

2013
Annual
Report





The U.S. Environmental Protection Agency's (EPA's) Responsible Appliance Disposal (RAD) Program

is a partnership launched in October 2006 to protect the ozone layer, cut greenhouse gas (GHG) emissions, and benefit communities. The RAD Program recognizes partners that ensure the disposal of refrigerant-containing appliances while using the best environmental practices available. The RAD Program invites utilities, retailers, manufacturers, local governments, universities, and other qualifying organizations to become partners. The RAD Program also invites states to become RAD affiliates to promote the program to potential partners and increase environmental benefits for their states and communities.

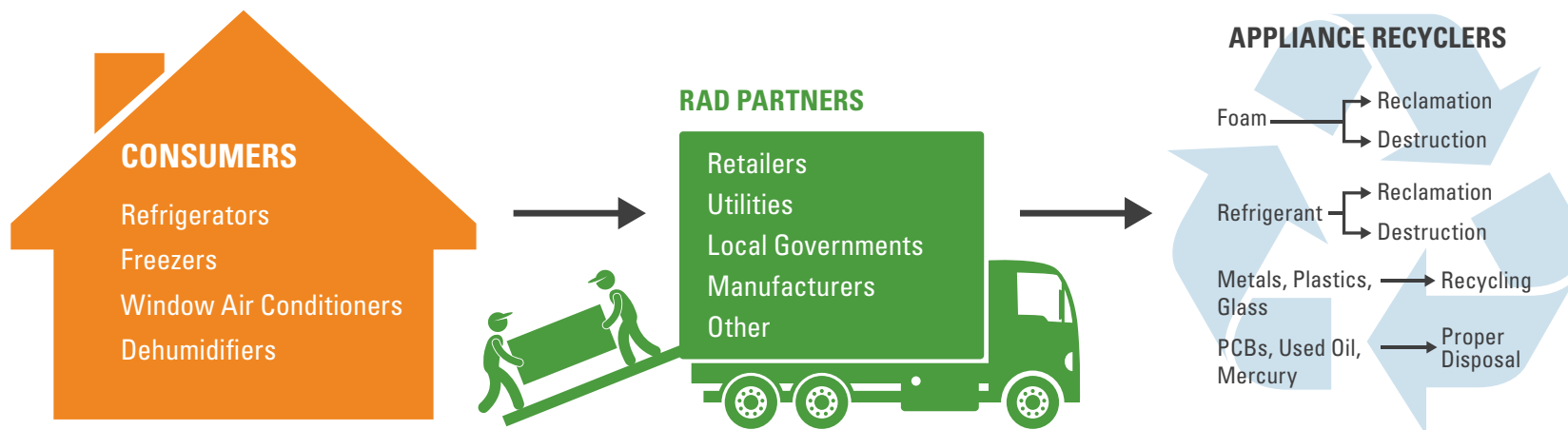
What is RAD?

In 2013, an estimated 11.1 million refrigerators and freezers, 5.6 million window air conditioning units, and 800,000 dehumidifiers were disposed of in the United States. These units contain ozone-depleting substances (ODS), other GHGs, hazardous substances, and recyclable materials.

Section 608 of the Clean Air Act requires recovery of chlorofluorocarbon (CFC) and hydrochlorofluorocarbon (HCFC) refrigerant prior to appliance dismantling or disposal. Federal law also requires proper management and storage of universal waste (e.g., mercury), used oil, and polychlorinated biphenyls (PCBs) prior to appliance disposal or recycling. However, federal law does not require the recovery of appliance foam, which is also a source of ODS and GHG emissions, or recovery of hydrofluorocarbons (HFCs), which are potent GHGs commonly used in refrigerant-containing appliances. Options for proper disposal may be limited, and up to 25% of disposed refrigerators/freezers are resold onto the secondary market.* The continued use of older, less efficient models demands more energy from the nation's grid.

The RAD Program is a partnership that protects the ozone layer and cuts emissions of GHGs by working with utilities, retailers, manufacturers, state affiliates, and others to dispose of appliances using environmentally sound practices and technology. RAD partners work with recyclers to ensure the proper recovery of both refrigerant *and* foam from end-of-life appliances. They also save landfill space and reduce energy consumption by ensuring the recycling of durable materials, and keep communities clean by preventing appliance dumping and the release of hazardous/toxic materials. Some RAD partners further reduce energy consumption by encouraging appliance owners to permanently retire old, inefficient units. RAD partners achieve these benefits by collecting old refrigerant-containing appliances from consumers and responsibly disposing of them with the help of an appliance recycler who uses best environmental practices (see figure below).

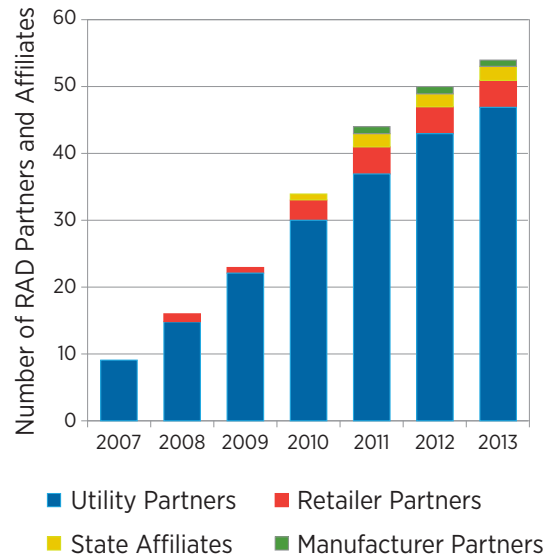
This annual report presents RAD partners' environmental achievements for 2013.



*Based on recent studies published by Cadmus Group, Innovologie, NMR Group, and the U.S. Department of Energy.

Program Growth

RAD has grown significantly over the past seven years. In 2013 alone, RAD expanded from 50 to 54 partners and affiliates.



RAD Partners and Affiliates

Fifty-two partners and two state affiliates reported their accomplishments for the RAD Program from January 1, 2013 through December 31, 2013:

- American Electric Power (OH)
- Appliance Smart (Nationwide)
- Arizona Public Service (AZ)
- Austin Energy (TX)
- Avista Utilities (WA)
- Baltimore Gas & Electric Company (MD)
- Best Buy (Nationwide)
- Cape Light Compact (MA)
- City of Burbank Water & Power (CA)
- City of Fort Collins Utilities (CO)
- City of Palo Alto Utilities (CA)
- City of Riverside Public Utilities (CA)
- Commonwealth Edison (IL)
- Consumers Energy (MI)
- Dayton Power & Light Company (OH)
- Delmarva Power (DE, MD, VA)
- Efficiency Vermont (VT)
- Energy Trust of Oregon (OR)
- Focus on Energy (WI)
- GE Appliances (Nationwide)
- Georgia Power (GA)
- The Home Depot (Nationwide)
- Hoosier Energy (IN)
- Idaho Power (ID)
- Indiana Michigan Power (IN, MI)
- Lodi Electric Utility (CA)
- Long Island Power Authority (NY)
- Los Angeles Department of Water & Power (CA)
- Louisville Gas & Electric and Kentucky Utilities (KY)
- MidAmerican Energy Company (IA, IL, NE, SD)
- National Grid (MA, NH, NY, RI)
- New York State Energy Research & Development Authority (NY)
- Northern Indiana Public Service Company (IN)
- NSTAR (MA)
- NV Energy (NV)
- Pacific Gas & Electric Company (CA)
- PacifiCorp (CA, ID, MT, OR, UT, WA, WY)
- Pepco (DC, MD)
- PNM (NM)
- Puget Sound Energy (WA)
- Roseville Electric (CA)
- Sacramento Municipal Utility District (CA)
- Salt River Project Power and Water (AZ)
- San Diego Gas & Electric (CA)
- Sears Home Services (Nationwide)
- Silicon Valley Power (CA)
- Snohomish Public Utility District No. 1 (WA)
- Southern California Edison (CA)
- Southern Maryland Electric Cooperative (MD)
- UGI Utilities (MD, PA)
- Unitil (MA, ME, NH)
- Vectren Energy Delivery (IN, OH)
- West Virginia Department of Environmental Protection (WV)
- Western Massachusetts Electric Company (MA)

Utilities, Retailers, and Manufacturers



State Affiliates



2013 PROGRAM ACTIVITIES

May 2013:
GE/AAP Podcast
This podcast featured the advanced recycling efforts of General Electric (GE) Appliances, ARCA Advanced Processing (AAP), and Home Depot. Listen in at:
<http://www.epa.gov/region03/multimedia/playercontents/audio/RAD2.html>

September 2013:
RAD Working Group on Reporting Form Updates

RAD partner discussions resulted in reporting form updates to enhance transparency and minimize user burden.

December 2013:
Annual Reporting Form Webinar

RAD Partner Activities

In 2013, RAD partners advanced appliance recycling by participating in collaborative working groups, webinars, and podcasts to share best practices. RAD partners also launched innovative promotions and campaigns to raise consumer awareness about safe appliance disposal.

Innovative RAD Partner Promotions and Campaigns

- **NSTAR** and **National Grid** partnered on a promotion where individuals who recycled refrigerated appliances could win a chance to meet a Boston Red Sox player. The event resulted in a large up-tick in scheduled pickups.
- **Focus on Energy** and **Dayton Power & Light** each implemented campaigns to find the oldest fridges in Wisconsin and Ohio, respectively. The winners were fridges from the 1930s!
- **Energy Trust of Oregon** partnered with the Oregon Food Bank to launch their “Fill A Fridge” campaign. This program gave customers the option to donate their recycling incentives directly to the food bank and raised \$31,960!



The Pembroke softball team, nominated by the winning NSTAR/National Grid customer, met former Red Sox player Jonny Gomes.

Photo Credit: NSTAR/National Grid



Bill insert announcing the winner of Dayton Power & Light's Oldest Fridge Contest.

Photo Credit: Dayton Power & Light



Flyer for Energy Trust of Oregon's “Fill A Fridge” Campaign.

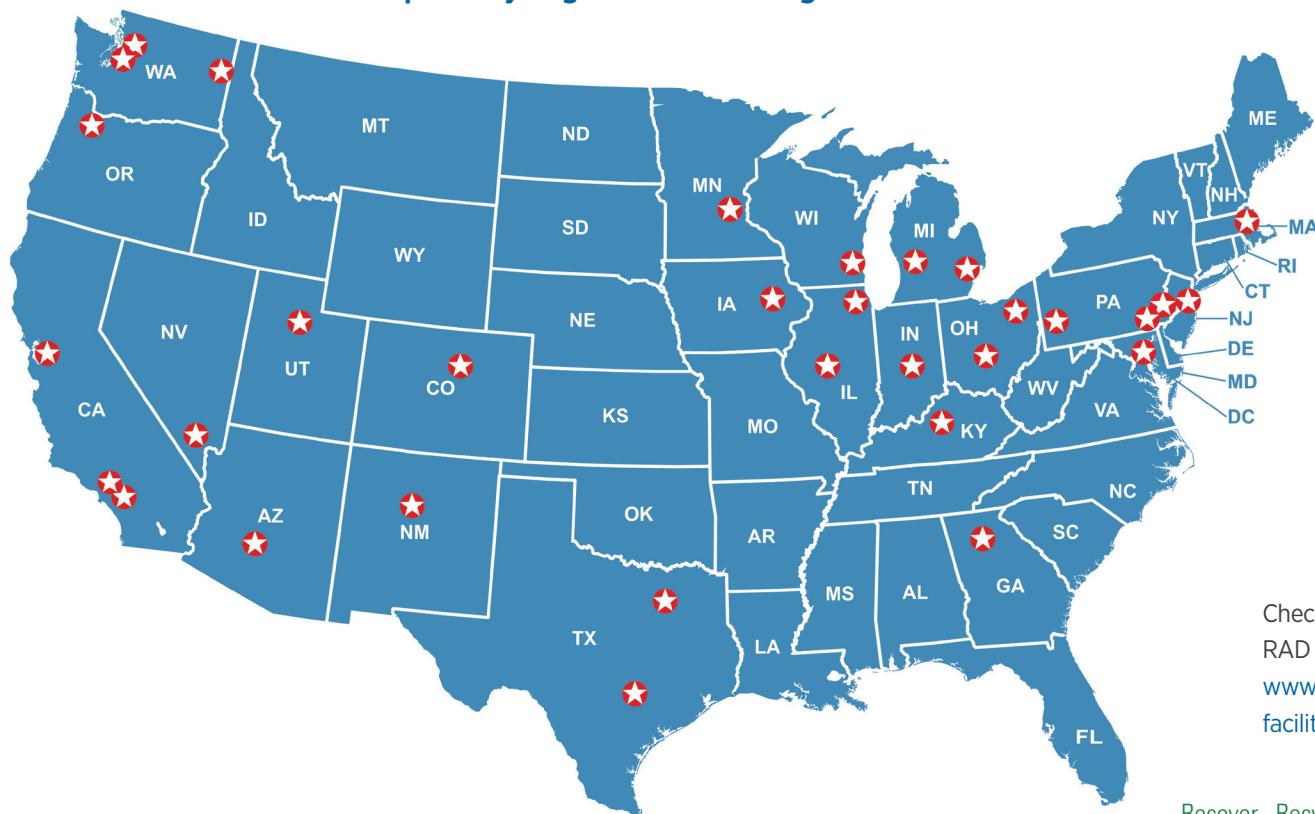
Photo Credit: Energy Trust of Oregon

RAD Recycling Facilities

Since the launch of the RAD Program in 2006, there are five times more appliance recycling facilities that service five times the number of states. The 34 facilities operating today have more options in their foam recovery technologies, and more are expected to come on line in the near future.

- 30 states have RAD Utility Partner programs.
- 23 states have recycling facilities servicing RAD partners.
- Within the facilities, the following foam recovery and processing methods are used:
 - Manual foam recovery without processing
 - Manual foam recovery with automated foam processing (e.g., Adelmann and JACO Polyurethane Foam Degasser)
 - Fully automated foam recovery and processing (e.g., JACO SEG-II and UNTHA Recycling Technology [URT] System)

Map of Recycling Facilities Servicing RAD Partners



Carbon Savings from Foam Recovery

If foam were recovered from all refrigerators and freezers disposed in the United States, approximately 7 million metric tons of carbon dioxide equivalent (MMT CO_2eq) would be avoided per year—equivalent to the carbon sequestered by 5.7 million acres of U.S. forests in one year.*

*U.S. EPA estimate, assuming 5% blowing agent recovery loss.

Check out the interactive RAD Facilities Map at www2.epa.gov/rad/appliance-recycling-facilities-servicing-rad-partners



In 2013, Consumers Energy helped nearly 27,000 Michigan customers recycle their old refrigerators or freezers, providing them with a free pick-up and \$50 rebate. Unplugging them has saved over 31,000 megawatt-hours of electricity in 2013 alone. To learn more, visit www.ConsumersEnergy.com/recycle.

Photo credit: Consumers Energy

“ In 2014, Consumers Energy will achieve a milestone of responsibly recycling over 100,000 appliances, following the RAD guidelines and best practices. We are proud of this achievement and our collaboration with RAD and other utilities. This relationship helps us provide our 1.8 million electric customers in Michigan with reliable and affordable energy that is sustainable. We highly value our retail partnerships introduced through RAD, and these partnerships continue to help drive high program satisfaction from our customers. ”

Garrick Rochow

Vice President of Customer Operations and Quality,
Consumers Energy - Michigan

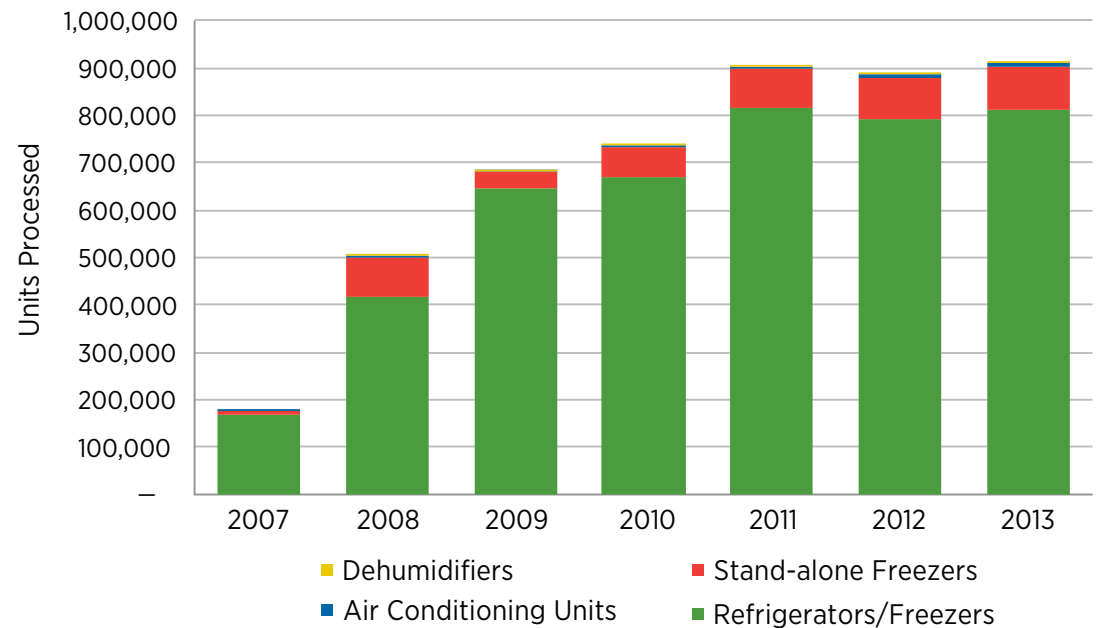
Results

In 2013, RAD's 52 partners collected and processed a total of 910,891 refrigerant-containing appliances, including:

- 811,458 refrigerators
- 89,905 stand-alone freezers
- 7,474 window air conditioning units
- 2,054 dehumidifiers

By disposing these units using the best available practices, RAD partners have helped protect the ozone layer, cut GHG emissions, reduce energy use, and increase recycling. The environmental benefits are described in the following pages.

Number of Appliances Processed by RAD Partners, 2007–2013

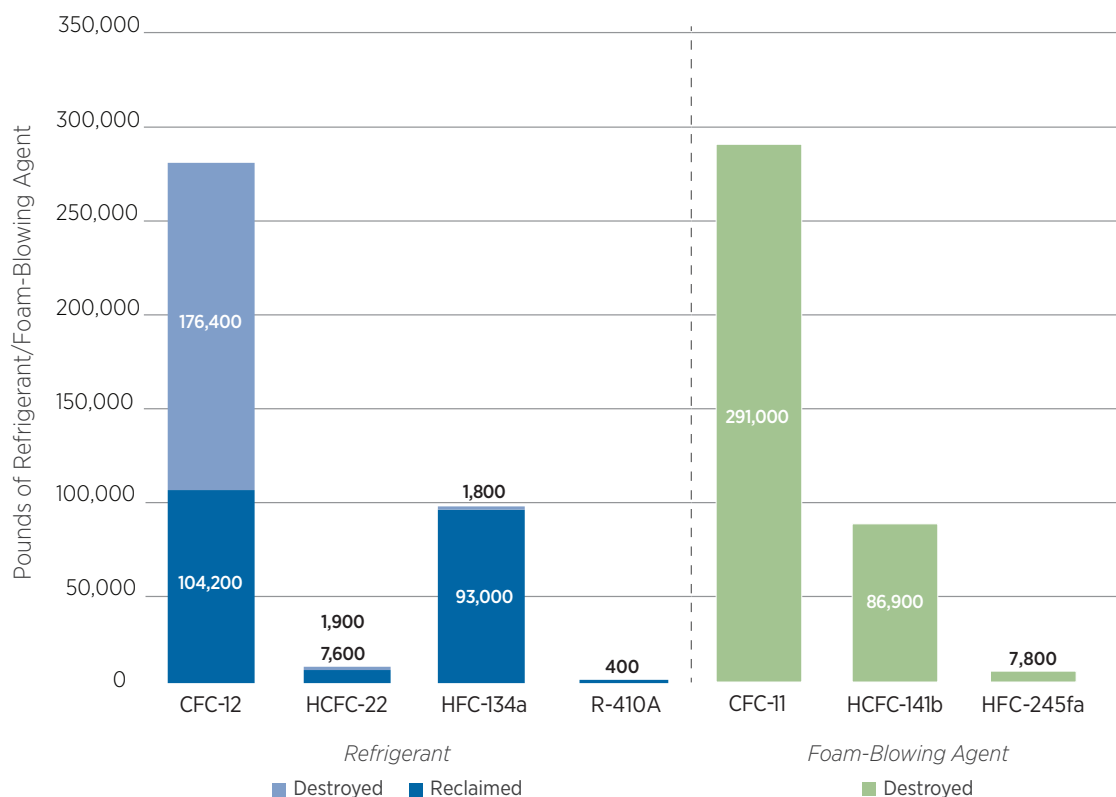


Stratospheric Ozone Benefits

RAD partners reduce emissions of ODS by safely recovering refrigerants as well as foam-blowing agents, which also deplete the ozone layer.

Older refrigerated appliances that were manufactured with ODS are being retired today. On average, partners recovered 0.4 lb. of refrigerants and 0.9 lb. of foam-blowing agents from each refrigerator/freezer. Across all equipment types, RAD partners recovered a total of approximately 290,100 lbs. of CFC and HCFC refrigerants, and 377,900 lbs. of CFC and HCFC foam-blowing agents, avoiding the release of 263 ODP-weighted metric tons in 2013. In addition to being ODS, refrigerants and foam-blowing agents also have high GWPs, as shown in the table to the right and discussed further on the next page. HFCs are also discussed further on the next page.

Refrigerants and Foam-Blowing Agents Reclaimed and Destroyed by RAD Partners in 2013



Characteristics of Gases Used as Refrigerants And Foam-Blowing Agents in Appliances Reaching End-of-Life

| Compound | Ozone Depletion Potential (ODP) [†] | Global Warming Potential (GWP) [*] | Predominant Use in Appliances |
|-----------|--|---|-------------------------------|
| CFC-11 | 1 | 4,750 | Foam |
| CFC-12 | 1 | 10,900 | Refrigerant |
| HCFC-22 | 0.055 | 1,810 | Refrigerant |
| HCFC-141b | 0.11 | 725 | Foam |
| HFC-134a | 0 | 1,430 | Refrigerant |
| HFC-245fa | 0 | 1,030 | Foam |

[†] ODPs are based on values provided in the Montreal Protocol.

^{*} GWP calculations are based on the 100-year direct GWPs provided in the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007), which are relative to CO₂.

JACO's Polyurethane Foam-Degasser

In this system, up to 500 lbs. of recovered foam pieces are placed in a vacuum-sealed tank, where nitrogen is added for explosion proofing. The foam is then milled into a fine powder over a period of two hours, after which time the powder and gases enter a second tank for separation. The liquid CFC blowing agent is then transferred into 1,000-lb. cylinders, while the foam powder is collected into a third tank via a conveyor belt and loaded into sacks. While this technology currently only processes CFC foam, methods for processing other blowing agents (e.g., HCFC-141b and HFCs) are under development.

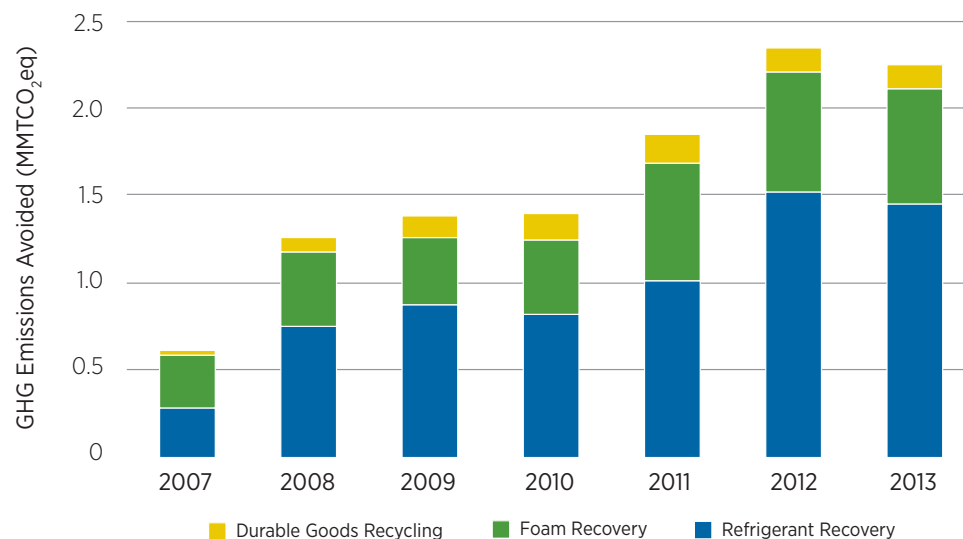
Climate Benefits

During 2013, RAD partners achieved a reduction of over 2.2 MMTCO₂eq, which is equivalent to the annual carbon emissions from the electricity use of more than 309,000 homes. Of this, 64% can be attributed to reclaiming or destroying refrigerants, 30% to reclaiming or destroying foam-blowing agents, and 6% to recycling durable materials. Additional climate benefits are realized through energy savings detailed on the next page.

In addition to CFCs and HCFCs, RAD partners prevent the release of HFCs. HFCs are potent GHGs commonly used in refrigerators and air conditioners. The use and emissions of HFCs are growing rapidly as they are increasingly adopted as replacements for ODS being phased out under the Clean Air Act and as economic growth spurs demand for new equipment, such as refrigerant-containing appliances. Recovering HFCs, even in small quantities, can result in significant climate benefits. For instance, over 50% of GHG emission reductions from the proper disposal of refrigerators can come from HFC foam (up to 0.5 MTCO₂eq/unit). During 2013, RAD partners recovered 103,000 lbs. of HFCs, as shown in the bar graph on the previous page.

Climate benefits are also achieved through the recycling of durable materials from appliances, which prevents indirect GHG emissions associated with the generation of electricity that would otherwise have been needed to produce virgin materials.

GHG Emissions Avoided through Proper Appliance Disposal by RAD Partners



In 2013, RAD partners achieved climate benefits equivalent to:

The amount of carbon emitted by more than 309,000 homes' electricity use in one year*



Source: EPA's Greenhouse Gas Equivalency Calculator. Available at www.epa.gov/cleanenergy/energy-resources/calculator.html.

*This does not include GHG emission reductions associated with early appliance retirement.

Climate Action Plan

President Obama's Climate Action Plan (CAP)—announced in June 2013—calls for the United States to lead through international diplomacy as well as domestic actions to reduce emissions of HFCs. RAD partners can make an important contribution to the President's CAP by collecting and disposing of HFC-containing appliances using the best available practices.



In October 2013, new RAD partner, Focus on Energy, hosted a contest to find Wisconsin's oldest fridge. Three 1931 General Electric (GE) refrigerators tied in the contest. In addition to the \$50 incentive that all participants received for recycling their old appliances, the three winners also received a \$1,000 prize.

Photo credit: Focus on Energy

Energy Savings

For utilities, appliance recycling programs are an important component of a successful demand-side management (DSM) program.

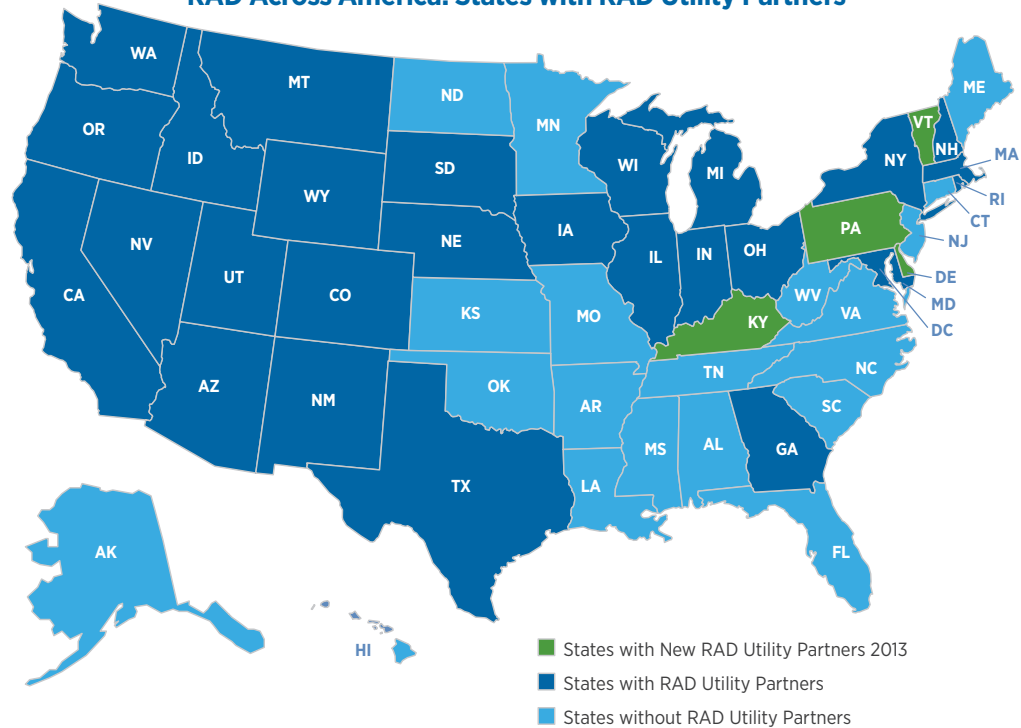
Replacing old, inefficient appliances with new ones reduces the amount of electricity needed to power them and, therefore, reduces the amount of indirect GHG emissions released. In 2013, appliance recycling programs operated by the 47 RAD utility partners covered a territory of 42 million households (approximately 34% of U.S. households) across 30 states. As shown in the map below, RAD utility partners are operating programs in states from coast to coast.

In total, RAD utility partners reduced energy use by more than 2.7 billion kWh by removing old refrigerators, stand-alone freezers, window air conditioning units, and dehumidifiers from the grid. These energy savings translate to climate benefits of nearly 2 MMTCO₂eq and are estimated to have saved consumers \$319 million.

Replacing a 15-year old refrigerator with one that is ENERGY STAR certified could save a household more than 400 kWh/year – or about \$50/year.*

*Actual energy and cost savings will vary by equipment model and region. These estimates are conservative (U.S. EPA: ENERGY STAR 2014 Databook).

RAD Across America: States with RAD Utility Partners



Environmental Benefits for Communities

In 2013, RAD partners further protected the environment by keeping recyclable materials out of landfills and ensuring the proper handling of hazardous waste, as shown below.

Materials prevented from going to a landfill:

- 119.2 million lbs. of ferrous metals (e.g., steel)
- 5.8 million lbs. of non-ferrous metals (e.g., copper)
- 21.2 million lbs. of plastic
- 3.4 million lbs. of glass

Toxic or hazardous materials properly handled:

- 73,700 gal. of used oil
- 41,500 PCB-containing capacitors
- 13,000 mercury-containing components

ARCA's URT System

This system shreds refrigerators and freezers and separates the materials (i.e., plastics, metal, degassed foam) into high-quality, uniformly sized pieces. As part of the process, the foam insulation is compressed into pellets in a sealed system, allowing the foam-blowing agent to be recovered and condensed into a liquid. The resulting foam pellets, which are roughly 40 times smaller in size than typical insulating foam waste from refrigerators, can also be burned and used as an alternative fuel in other processes, such as cement manufacturing. When used in cement manufacturing, the ash from the pellets is recycled into the cement, further reducing the burden on landfills. In total, the URT system is estimated to reduce the typical amount by weight of landfill waste from a refrigerator or freezer by 85%.



GE and the Home Depot utilize ARCA Advanced Processing's URT system that can transform refrigerator insulating foam into pellets for use as fuel or other products.

Photo credit: GE

“ The annual reporting requirement has helped Austin Energy to benchmark its efforts against other RAD partners. We use the information RAD requires to explore new opportunities and continue to increase the benefits of our program. ”

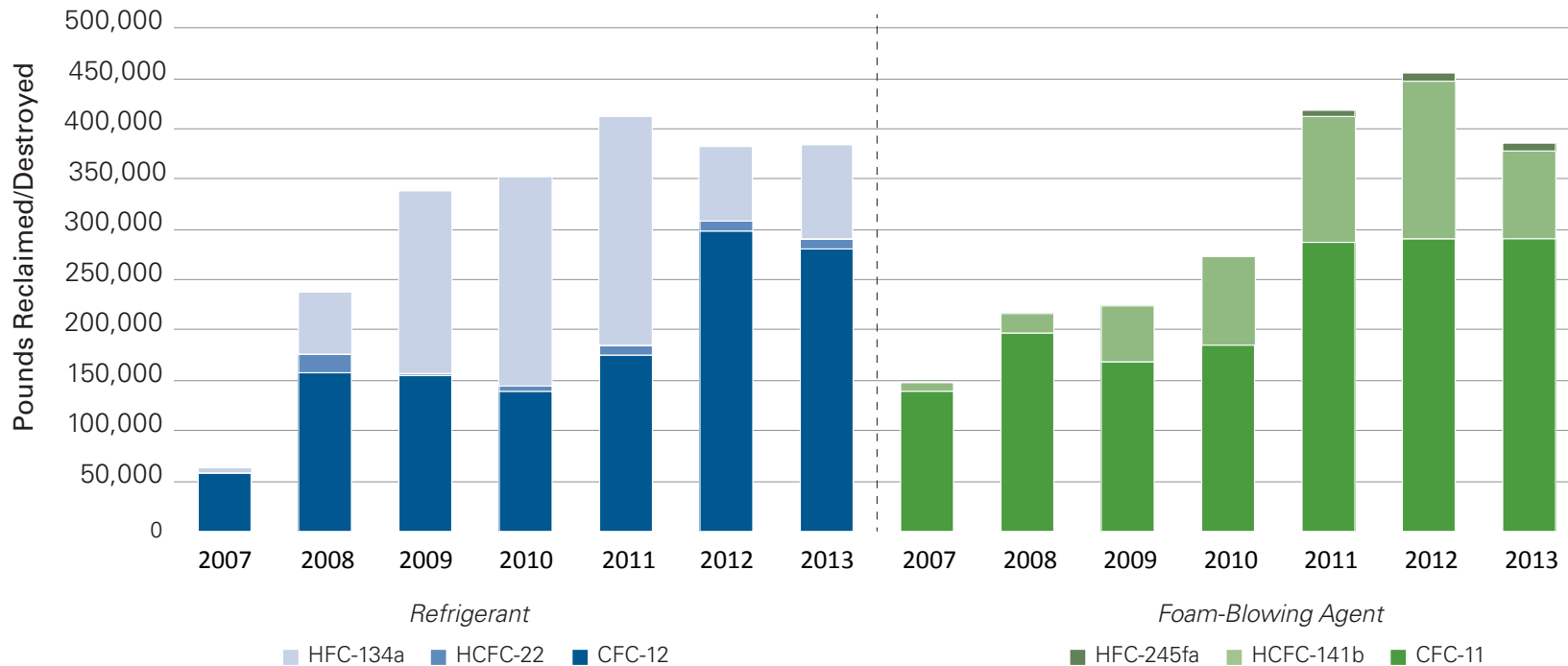
Donylle Seals
Program Coordinator, Austin Energy

RAD Benefits Over Time

In 2007, nine RAD partners recovered 63,400 lbs. of refrigerants and 147,700 lbs. of foam-blowing agent. As of 2013, the program has expanded to 52 partners and two state affiliates that have recovered 385,400 lbs. of refrigerant and 385,600 lbs. of foam-blowing agent.

The majority of refrigerant and foam-blowing agents recovered by RAD partners in 2013 were CFCs. This is the result of RAD partners' efforts to target older, less efficient units. In the coming years, more HCFC and, eventually, HFC units will be retired. Proper handling of HCFC and HFC refrigerants and blowing agents at end-of-life will reduce GHG emissions.

Refrigerants and Foam-Blowing Agents Recovered by RAD Partners, 2007–2013*



*This graph does not account for the recovery of refrigerants R-500 or R-410A due to the negligible amount recovered.

Working Toward a Safer Tomorrow

CFC, HCFC, and HFC refrigerants and foams contained in appliances can damage Earth's climate and ozone layer if not properly recovered at equipment disposal.

Fortunately, global production of new appliances is transitioning to safer alternatives. Climate-friendly foam-blowing agents, such as hydrocarbons, are increasingly used in household appliances today as alternatives to HCFCs and HFCs.

In addition, new technologies are emerging and are growing in capacity for recovering refrigerants and foams at appliance disposal sites nationwide. RAD partners are contributing to this progress.

Because appliances last a long time, we will continue to see ODS and high GWP substances, such as HFCs, in retired units for decades to come. As RAD partners work to properly recycle appliances using best environmental practices, the environmental benefits will continue. Together, we will continue to work towards a safer tomorrow.





To learn more, visit: www.epa.gov/rad

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