2011 Annual Report

Responsible Appliance Disposal Program

RAD

EPA

The U.S. Environmental Protection Agency's (EPA) Responsible Appliance Disposal (RAD) Program is a partnership launched in October 2006 to protect the ozone layer, reduce emissions of greenhouse gases, and benefit communities. The RAD Program recognizes partners that ensure the disposal of refrigerant-containing appliances by 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.

Overview

Through the RAD Program, partners reduce emissions of ozone-depleting substances (ODS) and greenhouse gases (GHGs) by recovering appliance foam and refrigerant. The program also leads to other environmental benefits by promoting the safe handling of hazardous materials and encouraging the recycling of durable materials—which protects human health, saves landfill space, and reduces energy consumption.

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. The appliance recycler uses best environmental practices to ensure:

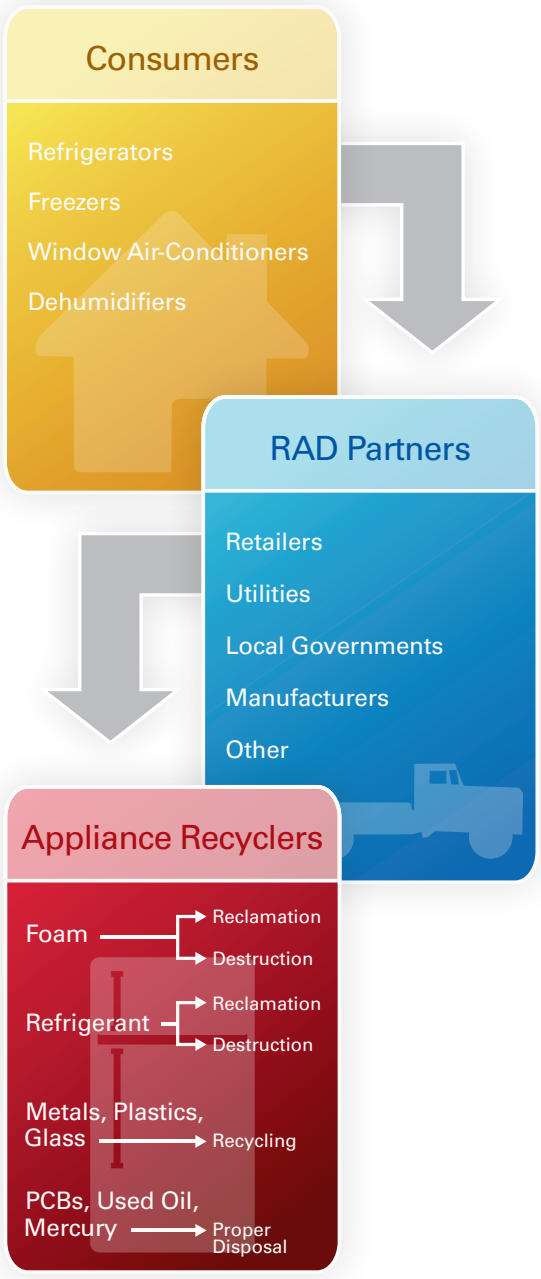
- Refrigerant is recovered and reclaimed or destroyed;
- Insulation foam is recovered and destroyed, or the foam-blowing agent is recovered and reclaimed;
- Metals, plastic, and glass are recycled; and
- Polychlorinated biphenyls (PCBs), mercury, and used oil are recovered and disposed of using best environmental practices.

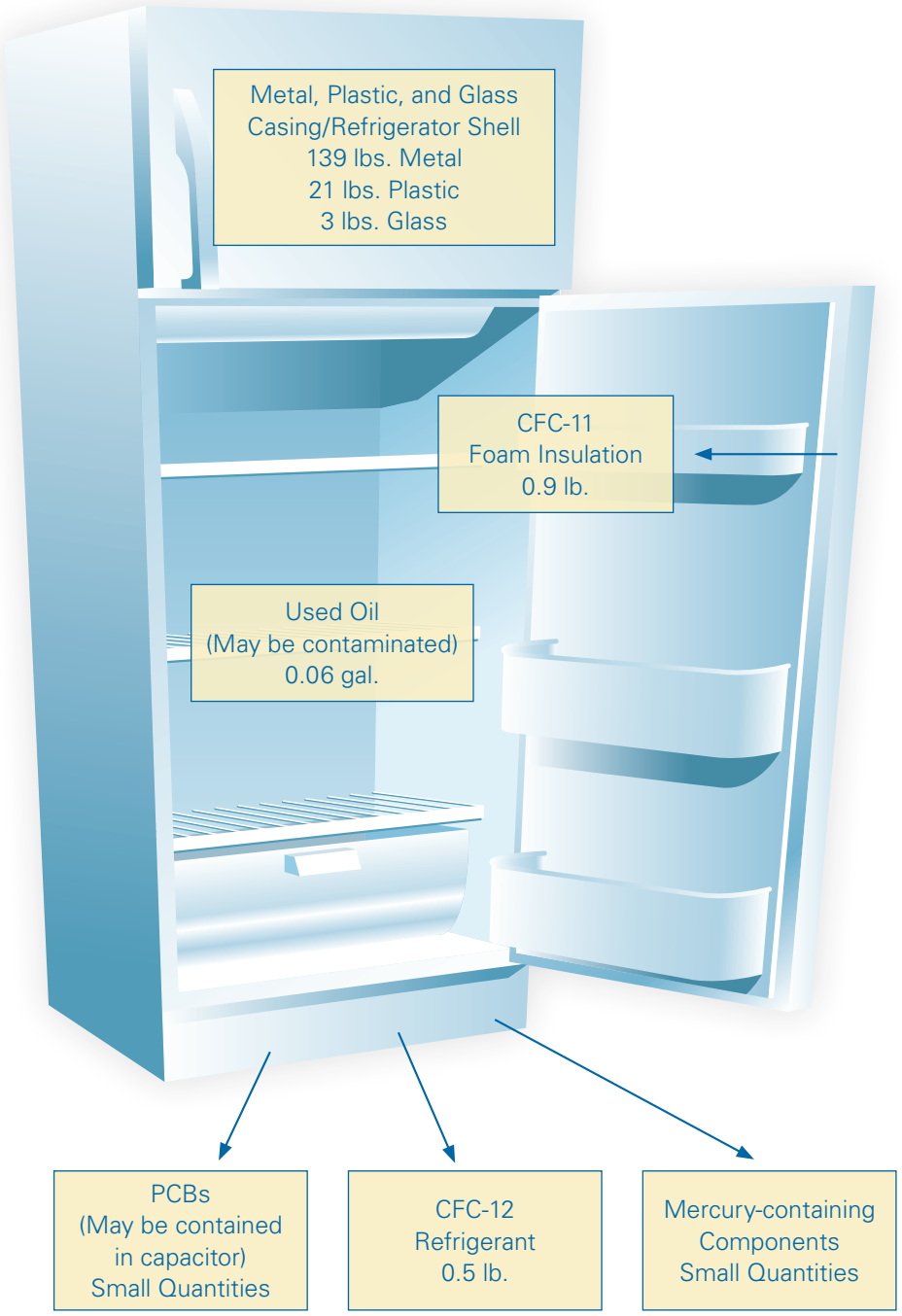
Some RAD partners also reduce energy consumption by encouraging appliance owners to permanently retire old, inefficient units. For example, many utility partners offer cash incentives to customers for the pick-up of old, working refrigerators.

The RAD Program's benefits are both global and local. The avoided emissions of ODS and GHGs result in global environmental benefits, while preventing appliance dumping and releases of hazardous/toxic materials keeps communities clean.

This annual report presents the RAD Program environmental benefits for 2011.

Appliance Disposal Under the RAD Program





The Need for the RAD Program

EPA estimates 9.4 million refrigerators and freezers, 6.3 million window air-conditioning units, and nearly 964 thousand dehumidifiers were disposed of in the United States in 2011.

Because these appliances contain ODS, GHGs, hazardous substances, and recyclable materials, disposing of them using best environmental practices results in significant benefits for the environment and human health. Federal law requires that prior to disposal or recycling of appliances (1) all refrigerant be recovered, and (2) universal waste (e.g., mercury), used oil, and PCBs be properly managed and stored. However, the laws do not require the recovery of appliance foam, which is also a source of ODS and GHG emissions.

Further, studies estimate that up to 25% of disposed refrigerators/freezers are resold onto the secondary market, resulting in increased energy demand from the continued use of older, less efficient models.* RAD helps reduce this energy demand by promoting responsible disposal of older appliances.

*Based on information presented in the following reports:

NMR Group, Inc. and Cadmus Group, Inc. 2011. "The Massachusetts Appliance Turn-in Program–Secondary Market and Appliance Disposal Report."

U.S. Department of Energy. 2009. "Refrigerator Market Profile."

Innovologie. 2010. "An Evaluation of Energy Trust of Oregon's Refrigerator Recycling Program."

Innovologie. 2010. "Final Report: Process and Market Evaluation of Southern California Edison's Appliance Recycling Program 2006-2008."

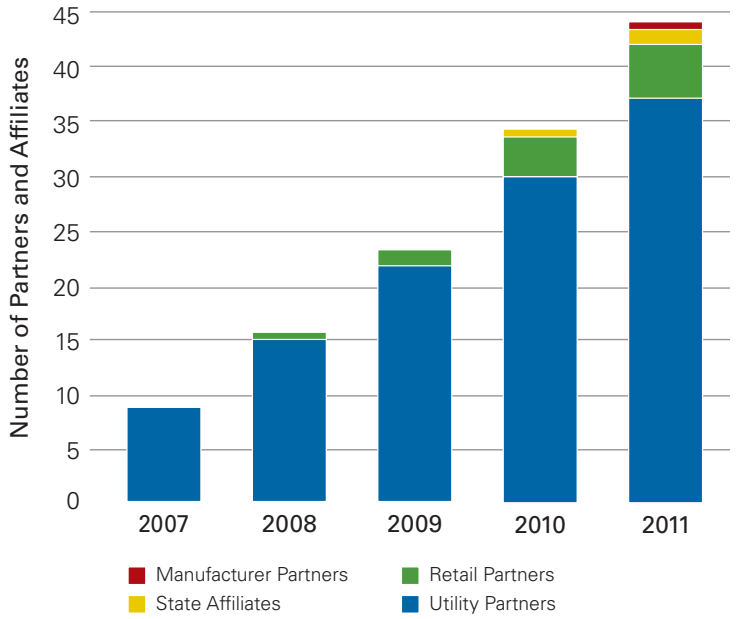
RAD Partners and Affiliates

Forty-four partners and affiliates reported their accomplishments for the RAD Program from January 1, 2011, through December 31, 2011:

- 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 Lodi Electric Utility (CA)
- City of Palo Alto Utilities (CA)
- City of Richland Energy Services (WA)
- City of Riverside Public Utilities (CA)
- Commonwealth Edison (IL)
- Consumers Energy (MI)
- Dayton Power & Light Company (OH)
- Energy Trust of Oregon (OR)
- GE Appliances (Nationwide)
- Georgia Power (GA)
- Great River Energy (MN)
- The Home Depot (Nationwide)
- Hoosier Energy (IN)
- Idaho Power (ID)
- Indiana Michigan Power (IN, MI)
- National Grid (MA, NH, NY, RI)
- Nebraska Public Power District (NE)
- New York State Energy Research & Development Authority (NY)
- Northern Indiana Public Service Company (IN)
- NV Energy (NV)
- Pacific Gas & Electric Company (CA)
- PacifiCorp (CA, ID, OR, UT, WA, WY)
- PNM (NM)
- Puget Sound Energy (WA)
- Sacramento Municipal Utility District (CA)
- Salt River Project (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)
- Vectren Energy Delivery (IN, OH)
- West Virginia Department of Environmental Protection (WV)
- WPPI Energy (WI)

Program Growth

RAD has grown significantly over the last 5 years. In the last year, the program has expanded from 34 to 44 partners and affiliates.



RAD Partner Activities

In 2011, RAD partners worked to advance appliance recycling through information exchange and innovative campaigns.

"Sears welcomes opportunities like the RAD Lunch to exchange ideas and explore new options for collaboration with EPA and all RAD partners—retailers, manufacturers, and utilities alike."

—Gary Fenske, Home Services, Sears Holdings Corp.

"During our first year as a RAD Partner, National Grid worked with prominent local artists in Rhode Island to create an exhibit of painted refrigerators that were scheduled for disposal. The refrigerators were displayed in public areas to encourage our customers to recycle their old appliances—and helped us collect over 6,500 refrigerators/freezers in Rhode Island for recycling and safe disposal."

—Timothy F. Horan, President, National Grid, Rhode Island

Idea Exchange and Collaboration Among RAD Partners

RAD continually explores new opportunities to enhance discussion among partners to share best practices, obstacles, and lessons learned. On November 9, 2011, EPA held its first RAD Partner Lunch at the ENERGY STAR® Products Partner Meeting in Charlotte, North Carolina. The lunch gave partners the opportunity to share RAD successes, challenges, and lessons learned.

Twelve RAD partners, two appliance recycling companies, and EPA representatives attended. The dialogue focused on how to enhance partnerships between RAD utilities, retailers and manufacturers. Specifically, participants discussed:

- Ways to improve communication and information-sharing;
- Opportunities for utilities and retailers to better understand each other's objectives and needs when removing appliances from the grid; and
- Prospects for partnering on consumer recycling education campaigns.

Fridge designed by artist Andrew Solan entitled "I Recycle" displayed in downtown Providence for National Grid's Fine Art of Recycling campaign.

Innovative Campaigns

To promote safe appliance disposal through consumer awareness, some RAD partners launched innovative campaigns—including use of creative advertising to customers, high-profile recycling contests with the chance to win new ENERGY STAR® qualified appliances, and school and community art exhibits. One great example is the Fine Art of Recycling campaign launched by National Grid, a new RAD partner, in July 2011. The Providence, Rhode Island launch event was attended by the city's mayor, Angel Taveras, and helped raise customer awareness about appliance recycling through an exhibit of painted refrigerators.

RAD Manufacturer

In 2011, RAD welcomed General Electric (GE) as its first manufacturer partner and the country's first supplier for a fully automated UNTHA Recycling Technology (URT) System.

GE Appliances became the first RAD Partner to send used appliances to the URT System at Appliance Recycling Centers of America's (ARCA's) Advanced Processing (AAP) recycling facility in Pennsylvania. The 40-foot tall URT Refrigerator Plant captures refrigerants and blowing agents and recovers and sorts materials, such as the plastic liner, aluminum, copper, steel, and insulating foam. ODS gas in foam is subsequently recovered during a grinding process under negative pressure, and then condensed to a liquid and collected in storage tanks. The degassed foam is compressed into pellets which can be used as fuel for other processes. Captured materials and substances are sold by ARCA for reuse, recycled or properly destroyed. The AAP facility, located in Philadelphia, receives appliance volume from 12 Northeastern and Mid-Atlantic states. According to GE, the high population density and appliance volume in the region, coupled with the logistics opportunities with GE Appliances' customers such as new RAD retail partner, The Home Depot, were critical factors in making this advanced recycling project viable.

The AAP recycling facility's de-manufacturing process and sealed refrigerator recycling system can process one refrigerator or freezer per minute (AAP expects to process 150,000 refrigerators and freezers annually), recovering the following materials:

- CFC, HCFC, HFC, and hydrocarbon refrigerants and foam blowing agents
- Ferrous and nonferrous metals
- PCB-containing capacitors
- Mercury-containing components
- Used oil
- Glass
- Rubber
- Plastics
- Power cords
- Universal waste

This fully automated refrigerator recycling technology can recover approximately 95% of the insulating foam contained in refrigerators and freezers and is estimated to reduce typical refrigerator landfill waste by 85% (by weight). By ensuring a high recovery rate for materials and increasing the volume of units that can be processed, this system allows for significant reductions of GHG and ODS emissions. ARCA has provided more than 50 green jobs in the process, showing that environmental and economic success can be achieved simultaneously. RAD partner and recycler projects like this demonstrate the potential for future growth in foam recycling technology throughout the country.

Top: URT System recycles a refrigerator at September 2011 media event. **Bottom:** Shawn Garvin, U.S. EPA Region 3 Administrator recognizes GE, ARCA, and Home Depot for their roles in advancing appliance recycling.

> *"General Electric is proud to join EPA's RAD Program and be the nation's first manufacturer to supply volume for North America's first URT recycling system. Appliance recycling using advanced environmental technologies such as the URT system is an example of a market-based system working to deliver environmental benefits. EPA's RAD program provides important encouragement for advanced recycling efforts such as these."*
>
> —Mark Shirkness, GE Appliance Distribution Services, General Electric

Refrigerators awaiting processing at an ARCA appliance recycling facility that services RAD partner, Southern California Edison.

PG&E was an early adopter of EPA's Responsible Appliance Disposal program. Through the program, we have helped customers recycle thousands of old, inefficient refrigerators and freezers using the best environmental practices. PG&E is proud to provide our customers the significant environmental benefits and energy savings that are possible through the Responsible Appliance Disposal program.

—Larry Goldstein, Director Customer Energy Solutions, Pacific Gas and Electric Company

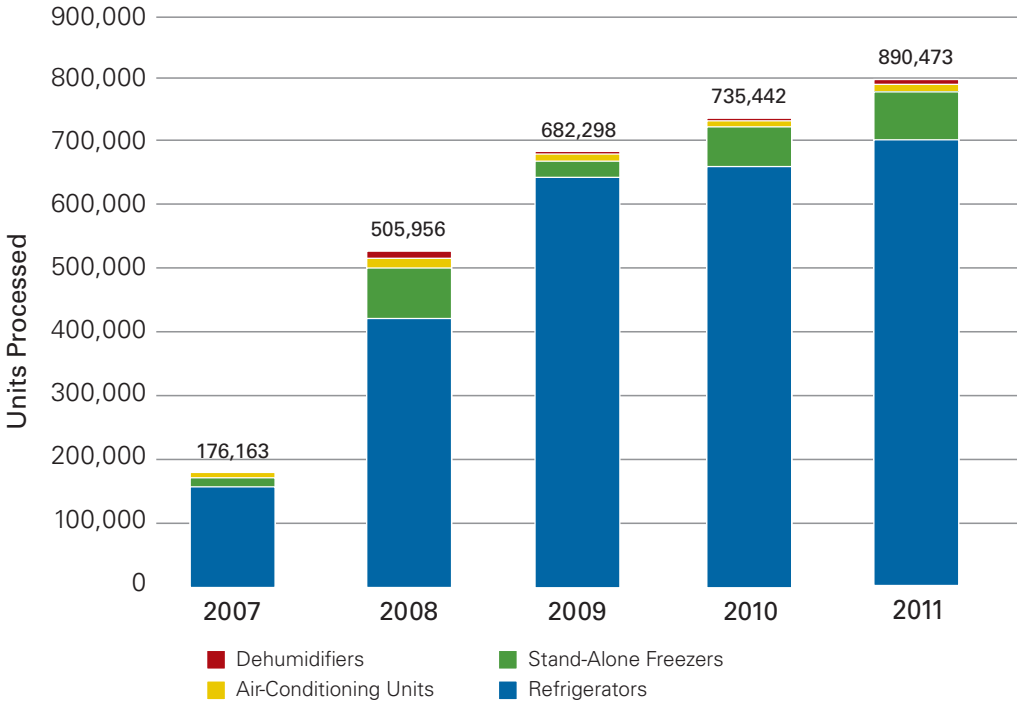
Results

In 2011, RAD's 42 partners collected and processed a total of 890,473 refrigerant-containing appliances, including:

- 802,712 refrigerators
- 81,630 stand-alone freezers
- 5,253 window air-conditioning units
- 878 dehumidifiers

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

Total Number of Refrigerant-Containing Appliances Processed by RAD Partners, 2007–2011

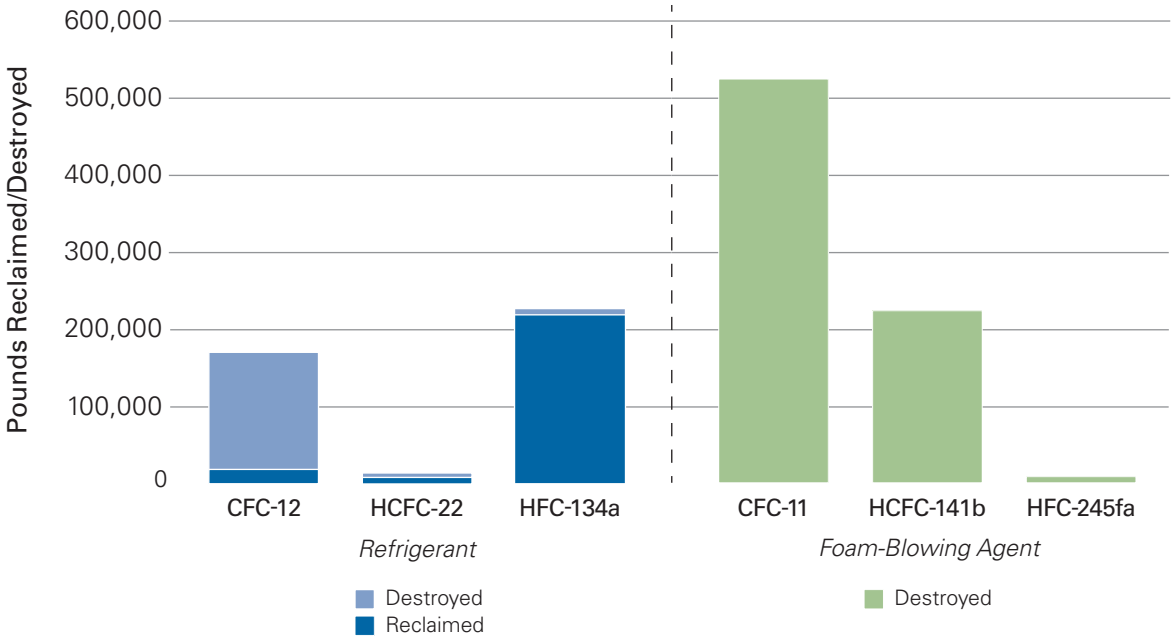


Stratospheric Ozone Benefits

RAD partners not only reduce emissions of ODS by recovering and reclaiming or destroying refrigerants, they recover and destroy foam-blowing agents, which also deplete the ozone layer.

Partners recover foam from appliances manually or by using an automated system, and then destroy the foam-blowing agents. Foam destruction is typically performed using municipal solid waste incinerators (e.g., waste-to-energy facilities) or rotary kiln incinerators. On average, partners recovered 0.45 lb. of refrigerants and 0.86 lb. of foam-blowing agents from each refrigerator/freezer. Across all equipment types, RAD partners recovered a total of 179,300 lbs. of CFC and HCFC refrigerants, and 765,300 lbs. of CFC and HCFC foam-blowing agents. By avoiding the release of these refrigerants and foam-blowing agents into the environment, an estimated 948,800 lbs. of ODS emissions (330 ODP-weighted metric tons) were avoided during 2011.

Refrigerants and Foam-Blowing Agents Reclaimed or Destroyed by RAD Partners in 2011



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

Compound	Global Warming Potential (GWP)*	Ozone Depletion Potential (ODP)	Predominant Use in Appliances
CO_2	1	0	--
CFC-11	4,750	1	Foam
CFC-12	10,900	1	Refrigerant
HCFC-22	1,810	0.055	Refrigerant
HCFC-141b	725	0.11	Foam
HFC-134a	1,430	0	Refrigerant
HFC-245fa	1,030	0	Foam

* GWP calculations are based on the 100-year direct GWPs provided in the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007).

Climate Benefits

CFCs, HCFCs, and HFCs contained in appliances all contribute to climate change.

These refrigerants and blowing agents have direct global warming potentials (GWPs) up to 10,900—meaning that they are up to 10,900 times more effective at damaging the climate system than CO_2 on an equal mass basis. Recovering these compounds, even in small quantities, can result in significant climate benefits. The recycling of durable materials from appliances prevents indirect GHG emissions associated with the generation of electricity, which would have otherwise been needed to produce virgin materials.

During 2011, RAD partners achieved the reduction of 2.38 million metric tons of carbon dioxide equivalent ($MMTCO_2eq$), which is equivalent to approximately 467,200 passenger car emissions for one year. Of this, 42% can be attributed to reclaiming or destroying refrigerants, 51% to reclaiming or destroying foam-blowing agents, and 7% to recycling durable materials. Additional climate benefits are realized through energy savings detailed on the next page.

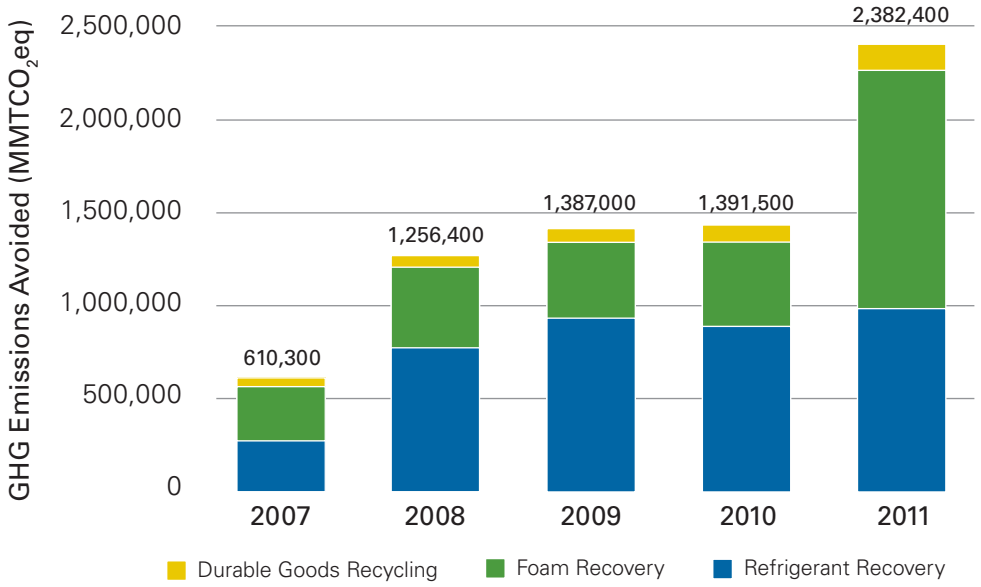
In 2011, RAD partners achieved climate benefits equivalent to:

467,200 passenger cars NOT driven for one year

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

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

GHG Emissions Avoided through Proper Appliance Disposal by RAD Partners



Energy Savings

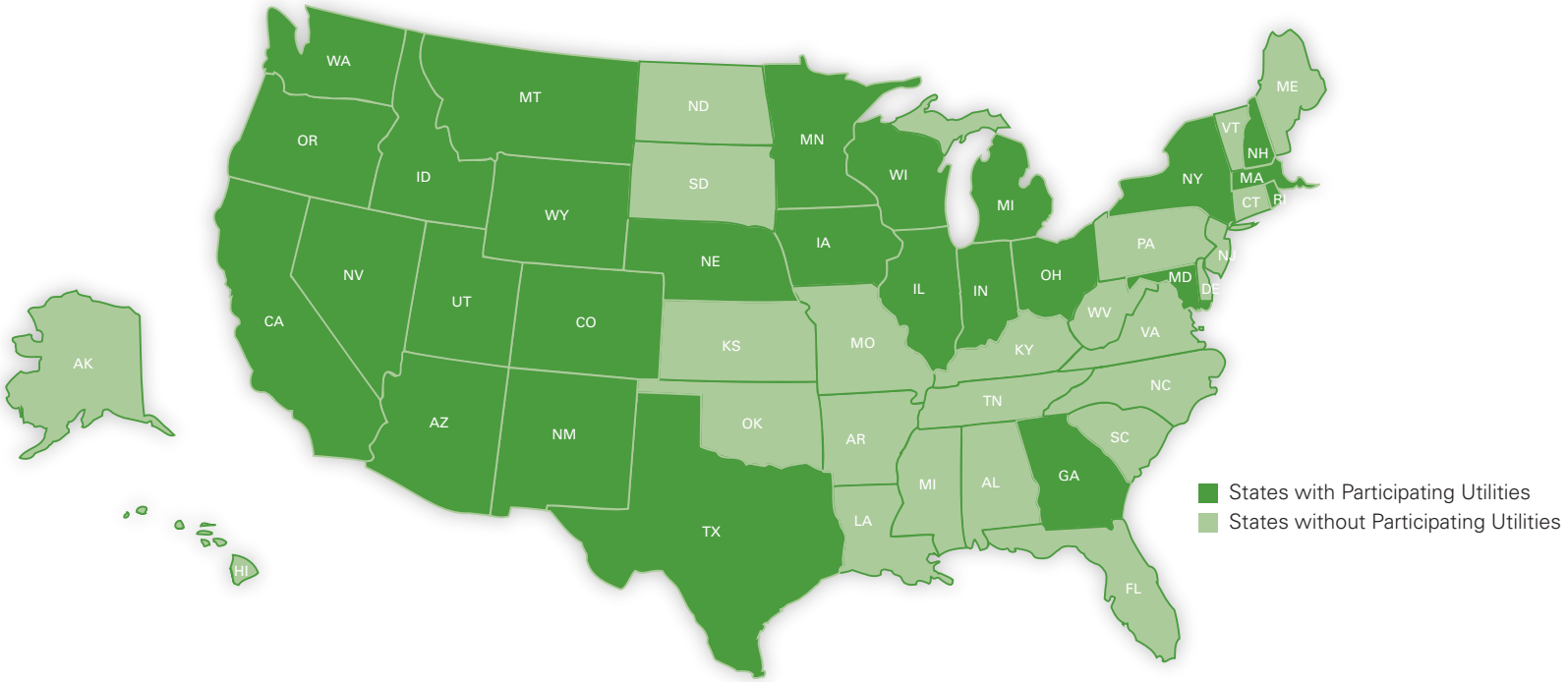
For utilities, appliance recycling programs can be an important component of a successful demand side management program.

Replacing old, inefficient appliances with new ones reduces the amount of electricity needed to power them and, therefore, the amount of indirect GHG emissions released. In 2011, appliance recycling programs operated by the 37 RAD utility partners covered a territory of 30.7 million households across 26 states, representing approximately 26% of U.S. households. In total, RAD utility partners reduced energy use by more than 3.2 billion kilowatt-hours (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 approximately 2.28 $MMTCO_2eq$ and are estimated to have saved consumers $424 million.

- On average, refrigerators collected by RAD utility partners in 2011 were over 20 years old.
- Replacing an inefficient, approximately 20-year-old refrigerator with one that is ENERGY STAR® qualified will save a household roughly 550 kWh/year—or about $65/year.*
- If a secondary refrigerator (e.g., in a basement or garage) is removed and not replaced, individual households can save over 1,000 kWh/year, or roughly $115/year.*

* Actual energy and costs savings will vary by equipment model and region. These estimates are conservative and are based on national averages (Energy Star 2012 Databook).

RAD Utility Partners Across the United States



Students learn about the benefits of recycling refrigerator components during a school field trip to a JACO Environmental appliance recycling facility that services RAD partner, NV Energy.

Environmental Benefits for Communities

In 2011, 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:

- 105.7 million lbs. of ferrous metals
- 17.5 million lbs. of non-ferrous metals
- 18.7 million lbs. of plastic
- 2.6 million lbs. of glass

Toxic or hazardous materials properly handled:

- 0.06 million gal. of used oil
- 48,400 PCB-containing capacitors
- 44,400 mercury-containing components

If released into the environment, used oil can leak into groundwater and major waterways and pollute drinking water sources. In addition to used oil, appliances may contain toxic chemicals and heavy metals—namely PCBs from capacitors and mercury from thermostatic switches. PCBs are regulated by EPA as toxic substances; they may cause cancer and liver damage and can have negative impacts on the neurological development of children, the human reproductive system, the immune system, and the endocrine system. Mercury is toxic and causes a variety of adverse health effects, including tremors, headaches, respiratory failure, reproductive and developmental abnormalities, and potentially, cancers.

Increasing Program Benefits Over Time

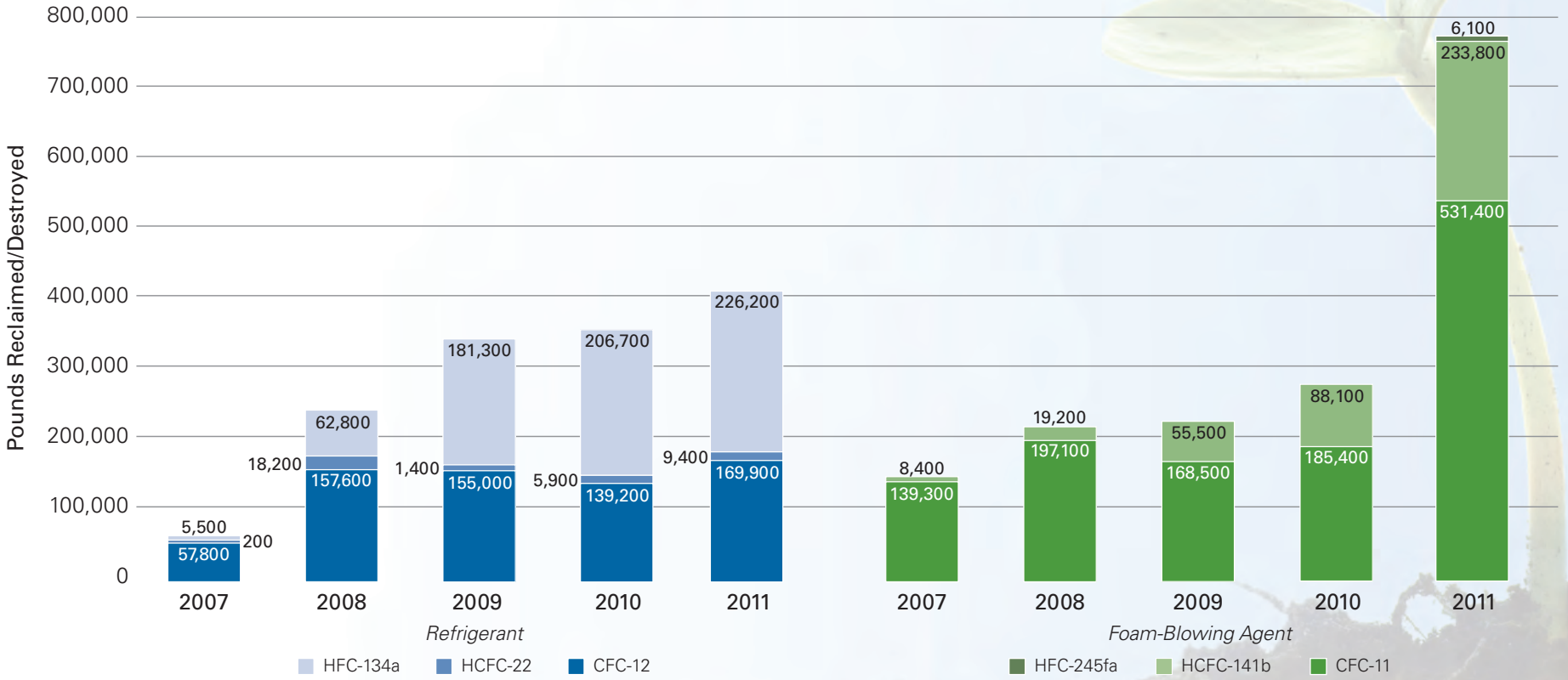
In 2007, nine RAD partners recovered 63,400 lbs. of refrigerants and 147,700 lbs. of foam-blowing agents. As of 2011, the program has expanded to 42 partners and two state affiliates, which have recovered 405,500 lbs. of refrigerant and 771,300 lbs. of foam-blowing agent.

As the program matures, the relative number of units collected with CFC-based refrigerant and foam-blowing agent is decreasing, while the number with HFC refrigerant and HCFC-based foam-blowing agent is increasing.

In 2011, PacifiCorp ran a campaign to promote responsible appliance disposal, involving special mailers and other marketing materials sent to our customers. Our participation in the RAD Program has benefitted our outreach efforts by assuring our customers that their old appliances are being recycled according to the best environmental practices recognized by EPA.

—Greg Stiles, Program Manager, PacifiCorp

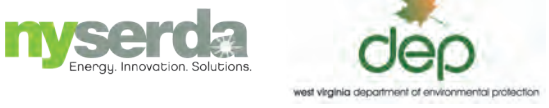
Refrigerants and Foam-Blowing Agents Recovered by RAD Partners, 2007–2011



RAD Partners and Affiliates

Utilities, Retailers, and Manufacturers

State Affiliates



Working Toward a Safer Tomorrow

CFC and HCFC refrigerants and foams contained in older appliances can damage the ozone layer and climate system if not properly recovered at equipment disposal.

Global production of new appliances is moving away from the use of CFCs and HCFCs. However, because appliances can last a long time, older appliances being retired today still contain CFCs and HCFCs. Newer units contain HFC refrigerants and foam-blowing agents that, while non-ozone-depleting, have high global warming potentials. If not properly handled at end-of-life, emissions from these HFC units can be damaging to the climate system. As RAD partners work to properly recycle appliances using best environmental practices, the environmental benefits will continue for years to come.

Fortunately, new technologies and growing capacity for recovering refrigerants and foams from appliances are increasing the ability to capture harmful substances at appliance disposal sites nationwide. The RAD Program, its partners, and innovative recyclers have been critical in this progress. Together, we will continue to build momentum and keep working towards a safer tomorrow.

To learn more, visit:

U.S. Environmental Protection Agency
Stratospheric Protection Division
www.epa.gov/Ozone/partnerships/rad

Refrigerator door design by McNeil High School; winner of Austin Energy's high school art contest to increase awareness of responsible appliance disposal.

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