The Refrigerant Transition: From Chaos to Order

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What we'll discuss…

- The American Innovation and Manufacturing (AIM) Act
- Best practice: Lessons learned in Europe
  - A chaotic transition
  - Toolkit to reduce demand
  - Petitions for sector-based controls
  - Energy Efficiency
- Best practices: Work together to identify and eliminate barriers
  - Enable new refrigerants
  - Reclaimed refrigerant (Best practice: Australia)

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The American Innovation and Manufacturing (AIM) Act of 2020:

The hydrofluorocarbon (HFC) phase-down

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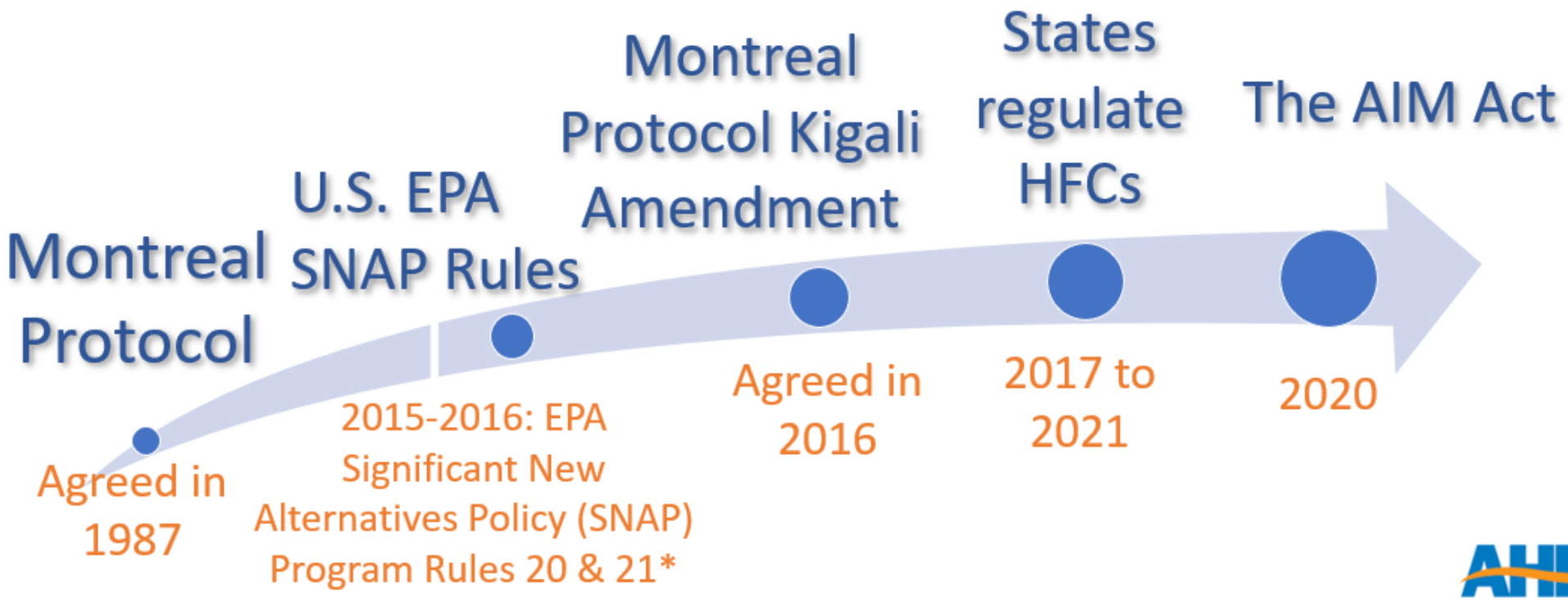
Refrigerant Transitions



*SNAP rules 20 & 21 were remanded back to EPA by DC Circuit Court (2017/2018)

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HFCs have been used in many market sectors.

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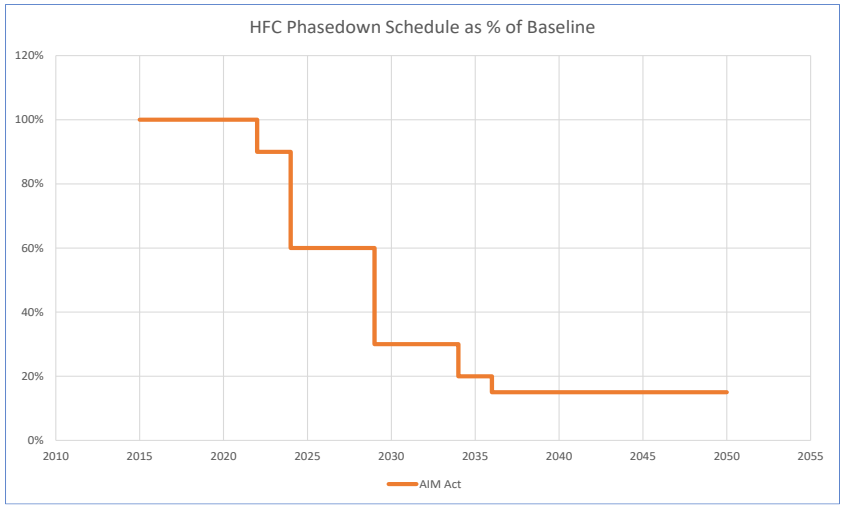
American Innovation and Manufacturing Act of 2020

- Mandates production and consumption phase-down of HFCs
  - Environmental Protection Agency (EPA) regulation Oct 1, 2021
- Allows sector transitions
- Refrigerant management including recovery and reclaim
  - Stakeholder meeting April 26, 2022



2011-2013 baseline:

- 2022: 10% reduction
- 2024: 40% reduction
- 2029: 70% reduction
- 2034: 80% reduction
- 2036: 85% reduction

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Consumption Doesn't Mean What You Think It Means

Consumption =

Production + Imports - Exports

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Consumption Doesn’t Mean What You Think It Means

Consumption is Supply not Demand!

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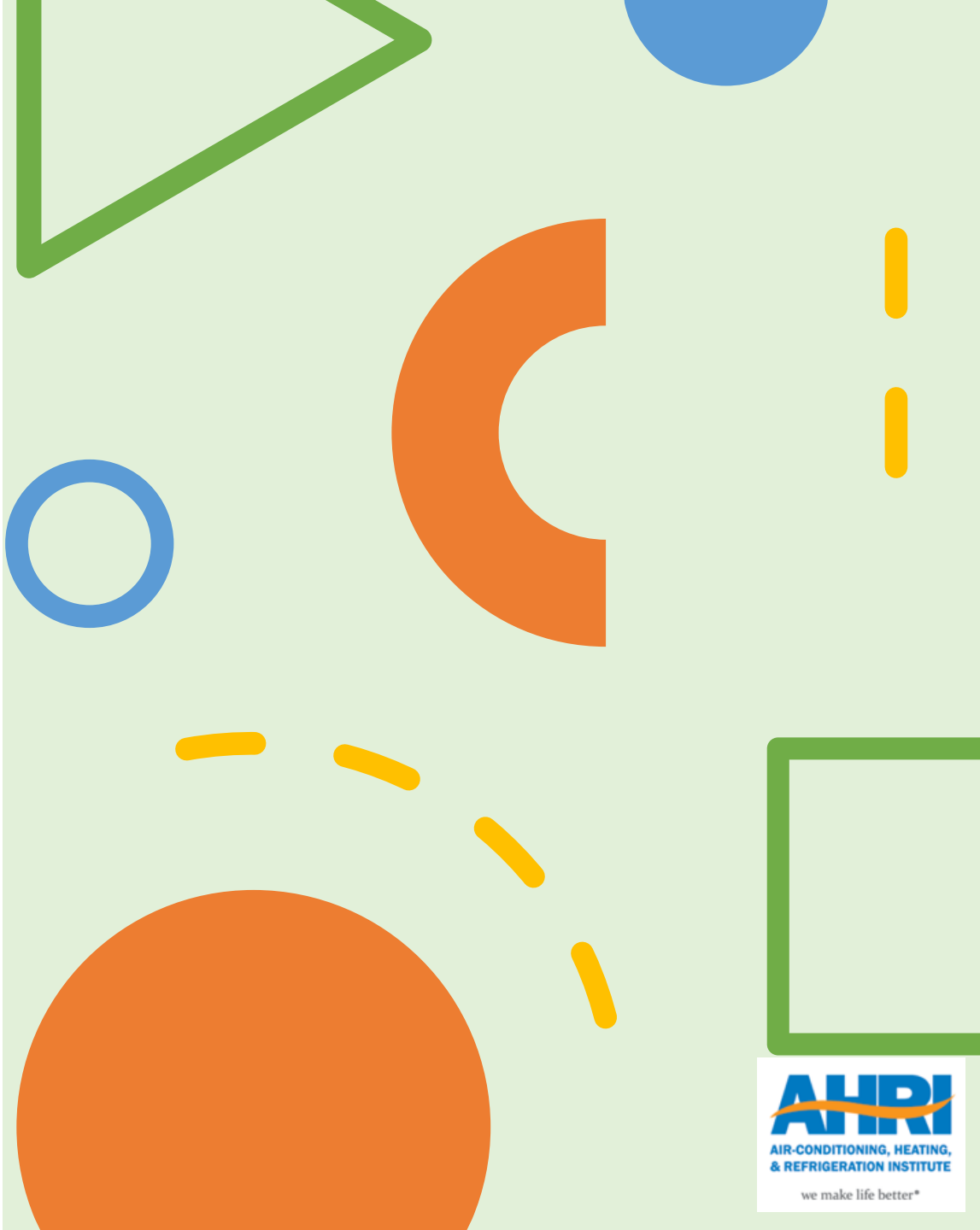
The HFC allocation phase-down is designed to create an economic supply imbalance with demand.

Reduced Supply Economics

- Scarcity
- Increased Prices



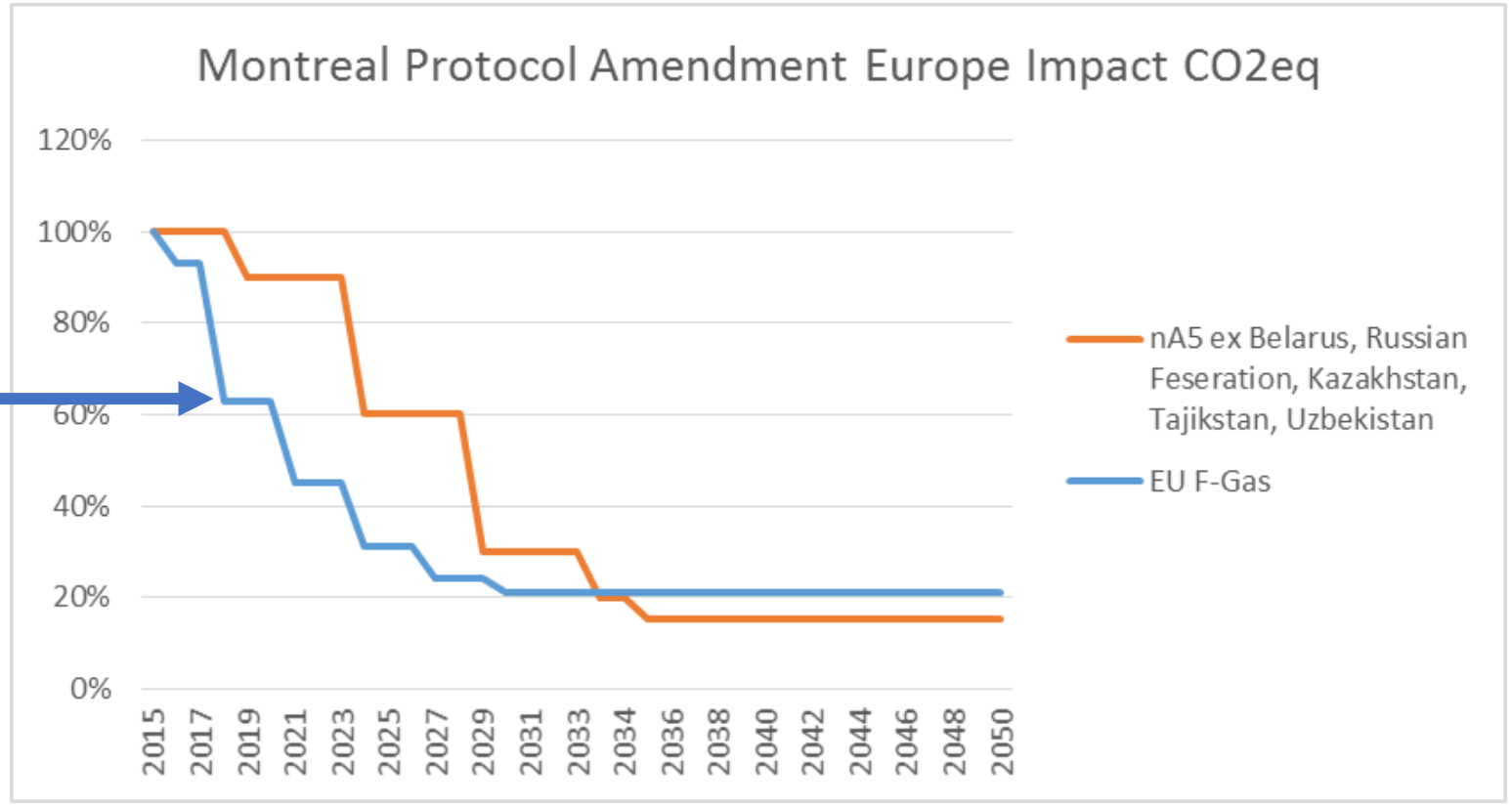
A Chaotic Transition

Lessons Learned in Europe

European Union Fluorinated Gas (F-Gas) Regulations

Retailers were not ready.

37.5% 2018



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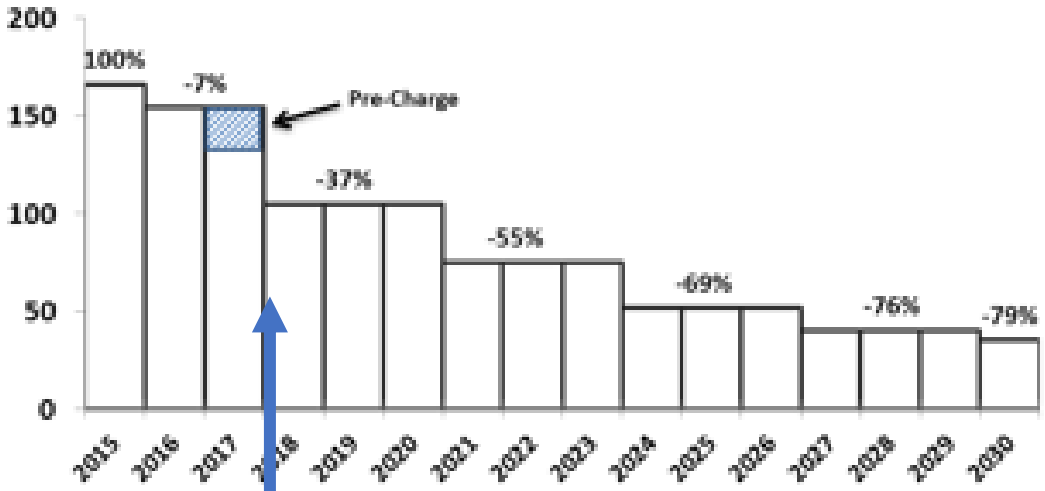
Europe (EU-28) F-Gas II

Cap basis: CO2 Eq MT

CO_2e sales 2009-2012



Bottom Line:

Very little sector control prior to 2020 created chaotic transitions in 2018

- **Equipment Ban:**
  - **2015:** HFC ≥150; refrigerators/freezers – foam & refrigerant
  - **2015:** HFC ≥ 2500; commercial refrig/freezers
  - **2020:** HFC ≥ 2500; stationary refrigeration
    HFC ≥ 150; movable room air conditioners
  - **2020:** HFC ≥ 150; XPS FOAM
  - **2022:** HFC ≥ 150; commercial refrigerators/freezers
  - **2023:** HFC ≥ 150; PU FOAM
  - **2025:** HFC ≥ 750; single split air conditioners
- **Service Ban:**
  - **2020:** Prohibit Service and maintenance of refrigeration equipment with a min charge size of 40 tonnes CO2-equivalent with refrigerants ≥2500 GWP

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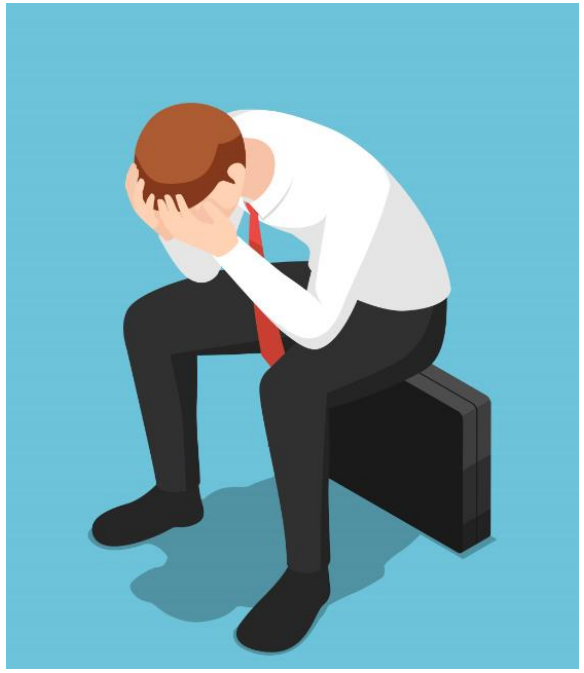
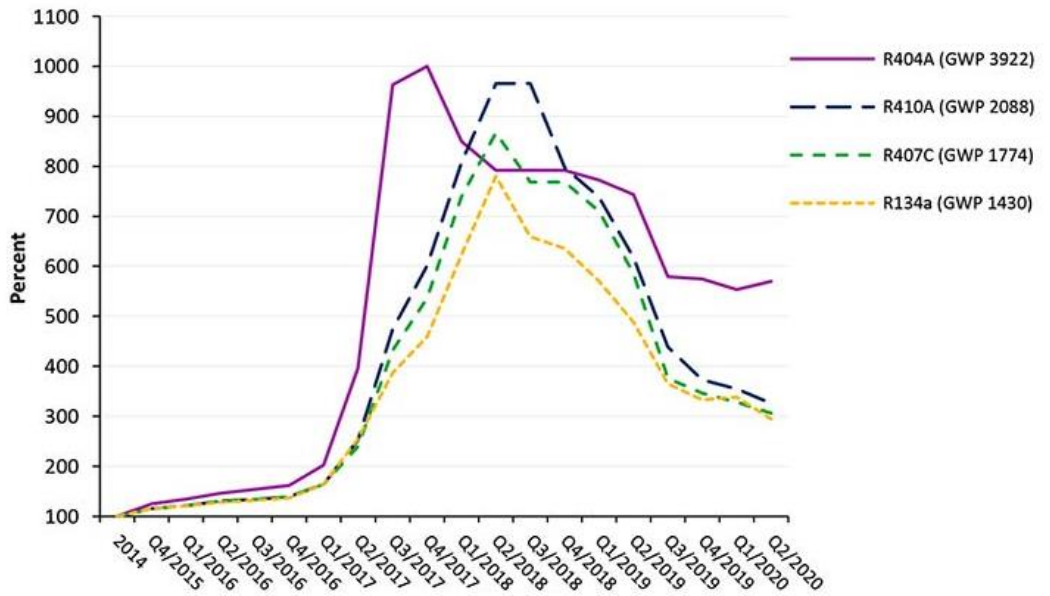
European Impact: Retailers and OEMs



- The Cooling Post 2020

Refrigerant demand and prices

29 SEP 2020



Average purchase prices reported by three large refrigerant distributors. Prices are indexed to the baseline year 2014

EUROPE: The effects of Covid-19 are held at least partly responsible for a fall in refrigerant demand and prices in the quarter to September.

The refrigerant price trends are recorded in the latest report from German consultancy Öko-Recherche.

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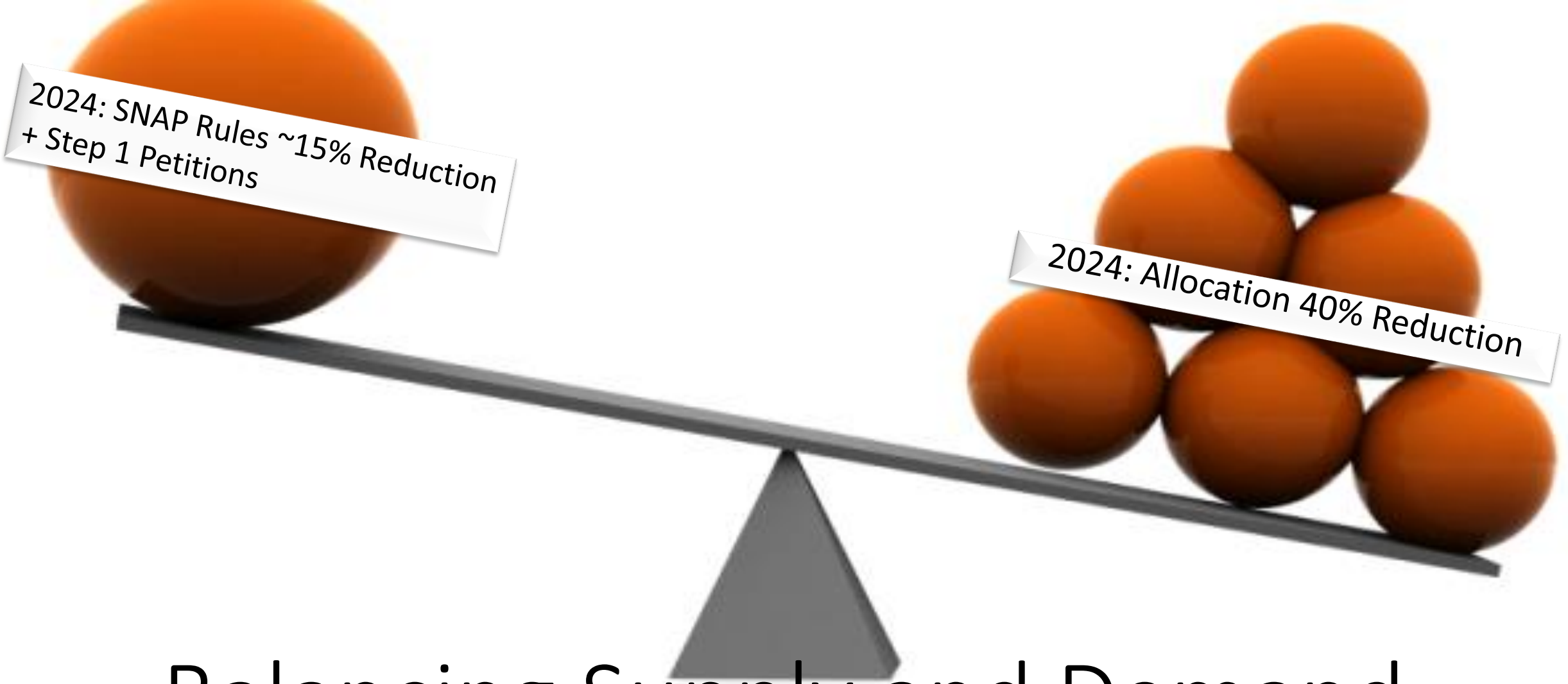

Balancing Supply and Demand

Where is the additional 25% going to come from?

Refrigerant Charge:

- More energy efficient equipment can require the use of larger charge sizes of refrigerant
- Heat pumps can require larger charges of heat transfer fluids than air conditioning alone
- Low global warming potential (GWP) refrigerants typically require smaller charges[1].

- All of this makes balancing supply and demand more critical

1 Cold Hard Facts 3 for The Australian Government by The Expert Group https://www.environment.gov.au/system/files/resources/bd7fa5d0-8da1-4951-bd01-e012e368d5d0/files/cold-hard-facts3.pdf

Reducing Demand to Balance Supply

- OEM/End-user Toolbox
  - Use low-GWP refrigerants in new equipment
  - Consider smaller charge sizes
  - Retrofit existing equipment, A1 -> lower GWP A1
  - Reduce leaks
  - Use recovered/reclaimed refrigerant

Bottom Line: Future compliance depends on starting now!

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Sector Transition Petitions Rulemaking Starts

NRDC/IGSD – Reinstate SNAP Rules 20 & 21 under AIM
AHRI – Air Conditioning 750 GWP 2025; Refrigeration Step 1, Refrigeration Step 2
EIA – All California requirements
AHAM – AC, dehumidifiers 750 GWP
IGSD – Auto DIY
DuPont – XPS 134a transition
CPI – PU Foam SNAP Rules
IIAR – Commercial Refrigeration
HCPA – Aerosol SNAP Rules
Climate Alliance States – SNAP Rules and California requirements

Enabling New Refrigerants: Safety Standards and Building Codes Refrigerant Listings

New Refrigerants must be approved by EPA and standards adopted into building codes.

Enabling Refrigerants

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SNAP 23 Rule Published in the Federal Register

Residential and light commercial air conditioning and heat pumps

- R-452B, R-454A, R-454B, R-454C, R-457A, R32†
- Acceptable subject to use conditions including safety standards

† EPA previously listed R-32 as Acceptable Subject to Use Conditions for self-contained room air conditioners (April 10, 2015; 80 FR 19454)

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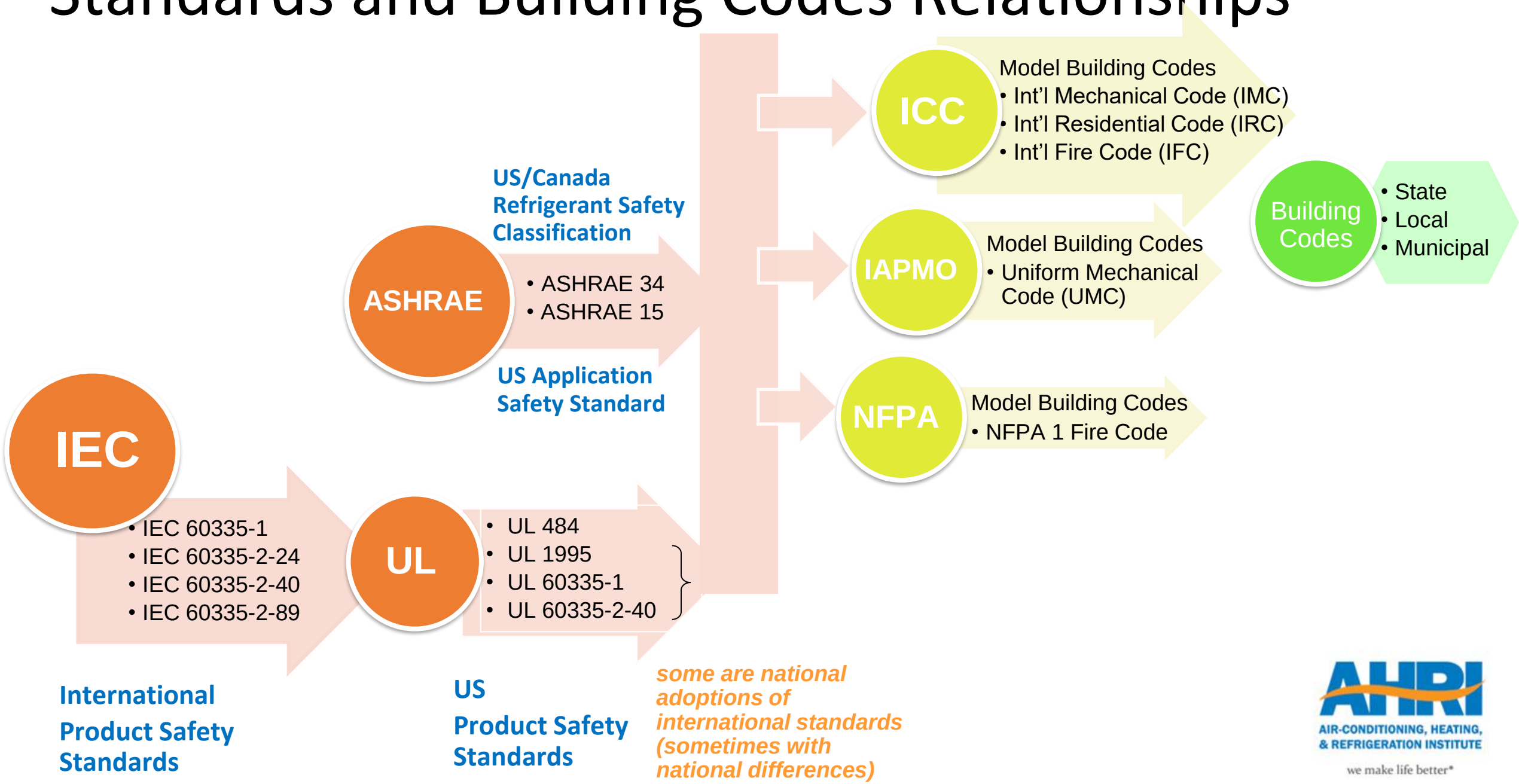
Standards and Building Codes Relationships



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Safe Refrigerant Transition Task Force (SRTTF) Federal Agency Activities

Department of Transportation

- Cylinder storage
- < 25 lb. Letter of interpretation
- 25 lbs. to 50 lbs. Special permit
- >50 lbs. Special permit

Occupational Safety and Health Administration

- Global Harmonized System (GHS) Purple Book 7

Coordinating across the border: Canada HRAI Transportation and Storage

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Refrigerant Recovery

- Best in class: 40%
- U.S. Climate Alliance States willing to test options
- If you're interested, contact Helen Walter-Terrinoni or Vivian Cox at hwalter-Terrinoni@ahrinet.org or vcox@ahrinet.org

We've come a long way…

2019

- States developing disparate regulations
- Safety standards unavailable for next generation refrigerants
- New refrigerants not allowed by EPA
- Building codes not enabling new solutions
- Training needed
- Questions around transportation

2022

- ✓Federal regulation through the American Innovation and Manufacturing (AIM) Act
- ✓Safety standards updated
- ✓EPA listed refrigerants for air conditioning
- ✓International Code Council (ICC) National Model Codes enabled the use of next generation refrigerants and storage.
  - ✓ 1/3 of AC systems are sold into states that have addressed building codes through regulation or legislation
- ✓Training available for technicians and first responders
- ✓Department of Transportation (DOT) Letter of Interpretation up to 25 pounds of charge

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We have more work to do…

- AIM Act petitions for sector-based controls.
- Increasing refrigerant recovery and reclaim use.
- EPA listing for refrigeration
- Building Codes
  - International Code Council (ICC) Uniform Mechanical Code (UMC) adoption of latest standards (e.g. UL-60335-2-89, ASHRAE 15)
  - Adoption of code changes by remaining states
  - International Association of Plumbing and Mechanical Officials (IAPMO) Uniform Mechanical Code
- DOT and shipping of chillers, horizontal cylinders, and mid-sized systems
- Enabling refrigerants in Canada and Mexico!

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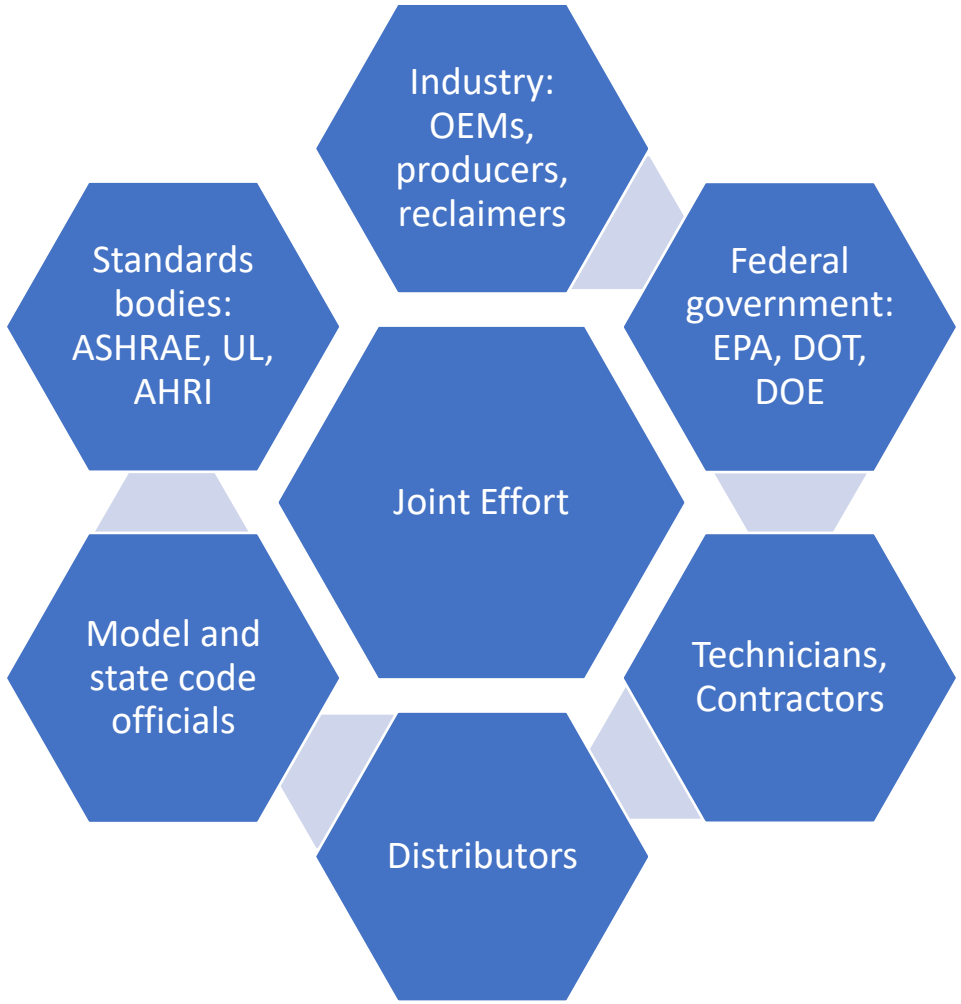
How will we do it?



- AHRI Safe Refrigerant Transition Task Force continues to work with all stakeholders to address barriers to a safe and orderly transition

- Contact Mary Koban if you are interested in participating: mkoban@ahrinet.org

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Thank-you!

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>$ 7 Million in Research on Flammable Refrigerants

- Testing
  - AHRTI-9007: Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing
  - AHRTI-9013: A2L Consequence Study
  - AHRTI-9012/Oak Ridge National Laboratory (ORNL): Real-world Leak Assessments of Alternative Flammable Refrigerants
  - AHRTI-9008: Investigation of Hot surface Ignition Temperature (HSIT) for A2L Refrigerants
  - AHRI-8017: Investigation of Energy Produced by Potential Ignition Sources in Residential Application
- Modeling
  - ASHRAE-1806: Flammable Refrigerants Post-Ignition Simulation and Risk Assessment Update
  - ORNL: Investigate the Proper Basis for Setting Charge Limits of A2L, A2, and A3 for Various Types of Products
  - NIST: Modeling tools for low-GWP Refrigerant Blends Flammability
- Servicing
  - ASHRAE-1807:Guidelines for Flammable Refrigerant Handling, Transporting, Storing and Equipment Servicing, Installation and Dismantling
  - ASHRAE-1808: Servicing and Installing Equipment using Flammable Refrigerants: Assessment of Field-made Mechanical Joints
- Detection
  - AHRTI-9009: Leak Detection of A2L Refrigerants in HVACR Equipment

*This is not a comprehensive list (excludes NFPA, Japan, Europe, Manufacturers, etc.)

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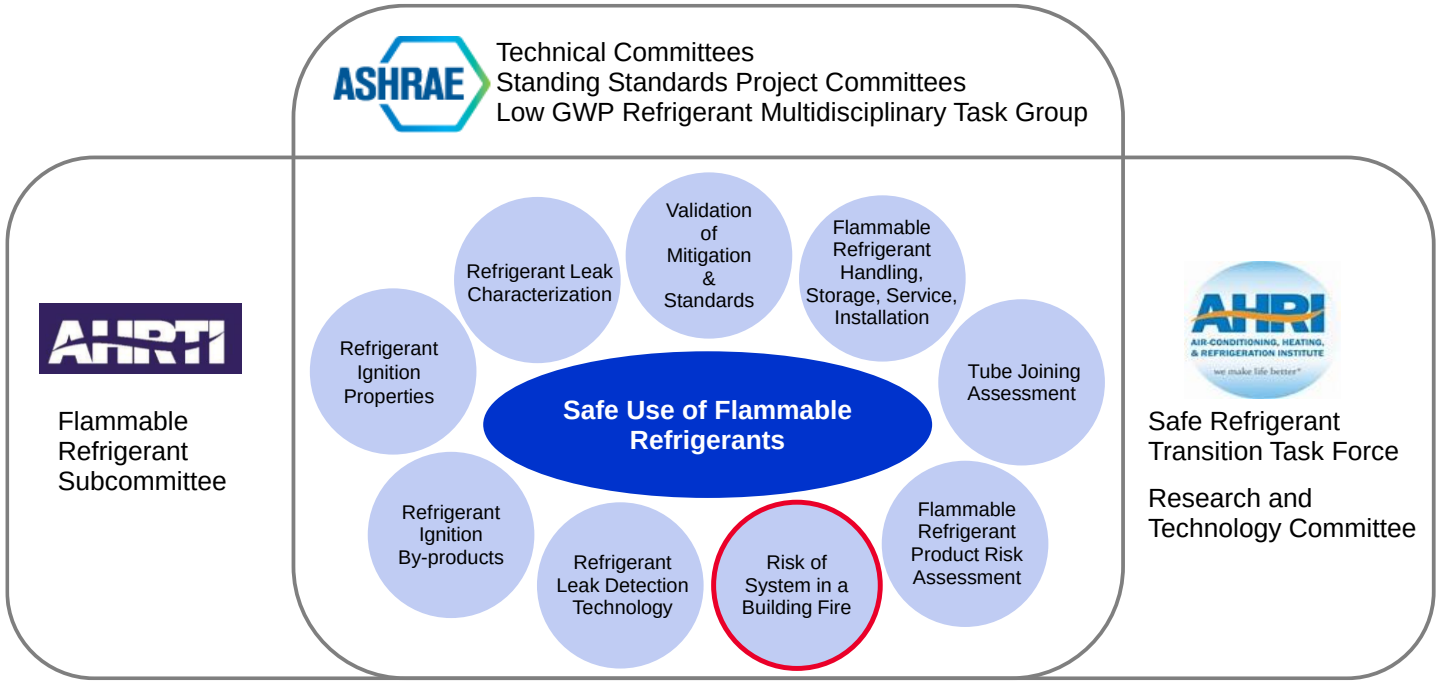
Refrigerants and Firefighter Tactical Considerations



https://training.ulfirefightersafety.org

Designed by firefighters for firefighters

First project of its kind related to fire impinging on refrigerants and equipment to provide practical information for first responders for the purpose of developing training

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- AHRI Safe Refrigerant Transition Task Force webinar series
- HVACR technician training: ACCA, ESCO, and North American Technician Excellence (NATE).
- Safe Refrigerant Transition Task Force Newsletter

- Webinar 1: Air Conditioning Applications
- Webinar 2: Commercial Refrigeration Applications
- Webinar 3: Understanding Refrigerant Sensors
- Webinar 4: Predictive Tools for Refrigerant Behaviors
- Webinar 5: Refrigerant Ignition in Open Flame/Hot Surfaces: Has Anything Fundamentally Changed?
- Webinar 6: A2L Refrigerant Behavior in a Structure Fire
- Webinar 7: Refrigerant Detection Systems 101
- Webinar 8: Servicing A2L Refrigerant Systems
- Webinar 9: A2L Refrigerants and Tactical Considerations for Firefighters
- Webinar 10: Codes and Standards "Unlocked"
- Webinar 11: Joint Types and A2L Refrigerants
- Webinar 12: HVACR Equipment Needed for the Safe Refrigerant Transition

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TRANSITION TASK FORCE

International Panel on Climate Change (IPCC) 7th Assessment Report (AR)

- The International Panel on Climate Change (IPCC) periodically updates the values for global warming potential (GWP)
  - Each Assessment Report results in new GWP values based on new information from atmospheric scientists or, in the case of the IPCC 7th AR, a modification to the calculation using "effective" radiative forcing extending the timeline used.
  - The new values are higher for many HFCs.
- The entire world regulates based on the 2007 IPCC AR4 which has a GWP for R-32 of 677 and R-410 A of 2088.
  - The AIM Act specifically requires the use of AR4
  - The new assessments are too frequent for regulators to re-regulate based on these changes
  - If regulators were to update GWPs in regulations, they would also need to update all baseline numbers on the same basis.
  - The relative GWPs rarely shift between reports and the same good HFC alternatives would be needed for compliance
  - Even if a relative change were made, design cycles and equipment lifetimes are too long to re-work designs to pivot to the latest numbers