerations for participants are the timing of the pickup and the disposition of their old unit. Timing and disposition are of equal importance. Shortening the timing of the pickup (from 7 days to 3 days) increases preference considerably, whereas participants are generally indifferent between having their old unit completely recycled and having it used by someone else.

Timing of the pickup is what matters most for non-participants, followed by cost and disposition. As with participants, shortening the pickup time from 7 days to 3 days boosts preference for the program. The program gets an additional boost among non-participants if pickup can be made same day. Non-participants are less interested in getting paid for their old unit. They still want to avoid having to pay for disposal, but they are more willing than participants to give it up for free. Keeping the unit, hauling it yourself, and having the unit junked all provide very low marginal utility, which means that most consumers are seeking to avoid these things. Consumers, then, are primarily seeking a convenient, no cost way for someone else to take the old unit off their hands. Receiving payment for the unit matters to some consumers (including those who have participated in the program), although is of little consequence to others.

Our work also shows that there is a high cancellation rate among participants and that this high cancellation rate is at least in part a function of not having the unit picked up quickly enough.

More generally, it appears that used appliance dealers are not a major factor in the market. There are still many refrigerators that the program could obtain although we know from data that is not shown in this paper that many of those units are quite recent, less than ten years old, and that customers may have a preference for selling or giving those units away. We also know that increasing the incentive might increase participation to some extent but that shortening the time from request for a pick-up to the actual removal might result in even greater number of units being removed while making the program more attractive to customers.

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