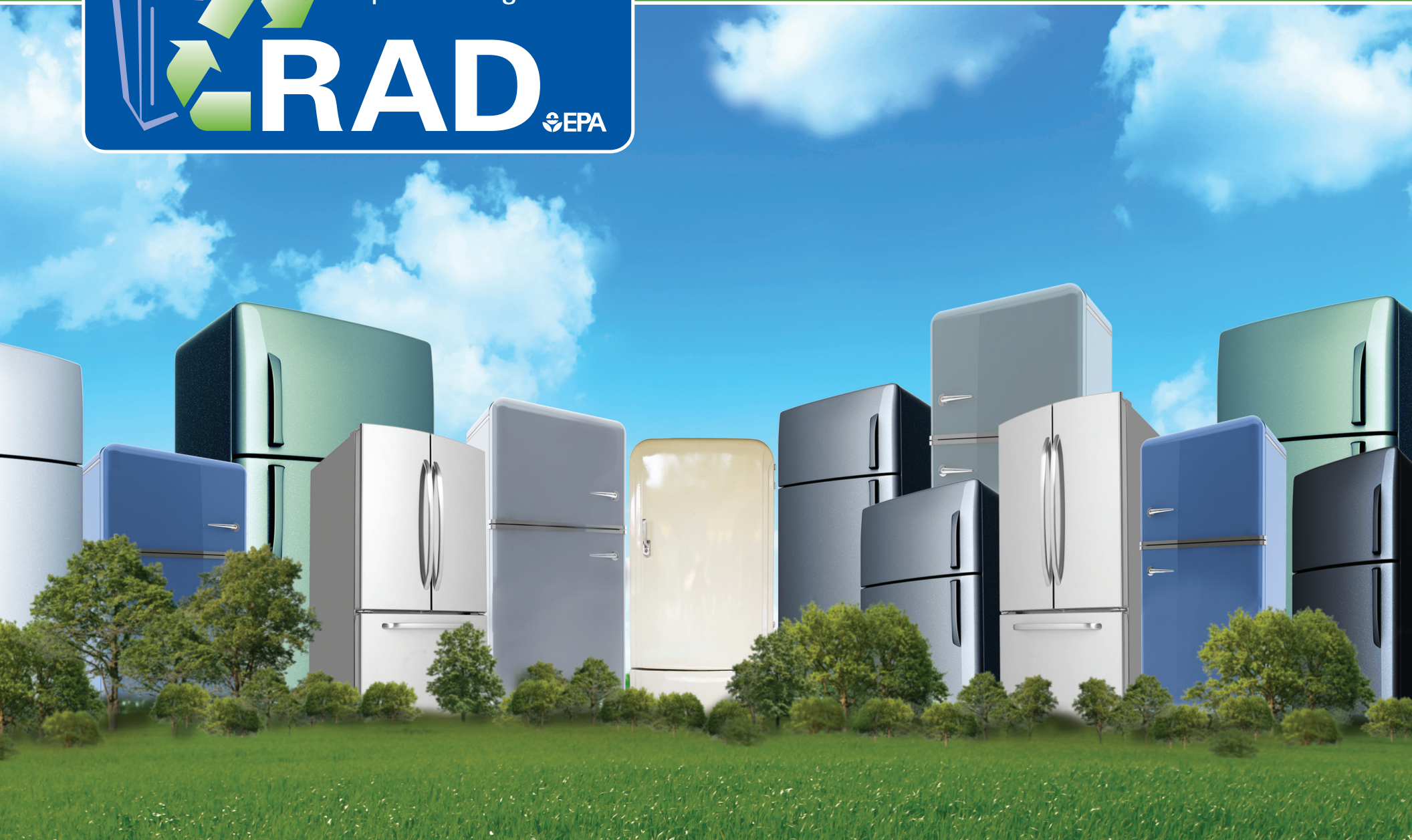


# 2012 Annual Report







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, 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.

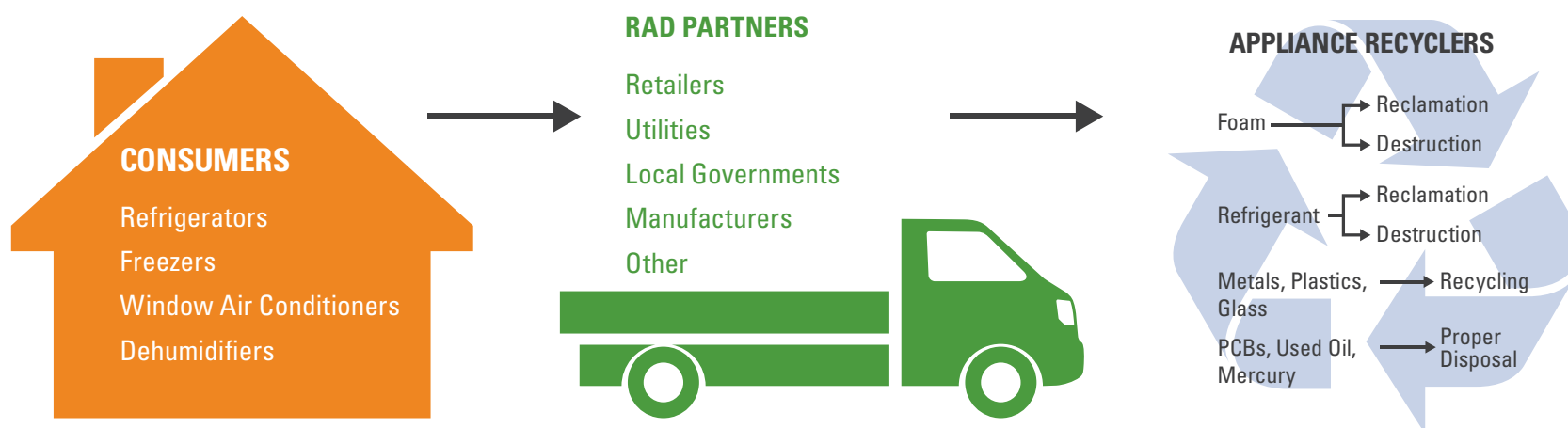
# Appliance Disposal: The RAD Way

In 2012, an estimated 10.4 million refrigerators/freezers, 6.5 million window air conditioning units, and 806,000 dehumidifiers were disposed of in the United States. These units contain ozone-depleting substances (ODS), greenhouse gases (GHGs), hazardous substances, and recyclable materials.

Federal law requires refrigerant recovery and 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. Unfortunately, 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 puts a strain on energy demand.

Through the RAD Program, partners reduce emissions of ODS and GHGs by ensuring 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).

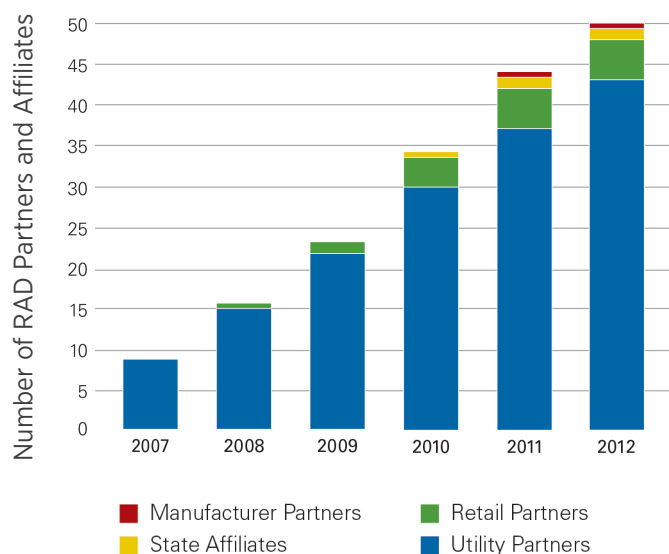
This annual report presents RAD partners' environmental achievements for 2012.



\*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 six years. In the last year alone, RAD expanded from 44 to 50 partners and affiliates.



## RAD Partners and Affiliates

Forty-eight partners and two affiliates reported their accomplishments for the RAD Program from January 1, 2012, through December 31, 2012:

- 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)
- Long Island Power Authority (NY)
- Los Angeles Department of Water and Power (CA)
- MidAmerican Energy (IA, IL, NE, SD)
- 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)
- NSTAR (MA)
- NV Energy (NV)
- Pacific Gas & Electric Company (CA)
- PacifiCorp (CA, ID, MT, OR, UT, WA, WY)
- 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)
- Vectren Energy Delivery (IN, OH)
- West Virginia Department of Environmental Protection (WV)
- WPPI Energy (IA, MI, WI)



## Utilities, Retailers, and Manufacturers



Appliances



## State Affiliates



# Founding RAD Partner Southern California Edison Celebrates One Million Refrigerators



EPA's Pacific Southwest Region Administrator, Jared Blumenfeld (second from right), celebrates the crushing of SCE's one millionth refrigerator with representatives from SCE and the Natural Resources Defense Council.

In 2012, RAD partner Southern California Edison (SCE) celebrated an unprecedented milestone: the safe disposal of its one millionth refrigerator!

The utility has been recycling refrigerators for 18 years and was one of the first RAD partners in 2006.

Properly disposing this volume of refrigerators—enough to fill a football stadium—has resulted in significant environmental benefits, namely:

- Avoided emissions of 177,000 lbs of ODS
- Avoided GHG emissions of nearly 4 million metric tons of carbon dioxide equivalent (MMTCO<sub>2</sub>eq)
- Energy savings of 7.9 billion kilowatt-hours (kWh)

The energy savings translate to \$1 billion in saved costs for consumers.

To celebrate the milestone with their customers, the utility held a sweepstakes and gave away a new ENERGY STAR®-qualified refrigerator.

SCE continues to engage their customers and ensure ongoing environmental protection and financial savings by promoting their appliance recycling program through retail stores, as well as social media. Under the program, the utility offers free pick-up and a \$35 incentive for customers to recycle old refrigerators.

“After many years of recycling fridges and freezers for households in our region, we’re the first utility in the U.S. to hit the one million mark. We’re very proud of this milestone and even more proud of the impact it has had on our customers and our communities.”

*Erwin Furukawa, SVP, Customer Service  
Southern California Edison*



# Foam Recovery Technologies

If foam were recovered from all refrigerators and freezers disposed in the United States using advanced foam recovery technologies, approximately 7 MMTCO<sub>2</sub>eq would be avoided per year—equivalent to the annual emissions of 1.5 million cars.\*

When appliances are disposed in the United States, the insulating foam, along with the whole appliance shell, is typically cut into pieces by auto shredders and then sent to landfills. This process releases the chemicals used to make the foam into the environment, which contributes to climate change and may harm the ozone layer. To protect the environment, RAD partners voluntarily prevent these emissions of ODS and GHGs with the help of appliance recyclers by handling the foam using best environmental practices and technologies. These practices and technologies include:

- **Manual** foam recovery is performed using saws to cut through appliances and expose the foam, which is then scraped apart, bagged, and sent for destruction in waste-to-energy (WTE) boilers.
- **Semi-automated** foam recovery is similar to manual recovery in that saws are used to cut appliances and remove insulating foam by scraping; however, the foam is then put into an automated, pressurized system, which captures the blowing agent as a gas and condenses it into a liquid for collection and safe destruction off-site (typically in a WTE boiler or rotary kiln). The residual foam “fluff” can be used as a landfill cover or burned for fuel.
- **Fully automated** foam recovery involves the shredding of appliance foam together with the whole appliance in a fully enclosed automated system that separates the blowing agent and other durable components. Similar to the semi-automated process, captured liquid blowing agent is sent off-site for destruction, while the foam fluff is used as a landfill cover or for fuel. In 2011, GE Appliances became the first RAD partner to send used appliances to the fully automated UNTHA Recycling Technology (URT) system at ARCA’s Advanced Processing (AAP) facility in Pennsylvania.

Since the launch of the RAD program in 2006, there has been growing momentum towards the use of foam recovery technologies across the United States, with more than 35 facilities now in use and additional facilities expected to come on line in the near future.



Bags of foam following manual recovery, awaiting destruction at the JACO Environmental, Inc. facility in Fullerton, CA.



Adelmann A-55, a semi-automated system, at the ARCA recycling facility in Compton, CA.

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



Refrigerators awaiting transport to a JACO appliance recycling facility that services RAD partner, National Grid.

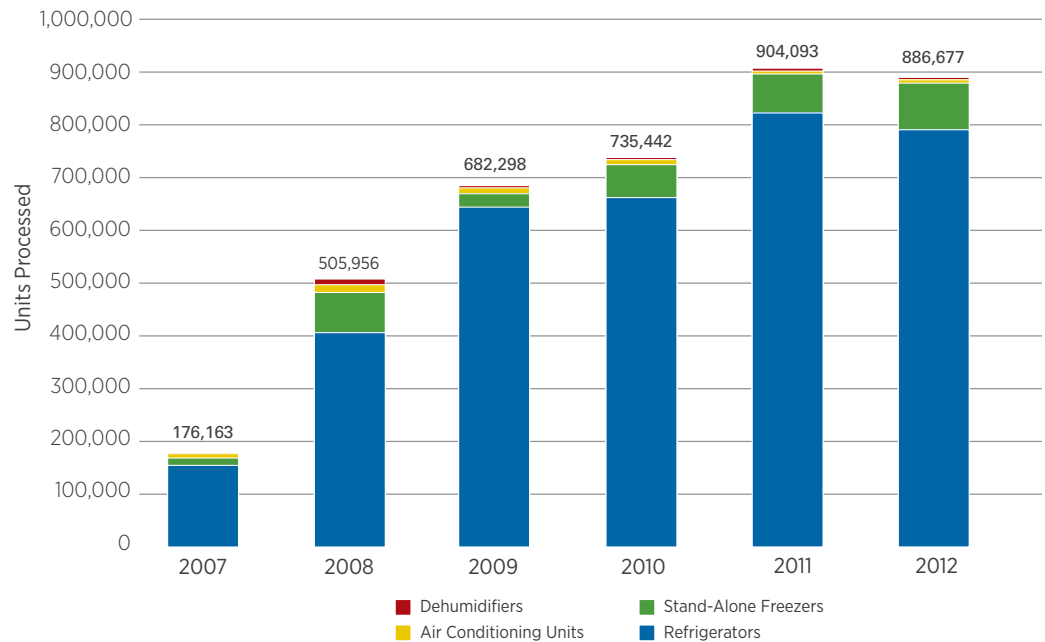
## Results

In 2012, RAD's 48 partners collected and processed a total of 886,677 refrigerant-containing appliances, including:

- 794,113 refrigerators
- 84,063 stand-alone freezers
- 7,321 window air conditioning units
- 1,180 dehumidifiers

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

### Number of Refrigerant-Containing Appliances Processed by RAD Partners, 2007-2012



“We are honored to be the RAD Program's 50th partner, joining the nation's leading utilities, retailers, and manufacturers in raising the bar for safe appliance disposal. RAD is the perfect complement to our Low Income Refrigerator Exchange Program, allowing us to offer our qualifying customers new, energy efficient appliances free of charge, while guaranteeing that their old units will be disposed of using the best environmental practices. It's a win-win for our customers and the environment.”

David Jacot, Director of Energy Efficiency, Los Angeles Department of Power and Water



# Ozone Layer Recovery: Where Are We Now?

Emissions of ODS, including chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), deplete the stratospheric ozone layer, which filters out dangerous ultraviolet (UV) solar radiation approximately 15 miles above the Earth's surface.

Significant increases in UV radiation reaching the Earth's surface have been linked to significant health problems, including:

- Skin cancer (melanoma and non-melanoma)
- Cataracts and other eye damage
- Premature aging of the skin and other skin problems
- Immune system suppression

Because of the damaging effects caused by UV rays, protecting the ozone layer also protects the health of humans and other living things on the planet.

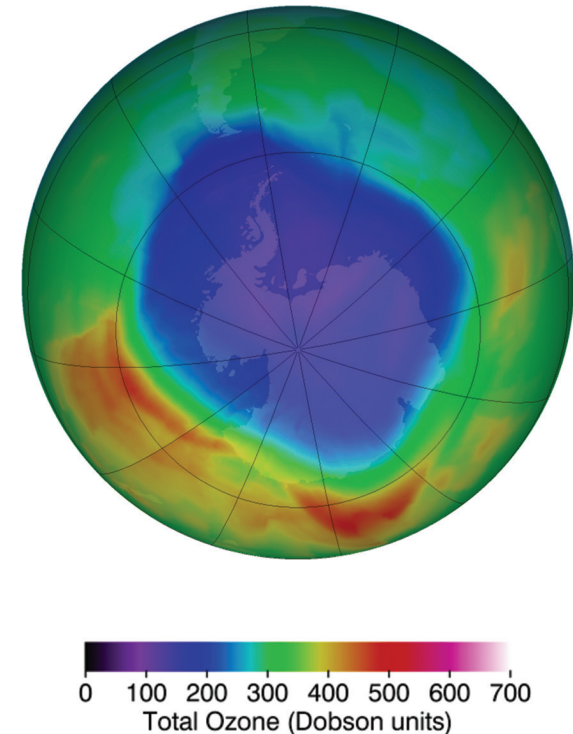
Beginning in the 1920s, CFCs and later HCFCs were widely used across a range of applications, including refrigerants and foam blowing agents in refrigerated appliances and other equipment types. Their harmful effects were discovered during the early 1980s, and their global production and consumption became controlled under the *Montreal Protocol on Substances that Deplete the Ozone Layer*, signed in 1987.

Due to the slow recovery process of stratospheric ozone and the long atmospheric lifetime of ODS—with CFC-12 lasting 100 years—seasonal ozone holes still gape over Antarctica (see figure, right).\* The ozone layer has gradually been recovering due to international efforts to end use of ODS, with full recovery expected around the middle of the century.†

\*National Aeronautics and Space Administration (NASA). 2013. Ozone Hole Watch. Available at <http://ozonewatch.gsfc.nasa.gov/>

†World Meteorological Organization (WMO). 2011. "Scientific Assessment of Ozone Depletion: 2010." Global Ozone Research and Monitoring Project-Report No. 52.

## Ozone Hole over Antarctica



The ozone hole observed over the Antarctic pole during September 2012. Photo Credit: NASA, 2013.

# Stratospheric Ozone Benefits

## 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
CFC-11	4,750	1	Foam
CFC-12	10,900	1	Refrigerant
HCFC-22	1,810	0.055	Foam
HCFC-141b	725	0.11	Refrigerant
HFC-134a	1,430	0	Refrigerant
HFC-245fa	1,030	0	Foam

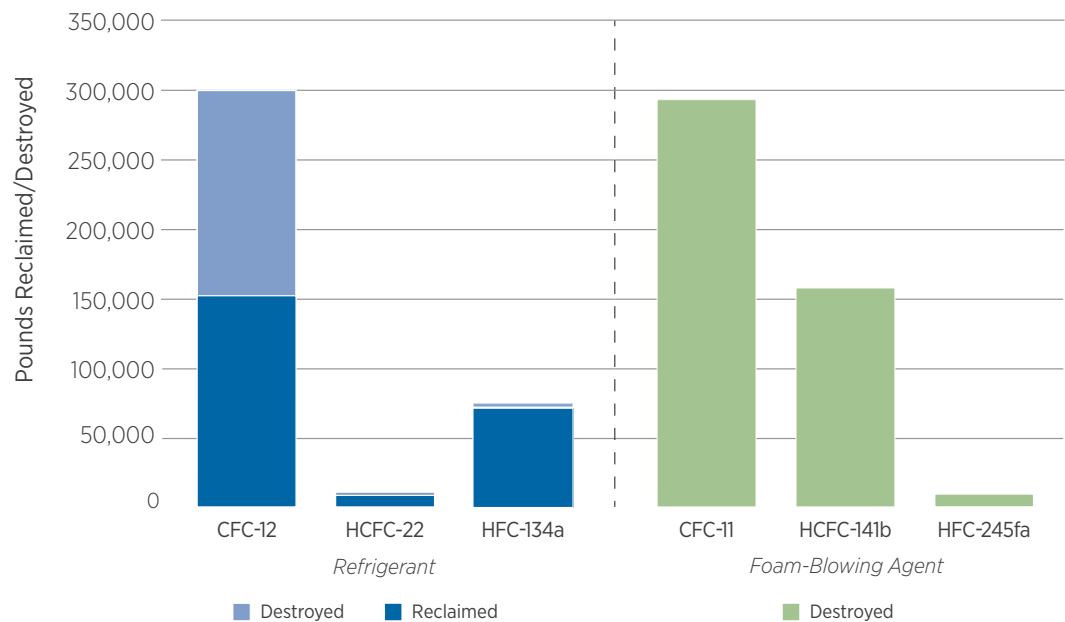
\*GWP calculations are based on the 100-year direct GWPs provided in the Intergovernmental Panel on Climate Change Fourth Assessment Report (2007), which are relative to CO<sub>2</sub>.

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

RAD partners reduce ODS emissions 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 0.42 lb. of refrigerants and 0.93 lb. of foam-blowing agents from each refrigerator/freezer. Across all equipment types, RAD partners recovered a total of 309,100 lbs. of CFC and HCFC refrigerants, and 447,200 lbs. of CFC and HCFC foam-blowing agents, avoiding the release of 274 ODP-weighted metric tons in 2012. In addition to being ODS, refrigerants and foam-blowing agents also have high GWPs, as shown in the table to the left and discussed further on the next page.

## Refrigerants and Foam-Blowing Agents Reclaimed or Destroyed by RAD Partners in 2012



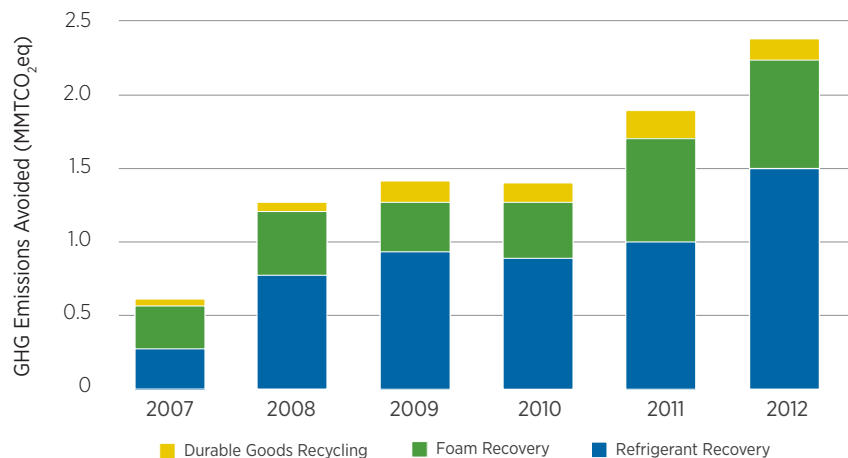
# Climate Benefits

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

These refrigerants and blowing agents are up to 100 to 10,900 times more damaging to the climate system than CO<sub>2</sub> on an equal mass basis. In addition to CFCs and HCFCs, RAD partners prevent the release of HFCs, non-ozone-depleting substances which are also potent greenhouse gases. Recovering these compounds, even in small quantities, can result in significant climate benefits. During 2012, RAD partners recovered 72,700 lbs. of HFCs. Additional climate benefits are achieved through the recycling of durable materials from appliances, which prevents indirect GHG emissions associated with the generation of electricity that would have otherwise been needed to produce virgin materials.

During 2012, RAD partners achieved the reduction of more than 2 MMTCO<sub>2</sub>eq, which is approximately equivalent to the annual carbon sequestered by U.S. forests spanning 1.9 million acres—an area larger than the state of Delaware. Of this, 65% can be attributed to reclaiming or destroying refrigerants, 29% 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.

## GHG Emissions Avoided through Proper Appliance Disposal by RAD Partners



**In 2012, RAD partners achieved climate benefits equivalent to:**

The amount of carbon sequestered by 1.9 million acres of U.S. forests in one year\*



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

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



# 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 2012, appliance recycling programs operated by the 44 RAD utility partners covered a territory of 36 million households across 27 states, representing approximately 30% of U.S. households. The average age of refrigerators collected was over 20 years old. In total, RAD utility partners reduced energy use by more than 2.6 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 MMTCO<sub>2</sub>e and are estimated to have saved consumers \$313 million.

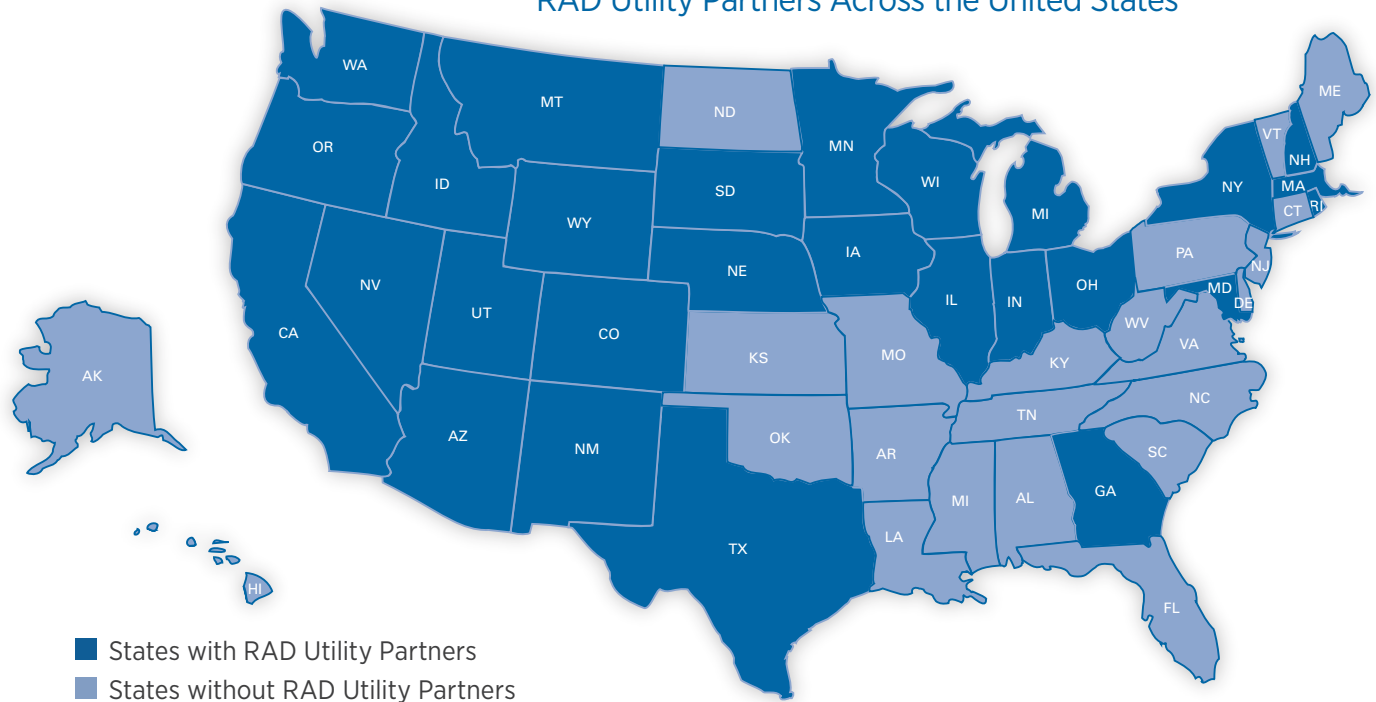


Karen Gaudet won \$500 from ARCA in a contest drawing by Austin Energy for customers who recycled their old, inefficient refrigerators and freezers.

Getting rid of a 20-year-old refrigerator could save your household roughly 1,040 kWh/year—or about \$125/year.\*

\*Actual energy and cost savings will vary by equipment model and region. These estimates are conservative and based on national averages (ENERGY STAR 2013 Databook).

RAD Utility Partners Across the United States



# Environmental Benefits for Communities

In 2012, 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:

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

Toxic or hazardous materials properly handled:

- 76,800 gal. of used oil
- 43,600 PCB-containing capacitors
- 3,700 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 effects on the neurological development of children, as well as the human reproductive, immune, and endocrine systems. Mercury is toxic and causes a variety of adverse health effects, including tremors, headaches, respiratory failure, reproductive and developmental abnormalities, and potentially, cancers.



The local community learns about the importance of proper refrigerator disposal at the pop-up museum hosted by National Grid and NSTAR in downtown Boston.

*“As a customer-owned cooperative, it’s important to us to offer the environmentally safe appliance disposal services that our community has been asking for. By joining RAD in 2012, we became the second RAD utility partner in the Mid-Atlantic region.”*

*Jeff Shaw,  
Environmental Programs and Energy  
Conservation Director, Southern Maryland  
Electric Cooperative*

# Increasing Benefits Over Time

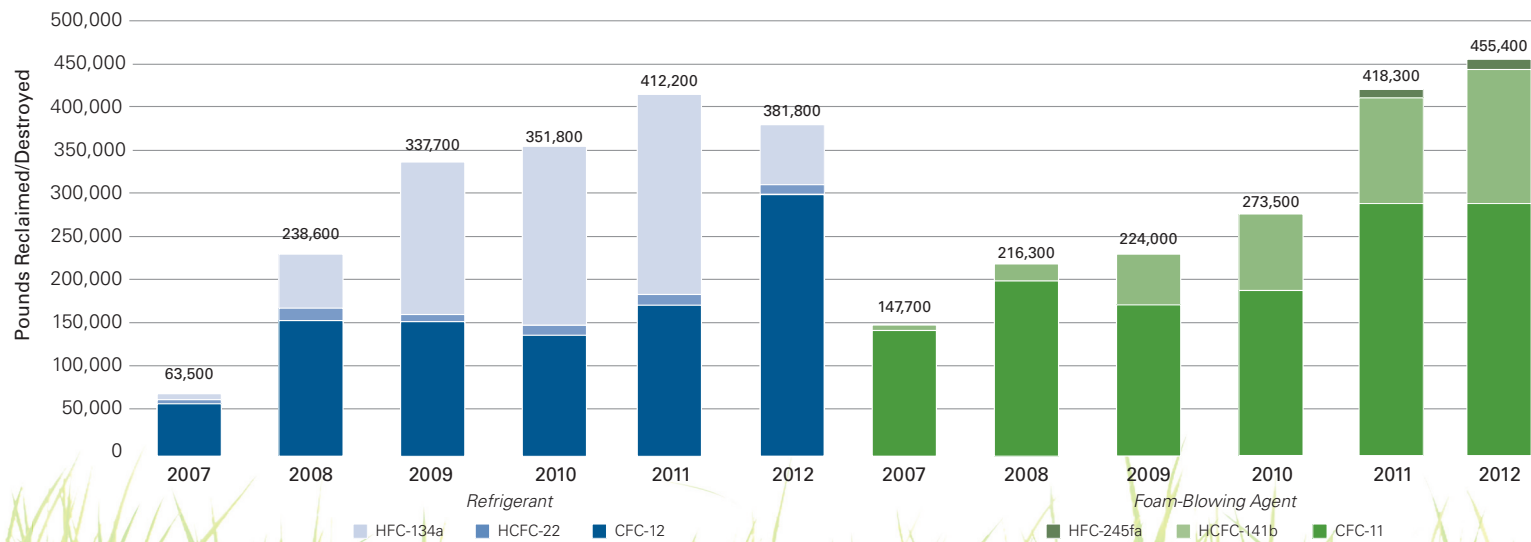
In 2007, nine RAD partners recovered 63,400 lbs. of refrigerants and 147,700 lbs. of foam-blowing agent. As of 2012, the program has expanded to 48 partners and 2 state affiliates, who have recovered 381,800 lbs. of refrigerant and 455,500 lbs. of foam-blowing agent.

The majority of refrigerant and foam-blowing agents recovered in 2012 were CFCs. This is the result of RAD partners' efforts to target older, inefficient units. In the coming years, more HFC units will be retired. Proper handling of HFC refrigerants and blowing agents at end-of-life will reduce GHG emissions.

*“At GE Appliances, we are committed to minimizing the environmental impact of our appliance products from manufacturing to end-of-life disposal. We are proud that through our efforts as the first RAD manufacturer, we reduce greenhouse gas emissions through safe handling of both ODS and HFC foams.”*

*Mark Shirkness, General Manager Distribution Services, GE Appliances*

**Refrigerants and Foam-Blowing Agents Recovered by RAD Partners, 2007–2012**





# 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 towards safer alternatives. But because appliances 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 not ozone depleting, can still damage the climate system if not properly handled at end of life. 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/rad](http://www.epa.gov/rad)



San Diego Gas & Electric rolls out its 150,000th appliance for proper disposal at an ARCA recycling facility.



U.S. Environmental Protection Agency  
Stratospheric Protection Division (6205J)

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[www.epa.gov/rad](http://www.epa.gov/rad)

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