Increasing Climate Benefits through Your Appliance Recycling Program:

Close-up on GE Appliances' Approach

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Responsible Appliance Disposal Program
RAD
EPA

Agenda

- Overview of RAD Partner Achievements and Climate Opportunities

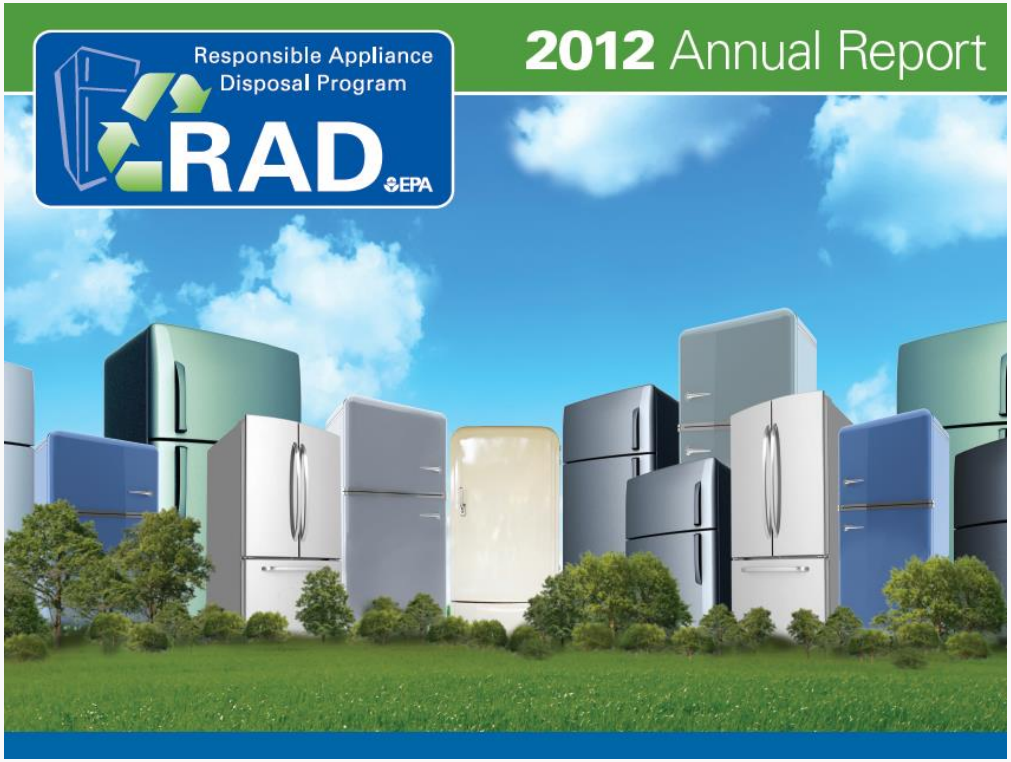
- Close-up on GE's approach
  - Approach to appliance recycling
  - Technologies in use
  - Lessons learned

- Discussion

Overview of RAD Partner Achievements

2012 Partner Ozone Layer Achievements

- 50 RAD partners recycled about 890,000 appliances
- Prevented the release of 756,300 lbs. of ozone-depleting refrigerants and foam-blowing agents



2012 Partner Climate Benefits

- >2 MMTCO$_2$eq in GHG emissions prevented through:
  - Recovering refrigerant
  - Recovering foam blowing agent
  - Recycling durable goods

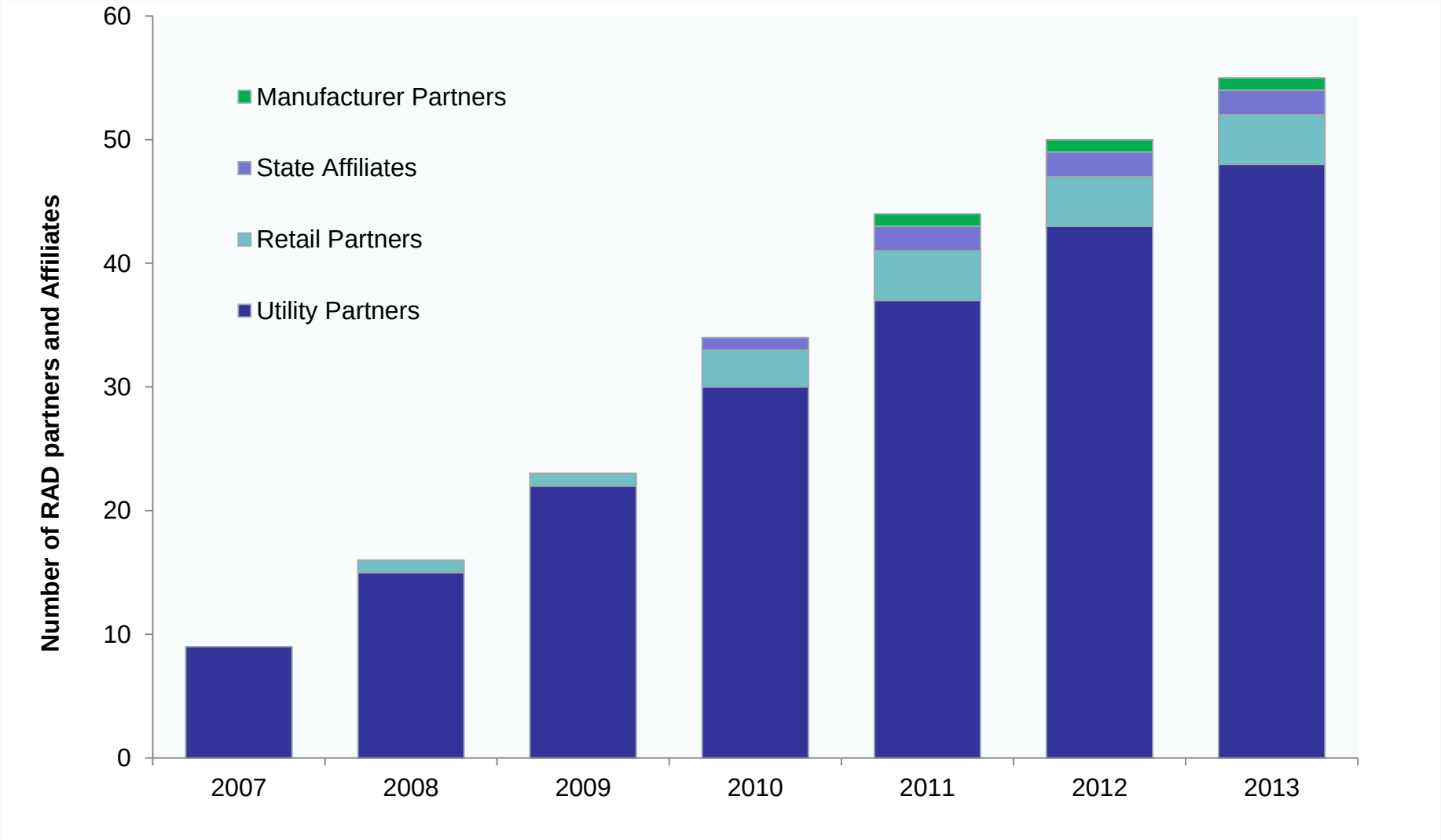
Equivalent to CO_2 emissions sequestered annually by 1.9 million acres of U.S. forests – larger than Delaware

RAD Partner Achievements

- Environmental benefits achieved by RAD Partners have been generally increasing since 2007:
  - More RAD Partners
  - More capacity
  - More units processed
  - More foam recovery
  - More types of foam blowing agent recovered

Partners & Affiliates

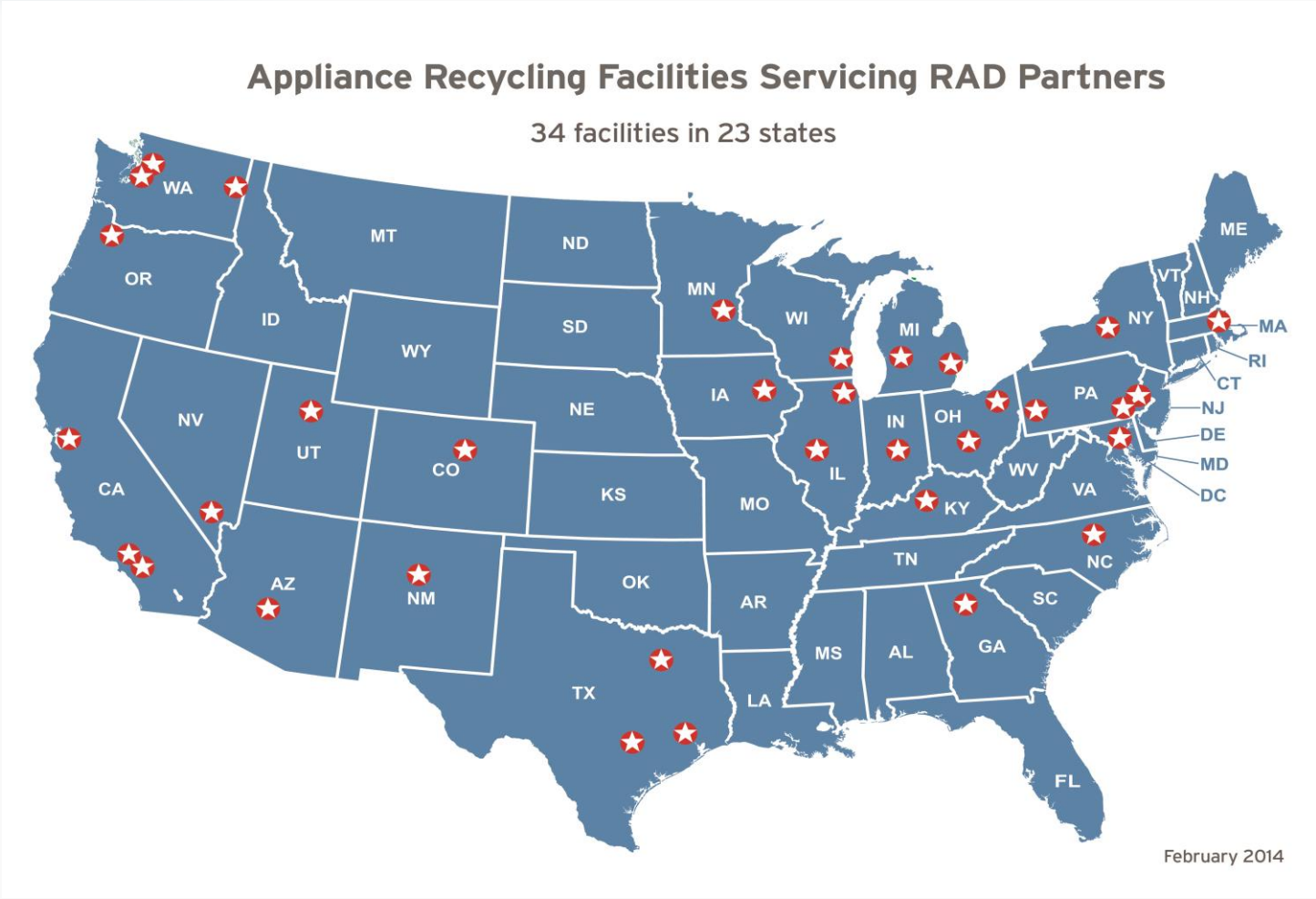
RAD Partners have increased from 9 in 2007 to 54 in 2013



Capacity

Since RAD launch:*

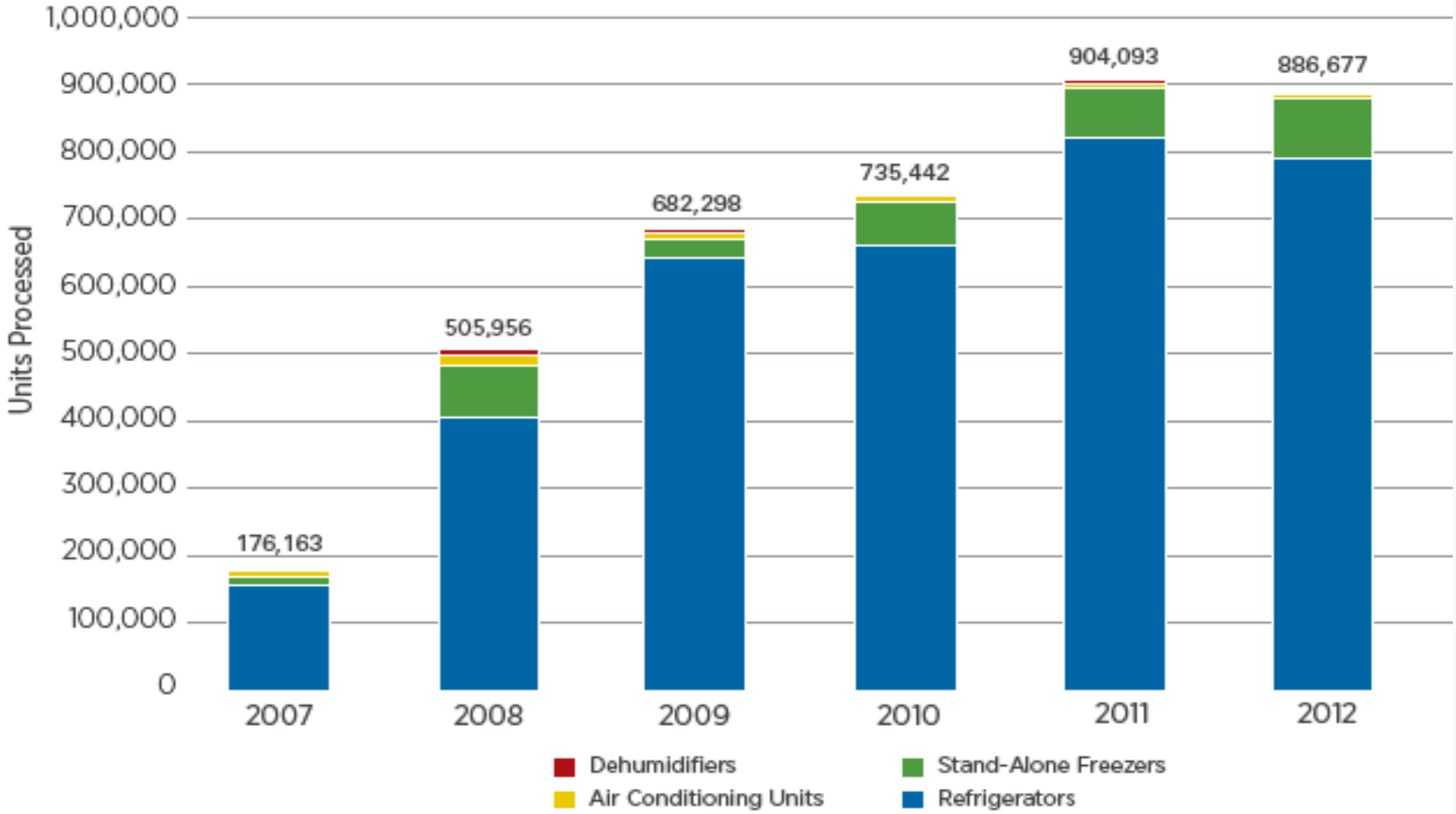
- 5x more recycling facilities
- 5x more states
- Greater diversity in foam recovery technologies



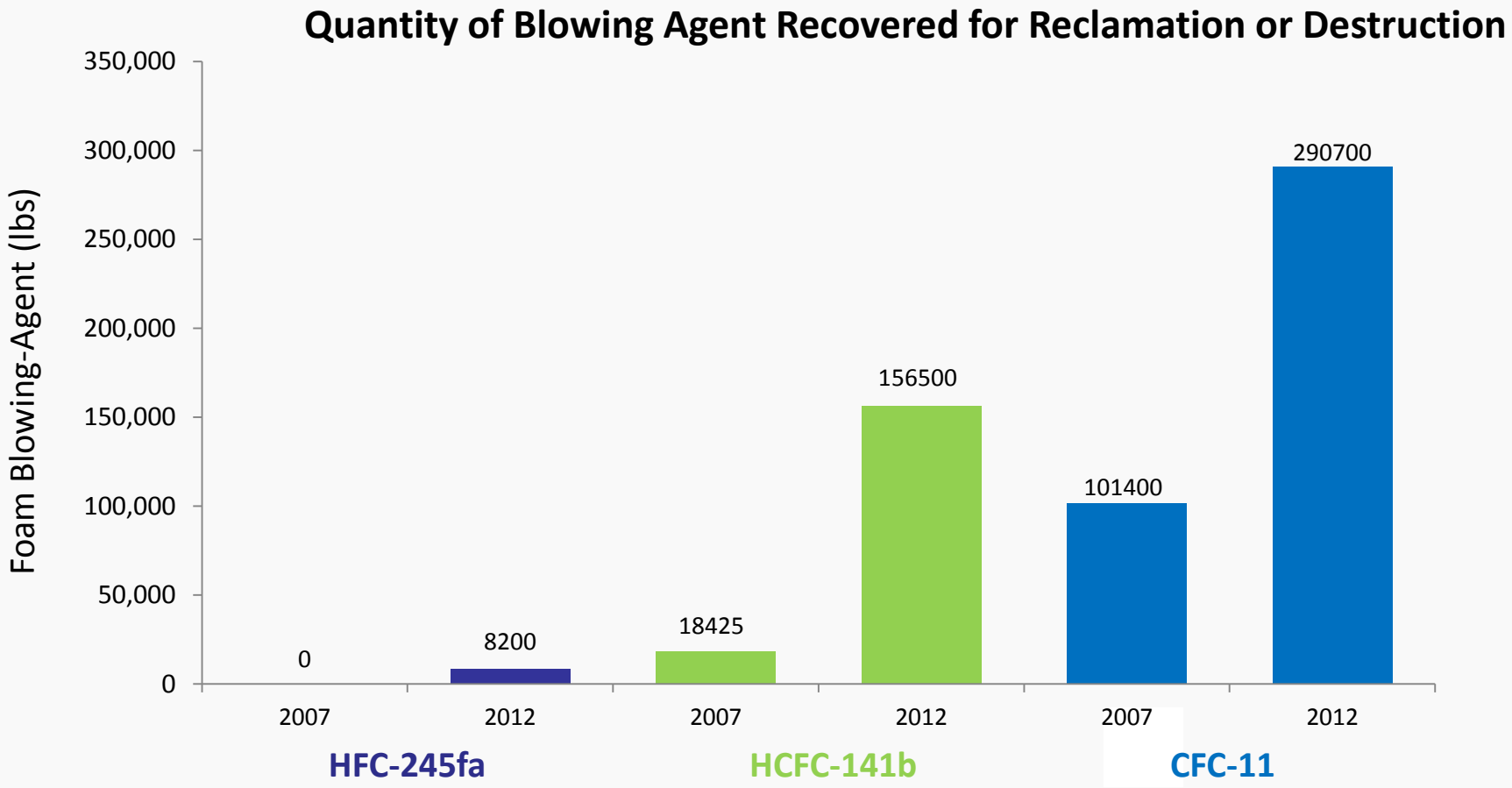
*Doesn't include facilities not currently serving RAD partners.
*New facilities likely coming on line in next few years

Appliances Processed

400% increase in number of units processed since start of program



CFC, HCFC, and HFC Foam Recovery



HFC Foam Recovery

- In 2012, there was minimal reported recovery of HFC foam
- But over time, more refrigerators containing HFC foam will reach disposal
- The recovery of HFC foam represents a significant c**limate opportunity**
  - Over 50% of GHG emission reductions from the proper disposal of refrigerators can come from HFC foam (up to 0.5 $MTCO_2eq$/unit)

Foam Blowing Agent	ODP	GWP
CFC-11	1.0	4,750
HCFC-141b	0.11	725
HFC-134a	0	**1,430**
HFC-245fa	0	**1,030**

HFC Foam Recovery

- In 2015, an estimated 25% of refrigerators reaching disposal will contain HFC foam
- If HFC foam were to be recovered from all refrigerators disposed in that year…

Over 0.0014 $MMTCO_2eq$ would be avoided

→ Equivalent to preventing nearly 160,000 gallons of gasoline from being consumed

What Does the President's Climate Action Plan Say about HFCs?

- Continue international diplomacy
  - Lead negotiations under the Montreal Protocol to phase down HFCs
    - Global phase down could reduce over 90 gigatons of CO2eq by 2050, equal to roughly two years worth of current global GHG emissions
  - Work with partners in the ***Climate and Clean Air Coalition to Reduce Short-Lived Climate Pollutants*** to promote climate-friendly alternatives to high-GWP HFCs, address standards, and reduce emissions from HFC use
- Address through domestic actions
  - Use existing Clean Air Act authority of ***Significant New Alternatives Policy (SNAP) Program*** to approve climate-friendly chemicals, prohibit some uses of most harmful chemical alternatives
  - Provide federal leadership by ***purchasing cleaner alternatives to HFCs*** whenever feasible and by ***transitioning to equipment using safe, more sustainable alternatives***

Close-up on GE's approach

GE Appliances First Appliance Manufacturer to Partner on EPA RAD Program

On February 8th, 2011 GE announced partnership with EPA on the RAD Program based on ARCA's Philadelphia Regional Processing Center(RPC)

- GE and ARCA collaboration on appliance recycling
- RPC specializes in appliance de-manufacturing including automated foam management
- Launched March 2010
- Serves a 12-state area in Northeast & Mid-Atlantic regions

imagination at work

RAD – Responsible Appliance Disposal
ARCA – Appliance Recycling Centers of America

Recycling Roadmap

GE Baseline:
- Over 1MM appliances requiring proper disposal annually
- Local solutions with process variation
- Compliance model focused on end of life management

EPA Responsible Appliance Disposal

- Refrigerant product focus
- Annual reporting on appliance end of life
- Foam management required
- EPA seeking partners (Manufacturers, Retailers, Utilities)

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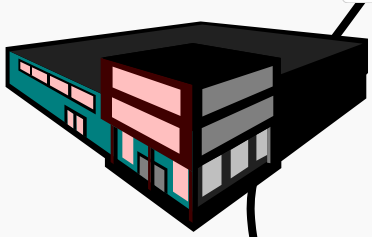
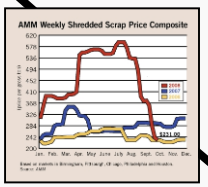
- Reduce greenhouse gas emissions
- Develop & deploy solutions to environmental challenges



Customer Inquiries

- Disposal practices



Market Dynamics

- Record scrap values – 1H'08
- Recycling industry – entrance of new players

Network Improvement Opportunities

- **Limited touch points / variation**
- **Aggregation is key**
- **Recycle vs. landfill**

GE Path Forward
- EPA RAD partnership
- More detailed & centralized reporting
- Consider additional opportunities

imagination at work

The Right Ingredients for PA

Key Factors

- Population density to support aggregation… Northeast/Mid-Atlantic volume
- Logistics / collection points…transportation cost considerations
- Third party recycling expertise…full service program via ARCA, Inc.
- Scale for foam management…automated foam processing / proven technology
- Robust EHS management
- High recovery rates

Population, Logistics and Expertise Aligned to Support ARCA Philadelphia RPC

ARCA Advanced Processing (AAP)

- Joint venture between ARCA and 4301 Operations to support recycling collaboration
- $10 million investment to open Philadelphia RPC to recycle all types of household appliances
- Large-scale, high-volume vertically integrated operation capable of producing high-quality raw materials
  - Hammermill shredder
  - UNTHA Recycling Technology (URT) to manage materials not typically recovered by industry recyclers
    - CFC, HCFC, HFC, HC and future blowing agents
    - Plastics
    - Degassed polyurethane foam pellets

First URT system in North America

Recycling Program Milestones

- Mar. 2010 –AAP opens in Philadelphia; currently recycles appliances from 12-state region for GE
- Apr. 2011 – First refrigerator processed through URT system
- Sep. 2012 – 100,000th refrigerator/freezer processed through URT system
- Dec. 2013 – Approximately 1.5 million appliances recycled for GE since beginning operations

Refrigerant & Oil Recovery

- ARCA-designed ARRIS (patent pending)
- Simultaneous recovery of refrigerants and oil from sealed systems of refrigerators and freezers
- Highly automated system, minimizing human involvement and potential of operator error
- Extensive data-logging capabilities with SmartValve

URT System Overview

- Employs sophisticated technology to shred refrigerators and freezers
- Recovers blowing agents from polyurethane foam insulation
- Optimizes fraction output by separating materials into high-quality, uniformly sized pieces (plastics, metal, degassed foam)
- Reduces typical landfill waste of a refrigerator or freezer by approximately 85% by weight, resulting in approximately 47 pounds diverted from a landfill*

**ARCA Advanced Processing 2010 Landfill Data, based on the component listing found in the American Plastics Council 1994 Composition, Properties and Economic Study of Recycled Refrigerators Report.*

URT System

40 feet

Processes 1 refrigerator per minute

Recovers approximately 95% of insulating foam in refrigerators and 95% of blowing agent in the foam

URT Foam Processing

- Degasses and compresses foam into pellets in a sealed system, reducing greenhouse gas and ozone-depleting substance emissions
- In typical industry method, one refrigerator's shredded insulating foam fills three large blue barrels (125 gallons) and is usually landfilled
- With URT system, one refrigerator's degassed and pelletized insulating foam equals approximately 3 gallons
  - Greater than 40:1 reduction in volume

Operational Considerations

- 750,000 annual unit capacity
  - Additional supply to maximize RPC capacity
  - Fragmented system in U.S. for managing appliances
- Continued investment in infrastructure
- Upcoming considerations
  - Improving byproduct qualities
  - Operational tuning for EPA-approved alternative refrigerants and blowing agents
  - Appliance composition and recovery

AAP Plans

- Continued development of post-shredding systems to enhance value of byproducts
- Continued reduction in volume of materials sent to landfill
- Potential RPC growth to other markets highly dependent on varying factors including appliance supply

Discussion

Discussion Questions

- How to increase foam recovery as a percentage of units processed?
- How to increase HCFC and HFC foam recovery?
- How to safely handle HC foam?

Discussion Questions

- Other barriers being experienced by RAD partners to improve/expand appliance recycling programs?
- What additional information or outreach materials might be useful?

For more information

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