

Appliance Turn-In Program Evaluation, Measurement, and Verification Report 2015 Participants

Prepared for FirstEnergy Ohio Companies:

Ohio Edison Company
The Cleveland Electric Illuminating Company
The Toledo Edison Company

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Table of Contents

1.	Executive Summary	2
2.	Introduction and Purpose of Study.....	4
3.	Description of Program	5
4.	Methodology	7
5.	Detailed Impact Evaluation Findings.....	15
6.	Conclusions and Recommendations	23
7.	Appendix A: Required Savings Tables	25
8.	Appendix B: Participant Survey Instrument.....	26
9.	Appendix C: Comparison of 2014 Pick-Ups to Full Program Population .	39

1. Executive Summary

In 2014, the Ohio operating companies The Cleveland Electric Illuminating Company (CEI), Ohio Edison Company (OE), and The Toledo Edison Company (TE) (collectively “Companies”) offered the Appliance Turn-In Program. This program offered residential customers rebates for the recycling of refrigerators, freezers, and room air conditioners (RACs). The program was suspended in 2015 pursuant to the Companies filing and Commission approval of an amended Plan for the 2015-2016 program years.¹ This EM&V report provides an assessment of savings associated with units that were requested for pick-up during 2014, but not picked-up or counted until 2015 (2015 Participants). The goal of the program is to permanently remove from the Companies' electric system old appliances, which are generally inefficient. Appliances removed from customers' homes cannot enter the used appliance market.

A total of 365 households in the Companies' service territories received appliance collection and recycling services in 2015. Program design allows for an individual household to turn in up to two refrigerators or freezers and up to two RACs per year. The number of participating households within each utility is shown in Table 1-1.

Table 1-1: Program Participation by Utility

<i>Utility</i>	<i>Number of 2015 Participants²</i>
CEI	143
OE	190
TE	32
Total Program	365

Ex ante savings estimates for the Companies' Appliance Turn-In program were taken directly from the *State of Ohio Energy Efficiency Technical Reference Manual (TRM)*³. The reported values for the 2015 participants were 1,376 kWh per refrigerator, 1,244 kWh

¹ See *In the Matter of the Application for Approval of Energy Efficiency and Peak Demand Reduction Program Portfolio Plans for 2013-2015*, Case Nos. 12-2190-EL-POR *et al.*, November 20, 2014 Finding and Order.

² The number of participants was counted by identifying the number of unique customer IDs in the program tracking database. A number of participants recycled more than one appliance.

³ Vermont Energy Investment Corporation (VEIC), *State of Ohio Energy Efficiency Technical Reference Manual*, Prepared for Public Utilities Commission of Ohio, August 6, 2010.

per freezer, and 122 kWh per RAC⁴ recycled through the program. Table 1-2 summarizes the *ex ante* per-unit annual kWh savings estimates by measure.

Table 1-2: Ex Ante Per-Unit Annual kWh Savings

<i>Measure</i>	<i>2014 Ex Ante Per-Unit Annual kWh Savings (2015 Pick-Ups)</i>	<i>Source</i>
Refrigerator	1,376	TRM
Freezer	1,244	TRM
Room Air Conditioner	122	TRM (assumed average capacity of 10,000 Btuh)

Ex post gross electric savings were estimated through detailed analysis of program tracking data and participant survey data. ADM Associates, Inc. (ADM) conducted analyses of these data using statistical models and evaluation protocols that have been utilized to evaluate similar recycling programs.

Ex post verified electric savings was 389,461 kWh annually (a realization rate of 72 percent) as a result of 2015 participation. *Ex post* verified peak demand reduction was 61 kW. For detailed tables listing energy savings and demand reductions by measure type, please refer to Appendix A. *Ex post* gross energy savings (kWh) and peak demand reduction (kW) for the program in the three service territories are compared to *ex ante* estimates in Table 1-3.

Table 1-3: Overall Evaluation Results 2015 Participants

<i>Utility</i>	<i>Savings</i>			
	<i>Ex Ante Expected Gross kWh</i>	<i>Ex Ante Expected Gross kW</i>	<i>Ex Post Verified Gross kWh</i>	<i>Ex Post Verified Gross kW</i>
CEI	211,362	41	153,261	24
OE	278,858	58	202,539	32
TE	46,388	7	33,661	5
Total	536,608	107	389,461	61

⁴ The annual kWh savings for RACs is based on an assumed average capacity of 10,000 Btuh as opposed to the 8,500 Btuh assumed in the TRM.

2. Introduction and Purpose of Study

Under contract with the Companies, ADM is performing measurement and verification (M&V) activities to confirm the energy savings and demand reduction being realized through the energy efficiency programs that the Companies are implementing in Ohio. The purpose of this report is to present the results of the impact evaluation effort undertaken by ADM to verify the energy savings and peak demand reductions that resulted from appliances collected and recycled in 2015, as further described in Section 3, through the Appliance Turn-In Program.

The impact evaluation component of this report estimates annual gross energy savings and peak demand reduction as framed by the following five research questions:

- How many eligible refrigerators, freezers, and room air conditioners were collected for recycling?
- How many of the room air conditioners were replaced and how many represent a net removal from the grid?
- What is the average annual kWh savings per collected appliance?
- What is the average kW reduction per collected appliance?
- What fraction of collected appliances were either not used, or used only part time over the past year?

3. Description of Program

First launched on May 2, 2011, the Appliance Turn-In program was designed to help customers reduce their energy consumption by removing old, working refrigerators, freezers, and room air conditioners (RACs) from their homes for recycling. There was a limit of two refrigerators or freezers per household per calendar year. A maximum of two room air conditioners could be picked up at the same time as the refrigerator and/or freezer. The Companies save energy because the old appliances, which are generally inefficient, are permanently removed from the system. The environment also benefits from the recycling process through safe disposal of environmentally harmful material.

The goal of the program was to reduce the number of old, inefficient refrigerators and freezers that customers have continued to use as secondary units in garages or other locations such as basements and patios. Many areas in which secondary units are placed are not space conditioned and most refrigerators used in that environment operate under a heavy thermal load during the summer. This is exacerbated by the fact that the appliances are usually quite old and inefficient. Previous studies by the Environmental Protection Agency (EPA)⁵, the Department of Energy (DOE)⁶ and other utilities have determined that removing these appliances, and properly recycling them, performs an energy saving service.

The Companies contracted with JACO, Inc. (JACO) to implement the program. The program is designed as a turnkey, stand-alone energy efficiency initiative. The program targets existing multi- and single-family households, renters and homeowners, and small C&I businesses⁷ that have old, inefficient refrigerators or freezers. Marketing for the program consists of newspaper, radio, and TV ads; bill stuffers. There is an additional marketing channel for low-income participants, who may become aware of the program from auditors from other low-income specific energy efficiency programs. To be eligible for the program, appliances to be recycled must be in working condition, plugged in and cooling at the time of pick-up. The customer receives pick-up and removal service in addition to a \$50 rebate per recycled refrigerator or freezer. Customers with inefficient, working RAC units receive a \$25 rebate for each recycled unit.

Removing old, inefficient refrigerators, freezers and RACs prevents them from being resold or transferred to another utility customer. The program provides annual electric energy savings for the remaining life of the unit by permanently removing the appliance

⁵ <http://www.epa.gov/ozone/title6/608/disposal/household.html>

⁶ http://apps1.eere.energy.gov/states/pdfs/ref_market_profile.pdf

⁷ Savings from small C&I business is included in the Commercial and Industrial Energy Efficiency Incentives Program Evaluation Report.

from service. As an added environmental benefit, 95% of the materials from these units are able to be recycled (metals, plastic, glass, oil, etc.) and disposed of in an environmentally responsible manner, thus preventing the materials from reaching landfills and potentially contaminating the environment.

4. Methodology

This chapter provides a description of the methodology applied by ADM in the evaluation of the 2015 participants in the Appliance Turn-In Program.

4.1 Impact Evaluation Methodology

The impact evaluation component of this report estimates annual gross energy savings (kWh) and peak demand reduction (kW) as framed by the following five research questions:

- How many eligible refrigerators, freezers, and room air conditioners were collected for recycling?
- How many of the room air conditioners were replaced and how many represent a net removal from the grid?
- What is the average annual kWh savings per collected appliance?
- What is the average kW reduction per collected appliance?
- What fraction of collected appliances were either not used, or used only part time over the past year?

The methodology used to address each of these questions is detailed in the following sections.

4.1.1 Verification of Units Recycled

A first aspect of conducting measurements of program activity is to verify the number of refrigerators, freezers, and RACs collected and recycled. ADM completed the following steps in the verification effort:

- Validating program tracking data provided in the Vision DSM SSRS reporting system by checking for duplicate or erroneous entries; and,
- Conducting verification telephone surveys with a statistically valid sample of program participants. The focus of these verification surveys was to verify that customers listed in the program tracking database did indeed participate and that the number of appliances claimed to be recycled was accurate. Additionally, survey respondents were asked a series of questions to verify the working condition of their recycled appliances; it is a program requirement that collected units be in working condition at the time of pick-up.

As the first step toward verification, tracking data for the program provided by JACO through the VisionDSM SSRS reporting system were reviewed. The numbers of refrigerators, freezers, and RACs reported in the program tracking data that were recycled by 2015 participants are shown in Table 4-1.

Table 4-1: Appliances Recycled by 2015 Participants

Utility	Appliances			
	Refrigerators	Freezers	RAC's	Total
CEI	134	21	7	162
OE	178	26	13	217
TE	31	3	-	34
Total	343	50	20	413

As the table above shows, the vast majority of program participation was represented by recycled refrigerators. Freezer units were a distant second while RACs represented the smallest portion of program participation. Refrigerators represent approximately 83% of appliances collected in 2015 while freezers represent approximately 12% and RACs represent 5%. ADM conducted telephone interviews with a sample of program participants to verify participation and obtain information with which to determine the percentage of units that were still operable when picked up by the recycler. A random sample, stratified by measure type and company, was selected to ensure that 90 percent confidence with ± 10 percent relative precision or better would be achieved for each utility.

4.2 Sampling Strategy

For the calculation of sample size, a coefficient of variation of 0.5 was assumed.⁸ On this assumption, a minimum sample size of 68 participants per utility was required, as shown in the following formula:

Minimum Sample Size Formula for 90 Percent Confidence Level

$$n_0 = \left(\frac{Z * CV}{RP} \right)^2 = \left(\frac{1.645 * 0.5}{0.10} \right)^2 = 68$$

Where:

- n_0 = minimum sample size
- Z = Z-statistic value (1.645 for the 90% confidence level)
- CV = Coefficient of Variation (assumed to be 0.5)
- RP = Relative Precision (0.10)

⁸ The coefficient of variation, $cv(y)$, is a measure of variation for the variable to be estimated. Its value depends on the mean and standard deviation of the distribution of values for the variable (i.e., $cv(y) = sd(y)/mean(y)$). Essentially, cv is a metric of how wide the distribution of values for the variable of interest is. Using a $cv = 0.5$ is recommended by the Uniform Methods Project Evaluation Protocol for Refrigerator Recycling Programs.

ADM conducted phone surveys with 210 participants across the three service territories⁹. Specifically, 70 surveys were completed with customers from each of the three operating companies. The questionnaire that was the instrument for the survey interviews is provided in Appendix B. Survey respondents were asked a number of appliance specific questions. Based on the measure stratification scheme outlined above, appliance specific information was collected for the following: 58 refrigerators, 18 freezers and 58 RAC in the CEI service territory; 47 refrigerators, 29 freezers and 42 RACs in the OE service territory; and 45 refrigerators, 33 freezers and 25 RACs in the TE service territory. The results of this survey effort were used to verify the number of program eligible appliances recycled through the 2014 program.

4.3 Calculating Gross Annual kWh Savings per Appliance

Ex ante savings estimates for the Companies' Appliance Turn-In program were taken directly from the *State of Ohio Energy Efficiency Technical Reference Manual (TRM)*¹⁰. These values are 1,376 kWh per refrigerator, 1,244 kWh per freezer, and 122 kWh per RAC¹¹ recycled through the program.

For the impact evaluation effort, these savings estimates were assessed by developing separate, independent gross unit energy consumption (UEC) estimates for refrigerators, freezers and RACs recycled through the program in 2014 and applied to the 2015 participants. The details regarding how these UEC estimates were developed are provided in the following sections.

Refrigerators and Freezers

Gross savings for refrigerators and freezers recycled through utility pickup programs have been estimated in previous impact evaluations by using multiple linear regression analysis to determine UECs of the recycled refrigerators and freezers. In analytical terms, the regression analysis involves estimating the parameters of a regression model:

$$\text{UEC} = \text{function of } (V_1, V_2, V_3, \dots, V_n)$$

⁹ The 210 survey participants all had their appliances picked-up in 2014. These values were used in the calculation of savings for the 2014 pick-up population and have already been reported with the 2014 filing. In order to provide consistency across evaluations and avoid confusion, ADM also used these values to calculate savings for the 2015 participants (who are actually part of the 2014 program population). Given that the 2015 participants only represent 2% of total 2014 program participation (2014 and 2015 pick-ups), it was not expected that adding them to the 2014 pick-up population would significantly change any of these values. ADM verified this in Appendix C

¹⁰ Vermont Energy Investment Corporation (VEIC), *State of Ohio Energy Efficiency Technical Reference Manual*, Prepared for Public Utilities Commission of Ohio, August 6, 2010.

¹¹ The annual kWh savings for RACs is based on an assumed average capacity of 10,000 Btuh as opposed to the 8,500 Btuh assumed in the TRM.

Where UEC is a measure of the annual energy use of a refrigerator and the V_i are independent variables (e.g., age, configuration, etc.) used to explain the amount of energy use. Energy use for the population of recycled appliances is then estimated by applying the regression equations to data characterizing these factors for appliances in the population.

This regression based approach to estimating refrigerator and freezer energy use was recently described in the U.S. Department of Energy's (DOE) *Uniform Methods Project Refrigerator Recycling Evaluation Protocol*.¹² The Uniform Methods Project (UMP) is a set of protocols under development by the DOE that provide straightforward methods for evaluating gross energy savings for common energy efficiency measures offered through utility sponsored programs. The first set of protocols, which includes the refrigerator recycling evaluation protocol, was published in April of 2013. The refrigerator recycling evaluation protocol includes a previously developed regression model based on in-situ monitoring from 472 refrigerators recycled through five separate utility sponsored programs. The regression model estimates refrigerator energy usage (kWh) based on a number of appliance characteristics including age, size, configuration, usage (primary/secondary), and location (conditioned or unconditioned space).

ADM used this regression model developed through the UMP to estimate the UEC for refrigerators recycled through the Companies' program. Specifically, the average characteristics of refrigerators recycled through the program were multiplied by the associated coefficients from the UMP model and summed to produce an estimated average UEC for refrigerators recycled through the program. This average UEC represents an estimate of the annual energy usage of the average refrigerator recycled through the program by 2015 participants. The program tracking data collected by JACO and stored in the VisionDSM database contained much of the necessary appliance characteristic data needed to utilize the UMP model. ADM supplemented the program tracking data with survey data from program participants regarding primary/secondary usage, and appliance location.

It is important to note that the UMP model only considers refrigerators. Accordingly, ADM used a refrigerator-to-freezer ratio factor to determine the average UEC for freezers. This refrigerator-to-freezer factor methodology is similar to that used by the NMR Group, Inc. in a recent evaluation of the Massachusetts Appliance Turn-in Program.¹³ Using relevant secondary sources, ADM concluded that freezers on average use 15% less energy annually than refrigerators. This implies a refrigerator-to-freezer factor of 0.85. The analysis supporting this refrigerator-to-freezer factor is detailed in the previously mentioned Massachusetts Appliance Turn-In Program Evaluation performed by NMR Group, Inc.¹⁴

¹² <http://www1.eere.energy.gov/wip/pdfs/53827-7.pdf>

¹³ NMR Group, Inc. *Massachusetts Appliance Turn-in Program Impact Evaluation, Final*. June 15th, 2011. Available at: <http://ma-eeac.org/wordpress/wp-content/uploads/Impact-Evaluation-Final-Report.pdf>

¹⁴ Ibid.

Finally, a part-use factor, consistent with the UMP protocol, was developed for refrigerators and freezers to adjust UEC estimates to reflect the fact that not all recycled refrigerators would have operated year-round had they not been decommissioned. Secondary appliances are more likely to be unplugged for a portion of the year than primary appliances, and since there was a large presence of secondary appliances in the program, the partial use factor is an important consideration when developing gross savings estimates.

Based on the proceeding discussion, the procedure used by ADM to estimate gross energy savings (kWh) for the refrigerators and freezers recycled through the program can be summarized by the following steps:

- 1) The UMP model was used to predict the average UEC for 2015 participants refrigerators based on the average refrigerator characteristics established from JACO tracking data and participant surveying.
- 2) Freezer UEC was obtained by multiplying the estimated refrigerator UEC by the refrigerator-to-freezer factor of 0.85 to obtain estimates of the average freezer UECs.
- 3) Part-use factors were applied to the UEC estimates to account for the fact that some appliances would likely not be plugged in year-around had they not been decommissioned.

The estimated average UECs for refrigerators and freezers were extrapolated to the population of recycled units (2015 participants) to obtain a program level estimate of gross kWh savings resulting from refrigerator and freezer decommissioning¹⁵.

Room Air Conditioners (RACs)

Calculating gross kWh savings for recycled room air conditioners was done in accordance with the algorithms in the Energy Star Room AC Calculator.¹⁶ For the sake of consistency with the methodology outlined in the TRM, savings were adjusted for units that were replaced by new RACs after recycling. The percentage of units replaced by new RACs was assumed to be 76% based on assumptions presented in the TRM. As part of the participant survey, respondents were asked to identify whether they replaced the RACs they recycled. The survey results suggest that 50% of RACs were replaced directly with new RACs, while an additional 17% of recycled RACs were supplanted by new central

¹⁵ The savings associated with the 2014 pick-up population has already been reported with the 2014 filing. In order to provide consistency across evaluations and avoid confusion, ADM employed the more conservative UEC calculated for the 2014 pick-up population to the 2015 pick-up counts. Given that the 2015 pick-ups only represent 2% of total 2014 program participation (2014 and 2015 pick-ups), it was not expected that adding them to the 2014 pick-up population would significantly change any of these values. ADM verified this in Appendix C.

¹⁶http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerRoomAC.xls?7e02-5075

AC systems¹⁷. While these results suggest that the actual direct replacement rate may be less than the 76% stipulation in the TRM, the cooling load in participant homes is likely met by new or existing equipment in most cases. The standard TRM algorithm may not be appropriate in all cases, given the various replacement scenarios. However, because RAC recycling makes up such a small percentage of program savings, the stipulated 76% replacement value from the TRM was used. The following formula was used to calculate kWh savings for the average RAC recycled through the program:

$$\text{Annual kWh Savings} = \frac{EFLH * \left(\frac{CAPY_{existing}}{EER_{existing}}\right)}{1000} - (\%replaced * \frac{EFLH * \left(\frac{CAPY_{newbase}}{EER_{newbase}}\right)}{1000})$$

Where:

$EFLH$ = Effective Full Load Cooling Hours

$CAPY_{existing}$ = Capacity of the average collected unit (in BtuH).

$CAPY_{newbase}$ = Capacity of the baseline replacement unit (in BtuH).

$ER_{existing}$ = The Energy Efficiency Ratio of the average collected unit.

$ER_{newbase}$ = The Energy Efficiency Ratio of the baseline replacement unit.

$\%replaced$ = The percentage of collected units replaced.

Furthermore, performance degradation of existing room air conditioners was accounted for using the methodology established by the National Renewable Energy Laboratory's 2006 "*Building America Performance Analysis Procedures for Existing Homes*" booklet.¹⁸ Specifically, the following equation was used to degrade the existing room air conditioners' at-manufacture EER value:

¹⁷ The survey results mentioned here all had their RACs picked-up in 2014; 2014 program participants who had their RACs picked-up in 2015 were also surveyed. The combined verification rates can be found in Appendix C.

¹⁸ NREL (2006). "*Building America Performance Analysis Procedures for Existing Homes*." <http://www.nrel.gov/buildings/pdfs/38238.pdf>

$$EER_{degrade} = (EER_{At-manufacture}) * (1 - M)^{age}$$

Where:

$EER_{degrade}$ = Estimated EER at time of collection.

$EER_{At-manufacture}$ = At-manufacture EER

M = Maintenance Factor (0.01)

Age = Age of unit at time of collection in years.

The program tracking database was not as detailed for RACs as it was for refrigerators and freezers. Information regarding the age of collected RACs was provided in the tracking database, but there was no information regarding capacity or EER. Additionally, the model numbers provided in the tracking database could not easily be used to find capacity and EER information in any systematic way. However, the Association of Home Appliance Manufacturers (AHAM) maintains sales weighted average capacity and EER data going back to 1972.¹⁹ The most recent year that the data was available was 2010. Some interpolation was required for the years 1973 and 1979 and 1998.

Using this AHAM data, each RAC recycled through the program was assigned a proxy EER value based on the unit's age reported in the tracking system. For RACs whose reported age indicated a vintage before 1972, the sales weighted average EER for 1972 was used as a proxy. For RACs whose reported age indicated a 2011 or 2012 vintage, the sales weighted average EER for 2010 was used as a proxy. The EER values were then adjusted to account for equipment degradation as described above. The baseline replacement RAC was assumed to have an EER equal to the sales-weighted average RAC in 2010 from the AHAM data (EER = 10.18). Effective Full Load Hours (EFLH) were assumed to be 233 hours based on the assumptions in the TRM. The existing and new baseline capacity was assumed to be 10,000 BtuH based on the assumptions in the Energy Star Room Air Conditioner Savings Calculator. This 10,000 BtuH capacity assumption is greater than the 8,500 BtuH assumption in the TRM. However, it is in line with the AHAM average sales-weighted capacity of RACs recycled through the program by 2015 participants based on vintage.

¹⁹ This AHAM data was accessed from two sources:

1. http://www.nwcouncil.org/energy/rf/meetings/2011/0301/LED_MF_RAC_supporting%20files.zip
2. <http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=5.7.7>

4.4 Calculating Gross Peak Demand (kW) Savings

Gross electric peak demand savings were calculated based on the algorithms and stipulations specified in the TRM. For refrigerators and freezers, the TRM stipulates that summer coincident peak demand savings are estimated by dividing verified gross per-unit kWh savings by 8,760, and multiplying by a temperature adjustment factor of 1.30²⁰ as well as a load shape adjustment factor of 1.074.²¹ For room air conditioning units, the TRM stipulates that summer coincident peak demand savings are estimated using a summer peak coincidence factor of 0.3.²² While the algorithm for calculating RAC peak kW reduction presented in the TRM is reasonable, there is an order-of-operations error in the TRM that results in an over-statement of the intended calculation's actual per-unit reduction. ADM corrected this error in applying the TRM algorithm for RACs recycled through the program by 2015 participants.

4.5 Calculating Lifetime kWh Savings

Lifetime kWh savings were calculated by multiplying *ex post* verified annual gross kWh estimates by remaining useful life (RUL) values for each appliance type. The RUL values used were three years for RACs and eight years for refrigerators and freezers based on the assumptions presented in the TRM.

²⁰ Temperature adjustment factor based on Blasnik, Michael, "Measurement and Verification of Residential Refrigerator Energy Use, Final Report, 2003-2004 Metering Study", July 29, 2004 (p. 47). It assumes 64% of Ohio homes have central air conditioning.

²¹ Daily load shape adjustment factor also based on Blasnik, Michael, "Measurement and Verification of Residential Refrigerator Energy Use, Final Report, 2003-2004 Metering Study", July 29, 2004 (p. 48, using the average Existing Units Summer Profile for hours ending 16 through 18)

²² Consistent with coincidence factors found in: RLW Report: Final Report Coincidence Factor Study Residential Room Air Conditioners, June 23, 2008 (http://www.puc.nh.gov/Electric/Monitoring%20and%20Evaluation%20Reports/National%20Grid/117_RLW_CF%20Res%20RAC.pdf)

5. Detailed Impact Evaluation Findings

This chapter presents the findings of the impact evaluation of the 2015 participants of the Appliance Turn-In Program.

5.1 Verification of Units Recycled

As a first step toward estimating program level kWh and kW impacts, ADM reviewed program tracking data contained in the VisionDSM SSRS reporting system for accuracy. No duplicate entries were discovered. To verify that the number of units claimed in the program tracking database was accurate, ADM administered a telephone survey with a sample of program participants.

All 210 respondents who completed the participant survey verified that they had in fact participated in the program during 2014²³. All except eight of the survey respondents also indicated that the number and type of appliances recycled was identical to the claims in the program tracking database. The five respondents who claimed they recycled different appliance types or quantities are shown in Table 5-1 below. Overall, these discrepancies make up less than 4% of survey respondents. Because the program tracking data includes detailed model information, it is likely these discrepancies reflect survey respondent recall issues. No changes to the number of units recycled were made based on these survey responses.

Table 5-1: Survey Respondent Appliance Type/Quantity Differences

<i>Respondent Number</i>	<i>Database Claim</i>	<i>Respondent Claim</i>	<i>Quantity Difference</i>
1	1 Refrigerator, 1 Freezer	2 Freezers	-1 Refrigerator, +1 Freezer
2	1 Freezer	1 Refrigerator	-1 Freezer, +1 Refrigerator
3	1 Freezer, 1 RAC	1 Freezer, 0 RAC	-1 RAC
4	1 Refrigerator, 2 RACs	2 Refrigerator, 2 RACs	-1 Refrigerator
5	2 Freezers, 1 RAC	1 Freezer	-1 Freezer, -1 RAC
6	1 Refrigerator	1 Refrigerator, 1 Freezer	+1 Freezer
7	1 Refrigerator, 1 RAC	1 Refrigerator	-1 RAC
8	2 Freezers, 1 RAC	2 Freezers	-1 RAC
Total			-4 RAC, - 1 Refrigerator

However, in order for participating appliances to accrue energy savings by being taken out of service, the units must be in working condition at the time of pick-up. Survey respondents were questioned regarding whether the recycled appliances were in working

²³ The 210 survey participants all had their appliances picked-up in 2014. 2014 program participants who had their appliances picked-up in 2015 were also surveyed. The verification rates for the combined surveys can be found in Appendix C.

condition at the time of pick-up. Across the three service territories, only seven out of 304 appliances were reported as non-working at the time of pickup. These non-working designations included a follow up question to ensure that by “not working” the respondents did not mean anything cosmetic or otherwise unrelated to the energy use of the appliance. Survey respondents for all of the other 297 appliances indicated that their units were in working condition at the time of pick-up, as expected based on the program requirements. RACs had a slightly lower verification rate than refrigerators and freezers. Based on these results, the verification rates shown in Table 5-2 for each utility and each appliance were determined:

Table 5-2: Verification Rates by Appliance Type

<i>Metric</i>	<i>Appliance Type as Reported in 2014</i>		
	<i>Refrigerator (n=135)</i>	<i>Freezer (n=75)</i>	<i>RAC (n=94)</i>
Verification Rate	98.5%	98.7%	95.7%

Based on these verification rates, Table 5-3 reports the numbers of refrigerators, freezers, and RACs recycled by 2015 participants that were verified as being in working condition when recycled and therefore program-eligible.

Table 5-3: Recycled Appliances Verified to be in Working Condition

<i>Verified Appliances 2015 Participants</i>			
<i>Utility</i>	<i>Quantity Reported as Recycled</i>	<i>Verification Rate</i>	<i>Quantity of Recycled Units Verified as Program Eligible</i>
<i>CEI</i>			
Refrigerator	134	98.5%	132
Freezer	21	98.7%	21
RAC	7	95.7%	7
<i>OE</i>			
Refrigerator	178	98.5%	175
Freezer	26	98.7%	26
RAC	13	95.7%	12
<i>TE</i>			
Refrigerator	31	98.5%	31
Freezer	3	98.7%	3
RAC	--	95.7%	--

5.2 Gross Annual kWh Savings per Appliance

Gross annual kWh savings were calculated as described in chapter four of this report. The details and results of these calculations are reported in this section.

5.2.1 Refrigerators and Freezers

For refrigerators, Unit Energy Consumption (UEC) estimates were derived using the UMP regression model developed based on in-situ metering data from 472 refrigerators just before decommissioning. The model specification and estimated coefficients of the UMP model are shown in Table 5-4.

*Table 5-4: DOE Uniform Methods Project UEC Regression Details²⁴
(Dependent Variable – Daily kWh)*

<i>Independent Variables</i>	<i>Coefficient</i>
Intercept	0.582
Appliance Age	0.027
Dummy: Manufactured Pre-1990	1.055
Appliance Size (square feet)	0.067
Dummy: Single-Door Configuration	-1.977
Dummy: Side-by-Side Configuration	1.071
Dummy: Primary Usage Type (in absence of program)	0.6054
Interaction: Located in Unconditioned Space x CDD	0.020
Interaction: Located in Unconditioned Space x HDD	-0.045

The program tracking database included information regarding configuration, size, age,²⁵ and pickup address for 15,517 refrigerators collected in 2014. Of these 15,517 refrigerators, 23.8% were side-by-side models; 4.2% were single door models;²⁶ the average size was 18.88 cubic feet; 34.9% percent were manufactured before 1990 and the average age was 22.12 years old²⁷. Additionally, the participant survey asked respondents to indicate whether their refrigerators were primary or secondary appliances. Across the three companies, 58.6% of respondents indicated the recycled unit was a primary refrigerator (n=140). Respondents also indicated that 36.9% of the recycled refrigerators were located in spaces that are generally unconditioned, such as a garage or porch (n=141). This information, along with TMY3 heating and cooling degree days (base temperature = 65F) for the Ohio reference cities outlined in the TRM were used to generate the final two interaction variables.

Table 5-5 shows all of the refrigerator characteristics relevant to the UMP model.

²⁴ Source: Uniform Methods Project Refrigerator Recycling Evaluation Protocol.

²⁵ Model year is listed on refrigerator nameplates for many but not all units. As explained to ADM staff, when model year is not listed on the nameplate it is estimated based on appliance characteristics common to certain vintages.

²⁶ The complete breakdown of recycled refrigerator configuration is: 67.4% top freezer, 23.8% side-by-side, 4.7% bottom freezer, and 4.2% single door.

²⁷ The savings associated with the 2014 pick-up population has already been reported with the 2014 filing. ADM employed the per unit savings values calculated for the 2014 pick-up population to the 2015 pick-up counts. The values reported in this paragraph are associated with the 2014 pick-up population. The 2015 pick-ups only represent 2% of the total 2014 program population and ADM verified that adding them to the 2014 pick-up population didn't materially change the per unit savings values. This analysis can be found in Appendix C.

Table 5-5: 2014 Program Refrigerator Characteristics

Average Appliance Characteristics	Refrigerators (2014 Pick-Ups)
Appliance Age (Years)	22.12
Percentage of Units Manufactured before 1990	35%
Average Size (Cubic Feet)	18.88
Percentage Single Door	4%
Percentage Side-by-Side	24%
Percentage Primary	59%
Interaction: Unconditioned Space x CDD	0.88
Interaction: Unconditioned Space x HDD	6.46
Average UEC kWh Savings	1,119.98

The refrigerator characteristics as reported (for 2014 participants who had their refrigerator picked-up in 2014)²⁸ from Table 5-5 were used in conjunction with the model coefficients in Table 5-4 to calculate annual energy consumption estimates for program participating refrigerators. The refrigerator-to-freezer factor of 0.85 was applied to develop annual energy consumption estimates for freezers. These calculations are shown below:

Refrigerator UEC (kWh)

$$365.25 \text{ (days per year)} * [0.582 + 0.027 * 22.12 \text{ (age)} + 1.055 * 0.349 \text{ (dummy: 1990)} + 0.067 * 18.88 \text{ (size, cu. ft.)} - 1.977 * 0.042 \text{ (dummy: single door)} + 1.071 * 0.238 \text{ (dummy: sbs)} + 0.6054 * 0.586 \text{ (dummy: primary)} + 0.02 * 0.877 \text{ (CDD Interaction)} - 0.045 * 6.458 \text{ (HDD Interaction)}] = 1,120 \text{ kWh}$$

Freezer UEC (kWh)

$$1,120 * 0.85 \text{ (refrigerator – to – freezer factor)} = 952 \text{ kWh}$$

²⁸ The savings associated with the 2014 pick-up population has already been reported with the 2014 filing. ADM employed the per unit savings values calculated for the 2014 pick-up population to the 2015 pick-up counts. The 2015 pick-ups only represent 2% of the total 2014 program population and ADM verified that adding them to the 2014 pick-up population didn't materially change the per unit savings values. This analysis can be found in Appendix C.

One final adjustment was made to account for the fact that not all refrigerators and freezers are plugged in year round. This part-use adjustment assigns different part-use factors based on three categories into which recycled appliances fall:

- 1) Some units that were recycled are not likely to operate at all in the absence of the program. The part-use factor for such units therefore would be zero.
- 2) Other units are likely to have operated part-time in the absence of the program. For these units, the part-use factor is calculated by dividing the number of months in the past year that the unit had been plugged in and running by the number of months in the year (i.e., 12). Based on data collected through the survey of participants, the average number of months in use for a refrigerator that was being partly used was 4.5 months, implying a use factor of 0.375 (i.e., 4.5/12). For freezers in this category, the use factor was calculated to be 0.435, reflecting an average of 5.22 months in use for freezers being partly used²⁹.
- 3) Units used all months have a part-use factor of one (1). It is assumed that all primary refrigerators operate all months.

The overall part-use factor and the corresponding overall Unit Energy Savings (UES) are calculated as a weighted average across the three categories, where the weights are determined by the percentages of units falling into the three categories. It is worth noting that the information used to calculate the part-use factor is based on usage during the past year, under the assumption that the distribution of usage patterns for the population of recycled units would be similar in the absence of the program. Table 5-6 shows the calculation of the overall UES for refrigerators and freezers when partial use is taken into account.

²⁹ These values reflect the results of those survey participants who had their appliances picked-up in 2014. ADM also surveyed 2015 participants to verify that the results did not vary significantly. The combined survey results can be found in Appendix C.

Table 5-6: Unit Energy Savings Adjusted for Part-Use

Adjusted UES (2014 Pick-Ups)			
Operating Status of Unit	Percentage of Recycled Units in Category	Use Factor	Calculation of UES to Adjust for Part Use
<u>Refrigerators (n=140)</u>			
Not running	3.57%	0	0
Running part time	8.57%	0.375	420
Running all time	87.86%	1	1,120
Weighted Average UES for Refrigerators			1,020
<u>Freezers (n=75)</u>			
Not running	4.00%	0	0
Running part time	12.00%	0.435	414
Running all time	84.00%	1	952
Weighted Average UES for Freezers			849

Based on the findings detailed in this section, the *ex post* gross per-unit annual kWh savings for refrigerators recycled through the program is estimated to be 1,020 kWh; the *ex post* gross per-unit annual kWh savings for freezers recycled through the program is estimated to be 849 kWh.

5.2.2 Room Air Conditioners (RACs)

AHAM Sales-weighted average EER values were applied to each RAC recycled through the program in 2015 based on the reported vintage consistent with 2014 program evaluation results. The resulting average EER value was 8.65. Appliance degradation was taken into account using the methodology established by the National Renewable Energy Laboratory's 2006 "*Building America Performance Analysis Procedures for Existing Homes*" booklet.³⁰ After accounting for degradation, the average EER for recycled RACs dropped to 7.12. Based on the assumptions presented in the TRM, EFLH were assumed to be 233 and 76% of units were assumed to be replaced. Average capacity for the average existing and baseline replacement RAC was assumed to be 10,000 BtuH based on the assumptions in the Energy Star Room Air Conditioner Savings Calculator. This assumption is in line with the AHAM data implied average of 9,927 BtuH for RACs recycled in 2014. The EER of replacement RACs was assumed to be 10.18 – the sales-weighted average RAC EER in 2010 according to AHAM data.

³⁰ NREL (2006). "*Building America Performance Analysis Procedures for Existing Homes*." <http://www.nrel.gov/buildings/pdfs/38238.pdf>

Based on these assumptions, annual gross per unit kWh savings for RACs recycled through the 2014 Appliance Turn-In Program was calculated to be 153.1 kWh as follows:

$$\begin{aligned}
 \text{RAC Annual kWh Savings} &= (233 * (10,000/7.12))/1000 - (0.76 * (233 * (10,000/10.18)))/1000 \\
 &= 153 \text{ kWh}
 \end{aligned}$$

5.2.3 Gross Peak Demand (kW) Savings per Appliance

The summer coincident peak demand savings formula, which incorporates a temperature adjustment factor and a load shape adjustment factor, was used to estimate the average kW reduction occurring during the PUCO defined on-peak period, for refrigerators and freezers. For RACs, the summer coincident peak demand savings formula from the TRM was used to calculate the average kW reduction occurring during the PUCO defined on-peak period.

Using the TRM methodology, ADM calculated an average on-peak demand reduction of 0.163 kW per recycled refrigerator, 0.135 kW per recycled freezer, and 0.197 kW per recycled RAC.

5.2.4 Lifetime kWh Savings per Appliance

Lifetime kWh savings were calculated by multiplying the gross annual kWh savings by assumed RULs for each appliance type. Based on the assumptions in the TRM, RUL values of three years for RACs and eight years for refrigerators and freezers were used. Table 5-7 shows the resulting per-unit lifetime kWh savings estimates.

Table 5-7: Per-Unit Lifetime kWh Savings

<i>Per-Unit Lifetime kWh Savings Reported</i>			
<i>Appliance Type</i>	<i>Ex Post Per-Unit Annual kWh Savings</i>	<i>RUL (years)</i>	<i>Ex Post Per-Unit Lifetime kWh Savings</i>
Refrigerators	1,020	8	8,160
Freezers	849	8	6,792
RACs	153	3	459

6. Conclusions and Recommendations

This chapter reports the conclusions and recommendations resulting from the impact evaluation of the Appliance Turn-In Program.

6.1 Energy and Demand Impacts

A total of 365 households in the service territories of the three Companies received appliance recycling services in 2015 through the Appliance Turn-In Program. The numbers of participants for each service territory is shown in Table 6-1.

Table 6-1: Number of Participants by Company

<i>Utility</i>	<i>Number of 2015 Participants ³¹</i>
CEI	143
OE	190
TE	32
All Companies	365

Estimated Ex Post electric impacts were 389,461 kWh saved annually, which represents a realization rate of 72 percent. Average on-peak Ex Post demand reduction was estimated to be 61 kW. For detailed tables listing energy savings and demand reductions by measure type, please refer to Appendix A. Estimates of annual gross energy savings (kWh) and on-peak demand reductions (kW) for the program in the three Companies are reported in Table 6-2.

³¹ The number of participants was counted by identifying the number of unique customer IDs in the program tracking database. A number of participants recycled more than one appliance.

*Table 6-2: Overall Evaluation Results for Gross kWh and kW Savings
(2015 Participants)*

<i>Utility</i>	<i>Savings</i>			
	<i>Ex Ante Expected Gross kWh</i>	<i>Ex Ante Expected Gross kW</i>	<i>Ex Post Verified Gross kWh</i>	<i>Ex Post Verified Gross kW</i>
CEI	211,362	41	153,261	24
OE	278,858	58	202,539	32
TE	46,388	7	33,661	5
Total	536,608	107	389,461	61

6.2 Recommendations

Overall, the program ran smoothly for 2015 participants. The Companies are confident with their implementation procedures and data. While the program is currently discontinued for 2015, the evaluation team offers the following recommendations for program consideration in the event the program is reinstated in the future.

- **Consider targeted marketing efforts among customers living in older homes.** When looking at the demographics of participating customers, those who live in older homes were more likely to utilize the program. The Companies could consider targeting their marketing efforts to customers in older homes who may have older, less efficient appliances or are more likely to have secondary appliances. Targeted marketing to specific neighborhoods with older housing stock may also create operational efficiencies for the program.
- **Continue to reach out to additional retail stores to promote the program.** In addition to working with existing retailers, continue to work with and encourage participation from other retailers. While large national retailers may be the easiest to partner with, smaller appliance stores and haulers may provide additional channels for collecting units that would otherwise end up on the used appliance market. Retail store partnerships offer an opportunity to reach out to customers purchasing a new appliance and can help promote the program even if the retailer does not ultimately sell the customer an appliance.

7. Appendix A: Required Savings Tables

Tables showing measure-level participation counts and savings for the 2015 Participants of the Appliance Turn-In Program were provided in various locations throughout this report. This appendix provides additional tables summarizing savings results.

Table 7-1 reports the annual *ex post* kWh savings by utility and measure.

Table 7-1: Annual Ex Post Energy Savings (kWh) 2015 Participants

<i>Appliance Type</i>	<i>CEI</i>	<i>OE</i>	<i>TE</i>	<i>All Companies</i>
Refrigerators	134,631	178,838	31,146	344,614
Freezers	17,605	21,796	2,515	41,916
RACs	1,026	1,905	--	2,930
Total	153,261	202,539	33,661	389,461

Table 7-2 reports the average annual *ex post* on-peak kW reductions by utility and measure.

Table 7-2: Annual Ex Post On-Peak Demand Reductions (kW) 2015 Participants

<i>Appliance Type</i>	<i>CEI</i>	<i>OE</i>	<i>TE</i>	<i>All Companies</i>
Refrigerators	24	31	5	60
Freezers	3	4	<1	7
RACs	<1	<1	--	<1
Total	27	35	6	68

Table 7-3 reports the lifetime *ex post* kWh savings by utility and measure.

Table 7-3: Lifetime Ex Post Energy Savings (kWh) 2015 Participants

<i>Appliance Type</i>	<i>CEI</i>	<i>OE</i>	<i>TE</i>	<i>All Companies</i>
Refrigerators	1,077,046	1,430,702	249,167	2,756,916
Freezers	140,837	174,370	20,120	335,327
RACs	3,077	5,714	--	8,791
Total	1,220,960	1,610,787	269,287	3,101,034

8. Appendix B: Participant Survey Instrument

The Illuminating Company, Ohio Edison Company, The Toledo Edison Company Appliance Turn-In Program Participant Telephone Survey

INTRODUCTION

Hello. My name is _____ and I am calling on behalf of **[INSERT UTILITY NAME]'s** Appliance Turn-In Program. May I speak with **[INSERT CUSTOMER'S NAME]**?

(If not the right person) May I please speak to the person who would know the most about the appliance that was picked up for recycling?

REPEAT INTRODUCTION AND CONTINUE

(If the correct person) We are conducting a study to evaluate **[INSERT UTILITY NAME]'s Appliance Turn-In Program**. **[INSERT UTILITY NAME]** will use the results of this study to determine the effectiveness of the program and to make improvements. We would like to include your feedback about the program in our evaluation. The interview will take approximately 10 minutes. May I ask you a few questions?

1. Yes
2. No

[If Intro=2, terminate survey]

PROGRAM PARTICIPATION VERIFICATION

1. Do you recall having a refrigerator, freezer, or room air conditioner picked up for recycling during 2014? (or the first half of 2015?)

1. Yes
2. No

[If Q1=2, terminate survey]

APPLIANCE VERIFICATION

2. Our records indicate that you recycled **[number of refrigerators from program data]**? Is this correct?

1. Yes
2. No

[If Q2=2, show Q3]

3. How many refrigerators did you recycle?

1. Zero
 2. One
 3. Two
 98. Don't know
 99. Refused
4. Our records indicate that you recycled **[number of freezers from program data]**? Is this correct?
1. Yes
 2. No

[If Q4=2, show Q5]

5. How many freezers did you recycle?
1. Zero
 2. One
 3. Two
 98. Don't know
 99. Refused

6. Our records indicate that you recycled **[number of room air conditioners from program data]**? Is this correct?
1. Yes
 2. No

[If Q6=2, show Q7]

7. How many room air conditioners did you recycle?
1. Zero
 2. One
 3. Two
 98. Don't know
 99. Refused

FIRST REFRIGERATOR

[If program data =1 or 2 refrigerators and Q2=1 or Q3=1 or 2, show Q8-19]

[If program data =2 refrigerators and Q2=1 or Q3= 2, Q8-19 will be repeated for the second refrigerator]

For the following set of questions, please focus on the refrigerator that you recycled. If you recycled more than one refrigerator, pick one of the refrigerators that you recycled and answer the following questions for the refrigerator that you picked.

8. When was your old refrigerator picked up? _____(mm/yy)
9. Approximately how old was your refrigerator at the time you recycled it?
[Record response in years, enter "00" if less than one year]

1. _____ **[Record years]**
 98. Don't know
 99. Refused

10. For the majority of the year prior to recycling, was the old refrigerator your primary or secondary (spare, auxiliary) unit?
 1. Primary
 2. Secondary
 98. Don't know
 99. Refused

11. Did you replace the old refrigerator with a new unit?
 1. Yes
 2. No
 98. Don't know
 99. Refused

12. For the majority of the year prior to recycling, where within your home was the refrigerator located?
 1. Kitchen
 2. Garage
 3. Porch/patio
 4. Basement
 5. Living room
 6. Family room
 7. Bedroom
 8. Hallway
 9. Other **[Specify]** _____
 98. Don't know
 99. Refused

13. Thinking about the year prior to recycling the refrigerator, was it plugged in and running ... **[Read all]**
 1. All of the time
 2. For special occasions only
 3. During certain months of the year only
 4. Never plugged in or running
 98. Don't know
 99. Refused

- [If Q13=2 or 3, show Q14]
14. If you were to add up the total amount of time it was running in the year prior to being picked up, how many months would that be? Your best estimate is okay. **[Get nearest month]**
 1. Record number of months [1-11] _____
 2. All of the time
 98. Don't know

99. Refused

15. Was the refrigerator still in working condition when it was picked up? By working condition I mean did the unit turn on and produce cold air?

1. Yes
2. No
3. It worked, but had some problems
98. Don't know
99. Refused

[If Q15=2 or 3, show Q16]

16. What was wrong with the unit? (If respondent is unsure, ask "would it turn on and produce cold air?")

1. Wouldn't turn on
2. Wouldn't keep food/room cold ENOUGH
3. Wouldn't keep food/room cold at all
4. Too loud
5. Don't know, but would produce cold air
6. Don't know, but would NOT produce cold air
7. Other **[Specify]** _____
98. Don't know
99. Refused

17. Had you already considered disposing of the refrigerator before you heard about **[INSERT UTILITY]**'s appliance recycling program?

By dispose of, I mean getting the appliance out of your home by any means including selling it, giving it away, having someone pick it up, or taking it to the dump or a recycling center yourself.

1. Yes
2. No
98. Don't know
99. Refused

18. What would you have most likely done with the refrigerator had you not disposed of it through **[UTILITY]**'s program?

[Read list unless respondent indicates choice without reading the list]

1. Sold it to a private party
2. Sold it to a used appliance dealer
3. Kept it and continued to use it
4. Kept it and stored it unplugged
5. Given it away to a private party, such as a friend or a neighbor
6. Given it away to a charity organization, such as Goodwill Industries or a church
7. Put it on a curb with a "Free" sign on it

8. Had it removed by the dealer you got your new or replacement refrigerator from
 9. Taken it to a dump or recycling center (note that there would have been a drop off fee)
 10. Hired someone to take it to a dump or recycling center
 11. Gotten rid of it some other way [**Specify**]_____
 98. Don't know
 99. Refused
19. What is the MAIN reason you chose to get rid of your refrigerator through [UTILITY]'s program over other methods of disposing of your appliance?

**[If multiple are mentioned, ask: "Of those, which is the main reason?"
Do not read, accept one answer only.]**

[If respondent says: "I didn't need or want the refrigerator/freezer," respond "Yes, but why did you choose to discard it through [UTILITY]'s program rather than through another method?"]

1. Cash/incentive payment
2. Free pick-up service/others don't pick up/don't have to take it myself
3. Environmentally safe disposal/recycled/good for environment
4. Recommendation of a friend/relative
5. Recommendation of retailer/dealer
6. Utility sponsorship of the program
7. Easy way/convenient
8. Never heard of any others/only one I know of
9. Other [**Specify**]
98. Don't know
99. Refused

FIRST FREEZER

[If program data =1 or 2 freezers and Q4=1 or Q5=1 or 2, show Q20-31]

[If program data =2 freezers and Q4=1 or Q5= 2, Q20-31 will be repeated for the second refrigerator]

For the following set of questions, please focus on the freezer that you recycled. If you recycled more than one freezer, pick one of the freezers that you recycled and answer the following questions for the freezer that you picked.

20. When was your old freezer picked up? _____ (mm/yy)
21. Approximately how old was your freezer at the time you recycled it? [**Record response in years, enter "00" if less than one year**]
 1. _____ [**Record years**]
 98. Don't know
 99. Refused

22. For the majority of the year prior to recycling, was the old freezer your primary or secondary (spare, auxiliary) unit?
1. Primary
 2. Secondary
 98. Don't know
 99. Refused
23. Did you replace the old freezer with a new unit?
1. Yes
 2. No
 98. Don't know
 99. Refused
24. For the majority of the year prior to recycling, where within your home was the freezer located?
1. Kitchen
 2. Garage
 3. Porch/patio
 4. Basement
 5. Living room
 6. Family room
 7. Bedroom
 8. Hallway
 9. Other **[Specify]** _____
 98. Don't know
 99. Refused
25. Thinking about the year prior to recycling the freezer, was it plugged in and running ... **[Read all]**
1. All of the time
 2. For special occasions only
 3. During certain months of the year only
 4. Never plugged in or running
 98. Don't know
 99. Refused

[If Q25=2 or 3, show Q26]

26. If you were to add up the total amount of time it was running in the year prior to being picked up, how many months would that be? Your best estimate is okay. **[Get nearest month]**
1. Record number of months [1-11] _____
 2. All of the time
 98. Don't know
 99. Refused

27. Was the freezer still in working condition when it was picked up? By working condition I mean did the unit turn on and produce cold air?
1. Yes
 2. No
 3. It worked, but had some problems
 98. Don't know
 99. Refused

[If Q27=2 or 3, show Q28]

28. What was wrong with the unit? (If respondent is unsure, ask "would it turn on and produce cold air?")
1. Wouldn't turn on
 2. Wouldn't keep food/room cold ENOUGH
 3. Wouldn't keep food/room cold at all
 4. Too loud
 5. Don't know, but would produce cold air
 6. Don't know, but would NOT produce cold air
 7. Other **[Specify]** _____
 98. Don't know
 99. Refused

29. Had you already considered disposing of the freezer before you heard about **[UTILITY]**'s appliance recycling program?
By dispose of, I mean getting the appliance out of your home by any means including selling it, giving it away, having someone pick it up, or taking it to the dump or a recycling center yourself.
1. Yes
 2. No
 98. Don't know
 99. Refused

30. What would you have most likely done with the freezer had you not disposed of it through **[UTILITY]**'s program?

[Read list unless respondent indicates choice without reading the list]

1. Sold it to a private party
2. Sold it to a used appliance dealer
3. Kept it and continued to use it
4. Kept it and stored it unplugged
5. Given it away to a private party, such as a friend or a neighbor
6. Given it away to a charity organization, such as Goodwill Industries or a church
7. Put it on a curb with a "Free" sign on it
8. Had it removed by the dealer you got your new or replacement refrigerator from

9. Taken it to a dump or recycling center (note that there would be a drop-off fee)
 10. Hired someone to take it to a dump or recycling center
 11. Gotten rid of it some other way [**Specify**]_____
 98. Don't know
 99. Refused
31. What is the MAIN reason you chose to get rid of your freezer through [UTILITY]'s program over other methods of disposing of your appliance?

[If multiple are mentioned, ask: "Of those, which is the main reason?" Do not read, accept one answer only.]

[If respondent says: "I didn't need or want the refrigerator/freezer," respond "Yes, but why did you choose to discard it through [UTILITY]'s program rather than through another method?"]

1. Cash/incentive payment
2. Free pick-up service/others don't pick up/don't have to take it myself
3. Environmentally safe disposal/recycled/good for environment
4. Recommendation of a friend/relative
5. Recommendation of retailer/dealer
6. Utility sponsorship of the program
7. Easy way/convenient
8. Never heard of any others/only one I know of
9. Other [**Specify**]
98. Don't know
99. Refused

FIRST ROOM AIR CONDITIONER

[If program data =1 or 2 RACs and Q6=1 or Q7=1 or 2, show Q32-44]

[If program data =2 RACs and Q6=1 or Q7= 2, Q32-34 and Q39-44 will be repeated for the second refrigerator]

For the following set of questions, please focus on the room air conditioner that you recycled. If you recycled more than one room air conditioner, pick one of the room air conditioners that you recycled and answer the following questions for the room air conditioner that you picked.

32. When was your old room air conditioner picked up?
_____ (mm/yy)
33. Approximately how old was your room air conditioner at the time you recycled it? [**Record response in years, enter "00" if less than one year**]
 1. _____ [**Record years**]
 98. Don't know
 99. Refused

34. Did you replace the old room air conditioner with a new unit?
1. Yes
 2. No
 98. Don't know
 99. Refused
35. Before recycling the unit, how many room air conditioners were in operation in your home?
1. _____ Record number of units
 98. Don't know
 99. Refused
36. How many room air conditioners are currently in operation in your home?
1. _____ Record number of units
 98. Don't know
 99. Refused
37. Before recycling the unit, did your home have a central air conditioning system?
1. Yes
 2. No
 98. Don't know
 99. Refused
38. Does your home now have a central air conditioning system?
1. Yes
 2. No
 98. Don't know
 99. Refused
39. For the majority of year prior to recycling, where within your home was the room air conditioner located?
10. Kitchen
 11. Garage
 12. Porch/patio
 13. Basement
 14. Living room
 15. Family room
 16. Bedroom
 17. Hallway
 18. Other **[Specify]** _____
 98. Don't know
 99. Refused
40. Was the room air conditioner still in working condition when it was picked up?
By working condition I mean did the unit turn on and produce cold air?

1. Yes
2. No
3. It worked, but had some problems
98. Don't know
99. Refused

[If Q40=2 or 3, show Q41]

41. What was wrong with the unit? (If respondent is unsure, ask "would it turn on and produce cold air?")

1. Wouldn't turn on
2. Wouldn't keep room cold ENOUGH
3. Wouldn't keep room cold at all
4. Too loud
5. Don't know, but would produce cold air
6. Don't know, but would NOT produce cold air
7. Other **[Specify]** _____
98. Don't know
99. Refused

42. Had you already considered disposing of the room air conditioner before you heard about **[UTILITY]**'s appliance recycling program?

By dispose of, I mean getting the appliance out of your home by any means including selling it, giving it away, having someone pick it up, or taking it to the dump or a recycling center yourself.

1. Yes
2. No
98. Don't know
99. Refused

43. What would you have most likely done with the room air conditioner had you not disposed of it through **[UTILITY]**'s program?

[Read list unless respondent indicates choice without reading the list]

1. Sold it to a private party
2. Sold it to a used appliance dealer
3. Kept it and continued to use it
4. Kept it and stored it unplugged
5. Given it away to a private party, such as a friend or a neighbor
6. Given it away to a charity organization, such as Goodwill Industries or a church
7. Put it on a curb with a "Free" sign on it
8. Had it removed by the dealer you got your new or replacement refrigerator from
9. Taken it to a dump or recycling center (note that there would be a drop-off fee)

- 10. Hired someone to take it to a dump or recycling center
- 11. Gotten rid of it some other way [**Specify**]_____
- 98. Don't know
- 99. Refused

44. What is the MAIN reason you chose to get rid of your room air conditioner through [**UTILITY**]'s program over other methods of disposing of your appliance?

[If multiple are mentioned, ask: "Of those, which is the main reason?" Do not read, accept one answer only.]

[If respondent says: "I didn't need or want the room air conditioner," respond "Yes, but why did you choose to discard it through [UTILITY**]'s program rather than through another method?"]**

- 1. Cash/incentive payment
- 2. Free pick-up service/others don't pick up/don't have to take it myself
- 3. Environmentally safe disposal/recycled/good for environment
- 4. Recommendation of a friend/relative
- 5. Recommendation of retailer/dealer
- 6. Utility sponsorship of the program
- 7. Easy way/convenient
- 8. Never heard of any others/only one I know of
- 9. Other [**Specify**]_____
- 98. Don't know
- 99. Refused

HOME and DEMOGRAPHICS

Now I have just a few final questions about your home and energy use.

45. How many people are in your household?
- 1. Number in household_____
 - 98. Don't know
 - 99. Refused
46. Which of the following best describes your home/residence?
- 1. Single-family home, detached construction [NOT A DUPLEX, TOWN HOME, OR APARTMENT; ATTACHED GARAGE IS OKAY]
 - 2. Single family home, factory manufactured/modular
 - 3. Single family, mobile home
 - 4. Row house
 - 5. Two or three family residences – traditional structure
 - 6. Apartment (4+ families) – traditional structure
 - 7. Condominium – traditional structure
 - 8. Other [**Specify**]_____
 - 98. Don't know

99. Refused
47. Do you own or rent this residence?
1. Own
 2. Rent
98. Don't know
99. Refused
48. Approximately when was your home constructed? **[DO NOT READ]**
1. Before 1960
 2. 1960-1969
 3. 1970-1979
 4. 1980-1989
 5. 1990-1999
 6. 2000-2005
 7. 2006 or later
98. Don't know
99. Refused
49. How many square feet is the above-ground living space for your home (IF NECESSARY, THIS EXCLUDES WALK-OUT BASEMENTS)?
1. Numerical open end [Range 0-99,999]_____
98. Don't know
99. Refused

[If Q49=98 or 99, show Q50]

50. Would you estimate the above-ground living space is about:
1. Less than 1,000 sqft
 2. 1,001-2,000 sqft
 3. 2,001-3,000 sqft
 4. 3,001-4,000 sqft
 5. 4,001-5,000 sqft
 6. Greater than 5,000 sqft
98. Don't know
99. Refused
51. How many square feet of conditioned living space is below- ground for your home (IF NECESSARY, THIS INCLUDES WALK-OUT BASEMENTS)?
1. Numerical open end [Range 0-99,999]_____
98. Don't know
99. Refused

[If Q51=98 or 99, show Q52]

52. Would you estimate the below-ground living space is about:?
1. Less than 1,000 sqft
 2. 1,001-2,000 sqft
 3. 2,001-3,000 sqft

- 4. 3,001-4,000 sqft
- 5. 4,001-5,000 sqft
- 6. Greater than 5,000 sqft
- 98. Don't know
- 99. Refused

This completes the survey. [INSERT UTILITY] appreciates your participation. Thanks for your time. Have a good day/evening.

9. Appendix C: Comparison of 2014 Pick-Ups to Full Program Population

The savings associated with the 2014 pick-up population has already been reported with the 2014 filing. In order to provide consistency across evaluations and avoid confusion, ADM employed the more conservative per unit savings values and verification rates calculated for the 2014 pick-up population to the 2015 pick-up counts. Given that the 2015 pick-ups only represent 2% of total 2014 program participation (2014 and 2015 pick-ups), it was not expected that adding them to the 2014 pick-up population would significantly change any of these values. ADM verified this below.

Table 9-1: Comparison of Verification Rate by Measure

Metric	Appliance Type (2014 Pick-Ups)		
	Refrigerator (n=135)	Freezer (n=75)	RAC (n=94)
Verification Rate	98.5%	98.7%	95.7%
Metric	Appliance Type (All Program Participants)		
	Refrigerator (n=194)	Freezer (n=86)	RAC (n=100)
Verification Rate	97.4%	98.8%	92%

Table 9-1 illustrates that there is a non-significant difference between verification rates for each measure between the 2014 pick-up population and the entire 2014 program population (both 2014 and 2015 participants).

Table 9-2: Comparison of Refrigerator Characteristics

Refrigerator Characteristics	Picked-Up in 2014	All Program Participants
Percentage of Units Manufactured before 1990	35%	35%
Average Size (Cubic Feet)	18.88	18.89
Percentage Single Door	4%	4%
Percentage Side-by-Side	24%	24%
Percentage Primary	59%	60%
Interaction: Unconditioned Space x CDD	0.88	0.80
Interaction: Unconditioned Space x HDD	6.46	5.87
Average UEC kWh Savings	1,119.98	1,140.31

Table 9-2 illustrates that there is a non-significant difference between refrigerator characteristics (and ultimately the 2014 pick-up population is more conservative) between the 2014 pick-up population and the entire 2014 program population (both 2014 and 2015 participants).

Table 9-3: Comparison of Use Factors

<i>Adjusted UES (2014 Pick-Ups)</i>			
<i>Operating Status of Unit</i>	<i>Percentage of Recycled Units in Category</i>	<i>Use Factor</i>	<i>Calculation of UES to Adjust for Part Use</i>
<i>Refrigerators (n=140)</i>			
Not running	3.57%	0	0
Running part time	8.57%	0.375	420
Running all time	87.86%	1	1,120
Weighted Average UES for Refrigerators			1,020
<i>Freezers (n=75)</i>			
Not running	4.00%	0	0
Running part time	12.00%	0.435	414
Running all time	84.00%	1	952
Weighted Average UES for Freezers			849
<i>Adjusted UES (All Participants)</i>			
<i>Operating Status of Unit</i>	<i>Percentage of Recycled Units in Category</i>	<i>Use Factor</i>	<i>Calculation of UES to Adjust for Part Use</i>
<i>Refrigerators (n=200)</i>			
Not running	3.00%	0	0
Running part time	7.00%	0.385	431
Running all time	90.00%	1	1,120
Weighted Average UES for Refrigerators			1,038
<i>Freezers (n=86)</i>			
Not running	3.49%	0	0
Running part time	10.47%	0.435	414
Running all time	86.05%	1	952
Weighted Average UES for Freezers			863

Table 9-3 illustrates that there is a non-significant difference between the refrigerator use factors between the 2014 pick-up population and the entire 2014 program population (2014 and 2015 participants).