DOCKETED	
Docket Number:	21-IEPR-06
Project Title:	Building Decarbonization and Energy Efficiency
TN #:	239473
Document Title:	Presentation - IEPR Commissioner Workshop on Building Decarbonization Embodied Carbon and Refrigerants Reducing Hydrofluorocarb
Description:	S2.4A_Helen Walter-Terrinoni_AHRI
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Submitter Role:	Public
Submission Date:	8/25/2021 3:29:29 PM
Docketed Date:	8/25/2021

IEPR Commissioner Workshop on Building Decarbonization: Embodied Carbon and Refrigerants Reducing Hydrofluorocarbon (HFC) Emissions

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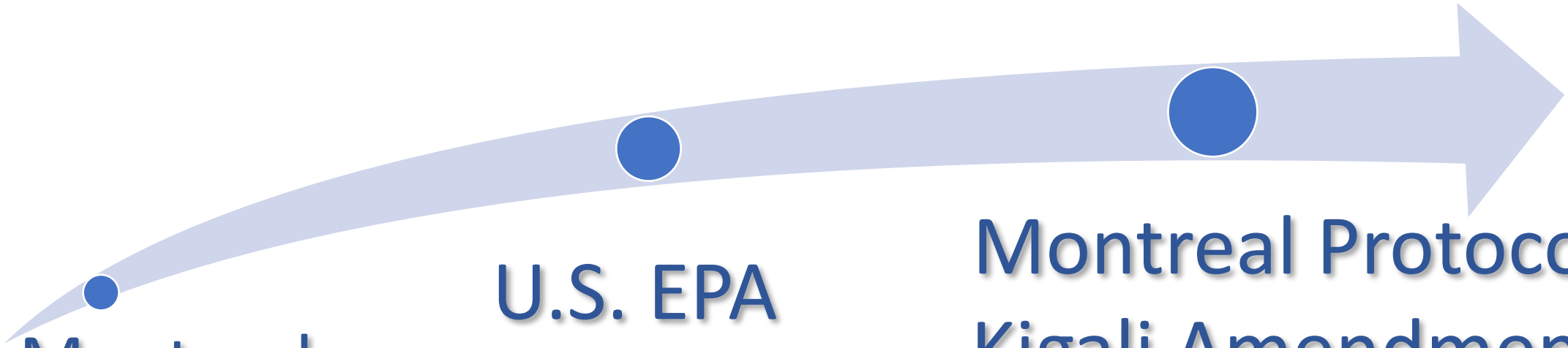
Monumental Success

Strong stakeholder input → Strong stakeholder support



Montreal Protocol
finalized in 1987

U.S. EPA
2015-2016:
HFC Rules

Montreal Protocol Kigali Amendment
2016 global commitment to phase down supply of HFCs

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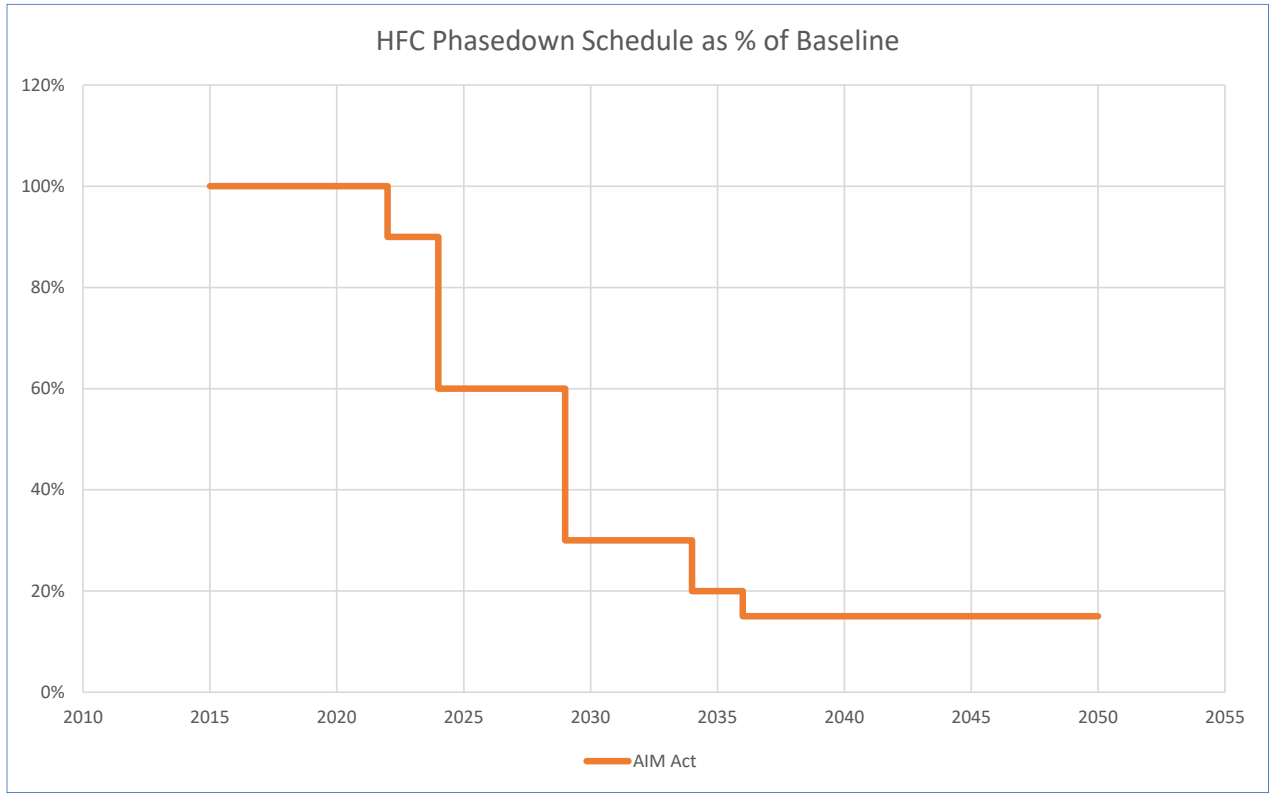

The AIM Act & The Kigali Amendment

Phase down supply and production of HFCs

- 2011-2013 baseline:
  - 2022: 10% reduction
  - 2024: 40% reduction
  - 2029: 70% reduction
  - 2034: 80% reduction
  - 2036: 85% reduction

Success!

Process allows for significant Industry and other stakeholder input → strong stakeholder support

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

Reduced Supply Economics

- Scarcity
- Increased Prices

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A Chaotic Transition

Lessons Learned in Europe

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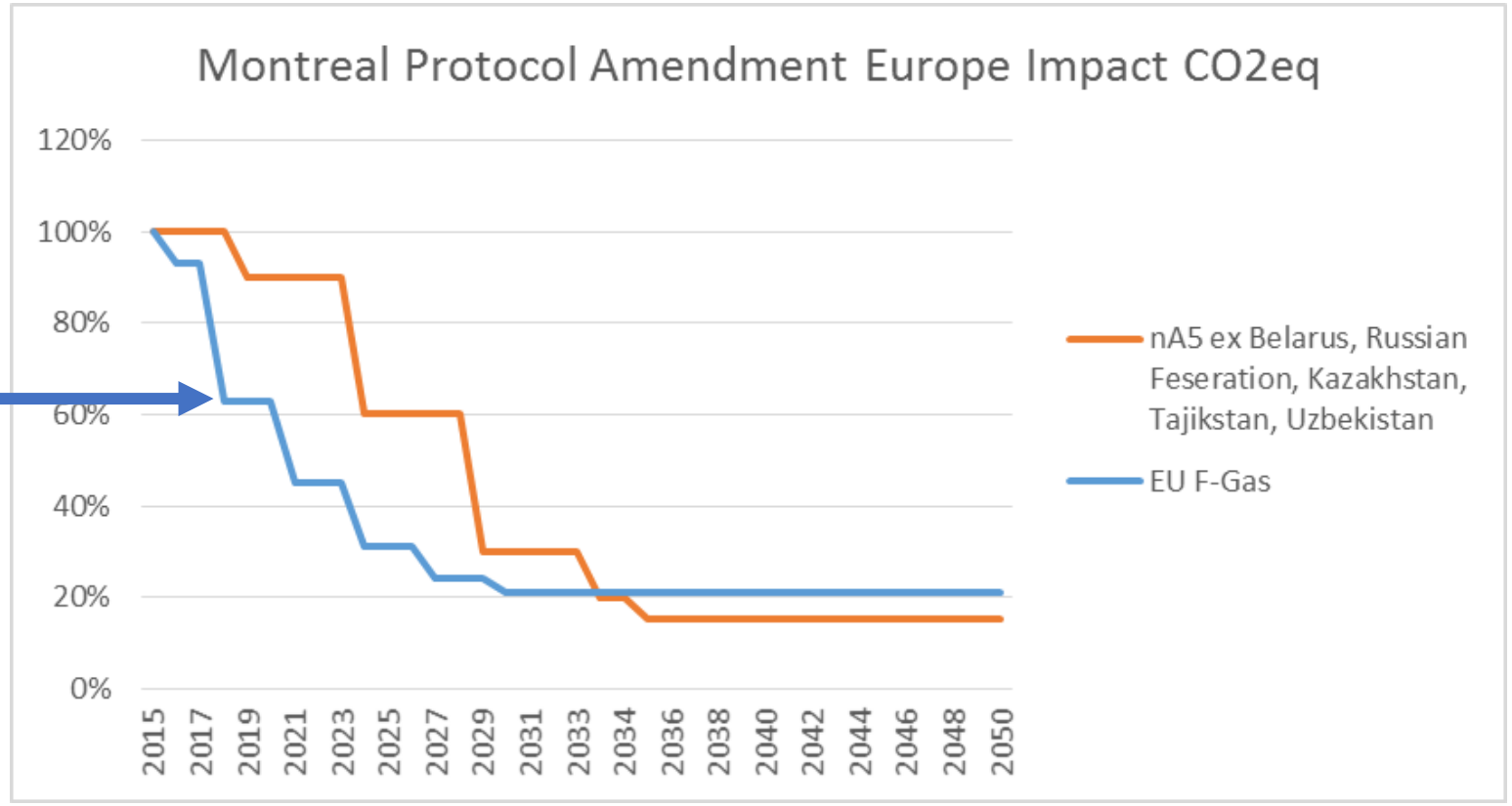
European Union Fluorinated Gas (F-Gas) Regulations

Supply reductions outpaced demand reductions!!!

37.5% 2018



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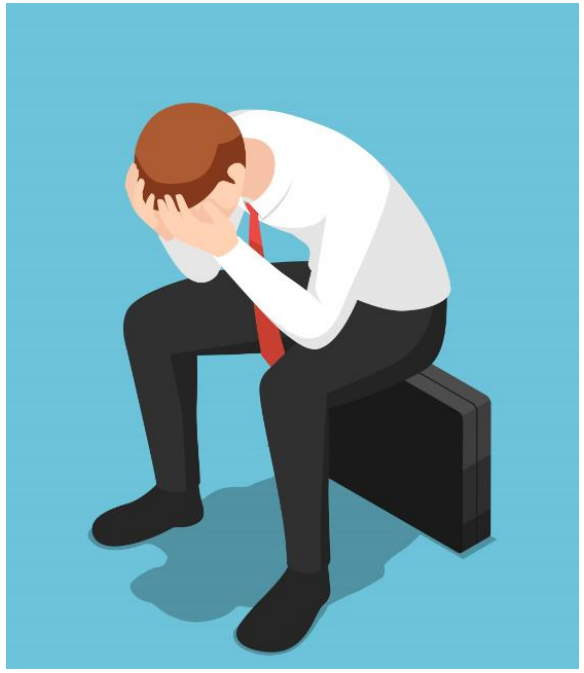
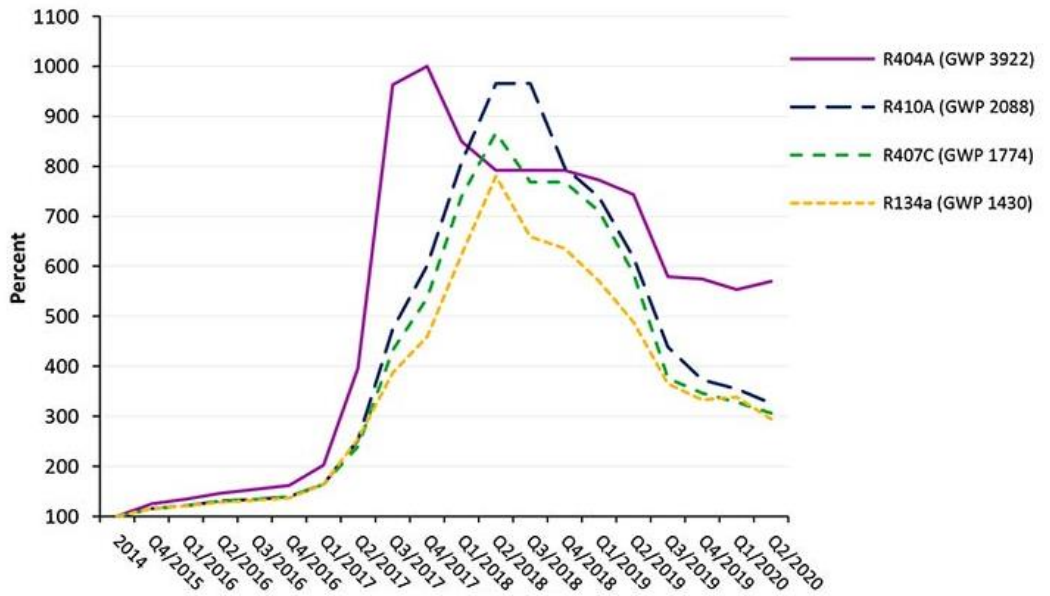
European Impact: Retailers, End-users and OEMs



- 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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How do we proceed with an orderly transition in the United States?

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There are options.

Doing nothing isn’t one of them.

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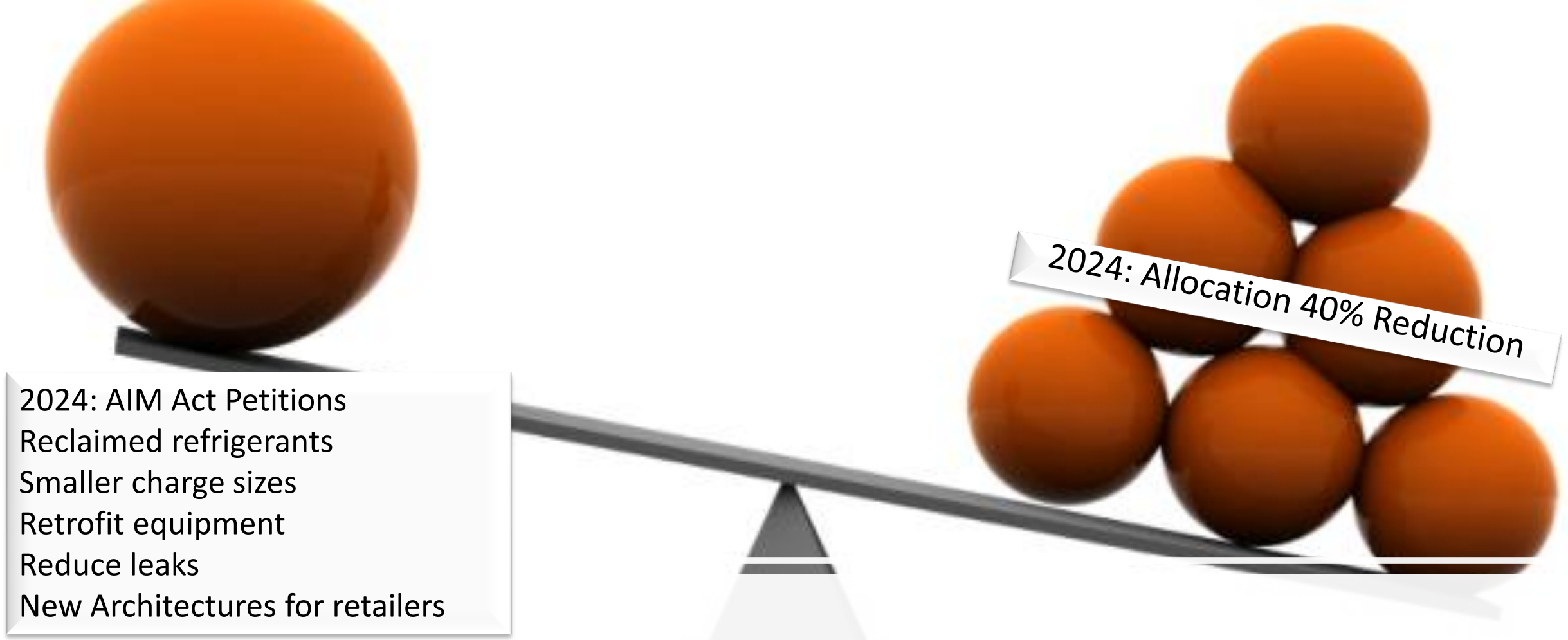

2024: AIM Act Petitions
Reclaimed refrigerants
Smaller charge sizes
Retrofit equipment
Reduce leaks
New Architectures for retailers

Balancing supply and demand

Be Proactive!

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Demand reductions coordinated with supply reductions

Regulations limiting hydrofluorocarbon (HFC) use for equipment (e.g. heat pumps)

- HFC or refrigerant blend bans
  - EPA and California Air Resources Board (CARB) HFC Regulations
- Global Warming Potential (GWP) limits
  - 2nd CARB HFC Regulations
  - AHRI AIM Act Petition to limit GWP to 750 in 2025

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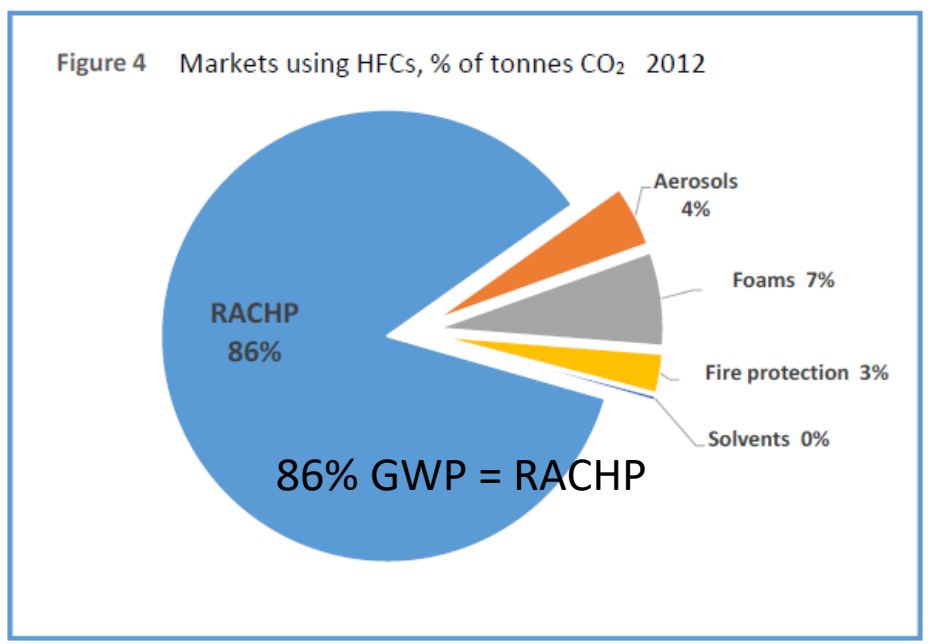
Better refrigerant management: Increased recovery and r of reclaimed refrigerants

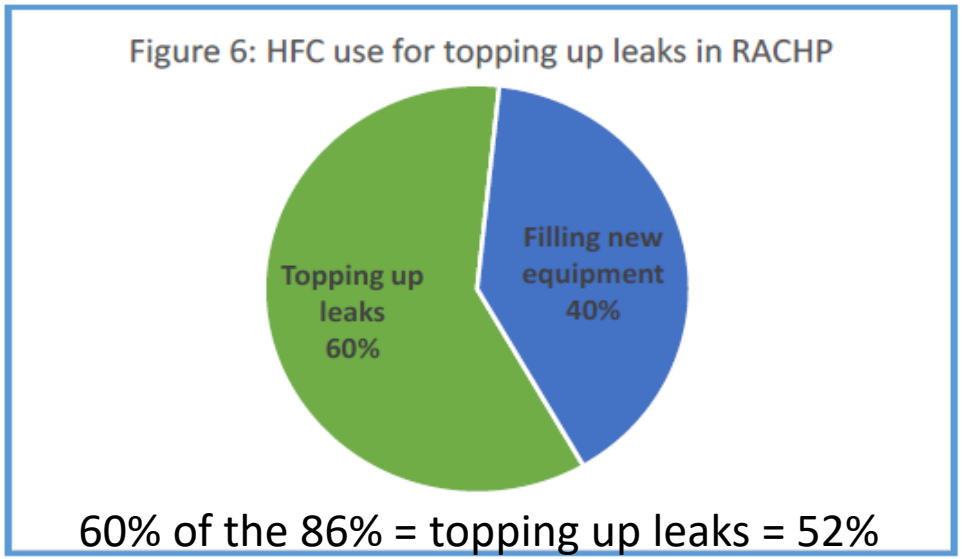
Courtesy of A-Gas

Better Refrigerant Management: Less leaks

Global: ~52% of global "GWP" is used to charge leaking equipment

United Nations Environment Program Fact Sheet





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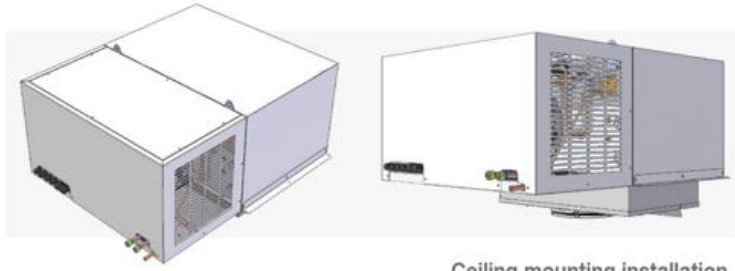

Ceiling mounting installation

Applications in Retail Food Equipment

- Medium Temperature display
  - Reach-In
  - Dairy & Deli
  - Bakery goods
  - Meat & Seafood
  - Beverage
- Low Temperature display
  - Reach-Ins
  - Islands/"Coffins" (often air-cooled)
- Walk-in cooler/freezers
  - Packaged units
- Larger equipment is often water-cooled—i.e., connected to a water loop in a micro-distributed system

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Existing System Designs In Commercial Refrigeration (US/Canada) – Retail and Food Service

A1 Non-Flammable
A2L Mildly Flammable
A3 Flammable

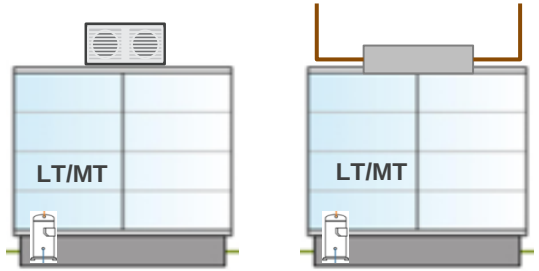
Packaged Units – Cold Rooms

A1 (~10s lbs)

A3 (150 g)

Integrated Case (A/W/R Cooled)

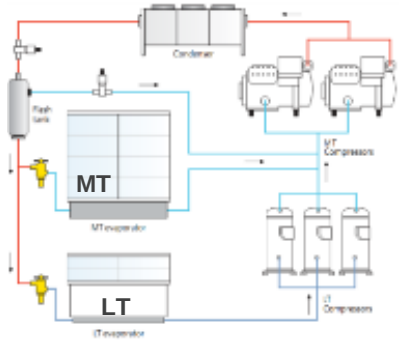
Micro / Macro Distributed



A1 (~10s lbs)

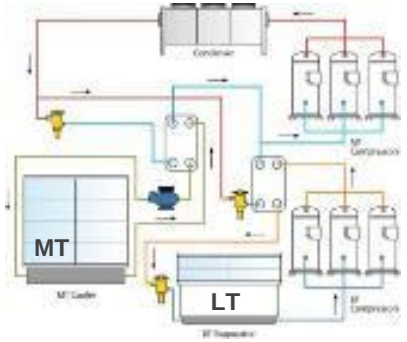
A3 (150 g)

CO2 Transcritical



CO_2

Hybrid/Cascade

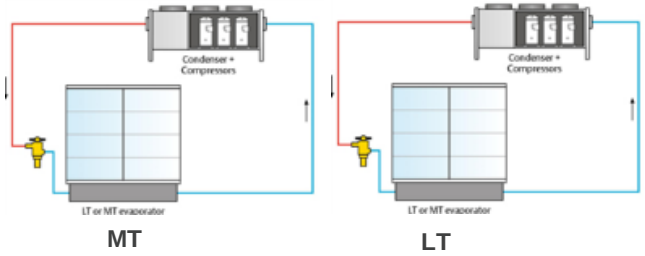


CO_2 A1 (~1000s lbs)

Remote Condensing Units

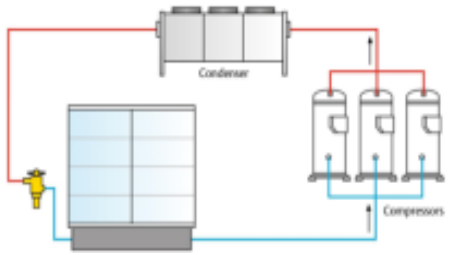
A1 (up to 100s lbs)

Distributed Units



A1 (~100s to ~1000 lbs)

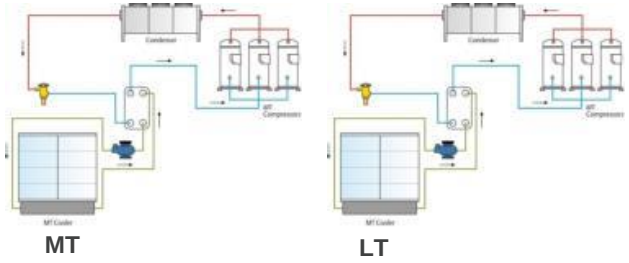
Central Racks



LT and MT racks

A1 (~1000s lbs)

Indirect (Glycol, CO2 or other sec fluid)



A1

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Future System Designs In Commercial Refrigeration
With Updated Mechanical, Electrical & Refrigerant Flammability Safety Standards/Codes

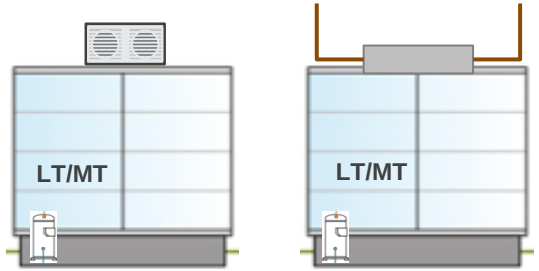
A1 Non-Flammable
A2L Mildly Flammable
A3 Flammable

Packaged Units – Cold Rooms

A1 (~10s lbs)
A2L (~4 kg)
A3 (300 g)

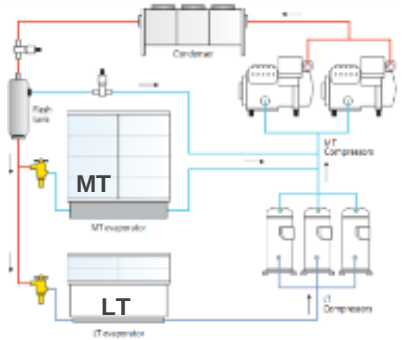
Integrated Case (A/W/R Cooled)

Micro / Macro Distributed



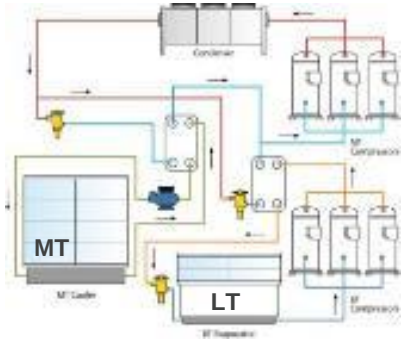
A1 (~10s lbs)
A2L (~4 kg)
A3 (300 g)

CO2 Transcritical



CO_2

Hybrid/Cascade

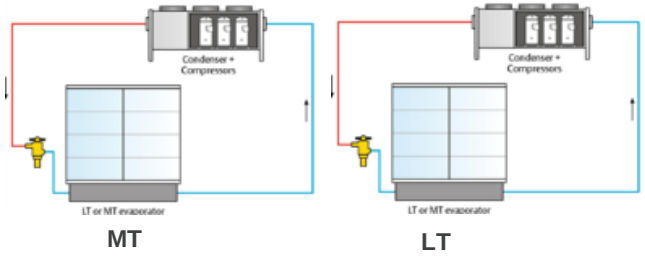


CO_2 ~~A1 (~1000s lbs)~~ ?
A2L (~170 lb)

Remote Condensing Units

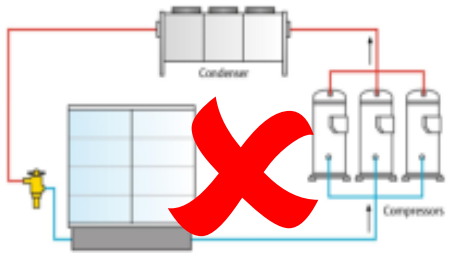
A1 (up to 50 lbs)
A2L (~170 lb)

Distributed Units



A1 (50 lb)
A2L (~170 lb)

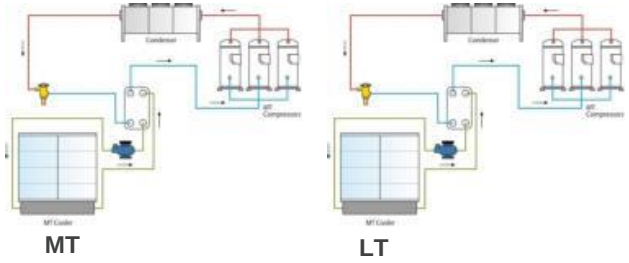
Central Racks



LT and MT racks

A1 (~1000s lbs)

Indirect (Glycol, CO_2 or other sec fluid)



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AIM Act: The EPA "To Do List"

- **"Supply-side"** allocation rule (Oct 1, 2021)
- **"Demand-side"** sector transitions
  - AHRI – AC 2025 AC and HP; refrigeration
  - NRDC/IGSD – Reinstate SNAP Rules 20 & 21 under AIM
  - EIA – All California requirements
  - AHAM – AC, dehumidifiers
  - California and other states
- **Refrigerant management leak reduction, recovery and reclaim**

Process allows for significant stakeholder input → Strong stakeholder support

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American Innovation and Manufacturing Act of 2020: "To Do List"

Low-GWP Refrigerants
What is the hold up already?!?

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Building Codes

Adoption of Safety Standards

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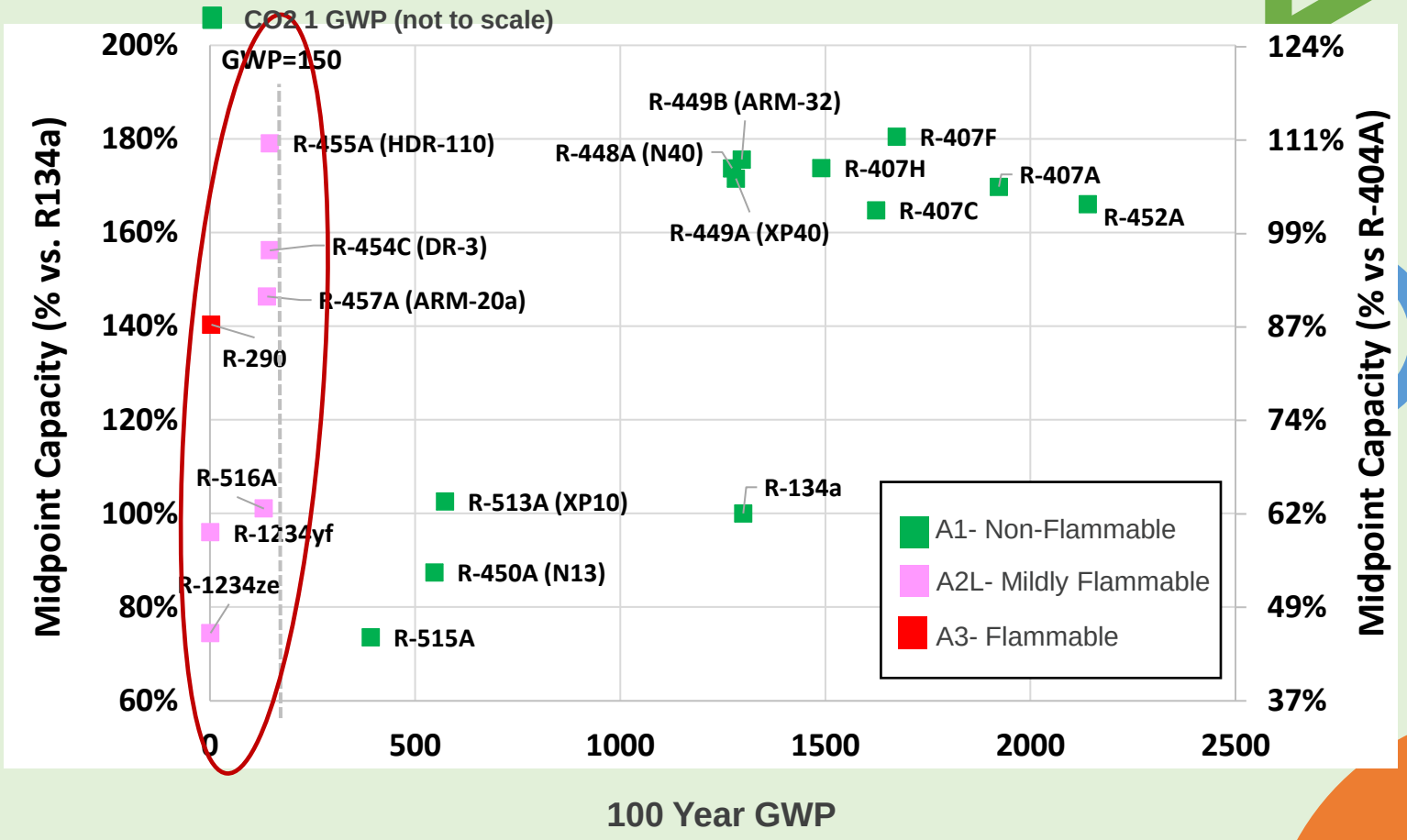
With Lower GWP comes Flammability



R-404A
3,943 GWP
(not to scale)

Chart courtesy of Emerson Climate Technologies

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SAFE REFRIGERANT TRANSITION TASK FORCE

Examine all aspects of supply chain to ensure a safe transition to low GWP refrigerants

Safe Recovery of Refrigerants

These safety precautions apply to all refrigerants (A1 and A2L)

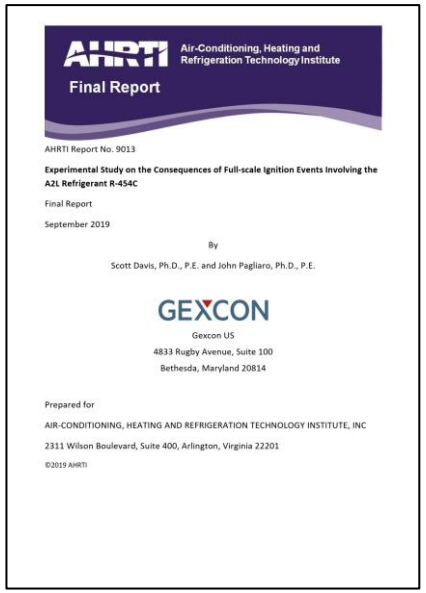
- Maintaining vacuum on empty cylinders will help ensure refrigerant purity when filled with refrigerant.
- Properly label recovery cylinders by refrigerant type contained within cylinder
- Never tamper with relief valves
- Ensure that scales are accurate.
  - •All refrigerant have different liquid densities
  - •fill weights will vary by product
- Return full recovery cylinders to the proper source for reclamation

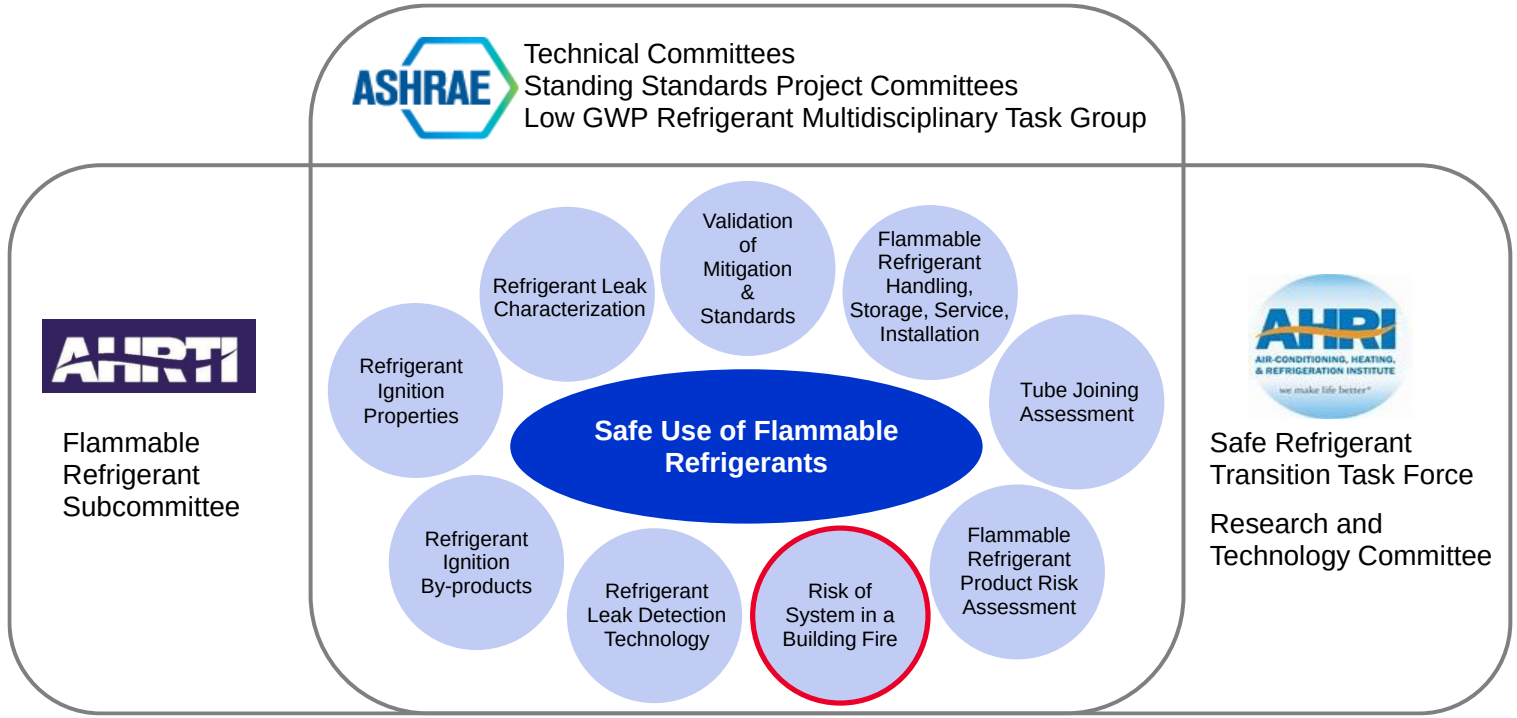
AHRI SAFE REFRIGERANT TRANSITION TASK FORCE

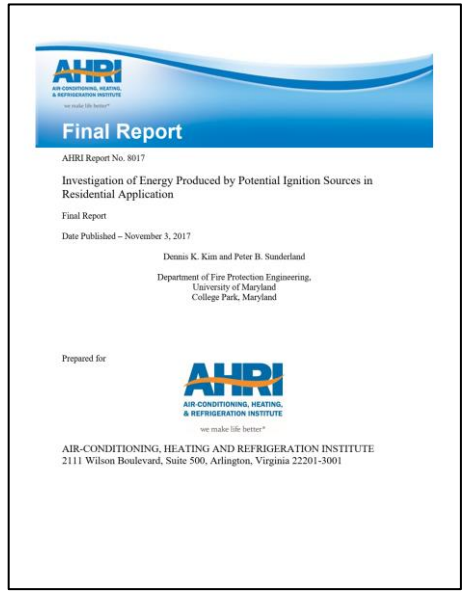
- Webinar 1 — Air Conditioning Applications
- Webinar 2 — Commercial Refrigeration Applications
- Webinar 3 — Understanding Refrigerant Sensors
- Webinar 4 — Predictive Tools for Refrigerant Behaviors
- Webinar 5 — Refrigerant Ignition in Open Flame/Hot Surfaces: Has Anything Fundamentally Changed?
- 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

> $7 Million in Next Generation Refrigerant Research







A2L refrigerants:

- Difficult to ignite,
- Slow flame speed
- Low heat of combustion

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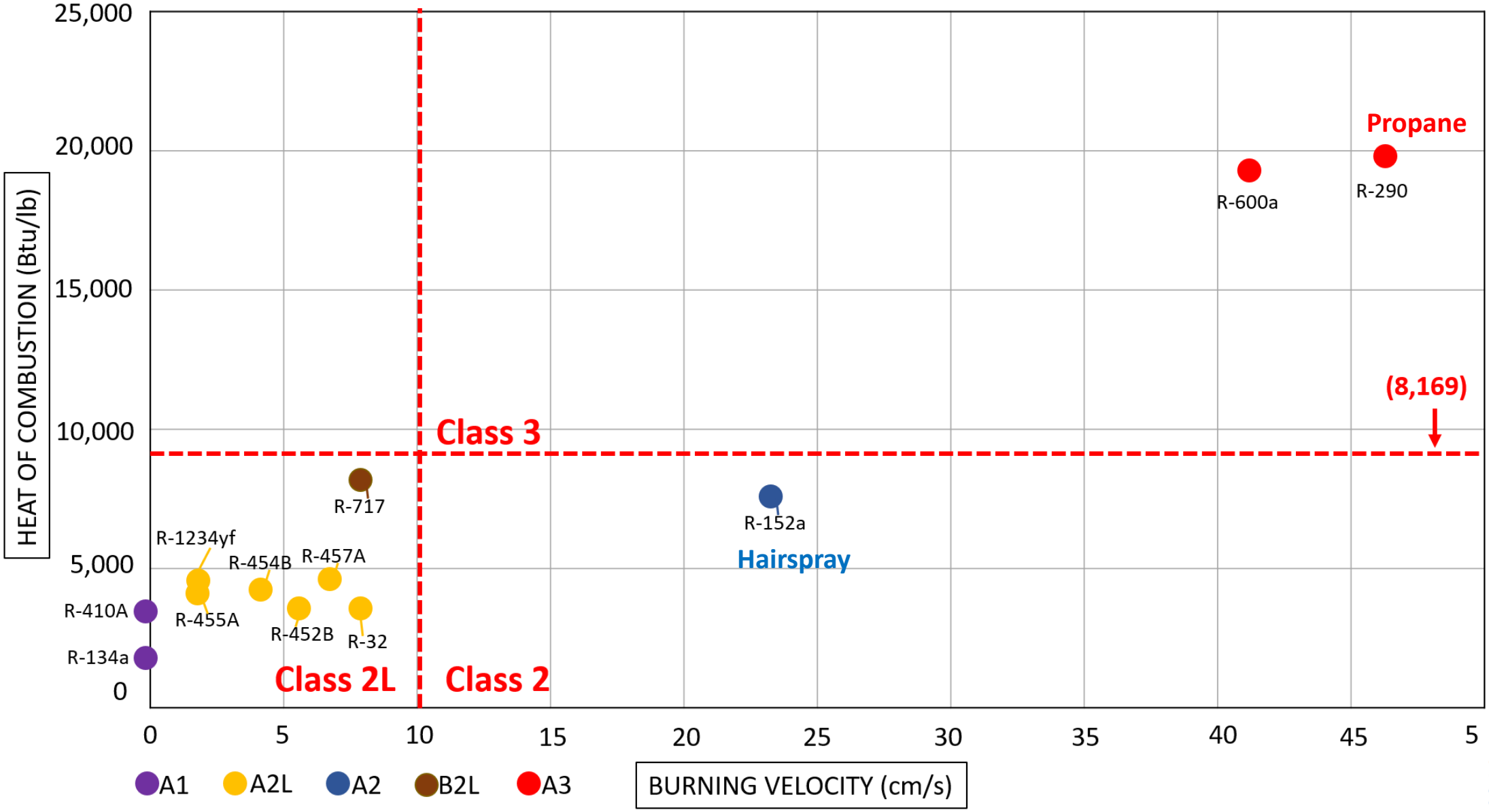
Refrigerant Flammability Properties



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AHRI / AHRTI Research

Refrigerant release + Competent ignition source = Ignition

Eliminate one (or both) to prevent ignition

Safety standards are developed to prevent the combination.

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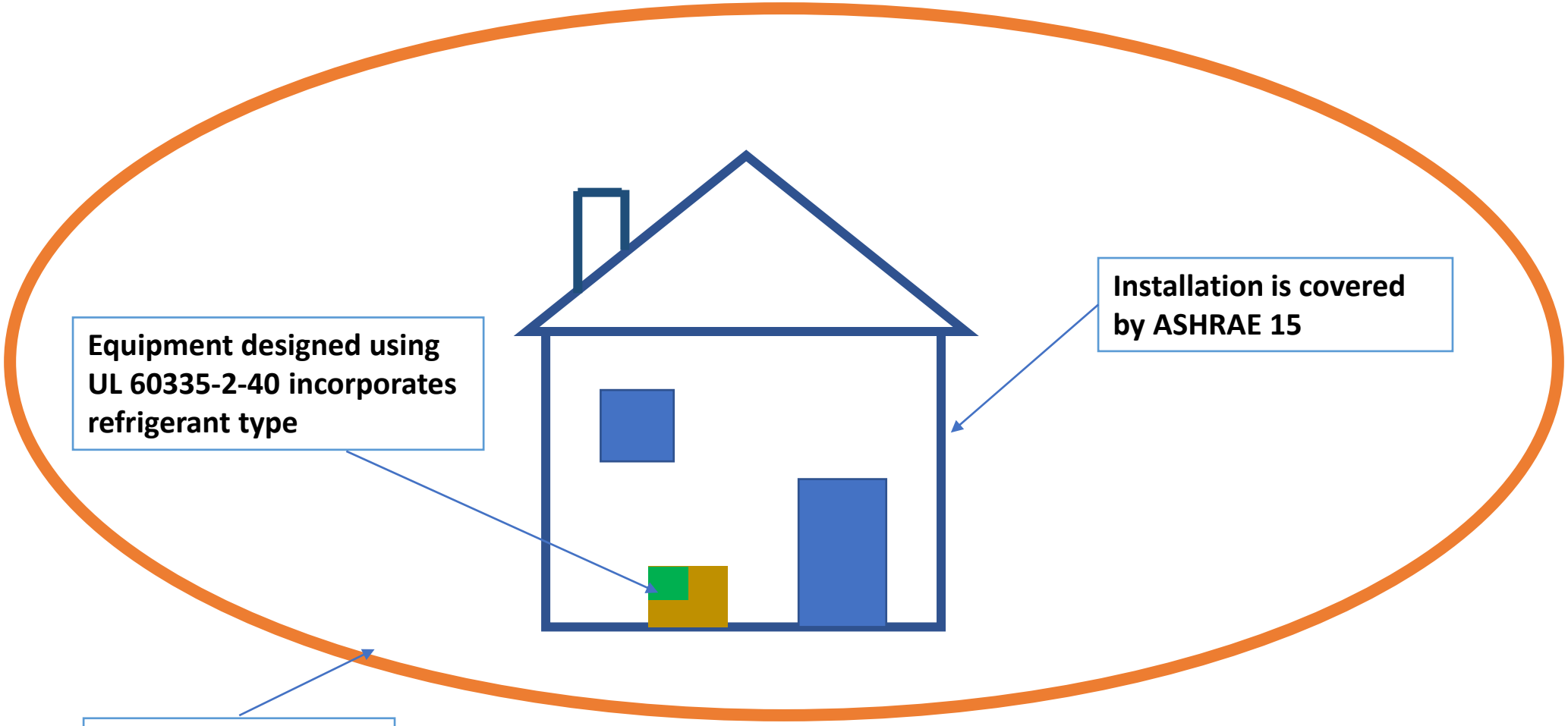
Quick summary of how standards work together



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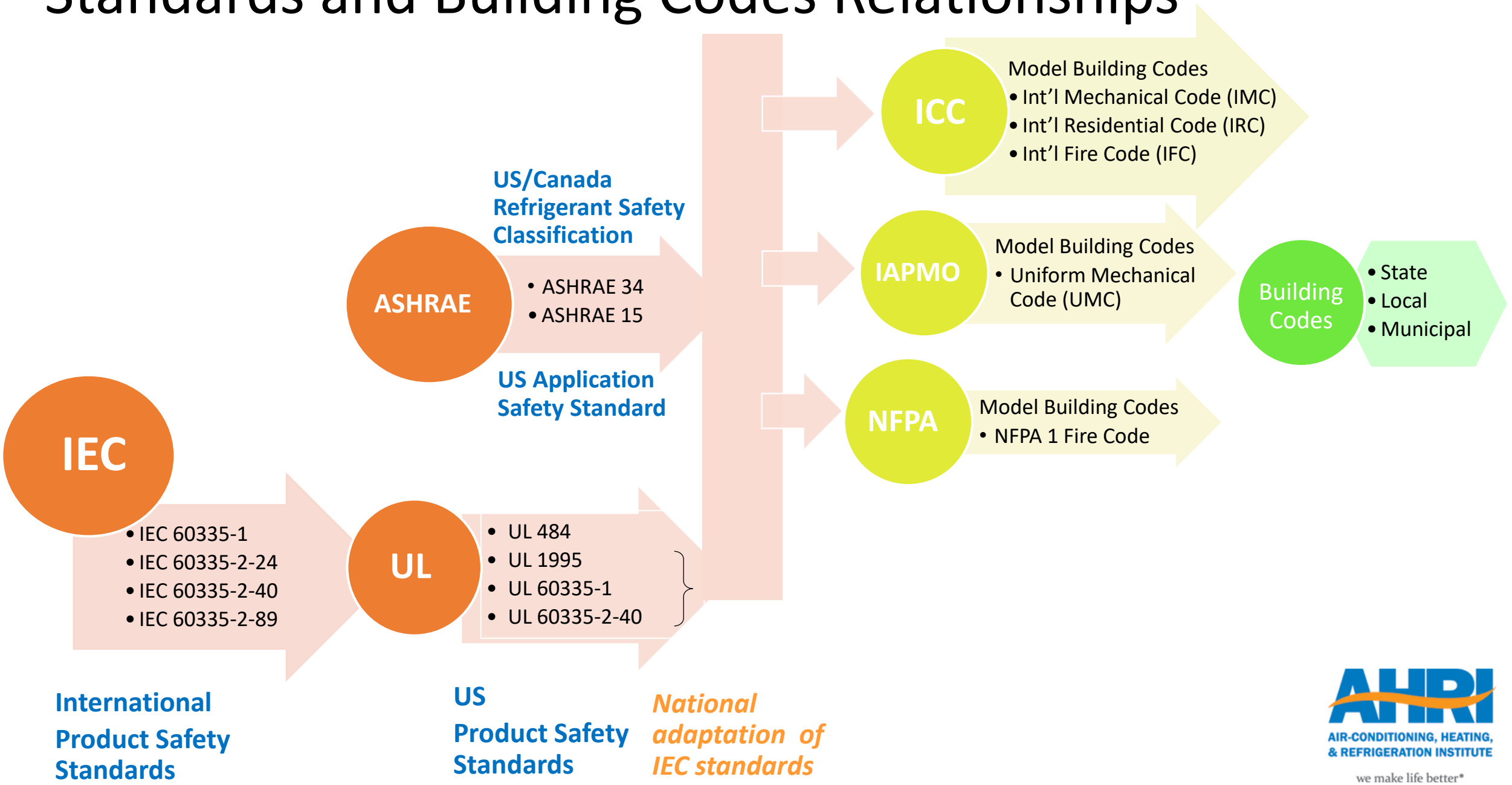
Standards and Building Codes Relationships



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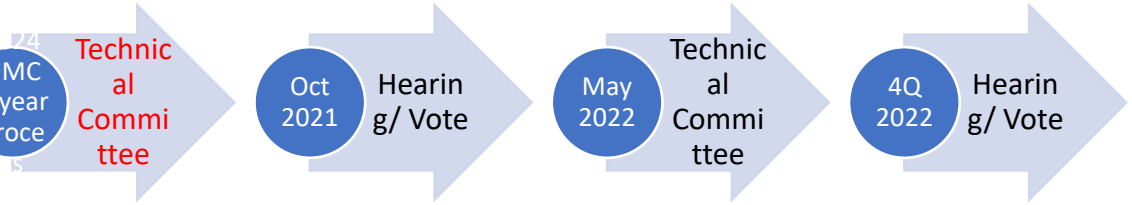
California codes do not enable AC Low GWP Refrigerants

FAIL

UMC



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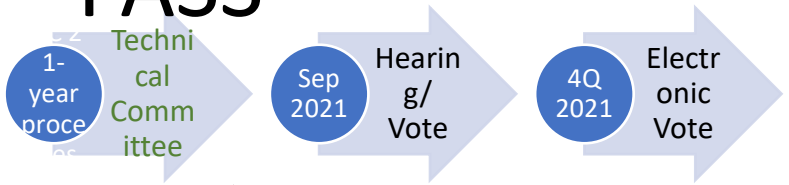
IMC PASS



✓

Industry needs at least 2 years to transition (normally has 6 years)

California State Fire Marshal can propose building code changes

CARB Deadline January 1, 2025

By statute, California adopts the Uniform Mechanical Code (UMC) which does not yet have a clear pathway for low GWP refrigerants.

International Mechanical Code (IMC) may have a clear path by year end

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Invest in future success now!

Toolbox

- Use low-GWP alternatives in new equipment
- Change architectures in stores
- Consider smaller charge sizes
- Retrofit existing equipment to lower GWP
- Reduce leaks
- Use recovered/reclaimed refrigerant

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Please contact us with any HFC questions!

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