



Exploring the True Cost of Refrigerant Leaks and Proactive Solutions

July 12, 2022

Today's Host



Kersey Manliclic, Doctor of Philosophy (PhD)

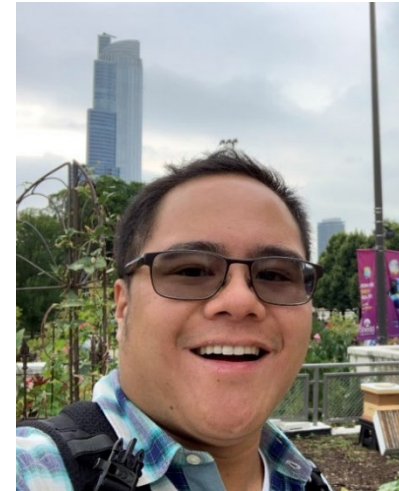
U.S. Environmental Protection Agency

Stratospheric Protection Division

GreenChill Partnership

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Kersey has worked in various sectors before coming to the U.S. Environmental Protection Agency (EPA). Most recently, he worked for 3.5 years at the California Air Resources Board implementing an incentive program for cleaner agricultural equipment and ensuring that Cap-and-Trade incentive programs benefitted disadvantaged communities. Prior to that, he worked with state agencies to plan hydrogen fueling infrastructure for fuel cell electric vehicles. He holds a Bachelor of Science (BS) in Mechanical Engineering, a BS in Materials Science & Engineering, a Masters of Science (MS), and a PhD in Environmental Engineering, all from the University of California, Irvine.

Questions and Webinar Feedback

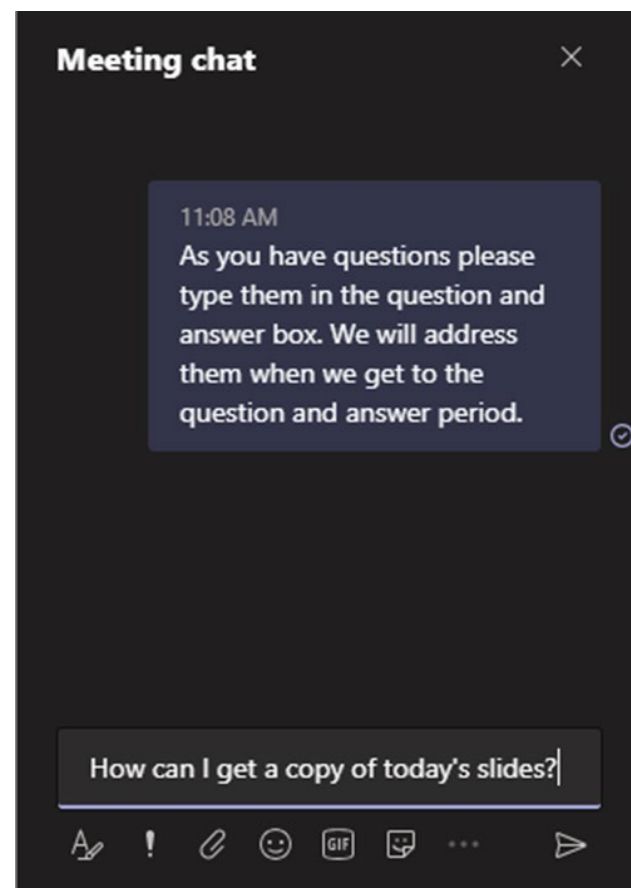


Question and Answer Session

- Participants are muted
- Questions will be moderated at the end
- To ask a question, enter your comment into the chat box

Feedback Form

- We value your input!
- The link to a feedback form will appear in the chat window





Recording and Slides

- Webinar is being recorded
- Materials will be posted on the GreenChill website under Events and Webinars:
www.epa.gov/greenchill
- To receive notification when materials are posted email: EPA-GreenChill@abtassoc.com

Program Overview

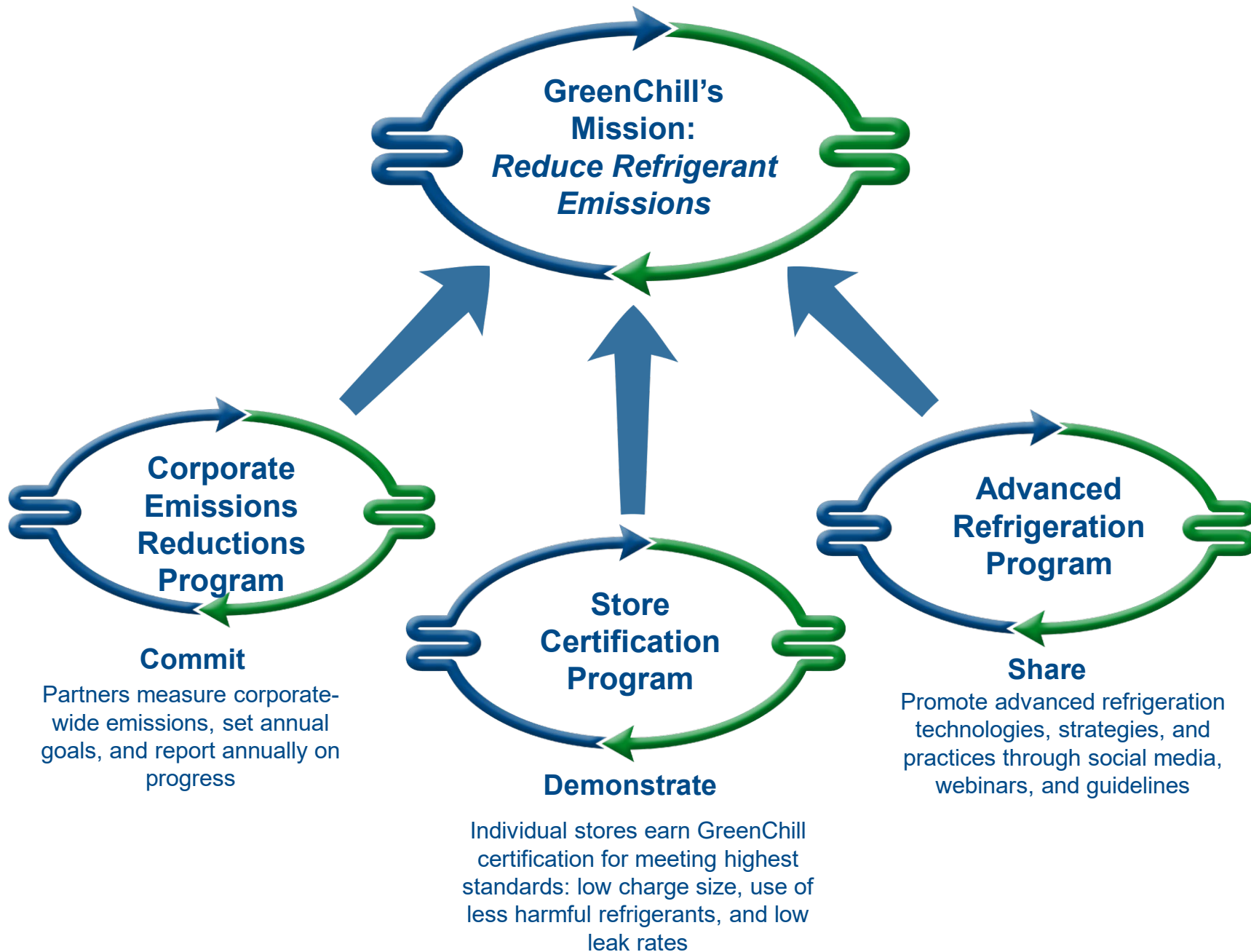


GreenChill is a voluntary partnership program that works collaboratively with the food retail industry to reduce refrigerant emission and decrease stores' impact on the ozone layer and climate system

GreenChill works to help food retailers:

- Lower refrigerant charge sizes and eliminate leaks
- Transition to environmentally friendlier refrigerants
- Adopt green refrigeration technologies and best environmental practices

www.epa.gov/greenchill



Upcoming GreenChill Webinars



- **August 30 at 2 PM Eastern: Refrigerant update: Hydrofluoroolefins (HFOs) and Emerging Architectures presented by Honeywell**
- GreenChill is planning the rest of the 2022 webinar season.
- If you are interested in presenting or have an idea for a presentation topic, email GreenChill@epa.gov
- To be added to our webinar invitation list, email EPA-GreenChill@abtassoc.com

Celebrating 15 Years of GreenChill



2022 is the 15th anniversary of GreenChill!

- 15th anniversary report later this year
- Explore GreenChill's Partner accomplishment page
- Email greenchill@epa.gov if you have ideas on how to celebrate!
- More to come!

Partnership Accomplishments

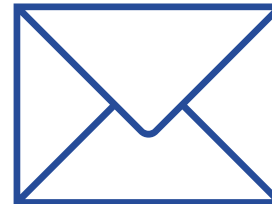


Each year GreenChill Partner companies share data on the amount of refrigerant contained in their systems and the amount of refrigerant leaked from those systems. These data demonstrate that GreenChill Partners generate environmental and economic benefits by transitioning to environmentally friendlier refrigerants, reducing the amount of refrigerant used by stores, eliminating refrigerant leaks, adopting green refrigeration technologies, and implementing environmental best practices.

[Refrigerant Types](#) [Using Less Refrigerant](#) [Reducing Emissions](#) [Saving Money](#)

www.epa.gov/greenchill/partnership-accomplishments

Learn More



www.epa.gov/greenchill

GreenChill@epa.gov

[!\[\]\(9c4f697052545ae4fab36076e03db94f_img.jpg\) @EPAair](https://twitter.com/EPAair)



Today's Speaker...

Danielle Wright



Danielle Wright

Executive Director

North American Sustainable Refrigeration
Council (NASRC)

Email: Danielle.wright@nasrc.org



Danielle is the executive director of the North American Sustainable Refrigeration Council, a nonprofit dedicated to advancing climate-friendly natural refrigerants. Prior to her current role, she oversaw large-scale utility energy efficiency programs to optimize performance and reduce costs for grocery stores.

Edward R. Estberg



Edward R. Estberg

Refrigeration Consultant/Raley's

Email: eedberg@me.com



Edward has been a Refrigeration Consultant for Raley's since 2009. Before that, he was the company's Senior Director of Facilities for 20 years. Prior to his roles at Raley's, Edward was President of Refrigeration Design Contractors from 1974 to 1989, and from 1965 to 1974, he was Installation and Service Manager of Hussmann's Sacramento branch.

North American Sustainable Refrigeration Council

Mission Create a sustainable future for supermarket refrigeration by removing barriers to natural refrigerant adoption

501c3

Non-Profit Organization

150+

Members

38,000+

Food Retail Locations

Goals

- ▶ Increase funding sources
- ▶ Increase technology solutions
- ▶ Ensure service readiness

Natural Refrigerants

Carbon
Dioxide
R744

Propane
R290

Ammonia
R717



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NASRC End-User Members



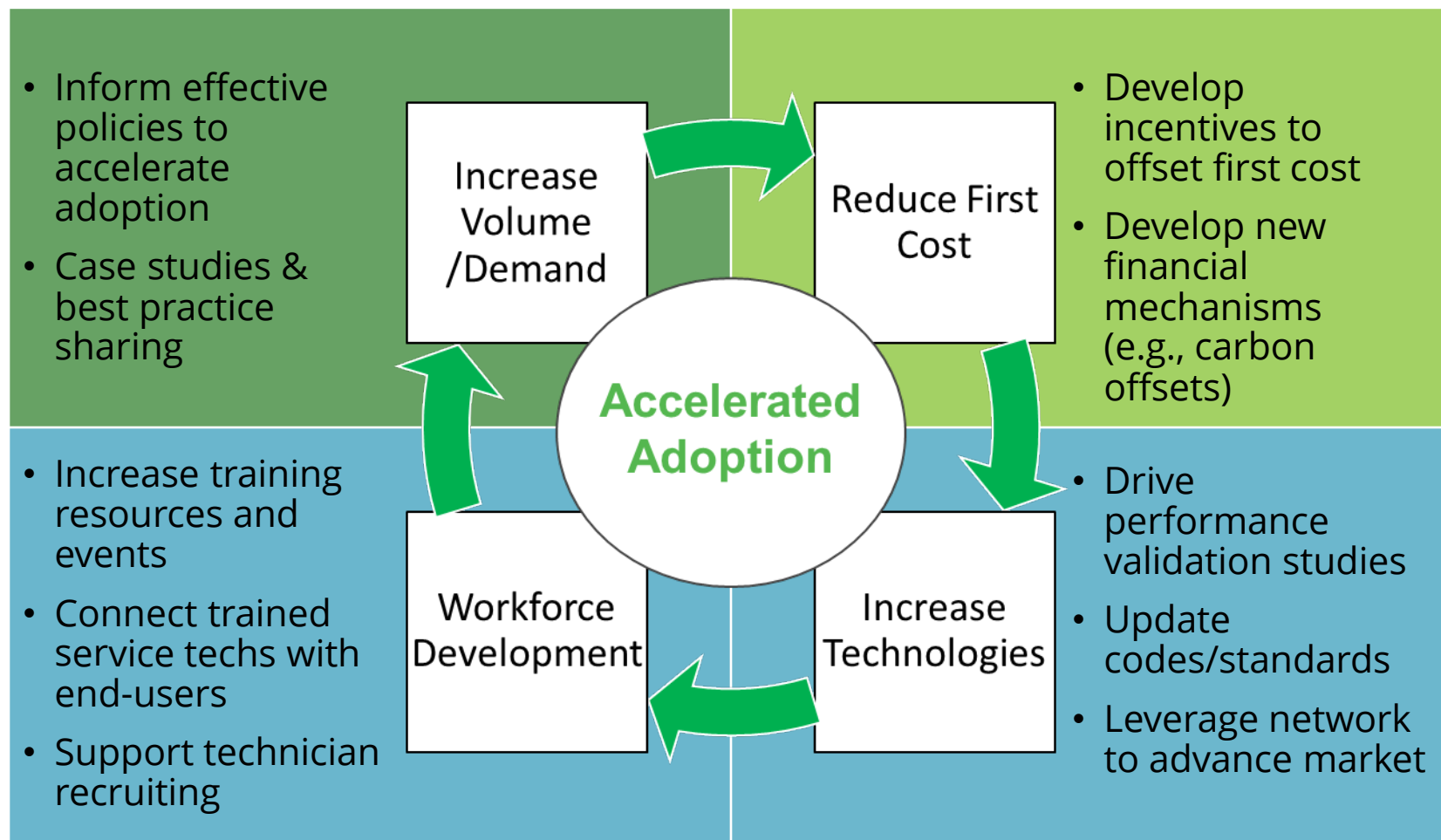
Other NASRC Members



Our Board of Directors



What We Do



Why Reduce Leaks?

Environmental Impact

Regulatory Impact

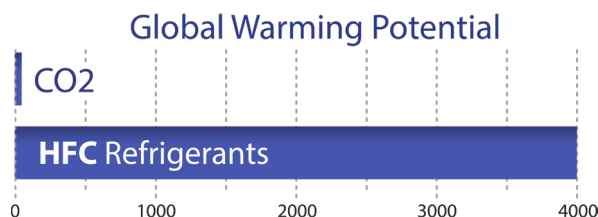
Operations Impact



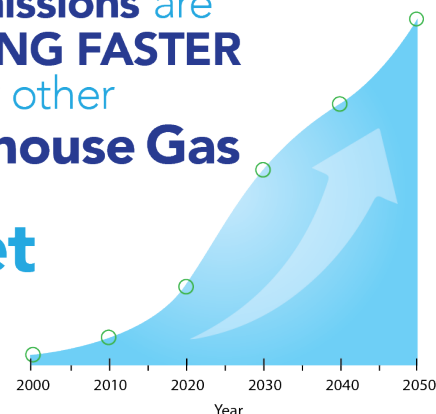
Environmental Impact: Hydrofluorocarbons (HFCs)

HFCs are **SUPER** climate polluting synthetic chemicals commonly used in air-conditioning & refrigeration

HFCs
have up to
4,000
TIMES MORE
GLOBAL WARMING
IMPACT than CO₂



and...
HFC Emissions are
GROWING FASTER
than any other
Greenhouse Gas
on the
Planet



The climate impact

from supermarket and grocery store refrigeration leaks

1 Year
**55 MILLION
MTCO₂e**

10 Year
**HALF BILLION
MTCO₂e**

CO₂: Carbon dioxide
MTCO₂e: Metric tons of carbon dioxide equivalent

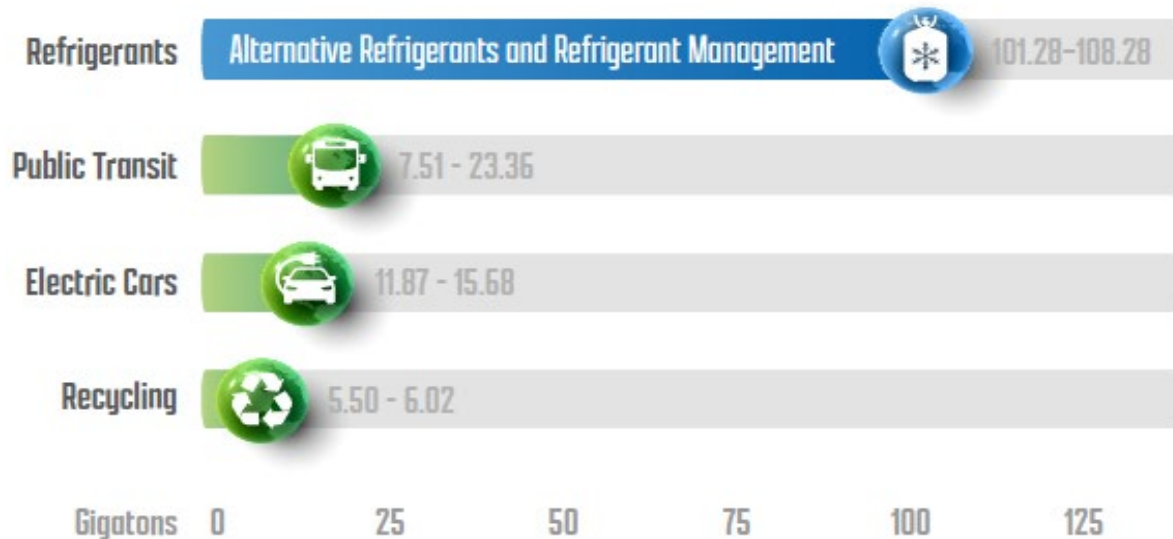


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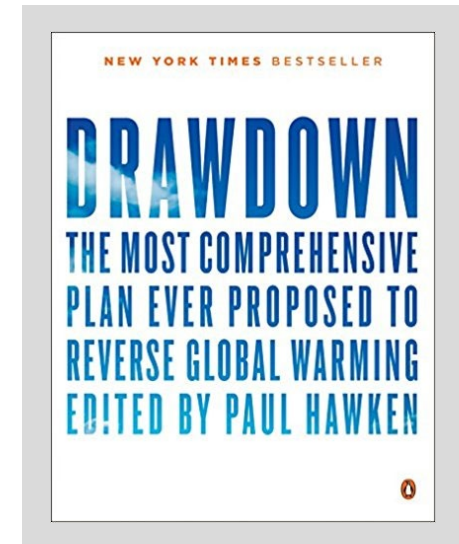
Environmental Impact: The Leading Climate Solution

Sustainable Refrigeration is the Most Impactful Solution to Climate Change

CO2 Emission Reduction Potential by 2050



Source: Project Drawdown <https://drawdown.org/solutions/table-of-solutions>

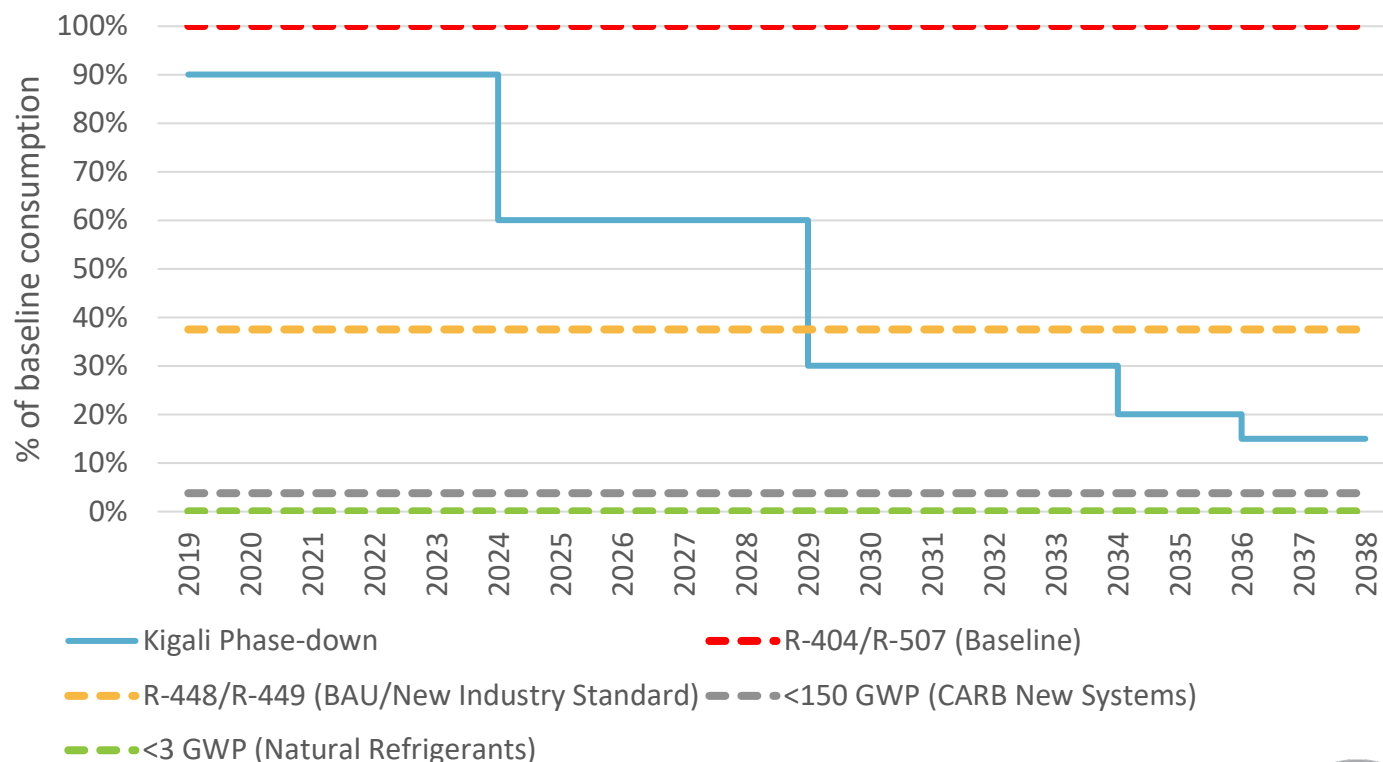


#1 climate solution

Avoid **0.5** degrees Celsius (C) of warming by 2100

Regulatory Impact: Refrigerant Supply

American Innovation and Manufacturing (AIM) (Kigali) Phasedown Schedule & Supermarket Refrigerant Options



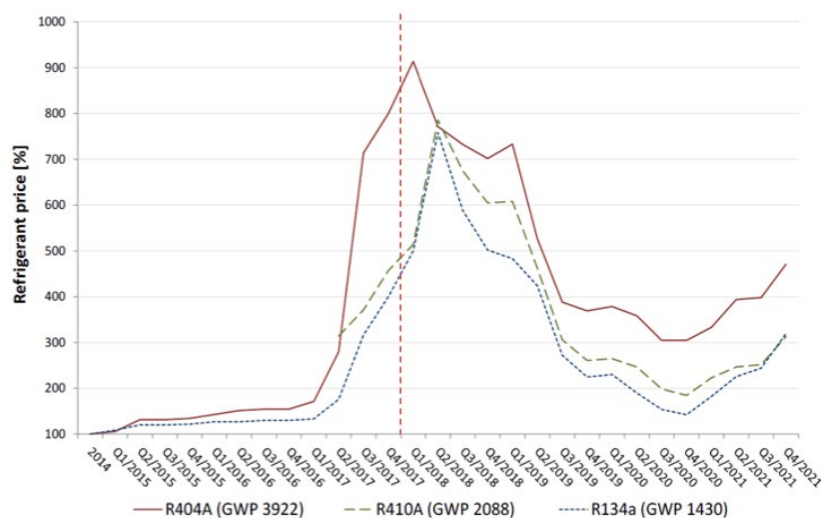
BAU: Business as usual
GWP: Global warming potential
CARB: California Air Resources Board



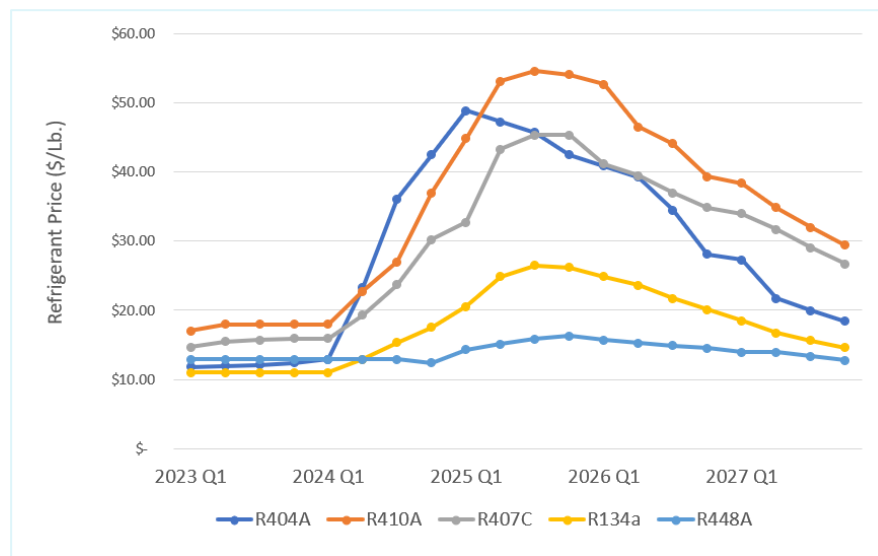
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Regulatory Impact: Refrigerant Costs

European Refrigerant Pricing Due to F-gas Regulation



Projected U.S. Refrigerant Prices Due to AIM Act



- HFC refrigerants saw 800% – 900% price increase

- Projected future prices of refrigerant based on European price increases

Source: Öko-Recherche on behalf of DG Clima
F-gas: Fluorinated greenhouse gas

Source: DC Engineering Presentation, NASRC
Sustainable Refrigeration Summit 2021

Regulatory Impact: State HFC Policies

The US Climate Alliance

Washington

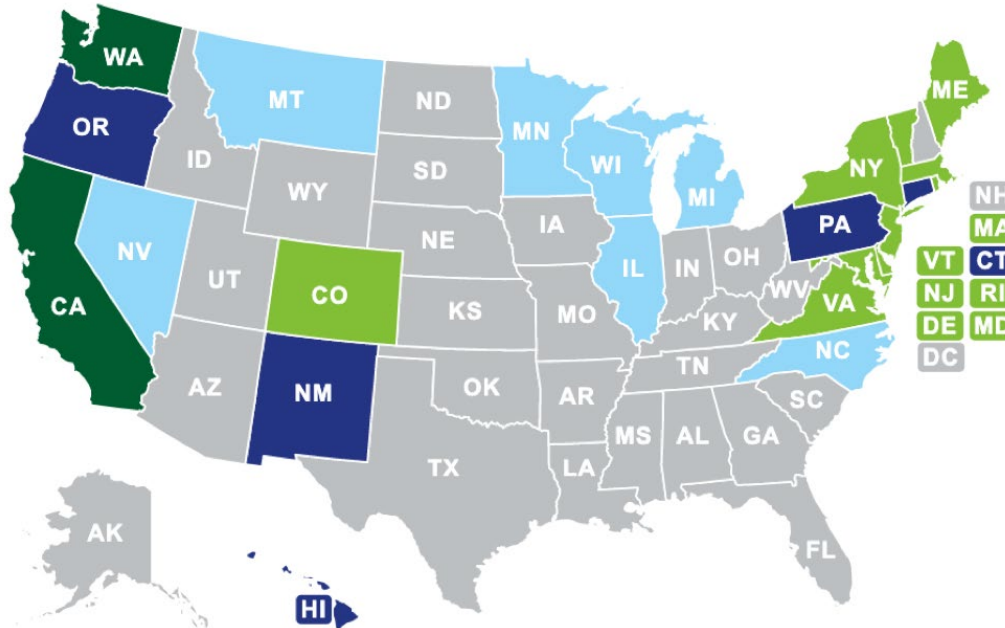
- <150 GWP for New EQUIPMENT

California

- <150 GWP for New Systems
- <1400 GWP for Existing Systems
- SB 1206 - Virgin Refrigerant Ban

New York

- 20-year GWP
- GWP threshold for New and Existing Systems
- Refrigerant Ban



SNAP + Additional GWP Limits



SNAP 20/21 Signed Into Law



Significant New Alternatives Program (SNAP) 20/21 Pending



US Climate Alliance Member

<https://nasrc.org/hfc-policy>



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Operations Impact: Refrigerant Leaks are Bad for Business!

Need to keep food cold!

- Increase service/maintenance costs
- Sub-optimal performance
- Compromised product integrity

Natural Refrigerants Leak too!

- Negligible environmental impact
- Exempt from compliance requirements
- Still bad for business (see above)

CO₂ Systems

- Higher leak rates
- High pressures
- Venting during service
- No CO₂ refrigerant reclaim technology



NASRC Leak Reduction Initiative

Retailer-driven initiative to reduce leaks over a system's lifespan

Retailer Best Practices Committee

Target
ALDI
COSTCO
Whole Foods
Raley's
H-E-B

Retailer & Original
Equipment
Manufacturer
(OEM) Kick-Off
Meeting

Q1 2020



Q2 2020

Identify
Top Leak
Sources

Retailer Best
Practices
Committee
Formed

Q3 2020



Q1 2021

Develop
Proposed
Equipment
Specs

Circulate
Specs with
OEMs for
Input

Q2 2021



2022

Leak Reduction
Handout



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Top Leak Issues

Category A: Cases and Fixtures

1. Evaporator leaks due to tubing failures
2. Access valves used for servicing
3. Lines rubbing together either through contact and vibration or through thermal expansion
4. Electrical wiring failure causing leaks

Category B: Machine Room and Rack

5. Compressor vibration relative to the rack structure, causing tubing failure (stress)
6. Leaks from high side control lines
7. Mechanical fitting connections
8. Access valves used for servicing, such as rotolock valves and stem packing leaks
9. Tubing vibrating against dissimilar metals

Category C: Condenser

10. Tube sheet leaks at condensers
11. Fan breakage/motors falling into the coil and causing leaks

Category D: Connecting Pipes

12. Corrosion and abrasion



Measure 1

Require 45 bar working pressure (Type K copper) in display case and walk-in coils, all piping, and on racks.

- **Problem:** Corrosion, stress, abrasion.
- **Solution:** Thicker wall tubing takes longer to corrode, leak due to fatigue, and wear out, adding years of leak-free service.
- **Category:** A, B, & D



Measure 2

Any tubing or part that carries refrigerant cannot come into contact with any other metal

- **Problem:** When copper piping carrying refrigerant comes into contact with other metals and wiring, thermal cycling can cause friction that wears away the piping over time, resulting in leaks.
- **Solution:** Properly isolate and clamp tubing to protect from wear and contact with any metals or hardened materials and reduce vibration related fatigue/stress.
- **Application:** Category A



Measure 3

Eliminate any flare fitting on copper tubing, except where needed for sensors and other equipment connections.

- **Problem:** Flare nuts loosen from vibration or thermal cycling.
- **Solution:** Use double ferrule compression fittings or solder all joints and fitting.
- **Application:** Category A & B



Measure 4

Eliminate rotolock fittings.

- **Problem:** Over time rotolock mount nut loosens from thermal cycling and compressor vibration.
- **Solution:** Eliminate rotolock valves and use a flange mount valve.
- **Application:** Category B



Measure 5

Add a temporary pressure gauge or indicator to visually confirm that the system is pressurized after arriving on site.

- **Problem:** Some leaks occur during shipping.
- **Solution:** Add gauges to pressurized components to ensure leaks are noticed before installation.
- **Application:** Category B



Measure 6

Regulate CO₂ release valves.

- **Problem:** Once CO₂ release valves engage, fine particles get into the valves, preventing them from reseating properly.
- **Solution:** Unknown.
- **Application:** Category B (for CO₂ Systems)



OEMs

Leak reduction measures will increase equipment and manufacturing costs

Considerations

- Market demand
- Specialization vs. Standardization
- Competition
- Component suppliers
- Serviceability

Needs

- Consensus on equipment specifications
- Commitment to incremental costs
- Scalability

Retailers

Need data to commit to leak reduction measures and justify upfront costs

Considerations

- Equipment age vs. effective useful life
- Ultra low leaks (self-contained) vs. energy performance
- Upfront cost vs. on-going cost of leaks

Needs

- Data on incremental cost of leak reduction measures
- Data on payback to justify upfront investment



Cost Scenario

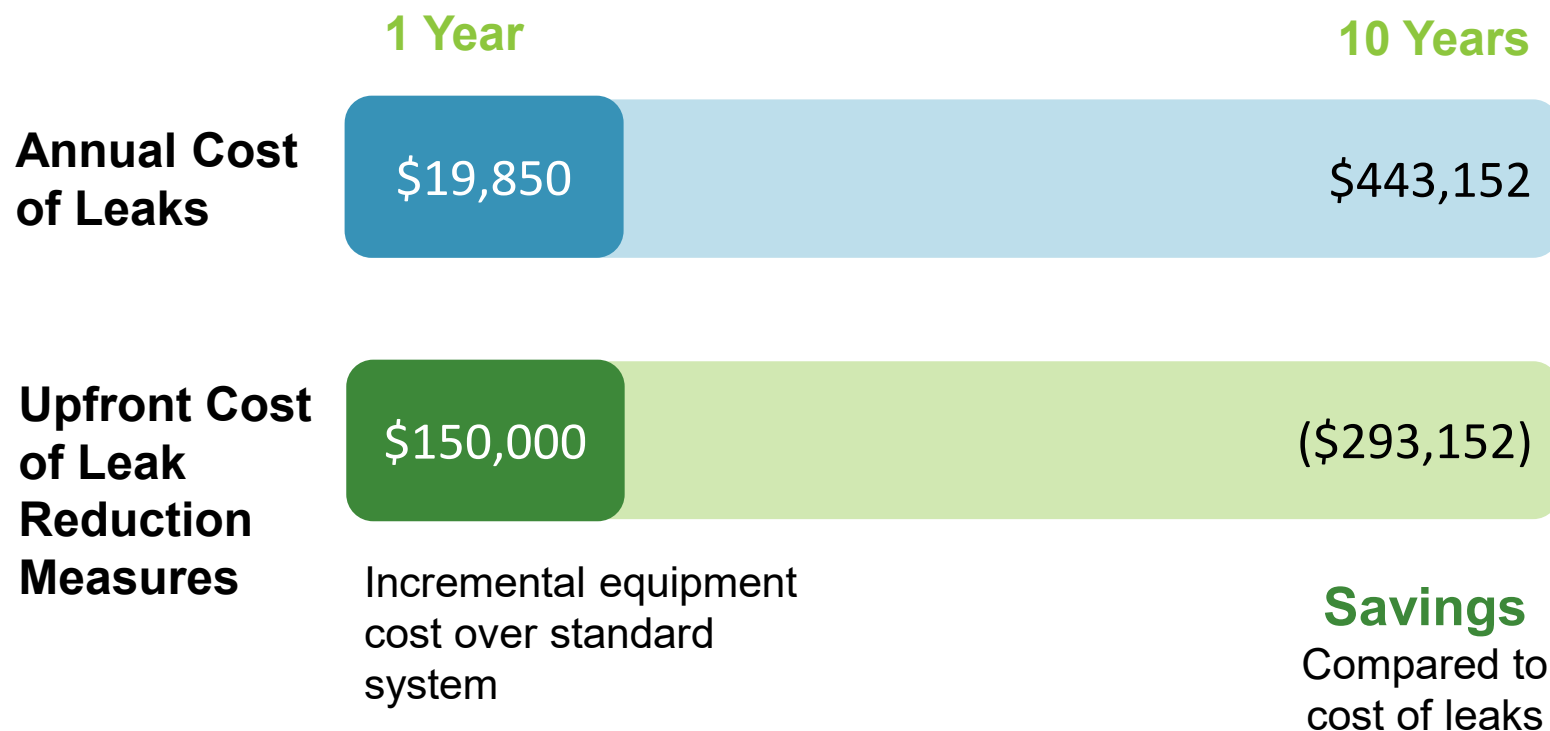


Assumptions

- 2,500 pounds (lbs.) R-404A
- 16% Annual Leak Rate
- Cost of leaks includes refrigerant, labor, and parts
- Refrigerant cost increase 30% per year

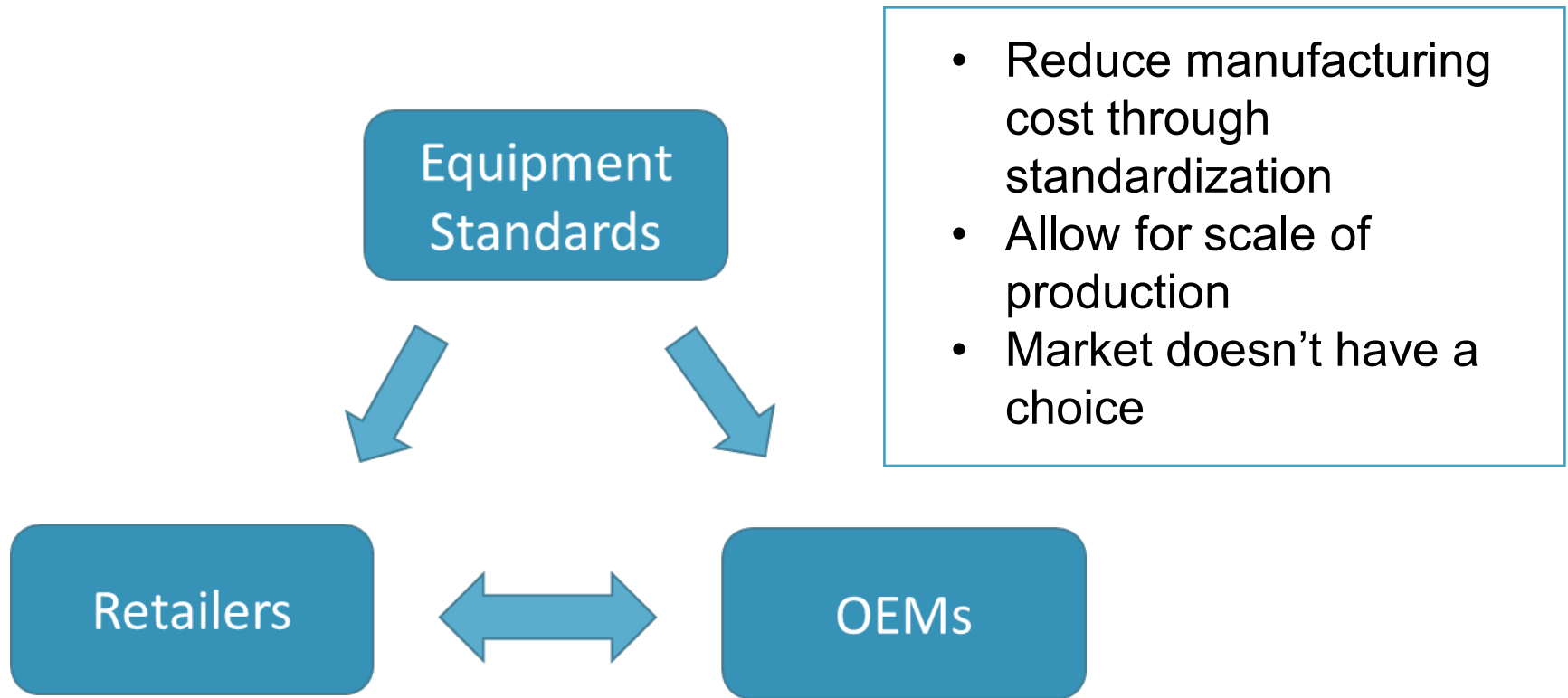


Cost Scenario



Equipment Standards

Potential to reduce equipment costs through standardization and scale



Next Steps... More Data!

NASRC Leak Reduction Handout

*Industry-led initiative to reduce
refrigerant leaks and emissions
over the lifetime of the system*

Sign-up to Receive!

nasrc.org/subscribe



Sustainable Refrigeration Summit

Connecting the Pieces for
Supermarket Refrigeration Solutions

OCT 24 - 28 | 2022



Bringing together **commercial refrigeration energy, environmental, and policy stakeholders** to solve the puzzle of sustainable refrigeration in supermarkets.

- Virtual and **FREE**
- **Flexible schedule** with live sessions, panel discussions, technology presentations, trainings and workshops

nasrc.org/2022-sustainable-refrigeration-summit

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NASRC Resources

- NASRC HFC Regulations Tracker: <https://nasrc.org/hfc-policy>
- NASRC Natural Refrigerants Technology Library: <https://nasrc.org/nat-ref-tech-lib>
- NASRC Resource Library: <https://nasrc.org/resource-library>
- NASRC Events: <https://nasrc.org/events>
- NASRC Member Directory: <https://nasrc.org/member-directory>
- NASRC Annual Report: <https://nasrc.org/about-nasrc>





Contacts and Upcoming Webinars

Presenter Contacts

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- Kersey Manliclic, U.S. EPA
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Upcoming Events

Date	Webinar Topic
8/30/22	Refrigerant update: HFOs and Emerging Architectures

If you have ideas for future webinar topics, email GreenChill@epa.gov

Join our webinar invitation list or request today's slides: EPA-GreenChill@abtassoc.com

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