The Benefits of EPA's Responsible Appliance Disposal (RAD) Program

Background

It is estimated that more than 11 million refrigerators/freezers, 6 million window air conditioning units, and 1 million dehumidifiers are disposed of annually in the United States. To reduce the harmful impacts these appliances have on the environment when they are taken out of service, federal law requires that all refrigerant is recovered prior to dismantling or disposal and that universal waste (e.g., mercury, used oil, and polychlorinated biphenyls [PCBs]) is properly managed and stored. Federal law, however, does not require the recovery of appliance foam blowing agents, which contribute to ozone depletion and climate change if released into the atmosphere. To encourage the proper handling of appliance foam, as well as compliance with federal law regarding safe appliance disposal, the U.S. Environmental Protection Agency (EPA) launched the Responsible Appliance Disposal (RAD) Program—a voluntary partnership that has achieved significant environmental benefits since its inception in 2006.

What are the concerns over appliance disposal today?

The resale of old, inefficient units leads to increases in energy consumption, energy costs, and greenhouse gas (GHG) emissions. At the time of disposal, many refrigerated appliances are collected through pick-up programs offered by municipalities or retailers (when a new unit is purchased and delivered). Municipalities and retailers typically subcontract the disposal of appliances to third parties, who often refurbish and resell an estimated 25% of these units. Old, inefficient appliances that are put back on the electricity grid continue to operate, consuming excessive amounts of electricity. The industry often refers to such reuse as "recycling." While it can be environmentally beneficial to reuse some second-hand appliances, extending the lifetime of old units can take an undue toll on our energy grid, resulting in higher energy costs for consumers and environmental and health impacts for all.

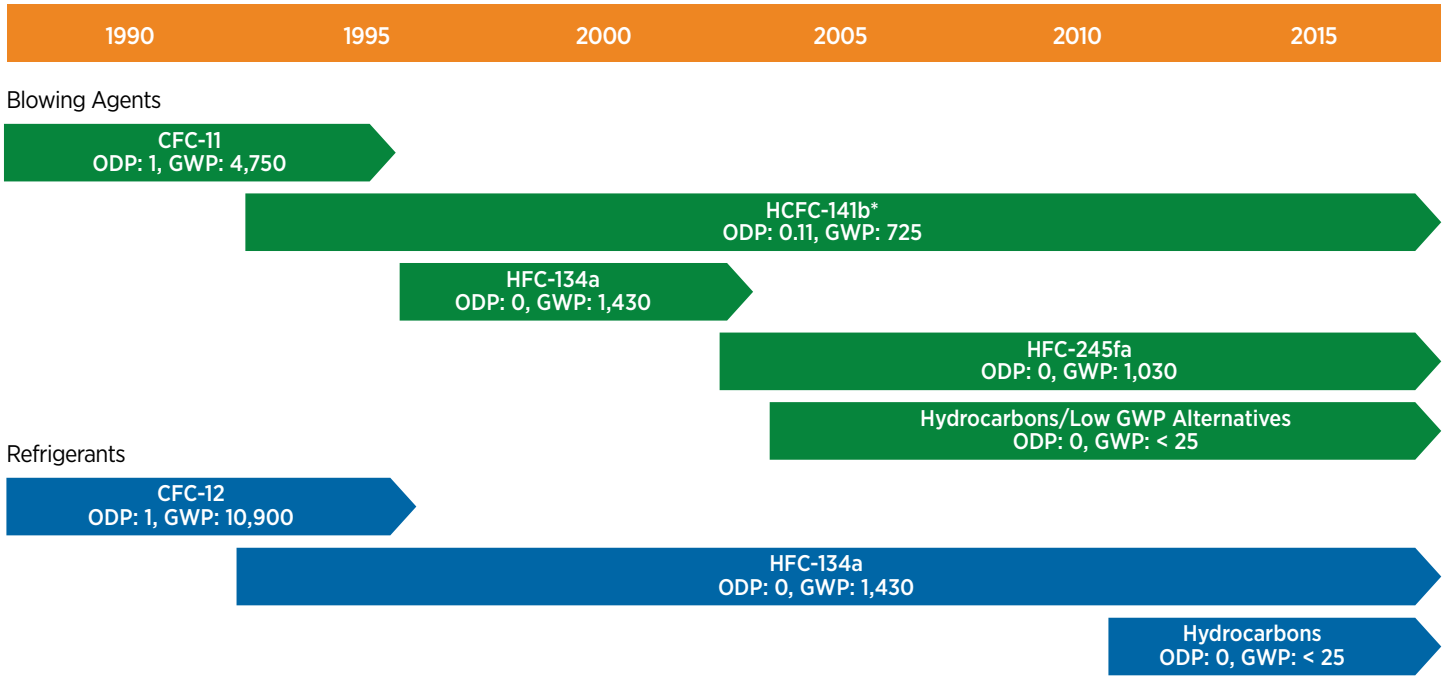
Appliance "recycling" is a term used loosely in the industry that can mean many things—the resale or reuse of an old unit, or the placement of the unit's valuable metals on the recycling market, while the remaining durable components are landfilled and some hazardous substances are released into the environment. "Recycling" is not synonymous with best environmental practices.

Only the most valuable metals get recycled, while other durable goods get landfilled. Units that are not fit for resale are typically sent to scrap metal companies, where valuable metals are salvaged for sale on the recycling market, but plastics, glass, and other durable materials are typically shredded and landfilled. The industry often refers to this practice as "appliance recycling."

Refrigerants and other harmful substances may be released to the environment, against federal requirements. Federal law requires that all refrigerant be recovered prior to dismantling or disposal and that universal waste—including mercury—as well as used oil and PCBs be properly managed and stored. However, because there may be little to no economic incentive for the proper disposal of these materials, their ultimate fate is often unknown. There have been reports of appliance dumping, venting of refrigerant, and release of hazardous components into the environment. Some of these improper disposal practices (i.e., the release of refrigerant and other hazardous components) may still be referred to as "appliance recycling" if the metals or other durable components are recycled.

Insulating foam blowing agents are released into the environment, contributing to stratospheric ozone depletion and climate change. Although federal law does not require the recovery and proper treatment of the insulating foam that lines the appliance walls of refrigerators, this foam contains substances that are potent GHGs and that may, depending on the vintage of the unit, deplete the ozone layer. Historically, appliance foam was manufactured with chlorofluorocarbon (CFC) or hydrochlorofluorocarbon (HCFC) blowing agents, both of which are potent ozone depleting substances (ODS) and GHGs. These ODS have been phased out under the Clean Air Act, although they continue to be seen in new appliances imported into the United States. Typically, newer units contain hydrofluorocarbon (HFC) blowing agents, which are safe for the ozone layer but are still potent GHGs. Increasingly, units are being manufactured using climate-friendly blowing agents, such as hydrocarbons and fluorinated olefins. But, given the long lifetime of refrigerators, we will continue to see ODS and GHG blowing agents reaching our landfills for decades to come.

Foam Blowing Agents and Refrigerants Contained in Refrigerators Sold in the United States



*HCFC-141b foams were phased out of new equipment manufactured in the United States starting in 2003, but continue to be produced in other countries and imported into the United States.

ODP = Ozone depletion potential. This is the relative amount of degradation caused to the ozone layer, with CFC-11 being fixed at an ODP of 1.0. Values shown are based on the Montreal Protocol.

GWP = Global warming potential. This is the relative measure of how much heat a GHG traps in the atmosphere relative to CO_2. Calculations are based on 100-year direct GWPs provided in the Intergovernmental Panel on Climate Change Fourth Assessment Report: Climate Change 2007.

How do RAD partners help?

Partners in EPA's RAD Program commit to collecting used refrigerated appliances and implementing best practices for the recycling/disposal of these units, which go beyond federal laws. This means:

- ✓ Complying with laws on the recovery of refrigerant, used oil, and PCBs
- ✓ Recovering appliance foam
- ✓ Promoting recycling of all durable goods
- ✓ Promoting the permanent retirement of old, inefficient appliances to save energy

RAD partners also commit to annual reporting to track the environmental impacts of their efforts.

RAD Benefits from Properly Disposing of 1,000 Old Refrigerators (20+ years old)[a]

Benefits	Cost Savings	GHG Emissions Avoided ($MTCO_2eq.$)[b]	ODS Emissions Avoided (ODP-Weighted kg)	Other Benefits
Energy savings from preventing appliance resale/reuse[c]	$766,700[d]	4,230	N/A	Reduces energy consumption
Recycling ferrous and non-ferrous metals[e]	$5,820[f]	145	N/A	Saves landfill space and energy by recycling rather than landfilling durable materials
Recycling plastics and glass in lieu of landfill	$2,680[f]	14	N/A	Saves landfill space and energy by recycling rather than landfilling durable materials
Avoided release of used oil	Not estimated	Not estimated	N/A	Avoided damage to the liver, brain, immune system, and reproductive system
Avoided release of mercury	Not estimated	Not estimated	N/A	Avoided impairment of neurological development and other problems associated with the human nervous system
Avoided release of PCBs	Not estimated	Not estimated	N/A	Avoided carcinogenic and non-cancerous effects
Avoided refrigerant emissions	$27,140[g]	2,240	210	Avoided cases of skin cancer, cataracts, skin problems, and immune system suppression
Avoided foam emissions	$25,050[g]	2,070	440	Avoided cases of skin cancer, cataracts, skin problems, and immune system suppression
TOTAL:	**$827,390**	**8,698**	**650**	

[a] 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.

[b] Metric tons of carbon dioxide equivalent ($MTCO_2eq.$) calculated based on 100-year GWPs provided in the Intergovernmental Panel on Climate Change Fourth Assessment Report: Climate Change 2007.

[c] Assumes that a 21-year-old unit has 6.89 remaining years of useful life based on the U.S. Department of Energy's Technical Support Document for the 2009 Final Rule on Residential Refrigerators, Refrigerator-Freezers and Freezers, available at: www1.eere.energy.gov/buildings/appliance_standards/pdfs/refrig_finalrule_tsd.pdf. Assumes each refrigerator consumes an average of 890 kWh/year based on RAD partner reporting.

[d] Assumes an average 2014 U.S. electricity price of $0.125/kWh based on the U.S. Energy Information Administration's (EIA's) Electric Power Monthly electricity statistics, available at: http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_03.

[e] Ferrous and non-ferrous metals are typically recycled in the United States due to their high economic value, though such practices are ensured by RAD partners as part of their commitment to using best environmental practices.

[f] Calculated based on the U.S. annual average market value of payments received from scrap yards, as provided in ScrapIndex.com's 2013 Annual Historical Market Price Information (available at www.scrapindex.com). Actual values of scrap yard payments may fluctuate significantly within and across years.

[g] Calculated using the California auction reserve price on February 25, 2015, which was $12.10 per ton CO_2eq. For more information, visit https://www.wci-auction.org.

What are the benefits?

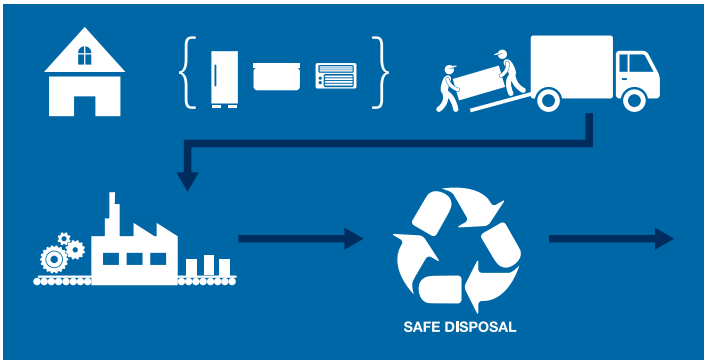
As a result of their commitments, RAD partners have successfully reduced emissions of ODS and GHGs. Partners have also reduced energy consumption, increased the recycling of durable goods, and ensured the proper handling of hazardous substances.

What have RAD partners accomplished so far?

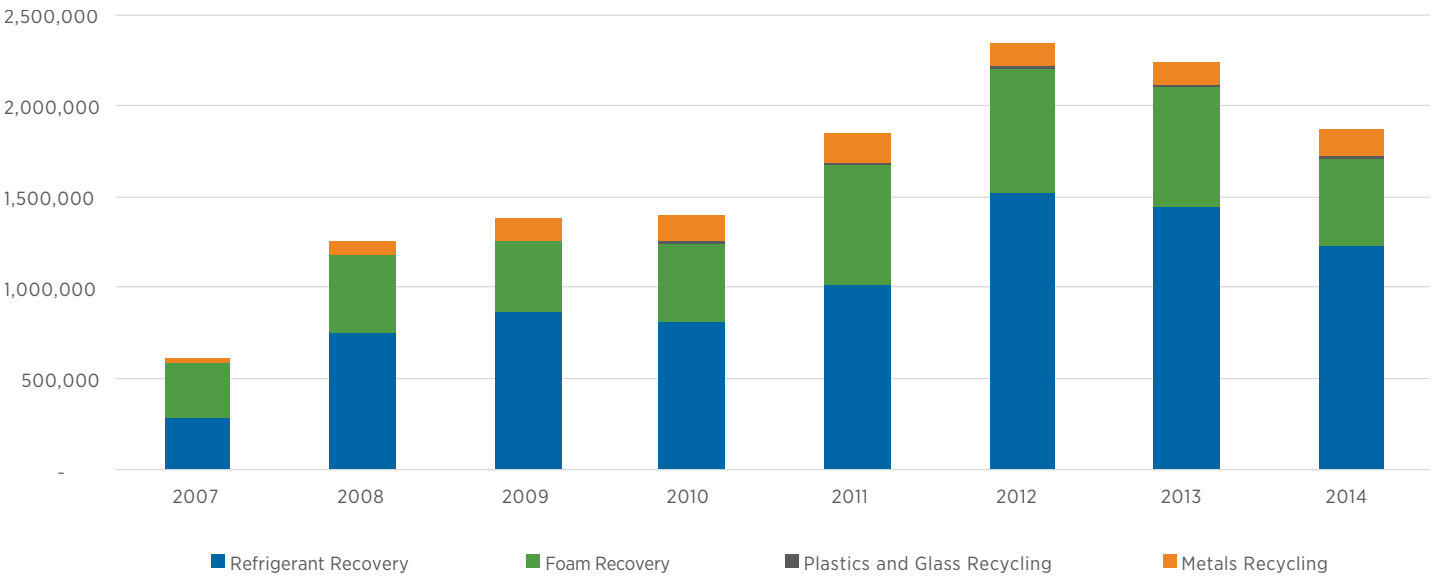
From 2007 through 2014, RAD partners achieved emissions reductions of over 12.9 million $MTCO_2eq$. Of this, 61% can be attributed to recovering refrigerants, 31% to recovering foam blowing agents, and 8% to recycling durable materials.

RAD partners have also prevented 725 million lbs. of ferrous metals (e.g., steel), 70 million lbs. of non-ferrous metals (e.g., copper), 126 million lbs. of plastic, and 19 million lbs. of glass from going to landfills. Additionally, RAD partners have ensured the proper handling of toxic or hazardous materials, including 569,000 gal. of used oil, 223,000 PCB-containing capacitors, and 121,000 mercury-containing components.

Since 2007, RAD partners achieved GHG reductions of over 12.9 million $MTCO_2eq$., which is equivalent to taking over 3 million passenger cars off the road for one year.



GHG Emissions Avoided through Proper Appliance Disposal by RAD Partners ($MTCO_2eq$.)



Note: Ferrous and non-ferrous metals are typically recycled in the United States due to the high economic value of metals, though such practices are ensured by RAD partners as part of their commitment to using best environmental practices.

In addition, RAD's utility partners ensure that old appliances being disposed of by one household do not get reused by other households on the grid. They have done this by offering cash for old appliances and/or rebates on the purchase of new ENERGY STAR® units, as part of Demand-Side Management (DSM) programs aimed at reducing electricity use through energy efficiency and conservation.

In recent years, many of these utilities have joined forces with other RAD retail partners who allow them to broaden their reach into consumer appliance channels. Together, these partners have made impressive strides in collecting a growing number of units and saving an increasing amount of energy. Since RAD's inception, partners have reduced energy use by more than 20 billion kWh by permanently removing old refrigerators, stand-alone freezers, window air conditioning units, and dehumidifiers from the grid. This has collectively resulted in more than $2.5 billion in consumer savings.

Where can I learn more?

To learn more about:

- EPA's RAD Program: visit https://www.epa.gov/rad or contact RAD Program Manager Sally Hamlin at Hamlin.Sally@epa.gov.
- Safe disposal procedures for refrigerated appliances: visit https://www.epa.gov/section608/safe-disposal-procedures-household-appliances-use-refrigerants.
- EPA's ENERGY STAR Program: visit https://www.energystar.gov/products/recycle/find_fridge_freezer_recycling_program.