GreenChill Advanced Refrigeration Partnership

United Association Instructor Training Program

Presentation Outline

- GreenChill's reason for being
- GreenChill's mission
- GreenChill programs

GreenChill's Reason for Being

- Environmental need
- EPA's mission
- Stratospheric Protection Division
- Montreal Protocol
- Clean Air Act
  - Regulations
    - R-22 Phaseout
    - Pre-Charged Appliance Rule
    - 608
    - SNAP
  - Enforcement
- Corporate social responsibility movement
  - Customers want to feel good about the places where they do business
  - Opportunity to do more
  - Brand positioning – stand for more than price
- Environmental progress = cost savings in an industry with very tight profit margins

The Ozone Layer

- Protects us from ultraviolet radiation from the sun
- Thinner ozone layer / holes in the ozone layer - allows more radiation to reach the Earth's surface
  - skin cancer
  - cataracts
  - weakened immune systems
  - reduced crop yields
  - disruptions in the marine food chain

- Ozone layer thinning/ozone holes caused by the release of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and other ozone-depleting substances, which were and are used widely as refrigerants, insulating foams, and solvents.

- When these substances reach the stratosphere, the UV radiation from the sun causes them to break apart and release chlorine atoms which react with ozone, starting chemical cycles of ozone destruction that results in significant thinning of the protective ozone layer. One chlorine atom can break apart more than 100,000 ozone molecules.

Ozone Layer Protection

- Montreal Protocol
  - International treaty signed by the U.S. & 179 other countries, developed & developing nations
  - purpose is to repair and protect the earth's ozone layer so we remain safe from the harmful effects of ultraviolet (UV) radiation
  - mandated the complete phaseout of CFCs
  - Gradual phaseout of HCFCs started in 2004 according to a schedule agreed upon by the signing parties, including the USA.

- The U.S. incorporated the Montreal Protocol requirements into Title VI of the United States Clean Air Act
  - Title 40, Part 82 of the Code of Federal Regulations contains EPA's regulations to protect the ozone layer
  - EPA's Stratospheric Protection Division manages these programs

- Outstanding environmental and health benefits
  - 6.3 million U.S. skin cancer deaths prevented by 2165

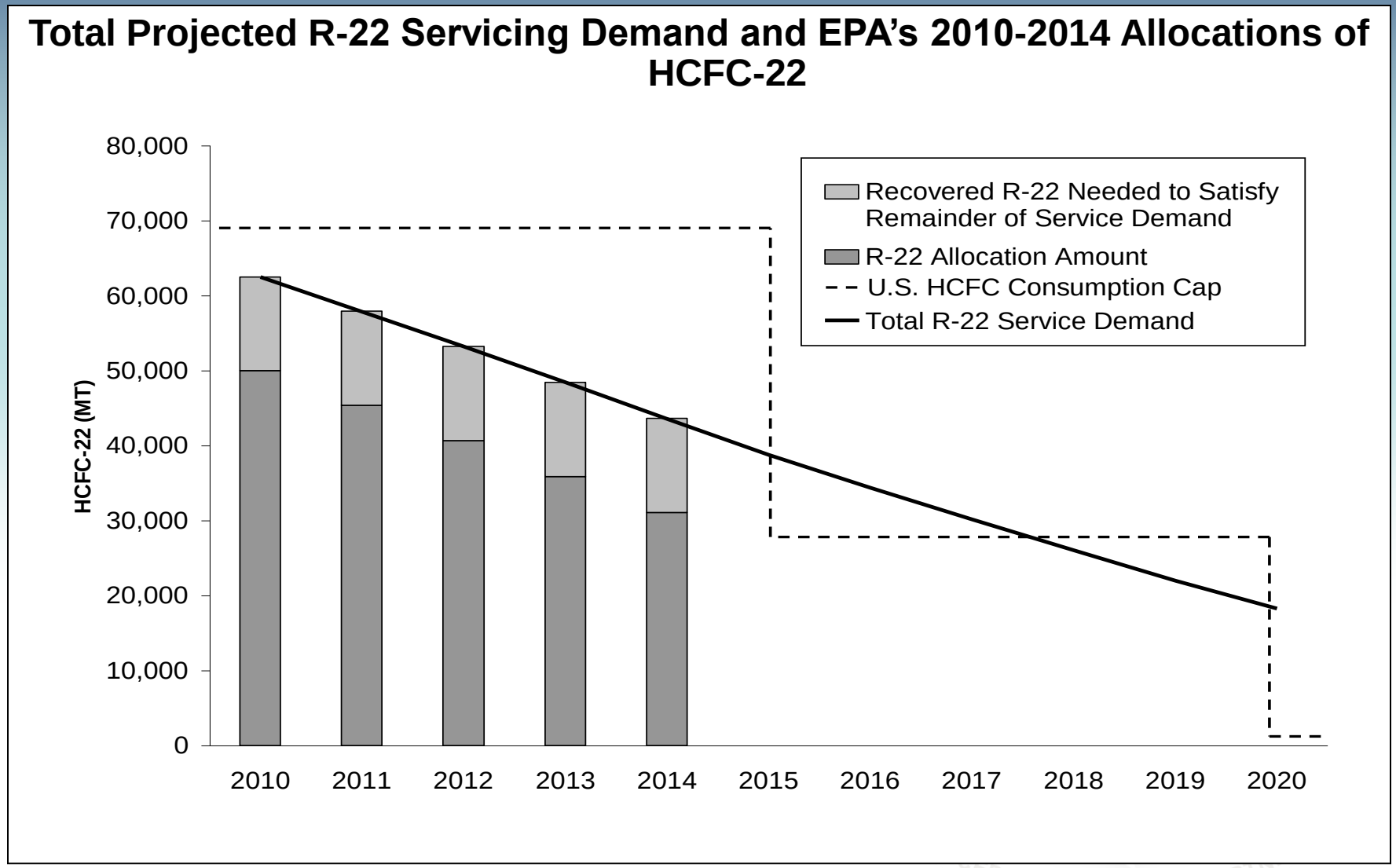
Phaseout of HCFC-22

- What does the phaseout of HCFCs mean for the availability of R-22?
  - **Newly produced R-22 will decline by half between 2010 – 2015**
  - **No R-22 or HCFC-142b may be produced in 2020**
  - **Increased recovery and reclamation/recycling is necessary to meet demand**
- What does the phaseout mean for existing refrigeration & A/C equipment?
  - **Existing equipment can continue to be serviced using R-22**
  - **EPA is not mandating the retrofit or replacement of existing R-22 equipment to HFC alternatives**
- What does the phaseout mean for expansions of existing refrigeration & A/C systems?
  - **An expansion is not "servicing"**
  - **Virgin R-22 cannot be used in new equipment (made after 1/1/2010)**
  - **Blends containing virgin HCFC-22 and/or HCFC-142b cannot be used in new equipment**
- What does the phaseout mean for new refrigeration & A/C equipment?
  - **Virgin R-22 cannot be used in new equipment (made after 1/1/2010)**
  - **Blends containing virgin HCFC-22 and/or HCFC-142b cannot be used in new equipment**
- http://www.epa.gov/ozone/title6/phaseout/rulesoverview.html

EPA ODS Phaseout Plan

Montreal Protocol		United States	
Implementation Year	% Reduction in Consumption and Production Using the Cap as the baseline	Implementation Year	Implementation of HCFC Phaseout through Clean Air Act Regulations
2004	35%	2003	No production and no importing of HCFC 141b
2010	75% (Reduced in 2007 from 65%)	2010	No production and no importing of HCFC 22 and HCFC 142b except for use in equipment manufactured before 1/1/2010 (no new production or importing for NEW equipment using these refrigerants)
2015	90%	2015	No production and no importing of any HCFCs except for use as refrigerants in equipment manufactured before 1/1/2020
2020	99.5%	2020	No production and no importing of HCFC 142b and HCFC 22
2030	100%	2030	No production and no importing of any HCFCs

Estimated R-22 Supply & Demand



Refrigerants & Global Warming

- HFC emissions (mostly refrigerants) are increasing rapidly in U.S. and world-wide
- EU phasing out high-GWP HFCs in some uses
  - New refrigerants, designs (CO2, HFO-1234yf)
- U.S. congressional bills include HFCs in proposed global warming controls
  - Phasedown, not phaseout
- Proposed amendments to the Montreal Protocol
  - Mauritius & Micronesia, U.S.-Canada-Mexico
- State action on climate change, CARB, RGGI

U.S. Federal Regulations & Proposals

- No venting ODS / HFCs!
- Mandatory GHG Reporting Rule (finalized 2009)
  - Bulk producers and importers* (not supermarkets)
    - *if >25,000 metric tons CO2 equivalent
    - 25,000 MT CO2eq = 1,475 pounds R-404A
- Mandatory GHG Reporting Rule (proposed 2010)
  - Importers of pre-charged Ref/AC equipment & foams* (possibly supermarkets, if direct importers)
- U.S. energy/climate bills include separate control regime for HFCs
  - Lieberman-Warner-Boxer
  - Waxman-Markey (passed House June 2009)
  - Kerry-(Graham?)-Lieberman…

Servicing Existing HCFC-22 Appliances after 2010

- In 2015, HCFC-22 needs could exceed the 2015 cap by approx. 10,000 metric tons
- Recovery and reuse needed to provide room under the cap and meet demand for all HCFCs
- What can you do?
  - Improve service practices (recover, recycle, reclaim)
  - Fix leaks
  - Retrofit/Replace where economical

During the Transition Period

- **Businesses have three options:**
  - Convert existing system to alternative refrigerant
  - Buy a new system that uses an alternative refrigerant
  - Continue to operate existing system
- **Establish a plan to replace/repair leaking equipment**
- **Recover and reuse refrigerant from equipment that is discarded**
- **Begin to transition to alternative refrigerants**
  - Many businesses have started to switch
  - Consider amount of time needed to convert

608 – Refrigeration & A/C

- Mandatory servicing requirements
- Leak repair
- Recovery and recycling of ODS
  - Recover refrigerant (CFCs, HCFCs, HFCs) rather than vent
  - Recycle (to same equipment) or Reclaim (clean and resell)
- Safe disposal requirements
- All the above REDUCES emissions
- Technician certification program creates awareness and education at the refrigerant point of sale

Contact Info – Phaseout & Regulatory

- **Phaseout: Cindy Newberg, newberg.cindy@epa.gov, 202-343-9729**

- **For Sec. 608: Julius Banks, banks.julius@epa.gov, 202-343-9870**

- **Additional Info:**

http://www.epa.gov/ozone/title6/phaseout/classtwo.html

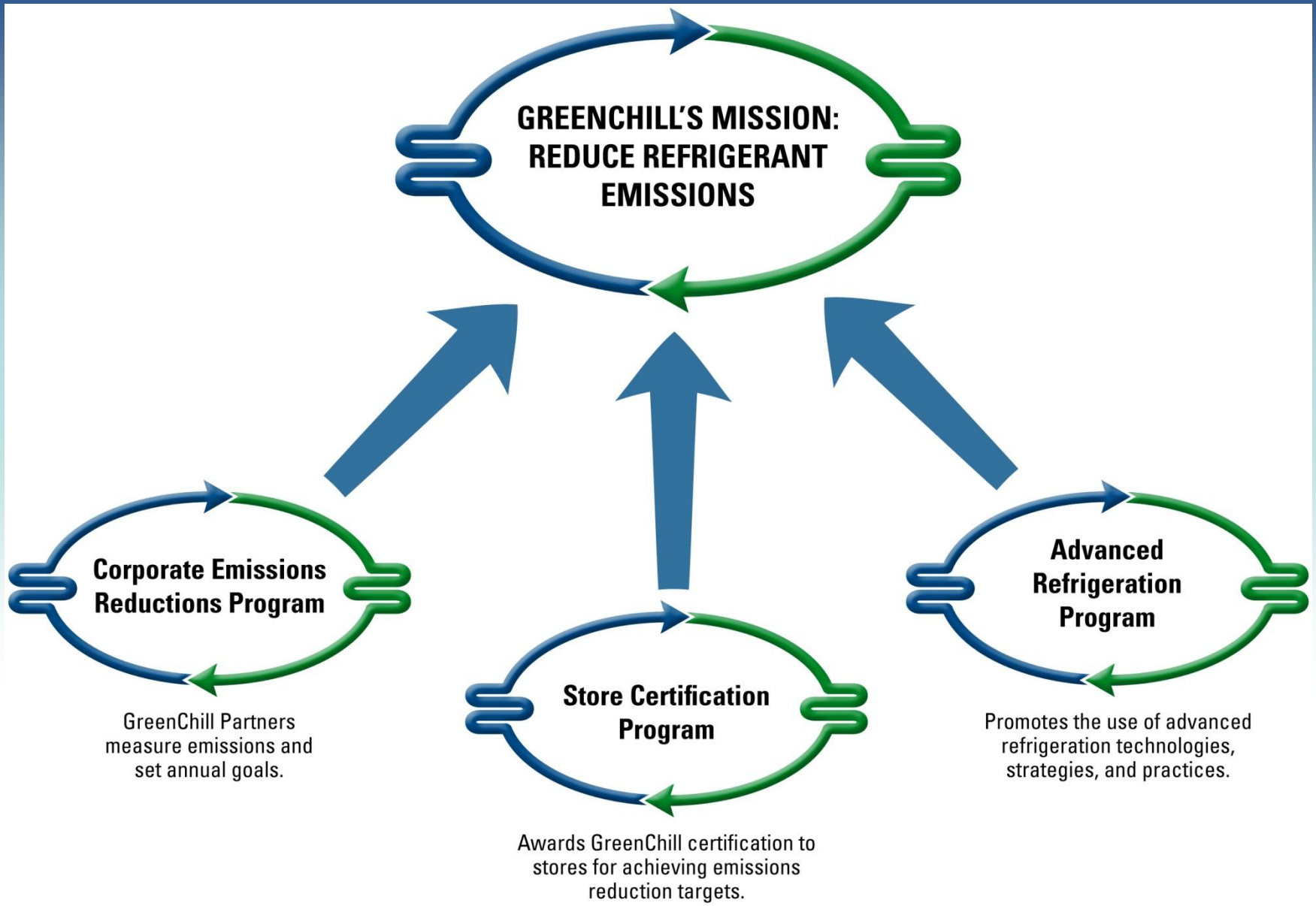
http://www.epa.gov/ozone/title6/allowance.html

EPA's GreenChill Partnership

- **For your environment & health**
- Ozone layer protection
  - R-22 is the most common refrigerant - depletes the ozone layer
  - Will prevent 6.3 million deaths from skin cancer by 2075
  - Intense UV radiation, sunburns, cataracts, immune disorders
- Climate change & global warming
  - Refrigerants are 1800-4000 times more potent global warmers that carbon dioxide
  - By 2010, ozone layer protection will have done more to mitigate climate change than initial Kyoto Protocol reduction target
  - Avoided 11 gigatons of CO_2 equivalent per year
  - Delayed climate impacts by approximately 10 years

The GreenChill Partnership

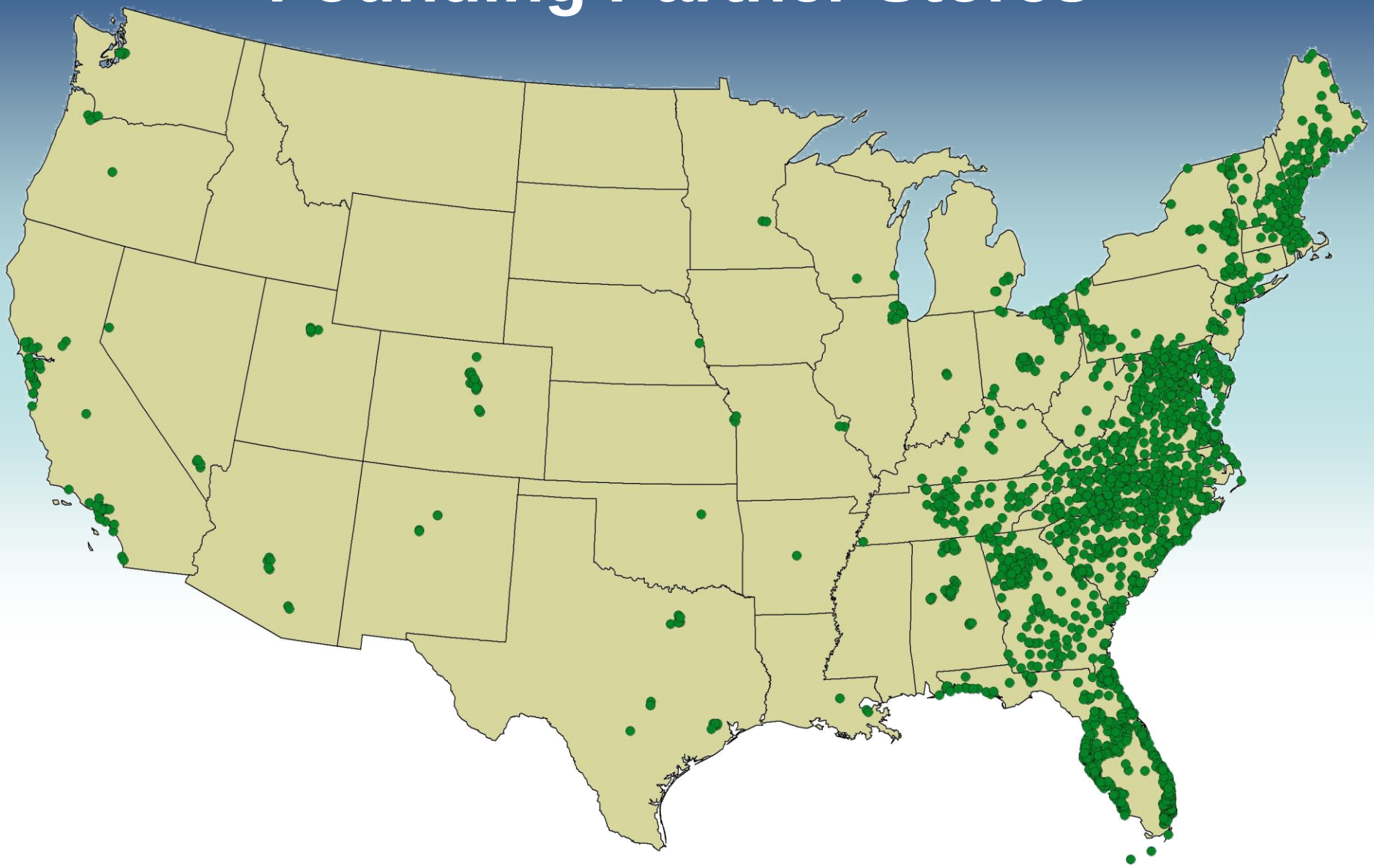
- Partnership between EPA, supermarkets, and other supermarket industry stakeholders
- Mission: to reduce refrigerant emissions from supermarkets and decrease their impact on the ozone layer and climate change
  - Lower refrigerant charge sizes and eliminate refrigerant leaks
  - Adopt green refrigeration technologies, strategies, and practices
- Three main GreenChill programs
  - Corporate Emissions Reduction Program
  - Store Certification Program
  - Advanced Refrigeration Program
- www.epa.gov/greenchill


GREENCHILL'S MISSION: REDUCE REFRIGERANT EMISSIONS
Corporate Emissions Reductions Program
GreenChill Partners measure emissions and set annual goals.
Store Certification Program
Awards GreenChill certification to stores for achieving emissions reduction targets.
Advanced Refrigeration Program
Promotes the use of advanced refrigeration technologies, strategies, and practices.

Founding Partner Corporate Headquarters

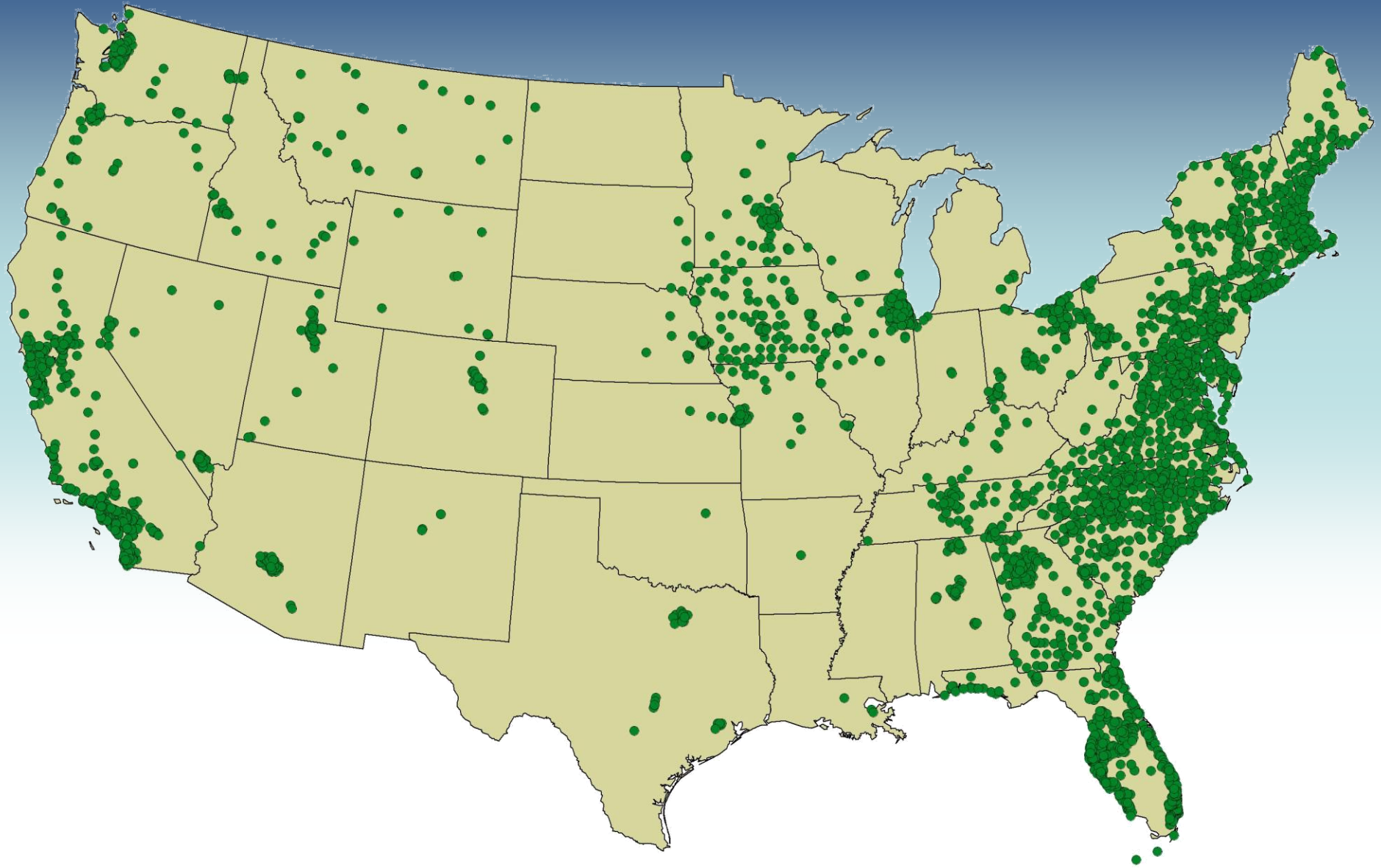
November 2007

Founding Partner Stores



November 2007

Partner Stores – As of June 2010

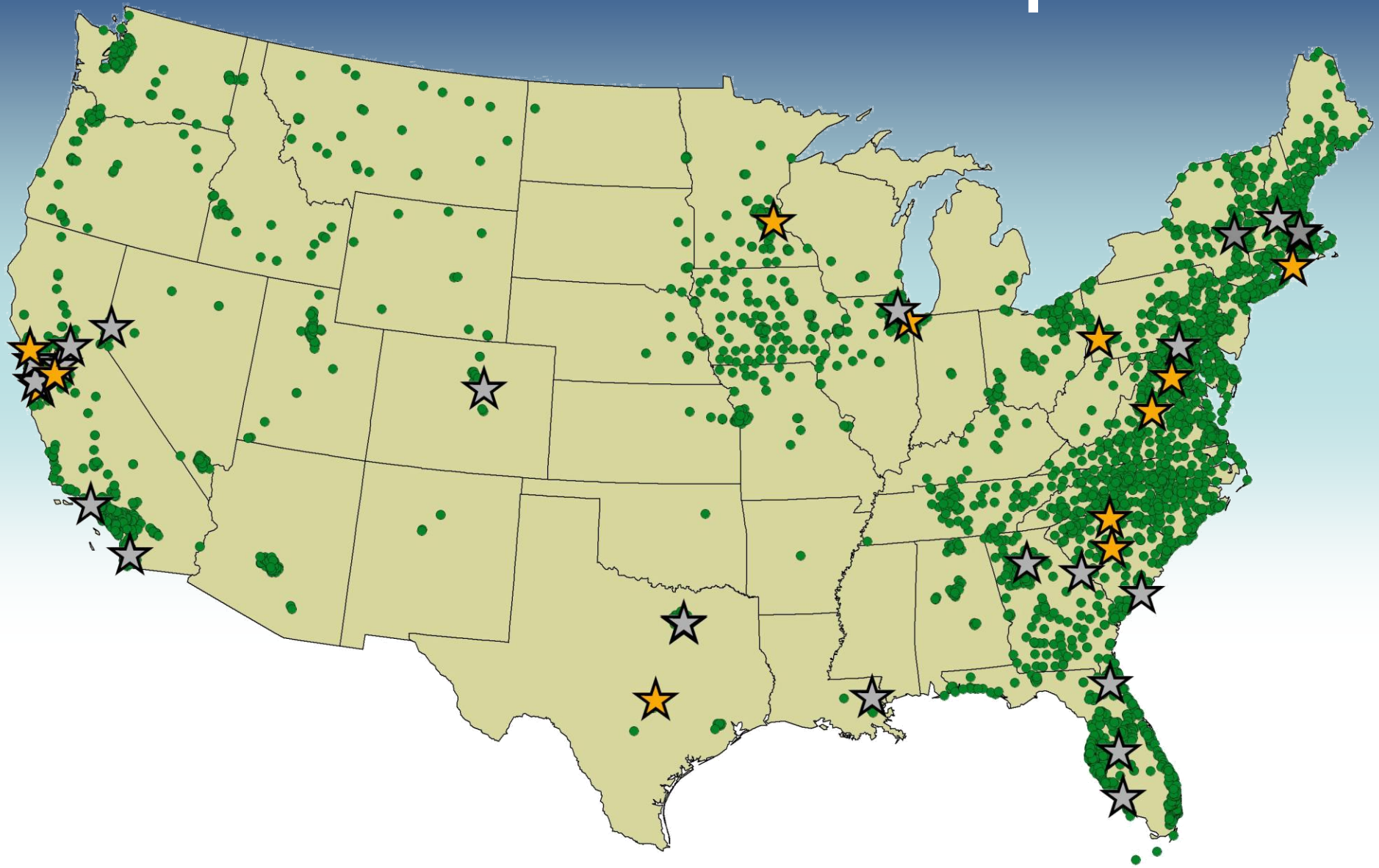


June 2010

GreenChill Store Certification Awards

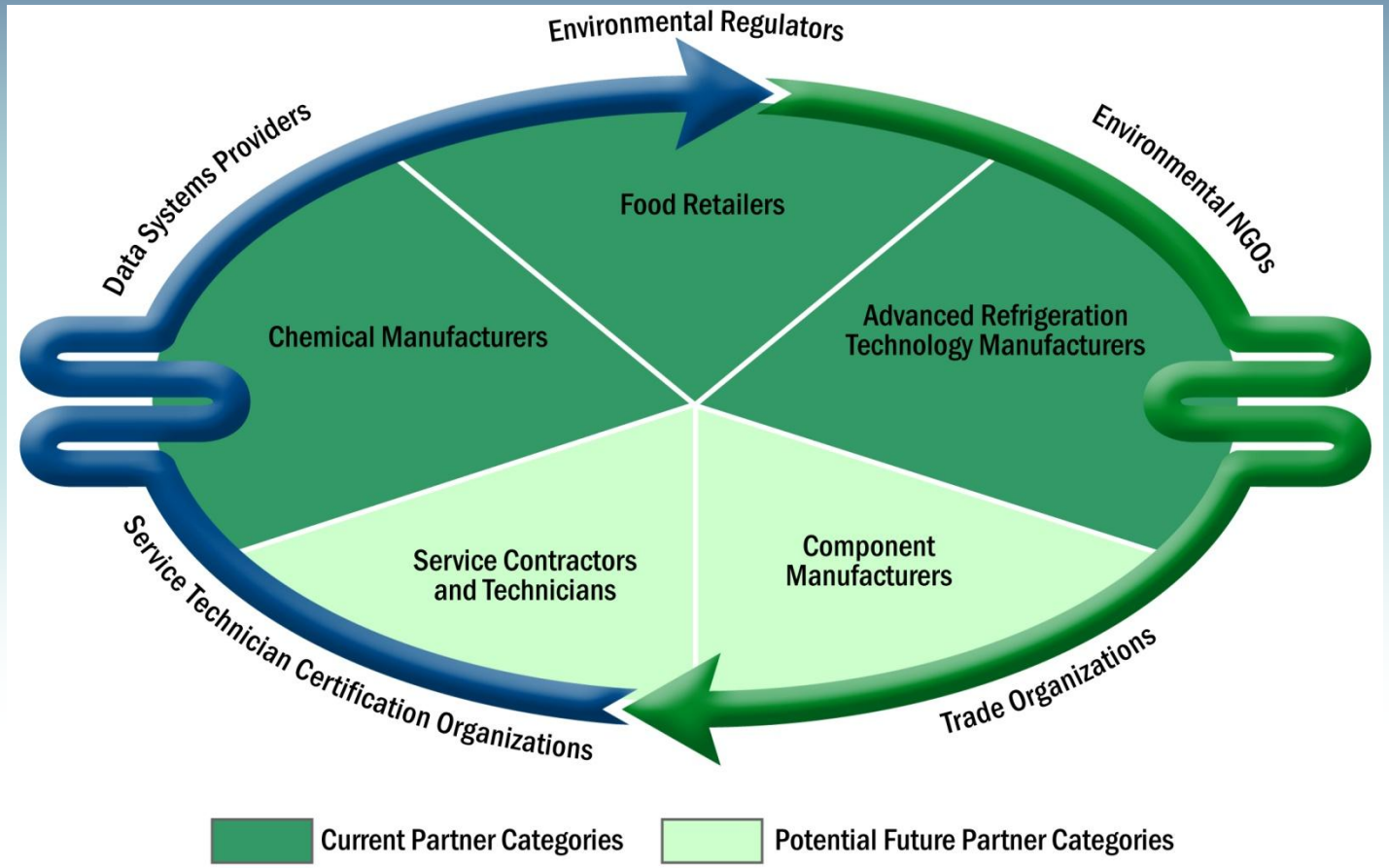
June 2010

GreenChill Partnership

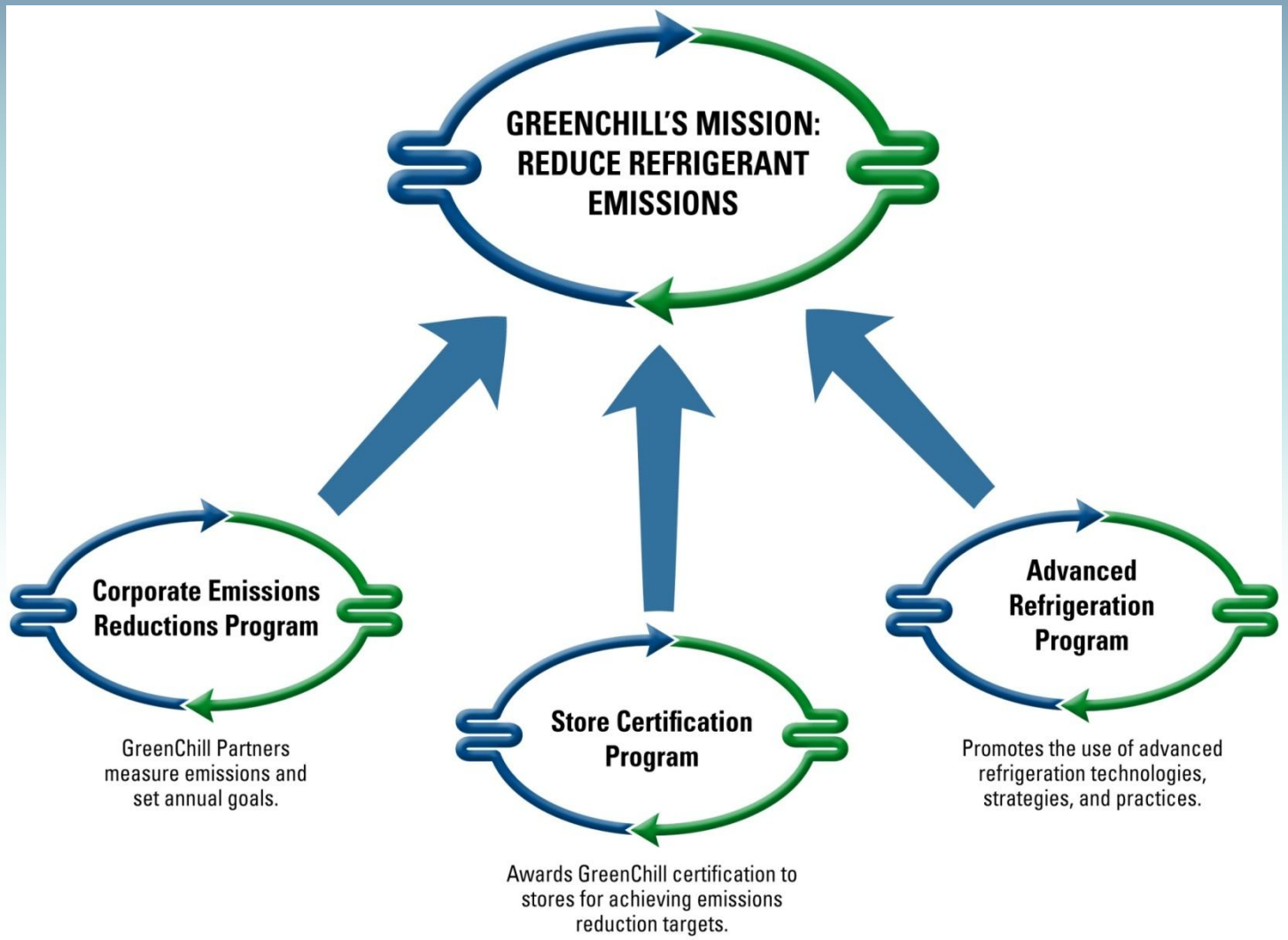


June 2010

GreenChill's Stakeholders



EPA's GreenChill Partnership



GreenChill's Store Certification Program
Why EPA?

- Environment is an important issue for consumers
- Consumer need for information
- Refrigeration is a large part of supermarket environmental footprint
- Need a way to recognize excellence
- It didn't exist yet
- We tried to get others to do it

GreenChill's Store Certification Program
Why you? Recognition.

- Important for stores to communicate with customers about their environmental achievements
  - If you don't tell them, they don't know!
- THE big issue: global warming
  - Supermarket refrigeration/global warming - very technical issues, difficult to communicate
- Everybody knows and loves the ozone layer
- GreenChill's certification program does the communicating for you (award ceremony/speech, in-store signage, hats/t-shirts)

GreenChill's Store Certification Program
Why you? Resources.

- Opportunity for award and recognition may help persuade decision-makers to finance advanced systems
- Helps communicate the importance of refrigeration within your company
- Helps generate recognition for your achievements within your company / help fight the "unsung hero" effect
- Rewards the hard work at the store level & store employees want to be part of it

GreenChill's Store Certification Program Overview

- EPA recognition for green refrigeration
- Three award levels: platinum, gold & silver
- Objective criteria for store achievement
  - Refrigerant charge
  - Refrigerant leak rate
  - Type of refrigerants used
  - Installation leak tightness (newly constructed stores only)
- Process is easy, fast and free
- See http://www.epa.gov/greenchill/certcenter.html for details and guidance

GreenChill's Store Certification Program Overview

- May be re-earned annually
  - "Continued excellence" awards
  - May lose certification - reapply in 1 yr.
- GreenChill may verify the information on your application by
  - inspecting the store
  - requesting third party certification
  - and/or requesting copies of store records related to the certification criteria

GreenChill's Store Certification Program Overview

- Do NOT have to be a GreenChill Partner
- Only for U.S. stores
- Only for supermarket-type stores
- Still a lot of "firsts"

GreenChill's Store Certification Program
Criteria for Platinum – 2 Routes

- HFC-based refrigeration systems: all refrigerants in the store must have zero ozone-depleting potential. No R-22.
  - Reduced refrigerant charge
    - Max 0.5 lbs. of refrigerant per 1000 BTU/hr. total evaporator cooling load
  - Low leak rate
    - ≤ 5%
  - If new construction, must follow GC's installation leak tightness guidelines

- Low GWP refrigeration systems: all refrigerants in the commercial refrigeration system must have a GWP <150
  - The low-GWP refrigerants must be on the SNAP list
  - All other refrigerants in the store must have zero ozone-depleting potential. No R-22.

GreenChill's Store Certification Program Criteria for Gold

- All refrigerants in the store must have zero ozone-depleting potential. No R-22.
- Refrigerants must be on EPA's SNAP list
- Reduced refrigerant charge
  - Max 1.25 lbs. of refrigerant per 1000 BTU/hr. total evaporator cooling load
- Low leak rate
  - ≤ 15%
- If new construction, must follow GC's installation leak tightness guidelines

GreenChill's Store Certification Program Criteria for Silver

- All refrigerants in the store must have zero ozone-depleting potential - no R-22
- Refrigerants must be on EPA's SNAP list
- Reduced refrigerant charge
  - Max 1.75 lbs. of refrigerant per 1000 BTU/hr. total evaporator cooling load
- Low leak rate
  - ≤ 15%
- If new construction, must follow GC's installation leak tightness guidelines

GreenChill's Store Certification Program Application Process

- Application forms are on GreenChill's website
  - Newly constructed stores
  - Fully operational stores
  - Recertifying stores
- Easy: 1 page – front and back
- Fast: often same day
- Free: No application fee, no EPA cost, awardee pays for the optional plaque


DANKE
תודה רבה
GRAZIE
DZIĘKUJĘ
Price Chopper
growinggreener


Cub


LAKEWOOD

GreenChill Certification Plaques

Platinum Level Certification

Gold Level Certification

Silver Level Certification

Company

– Platinum/Gold/Silver Level Certification –

Certified by U.S. EPA's GreenChill Partnership for using green refrigeration technology

Certified through MM/DD/YY

GreenChill's Store Certification Program Experience

- R-22 has ruined many applications (only an issue now for operational stores)
- Charge size is key
- Emailed applications are excellent!
  - we have to be able to read the refrigeration schedule/legend
- You may have to explain "new and different" equipment to us
  - "Steering committee" is invaluable
- Plan enough time for installation leak tightness checks
- Protocols available for handling situations like combined commercial refrigeration & A/C systems

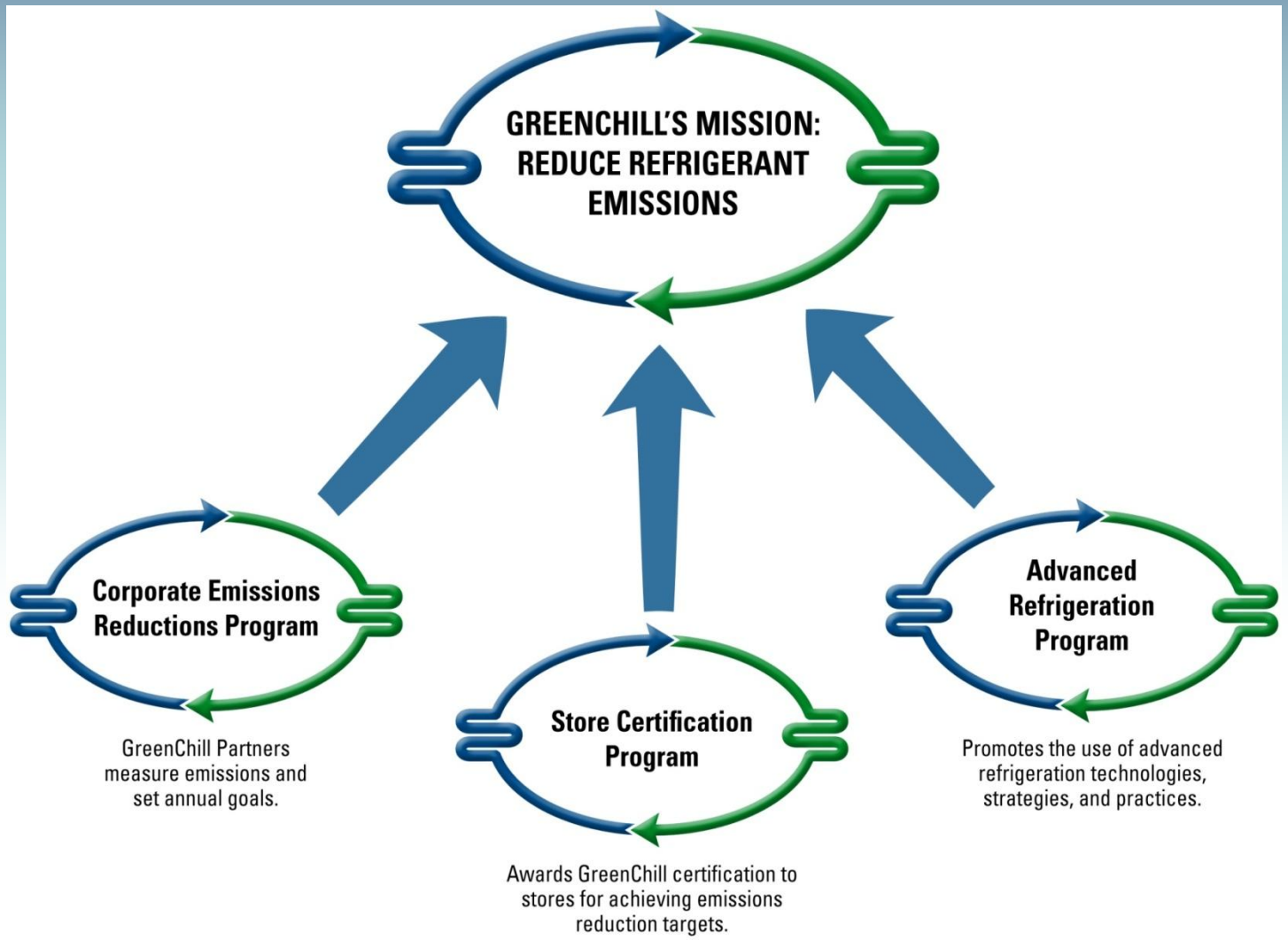
GreenChill's Store Certification Program Guidance

- Step-by-step instructions on the forms
- Detailed guidance on the website
- Different equipment is relevant for different criteria (see chart on next slide)

GreenChill's Store Certification Program Guidance

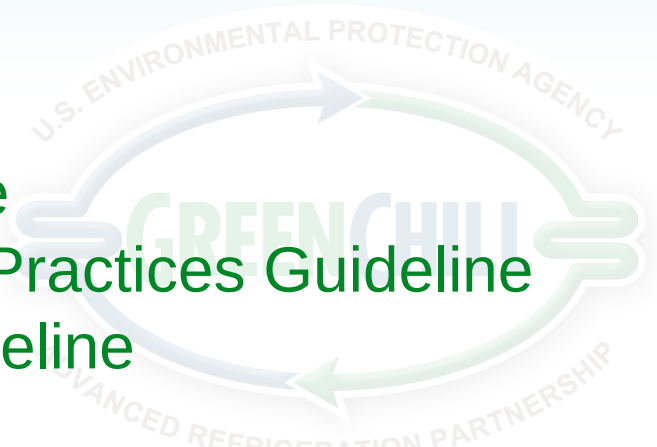
CERTIFICATION CRITERIA	INCLUDED EQUIPMENT		
	Self Contained Commercial Refrigeration Equipment	Remote Commercial Refrigeration Equipment	HVAC Equipment
Refrigerant Charge (lbs.)		✓	
Evaporator Heat Load (1000 BTU/Hr)		✓	
Refrigerant Emissions Rate (lbs.)		✓	
Non-Ozone-Depleting Refrigerant	✓	✓	✓
SNAP-Approved Refrigerant	✓	✓	✓
Installation Leak Tightness Standards (newly constructed stores only)		✓	

EPA's GreenChill Partnership

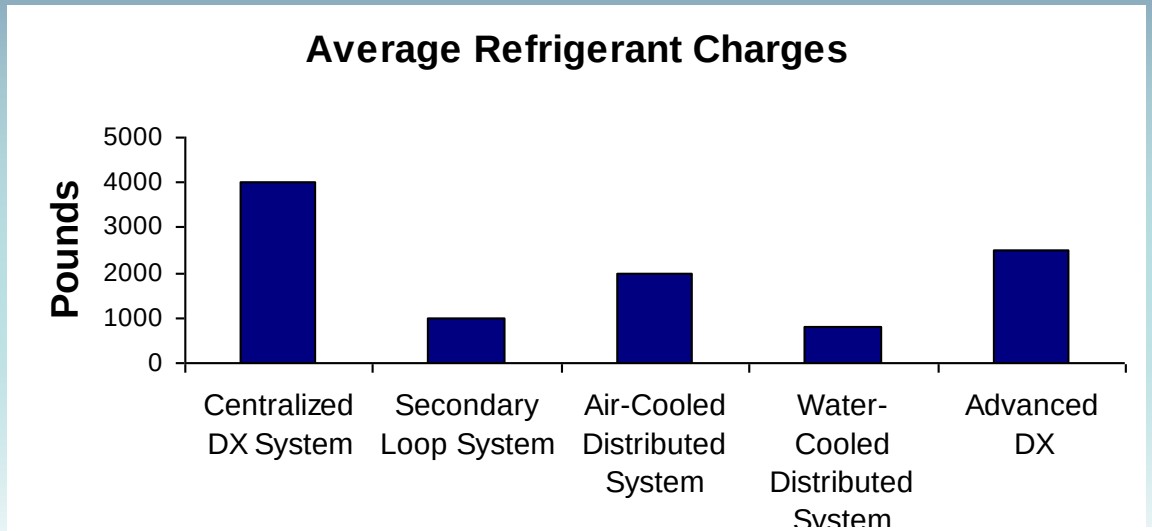


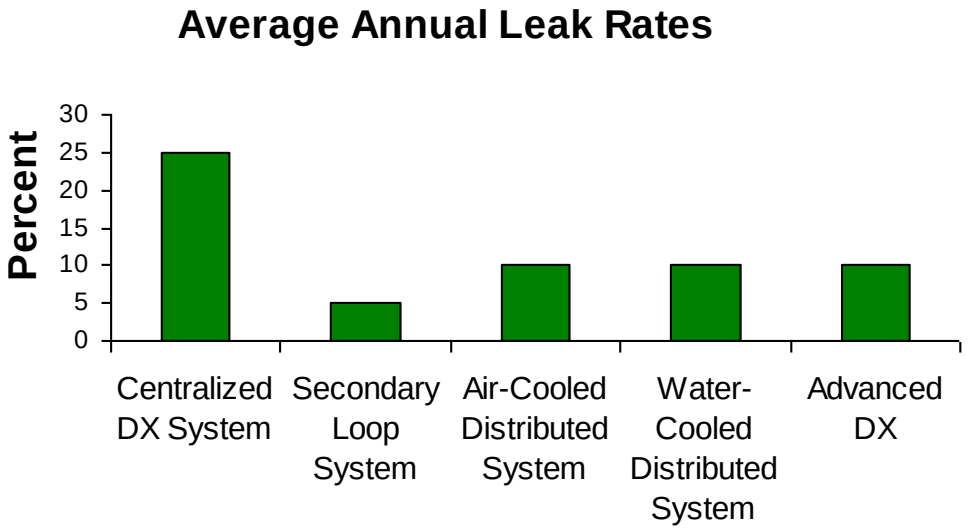
(3) Advanced Refrigeration Program

- Advanced Technologies
  - Technologies to reduce charge sizes and leaks
  - Technologies that use low GWP/no ODP refrigerants
- Advanced Strategies
  - Refrigerant Choice
  - Prioritize refrigerant management
  - Measure emissions
  - Set goals
  - Refrigerant choice
- Advanced Practices
  - Retrofit Best Practices Guideline
  - Leak Prevention & Repair Best Practices Guideline
  - Installation Leak Tightness Guideline



Advanced Refrigeration Technology: smaller charges & fewer leaks





Moving from traditional DX: means tighter systems, fewer emissions

Supermarket Refrigerant Choice

Note: All candidate refrigerants first must be proven safe to use, stable, and compatible with materials of construction

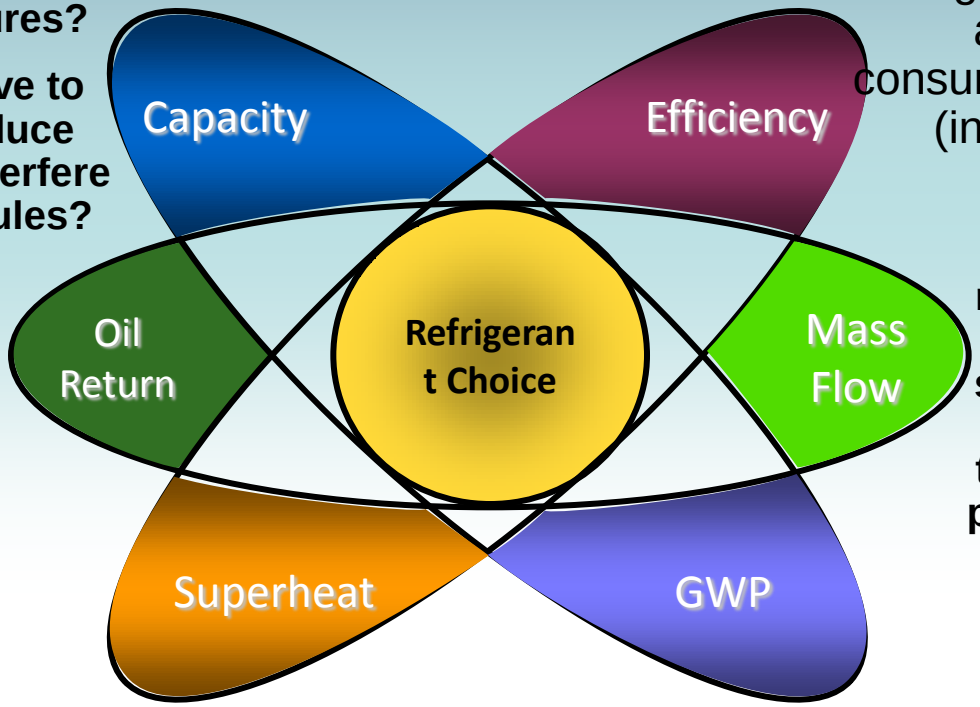
Is there enough capacity to keep the food at required temperatures?

Will the system have to run longer and reduce equipment life or interfere with defrost schedules?

How much does the refrigerant add to the total and peak power consumption of the system? (include all powered systems)

Higher mass flow means more refrigerant moving through the system. Different mass flow requires changes to TXV valves. Possible pressure drop penalties.

Is the refrigerant/oil relationship miscible assuring proper oil return to the compressors ?



Need to protect compressors and ensure full use of refrigerating capacity.

Lower is better, Reduced carbon footprint. (possible future GWP tax)

Key Selection Criteria for New Installations and Retrofits:

Many competing issues to consider

GreenChill and Refrigerant Choice

- **Refrigerant choice impacts the ozone layer & climate change**
- **GreenChill Partners have committed to no R-22 use in new construction and remodels (incl. expansions) since 2007**
- **Supermarkets are trying to reduce their dependence on R-22 by retrofitting R-22 equipment to use HFCs**
- **R-22 retrofits are not an environmental end, in and of themselves**
  - R-22 retrofits are not required by EPA regulations & they are not a GreenChill priority
  - Regardless of the refrigerant, leak tightness is the priority
    - Prioritize leak tightness when retrofitting from R-22 to other refrigerants
    - GreenChill Retrofit Best Practices Guideline: http://www.epa.gov/greenchill/downloads/RetrofitGuidelines.pdf
    - Fact sheet on Prioritizing Leak Tightness during R-22 Retrofits: http://www.epa.gov/greenchill/downloads/GChill_Retrofit.pdf

Commercial Refrigerants where are we headed?

- **Supermarkets have to choose between the many available refrigerants**
- **Environmental concerns are increasingly top of mind**
- **Two main environmental considerations in 2010 and beyond**
  - R-22 phase-out
  - Global warming concerns
- **“Natural” Refrigerants – future webinars**

GreenChill Best Practices Guideline Commercial Refrigeration Retrofits

- Mission: "provide food retailers with fact-based, neutral information on best practices for every aspect of the HCFC-22 conversion process

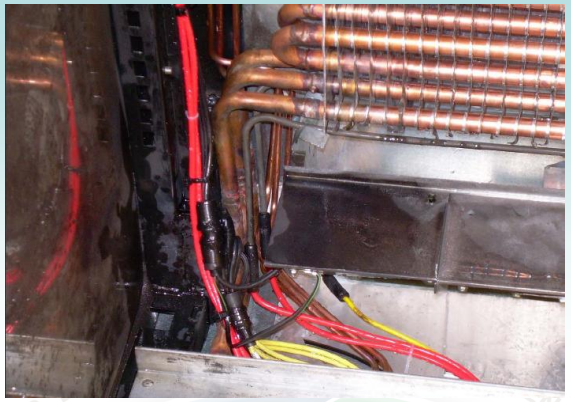
- Retrofit Guideline is at http://epa.gov/ozone/partnerships/greenchill/downloads/RetrofitGuidelines.pdf

Leak Prevention & Repairs

- Coming Soon: *GreenChill Best Practices Guideline – Leak Prevention and Repairs*
- No cookie-cutter solution for all stores!
- Supermarket refrigerant leaks
  - Average supermarket is 20-25%
  - GreenChill members average 12%
  - Individual partners average <7% across whole corporation
  - Advanced systems w/best practices can achieve 0-5%

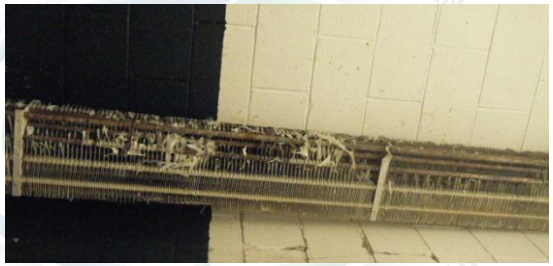
Where Leaks Occur

- Compressor racks
- Display Cases
- Remote Air Cooled Condensers
- Walk-In Evaporators
- Field-Installed Piping
- Condensing Units
- AC Units
- Remote Headers



Causes of Leaks

- Poor brazing techniques
- Improperly tightened fittings
- Valve caps and seals missing
- Material incompatible with oil or refrigerant
- Vibration
- Expansion/contraction
- Corrosion
- Metal-to-metal contact of tubing
- Improper support of tubing



No Tolerance Policy

- Establish a corporate-wide no tolerance policy for refrigerant leaks
- Give top priority to finding and repairing leaks
- Get senior management buy-in
- Focus on the cost of leaks

Tracking Leaks

- Invest in a refrigerant tracking system
- Benchmark!
  - Stores
  - Contractors
  - Service Techs
- Service Techs update company database of leak info
- System calculates EPA leak rate
- Flag high usage systems

Preventive Maintenance Practices: Clean Equipment

- Motivates service techs – instills pride!
- Makes leaks easier to find
- Compressor room is not a storage area (safety issue)

- Remove corrosion & keep steel components painted

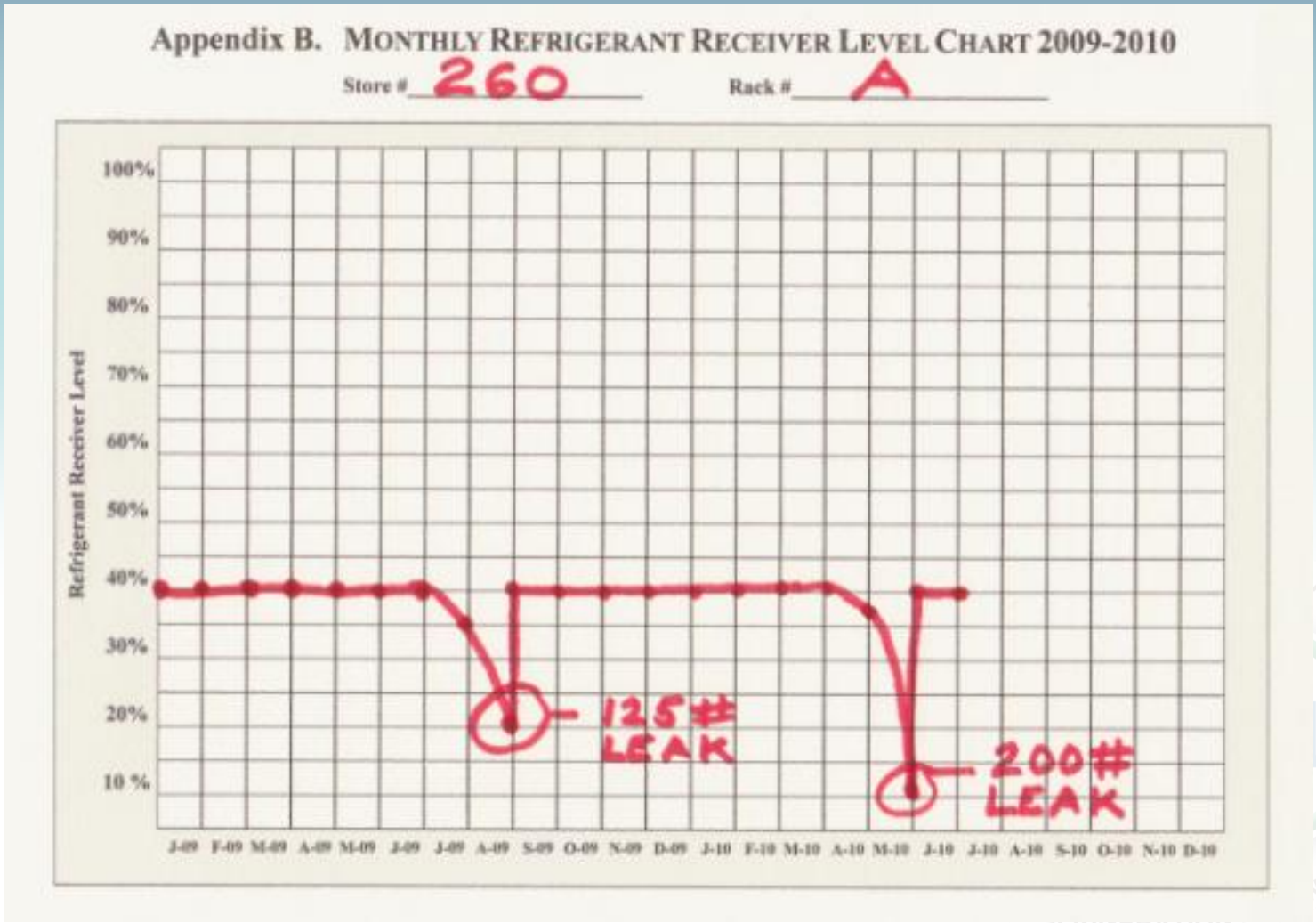
Preventive Maintenance Practices: Leak Detection Alarm Systems

- Direct or indirect system
- Direct system may require 16+ sensors or sampling tubes spread through store
- Indirect system may use receiver level sensors, temperature sensors or load cells
- Redundant alarm systems are critical

Preventive Maintenance Practices: Regular Leak Inspections

- Insist on a thorough leak check
  - First leak found may not be the only leak
  - Size of the leak must correlate with amount of refrigerant lost
- Insist on leak checks every 1-2 months
  - depends on size, type of refrigeration system

GreenChill *Receiver Level Chart*



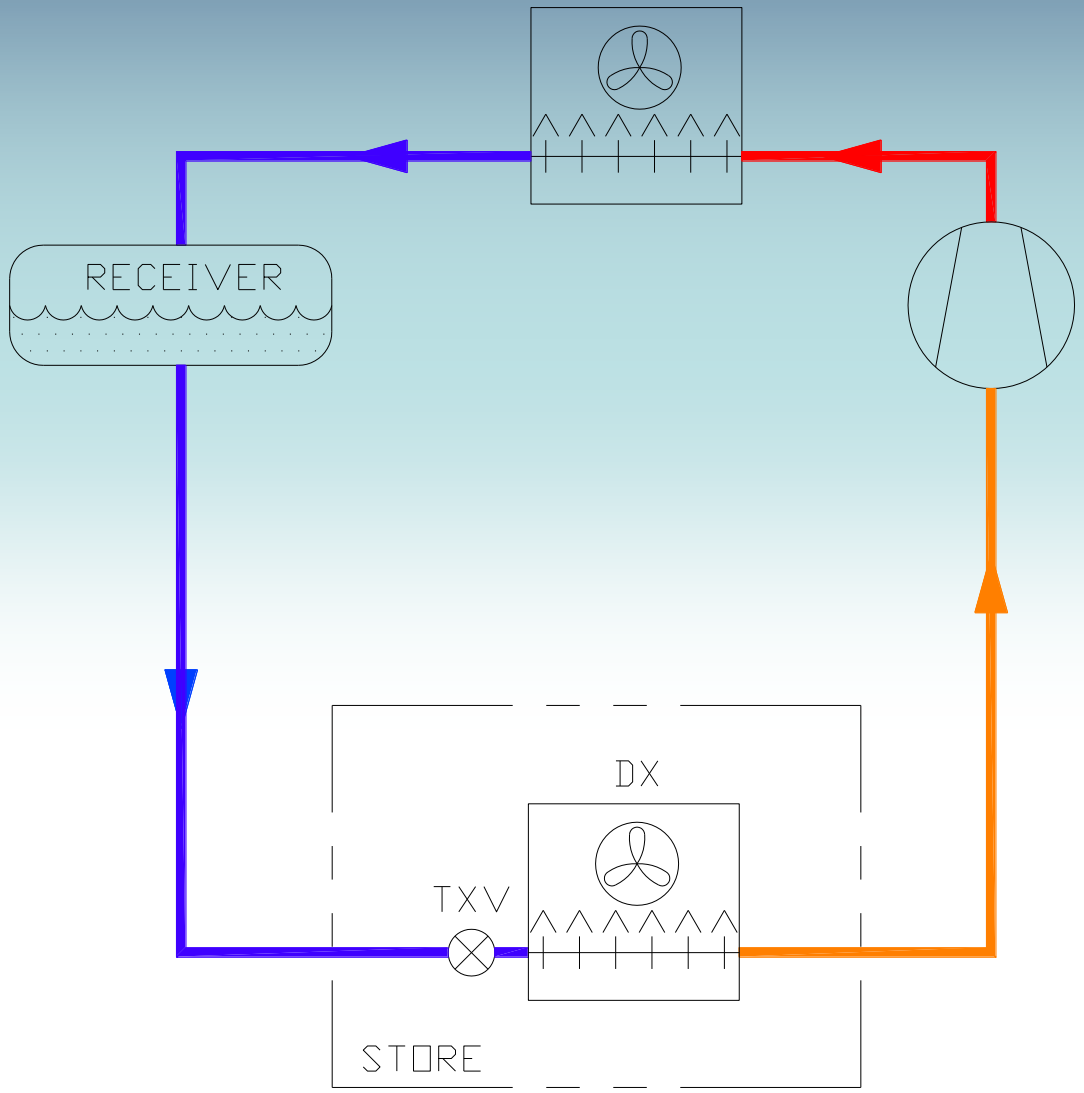
Leak Repairs

- Establish a response time
  - Usually 2 to 4 hours
  - Most leaks can be found and repaired within 24 hours
- Check and verify that the leak was repaired
  - Initial verification should be made immediately following the repair
  - Second verification should be made within 30 days

Reducing Leak Potential

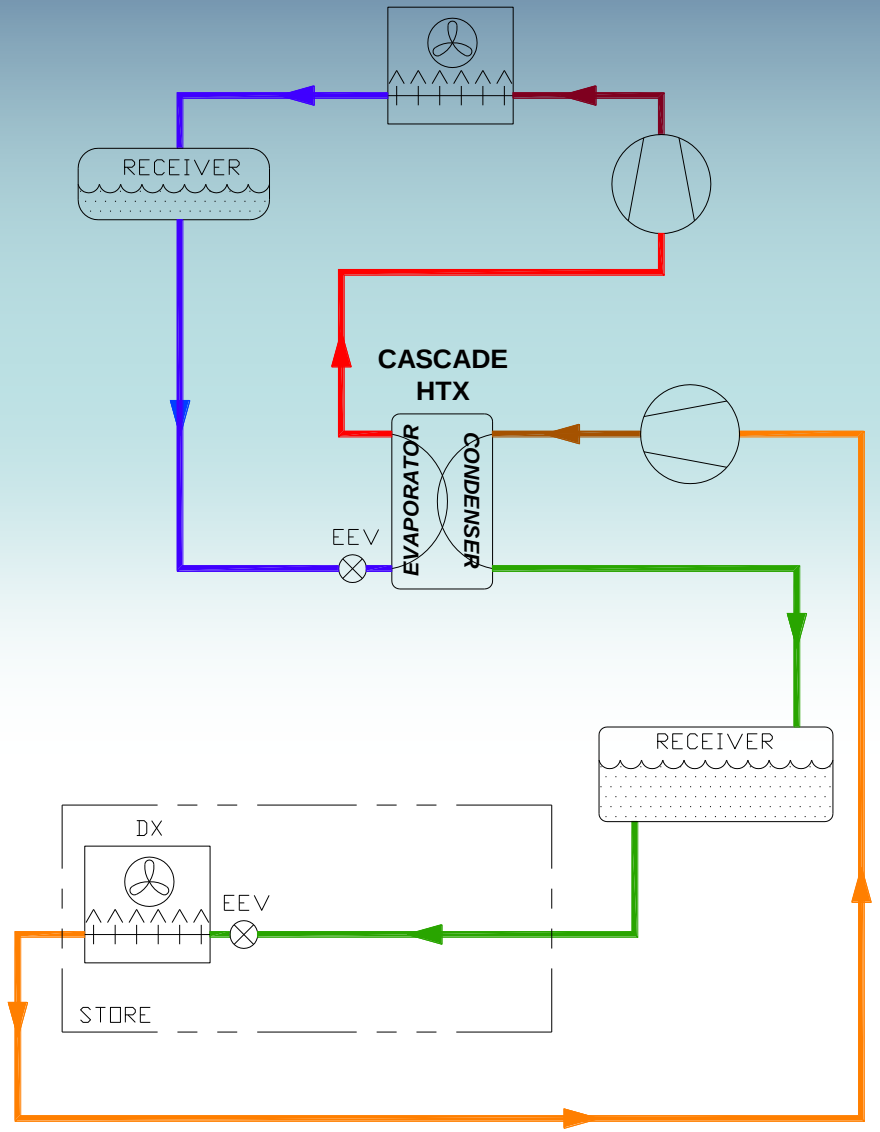
- Don’t overcharge systems
- Upgrade system components to more leak-resistant parts
- Upgrade systems to Advanced Refrigeration Systems during major remodels

Traditional Centralized DX System



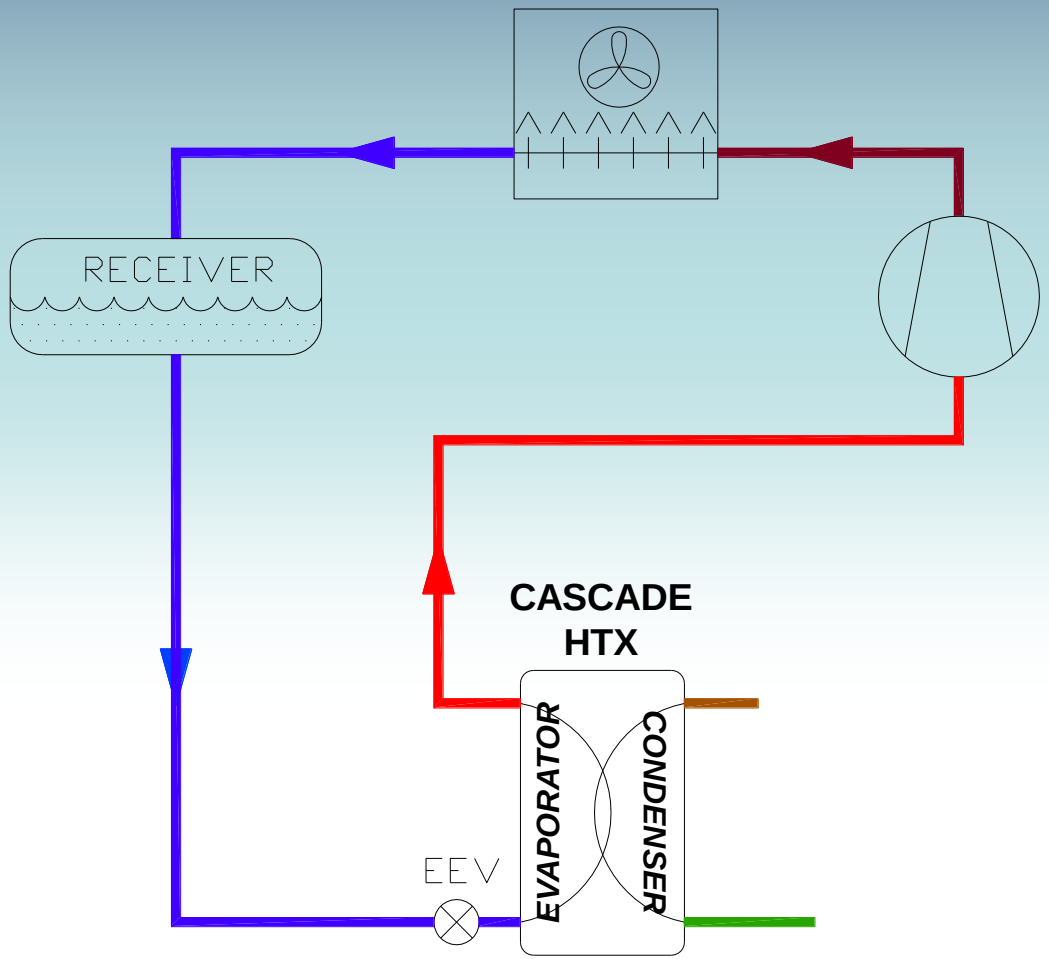
- Refrigerant is circulated through the store to the loads (cases) to remove the heat

CO_2 Cascade Refrigeration System



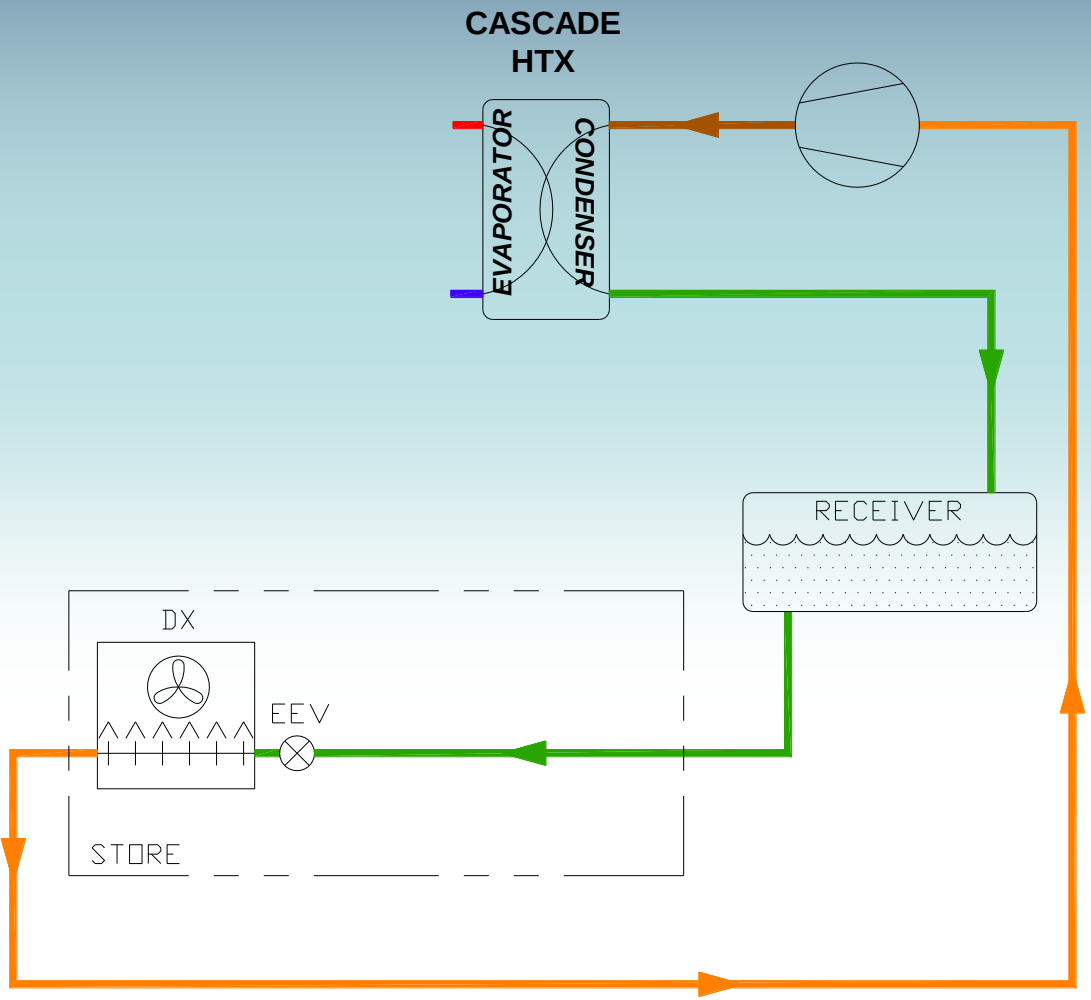
- Two systems
- Common cascade heat exchanger
- HFC condenses CO_2 refrigerant
- CO_2 circulated through store to refrigerated loads (cases)

CO_2 Cascade System : Top Cycle



- Just like a typical DX system
- Top cycle does not know it's part of a CO_2 cascade system
- In operation, the Top Cycle is removing the heat from the CO_2 system
  - allowing the CO_2 vapor to condense

CO_2 Cascade System : Bottom Cycle



- This portion looks similar to a typical DX system with a water cooled condenser
- Pressures are higher

CO_2 Pressures vs R404A

Temperature (ºF)	R744 (CO2)	R404A
-25 ºF	181 psig	14 psig
-20 ºF	200 psig	17 psig
-15 ºF	221 psig	21 psig
18 ºF	394 psig	53 psig
22 ºF	420 psig	58 psig
24 ºF	434 psig	62 psig
28 ºF	462 psig	67 psig
Critical Temperature/Pressure	87.7 ºF / 1,070 psig	162.5 ºF / 548 psig

CO_2 Cascade Systems - Special Attention Needed

- Component and piping selections
- Servicing tools and equipment
- Proper removal of non-condensables
- Thorough leak check and proper leak detection equipment
- Technician training

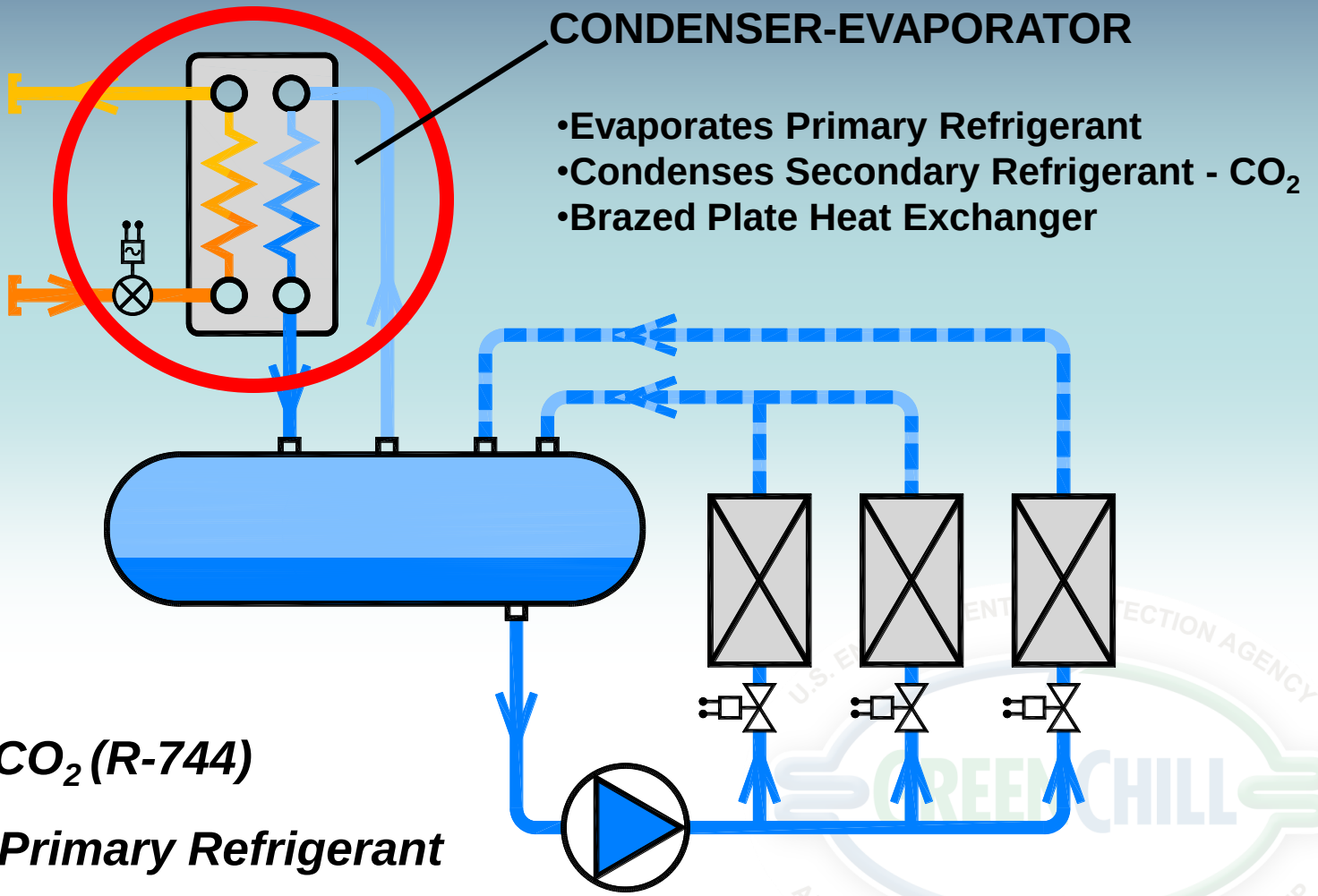
CO_2 Cascade Systems

- Known for reduced ‘primary’ refrigerant charges
  - 600 to 1,800 lbs or more (store dependant)
- Reduced leak rates of primary refrigerant
  - 2% to 15% per year (similar to secondary glycol)
- Reduces overall Total Equivalent Warming Impact
  - Reductions of 50% or greater are achievable
- Comparable energy performance is possible
  - +/- 3% is achievable (baseline dependant)
- Accelerated case temperature pull downs
  - 66% to 75% improvement

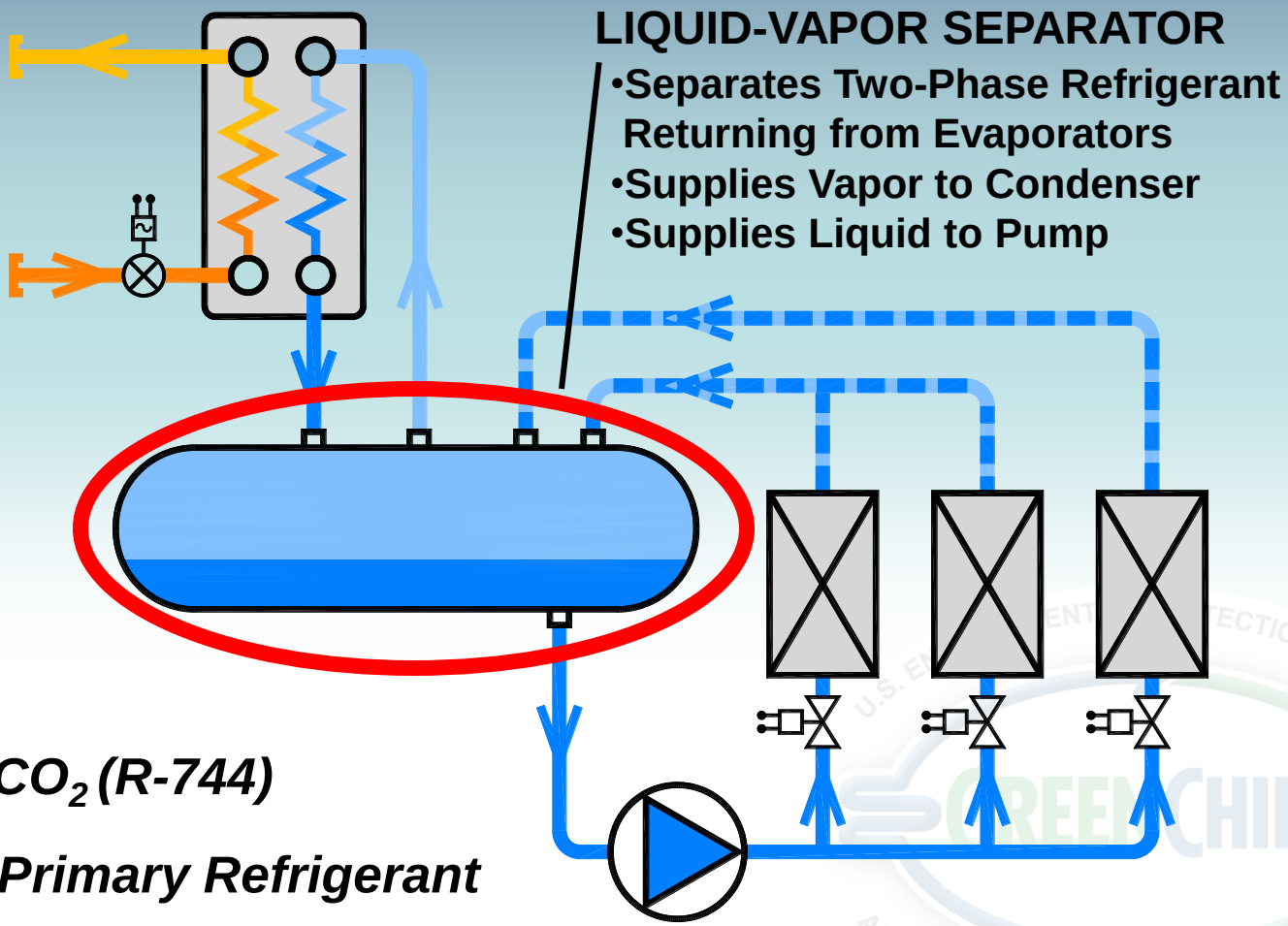
Useful Definitions

- **Refrigerant:** A fluid used to transfer heat from one source to another
- **Primary Refrigerant:** A fluid used to lower the temperature of a secondary coolant (i.e. R-22, R-404A, R-507, R-410A, etc…)
- **Secondary Coolant:** (a.k.a. Secondary Refrigerant, Secondary Fluid, Secondary Loop) – A fluid used to transfer heat from a heat source (i.e. refrigerated space) to a primary refrigerant.
- **Single-Phase Secondary Coolant:** a secondary fluid which absorbs heat by means of sensible heat transfer resulting in a change in temperatures (i.e. propylene glycol, brine)
- **Two-Phase Secondary Coolant:** a secondary fluid which absorbs heat by means of latent heat transfer resulting in a change of phase (i.e. carbon dioxide – CO2 - R-744, ice-slurry)

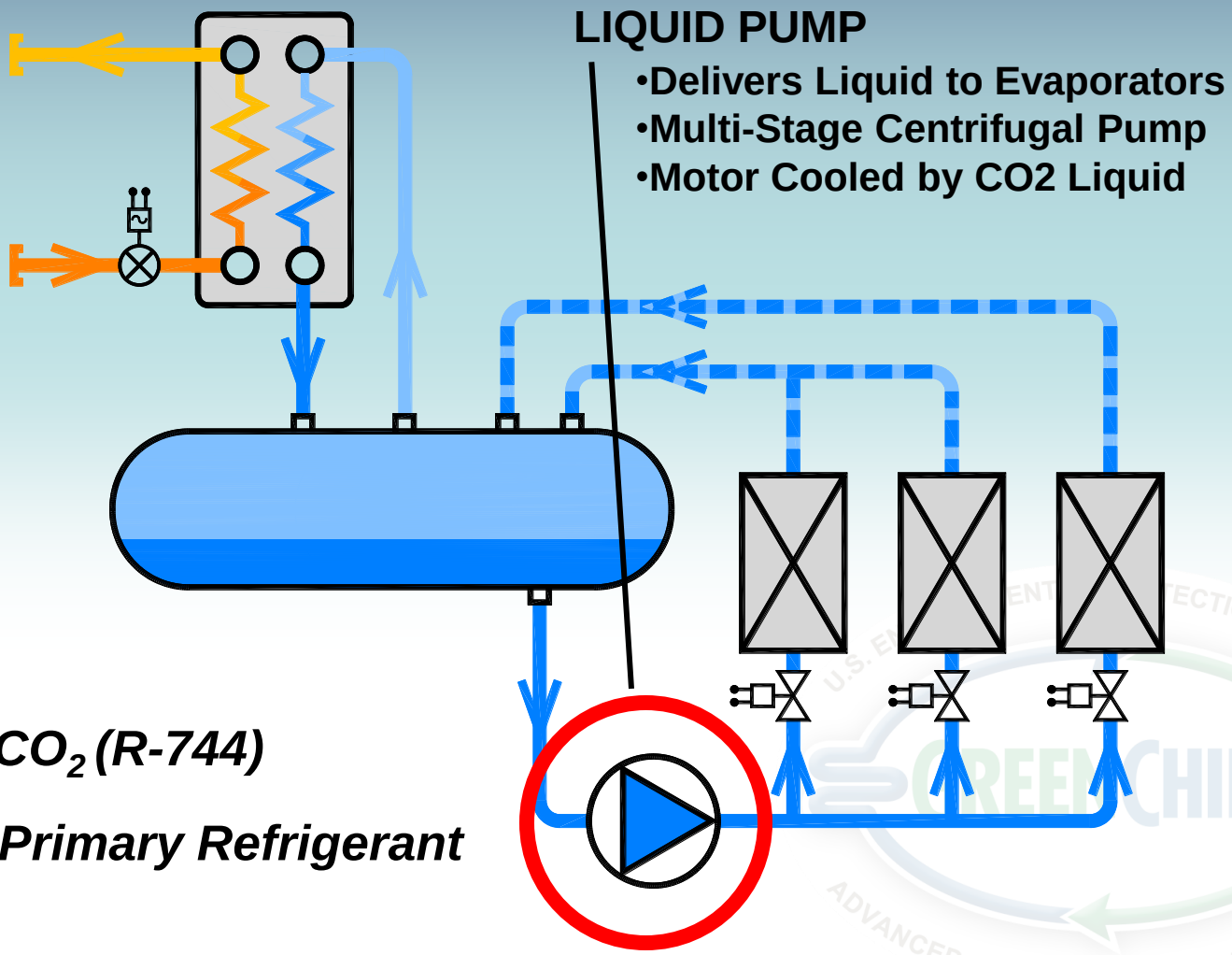
CO_2 Secondary Systems - How They Work



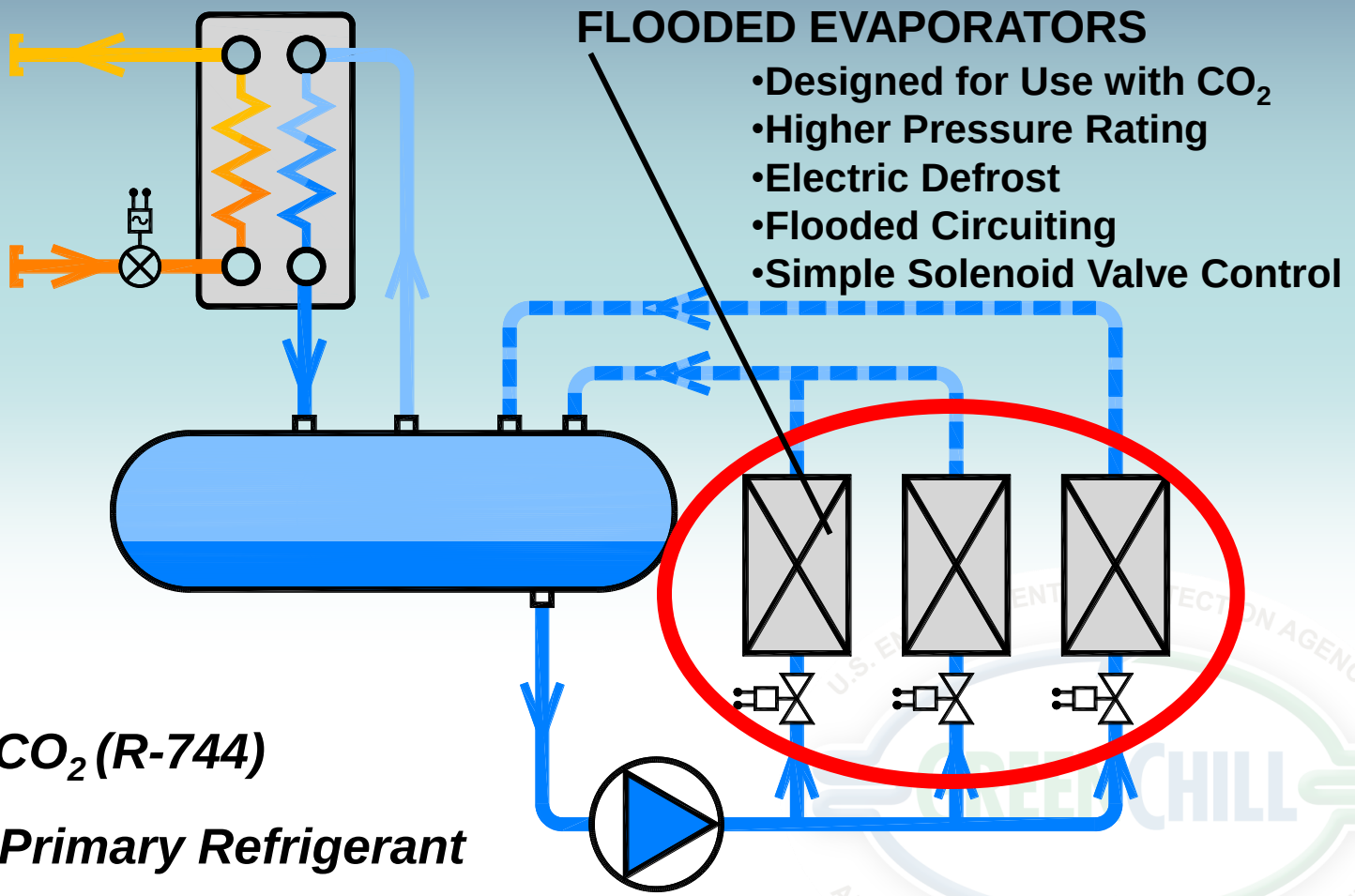
CO_2 Secondary Systems - How They Work



CO_2 Secondary Systems - How They Work



CO_2 Secondary Systems - How They Work



CO2 System Installations to Date