Appliance Recycling Update

ENERGY STAR APM SEPT 22, 2008

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Agenda

- Program Review & Advances - Sam Sirkin
- CO2e & Recycling Tech – Michael Dunham

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Key Features/Benefits

- Cost Effective
  - Exceeded only by lighting
- Huge Environmental Upside
  - ODS, GHG, toxics and materials
- Customer Service “Home Run”
  - Win – save energy
  - Win – free pick-up
  - Win – rebate/bounty
  - Win – environmental bonus
- Economic stimulus package

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Program Targets

- Second refrigerators/ freezers
  - Households with 2+ refrigerators or a stand-alone freezer
  - National avg = 1.2 fridges/home
- Primary refrigerators/freezers
  - Households replacing their kitchen refrigerator
  - Enhances ENERGY STAR purchase programs
  - Prevents Primary becoming Second

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Program Size and Duration

- Size
  - Over 750,000 units recycled by SCE program
  - Over 3% “harvest rates” - Rocky Mtn Power, Hydro-Québec
- Duration – multi-year programs
  - SCE - over 14 years
  - Nevada, SMUD & others over 6 years

2 Recent Program Advances

- Remove unit “vintage” requirement
  - Avoids customer confusion
  - Average unit age targets are unaffected
- Remove “dual transaction” for Primary fridge recycling
  - Retailers engaged in utility recycling program
  - Customer enjoys single transaction
  - Enhances ENERGY STAR incentive offer
  - Prevents primary unit from becoming secondary

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Typical Unit Vintage

- Average age, all programs - 21 years
- Harvest Oldest Units First

Table 1. 2004-2006 Program Comparison			
	2004	**2005**	**2006**
Total Number of Units	2604	3766	3739
- Refrigerators	68%	67%	68%
- Freezers	32%	33%	32%
Average Unit Size (cubic feet)	18.75	17.3	17.5
Average Vintage	**1976**	**1978**	**1979**
Average Age (years)	**28**	**27**	**26**

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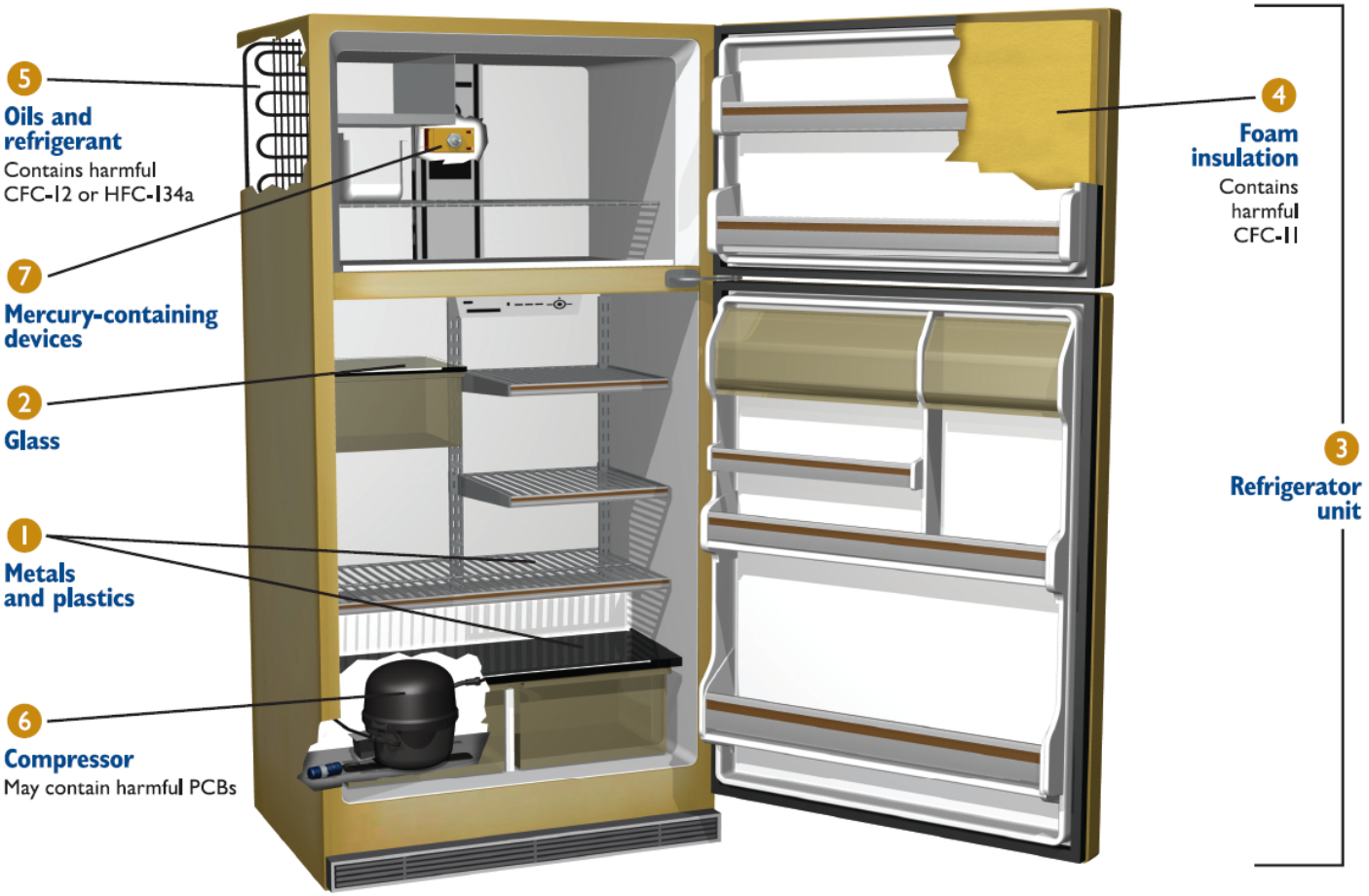
Retail Collaboration

- Retailers promote recycling old when selling new
  - Fliers
  - Sales staff education and promotion
- ENERGY STAR incentive + recycle “bounty” increases customer cash back
- Retailers deliver new and collect old units for recycling program

Environmental Benefits



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What's in the Fridge?

Composition of an Average Refrigerator Manufactured Pre-1994 and Post-1994

Component	Quantity per Refrigerator (lbs.)	
	Pre-1994	Post-1994
Metal	158	158
Plastic	25	25
Glass	11	11
CFC-12 Refrigerant	.5	-
HFC-134a Refrigerant	-	.4
CFC-11 Foam Blowing Agent	1	-
HCFC-141b Foam Blowing Agent	-	.8
Oil (which may be contaminated with refrigerant)	.5	.5
Mercury	.002	.002
PCBs	Small quantities in the compressor/motor	-

UNEP Task Force
Foam End-of-Life Issues

- 1 billion domestic refrigerators and freezers are in use globally at this time.
- Many contain foams blown with CFC-11, although the bank is already in decline.

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There are four key phases in which banks of blowing agent can reside:

- Within products during their normal service life
- Within products during an extended service life (often referred to as re-use)
- Within foams already landfilled without special treatment
- Within landfilled foams which have been segregated, shredded or otherwise treated

May 2005 Task Force Report on Foam End-of-Life Issues

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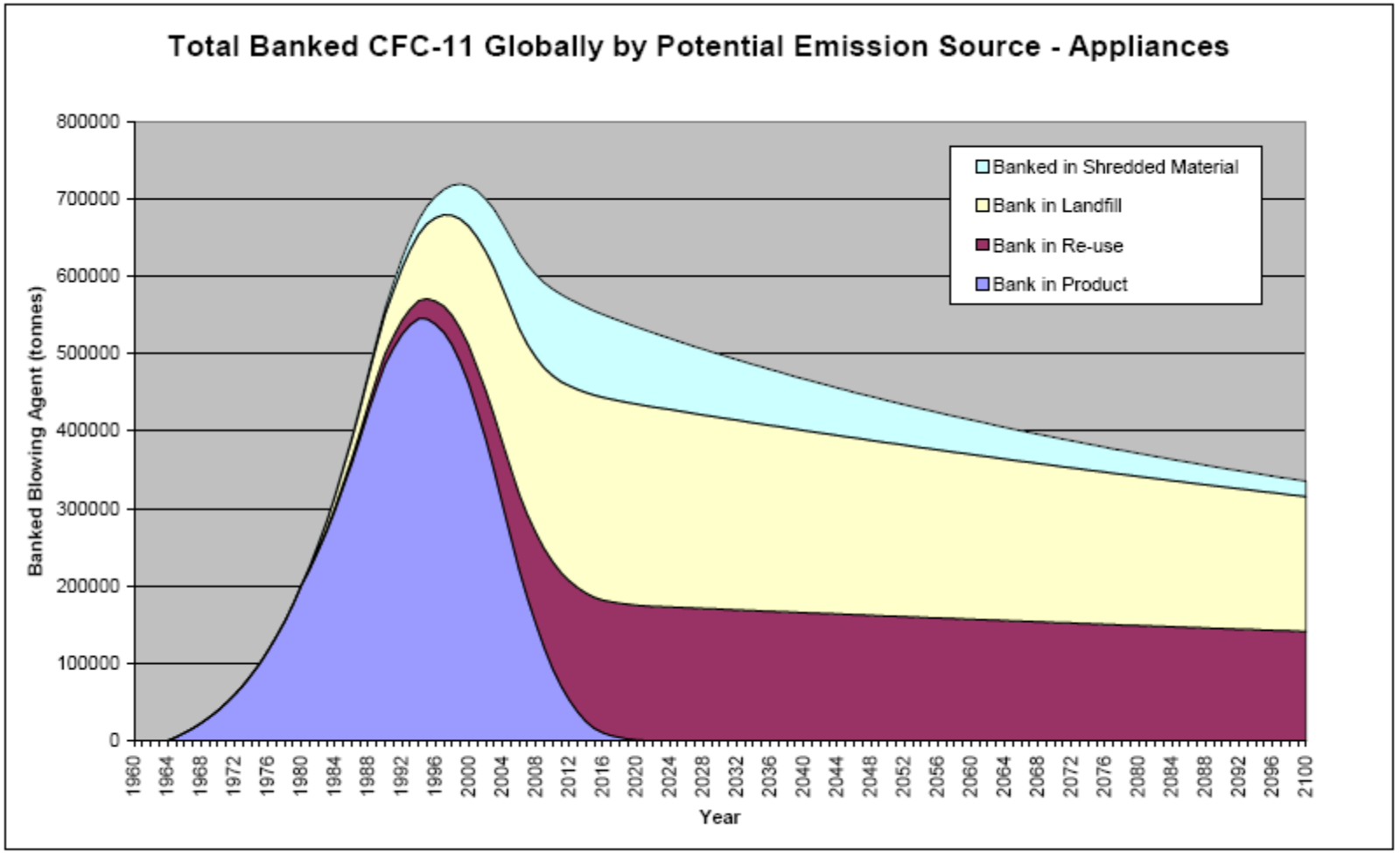

Figure ES-1 Predicted trends in the location of CFC-11 banks from appliances

Product Type	*Recovery Method*	*Losses in segregation*	*Losses in other pre-incineration steps*	*Losses in incineration*	*Recovery & Destruction Efficiency (RDE)*
General Building Foam	Mechanical Recovery	2-8%	0.5%	<0.1%	>90%
General Building Foam	Direct Incineration	2-8%	Not Applicable	<0.1%	>90%
Sandwich Panels	Mechanical Recovery	Not Applicable	<5%	<0.1%	>94%
Sandwich Panels	Direct Incineration	Not Applicable	Not Applicable	<0.1%	>99%
Appliance Foam	Mechanical Recovery	Not Applicable	<5%	<0.1%	>94%
Appliance Foam	Direct Incineration	0.5-4%	Not Applicable	<0.1%	>95%
Appliance Foam	Auto-shredder + managed attenuation	8-40%	<40%	Not Applicable	>20%

Table ES-1 Typical losses experienced in currently considered end-of-life strategies

CO2e Per Refrigerator

CFC destruction	lbs/ unit	GWP*	Tons CO2e
CFC-11 (foam) destruction	1	4,680	2.34
CFC-12 (refrig) destruction	0.5	10,720	2.68
Total CFC CO2e per unit			**5.02**

CO2 lbs/ kWh (est)	
Coal	**Nat Gas**
2 lbs/ kWh	1 lbs/ kWh

Energy Savings ~5,600 net lifetime kWh		11,200 lbs/ unit	5,600 lbs/ unit
Tons CO2 Avoided Energy		**5.6**	**2.8**
	CFC Tons CO2e	5.02	5.02
	TOTAL Tons CO2e/ Unit	**10.62**	**7.82**

* Global Warming Potential = multiple of CO2 impact (Source: USEPA)

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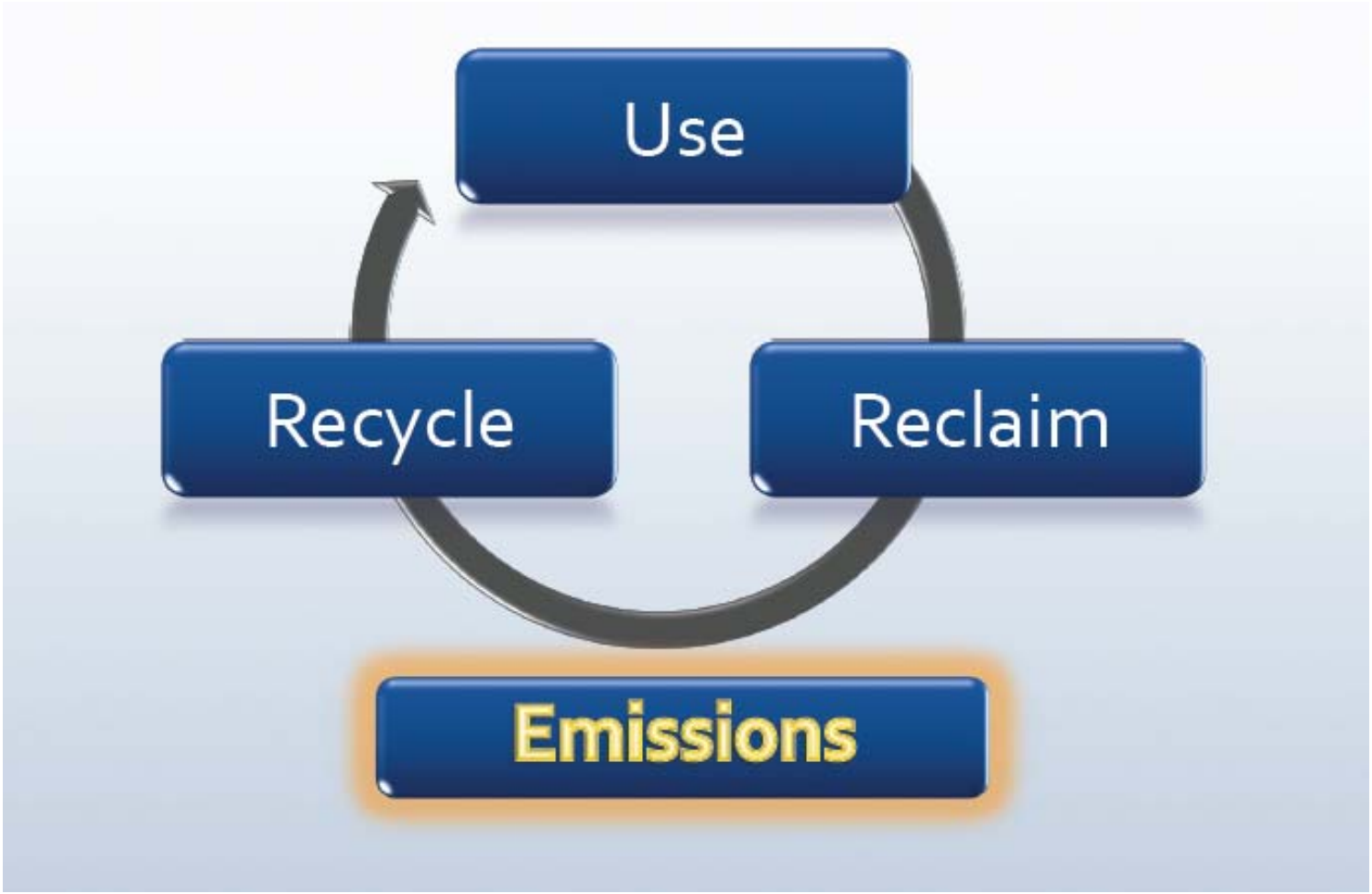
CFC Business As Usual



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CFC New Approach

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De-manufacturing Overview

- De-manufacturing steps are conducted in a clean, modern facility that looks like a combination warehouse and assembly line
- Recycling processing features state-of -the-art equipment from SEG of Germany

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Initial De-manufacturing

- Catalog units (type, size, vintage, etc.)
- Remove shelves and crispers
- Place on line conveyor belt
- Evacuate purified oils and refrigerant
  - Recycle oils
  - Destroy refrigerant (CFC-12)
- Remove possible hazmats
  - PCB starting devices
  - Mercury switches and thermostats

- Discern type of insulation (drill core sample)
- Record harvested materials (refrigerant type and quantity, oils quantity, presence of hazmats)

Units not containing CFC-11: "shell" is then transported to scrap yard for shredding and materials management

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Subsequent De-manufacturing - Low-Volume "Stage 1" Facilities

Applicable to smaller volume facilities

- Cut chassis into pieces manually (using saws)
- Separate foam, metals, and plastic
- Sell metals and plastic to secondary markets
- Seal CFC-11 foam in bags
- Transport foam to destruction facility
- Destroy foam in rotary kiln / plasma arc furnace / WTE facility

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Subsequent De-manufacturing - High-Volume "Stage 2" Facilities

Applicable to larger volume facilities

- Feed appliance chassis into negative atmospheric pressure chamber for shredding
- Separate materials using magnets for steel, eddy currents for nonferrous metals, and air currents for plastics
- Sell metals and plastic to secondary markets
- Grind CFC-11 foam into powder
  - Liquefy CFC-11
  - Ship degassed powder to plastics recyclers
- Destroy CFC-11
  - Current approach: ship to qualified destruction facility
  - Approach under research: destroy onsite using modular technologies

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EPA RAD Partnership

- Responsible Appliance Disposal initiative
- Launched with focus on fridges/freezers
- Utilities, retailers and manufacturers join
- Partners insure that:
  - Refrigerant is recovered and reclaimed or destroyed
  - Foam is recovered and destroyed, or the blowing agent is recovered and reclaimed
  - Metals, plastic, and glass are recycled
  - PCBs, mercury, and used oil are recovered and properly disposed

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Conclusion

- Cost Effective
- Huge Environmental Upside
- Customer Service “Home Ru

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Thank You

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