2014 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 commit to collecting and disposing of old refrigerated appliances using the best environmental practices available and going beyond what is required by federal law.

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.

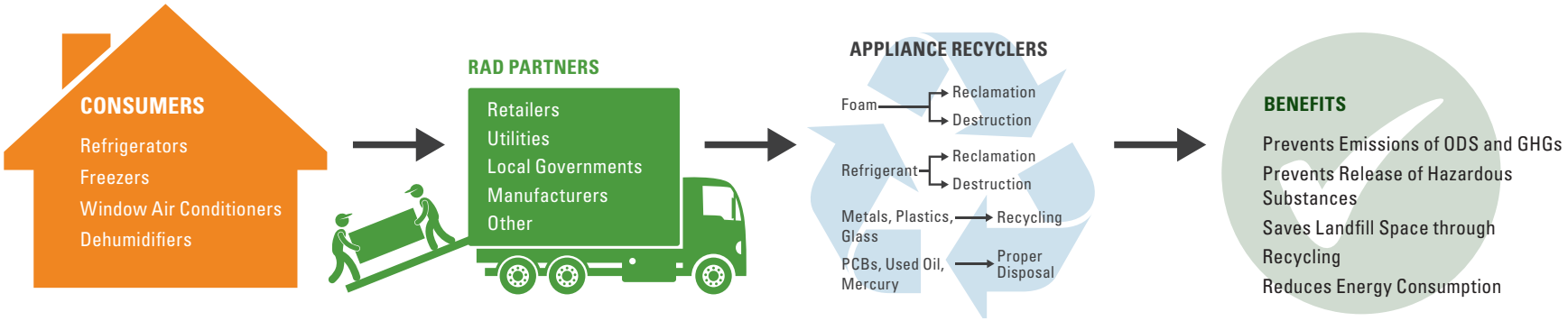
What Is RAD?

In 2014, an estimated 11.2 million refrigerators and freezers, 6.2 million window air conditioning units, and 1.3 million dehumidifiers were disposed of in the United States. These units contain ozone-depleting substances (ODS), hydrofluorocarbons (HFCs), 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 regulations do not require the recovery of appliance foam, which is also a source of ODS and GHG emissions, or currently, the recovery of HFCs, which are potent GHGs commonly used in refrigerant-containing appliances. Further, up to 35% of disposed refrigerators/freezers are resold onto the secondary market;[1] the continued use of these 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 handling of all materials in compliance with federal law, and in addition, take on the responsibility of recovering foam insulation from end-of-life appliances. This results in reduced emissions of GHGs and ODS from avoided releases of foam-blowing agents and refrigerants to the atmosphere. It also saves landfill space and reduces energy consumption by ensuring the recycling of durable materials, and keeps 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 2014.



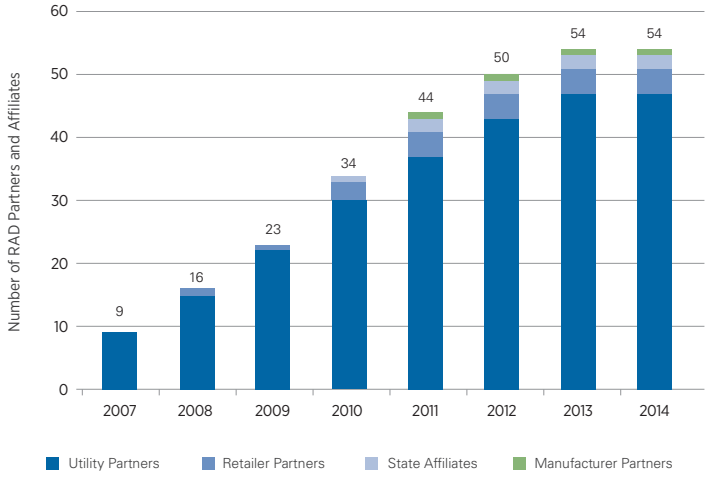
[1]Based on studies published by Cadmus Group, Innovologie, NMR Group, and the U.S. Department of Energy.

RAD Partners and Affiliates

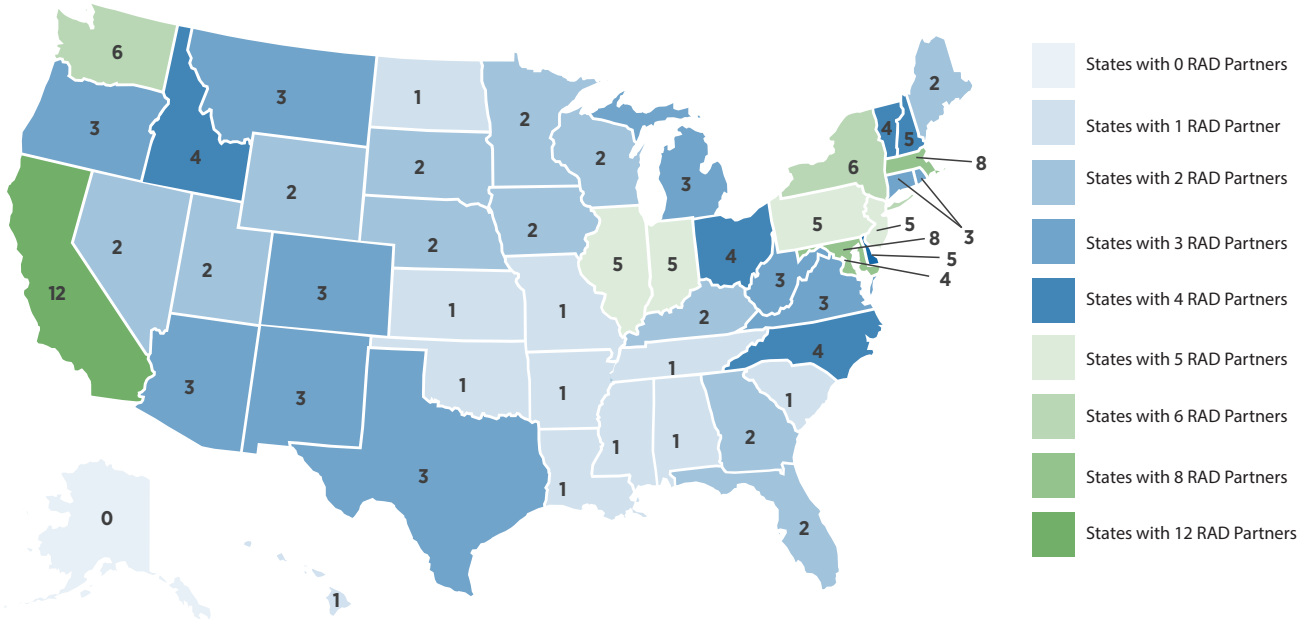
RAD has nearly achieved nationwide coverage, with 54 partners now servicing 49 states. California has the greatest number of RAD partners (12), followed by Maryland (8) and Massachusetts (8). The program is expected to continue expanding its reach in the coming years.

Program Growth

RAD has grown significantly over the past seven years, from nine partners in 2007 to 54 partners in 2014.



Map of RAD Partners and Affiliates



Utilities, Retailers, and Manufacturers

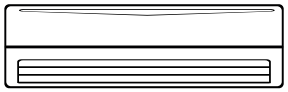
State Affiliates

Results

In 2014, RAD's 54 partners collected and processed a total of 938,084 refrigerant-containing appliances, representing an estimated 5% of the total disposed of in the United States. This includes:

837,364 Refrigerators

91,449 Stand-Alone Freezers



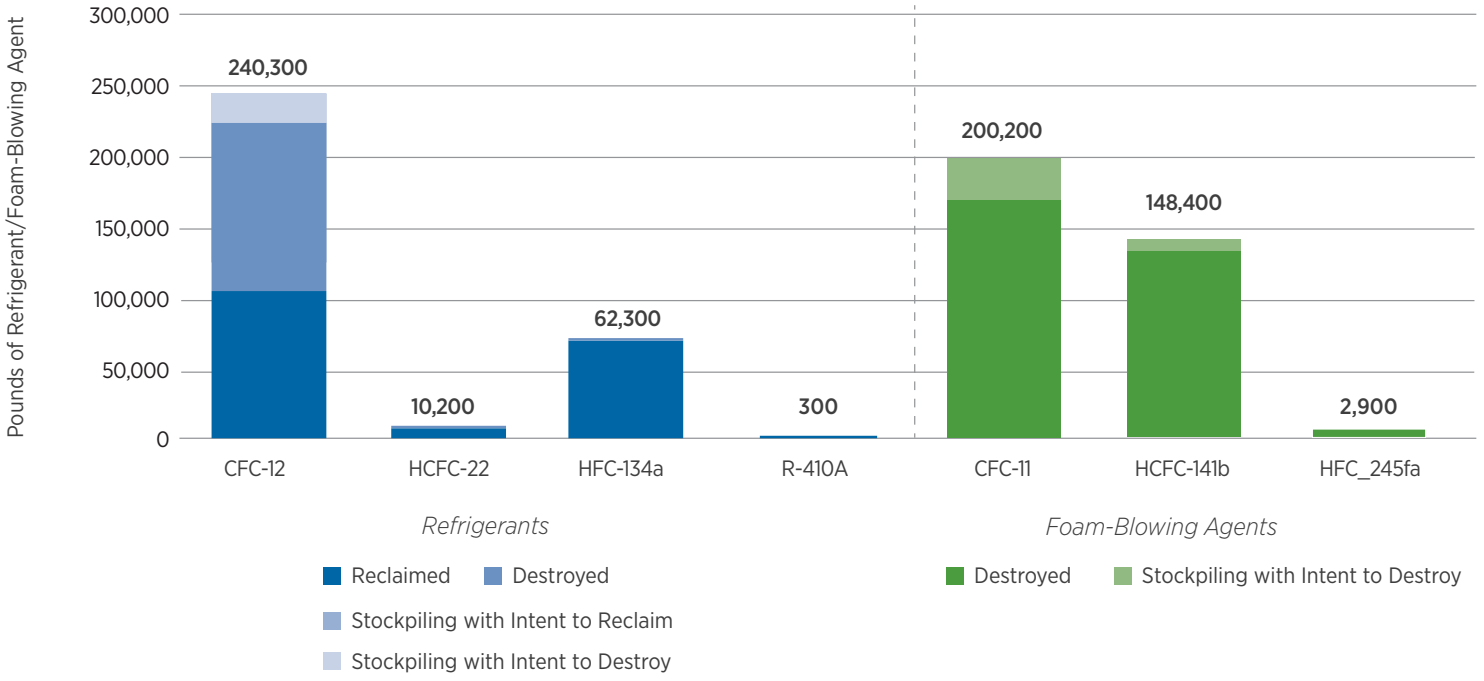
7,113 Air Conditioning Units

2,158 Dehumidifiers

By disposing of these units using the best available practices, RAD partners have helped reduce emissions of ODS and GHGs by safely recovering refrigerants as well as foam-blowing agents.

Partners have also helped to reduce energy use and increase recycling by removing energy inefficient appliances from the grid and properly recycling durable materials. The environmental benefits are described in the following pages.

Refrigerants and Foam-Blowing Agents Reclaimed or Destroyed by RAD Partners in 2014



Stratospheric Ozone Benefits

Older refrigerated appliances that were manufactured with ODS refrigerants and foam-blowing agents are being retired today and safely disposed of by RAD partners. On average, partners recovered 0.3 lbs. of refrigerants and 0.9 lbs. of foam-blowing agents from each refrigerator/freezer. Across all equipment types, RAD partners recovered a total of approximately 250,500 lbs. of CFC and HCFC refrigerants, and 348,600 lbs. of CFC and HCFC foam-blowing agents, avoiding the release of 207 ODP-weighted metric tons in 2014. In addition to being ODS, refrigerants and foam-blowing agents also have high GWPs, as shown in the table below and discussed further on the next page.

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 CO_2.

Ozone Update

In the early 1980s, scientists observed a thinning of the ozone layer over the Antarctic. This annual phenomenon, commonly referred to as the "ozone hole," began with the widespread use of CFCs and later HCFCs across a range of applications, including refrigerated appliances.

Recognizing the importance of protecting the stratospheric ozone layer, 27 countries signed the Montreal Protocol in 1987, a global agreement to eliminate the use of ODS, including CFCs and HCFCs. The Montreal Protocol came into force in 1989 and achieved universal ratification in 2009 from all countries in the United Nations (UN). According to a recent study, the Antarctic ozone hole and the thinning over the middle latitudes of the northern hemisphere would have grown in size by 40% and 15% by 2013, respectively, had the Montreal Protocol not come into force.

Today, ODS levels are 10-15% lower than peak values 10 to 15 years ago. The ozone layer is on track to recover within the next few decades.

For more information, see the World Meteorological Organization's Assessment for Decision-Makers: https://www.wmo.int/pages/prog/arep/gaw/ozone_2014/documents/ADM_2014OzoneAssessment_Final.pdf

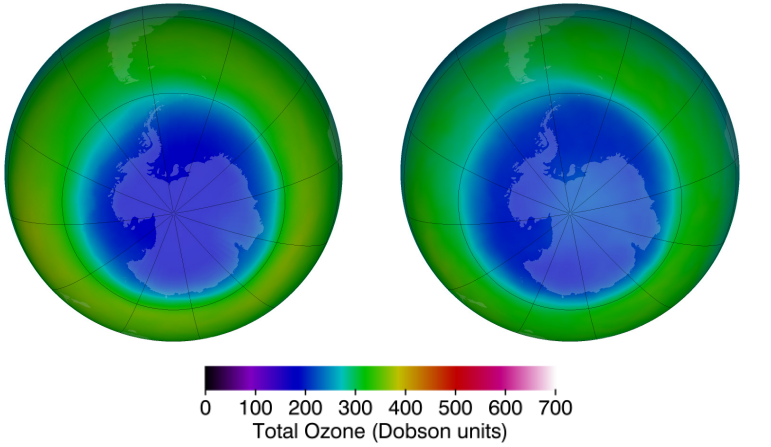


Image of the monthly-averaged total ozone over the Antarctic pole in September 1987 as the Montreal Protocol was being signed (left) and in September 2015 (right). The blue and purple colors represent areas with the least ozone, and the yellow and red colors represent areas with the most ozone.

Photo Credit: National Aeronautics and Space Administration (NASA) Ozone Hole Watch, September 2015.

Climate Benefits

During 2014, RAD partners achieved a reduction of nearly 2 million metric tons of carbon dioxide equivalent ($MMTCO_2eq$), which is equivalent to the annual carbon emissions from the electricity use of nearly 255,300 homes. Of this, 66% can be attributed to reclaiming or destroying refrigerants, 26% to reclaiming or destroying foam-blowing agents, and 8% 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. HFCs are rapidly increasing in the atmosphere mostly due to increased demand for refrigeration and air conditioning, particularly in developing countries, and because they are the primary substitute for ozone-depleting substances being phased out under the Clean Air Act and the *Montreal Protocol on Substances that Deplete the Ozone Layer*. Recovering HFCs can lead to significant climate benefits. For instance, more than 50% of GHG emission reductions from the proper disposal of refrigerators can come from HFC foam (up to 0.5 $MTCO_2eq$/unit). During 2014, RAD partners recovered 65,500 lbs. of HFCs.

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.

> ***"The RAD program helps us communicate the environmental benefits of our refrigerated appliance disposal program to our community and supports the goals set forth in our city's Climate Action Plan and Energy Policy. This includes the broader effort to ensure highly reliable, competitive, carbon neutral electricity supplies, managed in a sustainable, innovative, responsible and efficient manner for the Fort Collins community."***

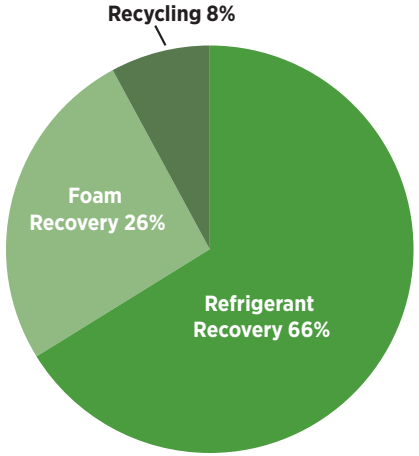
John Phelan,
Energy Services Manager
Fort Collins Utilities

In 2014, RAD partners achieved climate benefits equivalent to:

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.

GHG Emissions Avoided through Proper Appliance Disposal by RAD Partners in 2014



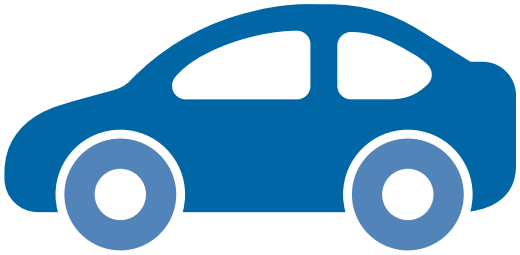
Energy Savings

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 2014, appliance recycling programs operated by the 47 RAD utility partners covered a territory of 46 million households (approximately 37% of U.S. households) across 35 states. RAD utility partners are operating programs in states from coast to coast.

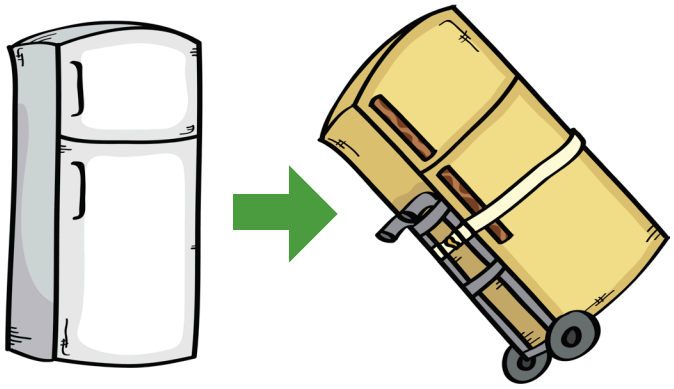
In total, RAD utility partners reduced energy use by more than 2.4 billion kWh by removing old refrigerators, stand-alone freezers, window air conditioning units, and dehumidifiers from the grid. These energy savings translate to climate benefits of nearly 2 $MMTCO_2eq$ and are estimated to have saved consumers $335 million.

Energy savings achieved by RAD partners in 2014 are equivalent to avoiding annual GHG emissions from more than 351,600 passenger vehicles.*



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

Replacing an inefficient, approximately 15-year-old refrigerator with one that is ENERGY STAR® certified will 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 2015 Databook).

Environmental Benefits for Communities

In 2014, 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:

- 123 million lbs. of ferrous metals (e.g., steel)
- 6 million lbs. of non-ferrous metals (e.g., copper)
- 23 million lbs. of plastic
- 4 million lbs. of glass

Toxic or hazardous materials properly handled:

- 76,000 gal. of used oil
- 42,700 PCB-containing capacitors
- 17,600 mercury-containing components

"In September of 2014, we achieved our goal of recycling 1 billion pounds of consumer electronics and appliances. This included more than 90,500 refrigerated appliances that were processed through RAD. Best Buy's new goal is to double the pace of our collection by recycling 2 billion pounds by 2020."

Rebecca Kulas,
Program Manager, Appliances
Best Buy

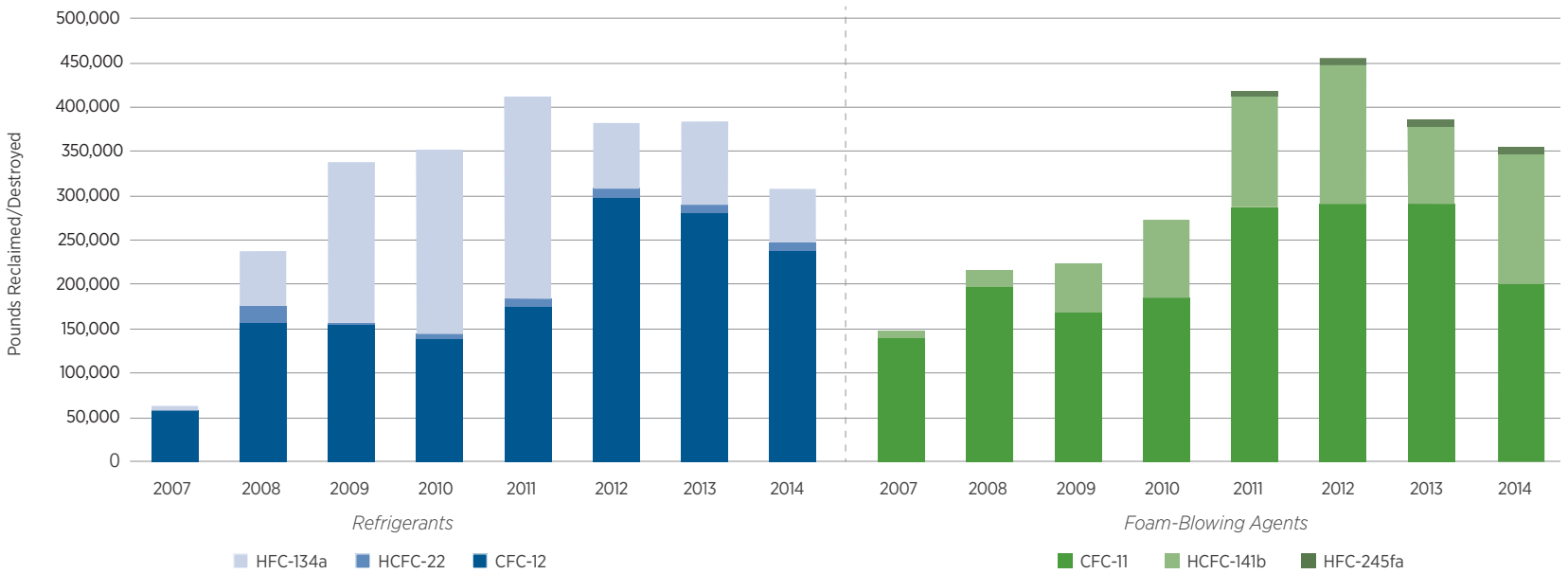
Benefits Over Time

In 2007, nine RAD partners recovered 63,400 lbs. of refrigerants and 147,700 lbs. of foam-blowing agents. As of 2014, the program has expanded to 52 partners and two state affiliates that have recovered 313,100 lbs. of refrigerant and 351,500 lbs. of foam-blowing agents.

The majority of refrigerant and foam-blowing agents recovered by RAD partners in 2014 were CFCs. This is the result of RAD partners' efforts, particularly utility partners, 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 foam-blowing agents at end-of-life will reduce GHG emissions.

> ***"By mid-August 2014, ARCA Advanced Processing had processed over 250,000 refrigerators and freezers through the UNTHA Recycling Technology (URT) system—a fully-automated refrigerator/freezer recycling plant with integrated foam processing technology. This was an important milestone for us, achieved only 4 1/2 years following initial operation of the UNTHA system. Looking ahead, we aim to increase the efficiency and capability of material separation of this system to ensure refrigerated appliances are disposed using the best environmental technology available."***
>
> **Brian Conners,**
> *President and COO*
> *ARCA Advanced Processing, LLC.*

Refrigerants and Foam-Blowing Agents Recovered by RAD Partners, 2007-2014*



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

A Growing Program to Meet a Growing Need

If unaddressed, HFC emissions in the United States are projected to nearly double by 2020 and triple by 2030. The RAD program is expected to play an increasing role in reducing emissions of HFCs in the coming years as more appliances containing HFCs reach end-of-life and enter the disposal stream.

While some RAD partners are already processing HFCs from refrigerated appliances, it is expected that more partners will begin to do so as the number of HFC-containing units reaching disposal continues to increase over time. To further encourage the proper recovery of HFC foam from end-of-life refrigerated appliances, RAD is exploring how best to introduce an enhanced recognition program to award outstanding partners for addressing HFC emissions through responsible appliance disposal, among other activities that demonstrate environmental leadership.

Upping the Ante on Addressing HFC Emissions in the United States

The President's June 2013 Climate Action Plan (CAP) states that, "to reduce emissions of HFCs, the United States can and will lead both through international diplomacy as well as domestic actions." Furthermore, the CAP states that EPA will "use its authority through the Significant New Alternatives Policy (SNAP) Program to encourage private sector investment in low-emissions technology by identifying and approving climate-friendly chemicals while prohibiting certain uses of the most harmful chemical alternatives." Since the release of the CAP, SNAP actions have included multiple rules and notices that directly impact the types of refrigerants and foams used in household refrigerators, among other equipment types (*see table on the right*). Under SNAP's July 2015 final rule, various HFCs and HFC-containing blends that were previously listed as acceptable alternatives will be listed as unacceptable in various end-uses in the aerosols, foam-blowing, and refrigeration and air conditioning sectors where other alternatives are available or potentially available. The implementation of the July 2015 SNAP action, known as the Status Change Rule, is estimated to reduce HFC emissions by 26 to 31 $MMTCO_2eq$ in 2020, and by 54 to 64 $MMTCO_2eq$ in 2025. For additional information on the SNAP program and these actions, visit **http://www2.epa.gov/snap**.

Recent SNAP Determinations that Impact New Household Refrigerators

Compound	SNAP Determination	Effective Date
Foam-Blowing Agents		
HFC-134a, HFC-245fa, HFC-365mfc and blends thereof	Unacceptable	1/1/2020
Formacel TI and Formacel Z-6	Unacceptable	1/1/2020
Methylal and HFO–1336mzz(Z)	Acceptable	10/21/2014
Refrigerants		
R-513A	Acceptable	7/16/2015
R-290 (propane)	Acceptable	4/10/2015
R-450A	Acceptable	10/21/2014

The CAP also directs the federal government "to purchase cleaner alternatives to HFCs whenever feasible and transition over time to equipment that uses safer and more sustainable alternatives." In May 2015, a proposed rule was published, sponsored by the Department of Defense, the General Services Administration, and the National Aeronautics and Space Administration, to amend the Federal Acquisition Regulations (FAR) to implement Executive branch policy in the CAP to procure, when feasible, alternatives to high-GWP HFCs. The proposed amendment is designed to promote the use of safer chemical alternatives to HFCs by service and vendor contractors.
For more information, visit: **http://www2.epa.gov/snap/reducing-hydrofluorocarbon-hfc-use-and-emissions-federal-sector**.

RAD Partner Activities

In 2014, RAD partners launched innovative promotions and campaigns to raise consumer awareness about safe appliance disposal.

RAD Partner Promotions and Campaigns

ComEd raised customer and employee awareness about their Fridge & Freezer Recycling program. To support these efforts, ComEd displayed an information poster (right) and made available samples of recycled materials from an old refrigerator, including oil & refrigerant, foam insulation, metals, glass, plastics, and mercury containing devices. The display was accompanied by an educational sign that read, "The Power of Recycling," which included the EPA RAD logo.

In 2014, **NIPSCO** promoted energy-saving tips and their Energy Efficiency Rebate Program at 15 environmental awareness events, including Earth Day and energy fairs.

PSEG Long Island ran a promotion from September 15, 2014 to November 15, 2014 to increase participation in their refrigerator recycling program, giving away two $500 gift cards to PC Richard & Son, a large regional appliance retailer. This promotion was advertised on customer bill inserts, the PSEG Long Island website, home shows and local festivals, as well as print ads in local weekly publications.

PSEG Long Island bill insert with recycling incentives.

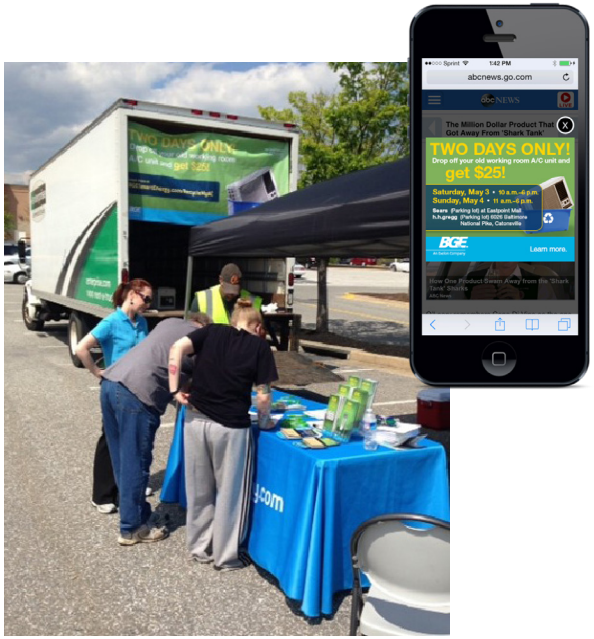
Photo Credit: PSEG Long Island

ComEd sign to increase awareness about their appliance recycling program.

Photo Credit: ComEd

Facebook post for Xcel Energy's "What's In Your Fridge" campaign.

Photo Credit: Xcel Energy



Baltimore Gas & Electric's two-day collection of room airconditioners.

Photo Credit: Baltimore Gas & Electric

Xcel Energy launched a social media promotion in the fall of 2014, titled "What's In Your Fridge?" to promote awareness of the utility's Refrigerator Recycling program and increase customer engagement online. Customers in Colorado, Minnesota, and New Mexico were invited to take photos of the inside of their refrigerators and share them on the company's Facebook pages for a chance to win. The prizes differed by state, and included one pair of tickets to a professional football game (one pair each for Colorado and Minnesota customers), and a $200 gift card (offered in New Mexico). One winner was randomly selected for each state.

Puget Sound Energy (PSE) promoted their appliance recycling program through digital ads, social media and key word search ads throughout PSE's electric service territory of Western Washington. The utility also developed flyers in English, Spanish, and Chinese to further promote their free appliance replacement and recycling programs to communities within their service territory.

At **Baltimore Gas & Electric (BGE)'s** room air conditioner recycling event in May of 2014, more than 200 old room air conditioners were recycled at two locations in BGE's service territory, resulting in nearly 30,000 kWh in energy savings. In exchange for recycling their units, customers received a $25 reward in the mail and a $25 rebate if they purchased a new ENERGY STAR® certified unit. Postcards, free—standing inserts, door hangers, the local news, and radio advertisements were among the most effective marketing tools used to promote the event.

RAD Recyclers and Foam Recovery

RAD partners work with recyclers to ensure the proper recovery of foam from end-of-life refrigerated appliances. While each of the recyclers uses different methods for processing the refrigerated appliances, all lead to significant ozone and climate benefits compared to business-as-usual disposal practices.

Foam Processing Technologies

Manual Foam Recovery is performed using saws to cut through appliances and expose the foam insulation, which is then removed by scraping or "fileting." Once manually removed, appliance foam is bagged with the blowing agent intact and sent for destruction at a waste-to-energy facility. This method is estimated to achieve a blowing agent recovery efficiency of 85%, meaning that only 15% of the blowing agent is released to the environment.

Semi-Automated Foam Recovery is where foam is manually recovered from an appliance, but is then processed using automated technologies to recover the blowing agent from the appliance foam. The automated technologies capture the foam-blowing agent under negative pressure and condense it into liquid form, which is bottled and sent off-site for reclamation or destruction. This method is estimated to achieve a blowing agent recovery efficiency of 85%, meaning that only 15% of the blowing agent is released to the environment.

Fully Automated Foam Recovery and Processing use automated technologies that both recover and process appliance foam in one step. These technologies shred the whole appliance (with foam intact) in fully enclosed equipment following the removal of refrigerant, used oil, appliance doors, and interior glass and metal shelving. This process results in the highest blowing agent recovery efficiency—estimated at 95%, meaning that only 5% of the blowing agent is released to the environment.

ARCA INCORPORATED

ARCA ADVANCED PROCESSING LLC

Founded in 1976, ARCA has facilities located in CA, CO, IL, IN, KY, MN, MO, NM, PA, TX, and WA. All ARCA facilities use manual and semi-automated foam processing methods, except for their Advanced Processing facility in PA, which uses fully automated foam processing methods. To learn more, visit: www.arcainc.com.

JACO ENVIRONMENTAL

JACO Environmental is the largest appliance recycling company in the United States, serving more than 200 utility territories in 35 states, and employing both manual and semi-automated foam processing methods. To learn more, visit www.jacoinc.net.

Recleim

Founded in 2012, Recleim has a fully automated closed loop foam processing facility in SC. To learn more, visit: www.recleim.com.

RAD Partners Meet to Exchange Ideas and Collaborate

RAD continually explores new opportunities for partners to exchange ideas and collaborate on ways to enhance the program. On October 27, 2014, EPA held its fourth annual RAD Partner Lunch as a side event to the ENERGY STAR® Products Partner Meeting in Phoenix, Arizona. Twenty-nine participants attended, representing six utilities, four retailers, three appliance recycling companies, one manufacturer, and one state affiliate.

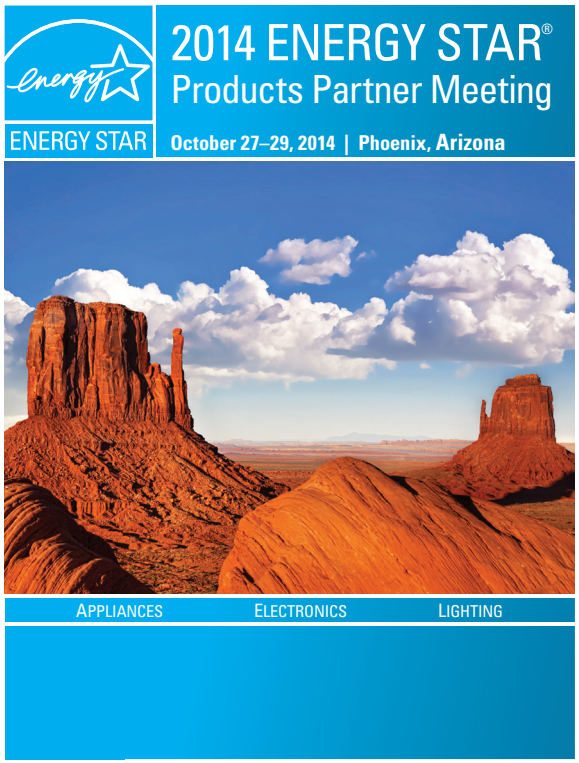
During the lunch, EPA provided an overview of recent RAD achievements, which was followed by a group brainstorming session which focused on:

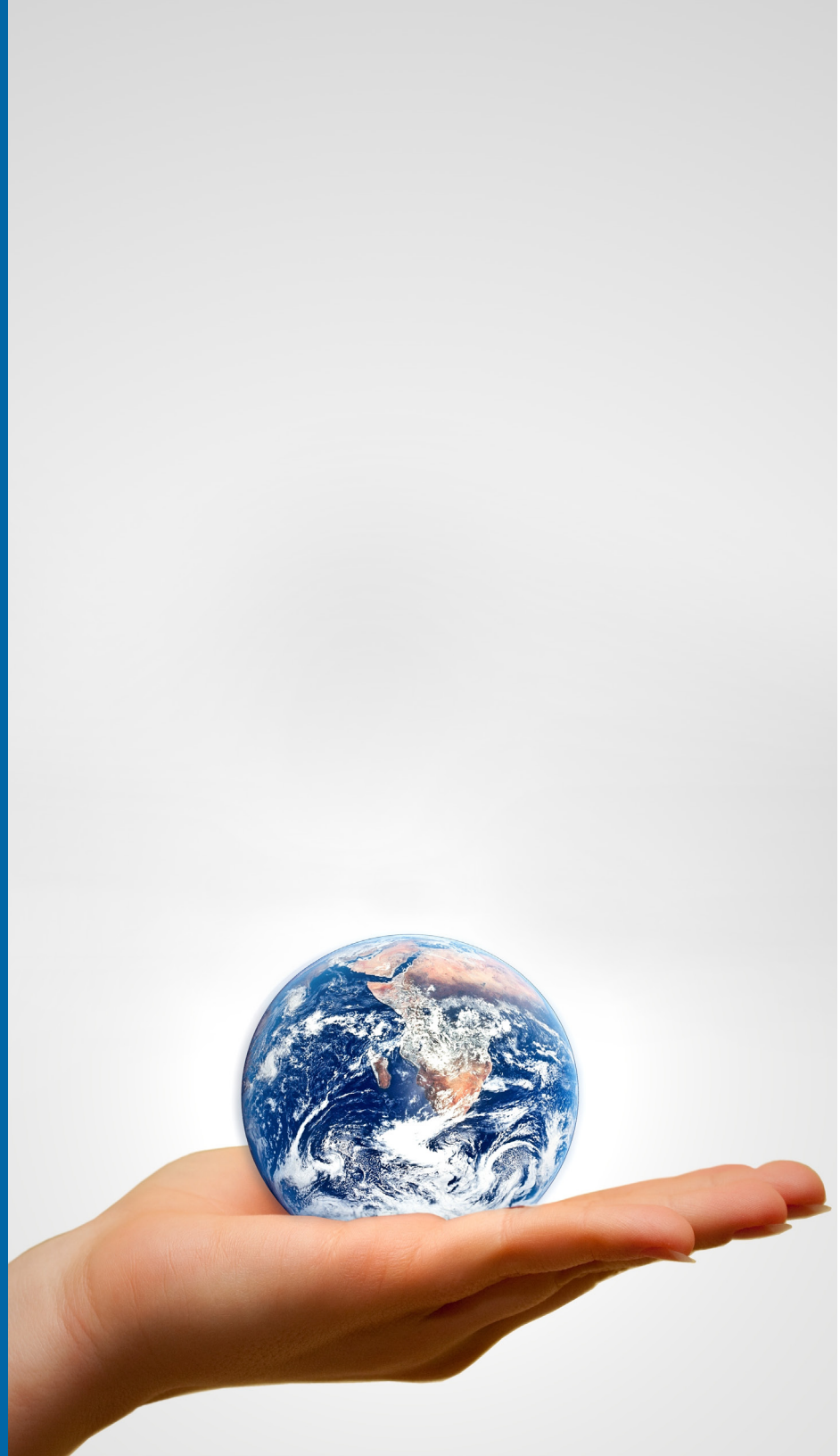
- Ways to quantify and better communicate the benefits of the RAD program, including non-energy benefits;
- Opportunities to collaborate on marketing the RAD program; and
- Enhancing RAD partner recognition.

Since the Partner Lunch, EPA has continued to exchange ideas with partners to establish a framework for better communicating the benefits of the RAD program, identifying collaborative marketing opportunities, and stronger recognition for partner achievements. Through these exchanges, partners have demonstrated a shared commitment to carrying out the RAD mission. Look out for some exciting program enhancements coming soon as a result of these continued efforts!

"Being able to connect with other RAD partners at national meetings such as the 2014 ENERGY STAR Products Partner Meeting has provided valuable opportunities for innovation and cross-fertilization."

William R. Ellis, Manager,
Demand Side Management
Delmarva Power





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

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