Navigating the Refrigerant Transition: What You Need to Know

Steve Kujak, Director of Next Generation Refrigerant Research,
Trane Technologies

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What You Need to Know

Steve Kujak – Director of Next Generation Refrigerant Research

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About the Speaker

- Steve Kujak is the Director of Next Generation Refrigerants Research for Trane Technologies
- 34 years in the industry conducting technology development of new refrigerants, lubricants and HVACR system design
- 60+ publications related to refrigerants and has 40+ patents related to HVAC products
- Member of ASHRAE Board of Directors
- Heavily involved in ASHRAE and international codes, standards around refrigerant development
- Located in La Crosse, Wisconsin

Presentation Overview

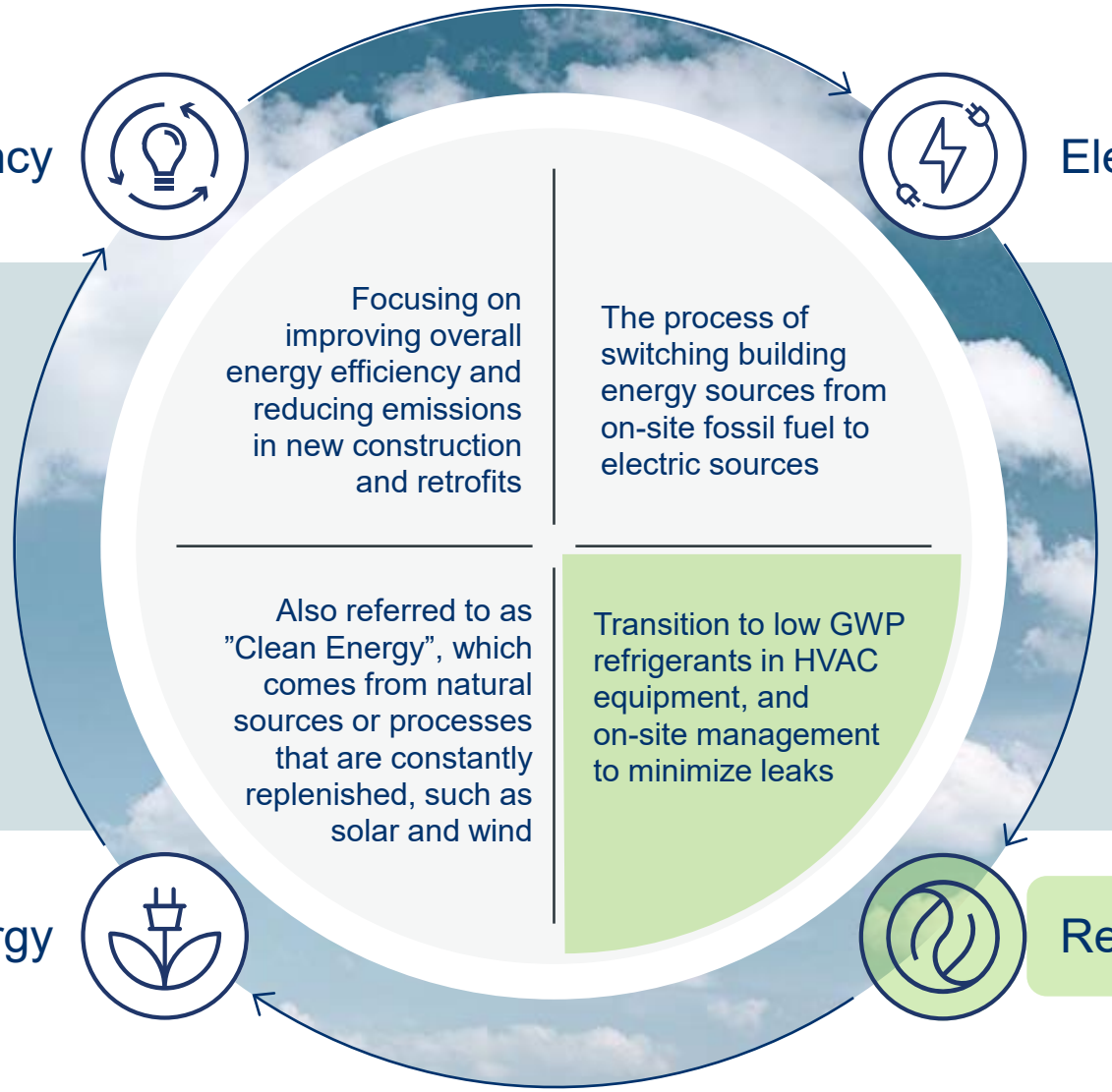
Navigating the Refrigerant Transition: What You Need to Know

Nearly all HVAC&R equipment on the market today have transitioned to lower global warming potential (GWP) refrigerants, some of which are flammable under certain conditions. Refrigerants like R-410A, R-404A and R-134a are now replaced with refrigerants that have GWPs less than 700 as required by the USEPA HFC phasedown program.

The HVAC&R industry was challenged to invest significant resources to understand the best refrigerants for each application that meet the above GWP requirements. More importantly, the industry invested heavily to understand how to apply flammable refrigerants and modify safety standard and updated building codes within regions, country, state, and sometimes locally by city.

This presentation will provide an update on new lower GWP products introduced into the marketplace and it will highlight some important considerations and product changes, particularly that engineers, designers, and building owners should keep in mind.

Pillars of Decarbonization



Reducing Indirect Emissions

Indirect GHG emissions (AKA Scope 2) are generally associated with emissions one step removed a customer’s direct operations

Reducing Direct Emissions

Direct GHG emissions (AKA Scope 1) are those that occur from sources directly controlled by the customer

What You Need to Know? - Outline

R-454B A2L Installation
Brownsville MN

- USA Regulatory Landscape
- New Low GWP Refrigerants per Application
- Understanding Flammable Refrigerants
  - ✓Product
  - ✓Application
  - ✓Service

Regulatory Landscape

Why Refrigerants are Transitioning and “Decarbonization is the New Trend”

ODP
Ozone Depletion Potential - *Past Concern*

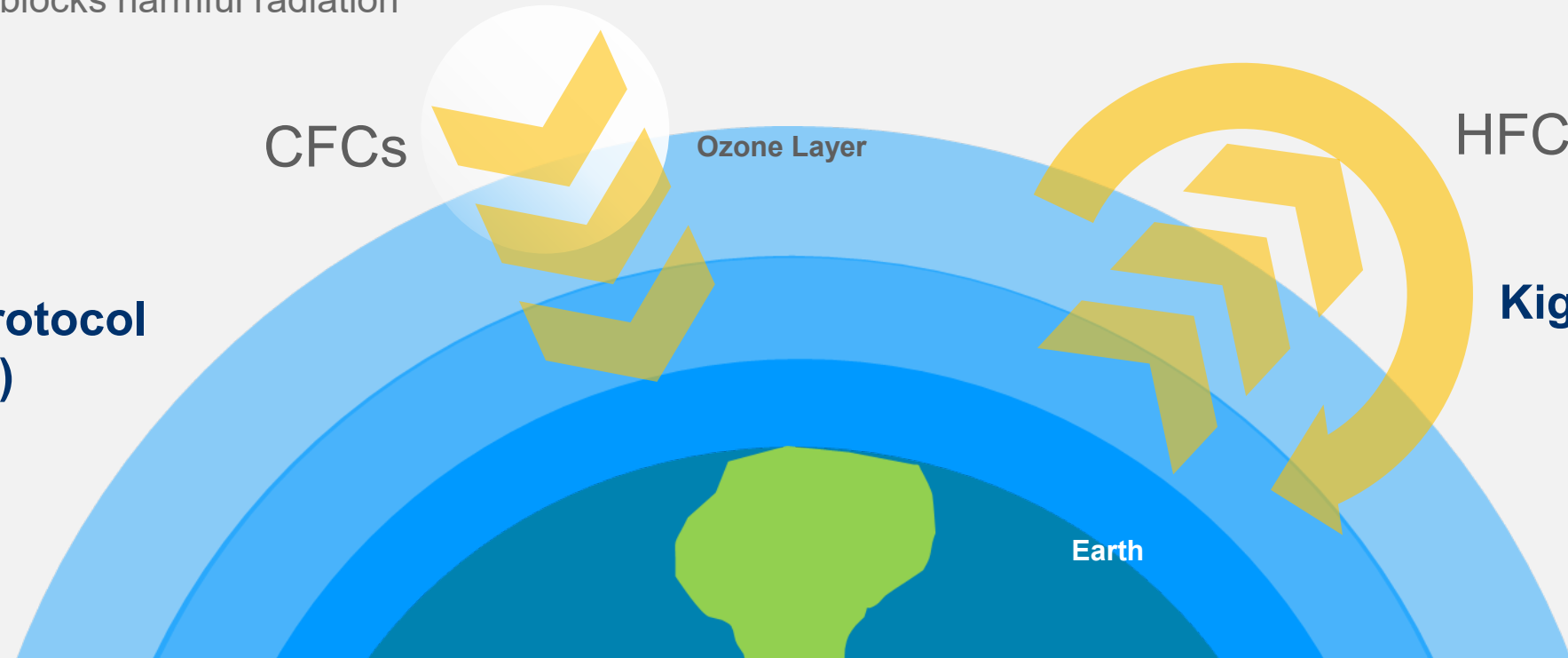
Potential of a substance to **reduce the amount of ozone** in the atmosphere which blocks harmful radiation

GWP
Global Warming Potential - *Current Concern*

Potential for a gas to **trap heat** in the atmosphere - contributing to climate change

CFCs

HFCs



Montreal Protocol (1987)

Kigali Amendment (2016)

United Nations Environment Program (UNEP)

Montreal Protocol – CFC (1987)

Kyoto Protocol – GHG (1997)

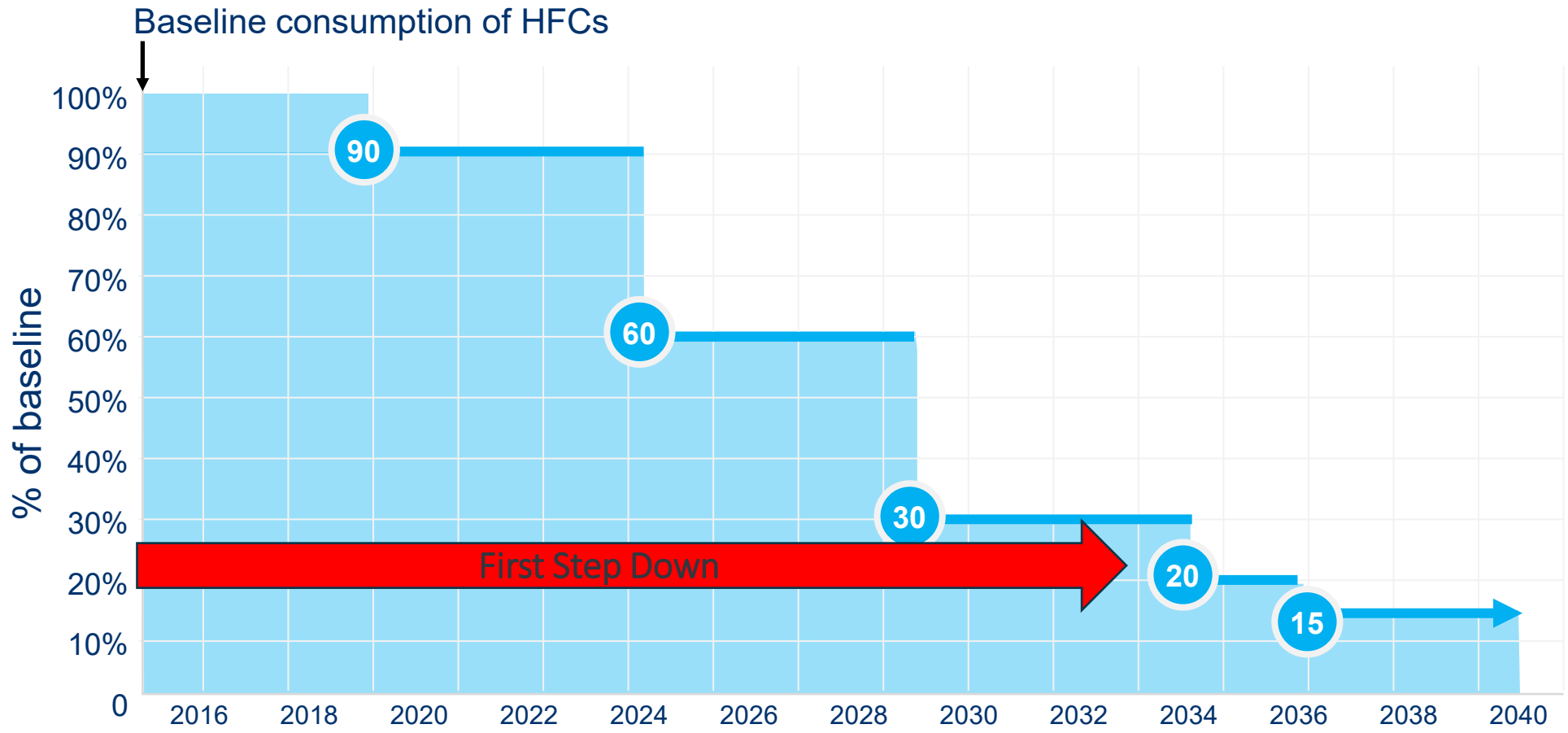
Kigali Amendment – HFC (2016)

Paris Agreement (2016)

USA Compliance – AIM Act (2020)

AIM Act Follows the Montreal Protocol Kigali Schedule

The American Innovation and Manufacturing (AIM) Act



The AIM Act implements the Kigali Amendment to the Montreal Protocol by mandating the USEPA to phase down HFC supply, based on GWP

U.S. EPA HFC Technology Transfer Rule

The AC/HP rule operates by:

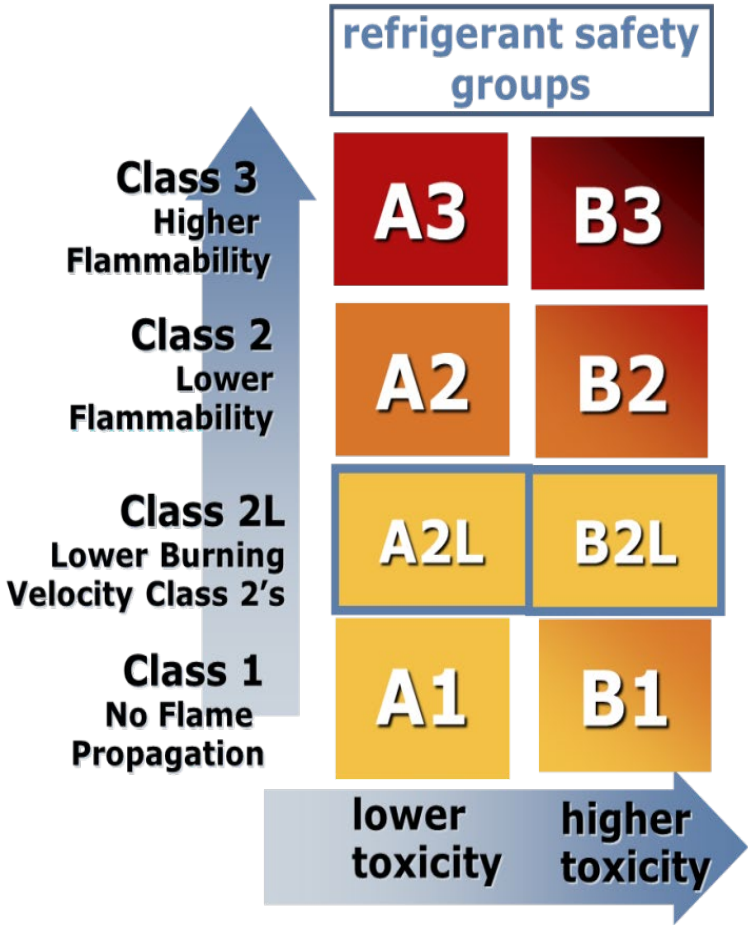
- Prohibiting the manufacture and import of products that use higher-GWP HFCs (700 GWP is the max)
- Prohibiting the sale, distribution, and export of those products three years after the manufacture and import restriction
- Prohibiting the installation of new refrigeration, air conditioning, and heat pump (RACHP) systems that use higher-GWP HFCs

Note: Compliance dates vary per product, system and sector

US EPA Technology Transitions Program Rule Fact Sheet

Low GWP Refrigerants

Standard 34 Overview - Safety Classification of Refrigerants



- Toxicity
  - A or B
  - **Class A**, most refrigerants, like R134a
  - **Class B**, R123 and ammonia are examples
- Flammability
  - **Class 1**, non-flame propagating most refrigerants
  - **Class 2L,** lower flammable most new HFOs, R32
  - **Class 2**, more flammable, R152a
  - **Class 3**, explosive, like propane (R290), R600a

Flammability is a continuum without specific limits
"Flammables are Flammable"

Next-Generation Refrigerants for Low Pressure Applications

Large Water-Cooled Centrifugal Chillers

	Baseline	New Ultra-Low GWP	
Refrigerant	R-123	R-514A	R-1233zd (E)
Classification	B1	B1	A1
GWP	77	1.7	1

Good long-term solutions for existing mechanical rooms

Nonflammable with Ultra Low GWP

Next-Generation Refrigerants for Medium Pressure Application

Air- and Water-cooled Chillers, Modular Chillers

	Baseline	New Low GWP		New Ultra-Low GWP	
Refrigerant	R-134a	R-513A	R-515B	R-1234yf	R-1234ze (E)
Classification	A1	A1	A1	A2L	A2L
GWP	1430	630	298	6	4

R-513A & R515B
Nonflammable with Low GWP
Good solutions for existing Mechanical rooms

Longer term –
Low flammability solutions to meet GWP goals

Next-Generation Refrigerants for High Pressure Applications

Chillers, Unitary, Residential and VRF

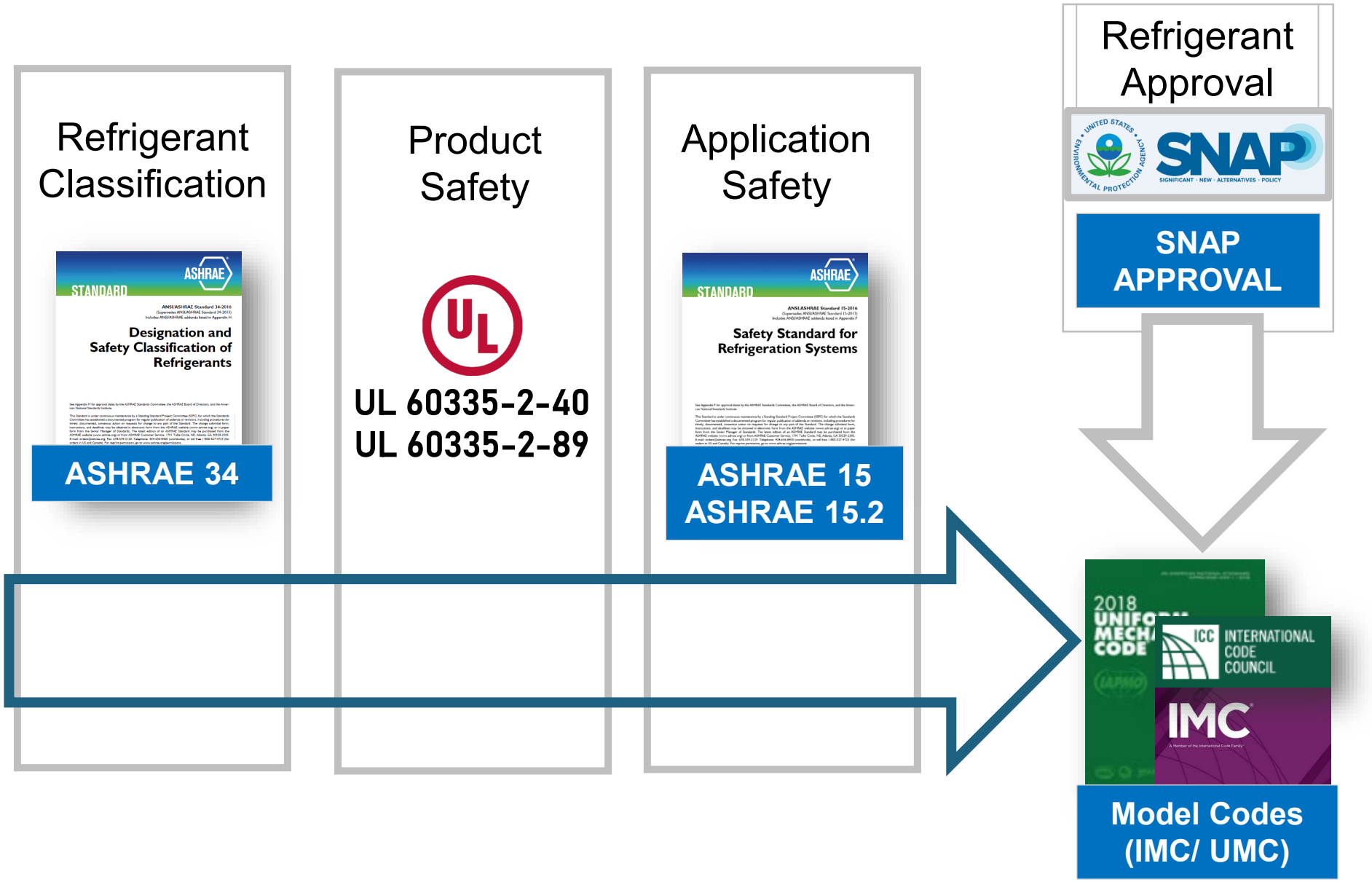
	Baseline	New Low GWP	
Refrigerant	R-410A	R-32	R-454B
Classification	A1	A2L	A2L
GWP	2088	675	467

R-454B & R-32 Low flammability solutions to meet GWP current goals

No class A1 options

Understanding Flammable Refrigerants

Safety Standards and Building Codes Process



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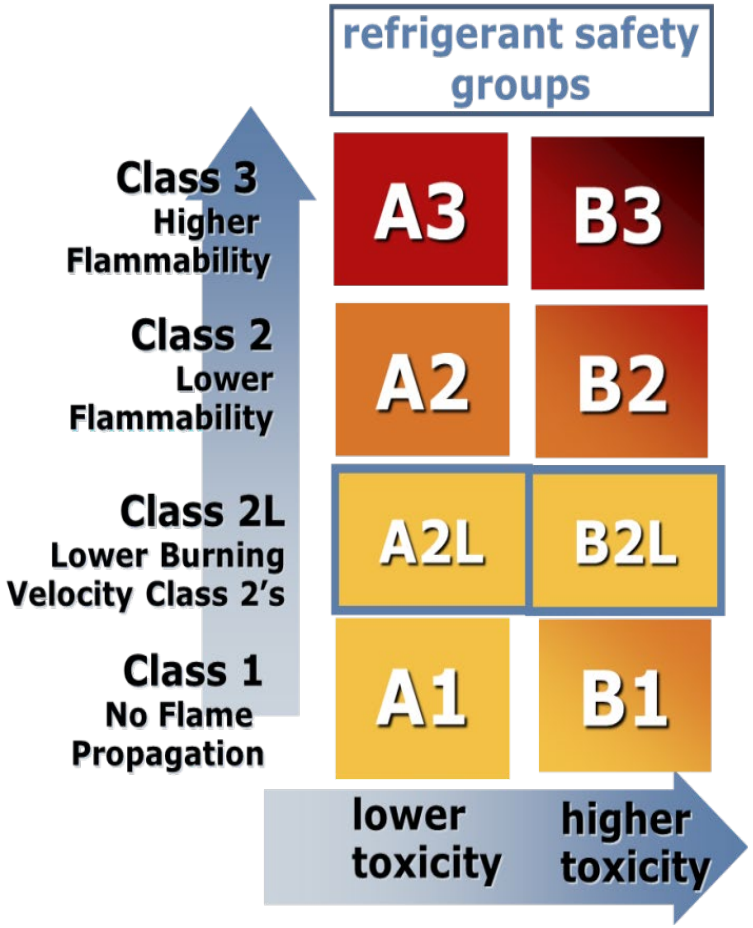

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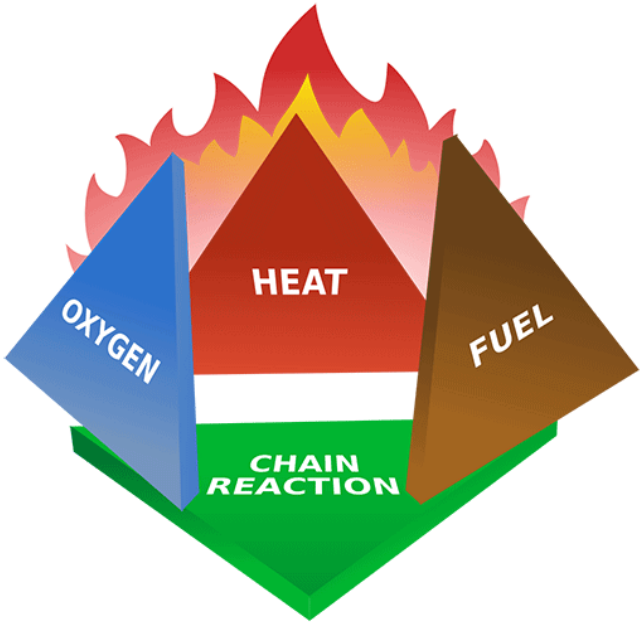
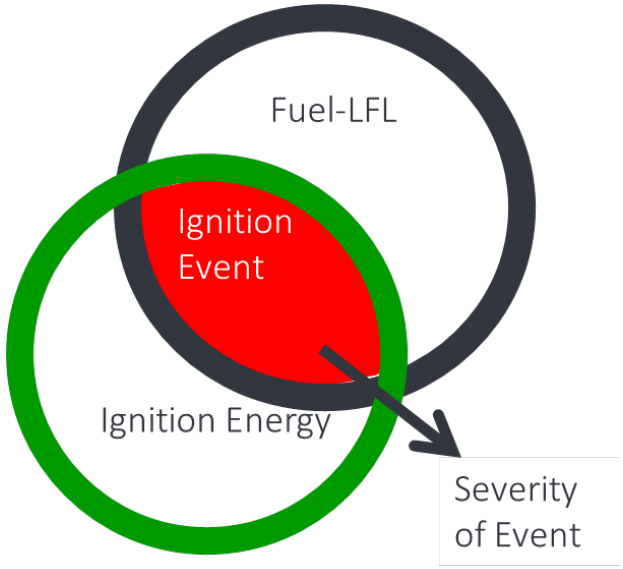
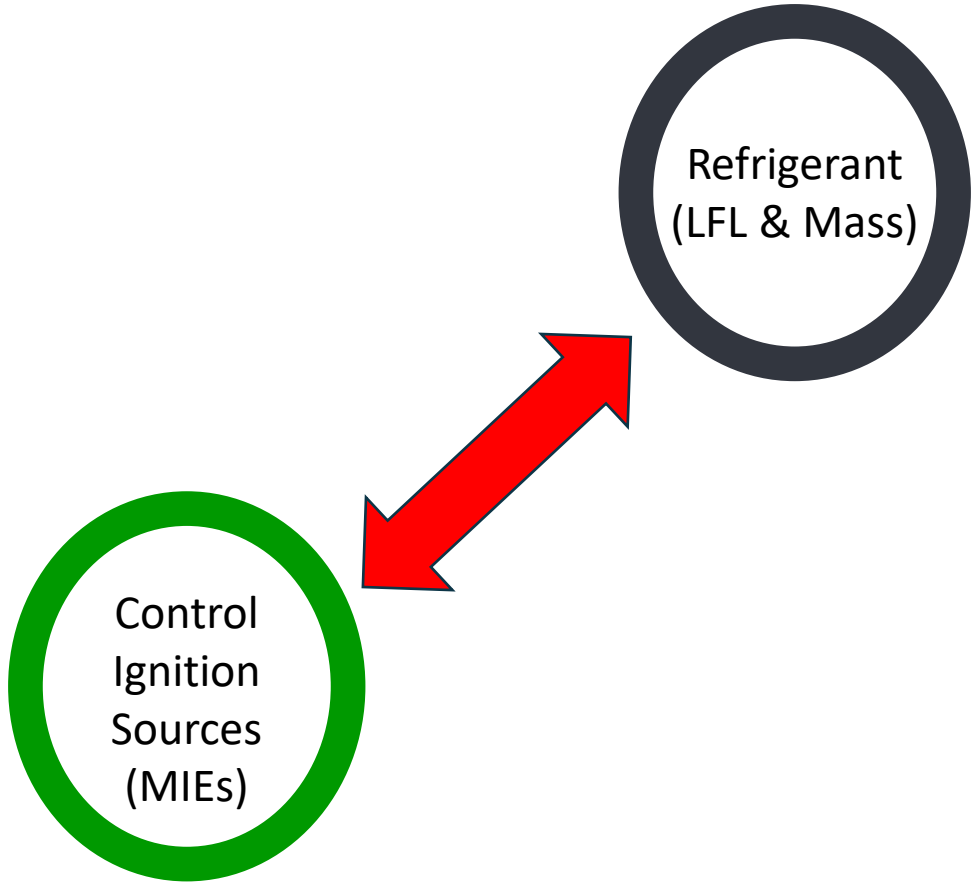
How Do The Standards Work - How to Prevent a Flammable Event?







Balancing & optimizing several factors to start & maintain the chain reaction
HVACR Equipment – Optimize refrigerant & potential interaction with ignition sources

Graphics courtesy of blog.ucogear.com, bluestarcooking.com, Fire-risk-assessment-network.com

Product & Application Safety – A2L Flammable Refrigerants

Small Appliances	Direct Systems	Mechanical Space or Closets	Machinery Rooms
Refrigerant Charge Only	Refrigerant Charge Detection Air Circulation	Refrigerant Charge Continuous Ventilation	Detection Ventilation Control of Ignition Sources

60335-2-40

Increasing Refrigerant Charge

Control of Ignition Sources

ASHRAE Standard 15

Product & Application Safety Standards Approach
Control refrigerant charge & ignition sources, plus add detection with circulation/ventilation

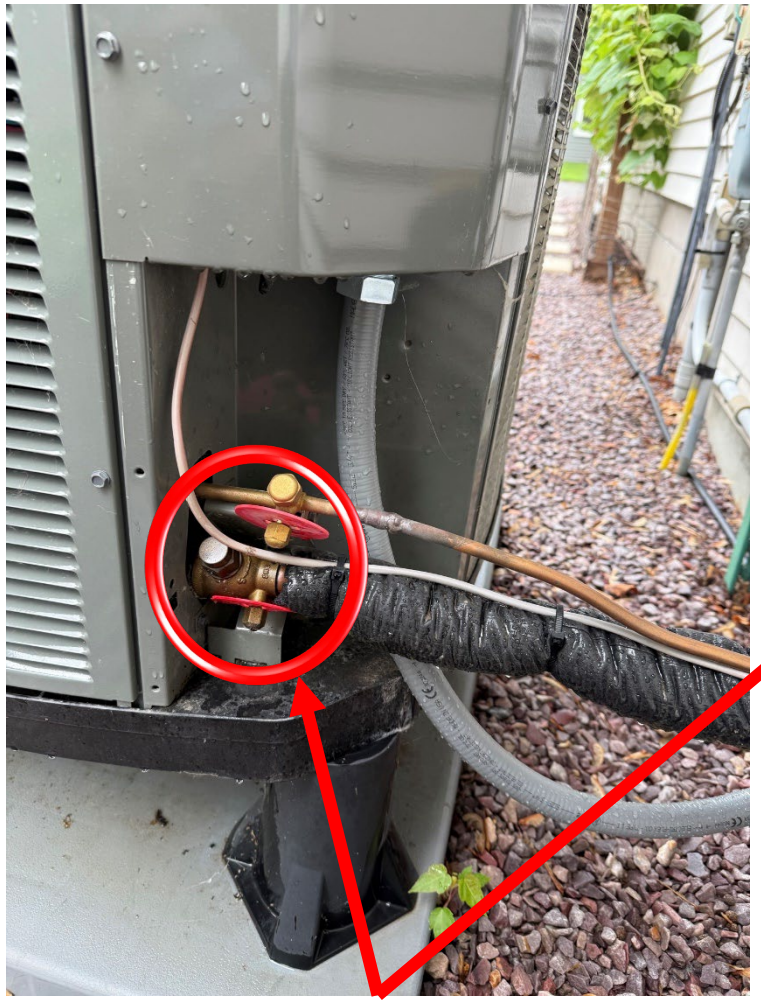
A2L R-454B Residential HP Installation

Three items are different

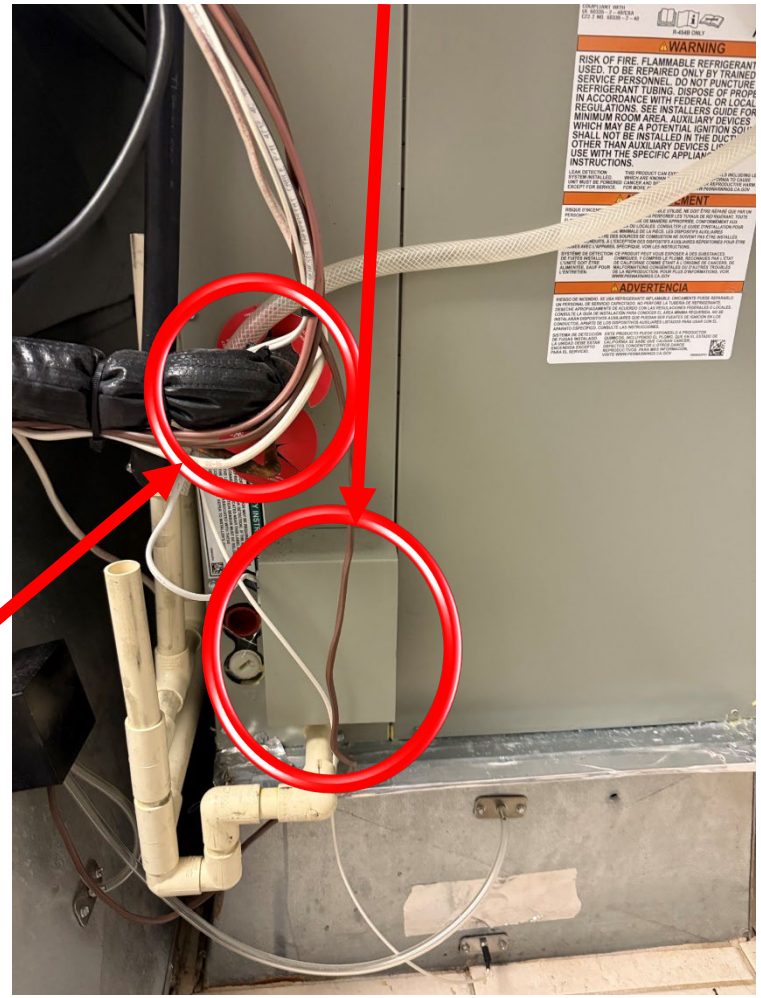
Can you see them?

Three Visible A2L Changes

Label

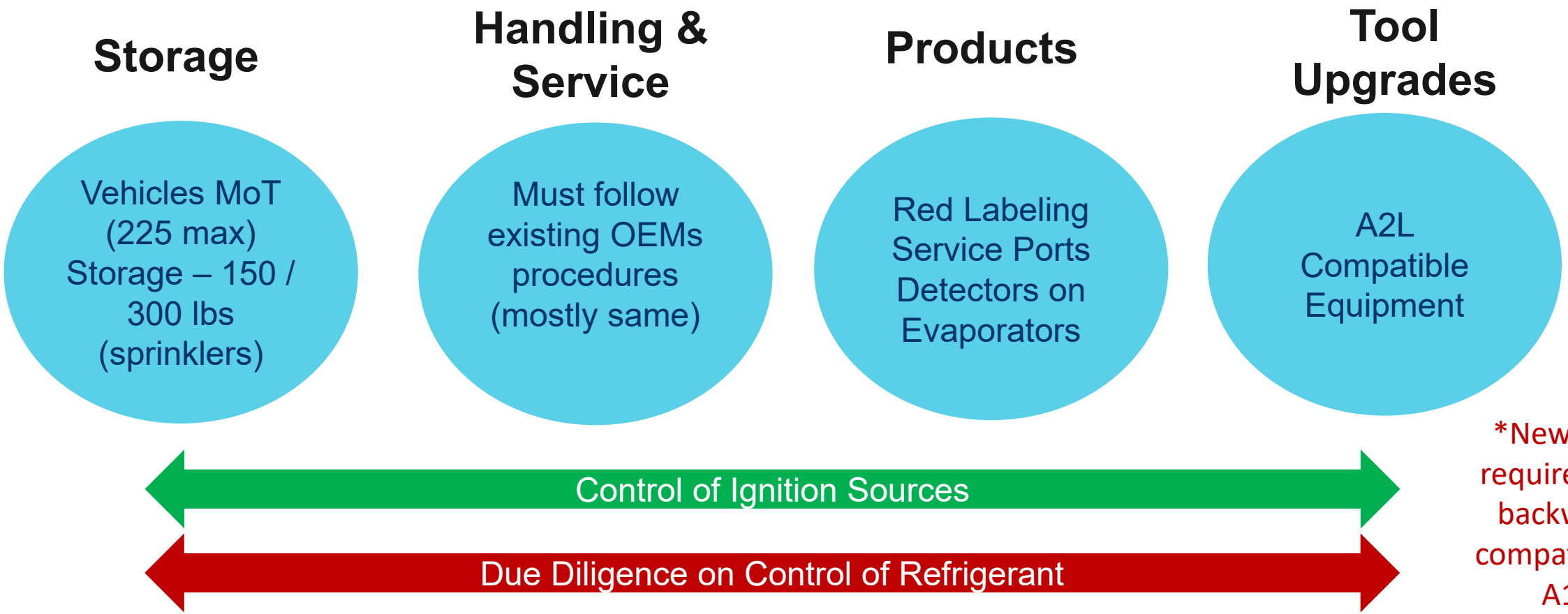


Refrigerant Sensor



Red Flammable Indicators

Handling & Servicing A2L Flammable Refrigerants



*New tools required, but backwards compatible to A1's

Controlling several factors to prevent refrigerant mixing with air & ignition sources

Resources

- EPA Technology Transition Program Final Rule: Restrictions on the Use of Certain HFCs under Subsection (i) of the AIM Act (epa.gov)

- Trane.com: Refrigerant Management
  - Refrigerant Transition Overview & FAQ (REFR-SLB006-EN)
  - HVAC Industry Update on Refrigerants (REFR-PRB001M-EN)
  - Engineers Newsletter: A2L Refrigerants and ASHRAE Standard 15 (ADM-APN088-EN)
  - Applications Engineering Manual: Refrigeration Systems and Machinery Rooms (APP-APM001G-EN)
  - Engineers Newsletter Live: ASHRAE Standard 15-2022

- ESCO institute: https://www.escogroup.org/training/lowgwprefrigerant.aspx

- ACCA-Air Conditioning Contractors of America: https://www.acca.org/education/a2l-refrigerants

- AHRI A2L Cylinder Storage Options (https://www.ahrinet.org)