



R2120 Connecticut and Rhode Island Joint Appliance Recycling Study

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Appliance Recycling Program Designs

- Permanently remove certain appliances from service to save electricity
- Reclaim refrigerants, glass, plastic, and metals
- Remove units from inside customers' homes
 - COVID protocols required customers to get unit outside of home
- Implemented by ARCA

Connecticut

- Program started mid-2020
- Incentives
 - \$30 under normal conditions
 - \$60 during COVID contactless pickup protocols
- 740 units recycled in 2020
 - 605 Refrigerators
 - 135 Freezers

Rhode Island

- Program re-started in 2017
- Incentives
 - \$50 under normal conditions
 - \$75 for special promos
 - \$125 during COVID contactless pickup protocols
- 7,579 units recycled in 2019/2020
 - 6,590 Refrigerators
 - 630 Freezers
 - 359 Dehumidifiers; only w/others

And then there is Massachusetts...

Incentive was \$75 in 2019

Currently conducting two studies, one survey

- Gross savings estimates
 - NMR collected data; Guidehouse / Illume analyzing
 - Results expected in April
- Net savings estimates
 - NMR collected and analyzed data
 - Preliminary results delivered to MA; finalization requires gross savings results

MA studies do not include 2020 participants

Study Objectives

Calculate gross savings and net savings

- Gross based on characteristics of recycled unit
- Net based on alternative outcome for unit if not recycled by program

Estimate program-induced reclamation of CFCs & other materials

Identify optimal incentive levels

- Compare alternative unit outcomes across states & incentive levels
- Account for COVID-driven changes
- Understand importance of incentives relative to other program features (ease of disposal, environmental benefits, energy / bill savings)

Program Savings Document Updates

Measure	Parameter	Current Value	Source of Update
Refrigerator Recycling	Annual Energy Savings	794 kWh	Program tracking + MA Impact Survey Results
Refrigerator Recycling	Realization Rate	100%	MA Impact Survey Results
Refrigerator Recycling	Free Ridership	31%	MA NTG Survey Results
Freezer Recycling	Annual Energy Savings	846 kWh	Program tracking + MA Impact Survey Results
Freezer Recycling	Realization Rate	100%	MA Impact Survey Results
Freezer Recycling	Free Ridership	41%	MA NTG Survey Results for April memo, but will review / update after CT survey complete

- Program-induced amount of refrigerants, other materials reclaimed or recycled
- Insights into optimal incentive levels

Study Tasks

Task 1: Work Plan and Kickoff (complete)

Task 2: Data Request (complete) and Data Review (in progress)

Task 3: Gross Savings Estimates

Task 4: Net Savings Estimates and Net Recycling Impact

Task 5: Incentives Exploration

Task 6: Reporting

Task 3: Gross Savings Estimates

- Focus on the unit, not the household
- Gross Savings = Unit Energy Consumption

UMP Regression Input	Appliance	Source
Appliance Age (years)	Refrigerators / Freezers	Program tracking
Manufactured before 1990 (%)	Refrigerators / Freezers	Program tracking
Appliance Size (ft ³)	Refrigerators / Freezers	Program tracking
Single-door (%)	Refrigerators	Program tracking
Side-by-Side Door (%)	Refrigerators	Program tracking
Primary (%)	Refrigerators	Program tracking
Chest Configuration	Freezers	Program tracking
Summer Unconditioned ¹	Refrigerators / Freezers	Massachusetts Survey / TMY3
Winter Unconditioned ¹	Refrigerators / Freezers	Massachusetts Survey / TMY3

¹ Interaction effect with CDD or HDD; will use TMY3

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Task 3 and Task 4: Adjusted Gross and Net Savings

Adjusted Gross Savings: *Gross x Realization Rate*

- Realization Rate = Part-use Adjustment
- Portion of the year prior to recycling that unit was plugged
- Source = Massachusetts survey

Net Savings: *Adjusted Gross x Net of Free-ridership*

- Free-ridership has two components
 - Unit would have been permanently removed without program
 - Unit keeps a would-be buyer from getting it second hand, and buyer ends up getting a brand new unit instead
- Source = Massachusetts survey, but maybe later adjustments based on CT/RI surveys

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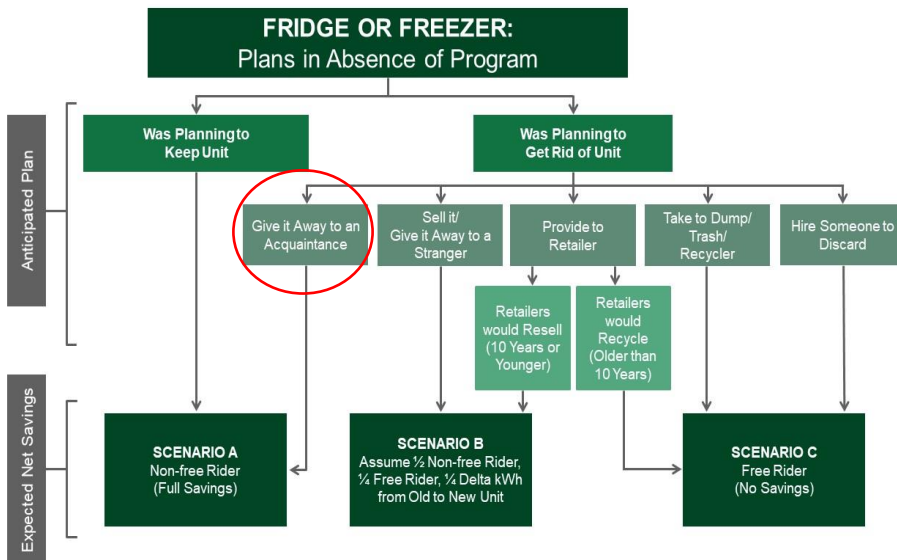
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Task 4: Proposed Free-ridership Allocation

Disposition in the Absence of the Program	Decision	Credited Proportion of Adjusted Gross Savings
Kept by the household	Not a free rider	100%
Given away for free to an acquaintance ¹	Not a free rider	100%
Sold/given to charity, classified ads, internet, etc.	See algorithm in next slide	0% to 50%
Provided to retailer (new or used)	If older than ten years, free rider	0%
Provided to retailer (new or used)	If ten years or younger: see algorithm in next slide	0% to 50%
Surrendered to municipality / hired a hauler	Free rider	0%
Other dispositions	Treated on case-by-case basis, per survey responses	Varies

¹ NMR suggests a sensitivity analysis in which we alternatively assign these units to the algorithm on the next slide.

Task 4: UMP Free Rider Algorithm



Task 4: Proposed Allocation for Recycling

Disposition in the Absence of the Program	Decision
Kept by the household	Wouldn't have been recycled
Given away for free to an acquaintance	Wouldn't have been recycled
Sold/given to charity, classified ads, internet, etc.	Wouldn't have been recycled
Provided to retailer (new or used)	If older than ten years, would have been recycled
Provided to retailer (new or used)	If ten years or younger, wouldn't have been recycled
Surrendered to municipality / hired a hauler	Would have been recycled
Other dispositions	Treated on case-by-case basis, per survey responses

Task 5: Incentives Research

Savings estimates don't consider incentives

Offering incentives assumes they influence behavior

Task 5 will explore two aspects of incentives

- Optimal incentive levels
- Importance of incentives relative to other program benefits

Task 5: Participant Survey

Ask a subset of MA survey questions

- Tease out alternative outcomes for recycled units
- Compare responses across all three states

Probe on likelihood to participate at lower incentive amounts

- Including having to pay to remove

Compare the importance of incentives to other program benefits

- Ease of disposal / unit pick-up
- Environment: reclaim CFCs, other materials; climate change
- Energy / bill savings

Task 5: Sample Design and Outreach

Target 220 participants in each state

- Freezers and refrigerators proportionate to shares in population

Web-based survey, with phone option

- State-specific postcards with QR code, URL listed
- NMR contact phone number / email for problems, to respond via phone

Digital completion incentive

- \$10 in RI / \$15 in CT because of smaller population
- Will offer option of mailing, but USPS advises against mailing gift cards

Task 6: Reporting and Timeline

- Memo on savings as soon as MA impact results available
 - Connecticut memo will also include recycling outcomes
- Connecticut memo on incentives research in June
- Finalized late August / Mid-September

Task	Feb	Mar	Apr	May	Jun	Jul	Aug
Task 1: Planning	■	■					
Task 2: Data Request / Review		■	■				
Task 3 and Task 4: Savings Research			■				
Task 5: Incentives Research			■	■	■		
Task 6: Reporting						■	■

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Budget - \$35,000

- Memo only, no overall report
- No calculation of 2019 gross or net saving

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Thank You

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Task 3: UMP Regression Coefficients – Daily Usage

UMP Regression Input	Refrigerator	Freezer
Constant	0.582	-0.955
Appliance Age (years)	0.027	0.045
Manufactured before 1990 (%)	1.055	0.543
Appliance Size (ft ³)	0.067	0.120
Single-door (%)	-1.977	NA
Side-by-Side Door (%)	1.017	NA
Primary (%)	0.605	NA
Chest Configuration	NA	0.298
Summer Unconditioned	0.020 * CDD	0.082 * CDD
Winter Unconditioned	0.045 * HDD	-0.031 * HDD