



# ComEd Fridge Freezer Recycling Combined Evaluation Report

**Energy Efficiency / Demand Response Plan:  
Plan Year 9 (PY9)**

**Presented to  
ComEd**

February 14, 2019

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## 1. INTRODUCTION

This report combines the key deliverables from the evaluation of the Fridge Freezer Recycling Program for PY9. Each of these deliverables were drafted, reviewed and finalized during the course of the PY9 evaluation.

**APPENDIX A. ComEd PY9 FFR IMPACT EVALUATION REPORT 2018-05-07**  
**FINAL**



# ComEd Fridge & Freezer Recycling Program Impact Evaluation Report

Energy Efficiency / Demand Response Plan:  
Plan Year 9 (PY9)

Presented to  
ComEd

**FINAL**

*May 7, 2018*

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## 1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's PY9 Fridge & Freezer Recycling (FFR) Program. It presents a summary of the energy and demand impacts for the total program and broken out by relevant measure and program structure details. Section 6 presents the impact analysis methodology. PY9 covers June 1, 2016 through December 31, 2017.

## 2. PROGRAM DESCRIPTION

The FFR Program is designed to achieve energy savings through the retirement and recycling of older, inefficient refrigerators, freezers, and room air conditioners (ACs). The primary objectives of the program are to decrease the retention of high energy-use refrigerators and freezers and to deliver long-term energy savings. A secondary objective is to dispose of these older units in an environmentally safe manner. The program projected that 71,500 units would be collected and recycled in the PY9 19-month program year. The associated PY9 ex ante net savings target was 33,375,000 kWh.

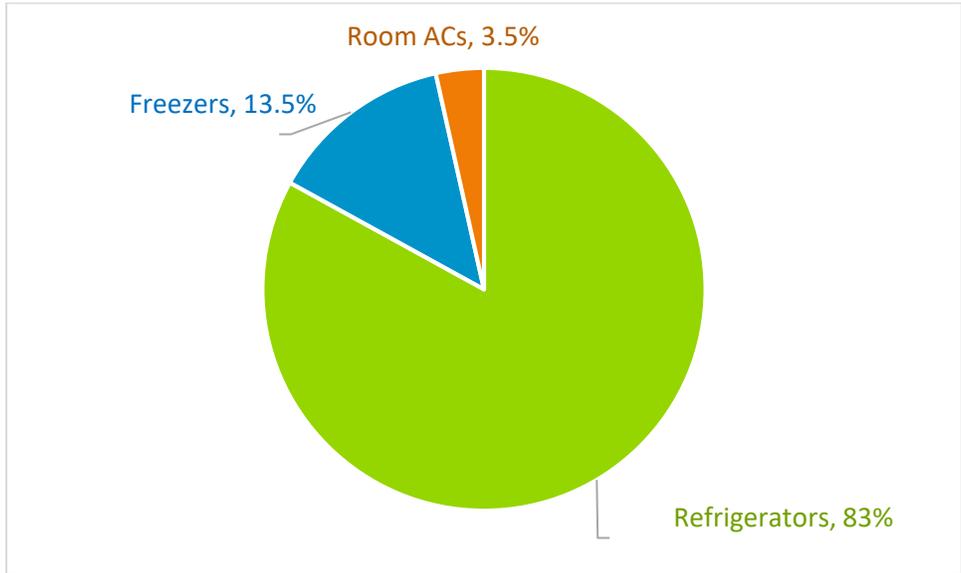
According to program tracking data, there were 71,031 participants in PY9 contributing a total of 81,633 recycled measures to the program. The PY9 volumes are higher than PY7 and PY8, due to the 19-month duration of PY9, and the program's five-month suspension during PY8. These values are shown in Table 2-1 and Figure 2-1 below.

**Table 2-1. PY9 Volumetric Findings Detail**

Participation	Program-Reported Number of Units	% of Total Units
<b>Number of Participants</b>	71,031	100%
<b>Units by Measure Type</b>		
Refrigerators	67,767	83.0%
Freezers	11,016	13.5%
Room ACs	2,850	3.5%
<b>Total Measures</b>	81,633	100.0%

Source: ComEd tracking data and Navigant team analysis.

Figure 2-1. Number of Measures Recycled by Type



Source: Evaluation Analysis

### 3. PROGRAM SAVINGS

Table 3-1 summarizes the energy and demand savings that the Fridge & Freezer Recycling Program achieved in PY9. Verified gross savings are approximately four percent higher than ex ante gross savings. Both ex ante and verified gross energy savings were computed using the equations specified in the TRM. However, a difference in the ex ante and verified refrigerator and freezer TRM savings calculation methods emerges due to an equation variable that indicates whether the appliance was located in a conditioned space. The verified gross savings calculations use the proportion of appliances located in conditioned space that are derived from the customer telephone surveys, whereas ex ante gross savings calculations are based on appliance locations in the program tracking database. The telephone survey findings use responses to a counterfactual question to the decision maker regarding where the unit would have been located if the program had not picked it up, while appliance locations in the program tracking database use the responses to a question posed by the truck driver at the time the unit is picked up (“How was this unit used during most of the past 12 months?”). The “no program” unit location based on the telephone survey’s counterfactual response by the decision maker is the appropriate value for the gross savings calculation. The TRM also stipulates the use of a part-use factor for refrigerator and freezer savings calculations. Both the ex ante and verified estimates used the PY7 Research Findings part-use factors.

Table 3-1. PY9 Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	63,751,662	10,343	8,681
Program Gross Realization Rate	104%	103%	104%
Verified Gross Savings	66,334,294	10,637	8,998
Program Net-to-Gross Ratio (NTGR)	Varies	Varies	Varies
Verified Net Savings	34,335,568	5,452	4,639

Source: ComEd tracking data and Navigant team analysis.

## 4. PROGRAM SAVINGS BY MEASURE

The program includes three measure types as shown in Table 4-1, Table 4-2 and Table 4-3 below. The Refrigerator measure contributed the greatest portion of energy savings (88 percent). Freezers accounted for another 11 percent, while the Room A/C measure comprised one percent. This breakdown of savings is almost identical to the proportions in PY4, PY5, PY6, PY7 and PY8.

**Table 4-1. PY9 Energy Savings by Measure**

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
Refrigerators	Refrigerators	56,009,727	104%	58,357,108	0.51	29,762,125	NA	NA	8
Freezers	Freezers	7,075,392	103%	7,310,620	0.58	4,240,160	NA	NA	8
Room ACs	Room ACs	666,543	100%	666,566	0.50	333,283	NA	NA	4
Total	Total	63,751,662	104%	66,334,294	0.52	34,335,568	NA	NA	8

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendations\_2016-02-26\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† EUL is a combination of technical measure life and persistence. EUL information in this table is subject to change and is not final.

‡ Note that the numbers do not sum exactly due to rounding.

Source: ComEd tracking data and Navigant team analysis

**Table 4-2. PY9 Demand Savings by Measure**

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTGR*	Verified Net Demand Reduction (kW)
Refrigerators	Refrigerators	6,389	104%	6,657	0.51	3,395
Freezers	Freezers	807	103%	834	0.58	484
Room ACs	Room ACs	3,146	100%	3,146	0.50	1,573
Total †	Total †	10,343	103%	10,637	0.51	5,452

A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendations\_2016-02-26\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† Note that the numbers do not sum exactly due to rounding.

Source: ComEd tracking data and Navigant team analysis.

**Table 4-3. PY9 Peak Demand Savings by Measure**

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTGR*	Verified Net Peak Demand Reduction (kW)
Refrigerators	Refrigerators	6,907	104%	7,196	0.51	3,670
Freezers	Freezers	830	103%	857	0.58	497
Room ACs	Room ACs	944	100%	944	0.50	472
Total †	Total †	8,681	104%	8,998	0.52	4,639

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendations\_2016-02-26\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

† Note that numbers do not sum exactly due to rounding.

Source: ComEd tracking data and Navigant team analysis.

## 5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

### 5.1 Impact Parameter Estimates

The Navigant team used the procedures specified in the Illinois TRM version 5.0 to calculate the verified gross energy savings. These procedures use regression equations to calculate energy savings, which are shown in Section 6. (Appendix 1. Impact Analysis Methodology). Section 7 (Appendix 2. Impact Analysis Detail) shows the input parameters used by the Navigant team to calculate verified energy and peak demand savings. Note that all the factors in the regression equations below are derived from pooled data from metering studies conducted by several Midwestern utilities, including one done by ComEd in PY4.

The following table details all the custom and deemed inputs used for calculating the energy and demand savings for each measure as well as their source.

Table 5-1. Verified Gross Savings Parameters

Measure	Custom* Input Parameters	Deemed† Input Parameters	Deemed† Input Data Source
Refrigerators	Part-Use Factor	Regression coefficients and intercepts for Unit Energy Consumption calculations, CDD/HDD zonal values, Summer Peak Coincidence Factor	IL TRM v5.0 Section 5.1.8
Freezers	Part-Use Factor	Regression coefficients and intercepts for Unit Energy Consumption calculations, CDD/HDD zonal values, Summer Peak Coincidence Factor	IL TRM v5.0 Section 5.1.8
Room ACs	N/A	Full Load Hours (FLH), Btu/H, EERexist, Summer Peak Coincidence Factor	IL TRM v5.0 Section 5.1.9

\* Based on the PY7 participating customer survey data

†State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

Source: Evaluation team

### 5.2 Other Impact Findings and Recommendations

The impact evaluation research findings and recommendations for measures included in the FFR Program are listed below.

#### 5.2.1 Program Savings Target Attainment

**Finding 1.** The evaluation-verified gross energy savings is 66,334,294 kWh, while evaluation-verified net savings were 34,335,568 kWh.

**Finding 2.** Based on this, the program met its 19-month PY9 net energy savings target of 33,375,000 kWh.

**Finding 3.** The evaluation-verified gross peak demand savings was 8,998 kW and net savings was 4,639 kW. There was no associated ex ante demand savings goal for the program.

#### 5.2.2 Gross Realization Rates

**Finding 4.** Verified gross savings including the part-use factor, are approximately four percent higher than ex ante gross savings, which is the equivalent of a gross realization rate of 1.04. Gross realization rates (GRRs) by measure type showed a small amount of variation, with a refrigerator value of 1.04, a freezer value of 1.03 and a room air conditioner value of 1.00.

**Finding 5.** The Navigant team’s method to account for the proportion of appliances located in conditioned space uses responses to counterfactual questions of the decision maker. The implementation contractor’s method uses a response to a single question posed by the truck driver at the time of pickup. The Navigant team’s method using a “no program” unit location based on the survey’s counterfactual responses by the decision maker is the appropriate value for the gross savings calculation.

**Finding 6.** Two key factors caused the evaluation-verified gross realization rate to exceed 1.00: (1) differences in the percentages of refrigerators and freezer units in unconditioned spaces between the telephone survey and tracking data and (2) differences in the percentages of primary unit refrigerators between the telephone survey and tracking data. For the 225 telephone survey respondents with refrigerators, the percentage in unconditioned spaces was 61 percent, compared to 72 percent according to the corresponding tracking data. Similarly, for the 100 telephone survey respondents with freezers, the percentage in unconditioned spaces was 60 percent, compared to 69 percent according to the corresponding tracking data. A lower percentage of units in unconditioned spaces caused the estimated energy savings to increase. Additionally, respondents reported a higher percentage of refrigerators that were the primary unit in comparison to the corresponding tracking data (54 percent telephone survey and 48 percent tracking data), which caused an increase in estimated energy savings.

**Recommendation 1.** The Navigant team recommends that the implementer modify their question timing and wording so that the approaches used by the implementer and the evaluation team converge in the future. This convergence should help to close the gap further between the ex ante and verified savings values.

### 5.2.3 Program Participation

**Finding 7.** The PY9 FFR Program recycled a total of 81,644 units. Based on this, the program easily met its 19-month PY9 unit participation target of 71,500 units. Given this, program marketing and promotion efforts appear to be on track, and the \$50 incentive level is effective at achieving the desired level of participation.

**Recommendation 2.** With the program’s relatively flat targets in CY2018-CY2021, the program should retain its current marketing and incentive approaches.

## 6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

The Navigant team calculated verified gross and net savings using the following regression specifications as defined by the IL TRM v5.0 in PY9.

### 6.1 Refrigerators

$$\Delta kWh = [83.32 + (Age * 3.68) + (Pre-1990 * 485.04) + (Size * 27.15) + (Side-by-side * 406.78) + (Proportion of Primary Appliances * 161.86) + (CDD/365.25 * unconditioned * 15.37) + (HDD/365.25 * unconditioned * -11.07)] * Part Use Factor$$

Where:

- Age = Age of retired unit
- Pre-1990 = Pre-1990 dummy (=1 if manufactured pre-1990, else 0)
- Size = Capacity (cubic feet) of retired unit
- Side-by-side = Side-by-side dummy (= 1 if side-by-side, else 0)
- Single-Door = Single-Door dummy (= 1 if Single-Door, else 0)
- Primary Usage = Primary Usage Type (in absence of the program) dummy (= 1 if Primary, else 0)

Interaction: Located in Unconditioned Space x CDD/365.25  
 (=1 \* CDD/365.25 if in unconditioned space)

CDD = Cooling Degree Days<sup>1</sup>

Interaction: Located in Unconditioned Space x HDD/365.25  
 (=1 \* HDD/365.25 if in unconditioned space)

HDD = Heating Degree Days<sup>2</sup>

Part Use Factor = To account for those units that are not running throughout the entire year.

**Table 6-1. Energy Savings for Refrigerators**

Independent Variable	Coefficient	Source
Intercept	83.324	TRM v.5.0
Age (years)	3.678	TRM v.5.0
Pre-1990	485.037	TRM v.5.0
Size (Cubic Feet)	27.149	TRM v.5.0
Side-by-side	406.779	TRM v.5.0
Primary Unit	161.857	TRM v.5.0
Unconditioned Space X CDD	15.366	TRM v.5.0
Unconditioned Space X HDD	-11.067	TRM v.5.0
Part Use Factor	0.79	PY7 evaluation

Table 6-2 below reports the average PY9 values for each independent variable of the regression equation for Refrigerators.

**Table 6-2. PY9 Values for Independent Variables - Refrigerators**

Independent Variable	Average Value	Source
Age (years)	21.7	PY9 Tracking Data
Pre-1990	0.21	PY9 Tracking Data
Size (Cubic Feet)	18.8	PY9 Tracking Data
Side-by-side	0.28	PY9 Tracking Data
Primary Unit	0.56	PY9 Tracking Data
Unconditioned Space	0.66	PY9 Tracking Data
Primary Unit - Surveyed*	0.54	PY9 Participant Survey
Unconditioned Space - Surveyed*	0.61	PY9 Participant Survey
CDD	835.7	PY9 Tracking Data, TRM v. 5.0
HDD	6404.5	PY9 Tracking Data, TRM v. 5.0

\*Based on the 225 surveyed refrigerator respondents

<sup>1</sup> Dependent on geographic location.

<sup>2</sup> Dependent on geographic location.

## 6.2 Freezers

$$\Delta kWh = [132.12 + (Age * 12.13) + (Pre-1990 * 156.18) + (Size * 31.84) + (Chest * -19.71) + (CDDs* unconditioned * -12.76) + (HDDs*unconditioned *9.78)] * Part Use Factor$$

Total kWh saved =  $\Delta kWh * \text{Number of Units} * \text{Installation Rate}$

Where:

- Age = Age of retired unit
- Pre-1990 = Pre-1990 dummy (=1 if manufactured pre-1990, else 0)
- Size = Capacity (cubic feet) of retired unit
- Side-by-side = Side-by-side dummy (= 1 if side-by-side, else 0)
- Single-Door = Single-Door dummy (= 1 if Single-Door, else 0)
- Chest = Chest freezer dummy (=1 if chest freezer, else 0)
- Primary Usage = Primary Usage Type (in absence of the program) dummy (= 1 if Primary, else 0)
- Interaction: Located in Unconditioned Space x CDDs = Proportion of units in unconditioned spaces interacted with CDDs
- Interaction: Located in Unconditioned Space x HDDs = Proportion of units in unconditioned spaces interacted with HDDs
- Part Use Factor = To account for those units that are not running throughout the entire year.

After energy savings based on full load hours have been computed, a part-use factor is then applied. This factor is based on the value from the most recent part-use factor participant survey results available at the start of the PY9 program year, in this case, the PY7 evaluation.

**Table 6-3. Energy Savings for Freezers**

Independent Variable	Coefficient	Source
Intercept	132.12	TRM v. 5.0
Age (years)	12.13	TRM v. 5.0
Pre-1990	156.18	TRM v. 5.0
Size (cubic feet)	31.84	TRM v. 5.0
Chest	-19.71	TRM v. 5.0
Unconditioned Space X CDD	-12.76	TRM v. 5.0
Unconditioned Space X HDD	9.78	TRM v. 5.0
Part-use factor	0.79	PY7 evaluation

Table 6-4 below reports the average PY9 values for each independent variable of the regression equation for Freezers.

**Table 6-4. PY9 Values for Independent Variables - Freezers**

Independent Variable	Average Value	Source
Age (years)	26.0	PY9 Tracking Data
Pre-1990	0.40	PY9 Tracking Data
Size (Cubic Feet)	15.4	PY9 Tracking Data
Chest	0.29	PY9 Tracking Data
Unconditioned Space	0.64	PY9 Participant Survey
Unconditioned Space - Surveyed*	0.60	PY9 Participant Survey
CDD	834.0	PY9 Tracking Data, TRM v. 5.0
HDD	6,423.1	PY9 Tracking Data, TRM v. 5.0

\* Based on the 100 surveyed freezer respondents

### 6.3 Refrigerator and Freezer Summer Coincident Peak Demand Savings

$$\Delta kW = kWh / 8760 * CF$$
 Where:
 

- kWh = Savings provided in algorithm above
- CF = Coincident factor defined as summer kW/average kW
  - = 1.081 for Refrigerators
  - = 1.028 for Freezers

### 6.4 Room Air Conditioner Energy Savings

Room AC gross energy savings are estimated using the algorithm specified in IL TRM version 5.0 and shown below.

$$\Delta kWh = ((FLH_{RoomAC} * BtuH * (1/EER_{exist})) / 1000)$$
 Where:
 

- FLH<sub>RoomAC</sub> = Full Load Hours of room air conditioning unit
- = dependent on location, see below

Climate Zone (City based upon)	FLH <sub>RoomAC</sub>
1 (Rockford)	220
2 (Chicago)	210
3 (Springfield)	319
4 (Belleville)	428
5 (Marion)	374
Weighted Average	248

BtuH = unit capacity [BTU/h] is a nameplate value  
 = Size of retired unit  
 = Actual. If unknown assume 8500 Btu/hr

EER<sub>exist</sub> = unit efficiency [EER] of the recycled unit  
 = Efficiency of existing unit  
 = 7.7

## 6.5 Room Air Conditioner Summer Coincident Peak Demand Savings

Room AC gross summer coincident peak demand (kW) savings is estimated using the algorithm specified in TRM version 5.0 and shown below.

$$\Delta kW = (\text{BtuH} * 1/\text{EER}_{\text{exist}})/1000 * \text{CF}$$

Where:

$$\text{CF} = \text{Summer Peak Coincidence Factor for measure} = 0.3$$

The lifetime energy and demand savings are estimating by multiplying the verified savings by the effective useful life for each measure.

The EM&V team conducted research in previous evaluations to validate the parameters that were not specified in the TRM (such as the Net-to-Gross ratio). The results are shown in the following table.

For the PY9 evaluation, the program tracking database and the TRM version 5.0 provide all the inputs needed to calculate verified gross savings. The source of the part-use factor is the PY7 evaluation.

## 6.6 Verified Gross Program Savings Analysis Approach

Savings estimates were developed for the full population of units collected in PY9 to estimate PY9 Unit Energy Consumption (UECs). The ex post savings estimates of energy (kWh) savings rely on regression equations as specified in the TRM version 5.0. Gross energy savings are expressed in terms of full-year UECs. UEC estimates were made using a regression-based approach that models full-year energy savings as a function of unit characteristics (i.e., age, size, configuration, defrost mode, and unit location prior to being recycled).

Gross peak demand (kW) savings were also calculated according to the algorithm specified in the TRM version 5.0. The coincidence factors in the TRM version 5.0 were calculated using the regression equations to predict consumption on summer peak days.

Both energy (kWh) and peak demand (kW) savings estimates were made based on the characteristics of the population of units collected by the program during PY9. In addition, gross energy savings estimates were adjusted for part-use, by applying part-use factors from the PY7 evaluation.

## 6.7 Verified Net Program Savings Analysis Approach

Verified net energy and demand (coincident peak and overall) savings were calculated by multiplying the verified gross savings estimates by a net-to-gross ratio (NTGR). In PY9, the NTGR estimates used to calculate the net verified savings were based on past evaluation research and approved through the Illinois Stakeholder Advisory Group consensus process.<sup>3</sup>

<sup>3</sup> A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendation\_2016-02-26\_Final\_EMV\_Recommendations.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

## 6.8 Survey Questions Used to Determine Part-Use Factor

The survey question structure used by the evaluation team to determine the part-use factor for a refrigerator or a freezer is designed to determine what the participant would have done with the unit if the program hadn't picked it up. The structure of the questions asked is as follows:

- At the time this MEASURE was picked up, were you using it as your main MEASURE, or had it been a secondary or spare?
- How long had you been using this MEASURE as a secondary or spare?
- Thinking just about the past year, was the spare MEASURE plugged in and running all the time, for special occasions only, during certain months of the year only, or was it never plugged in and running?
- If you add up the total time your spare MEASURE was plugged in and running during the last 12 months that you had it, about how many total months would that be?
- Was the MEASURE running during the summer or was it mainly running during other times of the year?
- Where would the MEASURE have been located if it had not been removed by ComEd? If the MEASURE was your primary unit, we're interested in whether you would have left it in the kitchen or moved it to another room.

In contrast, the program implementer relies on a single question, which is presented by the truck driver at the time the unit is picked up:

- "How was this unit used during most of the past 12 months?"

## 7. APPENDIX 2. IMPACT ANALYSIS DETAIL

Table 7-1 summarizes the program savings by measure. The verified net-to-gross ratio (NTGR) is based on deemed values including the Program Induced Replacement (PIR) component. The deemed values for PIR, which are pertinent to refrigerators and freezers only, are based on research conducted in the PY7 evaluation and were calculated using a procedure that is consistent with that specified in the Illinois Technical Reference Manual (TRM), version 5.0. Note that there are separate SAG-approved NTG values for refrigerators and freezers, delineated by whether the unit is assigned a Retailer NTGR or a Non-Retailer NTGR. The NTG ratios in the table below, which have been used to determine Verified Net savings, are a weighted average of the Retailer and Non-Retailer NTG ratio values for each appliance type. These NTG ratios, before the PIR is applied, are 0.54 for refrigerators (based on a weighted average of Retailer NTGR of 0.22 and Non-Retailer NTGR of 0.62), 0.60 for freezers (based on a weighted average of Retailer NTGR of 0.25 and Non-Retailer NTGR of 0.63) and 0.50 for room ACs. After adjusting for the PIR values, the weighted average program NTG ratio, based on deemed values, is 0.52.

**Table 7-1: PY9 Total Annual Incremental Savings, Detailed Calculation**

Savings Category	Refrigerators	Freezers	Room ACs
Ex-Ante Gross Savings (kWh)	56,009,727	7,075,392	666,543
Ex-Ante Gross Peak Demand Reduction (kW)	6,389	807	3,146
Deemed Part-Use Factor	0.95	0.74	1.00
Verified Gross Savings (kWh)	58,357,108	7,310,620	666,566
Verified Gross Peak Demand Reduction (kW)	7,196	857	944
Verified Gross Realization Rate	104%	103%	100%
Deemed Net to Gross Ratio (NTGR) *	0.54	0.60	0.50
Program Induced Replacement (PIR) *	-0.029	-0.013	N/A
Final Net to Gross Ratio (NTGR and PIR) *	0.51	0.58	0.50
Verified Net Savings (kWh)	29,762,125	4,240,160	333,283
Verified Net Demand Reduction (kW)	3,395	484	1,573

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendation\_2016-02-26\_Final\_EMV\_Recommendations.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>

Source: ComEd tracking data and Navigant team analysis.

## 8. APPENDIX 3. TOTAL RESOURCE COST DETAIL

Table 8-1 the Total Resource Cost (TRC) variable table, only includes cost-effectiveness analysis inputs available at the time of finalizing the PY9 FFR program impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation later. EUL information in this table is subject to change and is not final.

**Table 8-1: PY9 Total Resource Cost Savings Summary**

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Ex-Ante Gross Savings (kWh)	Ex-Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
Refrigerators	Refrigerators	Each	67,767	8	56,009,727	6,389	58,357,108	7,196
Freezers	Freezers	Each	11,016	8	7,075,392	807	7,310,620	857
Room ACs	Room ACs	Each	2,850	4	666,543	3,146	666,566	944

Source: ComEd tracking data and Navigant team analysis.

**APPENDIX B. COMED FRIDGE FREEZER RECYCLING PY9 PART USE FACTOR  
MEMO 2018-09-06**

*Memorandum*

**To:** Vince Gutierrez, ComEd

**CC:** Violeta Barrueta Gonzalez, ComEd  
Jennifer Morris, ICC Staff  
Jeff Erickson, Randy Gunn, and Nishant Mehta, Navigant

**Date:** September 06, 2018

**Re:** ComEd Fridge & Freezer Recycling Program PY9 Recommended Part-Use Factor Updates

## 1. INTRODUCTION

This memorandum presents the evaluation research<sup>1</sup> PY9 Part-Use Factor estimates for Refrigerators and Freezers units recycled through ComEd's Fridge & Freezer Recycling Program.

## 2. EVALUATION RESEARCH PART-USE FACTOR FINDINGS

The research findings part-use factors are based on the PY9 participant survey findings. These account for the fact that a unit that would have stayed in use would have been in use only part of the time. For example, the savings due to removal of a unit that would have been used only three months of the year is only one-quarter (3/12) the savings associated with full-year use (assuming essentially constant use over the year for a full-use unit). The part-use factor is used to adjust gross savings UECs to yield estimates of annualized gross savings that can be attributed to the program.

### 2.1 Refrigerators

The assumption is that any refrigerator that would otherwise have been kept in use would have been used as a secondary, not as a primary refrigerator. Therefore, the part-use factor for all primary refrigerators that would otherwise have been kept is set at the average part-use reported by participants who disposed of a secondary refrigerator. This part-use was the number of months, divided by 12, the participant reported the unit would have been plugged in and running had the program not picked it up. For PY9, this average was determined to be 91 percent or 0.91. As Table 1 below indicates, the UEC adjusted for the part-use factor yields an average refrigerator consumption of 835 kWh per year.

### 2.2 Freezers

For freezers, the average part-use factor is based on a similar question for all participants who disposed of a freezer. For PY9, this average was determined to be 86 percent or 0.86. The supplemental data collected in the survey provide no further insight into the

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<sup>1</sup> It should be noted that the NTGR estimates presented here are the evaluation verified estimates (based on the PY9 participating customer and non-participating retailer surveys).

part-year usage, nor do the tracking data. Adjusted for part-use, the average freezer consumes 774 kWh per year.

### 2.3 PY9 versus PY7 Part-Use Factors<sup>2</sup>

The PY9 part-use factor of 0.91 for refrigerators is down slightly from the PY7 level which was 0.95 for refrigerators. Conversely, the PY9 part-use factor for freezers is 0.86, which is up substantially from the PY7 level of 0.74. The net effect of these changes is an increase in overall savings per unit driven by refrigerators compared to PY7 values.

**Table 1. Research Findings Gross Savings (UECs) Adjusted for Part-Use**

Appliance Type	Gross Savings (UECs)	Part-Use Factor	UEC Adjusted for Part-Use
Refrigerators	914	91%	835
Freezers	897	86%	774

Source: Evaluation analysis

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<sup>2</sup> The PY8 evaluation was abbreviated, and therefore, the Part-Use factor was not calculated.

**APPENDIX C. COMED FRIDGE FREEZER RECYCLING PY9 PROCESS  
EVALUATION MEMO 2018-09-17**

**APPENDIX A.** *Memorandum*

**To:** Vince Gutierrez, ComEd

**CC:** Violeta Barrueta Gonzalez, ComEd  
Jennifer Morris, ICC Staff  
Jeff Erickson, Randy Gunn, Nicole DelSasso, Patricia Plympton and Nishant Mehta, Navigant

**Date:** September 17, 2018

**Re:** PY9 ComEd Fridge & Freezer Recycling Program Process Evaluation Findings and Recommendations

**PROCESS EVALUATION APPROACH AND FINDINGS**

This memorandum presents the results of the PY9 Process Evaluation of ComEd's Fridge & Freezer Recycling Program.

**Evaluation Objectives**

The process evaluation of the PY9 Residential Fridge & Freezer Recycling (FFR) Program studied participant program awareness, drivers of participation, motivations for appliance disposal, program processes, and participant satisfaction with all aspects of the program process. The key researchable questions for PY9, included:

1. Has the program, as implemented, changed from PY8? If so, how, why, and was this an advantageous change?
2. What are the strengths and weaknesses of the program? How can the program be improved?
3. How do customers become aware of the program? What marketing strategies could be used to boost program awareness?
4. How do participating customers rate their satisfaction of the program?
5. Is the program outreach to customers effective at increasing awareness of program opportunities?
6. Are program incentive levels appropriate to encourage participation?
7. How should the budget allocation between incentive spending and marketing spending be adjusted to maximize participation?

**Data Collection Activities**

The evaluation team reviewed ComEd tracking data, conducted in-depth interviews with the ComEd and Reclaim program managers, and fielded a telephone and on-line survey to program participants.

- **Tracking Data Review.** This review centered on tracking data completeness, accuracy and quality.
- **Program Manager In-Depth Interviews.** The interview with the FFR Program Manager focused on program marketing and processes to better understand the goals of the program, how the program was implemented, and the perceived effectiveness of it. The interview with the Reclaim manager focused on the

recycling process and the details of the appliance pickup and incentive distribution.

- **Telephone and On-line Participant Surveys.** The telephone and on-line surveys included questions to support the Process evaluation. These were related to sources of program awareness, program satisfaction, rebate satisfaction, and awareness of program features (e.g., rebates, technical assistance, marketing materials). In addition, the survey incorporated questions concerning Impact-related areas such as the part-use factor, free ridership and spillover questions.

The data collection activities are detailed in Table 1.

**Table 1. Primary Data Collection Activities**

What	Who	Target Completes	Completes Achieved	When
Tracking Data Analysis	All Program Participants	All	All	August 2017
In-Depth Interviews	ComEd and Reclim Program Managers	2	2	February 2018
Telephone/ On-line Participant Surveys	Sample of Program Participants	325	325	September / October 2018

## Participant Surveys

The evaluation team conducted surveys with participants both on-line and via telephone. By interviewing participants through multiple modes, we were able to improve the data collection coverage as well as quality. This study included participants who recycled either a refrigerator or stand-alone freezer through the program.

### Approach

The evaluation team compiled a random sample of FFR participants from the FFR Program tracking database provided by ComEd. The sample included program activity during the first 12 months of the 19-month program year (June 1, 2016 through May 31, 2017). The evaluation team performed basic data cleaning before pulling the sample from the database to remove records with missing or invalid contact information. From the 12-month program population of 35,873 participants, a total of 2,180 participants who recycled more than one appliance were dropped from the survey effort to minimize their confusion about which unit was the subject of the interview, and to keep the survey to a reasonable length<sup>1</sup>. In addition, 2,583 participants were dropped because of duplicate or missing phone numbers or because the tracking database indicated they were a business customer. The evaluation team removed an additional 111 participants because they had recently participated in a process-related survey administered by Reclim. Finally, 125 participants were excluded because they represented dorm-sized refrigerators that were too small for program eligibility. The final participant population, from which the survey sample was drawn, was 30,874 participants.

<sup>1</sup> Records with multiple appliances are included in the final impact results.

The sample was then stratified by appliance type and the evaluation team set quotas based on the proportion of each appliance in the general population. The evaluation team oversampled the freezer stratum (relative to the share of freezer measures recycled through the program) to ensure the sample quota could be met. No separate quota was set for room AC recyclers, since those units account for a very small percentage of the total population. Survey staff were instructed to randomly contact participants until they had reached the designated quotas. A 90% confidence interval was used in the analysis. The final sample design is in Table 2.

**Table 2. PY9 Participant Survey Population and Sample Sizes by Appliance Type**

Appliance Recycled	Population Size (N)	Sample Frame	Sample Quotas	Completed Surveys (n)	Sampling Error (90% confidence level)
Refrigerator	31,275	26,934	225	225	5.5%
Freezer	4,598	3,940	100	100	8.1%
<b>Total</b>	<b>35,873</b>	<b>30,874</b>	<b>325</b>	<b>325</b>	<b>4.5%</b>

### **Data Collection Methods**

The evaluation team used a multi-modal approach to conduct the participant survey, relying on both telephone and on-line survey approaches. This approach reflects the new utility industry survey research environment and improves survey data quality and coverage. Response rates in the industry continue to decline each year and with changing smartphone behavior, it is increasingly difficult to reach respondents on their land lines and cell phones. Many participants do not answer their telephone if the call is from an unknown number. These same participants may respond to an email request to take a survey on-line, particularly when they recognize the program in the subject line of the email. In addition to increasing response rates, using both telephone and on-line modes leads to results that more accurately reflect the demographic characteristics of program participants. Research in PY7 confirmed that demographic and household characteristics differ between telephone and on-line respondents.

The evaluation team minimized potential negative mode effects by carefully examining and in some cases, refining the question text and format. In addition, the evaluation team established quotas for each survey mode to get an equal proportion of interviews for the telephone and on-line components.

*Telephone surveys* were conducted between September 22, 2017 and October 23, 2017. The initial telephone sample frame consisted of 1,500 participants. Each sample point was called a minimum of 5 times at different times of the day and on different days of the week.

*On-line surveys* were fielded between September 22, 2017 and October 6, 2017. Participants who received the on-line survey received one invitation and two reminder emails. As this was the first year using this mode of data collection for the FFR Program, the initial on-line sample frame also was comprised of 1,500 participants. The initial response rate was high, so subsequent reminder emails were not needed. Based on this, a smaller starting sample size can be used in the future, leading to a higher response rate.

### Survey Sample Dispositions

Table 3 shows the final dispositions for the 2,829 program participants contacted via telephone and on-line survey modes. There were 171 participants that were not contacted because quotas were reached, and sample was closed. In total, 325 participants completed online and telephone surveys, or 11.5% of the sample frame. After considering ineligible sample<sup>2</sup>, the survey response rate was 15.6%. The survey response rate is the number of completed interviews divided by the total number of potentially eligible respondents in the sample and was computed using the standards and formulas set forth by the American Association for Public Opinion Research (AAPOR).<sup>3</sup>

**Table 3. Participant Survey Sample Disposition**

Sample Disposition	Customers	%
<b>Total Participants contacted via telephone and on-line</b>	<b>2,829</b>	<b>100.0%</b>
Completes	325	11.5%
Appliance not picked up	28	1.0%
Appliance removed, unsure of make of appliance	65	2.3%
Appliance removed, unsure of removal company	5	0.2%
Electric company not ComEd	3	0.1%
Incomplete	98	3.5%
Incomplete - undetermined survey eligibility	58	2.1%
Refusal	150	5.3%
Unable to reach	660	23.3%
Language barrier	45	1.6%
Phone number issue	183	6.5%
Non-specific callback/Appointment scheduled	75	2.7%
No response	1,068	37.8%
Invalid email	66	2.3%

## FINDINGS AND RECOMMENDATIONS

The FFR Program is very popular with participating customers and plays an important role in ComEd's residential program portfolio. Process evaluation for the FFR Program was last performed in PY6. Therefore, the evaluation team framed PY9 findings relative to PY6 findings.

### Summary Findings and Recommendations

A summary of key process findings and recommendations are as follows:

<sup>2</sup> Ineligible sample includes: Invalid email, Phone number issues, and Appliance not picked up.

<sup>1</sup> [https://www.aapor.org/AAPOR\\_Main/media/publications/Standard-Definitions20169theditionfinal.pdf](https://www.aapor.org/AAPOR_Main/media/publications/Standard-Definitions20169theditionfinal.pdf)

**Finding.** Given the 19-month duration of PY9, the PY9 program easily exceeded its goal (81,633 recycled units compared to a goal of 71,500 units). Program goals for CY2018 and the coming years (45,000 units) are ambitious but realistic.

**Recommendation.** Program staff should continue aggressive marketing and customer outreach as planned, while also considering new strategies. FFR Program staff should consider including an email marketing campaign to advertise the program to new participants. For example, on-line sign-ups could be increased by sending an email to customers about the program with a link for signing up embedded in the email message. This email campaign would be a cost-effective way to provide significant outreach, potentially leading to an additional ramp-up in participation.

**Finding.** Customers have an increased interest in the recycling process and its impact on the environment.

**Recommendation.** While ComEd has an informative handout detailing the advantages of recycling and the recycling process, this handout is provided at the time of pick-up and via an interactive description on the program website. The interactive description on the website is at the bottom of the page. The visibility of this feature can be increased on the website simply by moving it higher up on the webpage. A link to this interactive handout should also be included with any email communications.

**Finding.** Participants are satisfied with all aspects of the program, especially the sign-up process, the collection team, and the incentive. Satisfaction with the sign-up process, collection team, and overall satisfaction are all above 95%. One area that merits improvement is with respect to the time between scheduling and pick-ups (89% satisfied, based on ratings of 7 or greater on a 10-point satisfaction scale).

**Recommendation.** ComEd should continue to work to improve the time between sign-up and the collection of the appliance. Notably, ComEd is already looking to add features to the scheduling process to improve the customer experience, such as text messaging and calendar invites.

## Detailed Findings and Recommendations

Findings related to five key areas are described in detail in this section. These areas include, awareness & marketing, drivers of participation, reasons for appliance disposal, program processes & implementation, impact of participation on perceptions of ComEd. These areas cover the objectives of the process evaluation research.

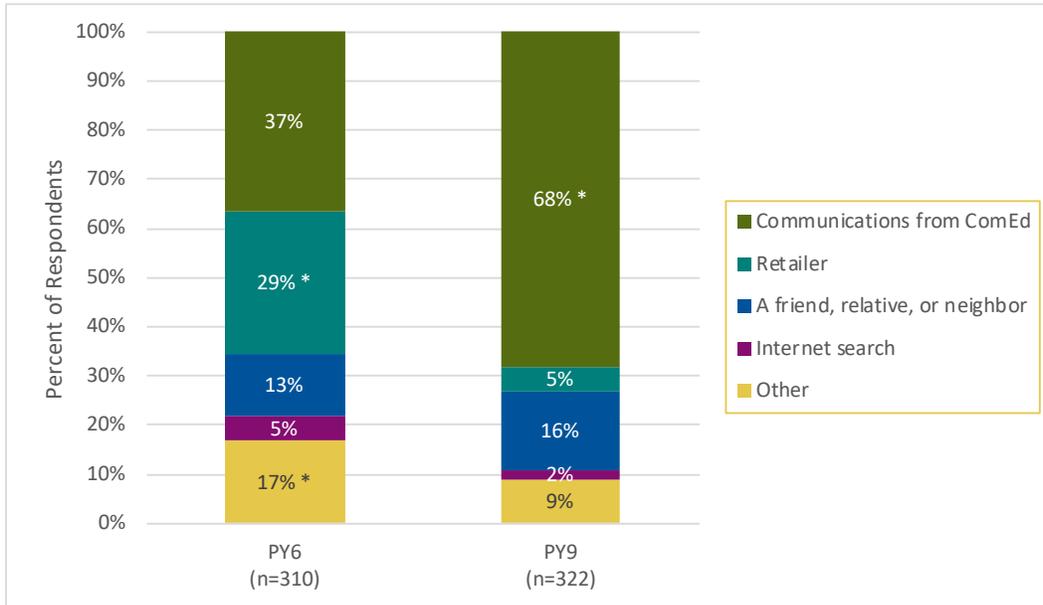
### *Awareness & Marketing*

In PY9, ComEd decided to end the retailer marketing channel. With this change to the program marketing and implementation, most customers are hearing about the program from ComEd communications, specifically bill inserts (85%) and ComEd's website (10%). A very small number of customers are still learning about the program through their retailer (5%). According to interviews, ComEd plans to increase marketing in CY2018 to reach program goals, using a mix of radio advertisements, social media campaigns, and digital ads at Chicago Cubs games.

### Awareness

With retailers no longer directly involved in the program, participants are first hearing about the program principally from ComEd sources. Nearly two-thirds (68%) of participants heard about the program through communications from ComEd, compared to 37% in PY6. (Figure 1).

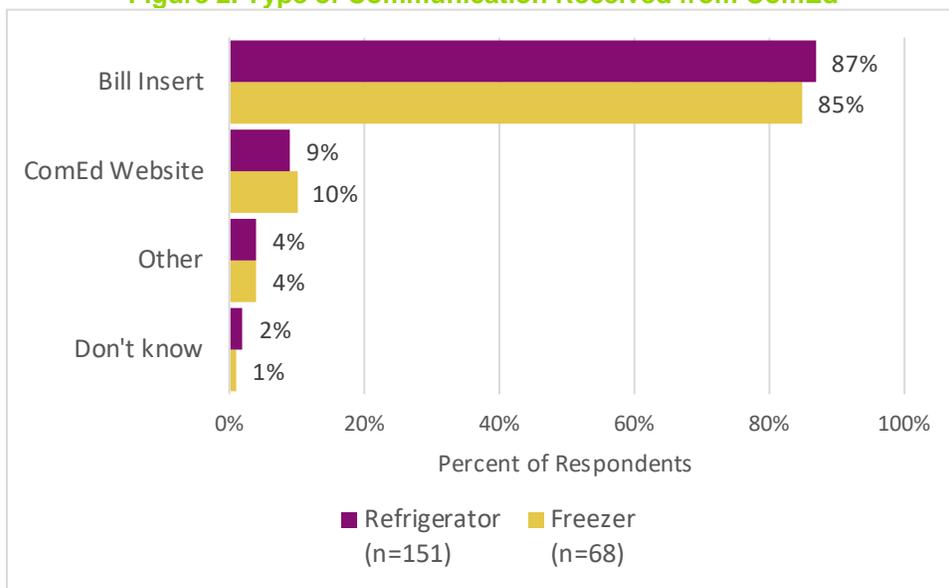
**Figure 1. Source of Information About the FFR Program**



\*Asterisk indicates significance at the 90% level.

Bill inserts are by far the most common ComEd information source. Of those who heard about the program from ComEd, 86% of total customers learned about the program from a bill insert, while 10% found out about the program from ComEd's website. Figure 2 shows the communications received from ComEd by participants who recycled a refrigerator and those who recycled a freezer.

**Figure 2. Type of Communication Received from ComEd**



\*Asterisk indicates significance at the 90% level.

## Marketing

For CY2018, ComEd's program manager indicated that they are increasing their marketing efforts to include a broad mix of sources: bill inserts, newspaper inserts, digital ads in home improvement and real estate markets, radio ads, billboards, Google ads, social media and Facebook mentions. During the summer of 2018, ComEd will sponsor digital ads at Chicago Cubs games. Importantly, ComEd also plans to track the effectiveness of marketing communications going forward. Understanding customer sources of information (the drivers of actual sign-ups) will help ComEd understand how effective its current marketing strategies are and identify steps to increase its marketing effectiveness.

During PY9, most participants enrolled in the program through the Call Center. Sixty-four percent of customers enrolled through the call center while 36% enrolled on-line<sup>4</sup>. ComEd could potentially increase the share of on-line signups through an email strategy where ComEd emails residential customers who did not participate recently in the program. ComEd could share marketing information that includes a direct link to the program website.

<sup>4</sup> Proportion of call center and on-line enrollment provided by ComEd's Program Manager.

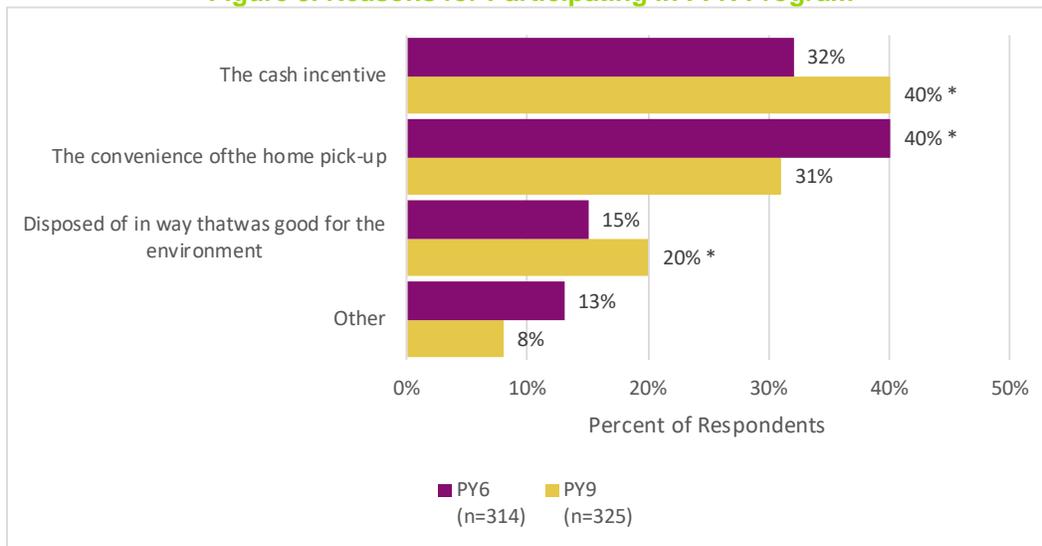
### Awareness & Marketing Recommendations

In CY2018, ComEd has several new marketing activities and social media campaigns. Program staff should consider including an email marketing campaign to advertise the program to new customers. An email campaign could be a cost-effective way to inform customers and drive new participation.

### Drivers of Participation

In PY9, ComEd’s cash incentive was the leading reason for participation (40%), with the convenience of the service as the next most common reason (31%). Compared to PY6, disposing of the appliance in an environmentally-friendly manner has increased in importance in PY9 (20% in PY9 compared to 15% in PY6).<sup>5</sup>

**Figure 3. Reasons for Participating in FFR Program**

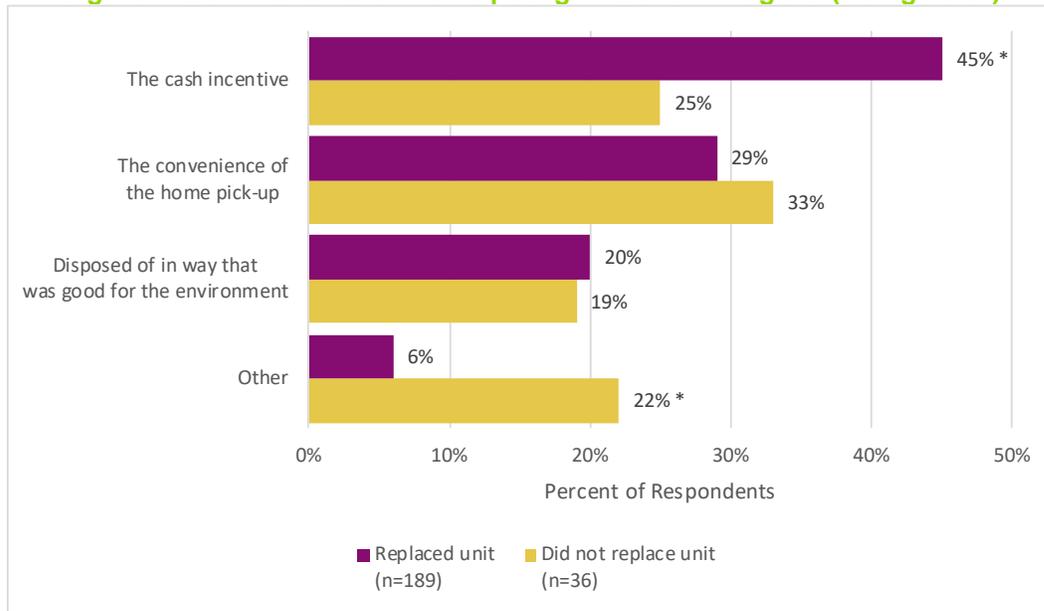


\*Asterisk indicates significance at the 90% level.

By measure type, the cash incentive was the most important participation driver for refrigerator replacers (45% replacers, versus 25% for non-replacers). In contrast, non-replacers cited the convenience of the home pick-up as the primary reason for participation (34%). These differences are more pronounced among refrigerator replacers and non-replacers than freezer replacers and non-replacers, as shown in Figure 4 and Figure 5.

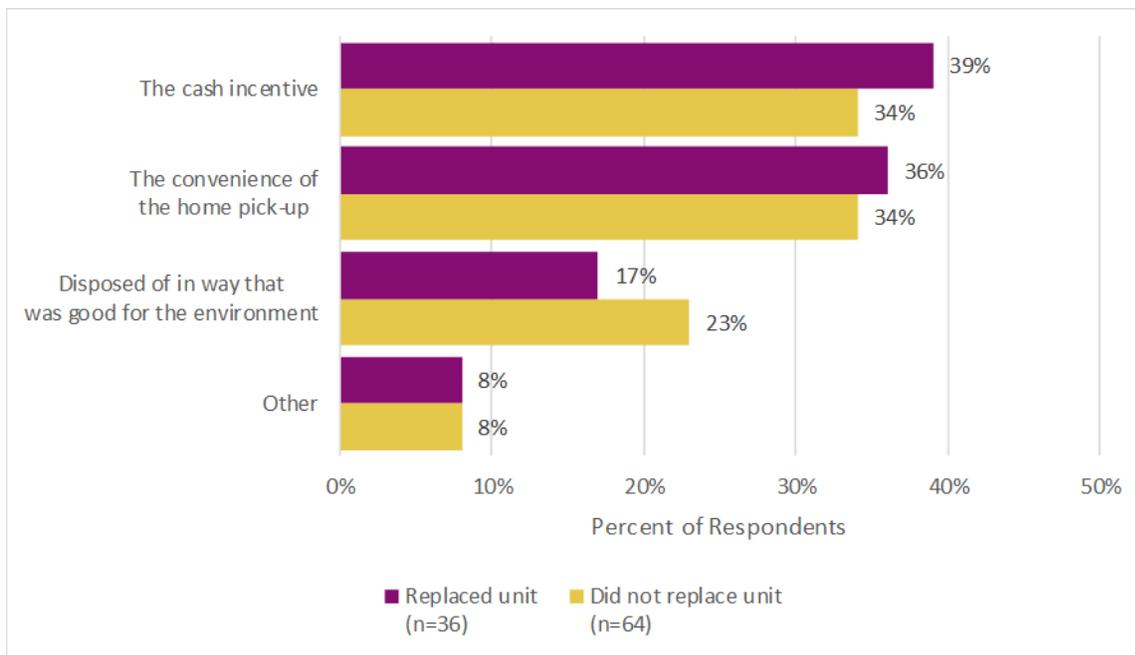
<sup>5</sup> As a part of the program, ComEd provides leave-behind materials for participants which explain the recycling process and its impact on the environment.

**Figure 4. Main Reasons for Participating in the FFR Program (Refrigerator)**



\*Asterisk indicate significance at the 90% level or above

**Figure 5. Main Reasons for Participating in the FFR Program (Freezer)**



\*Asterisk indicate significance at the 90% level

### Drivers of Participation Recommendations

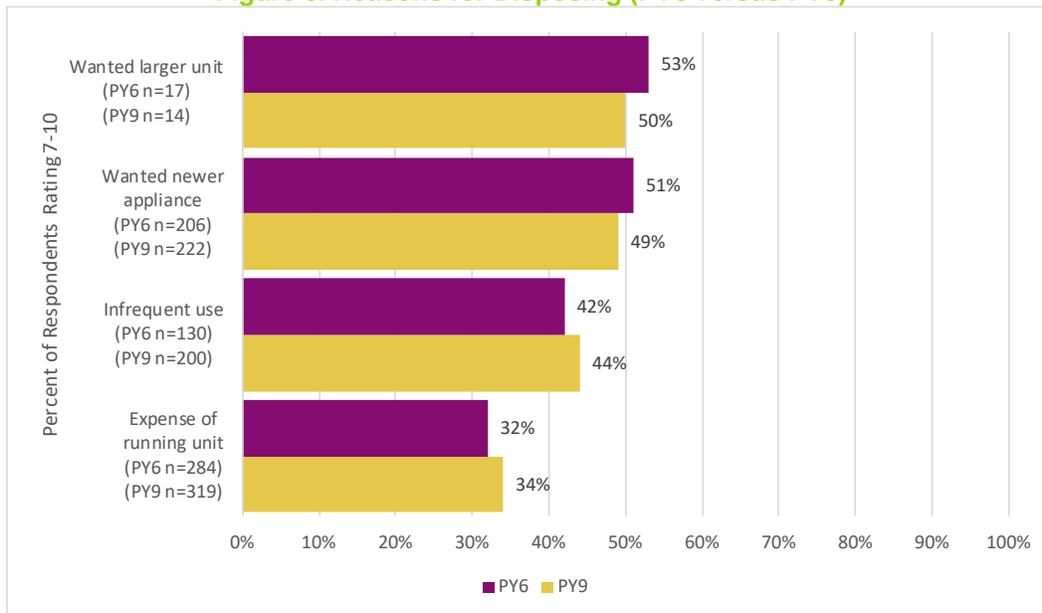
Participants are more interested in the recycling process and its impact on the environment than in PY6. Twenty percent of respondents in PY9 listed the recycling process being good for the environment as a reason for participation which is significantly

more than the 15% in PY6. Although ComEd has an informative handout explaining the benefits of recycling and the recycling process, this handout is provided at the time of pick-up and as an interactive description on the program website. The description on the website is at the bottom of the page. It is recommended that the visibility of this feature on the website be increased by moving the link up to a more visible location, and including a link to this interactive handout with any email communications.

**Reasons for Appliance Disposal**

Of those participants that replaced their refrigerator or freezer, about half wanted a newer appliance with more modern features, and this became highly important motivation in their decision to recycle their existing appliance. Another factor mentioned by one-third of respondents was the unit’s operating expense. Findings in are shown below in Figure 6 based on the percentage of participants who rated each factor as highly important (i.e., based on a score of 7 and higher on a 0-10 importance scale). Note that the PY9 and PY6 results are very similar.

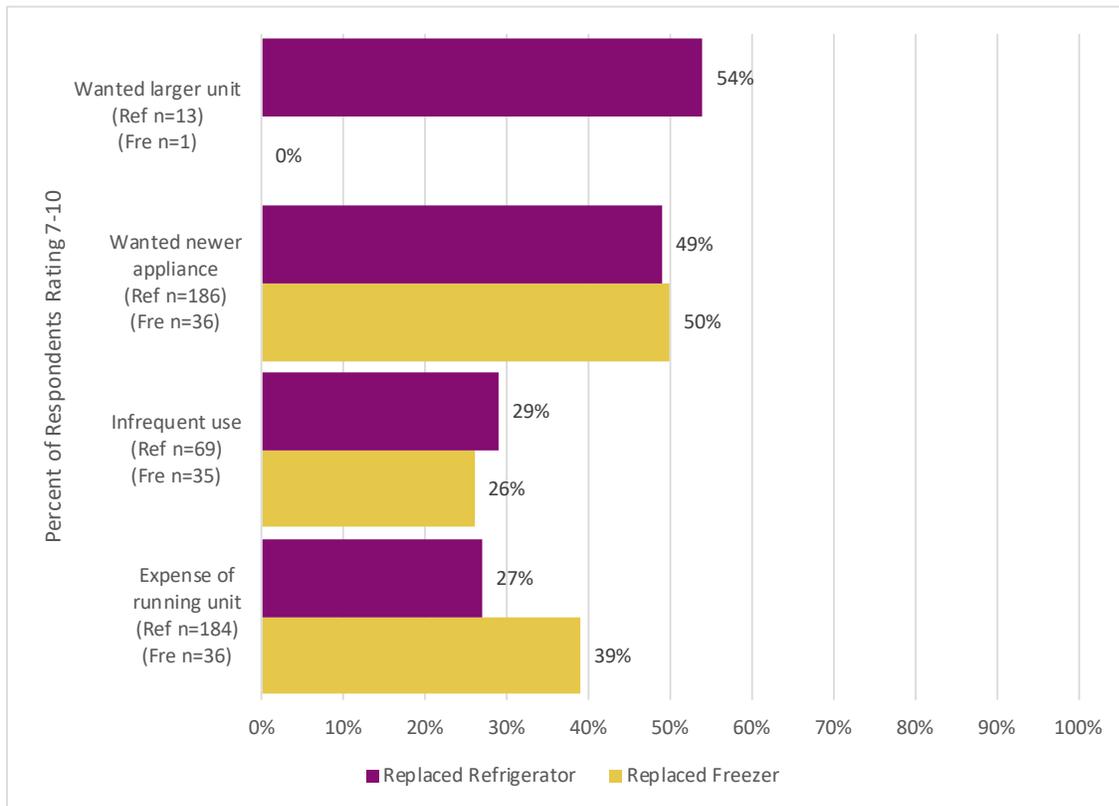
**Figure 6. Reasons for Disposing (PY6 versus PY9)**



\*Asterisk indicates significance at the 90% level.

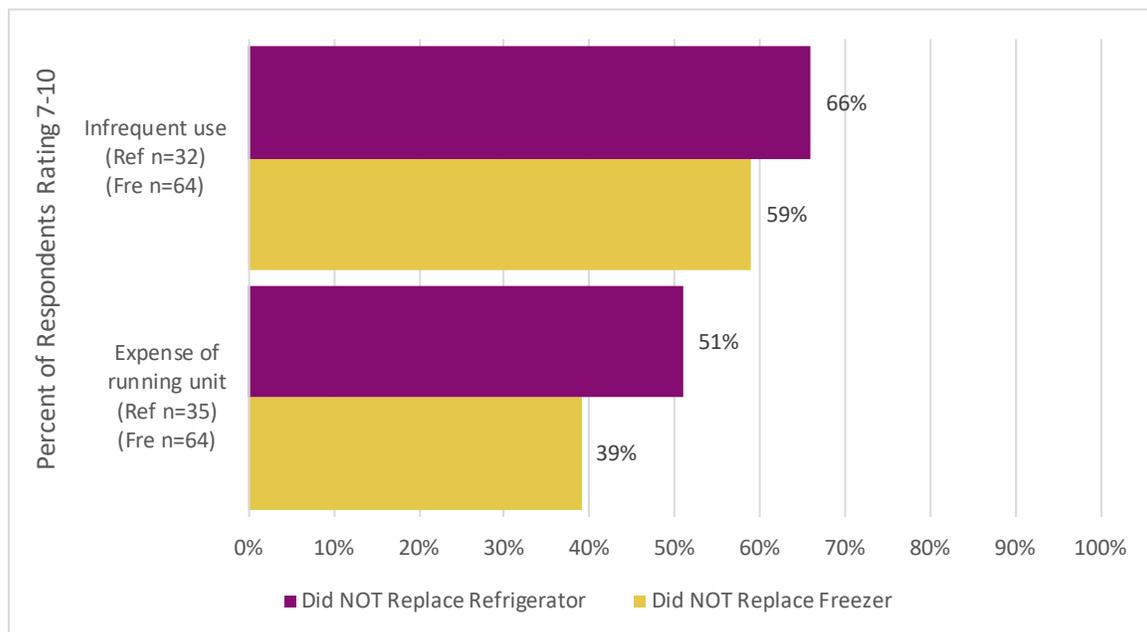
Replacers’ and non-replacers’ reasons to dispose of their old appliance differ significantly. For replacers, the rationale for disposal is to upgrade their unit or get a larger unit (Figure 7). Non-replacers were more likely to indicate the infrequent use of the appliance as highly important in their decision to recycle (Figure 8).

**Figure 7. Reasons for Disposing (Replacers)**



\*Asterisk indicates significance at the 90% level.

**Figure 8. Reasons for Disposing (Non-Replacers)**



\*Asterisk indicates significance at the 90% level.

## Reasons for Disposal Recommendations

No recommendations.

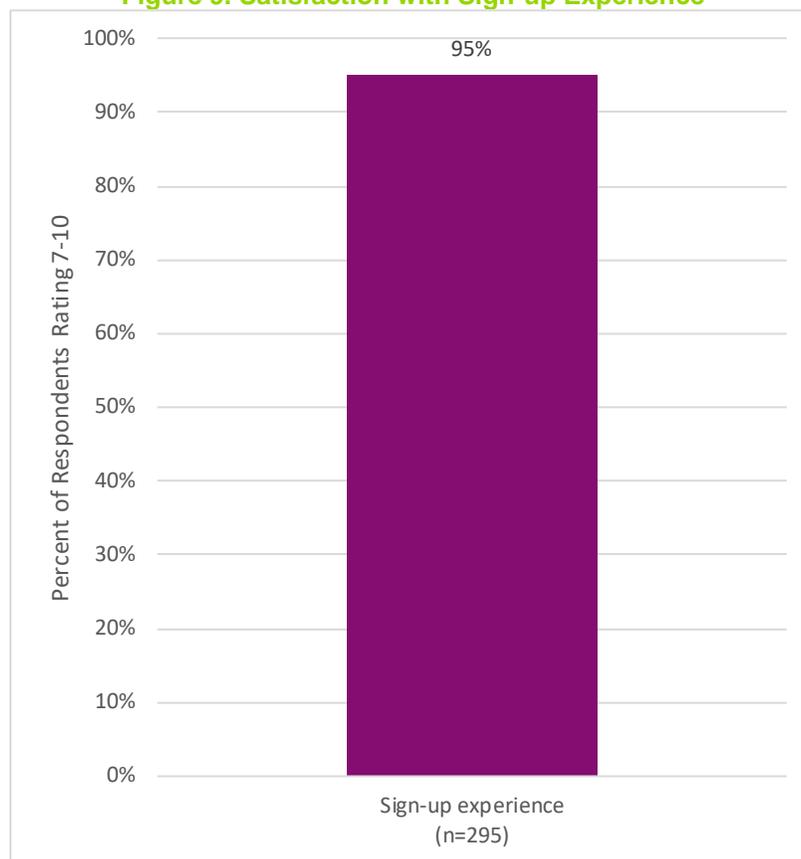
### *Program Processes & Implementation*

Program participants continue to be highly satisfied with all aspects of the participation process, including the sign-up process, their experiences with the Reclaim collection team, the time it takes to receive their incentive, and the size of the incentive.

### **Sign-up Process**

Ninety-five percent of participants were satisfied with the sign-up experience, rating it a 7 or above on a 0-10 satisfaction scale (Figure 9). Participants reported that signing up for the program via the website was easy and that the website and/or representative answered all their questions about the program. Note that satisfaction with the sign-up experience was not asked in PY6.

**Figure 9. Satisfaction with Sign-up Experience**



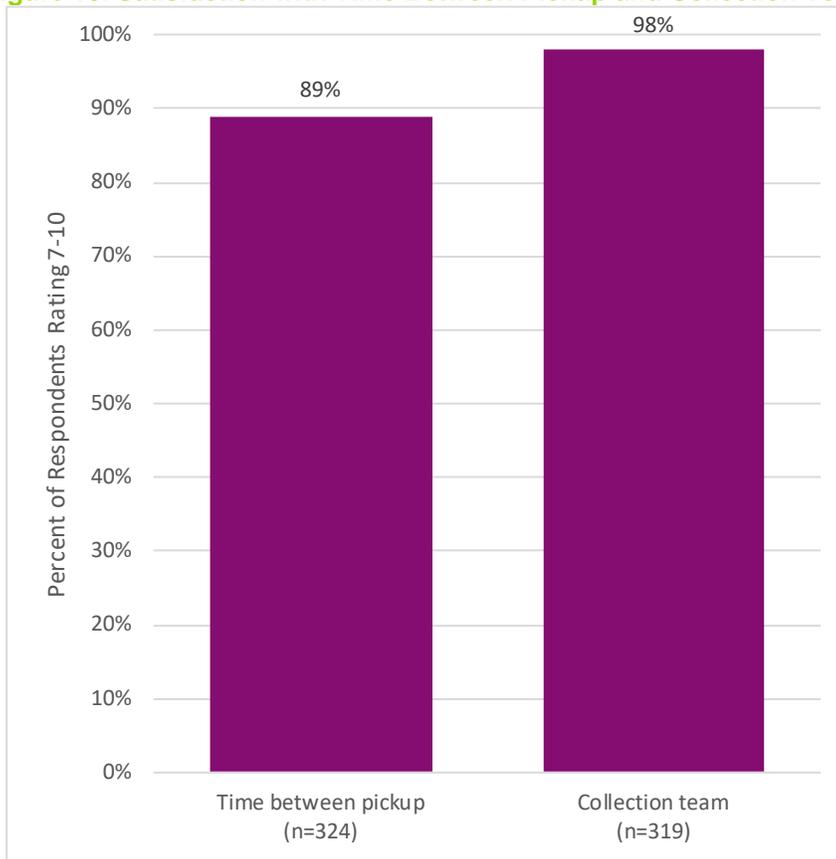
### **Scheduling & Appliance Pick-up**

Overall, participants had high regard for the scheduling process and the pick-up experience. The clear majority (96%) could set a pick-up time that was convenient for them, and had received a phone call to confirm the appointment. Similarly, nearly all

those surveyed (97%) reported that the collection team arrived within the established pick-up window.

There is some room for improvement in the time between scheduling and the actual appliance pick up, based on survey findings. In the future, the program implementer (Reclim) mentioned that they are planning to send out calendar invitations and text messages regarding scheduling and arrival times. The collection team would then text participants when they are close to arrival. Almost all participants (98%) are satisfied with the collection team. Figure 10 shows satisfaction with the time between pick-up and the collection team. Note, satisfaction with the timing and collection team was not asked in PY6.

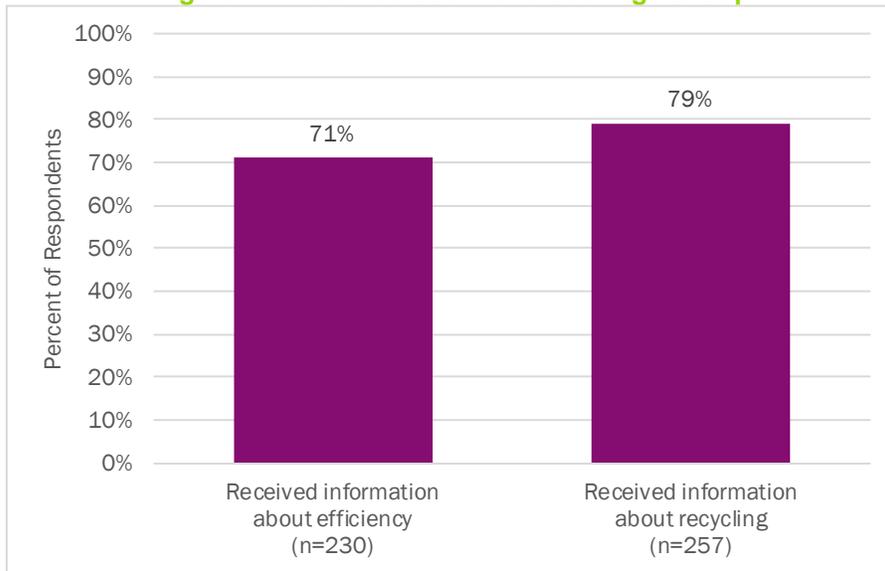
**Figure 10. Satisfaction with Time Between Pickup and Collection Team**



### Informational Materials

With regard to informational materials provided by the program, nearly three-fourths of participants (71%) recalled receiving a handout explaining that older refrigerators and freezers are less efficient and use more energy than newer ones, while 79% recalled collateral covering what it means when the appliance is recycled (Figure 11). Over three quarters of participants remembered receiving a handout explaining the benefits of recycling. Note, informational materials were not asked about in PY6.

**Figure 11. Received Information during Pick-up**

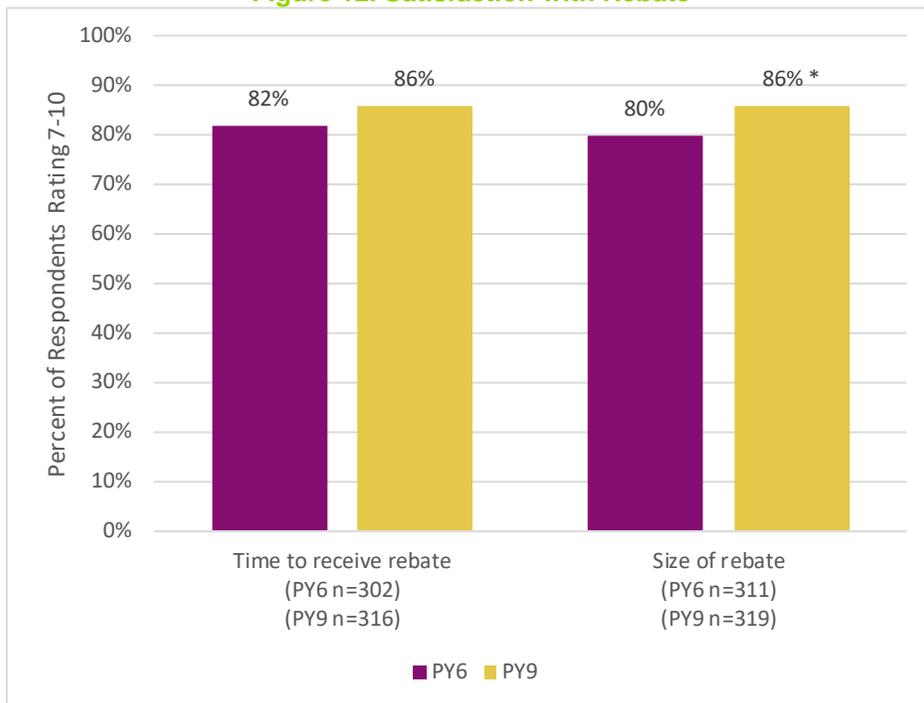


### **Incentive**

To encourage participation during PY9, ComEd provided incentives for up to two recycled refrigerators or freezers at \$50/unit. Operating room AC units were also eligible for pick up and recycling but could only be picked up from sites where the program implementer was already collecting a refrigerator and/or freezer (so the room AC unit could “ride for free”). Participants recycling these working room AC units received a \$10 program incentive. In PY9, 86% of all respondents were satisfied<sup>6</sup> with the size of payment they received and 86% were satisfied with the amount of time it took to receive the incentive. Based on these findings, the \$50 rebate amount is effective for motivating customers to participate in the program, and the payment process is timely.

<sup>6</sup> Responded 7 or higher on a 0-10 scale.

Figure 12. Satisfaction with Rebate



\*Asterisk indicates the difference between PY6 and PY9 findings are significant at the 90% level.

### Program Processes & Implementation Recommendations

Participants are well-satisfied with all aspects of the program, especially the sign-up process, the collection team, and the incentive. Potential areas of improvement are with respect to reducing the time between signing up and having the appliance picked up and with improving participant recall of the information handout at the end of collection. ComEd is planning to add features to the scheduling process to improve the customer experience—specifically text messaging and calendar invites.

### Impact of Participation on Perceptions of ComEd

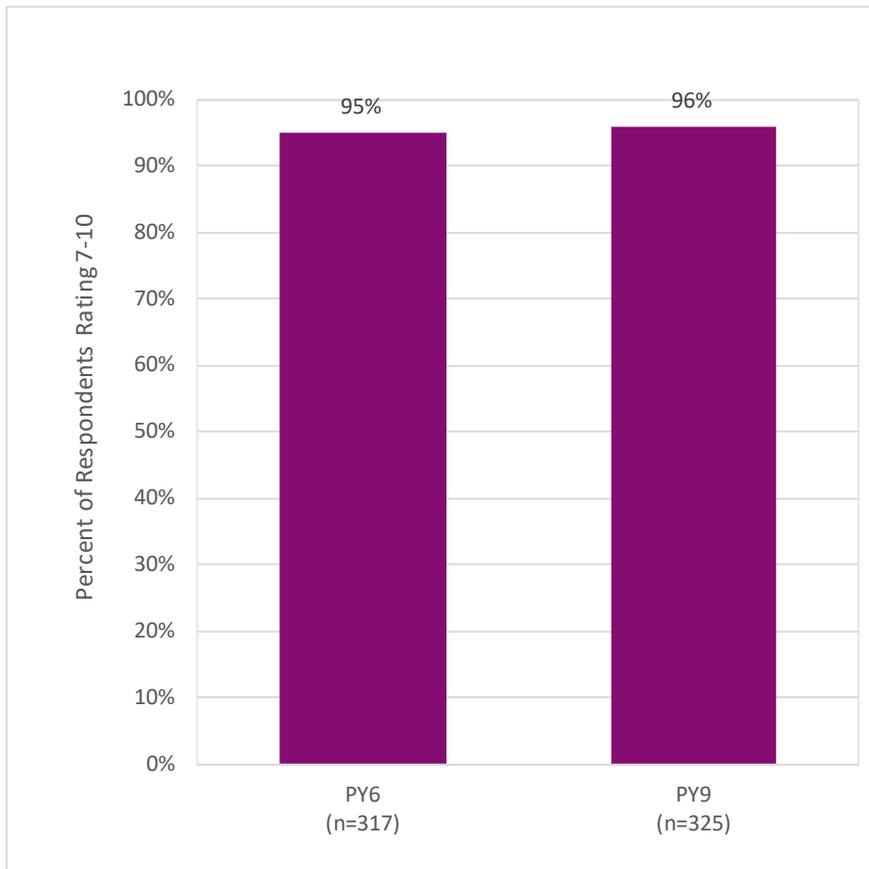
Overall satisfaction is very high, with an average satisfaction rating of 9.3 on a 0-10-point scale. Satisfaction with the program overall is consistent with PY6, based on an average rating of 9.2. In addition, 90% of PY9 participants are highly likely<sup>7</sup> to recommend the program to a friend or colleague.

The FFR Program continues to be very popular with participants, as evidenced by their high program satisfaction scores (see Figure 13). Nearly all participants (96%) are satisfied with the program<sup>8</sup> and with the service they received throughout their entire experience, with an average rating of 9.3.

<sup>7</sup> Likelihood of 9 or higher on a 0-10 scale.

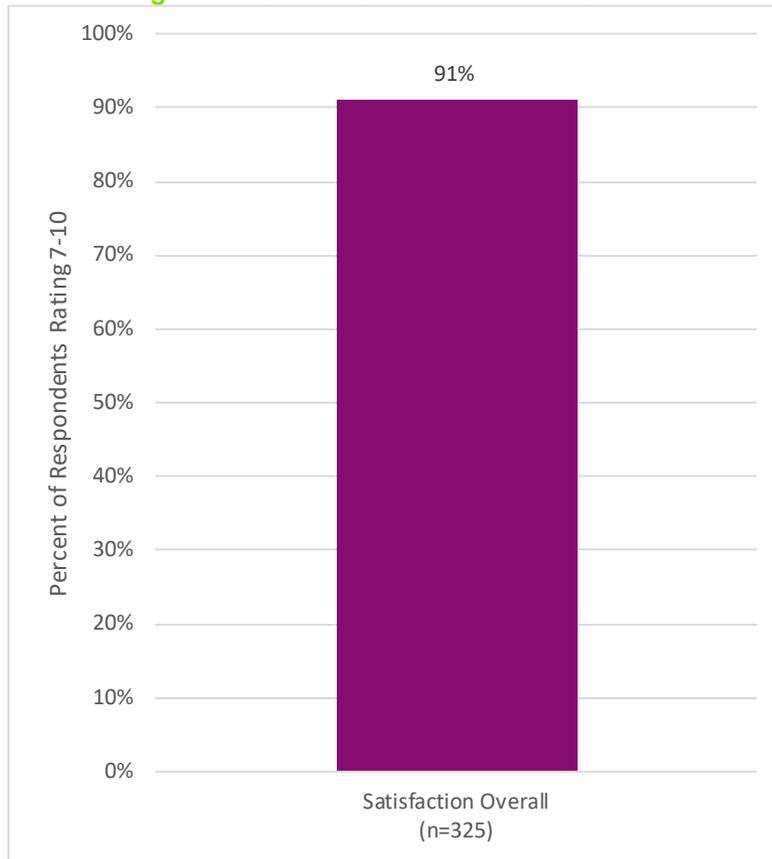
<sup>8</sup> Responded 7 or higher on a 0-10 scale.

**Figure 13. Overall Satisfaction with the FFR Program**



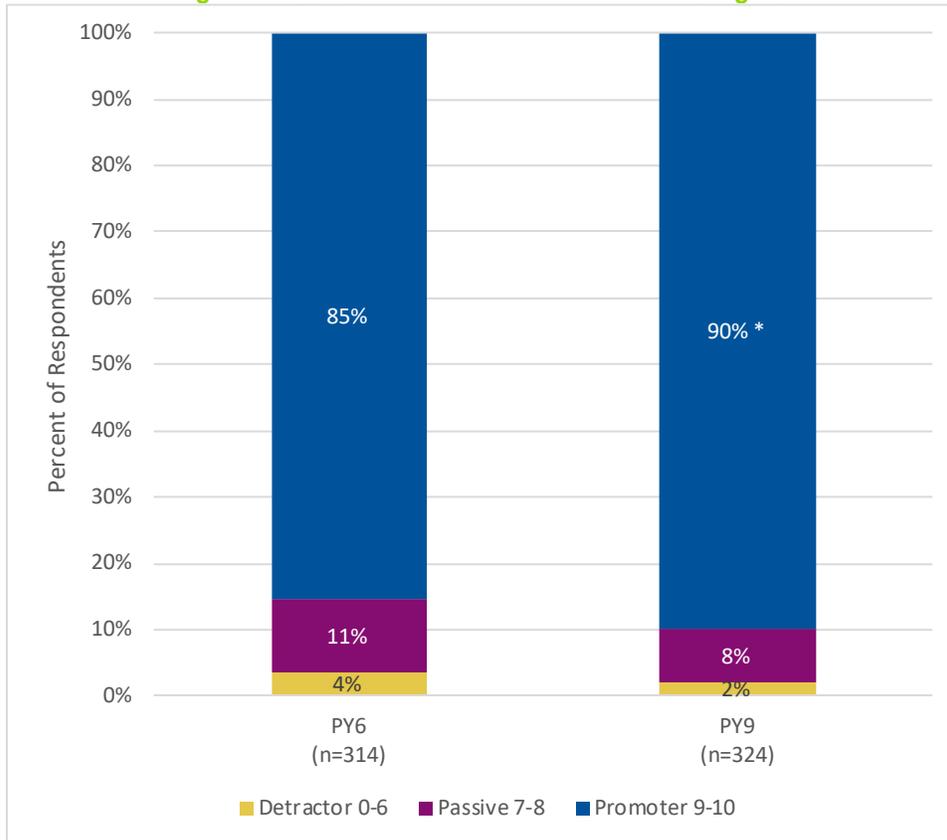
In addition, the experience of participating in the FFR Program has improved participants' perceptions of ComEd. Since participating in the program, nearly two-thirds of customers (65%) view ComEd more favorably. Their current satisfaction level with ComEd is quite high - 91% provided satisfaction ratings of 7 and higher. None reported a decrease in their perception of ComEd since participating in the FFR Program.

**Figure 14. Overall Satisfaction with ComEd**



Related, 90% of participants would be highly likely to recommend the program to a friend or colleague, based on likelihood ratings of 9 or 10 on a 0-10-point scale. This is up from the PY6 result, when 85% said they would promote the program to others (Figure 15).

Figure 15. Likelihood to Recommend the FFR Program

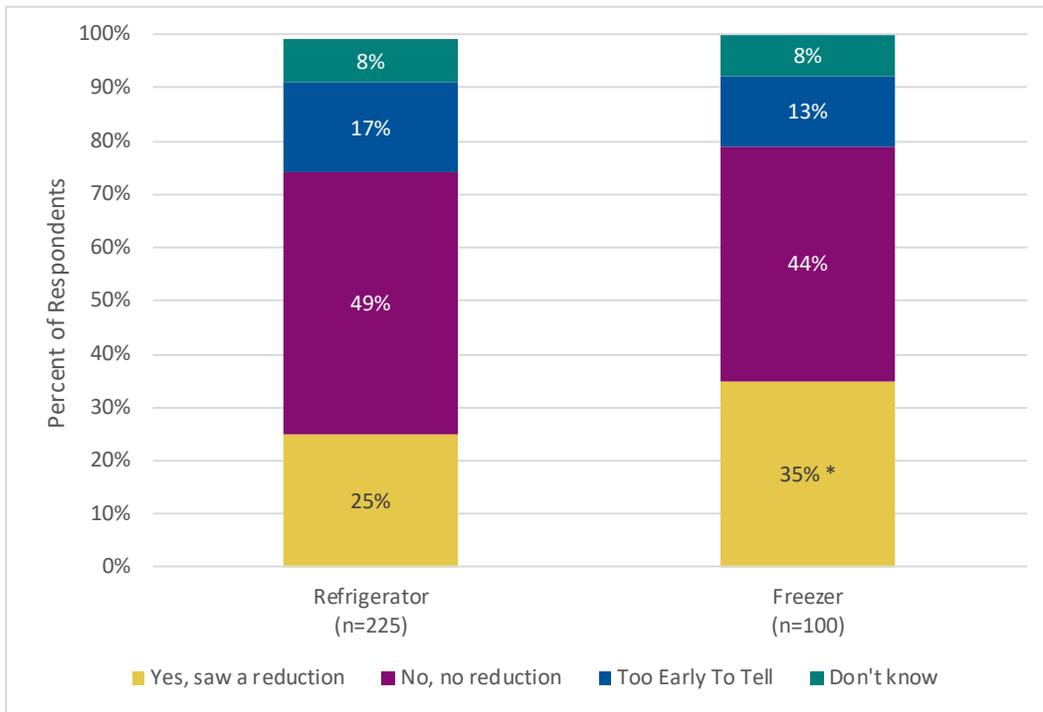


\*Asterisk indicate significance at the 90% level

The effect of the FFR Program experience on subsequent participation in other ComEd programs is slight. Just 8% of participants participated in other ComEd energy efficiency or pricing programs following their participation in the FFR Program, roughly the same as in PY6 (7%). The most frequently mentioned program was the Smart Thermostat rebate program, which was cited by 4% of respondents.

A minority of participants have noticed a reduction in their electric bill since their unit was recycled. However, it is interesting to note that a higher percentage of respondents who recycled their freezer noticed a reduction in their electric bill compared to those who recycled a refrigerator (Figure 16). These results do not vary by replacement/non-replacement status.

**Figure 16. Reduction in Bill Since Participating in the FFR Program**



\*Asterisk indicate significance at the 90% level

**APPENDIX D. COMED FRIDGE FREEZER RECYCLING PY9 NTGR MEMO 2018-09-19**

## Memorandum

**To:** Vince Gutierrez, ComEd

**CC:** Violeta Barrueta Gonzalez, ComEd  
Jennifer Morris, ICC Staff  
Jeff Erickson, Randy Gunn and Nishant Mehta, Navigant

**Date:** September 19, 2018

**Re:** ComEd Fridge & Freezer Recycling Program PY9 Recommended NTGR Updates

## 1. INTRODUCTION

This memorandum presents the evaluation research<sup>1</sup> PY9 net-to-gross ratio (NTGR) estimates for refrigerators, freezers and room air conditioners recycled through ComEd's Fridge & Freezer Recycling (FFR) Program. The approach used to calculate the program NTGR is based on the NTG algorithms specified in the Illinois TRM version 6.0.

## 2. EVALUATION RESEARCH NET IMPACT FINDINGS

The primary objective of the research findings net savings analysis for the FFR Program is to determine the program's net effect on customers' electricity usage. This requires estimating what would have happened in the absence of the program. Thus, after gross program impacts adjusted for part-use have been assessed, net program impacts are derived by estimating a NTGR which quantifies the percentage of the gross program impacts that can reliably be attributed to the program.

The PY9 NTG assessment of retailer-sourced units continues with the expanded scope initially implemented in PY5, which had a goal of assessing program influence in all cases where an existing unit has been replaced. Such an inquiry included surveys of the largest retailers<sup>2</sup> associated with unit replacements. Responses from the existing participant survey were used to guide the analytical approach for the retailer associated units, as well as the non-replaced units picked up by Reclaim at customers' homes. The "no program" question battery included probing surrounding the participating customer's disposal options associated with the retailer they purchased the new unit from, and their rationale for recycling the unit via ComEd's program rather than choosing to have the retailer remove it. This helped to ensure consistency and a fuller understanding of the responses given to the critical survey question used to determine free ridership for the program.

Data sources included the following:

- *Telephone surveys with participating customers.* As in previous years, we relied heavily on findings from telephone surveys of participating customers to determine how their units would have been disposed of if the program had not picked them up. A total of 325 surveys was completed.
- *Telephone surveys with retailers associated with unit replacements.* The evaluation team obtained contact information and attempted to conduct interviews with the six largest retailers associated with unit replacements. Ultimately, interviews were completed with four of these six firms. These interviews shed light on the disposition of used appliances absent the program for those participants that indicated absent ComEd's program, they would have given the unit away to the retailer they

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<sup>1</sup> It should be noted that the NTGR estimates presented here are the evaluation verified estimates (based on the PY9 participating customer and non-participating retailer surveys).

<sup>2</sup> Note that the FFR program no longer includes a participating retailer component. It was dropped from the program in PY8.

bought their new unit from. In such cases, the NTG ratio is based on that retailer's own disposal practices absent the program, which is revealed during these telephone surveys.

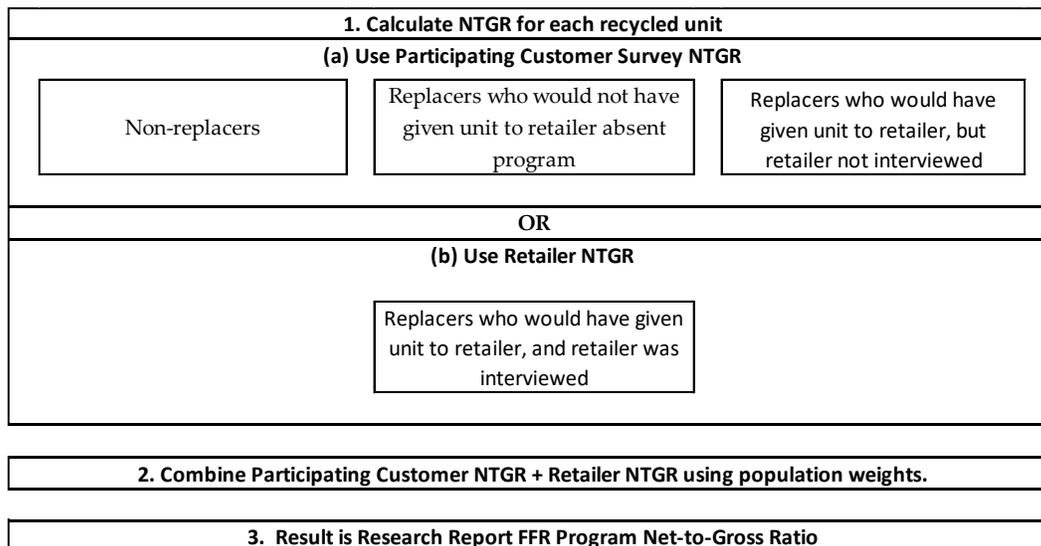
The retailer interviews and participating customer telephone surveys provided all inputs needed for the calculation of the program's net-to-gross ratio. The participating customer survey provided the self-reported percentage of units that: (1) would have been kept and used; (2) would have been kept by a household but not used; and (3) would have been discarded by a household through a method in which the refrigerator would have been destroyed. The retailer interviews provided the percentage of units that would be discarded and destroyed by each retailer absent the program. Units that would have been kept but not used, and those that would have been discarded and destroyed absent ComEd's program, are considered free riders. The program's NTGR is then calculated from these results.

The program NTGR is a weighted average resulting from calculations for two categories of participants:

1. Participating customer survey responses are used directly in the calculation of the NTGR for three categories of participants:
  - Those who did not replace their unit.
  - Those who replaced it but indicated they would have used a disposal method not involving the retailer they bought the new unit from.
  - Those who replaced it, would have used a disposal method involving the retailer, but where an interview with the retailer was not completed. This includes participants who indicated they would have otherwise sent the unit to a recycling facility, taken the unit to a landfill, or used another method that would have permanently removed the unit from the grid.
2. For the remaining customers, the NTGR is determined based on the disposal practices of each retailer interviewed. Those remaining are ones who would have used a method involving the retailer they bought the replacement unit from, would have used a disposal method involving the retailer, and where an interview with the retailer was completed. Interviews were completed with four major retailers that sold replacement units to participating customers. NTGRs were ultimately calculated for three of the four retailers interviewed.

Figure 2-1. below provides a graphical representation of this framework.

**Figure 2-1. Research Report NTG Framework**



## 2.1 Spillover

Information regarding participant spillover was also collected, but ultimately did not support a finding of any spillover. For this program, because the program approach does not support a theory for how meaningful spillover might occur, a finding of no spillover is not surprising. From the survey, there were four respondents who cited the program as being ‘very influential’ for their taking additional energy efficiency actions. However, all of these four respondents did so by participating in another ComEd residential program (for which the savings was presumably claimed). Programs cited included Home Energy Assessment, Home Energy Rebates, and Smart Lighting Discounts. There were additional respondents who also undertook further actions to reduce their energy use, however, they indicated the FFR Program was either only moderately or not at all influential in their decision making.

## 2.2 Participating Customer Findings

Of those survey respondents that replaced their units, 25 percent of refrigerator respondents (n=57 of 225) and 10 percent of freezer respondents (n=10 of 100) indicated they would have had their unit removed by the dealer (i.e., retailer). The remaining 75 percent of refrigerator respondents (n=168 of 225) and 90 percent of freezer respondents (n=90 of 100), would have used various other methods such as donating it to a charity, hauling it to the dump and recycling center, hiring someone to haul it away, and keeping it stored unplugged.

Of those participating customers who said they would not have had the dealer remove the unit, 59 out of 168 refrigerator respondents (40 percent) and 43 of 90 freezer respondents (448 percent) revealed they would have used a method to dispose of their unit that would have permanently destroyed it or would have kept the unit but not used it, indicating they are free riders.

Resulting NTGRs (excluding the Program-Induced Replacement factors) are 0.649 for refrigerators, and 0.522 for freezers. These values were applied to both non-replaced units, and those who would have used a method not involving the retailer they bought the replacement unit from in calculating the research findings program NTGR.

Additional questions in the participating customer surveys probed deeper into any disposal options other than ComEd's program that they may have considered. These were intended to assess the realism of the "no program" responses given and provide further insight into the responses given to the critical survey question used to determine free ridership for the program. Key findings from this battery are:

- Among the options available to refrigerator respondents (n = 225),
  - Over half (53 percent, n = 120) thought of giving the unit away to a charity or a private party
  - Another 43 percent (n = 97) considered having the garbage collector remove the unit
  - Approximately one third of respondents (30 percent, n = 67) considered having the unit hauled to a dump, landfill, or recycling center
  - Only 16 percent (n = 36) considered selling to a private party or appliance dealer
  - Just 11 percent (n = 25) thought of using Craigslist to dispose of their unit
- Among the options available to freezer respondents (n = 100),
  - A majority of respondents (55 percent, n = 55) considered giving the unit away
  - A quarter of respondents (23 percent, n = 23) considered selling to a private party or appliance dealer
  - Almost one-third (30 percent, n = 30) considered having the unit hauled to a dump, landfill, or recycling center
  - Also 11 percent (n = 11) thought of using Craigslist to dispose of their unit

## 2.3 Retailer Findings

Interviews were attempted with six major retailers of new refrigerators and freezers. These firms were the ones most commonly named by participants as the source of their replacement units. The purpose of these interviews was to learn of their appliance disposal practices in the absence of ComEd's program. Interviews were completed with four of the six retailers, and findings from three of these four firms were incorporated into the NTG calculation<sup>3</sup>. Retailers were asked a series of questions regarding the following:

- Pickup and disposal services for replaced units
  - Charges, if any for such services
  - Percentage of customers that receive such services
- Recycling and/or deconstruction of units picked up by the retailer
  - Approach for units outside of ComEd's program – percentage of units affected
  - Approach prior to the start-up of ComEd's program – percentage of units affected
- Other disposition of units
  - Percentage that are picked up by a hauler/third party and resold (i.e., remain grid connected)

Each retailer provided specific answers to each of these topic areas. In general, a high percentage of units turned over to retailers are being disposed of via a method that permanently removes them from the grid. Only a small percentage, the newest units in the best condition, are resold.

From this information, we constructed a retailer-specific NTGR, representing one minus the percentage of units that would otherwise have been recycled or deconstructed in the absence of ComEd's program. As indicated in the table below, the rate of recycling varies significantly by retailer. The retailers interviewed represent 13 percent of the refrigerators and 6 percent of the freezers recycled by program participants.

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<sup>3</sup> The fourth firm indicated they resold or gave away used units to as many as 15 different firms, whose names they did not provide. This made it difficult to follow up with the reseller to determine their disposal practices. For these reasons, the NTG ratio for units replaced through this retailer were based on the average of the NTGR -Retailer values.

**Figure 2-2: PY9 Net-to-Gross Ratios for Nonparticipating Retailers**

Retailer	NTGR ratio	Percentage of Program Units Given to Retailer Absent the Program (Survey based)
Retailer # 1 – national chain	0.15	2% for refrigerators, 0% for freezers
Retailer #2 – national chain	0.10	6% for refrigerators, 4% for freezers
Retailer #3 – national chain	0.00	5% for refrigerators, 2% for freezers
<b>Share of Units Associated with Retailer NTGRs</b>		13% of new refrigerators 6% of new freezers <sup>4</sup>

## 2.4 Weighted Average NTGR

A weighted average of the two net-to-gross ratios are then calculated separately for refrigerators and freezers using the proportions of participants who fall into each of the two categories of participating customer survey NTGR and retailer survey NTGR. The proportion of participants in the retailer category is combined for both refrigerators and freezers since the retailer interviews did not distinguish between unit types.

The formula for this calculation is:  $(NTGR_{nr} * \%nr) + (NTGR_r * \%r)$

Where:

NTGR<sub>nr</sub> = non-retailer-based net-to-gross ratio

%t = percentage of participants who receive non-retailer-based net-to-gross ratio

NTGR<sub>r</sub> = retailer-based net-to-gross ratio

%r = percentage of participants who receive retailer-based net-to-gross ratio

The resulting NTGR is then applied to the average unit energy consumption per unit recycled by the respective retailers or by Reclim and is also weighted by the number of units recycled by each retailer or Reclim. The result produces a weighted NTGR for refrigerators and freezers that considers both non-retailer and retailer based NTGRs. Figure 2-3 presents the non-retailer and retailer-based recycling channels and the resulting weighted NTGR by appliance type.

**Figure 2-3: PY9 Research Findings Net-to-Gross for Retailer and Non-Retailer Participants**

Unit Type	NTGR Non-Retailer	NTGR Retailer	NTGR Weighted Average (before PIR)
Refrigerator	0.649	0.072	0.503
Freezer	0.522	0.067	0.477
Room ACs	0.50	---	0.50

Source: Evaluation Team analysis.

Appendix A provides the detailed NTG framework and documents the calculation of the NTGRs for Refrigerators and Freezers.

<sup>44</sup> Note that these percentages do not sum up to the total percentage of the units that would have gone to the retailer absent the FFR program. The remaining share of units is accounted for by retailers that were not interviewed or used appliance dealers.

## 2.5 Program-Induced Replacements

The final NTGR also includes a term for Program-Induced Replacements (PIR). This term accounts for the role played by the FFR Program and specifically, the incentive, in inducing a customer to replace their unit after the old unit was removed by the program and recycled. Pursuant to the TRM procedure, such inducement is to be based on the influence of the program incentive only. Savings from participants who indicate that the incentive provided by the program caused them to replace their old unit are reduced by the estimated consumption of the replacement unit. In calculating the PIR, induced kWh values per unit of 501 kWh for refrigerators and 468 kWh for freezers were assumed, which are in line with the values estimated using the ENERGY STAR Appliance Savings Calculator available on the ENERGY STAR website. Incorporating the PIR factors into the NTGR causes the value to decline by the magnitude of the adjustment, similar to the effect of free ridership.

Table 2-1 and Table 2-2 below illustrate the PIR calculation used for refrigerators and freezers, respectively. For those who replaced a refrigerator, 13 percent cited the FFR Program as having induced the replacement, and of those, 60 percent (or 7 percent of replacers) said the incentive was the primary factor in their replacement decision. Similarly, for freezer replacers, 19 percent said the program caused them to replace their unit and of those, 29 percent (or 2 percent of replacers) cited the incentive as the causal factor. The resulting PIR factors associated with incentives only are -3.8 percent for refrigerators and -1.4 percent for freezers.

**Table 2-1. PY9 Program-Induced Replacement Calculation – Refrigerators**

Replaced Recycled Unit?	Percent of Respondents	Program Induced Replacement?	Percent of Respondents	Motivated by Incentive	Percent of Respondents	Percent of Total Population	Induced kWh/Unit	Number of Units	Total Induced kWh
Yes	84%	Yes	13%	Yes	60%	7%	501	4,481	2,244,746
		No	87%	No	40%	4%	0	2,987	0
No	16%					73%	0	49,987	0
						16%	0	10,753	0
<b>Totals</b>								67,208	2,244,746
Weighted Average Program Induced Replacement Factor (all units)							33.4		-3.8%

**Table 2-2: PY9 Program-Induced Replacement Calculation – Freezers**

Replaced Recycled Unit?	Percent of Respondents	Program Induced Replacement?	Percent of Respondents	Motivated by Incentive	Percent of Respondents	Percent of Total Population	Induced kWh/Unit	Number of Units	Total Induced kWh
Yes	36%	Yes	19%	Yes	29%	2%	468	220	103,110
		No	81%	No	71%	5%	0	551	0
No	64%					29%	0	3,195	0
						64%	0	7,050	0
<b>Totals</b>								11,016	103,110
Weighted Average Program Induced Replacement Factor (all units)							9.4		-1.4%

After accounting for PIR, the final NTGRs are shown below in Table 2-3.

**Table 2-3: PY9 Research Findings Final Program Net-to-Gross Ratios**

Unit Type	NTGR Non-Retailer	NTGR Retailer	NTGR Weighted Average (before PIR)	PIR Factor	NTGR Weighted Average (after PIR)
Refrigerator	0.649	0.072	0.503	-0.038	0.464
Freezer	0.522	0.067	0.477	-0.014	0.463
Room ACs	0.50	---	0.50	---	0.50

Given the significant difference between retailer and non-retailer NTGRs (i.e., 0.649 versus 0.072 for refrigerators), we recommend that the program modify the media channels utilized and/or the program messaging content accordingly to focus participation more on long-term secondary units. Free ridership can be reduced by reorienting the program towards those customers who have true secondary units and de-emphasizing participation by those who are replacing existing primary units. However, this comes at a cost, since the pool of available participants is reduced significantly by doing so. ComEd should weigh the pros and cons of this strategy versus alternatives as it is making changes to the CY2019 program design.

## APPENDIX A: DETAILED CALCULATION OF PY9 FRIDGE FREEZER RECYCLING PROGRAM NTG RATIO

<b>Participant Survey Q.</b> Now suppose that ComEd Fridge and Freezer Recycling program hadn't been available. Which one of these alternatives would you have been most likely to do, if the ComEd Fridge and Freezer Recycling program had not been available?	Have it removed by the retailer you got your new or replacement [appliance] from [Ref: n=57 of 225, 25%] [Frz: n=10 of 100, 10%]	Do we have a retailer-specific NTGR for the respondent's associated retailer per RETAILER SURVEY?	Yes	<b>Respondent NTGR (Type_A)</b> = NTGR of associated retailer per RETAILER SURVEY [Ref: 30 of 225, 13%] [Frz: 6 of 100, 6%]	<b>Retailer NTGR Score</b> = average(respondent NTGRs Type_A & Type_B) [Ref: 0.072] [Frz: 0.067]	<b>Program NTGR</b> = (Retailer NTGR * Retailer Weight + Nonretailer NTG * Nonretailer Weight) / (Retailer Weight + Nonretailer Weight) [Ref: 0.503] [Frz: 0.477]*  *excluding PIR
			No	<b>Respondent NTGR (Type_B)</b> = average(respondent NTGRs Type_A) [Ref: 27 of 225, 12%] [Frz: 4 of 100, 4%]		
	Sell it to a private party [Ref: n=6 of 225, 3%] [Frz: n=1 of 100, 1%] Give it away to a private party [Ref: n=22 of 225, 10%] [Frz: n=8 of 100, 8%]	Industries or a church [Ref: n=19 of 225, 8%] [Frz: n=4 of 100, 4%]	<b>Respondent NTGR (Type_C)</b> = 1 [Ref: n=65 of 225, 29%] [Frz: n=29 of 100, 29%]	<b>Nonretailer NTGR Score</b> = average(respondent NTGRs Type_C & Type_D) [Ref: 0.649] [Frz: 0.522]		
	Keep it and use it as a spare [Ref: n=18 of 225, 8%] [Frz: n=16 of 100, 16%]					
	Haul it to the dump or landfill [Ref: n=3 of 225, 1%] [Frz: n=2 of 100, 2%]					
	Haul it to the recycling center [Ref: n=25 of 225, 11%] [Frz: n=9 of 100, 9%]	Hire your garbage collector or someone else to haul it away [Ref: n=29 of 225, 13%] [Frz: n=28 of 100, 28%]	<b>Respondent NTGR (Type_D)</b> = 0 [Ref: n=59 of 225, 26%] [Frz: n=43 of 100, 43%]	<b>Nonretailer Weight</b> = count and share of respondents [Ref: 168 of 225, 75%] [Frz: 90 of 100, 90%]		
	Keep it and store it unplugged [Ref: n=2 of 225, 1%] [Frz: n=4 of 100, 4%]					

## APPENDIX B: FRIDGE FREEZER RECYCLING PROGRAM NTG HISTORY

	Fridge Freezer Recycling	
EPY7	FFR NTG Refrigerators Retailer	0.11*
	FFR Free Ridership Refrig. Retailer	0.89*
	FFR NTG Refrigerators Non-Retailer	0.73*
	FFR Free Ridership Refrig. Non-Ret.	0.27*
	FFR NTG Refrigerators Wtd. Average	0.56*
	FFR Free Ridership Refrig. Wtd. Avg.	0.44*
	FFR NTG Freezers Retailer	0.18*
	FFR Free Ridership Freezers Retailer	0.82*
	FFR NTG Freezers Non-Retailer	0.56*
	FFR Free Ridership Freezers Non-Ret.	0.44*
	FFR NTG Freezers Wtd. Average	0.53*
	FFR Free Ridership Freezers Wtd. Avg.	0.47*
	FFR NTG Room AC:	0.50
	Participants Spillover: Negligible	0
* Includes impact of Program-Induced Replacement factors of -0.07 for refrigerators and -0.03 for freezers. Data Sources: PY5 Participant Survey and PY5 Retailer Surveys		
EPY8	FFR NTG Refrigerators Retailer	0.15*
	FFR Free Ridership Refrig. Retailer	0.85*
	FFR NTG Refrigerators Non-Retailer	0.63*

	<b>FFR Free Ridership Refrig. Non-Ret. 0.37*</b> <b>FFR NTG Refrigerators Wtd. Average 0.40*</b> <b>FFR Free Ridership Refrig. Wtd. Avg. 0.60*</b> <b>FFR NTG Freezers Retailer 0.16*</b> <b>FFR Free Ridership Freezers Retailer 0.84*</b> <b>FFR NTG Freezers Non-Retailer 0.57*</b> <b>FFR Free Ridership Freezers Non-Ret. 0.43*</b> <b>FFR NTG Freezers Wtd. Average 0.54*</b> <b>FFR Free Ridership Freezers Wtd. Avg. 0.46*</b> <b>FFR NTG Room AC: 0.50</b> <b>Participants Spillover: Negligible 0</b> <b>* Includes impact of Program-Induced Replacement factors of -0.07 for refrigerators and -0.03 for freezers.</b> <b>Data Sources: PY6 Participant Survey and PY6 Retailer Surveys</b>
EPY9	<b>FFR NTG Refrigerators Retailer 0.22*</b> <b>FFR Free Ridership Refrig. Retailer 0.78*</b> <b>FFR NTG Refrigerators Non-Retailer 0.62*</b> <b>FFR Free Ridership Refrig. Non-Ret. 0.38*</b> <b>FFR NTG Refrigerators Wtd. Average 0.51*</b> <b>FFR Free Ridership Refrig. Wtd. Avg. 0.49*</b> <b>FFR NTG Freezers Retailer 0.25*</b> <b>FFR Free Ridership Freezers Retailer 0.75*</b> <b>FFR NTG Freezers Non-Retailer 0.63*</b> <b>FFR Free Ridership Freezers Non-Ret. 0.37*</b> <b>FFR NTG Freezers Wtd. Average 0.58*</b> <b>FFR Free Ridership Freezers Wtd. Avg. 0.42*</b> <b>FFR NTG Room AC: 0.50</b> <b>Participants Spillover: Negligible 0</b> <b>* Includes impact of Program-Induced Replacement factors of -0.07 for refrigerators and -0.03 for freezers.</b> <b>Data Sources: PY7 Participant Survey and PY7 Retailer Surveys</b>
EPY10	<b>FFR NTG Refrigerators Retailer 0.22*</b> <b>FFR Free Ridership Refrig. Retailer 0.78*</b> <b>FFR NTG Refrigerators Non-Retailer 0.62*</b> <b>FFR Free Ridership Refrig. Non-Ret. 0.38*</b> <b>FFR NTG Refrigerators Wtd. Average 0.51*</b> <b>FFR Free Ridership Refrig. Wtd. Avg. 0.49*</b> <b>FFR NTG Freezers Retailer 0.25*</b> <b>FFR Free Ridership Freezers Retailer 0.75*</b> <b>FFR NTG Freezers Non-Retailer 0.63*</b> <b>FFR Free Ridership Freezers Non-Ret. 0.37*</b> <b>FFR NTG Freezers Wtd. Average 0.58*</b> <b>FFR Free Ridership Freezers Wtd. Avg. 0.42*</b> <b>FFR NTG Room AC: 0.50</b> <b>Participants Spillover: Negligible 0</b> <b>* Includes impact of Program-Induced Replacement factors of -0.07 for refrigerators and -0.03 for freezers.</b> <b>Data Sources: PY7 Participant Survey and PY7 Retailer Surveys</b>