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Impact and Process Evaluation of 2015 (PY8) Ameren Illinois Company Appliance Recycling Program

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1. Executive Summary

This report presents results from the evaluation of the Appliance Recycling Program (ARP) for Program Year 8 (PY8), which ran from June 1, 2015 to May 31, 2016, and was the eighth year of program operation. Ameren Illinois Company (AIC) offered a \$50 turn-in incentive and free recycling of refrigerators and freezers directly from the homes of AIC electric customers. AIC also provided information and education on the cost of keeping inefficient units in operation. AIC expected ARP to achieve approximately 12% of the electric savings for AIC’s overall residential portfolio in PY8. Leidos Engineering managed the program and oversaw its advertising. Appliance Recycling Centers of America (ARCA) served as a subcontractor, marketing and implementing the program. This included scheduling, pickup, and recycling the appliances as well as customer service.

The evaluation of the PY8 ARP involved both process and impact assessments. The process evaluation included a review of program-tracking data and program materials and interviews with program implementation staff to gauge program performance. Because AIC does not intend to offer the program after PY9, we also conducted interviews and a literature review of how other utilities ended similar programs. Our impact evaluation research efforts involved applying deemed values from the Illinois Statewide Technical Reference Manual for Energy Efficiency Version 4 (IL-TRM V4.0) to calculate gross impacts. To calculate net impacts, we applied the Illinois Stakeholder Advisory Group (SAG)-approved measure-level net-to-gross ratios (NTGR) for freezers and refrigerators. Key findings from the PY8 evaluation are presented below.

Program Impacts

Table 1 summarizes net electricity and demand savings from the PY8 ARP. The evaluation team calculated ex post gross savings by applying IL-TRM V4.0 algorithms to verified measure quantities from the program tracking database. The program achieved ex ante gross savings of 7,190 MWh and ex post gross savings of 7,325 MWh, which resulted in a 102% gross realization rate. We then applied the Stakeholder Advisory Group (SAG)-approved PY8 net-to-gross ratios (NTGR) for the program: the PY6 NTGR of 59% for freezers and the PY6 NTGR of 51% for refrigerators. Similar to PY7, we applied a NTGR of 50% for room air conditioners from ComEd’s PY5 evaluation because a NTGR for air conditioners was not agreed upon by the SAG. The gross savings-weighted average NTGR was 52%.

Table 1. PY8 Net ARP Impacts

	Ex Ante Gross	Realization Rate	Ex Post Gross	NTGR	Ex Post Net*
Energy Savings (MWh)					
Total MWh	7,190	102%	7,325	52%	3,844
Demand Savings (MW)					
Total MW	0.88	102%	0.90	52%	0.47

*Ex post determined by applying NTGR and verified participation.

Key Findings and Recommendations

The ARP surpassed its energy savings and participation goals, achieving 3,844 MWh of net energy savings (109% of its target) and recycling 7,953 units (103% of its target). Program staff attributed the program’s PY8 success to customers becoming familiar with and coming to expect the service. That said, the PY8 targets were set lower than the PY7 goals (8,375 units for 4,010 MWh of net savings) with the expectation that the program was more mature and participation would be lower than the previous year.

In assessing programs for inclusion in its PY10 through PY12 plans, AIC decided to discontinue the ARP part way through PY9 since the program was no longer cost-effective due to decreased savings for recycled appliances as appliance stock became more efficient and presented lower avoided costs than in the previous plan.

Conclusions and Recommendations

Based on the research discussed, the evaluation team provides the following conclusions and recommendations to help AIC manage the transition after the program's closure:

- **Key Finding #1:** The utilities that the evaluation team interviewed considered appliance recycling to be an important customer service offering. Appliance recycling programs typically have high customer satisfaction ratings. Utilities deciding whether to continue or end the program carefully considered the program popularity in their decision.
- **Key Finding #2:** Some utilities deciding to end appliance recycling programs tried to communicate alternative options for recycling appliances. Interviewed utilities discussed directing customers to waste management services or state natural resource management agencies. Evidence from evaluations of Commonwealth Edison's PY5 program and from one run by PG&E suggest that many retailers recycle the appliances picked up when customers purchase new appliances. This service continues to remove some appliances from operating on the grid.
 - **Recommendation:** Consider directing customers interested in recycling an appliance to an appliance waste management service or to retailers that participate in the EPA Responsible Appliance Disposal (RAD) Program or recycle haul-away appliances.
- **Key Finding #3:** Advanced planning for program discontinuation will be critical to minimizing customer confusion. Utility program staff we interviewed did not anticipate their programs being interrupted and had no chance to communicate future program changes. Call centers and program websites serve as the two key methods used by interviewed utilities to update customers about program operations.
 - **Recommendation:** AIC's ARP participants most commonly cited friends/neighbors and bill inserts as their two primary sources of program information when asked how they learned about the program. Unlike the interviewed utilities, AIC has time before the program discontinues, and bill inserts may be an effective method of communicating the termination of the program. AIC could include names and contact information for alternative recycling facilities in the bill inserts and should continue to recommend that consumers recycle appliances on their own.

2. Evaluation Approach

The PY8 evaluation built upon research the evaluation team conducted in previous evaluations, including process and impact analyses.

2.1 Research Objectives

For PY8, the evaluation team explored process-related research questions, including the following:

- Did program implementation change since PY7? If so, how and why, and was this change advantageous?
- In other jurisdictions where appliance recycling programs were suspended and then relaunched, what factors did the utility consider when relaunching the program?
- In other jurisdictions where appliance recycling programs were permanently discontinued, what factors did the utility consider when making this decision?
- In other jurisdictions where appliance recycling programs no longer exist, do utilities offer customers information on available options for recycling appliances? If so, do utilities continue to emphasize the energy saving benefits of recycling?
- Are there any lessons learned for how to minimize customer and market confusion from other jurisdictions where an appliance recycling program was offered and then discontinued?

In addition, the evaluation team sought to estimate electric savings attributable to the program. In particular, the study focused on the following research questions:

- What are the estimated gross energy and demand impacts from this program?
- What are the estimated net energy and demand impacts from this program?

2.2 Evaluation Tasks

Table 2 summarizes the PY8 evaluation activities conducted for the ARP.

Table 2. PY8 ARP Evaluation Methods

Activity	PY8 Process	PY8 Impact	Forward Looking	Details
Program Staff In-Depth Interviews	✓			Program staff interviews provided insights into program design and delivery. Stakeholders included staff from AIC and Leidos.
Review of Program Materials and Database	✓	✓		The team reviewed all program materials and data in the tracking database to ensure collection of appropriate data to inform the evaluation.
Literature Review	✓		✓	The team completed a literature review (including select interviews with other utility program managers where a program

Activity	PY8 Process	PY8 Impact	Forward Looking	Details
				was discontinued or relaunched), focusing on how other jurisdictions managed transitions away from utility-sponsored appliance recycling programs.
Gross Savings and Net Savings Calculations		✓		The team applied the IL-TRM V4.0 algorithm to calculate gross savings and the SAG-approved NTGRs to determine net savings.

2.2.1 Review of Program Materials and Database

The evaluation team reviewed program data, including marketing materials and the program-tracking database.

2.2.2 Program Staff Interviews

The evaluation team conducted interviews¹ with AIC’s program manager and Leidos’ program manager. Interviews with program staff sought to gain information about the program’s design, implementation, and processes. The team also asked about data tracking and customer outreach related to the program.

2.2.3 Literature Review and Select Utility Interviews

The evaluation team conducted a literature review to determine how other utility sponsors are phasing out appliance recycling programs from their energy efficiency portfolios. Additionally, the team conducted brief telephone interviews with program managers of other suspended appliance recycling programs to understand how other jurisdictions are navigating the changing marketplace.

Literature Review

The evaluation team reviewed programs with designs similar to AIC’s ARP to benchmark relevant and available program performance information with 17 other programs in 14 different states. As part of our benchmarking, we looked at program cost effectiveness and how it relates to program cancellation. We reviewed customer communication after program end and noted if utilities offer customers tips or sources for secondary refrigerator recycling options. We also include a discussion of secondary market dynamics to assess potential market confusion and the possible impact on the secondary appliance market related to AIC’s exit.

Table 3 lists the programs the team reviewed. The evaluation team used program performance information primarily drawn from the E Source DSM Insights database.² The team also consulted publicly available market assessments, evaluation reports, and other relevant documentation (see Appendix B).

¹ The program staff interview guide is included in Appendix A.

² <https://www.esource.com/about-dsminsights>

Table 3. Comparison of Appliance Recycling Programs

Utility	State	Current Status of Program
AEP Ohio	Ohio	Currently Available
Ameren Illinois	Illinois	Discontinued
Ameren Missouri	Missouri	Currently Available
Avista Utilities	Washington, Idaho, Oregon	Discontinued
Consumers Energy	Michigan	Relaunching in 2017
Duke Energy	Indiana	Suspended
Indiana Michigan Power	Indiana	Currently Available
Indianapolis Power & Light	Indiana	Currently Available
MidAmerican Energy	Iowa	Currently Available
Nevada Energy	Nevada	Discontinued
Pacific Gas & Electric	California	Discontinued
Pacific Power	California, Washington	Discontinued
Rocky Mountain Power	Idaho, Wyoming	Discontinued
Southern California Edison	California	Discontinued
Vectren Indiana	Indiana	Suspended
Wisconsin Focus on Energy	Wisconsin	Relaunching in 2017
Xcel Energy	Minnesota	Currently Available

Select Utility Interviews

For the utility interviews³, the evaluation team spoke with three program administrators. Two of these—Wisconsin Focus on Energy and Consumers Energy in Michigan—were forced to suspend their appliance recycling programs when their implementer (JACO Environmental) ceased operations in November 2015. The third—PacifiCorp—decided to permanently discontinue their program after the closure of JACO Environmental. We provide a summary of the interviews in Table 4.

Table 4. Utility Interviews and Reason for Interviews

Utility	Title of Interviewee	Reason Interviewed
Consumers Energy	Program Manager	This program was suspended in November 2015 after JACO Environmental ceased operations, and is scheduled to relaunch in January 2017. The team focused this interview on the decision making process that led to the program relaunch.
PacifiCorp (Pacific Power & Rocky Mountain Power)	Program Manager	In November 2015, PacifiCorp suspended the program and subsequently discontinued it. The team focused this interview on why the program was discontinued and how PacifiCorp is communicating with its customers in absence of a utility-sponsored program.
Wisconsin Focus on Energy	CB&I ^a Marketing and Customer Service	This program was suspended in November 2015 after JACO Environmental ceased operations, and will resume with appliance

³ The utility staff interview guide used as part of the literature review is included in Appendix A.

Utility	Title of Interviewee	Reason Interviewed
	Manager (currently) CB&I Program Lead for the Appliance Recycling Program (formally)	pick-ups in January 2017. The team focused this interview on the decision making process that led to relaunching the program.

^a Chicago Bridge & Iron Company

2.2.4 Impact Analysis

Gross Impacts

The evaluation team applied a verification rate, based on self-report responses from the PY6 participant surveys, and combined with a review of program tracking data for the percentage of picked-up appliances meeting the program’s requirements.

In PY8, the team determined gross ARP impacts by multiplying the sample-based verification rate by reported measure counts and unit savings estimated by applying the IL-TRM V4.0 algorithm (with PY8 program tracking data and PY6 participant survey responses as inputs).

Net Impacts

To determine net savings, the team used SAG-approved NTGRs for refrigerators and freezers for PY8, as shown in Table 5. The SAG does not provide NTG values for room air conditioners so the team applied results from ComEd’s PY5 evaluation⁴.

Table 5. PY8 NTGRs

Measure Description	Electric NTGR
Refrigerator	0.51
Freezer	0.59
Room Air Conditioner	0.50

2.3 Sources and Mitigation of Error

Table 6 summarizes possible error sources associated with data collection conducted for the ARP.

⁴Navigant. “Refrigerator and Freezer Recycle Rewards Program PY5 Evaluation Report”. April 2014.
http://ilsagfiles.org/SAG_files/Evaluation_Documents/ComEd/ComEd%20EPY5%20Evaluation%20Reports/ComEd_FFRR_EMV_Report_PY5_2014-04-15_Final.pdf

Table 6. Possible Sources of Error

Research Task	Survey Error		Non-Survey Error
	Sampling Error	Non-Sampling Error	
Gross Impacts	N/A	N/A	Data Processing Errors
Net Impacts	N/A	N/A	Data Processing Errors

Throughout planning and implementing the PY8 evaluation, the evaluation team took a number of steps to mitigate against potential sources of error.

Non-Survey Error

- **Data Processing Errors:** The evaluation team applied the IL-TRM V4.0 calculations to participant data in the tracking database to calculate gross impacts. We also applied the PY8 SAG-approved NTGR to estimate the program’s net impacts. To minimize data processing errors, different evaluation team members reviewed all calculations to verify their accuracy.

3. Detailed Evaluation Findings

3.1 Program Description

The AIC ARP encourages residential customers to retire working, primary and secondary, inefficient refrigerators and freezers. Leidos administered the program, with responsibilities including program reporting and quality control (including handling customer complaints). ARCA (the program implementer) was responsible for scheduling and collecting appliances, recycling units in an environmentally sound manner, and processing customer incentives.

The program offered a \$50 turn-in incentive and free recycling of refrigerators and freezers from the homes of residential customers. Room air conditioners were picked up as a convenience service for customers who recycle a refrigerator or freezer but no incentives were offered.

3.2 Process Findings

3.2.1 Program Description and Participation

During PY8, AIC’s ARP offered a \$50 incentive to customers who signed up to have a refrigerator or freezer recycled through the program. Participants could sign up for the program by phone, through the program website, or through participating retail partners when purchasing a new appliance. According to data collected by ARCA, only 1% of units were recycled through the retail partners.

The ARP sought to achieve 3,535 MWh of net energy savings and to recycle 7,730 appliances—targets set lower than PY7 goals with the expectation that the program was more mature and participation would be lower than the previous year, as shown in Table 7. Prior years’ goals were based on a potential study conducted prior to program launch. The program surpassed its PY8 energy savings and participation goals, achieving 3,844 MWh of net energy savings (109% of its goal) and recycling 7,953 units (103% of its goal).

Table 7. AIC ARP Historical Program Performance

Year	MWh Savings Target	MWh Savings Actual	Percent Goal Achieved	Participation Target	Participation Actual	Percent Goal Achieved
PY7	4,010	4,675	117%	8,375	9,014	108%
PY8	3,535	3,844	109%	7,730	7,953	103%

According to program staff, PY8 ARP performance exceeded expectations. At times, program staff rerouted ARP program budget to meet customers’ requests for appliance pickups. Program staff attributed the ARP’s success to customers becoming familiar with the service and coming to expect it. Additionally, appliance recycling serves as a good “gateway” program for customers that may not have participated in a utility program before.

Although the program met its PY8 participation target, as shown in Figure 1, the overall trend in decreasing participation continued from the program's peak year of PY4. This trend is typical of appliance recycling programs as they mature. Initially, in the first years of operation, programs tend to pick up lightly used secondary appliances for which customers did not have a convenient disposal option. The units are older and

less efficient, but not as heavily used. However, as the older, secondary units become less common, programs tend to pick up more appliances that were being used as primary appliances and have been replaced. The program keeps these units from being transferred to a new household where they could become a secondary unit.

The program recycled 7,953 appliances in PY8, a decrease of 12% in comparison to PY7.

Figure 1. Total Units Recycled by Program Year

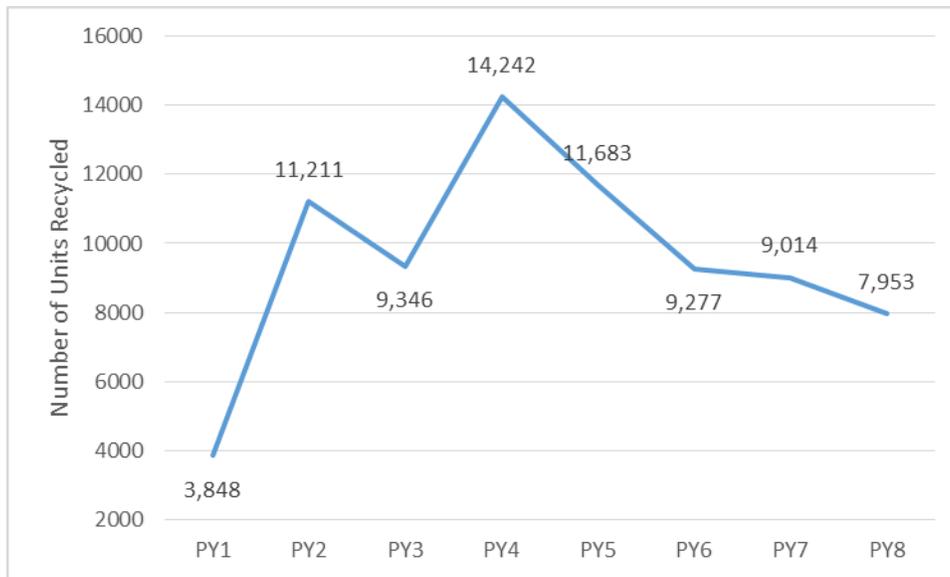


Table 8 shows the number of units recycled by year and appliance type. The total number of refrigerators, freezers, and air conditioners recycled decreased over PY7. The program continued to pick up a small number of room air conditioners in PY8. Historically, AIC’s program picked up room air conditioners as a convenience service for its customers, though AIC did not offer a customer incentive for these units.

Table 8. AIC ARP Historical Participation by Appliance

Year	Refrigerators	Freezers	Room A/Cs	Total
PY1	2,752	1,096	N/A	3,848
PY2	7,762	3,422	27	11,211
PY3	7,202	2,131	13	9,346
PY4	10,696	3,536	10	14,242
PY5	8,780	2,899	4	11,683
PY6	7,079	2,181	17	9,277
PY7	7,084	1,912	18	9,014
PY8	6,239	1,708	6	7,953

3.2.2 Program Delivery

As stipulated in the PY8 Appliance Recycling Program Implementation Plan, the program design or delivery did not change substantially in PY8. Early in PY8, program staff reported exploring the idea of expanding the program to include picking up dehumidifiers as a convenience service, providing free haul-aways, but no monetary incentives (the same way the program treated room air conditioners). It was decided, however, that the program did not need the additional savings.

As in PY7, the PY7 program surpassed its participation goal. However, the implementation team had to managed program participation by halting pickups between May 21 and June 1 so as not to exceed the participation target by more than 300 recycled units. Together AIC's program manager and Leidos' program manager found a creative solution to help accommodate as many customers as possible by moving budget from marketing efforts to incentives.

AIC's program manager and Leidos' program manager attributed the program's smooth delivery to relocating the recycling center from Springfield to Decatur and to adding a truck for appliance pickups which facilitated more timely pickups. ARCA also targeted its marketing to certain geographical areas to make scheduling more efficient and to help streamline appliance pickups. In PY8, only a few issues arose concerning pick up procedures, mainly due to damaged customer property. AIC mitigated each incident, and the program staff reported that the outcomes pleased customers.

3.2.3 Program Communication and Marketing

Leidos and ARCA maintained the communication structure used in PY7, with biweekly calls and monthly reviews of the program's progress. ARCA's monthly progress reports included the following: numbers of units ordered and cancelled (tracked against monthly goals), customer awareness reports, reports on numbers of appliances recycled through the participating retailer (Sears), and the top five order-producing zip codes.

PY8 program marketing efforts included bill inserts, digital marketing (e.g., Pandora radio ads), social media marketing, advertising at Sears, and advertising in the local Peoria baseball stadium, home of the Peoria Chiefs. The marketing team spent a little over half of its budget (51%) in August and halted marketing spend between February and May, deciding not to do a regular March bill stuffer (shifting the money to incentives for increased participation). In PY7, after taking the marketing responsibility from Conservation Services Group, ARCA rebranded the ARP's marketing materials, shifting away from the Energy Hog mascot used for several years in favor of the message: "Cool Savings are Hiding in Your Fridge." In PY8, the team continued to use this slogan as well as "I used to be so cool. Now I just waste your energy" as shown in Figure 2.

Figure 2. Examples of Appliance Recycling Marketing Materials



AIC’s program manager and Leidos’ program manager could not identify any barriers to eligible customers’ awareness of the program. Even though marketing materials did not change, the program continued to reach new customers. According to data collected by ARCA, participants in AIC’s appliance recycling program most commonly mentioned friends/neighbors and bill inserts as the two primary sources of program information when asked how they heard about the program. In the Awareness Report covering the period from June 2015 to May 2016 submitted by ARCA to AIC, 31% of 9,087 participants said they heard about the program through a friend/neighbor and 26% cited a bill insert. Additionally, 46% of participant survey respondents in PY6 mentioned bill inserts when asked how they heard about the program and 17% mentioned a friend/neighbor. Leidos, attributed continuing interest in the program to organic growth through word-of-mouth as the program became more widely known among customers.

Despite the program exceeding participation expectations in PY8, AIC discontinued the ARP part way through PY9 as a result of low cost-effectiveness due to decreased savings for recycled appliances as appliance stock becomes more efficient and presents lower avoided costs than in its previous plan.

3.3 Literature Review Findings

This section describes the results from the evaluation team’s interviews with other utilities to learn how they are phasing out appliance recycling programs from their energy efficiency portfolios, as well as the literature review comparing metrics from similar appliance recycling programs to AIC’s.

3.3.1 Utility Interviews

The evaluation team gathered differing perspectives on the future of appliance recycling programs by interviewing one program sponsor (PacifiCorp) that permanently discontinued its program and two program sponsors (Wisconsin Focus on Energy and Consumers Energy) that temporarily suspended their programs. All three of the programs were impacted when JACO Environmental went out of business suddenly in late 2015. The unexpected interruption of service provided several opportunities, not only to review how the utilities handled the interruption of service regarding customer communication, but also allowed some utilities to step back and consider the value of their programs in light of declining savings as eligible appliances become younger and more efficient.

Program Interruption and Customer Communication

After the closure or interruption of the respective programs, the utilities we interviewed used call centers and program websites as the two key methods of updating customers about program operations. Regarding alternative options for recycling appliances, all three utilities mentioned directing customers to waste management services or state natural resource management agencies.

Wisconsin Focus on Energy

After JACO Environmental ceased operations, Wisconsin Focus on Energy immediately informed its call center and updated its website to let customers know that the program was discontinued. Since the closure was unexpected, Wisconsin Focus on Energy staff called each customer who was expecting an appliance pick-up in November 2015, and sent letters to customers expecting a pickup in December to tell them about JACO Environmental's closure. Since Wisconsin Focus on Energy staff did not know if it would relaunch the program at that time, the utility gave customers the option of requesting a free Express Pack, which was a mail-order kit including energy efficiency items such as LEDs, CFLs, efficient showerheads, and faucet aerators.

While deciding how to proceed, Wisconsin Focus on Energy put a communication plan in place with customers assuming they would not relaunch the program. As part of this plan, the utility told customers who inquired about the program, either through the call center or through the website, to look into local recycling facilities in their area or to visit the Wisconsin Department of Natural Resources website, which has information on safe recycling and disposal of appliances. The website gives visitors the following disposal options:⁵

- Giving the appliance to a charitable foundation;
- Having the appliance removed by a retailer when a new appliance is delivered;
- Arranging removal during curbside garbage collection with your local public works department;
- Contacting a private waste company;
- Locating a recycler through the website Earth911.org; or
- Taking their appliance to a local scrap yard.

⁵ Wisconsin Department of Natural Resources. "Large Appliance Recycling Guide." <http://dnr.wi.gov/files/pdf/pubs/wa/wa1814.pdf>

Wisconsin Focus on Energy also stopped promoting the amount of energy savings a customer could achieve through recycling an appliance.

PacifiCorp

PacifiCorp's immediate step after JACO Environmental closed was to hire a vendor to call customers scheduled for an appliance pick-up through the end of the year to explain the situation. If a customer was very upset, the vendor offered that customer a \$20 bill credit. Then in early 2016, PacifiCorp contracted with ARCA to contact and reschedule as many of the outstanding appointments as possible. According to the interviewed program manager, most customers were interested in this offer: only a small portion of customers chose not to participate.

Initially, PacifiCorp received a lot of inquiries from new potential recycling program participants; however, this has slowed substantially in recent months. PacifiCorp's call center tells customers that inquire about appliance recycling to dispose of their appliance in an environmentally sound manner, and directs them to contact their local waste management organization or call 1-800-GOT-JUNK.

Consumers Energy

Consumers Energy's top priority when the program was unexpectedly suspended was to resolve any issues for customers whose program experience was interrupted, such as appointment no-shows, or incentive payments not processed. Consumers Energy also posted a notification on their program webpage alerting customers that the program was suspended with no planned relaunch date. They provided information on alternative recycling options only to customers who asked and, in that case, suggested customers contact their local waste management company.

Market Response

Each of the various program managers the evaluation team interviewed had different opinions about the impact on the secondary appliance market when their programs were not operating. Estimated impacts on the secondary market were speculative or based on experience with retailer partners that accounted for a small portion of overall program participation. None of the interviewees indicated that they track appliance recycling efforts outside of their utility's program.

Wisconsin Focus on Energy

The closure of the Wisconsin Focus on Energy Appliance Recycling Program ended their relationship with Sears as a retail partner, who in the past had provided information about the program to shoppers purchasing a new refrigerator or freezer. Customers were able to sign up for the program while in a Sears store purchasing a new appliance. This channel accounted for a very small amount of the overall recycled appliances (only about 5%); therefore, the relaunched program will not initially have a retailer channel. Wisconsin Focus on Energy may reconsider including this marketing channel in the future.

PacifiCorp

The PacifiCorp interviewee believes that ending the Appliance Recycling Program probably had a big impact on the secondary appliance market because there are few options for customers to recycle appliances, and no option is as easy or as enticing as the utility appliance recycling program, which includes a financial incentive. However, PacifiCorp has no data or information regarding what happened to appliances in the secondary market in the absence of the program.

Additionally, PacifiCorp was working with retailers (e.g., Sears) to pick up appliances in bulk and recycle them. Prior to the partnership, Sears had been reselling some appliances they hauled away from customers' homes after delivering a newly purchased appliance. Units that were deemed to be re-sellable were then refurbished instead of being disposed. These appliances never left the market, though their ultimate destination was not tracked by PacifiCorp so there is no way to know how many appliances would have been resold into the local market. Because the Sears relationship ended (when the program ended), PacifiCorp staff did not know if Sears would return to reselling over recycling. However, the interviewee noted that many retailers (in general) are striving to be more environmentally friendly and have begun to recycle appliances instead of reselling them.

This sentiment is consistent with findings from a recent assessment Cadmus conducted for Pacific Gas & Electric (PG&E).⁶ The proposed pilot program would have targeted and recycled units that are picked-up by retailers when they deliver newly purchased appliances to customers. The pilot assessment found limited potential for such a program as many national retailers recycle most, if not all, of the appliances they haul away from customers' homes. Similarly, the PY5 evaluation of Commonwealth Edison's Fridge and Freezer Recycling Program found that retailers who provide pick-up services with the purchase of a new appliance recycle between 50% and 99% of the appliances they pick up.⁷ Additionally, the U.S. Environmental Protection Agency (EPA) has been promoting its Responsible Appliance Disposal (RAD) Program via retail partners since 2006.⁸

Consumers Energy

The Consumers Energy interviewee did not think the suspension of the program affected the secondary market in any meaningful way, largely because the program was only suspended for several months, a relatively short time. The Consumers Energy program also included a retailer partnership, where customers could sign up for the program when purchasing a new appliance. As with the Wisconsin Focus on Energy program, the partnership accounted for a small portion of overall participation.

Decision to Relaunch the Program

The popularity of the appliance recycling program with utility customers is a key factor in the decision to relaunch or continue an appliance recycling program. In a portfolio of programs, the appliance recycling program has lower barriers to entry compared with other efficiency program offerings as customers do not have to pay to participate (although they have to own a refrigerator that qualifies). Wisconsin Focus on Energy's decision to relaunch was primarily due to customer demand even though the program has poor cost-effectiveness. In comparison, the PacifiCorp interviewee suspected that the utility probably would have kept this very popular program if it had been more cost-effective.. Consumers Energy never considered permanently ending its program, as it is highly cost-effective and customer satisfaction with the program is very high.

⁶ Cadmus. "Appliance Recycling Program Process Evaluation Research: Retailer Haul-Away Market Intervention." April 30, 2016. http://www.calmac.org/publications/PGE_RHAMI_Assessment_Report_final.pdf

⁷ Navigant Consulting. "Refrigerator and Freezer Recycle Rewards Program PY5 Evaluation Report." April 15, 2014. http://ilsagfiles.org/SAG_files/Evaluation_Documents/ComEd/ComEd%20EPY5%20Evaluation%20Reports/ComEd_FFRR_EMV_Report_PY5_2014-04-15_Final.pdf

⁸ For more information, see <https://www.epa.gov/rad>

Wisconsin Focus on Energy

When Wisconsin Focus on Energy's program was discontinued they did not know if the program would relaunch. Although the appliance recycling program is one of the least cost-effective programs in the residential portfolio, Leidos ultimately decided to relaunch because the program is the residential portfolio's biggest source of cross-promotion. It is popular with customers, and customers have continued to ask about how to recycle their appliance long after the program ended.

When reviewing program data, Wisconsin Focus on Energy indicated during the interview that of all the programs offered, more customers go on to participate in other efficiency programs after recycling an appliance than after participating in any of the other program. This finding was a surprise to the interviewee who previously thought that Wisconsin Focus on Energy's direct install program would be the biggest source of cross-promotion rather than appliance recycling.

Additionally, in 2015, Wisconsin Focus on Energy's Appliance Recycling Program received the highest satisfaction from customer surveys of any program in the residential portfolio, earning a 9.5 out of 10. Lastly, according to the interviewee, customers had come to expect that their utility would offer a service to safely dispose of their appliance, and there is evidence of continued market demand for the program. Wisconsin Focus on Energy continues to receive an average of six calls per day from customers who are asking about appliance recycling.

PacifiCorp

PacifiCorp's program was abruptly suspended after JACO Environmental's departure in November 2015. Then in early 2016, PacifiCorp decided to permanently cancel the program, primarily due to its poor cost-effectiveness. The savings for recycled appliances were decreasing each year while the cost to recycle the appliance, especially the cost to the vendors, was increasing. In addition to lack of cost-effectiveness, PacifiCorp did not continue the program because it seemed that the program had hit market saturation after operating for 12 years, as each year there were fewer and fewer appliances to recycle.

Although PacifiCorp did not continue their program, before discontinuing it they brainstormed ways to increase cost-effectiveness, and considered providing a tiered incentive based on the appliance age, instead of giving the same incentive amount for all appliances, regardless of age. The utility also claimed the same amount of savings per appliance, regardless of age, but potentially could have changed how savings were calculated and by claiming more savings for the older appliances that receive a higher incentive.

With better cost-effectiveness, the interviewee suspected that they probably would have kept the program due to the high customer satisfaction ratings. According to the interviewee, one aspect of the program that contributed to the high customer satisfaction historically was the utility allowing customers to donate their incentive to a local charity, such as a food bank. The interviewee said there should be a program for people to safely dispose of appliances, but that program should not be tied to energy savings goals or cost-effectiveness tests.

Consumers Energy

Consumers Energy never considered permanently ending its program, as it is highly cost-effective, but suspended it long enough to resolve outstanding issues from JACO Environmental and search for a new program implementer. The 2015 program achieved a total resource cost (TRC) test result of 3.28 (see Table 9 for more details about program cost-effectiveness). According to the interviewee, the program is expected to relaunch in January 2017.

Future of the Program

Utilities relaunching the program plan to keep the same turnkey program delivery as before the interruption.

Wisconsin Focus on Energy

The relaunched Wisconsin Focus on Energy program will follow the same design as the previous program, with the largest difference being the new implementer, ARCA, who is currently finding a recycling facility location. Wisconsin Focus on Energy will focus the new program on secondary appliances, which are older, as a way to increase savings and will potentially include dehumidifiers and air conditioners, which were not part of the original program. For the new program, Wisconsin Focus on Energy may also establish ties with municipal utilities, whereby they organize pick-up events at the office of the municipal utility as a way to increase the number of recycled appliances.

The interviewee from Wisconsin Focus on Energy said the biggest risk for the future of their program is the financial stability of the subcontractor, and thus the program. JACO Environmental ceased operating abruptly as their business model relied heavily on the price of scrap metal, which plummeted. The interviewee said that since their new subcontractor, ARCA, is a public company, there is more transparency surrounding their finances, which will help to mitigate the risk of the program being interrupted abruptly again.

Currently, Wisconsin Focus on Energy does not have criteria to determine when to permanently discontinue the program; however, this is something they will consider if the program matures to the point where there is no longer demand, or if customer satisfaction and/or cost-effectiveness decreases.

Consumers Energy

Consumers Energy does not have pre-defined criteria to determine when to discontinue a program, but rather reviews each program annually. The utility considers cost-effectiveness at the portfolio level, so some programs with lower cost-effectiveness can be offset by other programs. By reviewing portfolio cost-effectiveness, Consumers Energy can consider additional factors when assessing program performance. The Consumers Energy Appliance Recycling Program serves a much more diverse array of customers compared with other efficiency program offerings, and the program manager reported that customer satisfaction with the program is very high, typically well over 90%.

Customer service is an important aspect of the program, and Consumers Energy places a high amount of emphasis on customer service. Though savings have decreased over time, as with PacifiCorp's program, Consumers Energy still considers their program to be strong and it expects the program to remain a part of the portfolio indefinitely. The relaunched Consumers Energy program will follow the same design as the previous program.

3.3.2 Literature Review

Cost-Effectiveness Benchmarking

To supplement the utility interviews, the evaluation team collected program performance data from a number of Midwestern and Mountain West utilities. The team collected the most recent publicly available evaluation

reports or most recent year’s data reported in the E Source DSM Insights database.⁹ Table 9 summarizes the cost-effectiveness data by utility including each utility’s TRC ratio, whether cost effectiveness is based on ex ante or ex post results, whether it is based on gross or net savings as well as the spending per kWh.

Table 9. Benchmarking Cost-Effectiveness

Utility	Program Year	TRC Ratio	TRC Reporting Type	Savings Type	Spending (\$ per kWh)
AEP Ohio	2015	3.90	Verified (ex post)	N/A	--
Ameren Missouri	2015	1.60	Verified (ex post)	Net	\$0.24
Consumers Energy	2015	3.28	Verified Savings	Gross	\$0.02
Duke Energy (Indiana)	2015	1.10	Program Reported (ex ante)	N/A	--
Indiana Michigan Power	2015	2.33	Verified (ex post)	Gross	\$0.17
Indianapolis Power & Light	2015	1.73	Verified (ex post)	Gross	\$0.24
MidAmerican Energy (Iowa)	2015	0.76	Program Reported (ex ante)	Gross	\$0.23
Pacific Gas and Electric (PG&E)	2010-2011	0.98	Verified (ex post)	Net	
Pacific Power Washington	2013-2014	0.98	Verified (ex post)	Net	--
Rocky Mountain Power (Idaho)	2013-2014	0.46	Verified (ex post)	Net	--
Rocky Mountain Power (Wyoming)	2013-2014	0.37	Verified (ex post)	Net	--
Southern California Edison (SCE)	2010-2011	1.46	Verified (ex post)	Net	
Vectren Indiana	2015	2.52	Plan	N/A	\$0.15
Wisconsin Focus on Energy	2015	1.97	Verified (ex post)	Net	-
Xcel Energy (Minnesota)	2015	3.31	Plan	Net	\$0.15

Note: References for Pacific Power, Focus on Energy, Rocky Mountain Power, SCE, and PG&E evaluation reports are provided in Appendix B. The remainder of the programs were sourced from the E Source DSM Insights database.

The table contains metrics for two Mountain West utilities, both Rocky Mountain Power (owned by PacifiCorp). These TRC ratios are well below 1.00, indicating these programs cost more to operate than the value of benefits they achieved in the 2013-2014 evaluation cycle.

Although both are considered cost-effective, Wisconsin Focus on Energy’s 2015 program year had a TRC ratio of 1.97, which is lower than the 3.28 TRC ratio for Consumers Energy’s program.

Comparing the TRC ratios to Table 3 we see that the majority of programs that have been discontinued (Rocky Mountain, Pacific Power, &E, SCE) had TRC ratios of less than 1.00, suggesting cost-effectiveness was a consideration. SCE is an exception with the most recent published TRC ratio of 1.46, though the results are from 2011. The only program still operating with a TRC ratio of less than one is MidAmerican Energy Iowa.

Customer Communication After Program End

When examining information in jurisdictions where appliance recycling programs no longer exist, we noted if the utility offers customers tips or sources for secondary refrigerator recycling options or if they continue to promote the energy savings benefits of recycling. As shown in Table 10, utilities with discontinued programs give very little information to their customers about where to recycle their appliance. We found only one utility,

⁹ All sources are included in Appendix B.

Avista Utilities, that mentions that appliance recycling is beneficial. However, their website does not give specific energy saving information.

Table 10. Customer Communication After Program Discontinuation

Utility	Customer Communication of Discontinued Programs
Avista Utilities	The program was discontinued in 2015. Utility website includes the following language “Avista encourages you to recycle your refrigerator or freezer, as it is always a good idea. Many used appliance retail locations are accepting used appliances. We recommend looking in your local phonebook for used appliance shops.”
Nevada Energy	Utility website lists program as having been offered for a limited time and has been discontinued as of January 1, 2016.
Pacific Gas & Electric	Utility website does not list the program as discontinued. Web search returns links that go to pages that are no longer available.
Pacific Power (PacifiCorp)	California website provides notice of discontinuation of program but no further information about recycling options. Washington website provides no information about appliance recycling options. Oregonians are still able to recycle their appliances via Energy Trust of Oregon.
Rocky Mountain Power (PacifiCorp)	Utility websites do not provide easy access to information about cancelled “See Ya Later, Refrigerator” Program.
Southern California Edison	Utility website does not list the program as discontinued. Web search returns links that go to pages that are no longer available.

Secondary Market Dynamics

To assess potential market confusion and the potential impact on the secondary appliance market related to AIC’s exit, we reviewed the results of a market characterization report for two California utilities, PG&E and SCE. The market characterization estimated the total potential for the two utilities’ appliance recycling programs, as well as the proportion of potential units the programs were actually capturing. The authors of this study, Cadmus, estimated that the California programs captured between 7% and 14% of eligible refrigerators disposed of annually within the two utilities’ service territories, after having run for over a decade.

The evaluation team also found that program awareness was likely not a factor in the relatively low proportion of units captured by the program. For both SCE and PG&E, Cadmus surveyed customers who had recently disposed of a working appliance outside of the appliance recycling programs. Fewer than 10% of respondents in either utilities’ service territory were unaware of the program in the most recent survey. The most common responses when asked the reason for not participating was that a retailer had picked up the old appliance when they bought a new one (over 30% for both utilities). The second most common response was that the respondent planned to give their appliance away to a friend or relative (over 20% for both utilities).

For the PY6 evaluation of AIC’s program, 40% of participant survey respondents who recycled a refrigerator and 48% of those who recycled a freezer said they would have kept their appliance absent the program. If this pattern holds after AIC’s program is discontinued, there could be growth in the number of secondary appliances operating in AIC territory.

However, of PY6 respondents who recycled their refrigerator, 67% recycled their primary refrigerator, which means that these respondents purchased a new primary refrigerator. Additionally, 37% of respondents who recycled a freezer replaced their freezer after recycling. This suggests that appliances that *would not have been kept* absent AIC’s program are likely to be picked up by retailers. Since retailers are more likely to recycle

the appliances they pick up when delivering a new appliance, this could limit the growth of secondary appliances even absent AIC’s program.

3.4 Impact Assessment

As shown in Table 11, the evaluation team applied the verification rate determined in the PY6 participant survey (100%). As the program only recycled six air conditioners in PY8, the team applied the PY4 verification rate of 100% for air conditioners.

Table 11. Summary of PY8 Participant Verification Results

Recycling Measure	Participants	Verification Rate	Verified Participants
Refrigerator	6,239	100%	6,239
Freezer	1,708	100%	1,708
Room Air Conditioner	6	100%	6
Total	7,953	100%	7,953

3.4.1 Ex Post Gross Impacts

Using PY8 tracking data, PY6 participant survey data, and algorithms specified in the IL-TRM V4.0, the evaluation team calculated ex post gross savings. As participant surveys were not conducted in PY7 or PY8, the team applied the PY6 survey-based verification rate of 100%.

Estimated Annual Consumption

The IL-TRM V4.0 algorithm provides coefficients to calculate energy consumption of recycled appliances based on a collaborative metering study conducted for ComEd, Consumers Energy and DTE Energy in Michigan for PY4.¹⁰ Holding all other variables constant, the coefficient of each independent variable indicates the influence of that variable on annual consumption:

- A positive coefficient indicates an upward influence on consumption
- A negative coefficient indicates a downward influence on consumption

The coefficient value indicates the marginal impact of a one-point increase in the independent variable on the unit energy consumption (UEC). For instance, a 1-cubic-foot increase in refrigerator size results in a 27.15 kWh increase in average annual consumption. For dummy variables, the coefficient value represents the difference in consumption if a given condition holds true. For example, the 161.86 coefficient for the variable indicates a refrigerator was used as a primary unit; all else equal, this means a primary refrigerator annually consumed 161.86 kWh more than a secondary unit.

Table 12 lists the IL-TRM V4.0 coefficients for refrigerators.

¹⁰ The IL-TRM V4.0 refrigerator algorithm differs slightly from the IL-TRM Version 3.0 algorithm by removing the dummy variable for single-door units.

Table 12. UEC Refrigerator Regression Algorithm

Independent Variables	Estimate Coefficient
Intercept	83.32
Age (years)	3.68
Pre-1990 (= 1 if manufactured pre-1990)	485.04
Size (cubic feet)	27.15
Dummy: Side-by-Side (= 1 if side-by-side)	406.78
Dummy: Primary Usage Type (in the program's absence) (= 1 if primary unit)	161.86
Interaction: Located in Unconditioned Space x CDD/365.25	15.37
Interaction: Located in Unconditioned Space x HDD/365.25	-11.07

Table 13 lists the regression coefficients for freezers from the IL-TRM V4.0.

Table 13. UEC Freezer Regression Algorithm

Independent Variables	Estimate Coefficient
Intercept	132.12
Age (years)	12.13
Pre-1990 (= 1 if manufactured pre-1990)	156.18
Size (cubic feet)	31.84
Chest Freezer Configuration (= 1 if chest freezer)	-19.71
Interaction: Located in Unconditioned Space x CDD/365.25	9.78
Interaction: Located in Unconditioned Space x HDD/365.25	-12.76

Extrapolation

Using the PY8 tracking database, the evaluation team calculated the corresponding characteristics (i.e., independent variables) for participating appliances to input into the IL-TRM V4.0 algorithm. Table 14 summarizes program averages or proportions for each independent variable.

Table 14. PY8 Mean Explanatory Variables

Appliance	Independent Variables	Participant Population Mean Value	Participant Population Mean Value PY8
Refrigerator	Age (years)	24.08	22.70
	Pre-1990 (= 1 if manufactured pre-1990)	0.39	0.37
	Size (cubic feet)	19.27	19.02
	Dummy: Side-by-Side (= 1 if side-by-side)	0.23	0.23
	Dummy: Primary Usage Type (in the program's absence) (= 1 if primary unit)	0.67	0.67
	Interaction: Located in Unconditioned Space x CDD/365.25	0.98	0.99
	Interaction: Located in Unconditioned Space x HDD/365.25	5.11	5.09

Appliance	Independent Variables	Participant Population Mean Value	Participant Population Mean Value PY8
Freezer	Age (years)	29.21	27.65
	Pre-1990 (= 1 if manufactured pre-1990)	0.62	0.58
	Size (cubic feet)	15.56	15.68
	Chest Freezer Configuration (= 1 if chest freezer)	0.45	0.44
	Interaction: Located in Unconditioned Space x CDD/365.25	2.47	2.49
	Interaction: Located in Unconditioned Space x HDD/365.25	12.91	12.85

To determine annual and average-annual per-unit energy consumption using the IL-TRM V4.0 algorithm and PY8 AIC tracking data, the evaluation team applied average participant refrigerator and freezer characteristics to the regression model coefficients. This approach ensured the resulting UEC was based on specific units recycled through AIC’s program in PY8, rather than on a point estimate based on a secondary data source.

Per-unit room air conditioner energy savings were calculated by applying the following formula from the IL-TRM V4.0:

$$\Delta kWh = FLH_{RoomAC} * \frac{BTU}{Hour} * \left(\frac{1}{EER_{Exist}} \right) / 1000$$

Assumptions for full load hours (FLH) and efficiency of existing unit (EER_{Exist}) are listed in Appendix C. We averaged per-unit room AC savings across the six units that were recycled in PY8 to arrive at average unit energy savings.

Table 15 provides the annual UEC for refrigerators and freezers AIC recycled in PY8.

Table 15. PY8 ARP Unit Energy Savings (without part-use)

Recycling Measure	Unit Energy Savings (kWh)	Unit Demand Savings (kW)
Refrigerator	1,048	0.13
Freezer	930	0.11
Room Air Conditioner	220	0.08

Table 15 also shows demand savings calculated by applying the following formula (included in the IL-TRM V4.0 for refrigerators and freezers):

$$\text{Unit Demand Savings} = \Delta kW = \frac{kWh}{8,760} * \text{Coincidence Factor}$$

Where coincidence factors equal 1.081 for refrigerators and 1.028 for freezers.

The following formula, specified in the IL-TRM V4.0, calculated demand for room air conditioners:

$$\text{Unit Demand Savings} = \Delta kW = \left(\frac{Btu}{hr} * \left(\frac{1}{EER_{Existing}} \right) \right) * \text{Coincidence Factor}$$

Where the coincidence factor for room air conditioners equals 0.3.

Part-Use

The part-use factor accounts for appliances not plugged in year-round prior to participation. For PY8, the evaluation team applied a part-use factor of 0.91 for refrigerators and 0.86 for freezers, estimated using PY6 survey responses, as specified in the IL-TRM V4.0.

Applying part-use factors to modeled annual consumption from Table 15 yielded AIC’s average per-unit gross energy savings for PY8. As shown in Table 16, the verified per-unit values for refrigerators and freezers were 956 kWh and 796 kWh, respectively.

Table 16. PY8 Evaluated Gross Energy Savings (Per-Unit)

Recycling Measure	Ex Ante Unit Energy Savings (kWh)	Ex Post Unit Energy Savings (kWh)	Percent Difference
Refrigerator	931	956	3%
Freezer	810	796	-2%
Room Air Conditioner	160	220	38%

Table 16 also compares ex ante and ex post gross savings. Ex ante savings were derived from estimates generated by Leidos using the IL-TRM V4.0 algorithm. The source of the discrepancy between ex ante and ex post savings is due to the fact that Leidos used the program tracking data to determine which units were primary and which were secondary whereas Cadmus used the PY6 participant surveys to determine the proportion of primary units. Using the PY6 survey responses is consistent with past evaluation methodology.

Overall, there was little discrepancy in per-unit savings with ex post gross refrigerator savings 3% higher than ex ante savings and ex post gross freezer savings 2% lower than ex ante savings. Ex post gross room air conditioner savings are 38% higher than ex ante savings.

3.4.2 Net Impacts

The program’s NTGR, as calculated in PY6, drew on the self-report approach methodology established in the Uniform Methods Project protocol for evaluation of appliance recycling programs. The PY6 NTGR offered the most recent analysis that met the Illinois NTGR framework. As shown in Table 17, the team applied the SAG-approved NTGR for PY8 for refrigerators and freezers. The SAG does not provide NTGR values for room air conditioners so the team applied results from ComEd’s PY5 evaluation.¹¹

¹¹ Navigant. “Refrigerator and Freezer Recycle Rewards Program PY5 Evaluation Report”. April 2014. http://ilsagfiles.org/SAG_files/Evaluation_Documents/ComEd/ComEd%20EPY5%20Evaluation%20Reports/ComEd_FFRR_EMV_Report_PY5_2014-04-15_Final.pdf

Table 17. Ex Post Per-Unit Net Savings

Measure	Ex Post Gross Per-Unit Savings (kWh)	NTGR	Ex Post Net Per-Unit Savings (kWh)
Refrigerator	956	51%	487
Freezer	796	59%	470
Room Air Conditioner	220	50%	110

4. Conclusions and Recommendations

Based on the research discussed, the evaluation team provides the following conclusions and recommendations to help AIC manage the transition after the program's closure:

- **Key Finding #1:** The utilities that the evaluation team interviewed considered appliance recycling to be an important customer service offering. Appliance recycling programs typically have high customer satisfaction ratings. Utilities deciding whether to continue or end the program carefully considered the program popularity in their analysis.
- **Key Finding #2:** Some utilities deciding to end appliance recycling programs tried to communicate alternative options for recycling appliances. Interviewed utilities discussed directing customers to waste management services or state natural resource management agencies. Evidence from evaluations of Commonwealth Edison's PY5 program and from one run by PG&E suggest that many retailers recycle the appliances picked up when customers purchase new appliances. This service continues to remove some appliances from operating on the grid.
 - **Recommendation:** Consider directing customers interested in recycling an appliance to an appliance waste management service or to retailers that participate in the EPA Responsible Appliance Disposal (RAD) Program or recycle haul-away appliances.
- **Key Finding #3:** Advanced planning for program discontinuation will be critical to minimizing customer confusion. Utility program staff we interviewed did not anticipate their programs being interrupted and had no chance to communicate future program changes. Call centers and program websites serve as the two key methods used by interviewed utilities to update customers about program operations.
 - **Recommendation:** AIC's ARP participants most commonly cited friends/neighbors and bill inserts as their two primary sources of program information when asked how they learned about the program. Unlike the interviewed utilities, AIC has time before the program discontinues and bill inserts may be an effective method of communicating changes in the program's availability and to list other recycling options. AIC could include names and contact information for alternative recycling facilities in the bill inserts and should continue to recommend that consumers recycle appliances on their own.

Appendix A. Data Collection Instruments

Embedded below are the following interview guides:

- Utility staff interview used as part of the literature review



LitReviewGuide

- Program staff interview guide



StakeholderGuide

Appendix B. Literature Review References

- Cadmus. "Appliance Recycling Program Process Evaluation and Market Characterization Volume 1." September 2013. Available online:
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- Consumers Energy Company. Before the Michigan Public Service Commission. Case No. U-18025. "In the matter of the Commission's own motion regarding the regulatory reviews, revisions, determinations, and/or approvals necessary for CONSUMERS ENERGY COMPANY to fully comply with Public Act 295 of 2008: Application to Reconcile Its 2015 Energy Optimization Plan Costs." Appendix, Tables 4-6 and 4-7. May 31, 2016.
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Appendix C. ARP Assumptions and Algorithms

Refrigerators and Freezers

The evaluation team used the following algorithms from the IL-TRM V4.0 to estimate average UEC, energy savings, and demand savings for refrigerators and freezers recycled through the ARP.

Equation 1. Refrigerator and Freezer Demand Algorithm

$$\text{Unit Demand Savings} = \Delta kW = \frac{\text{kWh}}{8,760} * \text{Coincidence Factor}$$

Table 18 provides the regression algorithm from the IL-TRM V4.0 that was used to estimate average UEC for refrigerators recycled through the ARP.

Table 18. UEC Refrigerator Regression Algorithm

Independent Variables	Estimate Coefficient
Intercept	83.32
Age (years)	3.68
Pre-1990 (= 1 if manufactured pre-1990)	485.04
Size (cubic feet)	27.15
Dummy: Side-by-Side (= 1 if side-by-side)	406.78
Dummy: Primary Usage Type (in the program’s absence) (= 1 if primary unit)	161.86
Interaction: Located in Unconditioned Space x CDD/365.25	15.37
Interaction: Located in Unconditioned Space x HDD/365.25	-11.07

Table 19 provides the regression algorithm from the IL-TRM V4.0 that was used to estimate average UEC for freezers recycled through the ARP.

Table 19. UEC Freezer Regression Algorithm

Independent Variables	Estimate Coefficient
Intercept	132.12
Age (years)	12.13
Pre-1990 (= 1 if manufactured pre-1990)	156.18
Size (cubic feet)	31.84
Chest Freezer Configuration (= 1 if chest freezer)	-19.71
Interaction: Located in Unconditioned Space x CDD/365.25	9.78
Interaction: Located in Unconditioned Space x HDD/365.25	-12.76

Table 20 provides assumptions used to estimate ex post savings for refrigerators and freezers.

Table 20. Ex Post Assumptions for Refrigerators and Freezers

Parameter	Value	Units	Notes/Reference
Coincidence Factor (Refrigerator)	1.081	N/A	Summer peak coincidence factor for refrigerator (IL-TRM V4.0)
Coincidence Factor (Freezer)	1.028	N/A	Summer peak coincidence factor for freezer (IL-TRM V4.0)
Part Use Factor (Refrigerator)	0.91	N/A	Calculated based on PYt-2 participant surveys
Part Use Factor (Freezer)	0.86	N/A	Calculated based on PYt-2 participant surveys
CDD	Location Dependent (See Table 21)	Days	Cooling degree days (IL-TRM V4.0)
HDD	Location Dependent (See Table 22Table 24)	Days	Heating degree days (IL-TRM V4.0)

Table 21. Cooling Degree Days

Climate Zone (City based upon)	CDD 65	CDD/365.25
1 (Rockford)	820	2.25
2 (Chicago)	842	2.31
3 (Springfield)	1,108	3.03
4 (Belleville)	1,570	4.30
5 (Marion)	1,370	3.75

Table 22. Heating Degree Days

Climate Zone (City based upon)	HDD 65	HDD /365.25
1 (Rockford)	6,569	17.98
2 (Chicago)	6,339	17.36
3 (Springfield)	5,497	15.05
4 (Belleville)	4,379	11.99
5 (Marion)	4,476	12.25

Room Air Conditioners

The evaluation team used the following algorithms from the IL-TRM V4.0 to estimate energy and demand savings for room air conditioners recycled through the appliance recycling program (ARP).

Equation 2. Room Air Conditioner Energy Savings Algorithm

$$\Delta kWh = FLH_{RoomAC} * \frac{BTU}{Hour} * \left(\frac{1}{EER_{Exist}} \right) / 1000$$

Equation 3. Room Air Conditioner Demand Algorithm

$$\text{Unit Demand Savings} = \Delta kW = \left(\frac{\text{Btu}}{\text{Hour}} * \left(\frac{1}{EER_{Exist}} \right) \right) * \text{Coincidence Factor}$$

Table 23 provides assumptions used to estimate ex post savings for room air conditioners.

Table 23. Ex Post Assumptions for Room Air Conditioners

Parameter	Value	Units	Notes/Reference
FLH _{RoomAC}	Location Dependent (See Table 24)	Hours	Full load hours of room air conditioning unit (IL-TRM V4.0)
EER _{Exist}	7.7	N/A	Efficiency of existing unit (IL-TRM V4.0)
Coincidence Factor	0.3	N/A	Summer peak coincidence factor for room AC (IL-TRM V4.0)

Table 24. Full Load Hours by Climate Zone

Climate Zone (City based upon)	FLH _{RoomAC}
1 (Rockford)	220
2 (Chicago)	210
3 (Springfield)	319
4 (Belleville)	428
5 (Marion)	374
Weighted Average	248

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