

RAD Non-Energy Benefits (NEBs)

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Agenda



- **“ComEd Fridge & Freezer Recycling (FFR) Program”**
 - Presented by Mike Butkus (Senior Program Manager, ComEd)
- **“ARPs are RAD: Quantifying Non-Energy Benefits in Appliance Recycling Programs”**
 - Presented by Jason Christensen (Associate, Cadmus Group)
- **“The NEBs of EPA’s RAD Program”**
 - Presented by Christine Gajewski (Senior Associate, ICF International)
- **Questions**



ComEd Fridge & Freezer Recycling (FFR) Program

**Mike Butkus
Sr Program Manager, ComEd**



smart ideas®

ComEd® Energy Efficiency Program

WAYS TO SAVE



Assessments



Rebates



Discounts



Recycling



My Account

ComEd Residential EE Portfolio




- 2007 legislation required IOUs in Illinois to offer EE opportunities to their customers
- First programs launched on 6/1/2008 and included “appliance” recycling
- FFR is consistently one of the most recognized programs offered by ComEd

FFR Customer Engagement



- ComEd manages all program marketing efforts
- Monthly bill inserts serve as a foundation
- Key message elements:
 - Free pickup
 - Get \$50
 - Environmentally responsible recycling
- Incentive offer started at \$25 (fridge or freezer) and increased to \$50 on 6/1/2015

FFR Customer Engagement



smart ideas[®]

RETIRE ME AND GET \$50

Retire your old, working fridge through the ComEd Smart Ideas[®] Energy Efficiency Program and get \$50. We'll pick it up for FREE and recycle it, too.

SCHEDULE YOUR FREE PICKUP
855-433-2700
ComEd.com/FridgeRecycling

ComEd | powering lives
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Size and other restrictions apply. Call or visit our website for details.
Smart Ideas[®] Energy Efficiency Program is funded by ComEd customers in compliance with Illinois law.

- ComEd FFR bill insert
- Size: 3.5" x 8.5"
- Reach: 1.9 million SF households each month

FFR Customer Experience



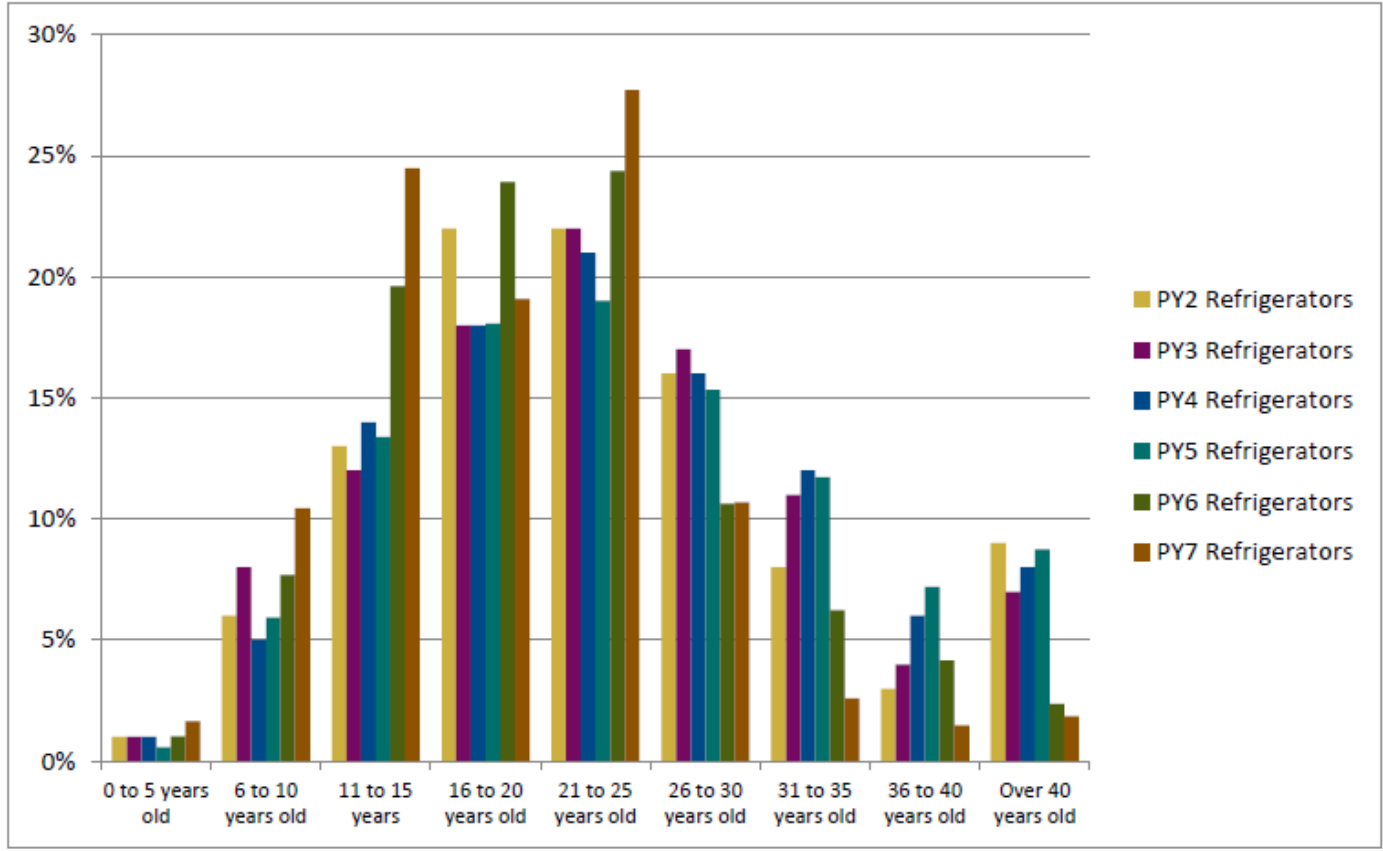
- Enrollment
- Establish Pickup Window
- Day of Collection
- Resolve Customer Issues (if any)
- Incentive Fulfillment



FFR Evaluation Results



Figure 6-2: Age of Refrigerators



Source: Evaluation analysis

Looking at trends in unit age over time, the PY7 unit data continues and extends the general trend toward newer refrigerators in the program. This year's data and the general trend across program years appropriately reflect the decline in the stock of older appliances over time due to the program.

FFR – Then & Now



- Worked with JACO Environmental until Nov. 2015
 - Recycled 280,000+ refrigerators & freezers during first 7.5 years.
- Program suspended and re-launched with Recleim in Apr 2016.
 - Recycled 5,000+ refrigerators & freezers during past 2 months.
- PY9 goal is 45,000 units, including room ACs.

FFR – Environmental Benefits



- Recycled 280,000+ refrigerators & freezers during first 7.5 years – kept out of landfills
 - Metal: 18,000+ tons
 - Plastic: 3,500+ tons
 - Glass: 700+ tons
- Plus refrigerant, oil, and mercury containing devices



- Recleim provides a clear chain of custody
 - Enrollment
 - Collection
 - De-manufacturing



FFR – Environmental Benefits



- Reclam provides an improved, advanced recycling process from the previous “bag & burn” method
 - More automated
 - Foam blowing agent from all units is processed/neutralized onsite
 - Materials are pelletized and well-segregated
- Material outflow destinations – domestic & international



ARPs are RAD: Quantifying Non-Energy Benefits in Appliance Recycling Programs

**Jason Christensen
Associate, The Cadmus Group**

Background



- Utility-sponsored recycling programs have historically focused only on energy benefits
- RAD introduced to encourage best environmental practices and going beyond what is required by federal law
- Cadmus developed method for quantifying non-energy benefits (NEBs)



Potential Non-Energy Benefits of RAD



- Potential benefits from proper disposal/reclamation of most materials, including:
 - Avoided GHGs
 - Reclaimed oil, copper, aluminum, plastic, and glass
 - Avoided PCB and mercury contamination
 - Reclaimed foam and fiberglass

Energy Efficiency Program Overview



- Utility-run energy efficiency programs generally require measures to pass cost-effectiveness screening
- All benefits and costs must be quantified and monetized

Present Value of Benefits

Present Value of Costs

$>1 = \text{☺}$

$<1 = \text{☹}$

Cost-Effectiveness Tests



Elements	TRC	RIM	UCT	PCT	SCT
BENEFITS					
Avoided Power Supply Costs	✓	✓	✓		✓
Avoided Capacity Costs	✓	✓	✓		✓
Bill Reductions				✓	
Non Energy Benefits	✓*				✓
Incentives				✓	
COSTS					
Direct Utility DSM Costs	✓	✓	✓	✓	✓
Direct Customer DSM Costs	✓			✓	✓
Utility Program Administration	✓	✓	✓		✓
Lost Revenues		✓			

TRC = Total resource cost test, **RIM** = Ratepayer Impact Measure, **UCT** = Utility Cost Test, **PCT** = Participant Cost Test, and **SCT** = Societal Cost Test

*Not all regulators accept non-energy benefits for TRC

NEBs Evaluation Process



Construct list of all materials recycled or destroyed

Calculate average weight or counts of deconstructed materials

Estimate monetary value

Develop non-program disposal scenarios

Estimate net benefits of program

Method



- Spreadsheet tool that monetizes:
 - Energy reduction
 - Benefits from reclaimed materials
 - Landfill offsets for recycled materials
 - Avoided water contamination
- Monetary values come from multiple sources
- Develop non program disposal scenarios
- Monetize benefits of program

Step 1.



Inventory of Recovered Materials

- Appliance recycler database provides list of materials
 - CFCs, HFCs, PCBs, foam, metal, oil
- RAD reports

Step 2.



Valuation of Raw Materials/Conversion Values

Benefit	Potential Sources
Reduced GHG emissions	Carbon market prices, EPA, Social Cost of Carbon
Reclaimed oil	Recycling/Scrap prices
Avoided oil contamination	Oil Spill Clean up Costs
Reclaimed ferrous metal	Recycling/Scrap prices, EPA WARM model
Reclaimed copper	Recycling/Scrap prices, EPA WARM model
Reclaimed aluminum	Recycling/Scrap prices, EPA WARM model
Reclaimed plastic	Recycling/Scrap prices, EPA WARM model
Reclaimed glass	Recycling/Scrap prices, EPA WARM model
Avoided PCB contamination	PCB Clean up Costs
Avoided mercury contamination	Mercury Clean up Costs, Public Health Data
Reclaimed foam	Recycler/Scrap prices
Avoided Landfill Space	Landfill tipping fees



Participant Surveys to Determine Non-Program Discard Scenarios

- “What would you have done with your appliance if you had not participated in the appliance recycling program?”
- Responses fall into one of five scenarios



Non-Program Discard Scenarios

- 1. Full Non-Compliance:** Worst-case scenario, no materials would be recycled, and all substances would be disposed of in an EPA-noncompliant manner
 - Example: dumping appliances in isolated areas
- 2. Modified Non-Compliance:** Unit would still be disposed of in an environmentally non-compliant manner, but materials with retail values (namely ferrous and non-ferrous metals) recycled
 - Example: abandoning a unit in a public place, such as leaving the appliance on the curb
- 3. Likely Minimum Compliance:** Minimum formal compliance, though not explicitly involve recycling, e.g., refrigerant and compressor oil disposed of in an EPA-compliant manner
 - Example: taking a unit to a dump



Non-Program Discard Scenarios, cont.

4. **Full Compliance Recycling:** Non-program recycling facility
 - Much of the unit would be broken down and recycled, full compliance for all substances, save for the blowing agent
5. **Full Compliance, Utility-Sponsored RAD Program:** Program case, with benefits realized that represented the program's gross environmental benefits

Step 3.



Non-Program Discard Scenario Example

Survey Response	Proportion	Likely Scenario
Sold to private individual	16%	N/A
Gave away to individual	18%	N/A
Sold to appliance dealer	4%	N/A
Given to charity organization	6%	N/A
Picked up, delivery service with new purchase	20%	2, 3, 4
Haul to landfill or dump on own	8%	1, 2, 3
Haul to waste management/recycling facility	10%	4
Hired someone to haul away	2%	3
Left on curb	1%	2
Kept it	15%	N/A

Step 4.



Calculation of Net Benefits

Benefit	Units	Gross Benefits		Net Benefits	
		Amount (in units)	Monetary Value	Amount (in units)	Monetary Value
GHG emissions	MTCO ₂ E	2.83	\$16.05-\$48.14	1.96	\$11.11-\$33.34
Reclaimed oil	lbs.	0.58	\$0.54-\$1.61	0.58	\$0.54-\$1.61
Avoided oil contamination	gal.	0.08	\$1.76-\$57.84	0.08	\$1.76-\$57.84
Reclaimed ferrous metal	lbs.	125.00	\$5.63-\$16.88	68.88	\$3.10-\$9.30
Reclaimed copper	lbs.	4.06	\$10.38	1.82	\$4.65
Reclaimed aluminum	lbs.	4.00	\$1.33-\$3.99	1.76	\$0.59-\$1.76
Reclaimed plastic	lbs.	20.00	\$1.00-\$3.00	14.10	\$0.70-\$2.12
Reclaimed glass	lbs.	2.43	\$0-\$0.01	2.30	\$0-\$0.01
Avoided PCB contamination	lbs.	0.0024	\$5.35-\$16.05	0.0016	\$3.57-\$10.70
Avoided mercury contamination	lbs.	0.0002	\$0.19-\$0.81	0.0001	\$0.10-\$0.40
Reclaimed foam	lbs.	7.47	\$0.73-\$2.19	7.47	\$0.73-\$2.19
Reclaimed fiberglass	lbs.	0.00	\$0	0.00	\$0
Environmental Benefits Total			\$43-\$160		\$27-\$124

Benefits are calculated per-appliance



The Non-energy Benefits (NEBs) of EPA's RAD Program

Christine Gajewski
Senior Associate, ICF International



Overview



- **What** are the non-energy benefits associated with RAD?
- **Why** is there a need to quantify non-energy benefits?
- **How** does RAD quantify non-energy benefits for partners?

What are the NEBs associated with RAD?



RAD NEBs	Cost Savings	GHG Emissions Avoided	ODS Emissions Avoided	Other
Recycling ferrous and non-ferrous metals	✓	✓	N/A	✓
Recycling plastics	✓	✓	N/A	✓
Avoided release of used oil	Not estimated	Not estimated	N/A	✓
Avoided release of mercury	Not estimated	Not estimated	N/A	✓
Avoided release of PCBs	Not estimated	Not estimated	N/A	✓
Avoided refrigerant emissions	✓	✓	✓	✓
Avoided foam emissions	✓	✓	✓	✓

Let's take a closer look at each RAD NEB...

What are the NEBs associated with RAD? (continued)



Recycling durable materials:

- Durable materials include:
 - Ferrous metals (e.g., steel) and non-ferrous metals (e.g., aluminum and copper)
 - Plastics and glass
- Benefits include:
 - Cost savings associated with receiving payments from scrap yards
 - GHG emissions avoided “upstream” by making a product with recycled materials vs. virgin materials
 - Landfill space savings

What are the NEBs associated with RAD? (continued)



Properly managing waste:

- Waste includes:
 - Used oil ([40 CFR Part 279](#))
 - Mercury-containing components ([40 CFR Part 273](#))
 - Polychlorinated biphenyl (PCB)-containing capacitors ([40 CFR Part 761](#))
- Benefits include:
 - Avoided release of used oil to the environment – leading to reductions in human health and ecosystem impacts
 - Avoided release of mercury – reducing neurological and development impacts
 - Avoided release of PCBs – resulting in fewer carcinogenic, developmental, and reproductive effects

What are the NEBs associated with RAD? (continued)



Recovering ODS and HFC refrigerants and foam blowing agents:

- Refrigerants and foam blowing agents include:
 - Refrigerants: CFC-12, HCFC-22, HFC-134a, R-500, R-407C, R-410A
 - Foam blowing agents: CFC-11, HCFC-141b, HFC-134a, HFC-245fa
- Benefits include:
 - ODS emissions avoided – protecting the ozone layer
 - GHG emissions avoided – protecting the climate system
 - Cost savings associated with monetized value of avoided CO₂ emissions, skin cancer, cataracts, and immune system suppression

Why is there a need to quantify NEBs?



- Cost-effectiveness of some appliance recycling programs (ARPs) may decline as programs mature
- Some utilities are facing increasing pressure from Public Utility Commissions (PUCs) to demonstrate program effectiveness
- Incorporating NEBs into cost-effectiveness calculations can help justify the continuation of programs
- Quantifying NEBs can also help partners communicate the benefits of RAD



How does RAD quantify NEBs for partners?



- RAD quantifies cost savings and emissions avoided for:
 - Recycling durable materials
 - Avoided refrigerant emissions
 - Avoided foam emissions
- RAD also quantifies amounts of properly recovered components, including:
 - Gallons of used oil recycled or properly disposed
 - Number of PCB-containing capacitors destroyed
 - Number of mercury-containing components recycled or properly disposed



How does RAD quantify NEBs for partners? (continued)



Recycling durable materials:

- RAD calculates cost savings based on the U.S. annual average market value of payments received from scrap yards
 - Actual payments may fluctuate significantly within and across years
 - RAD calculations are based on ScrapIndex.com's 2013 Annual Historical Market Price Information (available at www.scrapindex.com)
- To calculate GHG emissions avoided, RAD uses emission factors specific to each durable material and multiplies them by the weight reported by partners
 - Emission factors are based on U.S. EPA's Waste Reduction Model (WARM) (available at <https://www.epa.gov/warm>)
 - WARM factors calculate the difference between emissions from the alternative scenario (i.e., recycling) and emissions from the baseline scenario (i.e., landfilling)

How does RAD quantify NEBs for partners? (continued)



Avoided refrigerant and foam emissions:

- GHG emissions avoided = quantity of refrigerant/foam recovered x global warming potential (GWP)
 - Calculated based on 100-year GWPs provided in the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4)
- ODS emissions avoided = quantity of refrigerant/foam recovered x ozone depletion potential (ODP)
 - Based on ODP values provided in the Montreal Protocol
- Emissions from refrigerant destruction and reclamation are assumed to be 0.01% and 1.5%, respectively
- Emissions from foam destruction and reclamation are assumed to be 0.09% and 1.5%, respectively
 - Baseline emissions are assumed to be 100% (i.e., no anaerobic degradation of blowing agent in landfills)

How does RAD quantify NEBs for partners? (continued)



Avoided refrigerant and foam emissions (continued):

- RAD calculates cost savings based on the California auction reserve price
 - Reserve price = minimum price that emission allowances can be sold for (each allowance is equivalent to one metric ton of carbon dioxide equivalent (CO₂e))
 - Calculated based on reserve price from February 25, 2015, which was \$12.10 per ton CO₂e (<https://www.wci-auction.org/>)

How does RAD quantify NEBs for partners? (continued)



Calculated RAD NEBs from Properly Disposing of 1,000 Old Refrigerators (20+ years old)*

Non-energy Benefits	Cost Savings	GHG Emissions Avoided (MTCO ₂ e)	ODS Emissions Avoided (ODP-weighted kg)	Other
Recycling ferrous and non-ferrous metals	\$5,820	145	N/A	✓
Recycling plastics	\$2,680	14	N/A	✓
Avoided release of used oil	Not estimated	Not estimated	N/A	✓
Avoided release of mercury	Not estimated	Not estimated	N/A	✓
Avoided release of PCBs	Not estimated	Not estimated	N/A	✓
Avoided refrigerant emissions	\$27,140	2,240	210	✓
Avoided foam emissions	\$25,050	2,070	440	✓
NEB Sub-Total:	\$60,690	4,468	650	✓

*Values are based on average quantities of materials recovered per unit, based on 2013 RAD partner reports. Units are assumed to contain CFC-12 refrigerant and CFC-11 foam blowing agent.

How does RAD quantify NEBs for partners? (continued)



- Partners have access to RAD calculations in annual reporting forms
 - Step 5: Summary of Program's Environmental Benefits
 - Reporting forms are being updated to include simple figures and GHG equivalencies
- Partners also have access to RAD calculations in the new benefits piece, "The Benefits of EPA's RAD Program"
 - Word document was distributed to partners on February 17th
 - PDF version of document will be available soon

EPA United States ENVIRONMENTAL PROTECTION AGENCY

Step 5: Summary of Program's Environmental Benefits
 Instructions: No action is required. The tables below are for reference only and are self-populated based on the activity data reported in the Step 3 worksheet(s).

Emissions Avoided
 The table below presents the cumulative avoided emissions of greenhouse gas and ozone depleting substances resulting from your program. It is calculated based on assumptions of destruction and reclaimation efficiencies developed by the U.S. EPA. After it is assumed that removing units from the electrical grid will result in environmental benefits if your program offers an incentive to retire old working appliances. In addition, the estimated ozone and greenhouse gas benefits associated with avoided releases of refrigerant and flame blowing agent are subject to change as more information becomes available (e.g., regarding loss rates associated with various recovery technologies and practices, baseline emissions, global warming potentials, etc.).

Appliance Component	Total Amount Prevented from Being Emitted		Greenhouse Gas (GHG) Emissions Avoided (MTCO ₂ e) ^a	Ozone Depleting Substances Avoided (ODP-Weighted kg) ^a
	(lb)	(kg)		
Refrigerant^b				
CFC-12 Reclaimed	0.0	0.0	0.0	0.0
HCFC-22 Reclaimed	0.0	0.0	0.0	0.0
HFC-134a Reclaimed	8.8	3.1	4.5	0.0
R-500 Reclaimed	0.0	0.0	0.0	0.0
R-407C Reclaimed	0.0	0.0	0.0	0.0
R-410A Reclaimed	0.0	0.0	0.0	0.0
Reclaimed	8.8	3.1	4.5	0.0
CFC-12 Stockpiling with Intent to Reclaim	0.0	0.0	0.0	0.0
HCFC-22 Stockpiling with Intent to Reclaim	0.0	0.0	0.0	0.0
HFC-134a Stockpiling with Intent to Reclaim	0.0	0.0	0.0	0.0
R-500 Stockpiling with Intent to Reclaim	0.0	0.0	0.0	0.0
R-407C Stockpiling with Intent to Reclaim	0.0	0.0	0.0	0.0
R-410A Stockpiling with Intent to Reclaim	0.0	0.0	0.0	0.0
Stockpiling with Intent to Reclaim	0.0	0.0	0.0	0.0
CFC-12 Destroyed	2,947.1	1,291.4	14,876.3	1,291.4
HCFC-22 Destroyed	0.0	0.0	0.0	0.0





Questions?

For more information



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