



2022 ENGINEER SUMMIT

The Changing Refrigerant Landscape

It's No Longer Just a Chiller Issue, It's an Industry Issue

11/14/2022

Learning Objectives



After viewing the presentation, attendees will be able to:

- Summarize the drivers behind the new regulations and legislation for HVAC refrigerants.
- Discuss the actions being taken both globally (*via the Kigali Amendment to the Montreal Protocol*) and domestically (*via the U.S. EPA and Climate Alliance States*).
- Discuss the science behind why and how HVAC refrigerants are evolving.
- Compare Safety, Efficiency, and Environmental impact of current and next-generation refrigerant options.

Understand the Facts Today; Plan for Tomorrow



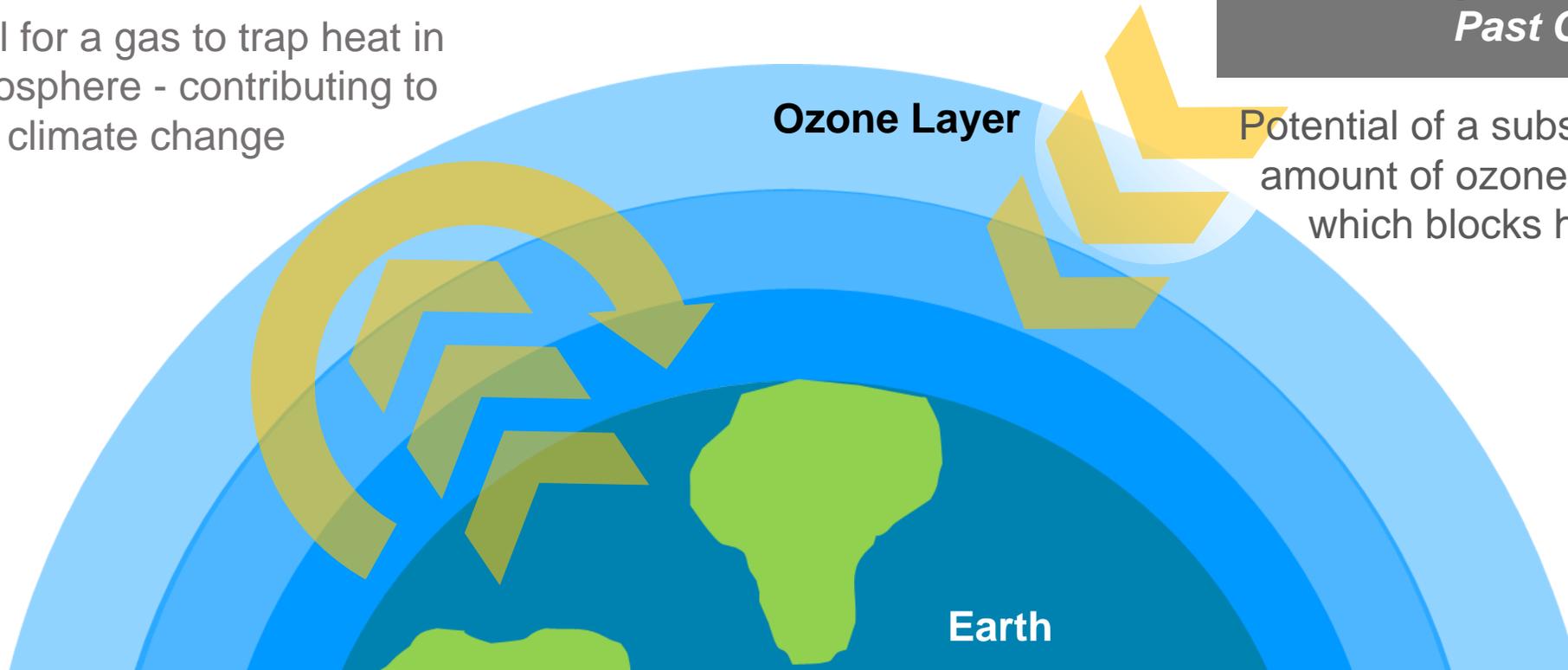
Why Are Refrigerants Transitioning?

Global Warming Potential (GWP) *Current Concern*

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

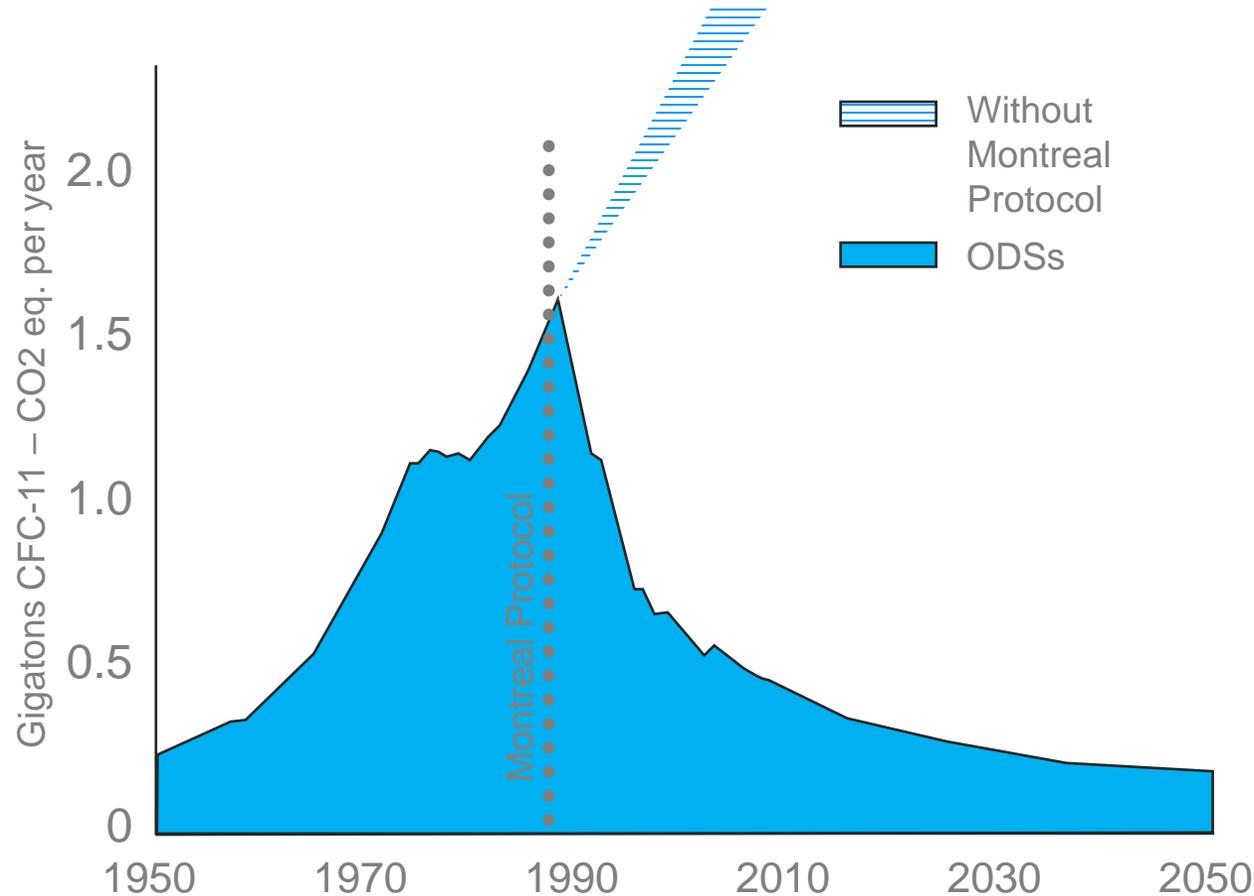
Ozone Depletion Potential (ODP) *Past Concern*

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



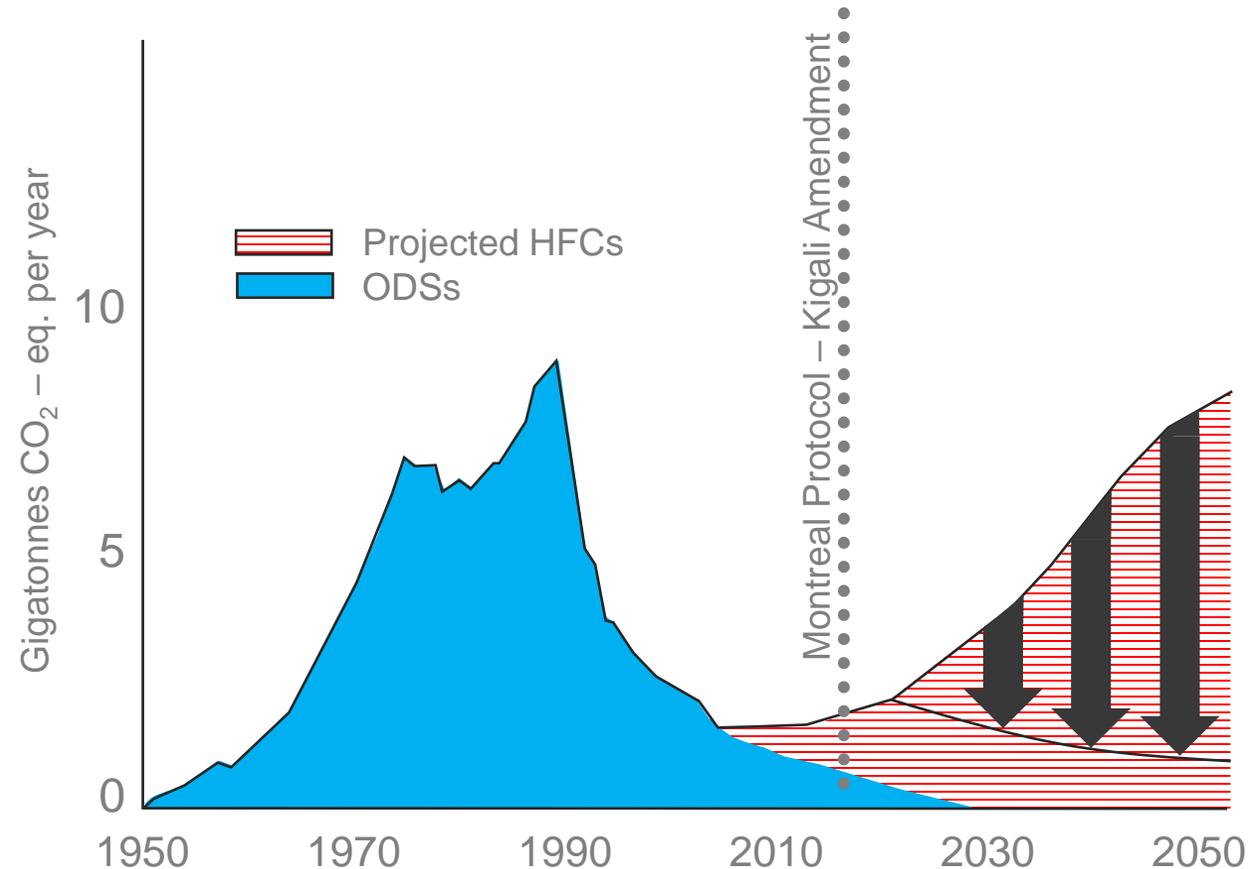
What could have happened...

ODP-weighted emissions



What could have happened...

GWP-weighted emissions

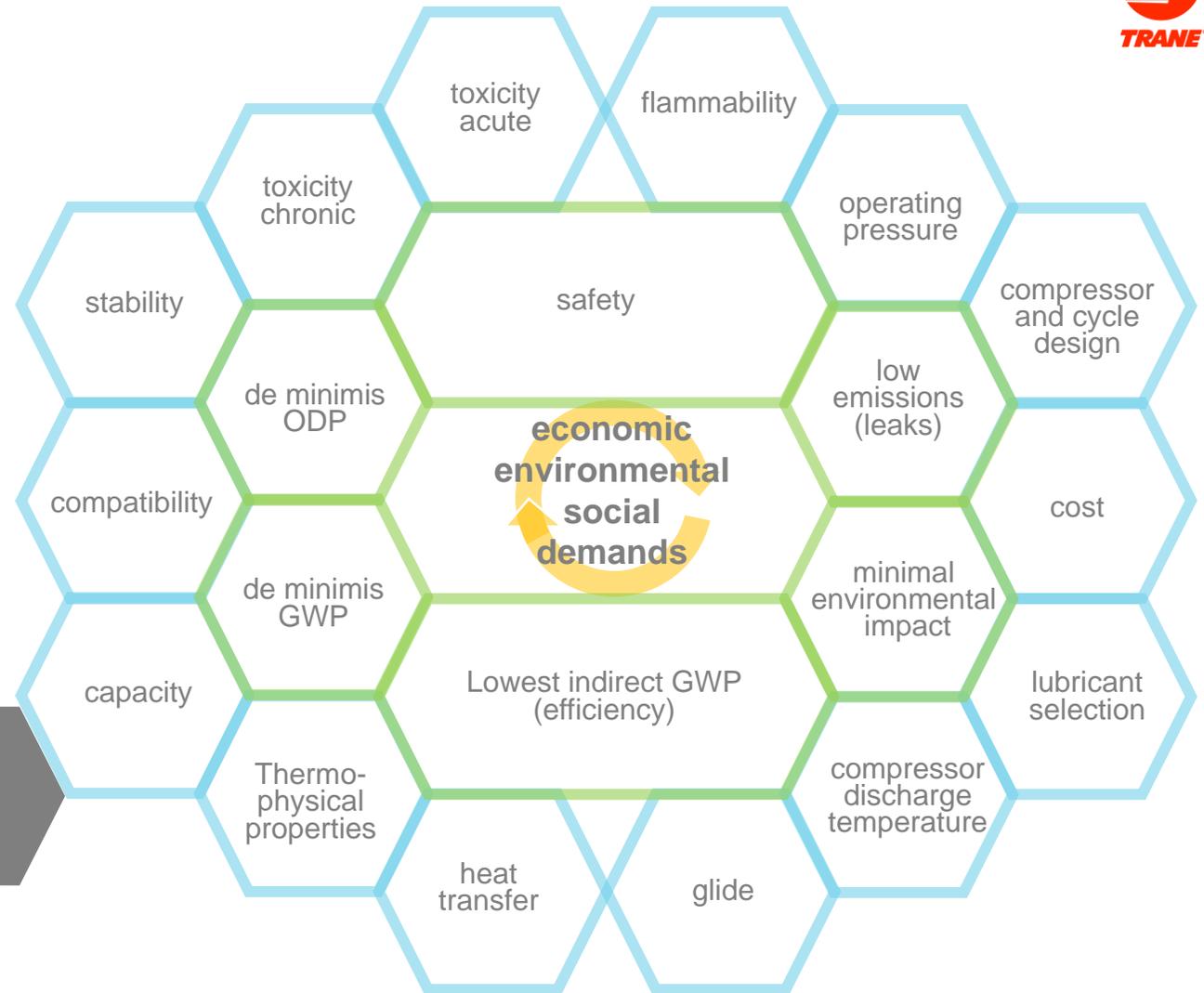




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Refrigerant Choices

Next-Generation Refrigerants is About Balancing Critical Factors



There is No Perfect Refrigerant

Next-Generation Refrigerants



refrigerant safety groups

A3	B3
A2	B2
A2L	B2L
A1	B1



*lubricant development was largest issue in last CFC to HFC transitions. Needed to develop new compatible lubricants, e.g., POEs, PVEs

Closer Look - Low Pressure Options



		Baseline	Ultra-Low GWP	
		R-123	R-514A	R-1233zd(E)
Flammability	ASHRAE Class	1	1	1
Toxicity ¹	ASHRAE Class	Higher (B)	Higher (B)	Lower (A)
	OEL (ppm)	50	320	800
Efficiency (COP)		8.95	8.91	8.87
Capacity Change		baseline	~5% loss	~35% gain
GWP ²		77	1.7	1
Atmospheric Life		1.3 years	22 days	26 days

¹None of these refrigerants shown in the table are considered "toxic" or "highly toxic" as defined by the IFC, UFC, NFPA 1 or OSHA regulations.

²GWP values reported are per the Fourth Assessment Report (AR4) of the IPCC (Intergovernmental Panel on Climate Change).

*Modeling Conditions: 100% isentropic compressor efficiency, 95°F/44°F, 0 superheat, 0 subcooling

**R-514A & R-1233zd(E) Both Good Choices
Non-Flammable (Class 1), Ultra Low GWPs with High Efficiency Available Now**

Closer Look - Medium Pressure Options



		Baseline	Lower GWP		Ultra-Low GWP	
		R-134a	R-513A	R-515B	R-1234yf	R-1234ze(E)
Flammability	ASHRAE Class	1	1	1	2L	2L
Toxicity ¹	ASHRAE Class	Lower (A)	Lower (A)	Lower (A)	Lower (A)	Lower (A)
	OEL (ppm)	1000	650	810	500	800
Efficiency (COP)		8.47	8.27	8.32	8.17	8.45
Capacity Change		baseline	similar	~25% loss	~5% loss	~25% loss
GWP ²		1430	630	298	6	4
Atmospheric Life		13.4 years	5.9 years	3.1 years	11 days	18 days

*Modeling Conditions: 100% isentropic compressor efficiency, 95°F/44°F, 0 superheat, 0 subcooling

*R-513A introduced for ice rinks applications in 2019

**R-513A & R-515B Good Solutions for Existing Mechanical Rooms
Longer Term – Flammable Solutions Required to Meet GWP Goals**

Closer Look – High Pressure A/C Options



		Baseline	Lower GWP	
		R-410A	R-454B	R-32
Flammability	ASHRAE Class	1	2L	2L
Toxicity ¹	ASHRAE Class	Lower (A)	Lower (A)	Lower (A)
	OEL (ppm)	1000	850	1000
Efficiency (COP)		7.99	8.16	8.22
Capacity Change		baseline	~3% loss	~8% gain
GWP ²		2088	467	675
Atmospheric Life		17 years	3.6 years	5.2 years

*Modeling Conditions: 100% isentropic compressor efficiency, 95°F/44°F, 0 superheat, 0 subcooling

[Comparing refrigerants R454B vs R32](#)

R-454B & R-32 Good Interim Solutions
 Gap: No Nonflammable Lower GWP Retrofit Options
 Longer Term – More Innovation Required to Meet GWP Goals



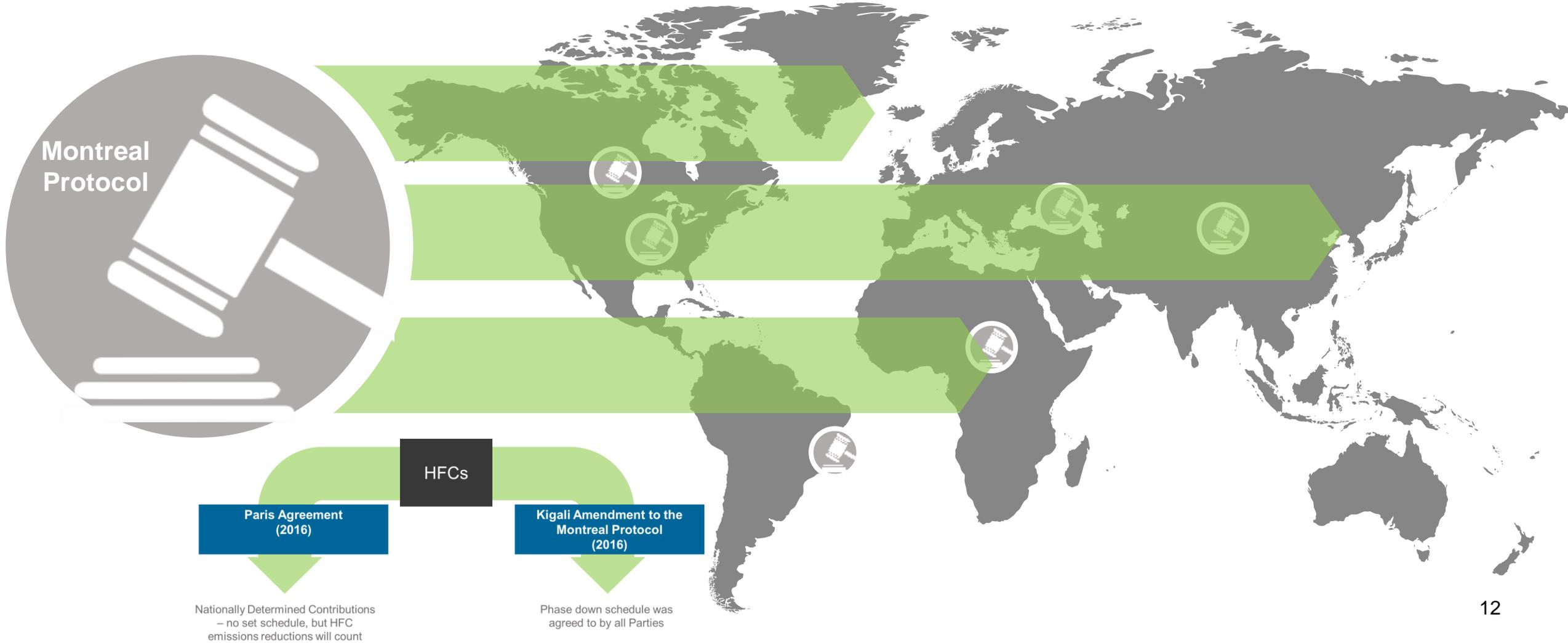
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Regulatory Landscape

The Legal Framework behind the Refrigerant Transition



The transition out of high GWP HFCs is occurring globally under both the Montreal Protocol and the Paris Agreement



The U.S. is Regulating the HFC Transition Now



Comprehensive Federal U.S. HFC phase down

- U.S. AIM Act requires EPA to regulate HFC phase down in the same time frame as the Kigali Amendment (Senate Ratified Oct 22)
- EPA allocation regulation (Sept. 2021) reduces refrigerant supply by 10 percent (GWP) in 2022 to align with legislation
- EPA sets equipment sector bans with GWP limits by **Oct 2023** per AIM Act and industry petitions
- EPA to add HFCs to refrigerant management regulation (CAA 608)
- Federal regulation reduces refrigerant supply by 40 percent (GWP) in 2024

The Future is Known... the How and When is becoming Clearer

AIM (American Innovation and Manufacturing) Act – Enacted Dec 2020

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Cap & Phasedown Process

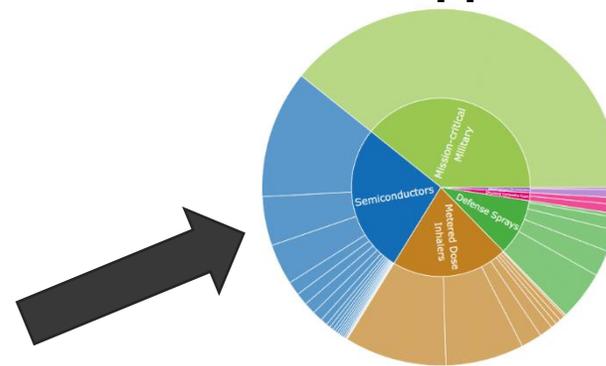
GWP Based Refrigerant Allocations Reductions



USEPA issued allowances to companies that produced and/or imported HFCs in 2020, based on the three highest non-consecutive years of production or import between 2011 – 2019

*6 entities given application specific allowances

Critical Applications

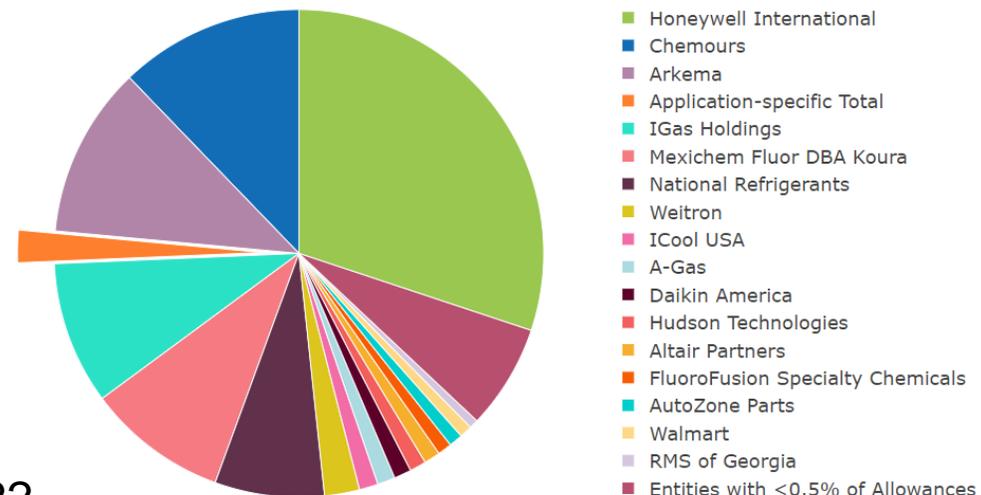


- Semiconductors
- Mission Critical Military
- Meter Dose Inhaler
- Defense Spray
- Structural Composite Foams

Production (GWP Based)

Entity	Number of Production Allowances Issued (MTEVe)
Arkema	40,821,168.5
Chemours	75,606,548.8
Honeywell International	171,527,851.5
Iofina Chemical	1,756.3
Mexichem Fluor DBA Koura	50,481,897.5
Application-specific allowances ^a	5,859,934.4
Total	344,299,157.0

Consumption (Sell or Use)



↓10% in 2022

6 Entities Allowed Production Allocations; 60+ Consumption Allocation Allowances

AHRI Petition and Accepted by EPA



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AIR-CONDITIONING, HEATING,
& REFRIGERATION INSTITUTE
we make life better*

2311 Wilson Boulevard Suite 400 Arlington VA 22201 USA
Phone 703 524 8800 | Fax 703 562 1942
www.ahrinet.org

April 21, 2021

The Honorable Michael S. Regan
Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Re: AHRI Petition for Technology Transition under The American Innovation and Manufacturing Act of 2020 (Air Conditioning)

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April 21, 2021

The Honorable Michael S. Regan
Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460

Re: AHRI Petition for Technology Transition under The American Innovation and Manufacturing Act of 2020 (Commercial Refrigeration and Chillers)

Unitary and VRF Equipment

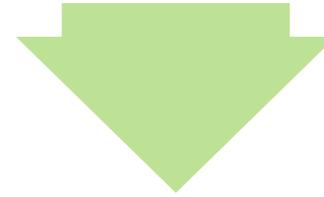


Unitary: January 1st 2025
VRF: January 1st 2026



Source: <https://www.epa.gov/climate-hfcs-reduction/technology-transition-petitions-under-aim-act>

Chiller Equipment

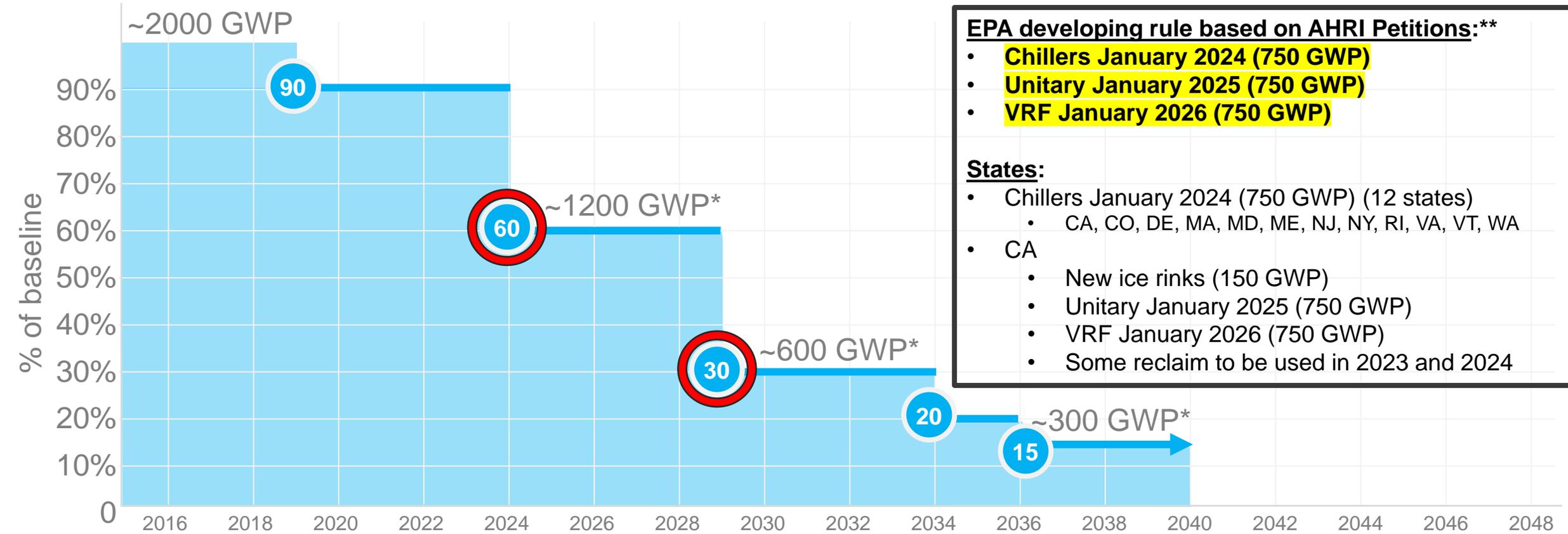


January 1st 2024
(Potential for Enforcement Delay to Oct 1, 2024)

Industry is Aligned around Dates and GWP Limits

The U.S. HFC Transition

AIM Act Requires Production/Consumption Reductions through Allocations Following the Montreal Protocol Kigali Schedule for Developed Countries



EPA developing rule based on AHRI Petitions:**

- **Chillers January 2024 (750 GWP)**
- **Unitary January 2025 (750 GWP)**
- **VRF January 2026 (750 GWP)**

States:

- Chillers January 2024 (750 GWP) (12 states)
 - CA, CO, DE, MA, MD, ME, NJ, NY, RI, VA, VT, WA
- CA
 - New ice rinks (150 GWP)
 - Unitary January 2025 (750 GWP)
 - VRF January 2026 (750 GWP)
 - Some reclaim to be used in 2023 and 2024

* Estimated GWP caps based on an overall average production baseline
 ** U.S. Supreme Court ruling on WVA v EPA should not impact

Significant GWP Reductions in 2024 and 2029 and Overlapping Product Bans

California HFC Regulations



California continues to develop more aggressive and restrictive regulations on HFCs than other state or USEPA.

- Reclaimed refrigerant for R-410A system fills in 2023 & 2024
- California just enacted legislation that prohibits the sale or distribution of bulk HFCs that exceed GWP limits of
 - 2,200 by 2025 (no R-404A)
 - 1,500 by 2030 (no R-410A)
 - 750 by 2033 (no R-134a)

*Note: State owned buildings will need to use reclaim for service in anything above 750 GWP in 2025.

CARB must also post an assessment by January 1, 2025, on how to transition the state to low or ultra-low GWP (<10 GWP) alternatives by 2035.

California Continues to be More Aggressive/Restrictive

Canada Regulatory Details



The baseline HFC consumption quantity for Canada is 19,118,651 tons of CO2 equivalent. The reduction regulation is as follows:

90% in 2019
60% in 2024
30% in 2029
20% in 2034
15% in 2036

The second part of the regulation establishes limits on global warming potential (GWP) of refrigerants that can be used with industry systems and compliance dates for these limits. The limits and compliance dates are as follows: (Note compliance dates either import or manufacturing)

- | | |
|--|------------------------|
| 1. Stand-alone medium temp refrigeration systems | 1400 (January 1, 2020) |
| 2. Stand-alone low temp refrigeration systems | 1500 (January 1, 2020) |
| 3. Centralized refrigeration systems | 2200 (January 1, 2020) |
| 4. Condensing Units | 2200 (January 1, 2020) |
| 5. Chillers | 750 (January 1, 2025) |
| 6. Mobile refrigeration systems | 2200 (January 1, 2025) |

ECCC - USEPA to Align Regulations as Much as Possible

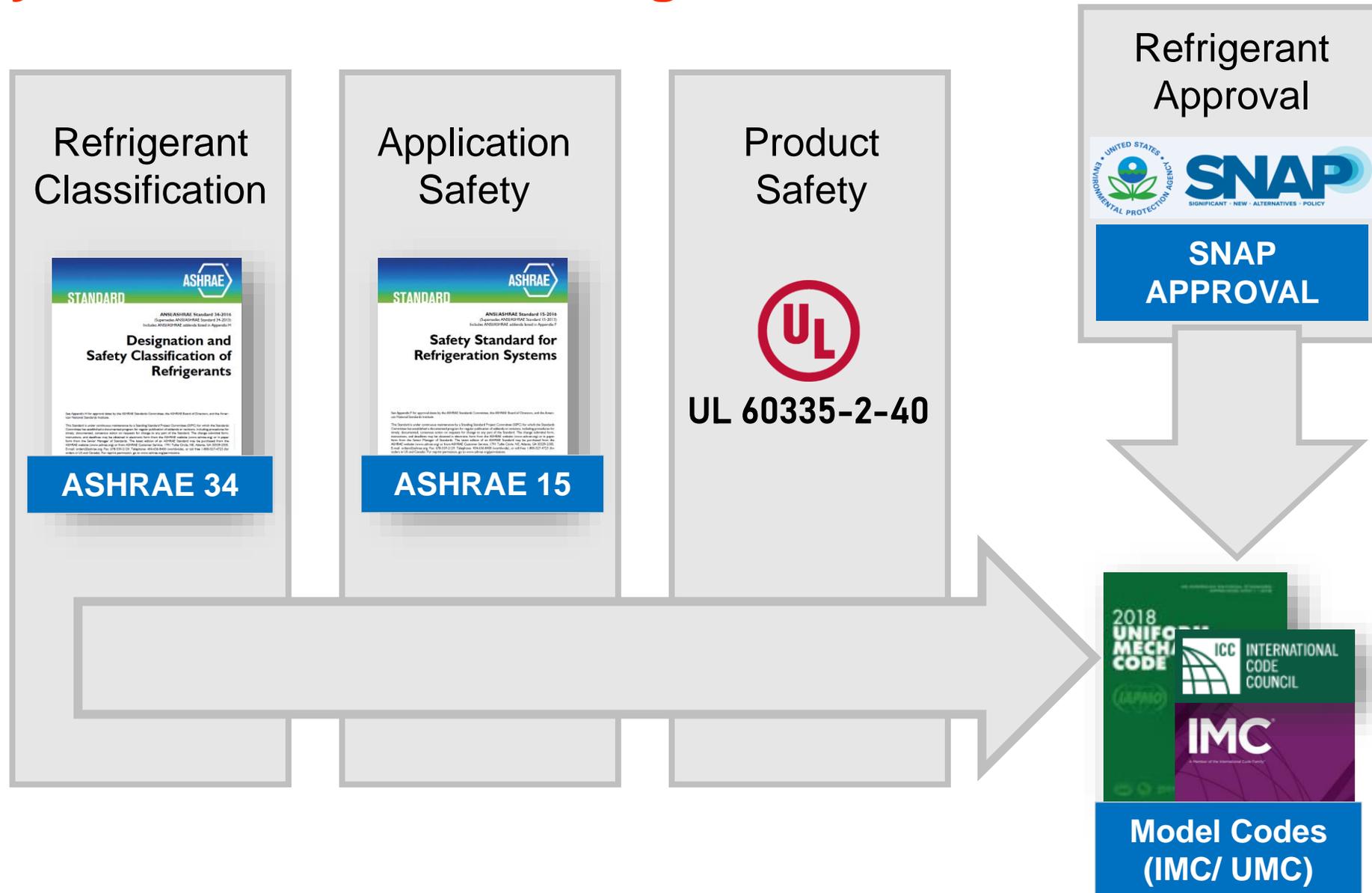
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Standards Changes

Safety Standards and Building Codes Process



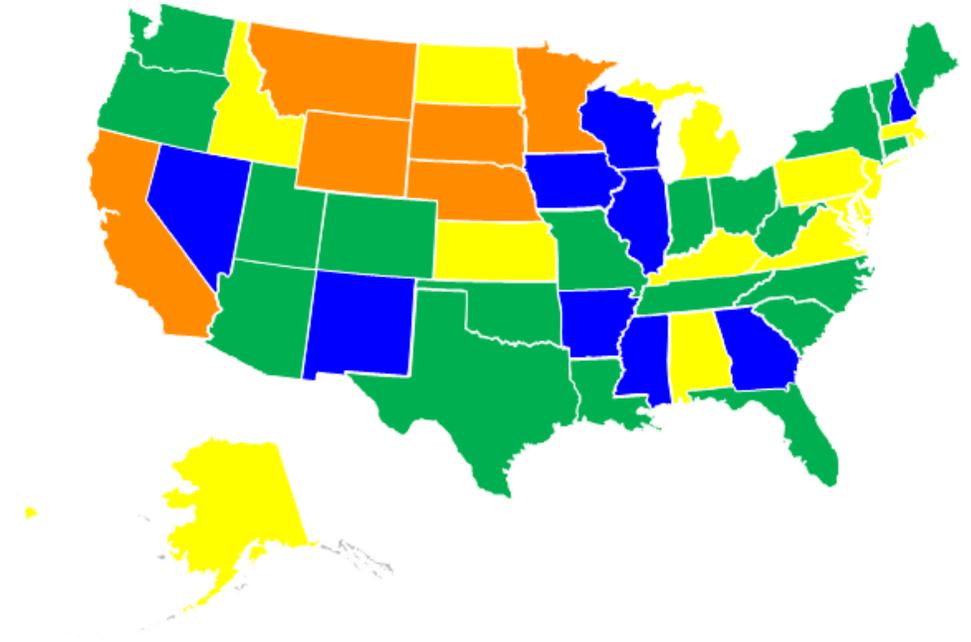
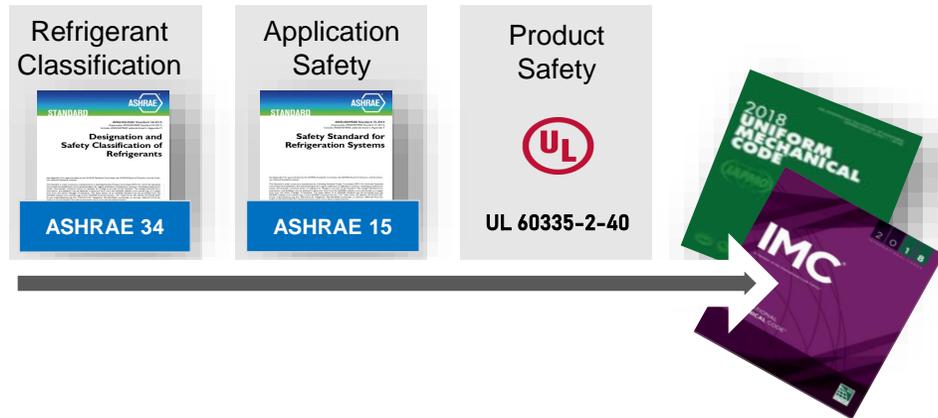
States are Enacting Legislation and Updating Building Codes to Enable A2Ls for the Unitary, VRF and Residential Systems

- **Legislation**

- “Codes cannot prohibit the use of SNAP approved refrigerants in listed equipment”

- **State Code updates**

- ASHRAE® 34, 15, UL 60335-2-40



■ A2Ls Enabled
 ■ A2L Enablement likely in 2022

■ A2L Enablement likely in 2023
 ■ A2L Enablement likely in 2024

- **A2Ls already enabled for Chillers**

- 2018 model codes updated and adopted by most states
- Jurisdictions can also approve by project (AMM)

ASHRAE® 15 – 2019 Indirect Systems - Machinery Room using 2Ls



Impacted Product Types:

Chillers

Impacted Refrigerants:

R-1234ze

R-32

R-454B

R-1234yf

NEW REQUIREMENTS

Space Refrigerant Detectors:

- When activated increase airflow supplied to the occupied space and turns off compressors, heaters, and other electrical devices. (25 percent of Lower Flammability Limit)
- Must activate in under 15 seconds

Remote Control:

- Must be possible to initiate a chiller stop and initiate the ventilation sequence from immediately outside the machinery room.

Multipoint Refrigerant Detector:

- Are no longer allowed for 2L refrigerants

Ventilation Rates:

- 2 rates required
 - Trouble Alarm
 - Emergency Alarm
- Increased ventilation rates

ASHRAE® 15 – 2019 Direct Systems - Occupied Space using 2Ls



Impacted Product Types:

RTU's	VRF	WSHP	Splits
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Impacted Refrigerants:

R-32	R-454B
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NEW REQUIREMENTS

Equipment Refrigerant Detectors:

- Factory installed at the evaporator coil
- Must act quickly (<15 seconds) and at low levels (25 percent of Lower Flammability Limit)
- When activated increase airflow supplied to the occupied space and turns off compressors, heaters, and other electrical devices

Ignition Sources

- Avoid locating potential ignition sources in ductwork
 - Electric resistance allowed with minimum CFM (200 ft/min)



What Actions Should I Take?

- This is not our first refrigerant transition! Trane is well prepared to offer products with lower GWP refrigerants well ahead of regulations
 - *Next-generation alternatives are available today for some products (larger applied products)*
 - *1st to introduction ultra-low <10 GWP refrigerants, R1233zd (2015) & R514A (2017)*
- There is no perfect refrigerant. Remember take a balanced approach
 - *Safety, Efficiency, Environmental Impact*
 - *Safest, best balance that enables the LOWEST emissions, the HIGHEST efficiency and the LOWEST life-cycle costs*
 - *Continued Leak tightness is key!*
- Unitary and residential applications need states and jurisdictions to update the mechanical/building codes to the latest standards
 - *All states should be updated by 2024*
- Contact your account manager for further questions

Use the Facts to Plan for Tomorrow



Thank you!

Any questions?

Survey



Survey





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