



US Refrigerant Regulations Update and Emerging Trends

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Key Topics

Policy Drivers for Low GWP Refrigerants

US Refrigerant Actions

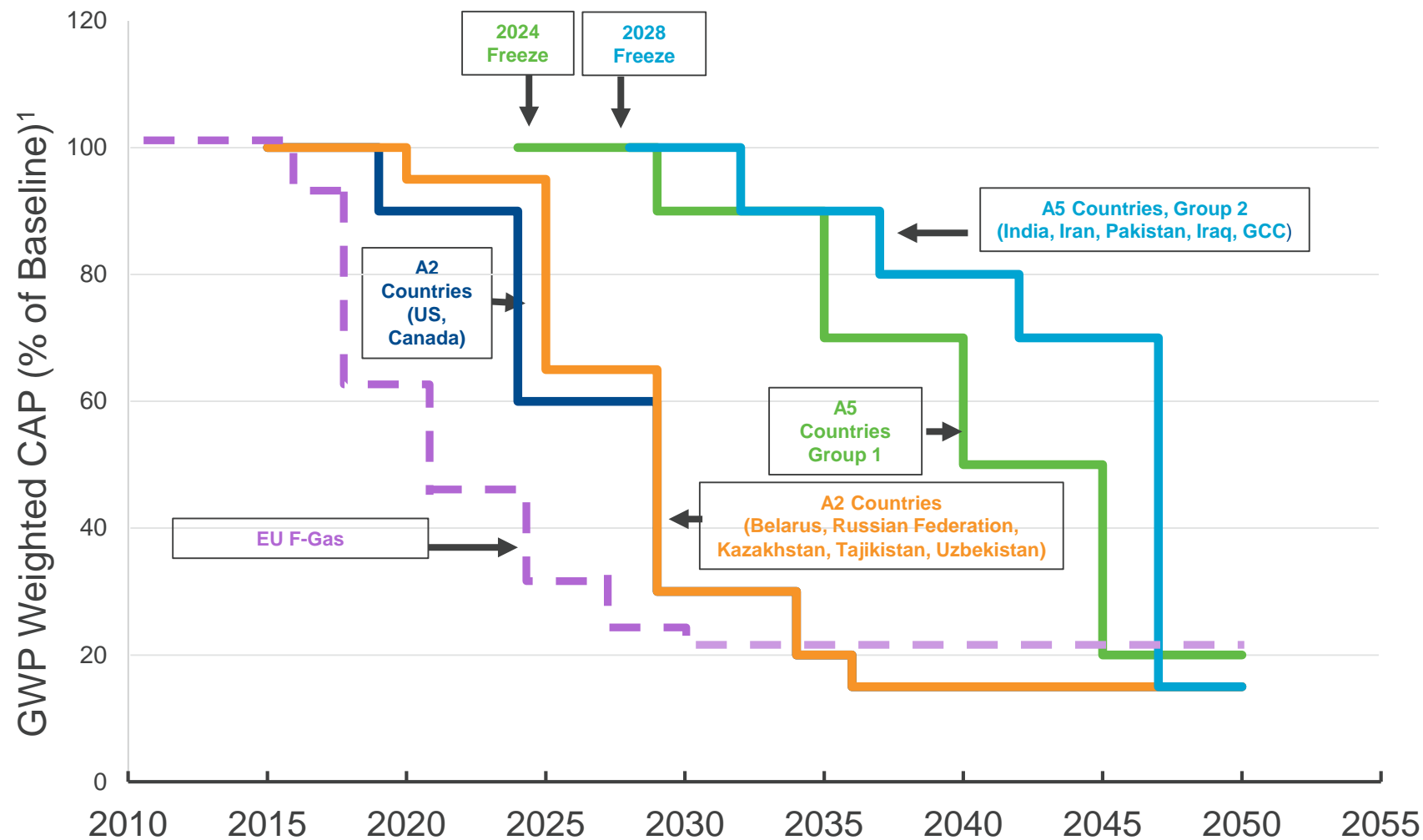
Refrigerant Properties of Lower GWP Alternatives

Codes and Standards

Beyond Refrigerants: Emerging Trends

Policy Drivers for Low GWP Refrigerants

Refrigerant regulations are coming – not IF, but WHEN and HOW



F-Gas (EU): effective May 20, 2014²

Commercial application	GWP limit	Date
Self-contained refrigeration	2,500	2020
Stationary refrigeration	2,500	2020
Self-contained refrigeration	150	2022
Centralized refrigeration	150	2022
– Except top side of cascade	1,500	2022
Stationary AC <3kg	750	2025



Environmental Canada (EC) Reg. Oct. 18, 2017³

Commercial application	GWP limit	Date
Refrigeration – centralized systems (MT/LT racks)	2200	2020
Refrigeration – condensing units	2200	2020
Refrigeration – LT stand-alone	1500	2020
Refrigeration – MT stand-alone	1400	2020
Mobile refrigeration	2,200	2025
Chillers Refrig & AC	750	2025
Domestic refrigeration	150	2025

Global trend to require the use of lower GWP refrigerants is well underway

¹ https://treaties.un.org/Pages/ViewDetails.aspx?src=IND&mtdsg_no=XXVII-2-f&chapter=27&clang=en

² <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014R0517&from=EN>

³ <http://www.gazette.gc.ca/rp-pr/p2/2017/2017-10-18/html/sor-dors216-eng.html>

US Refrigerant Actions

U.S. EPA Continues to Roll Back Previous Regulations

- SNAP Rules 20/21 Vacated at Federal Level due to Court Challenge
 - EPA currently not enforcing HFC delistings¹
- Clean Air Act Section 608 Proposal
 - Would exclude HFCs from Section 608 of Refrigerant Management Program (RMP)²
 - Would still apply to ozone-depleting substances
 - Appliances with 50 or more pounds of refrigerant would no longer be subject to:
 - Conduct leak rate calculations when refrigerant is added to an appliance
 - Repair an appliance that leaks above a threshold leak rate
 - Conduct verification tests on repairs
 - Conduct periodic leak inspections on appliances that exceed the threshold leak rate
 - Report to EPA on chronically leaking appliances
 - Retrofit or retire appliances that are not repaired
 - Maintain related records



New EPA regulation expected in 2020

¹<https://www.regulations.gov/document?D=EPA-HQ-OAR-2003-0118-1641>

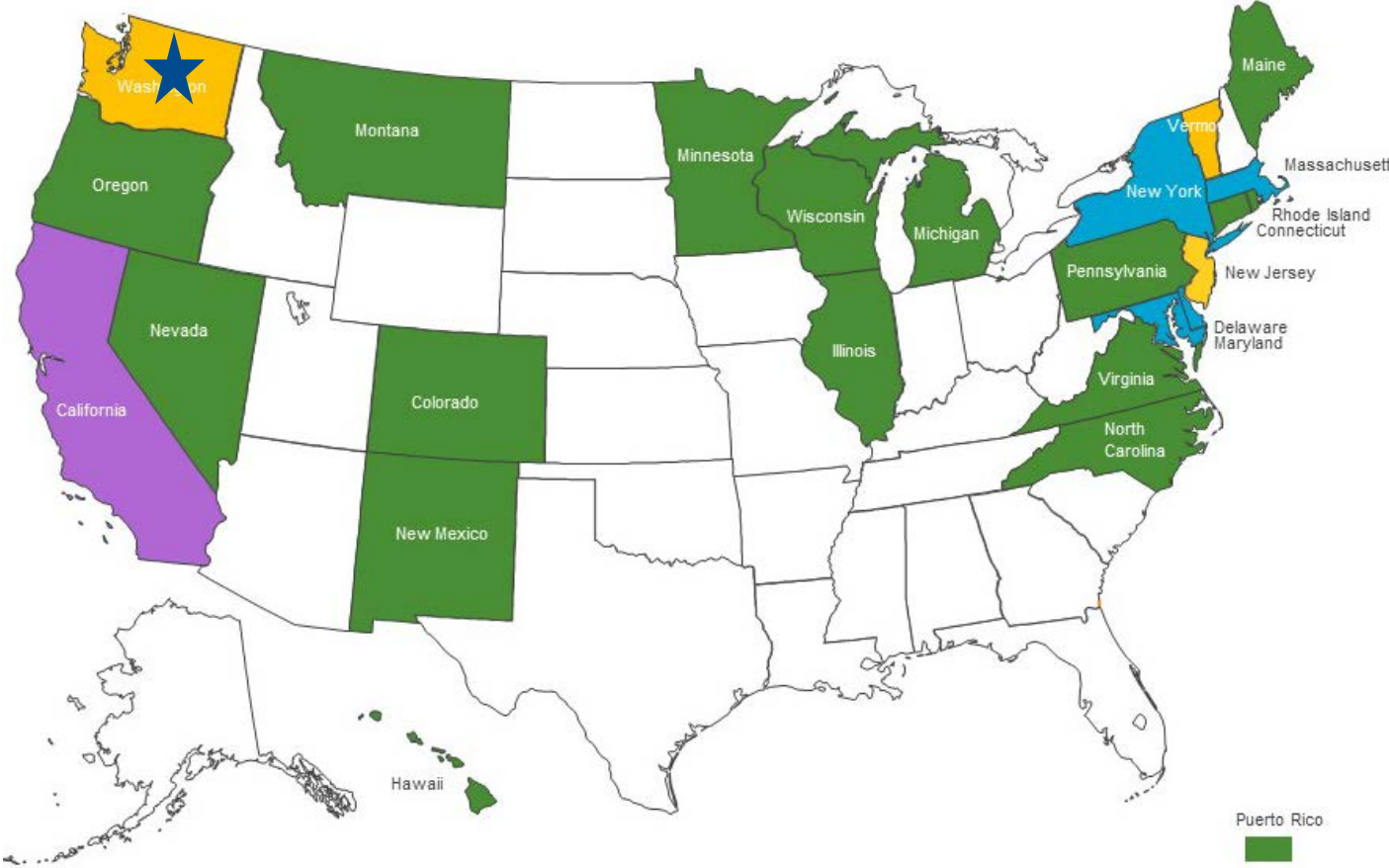
²<https://www.epa.gov/section608/section-608-refrigerant-management-regulations>

US Lacks Federal HFC Regulations – States Take Lead

US Climate Alliance States committed to leading on climate change initiatives, including reduction of HFCs

- 25 members and growing
 - 8 states have joined this year
 - Now make up over 55 percent of population and an \$11.7 trillion economy
- Three states have adopted US EPA SNAP 20/21
 - California, Washington, & Vermont
 - Allow for addition and removal of substitutes or use conditions based on risk to human health and environment

Climate Alliance	SNAP 20/21 In Process	SNAP 20/21	SNAP 20/21 Plus GWP Limits
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It is desired that states be consistent in their approach when adopting SNAP rules

State by State Adoption of EPA SNAP 20/21

EPA SNAP Rule 20 Implementation Dates by State											EPA SNAP Rule 21 Implementation Dates by State					
Refrigerant	GWP (AR4)	Supermarket Central Systems		Remote Condensing Unit		Stand-Alone					C: California; W: Washington; V: Vermont; N: New Jersey					
		New	Retrofit	New	Retrofit	MT <2,000 BTU/hr with Flooded Evap (New)	MT <2,000 BTU/hr With Flooded Evap (New)	MT <2,000 BTU/hr Without Flooded Evap (New)	LT (New)	LT and MT (Retrofit)	Refrigerated Food Processing and Dispensing Equipment	Cold-Storage Warehouses (New)	Ice Machines (New)	Very Low-Temp Refrigeration (New)	Positive Displacement Chillers	
R-404A/R-507A	3,922/3,985	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-19 NW:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-20 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-20 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-20 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	1-Jan-21	1-Jan-23	OK	OK	—	
R-452A	2,141	—	—	OK	OK	—	—	—	—	—	—	—	—	—	—	—
R-410A	2,088	OK	—	OK	—	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	—	1-Jan-21	1-Jan-23	OK	OK	1-Jan-24	
R-407A/R-407C/R-407F	2,107/1,774/1,825	OK	OK	OK	OK	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	OK	1-Jan-21	1-Jan-23 (R-407A) R-407C/F	OK	R-407C Only	—	
R-407H	1,500	—	—	OK	OK	—	—	—	—	—	OK	—	—	—	—	—
HFC134a	1,430	OK	OK	OK	OK	C:1-Jan-19 W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	C, W:1-Jan-20 N:1-Jul-20 V:1-Jan-21	OK	OK	OK	OK	OK	—	—	1-Jan-24
R-448A/R-449A	1,387/1,397	OK	OK	OK	OK	Neither SNAP approved nor banned	Neither SNAP approved nor banned	Neither SNAP approved nor banned	OK	OK	OK	—	OK	—	—	—
R-513A/R-450A	631/604	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	—	OK	—	—	R-513A
R-290	3	—	—	—	—	OK	OK	OK	OK	—	—	—	OK	OK	—	—
R-744	1	OK	—	OK	—	OK	OK	OK	—	—	OK	—	—	OK	—	—
R-717	0	OK (in primary loop or secondary system)	—	OK (in primary loop or secondary system)	—	OK (in primary loop or secondary system)	OK (in primary loop or secondary system)	OK (in primary loop or secondary system)	OK (in primary loop or secondary system)	OK (in primary loop or secondary system)	OK (in primary loop or secondary system)	—	OK	—	—	3

New

3,922/
3,985

C:1-Jan-19
W:1-Jan-20
N:1-Jul-20
V:1-Jan-21

C:1-Jan-19
NW:1-Jan-20
N:1-Jul-20
V:1-Jan-21

Added complexity of managing implementation dates

California Proposes Additional Rulemaking – AC and Chillers

<u>General End-Use</u>	<u>Specific End-Use</u>	<u>Prohibited Substances</u>	<u>Effective Date</u>
<u>Air-conditioning</u>			
<u>Air-conditioning Equipment</u>	<u>Air-conditioning equipment (new), residential and non-residential</u>	<u>Refrigerants with a GWP of 750 or greater</u>	<u>Prohibited as of January 1, 2023</u>
<u>Chillers - Air-conditioning, Industrial Process Cooling</u>			
<u>Chillers</u>	<u>Chillers (new) designed for minimum evaporator temperature > -15 °F (-26 °C)</u>	<u>Refrigerants with a GWP of 750 or greater</u>	<u>Prohibited as of January 1, 2024</u>
<u>Chillers</u>	<u>Chillers (new) designed for minimum evaporator temperature -15 °F (-26 °C) through -58 °F (-50 °C)</u>	<u>Refrigerants with a GWP of 2200 or greater</u>	<u>Prohibited as of January 1, 2024</u>

CARB Proposal – Refrigeration and Ice Rink End Uses

<u>General End-Use</u>	<u>Specific End-Use</u>	<u>Prohibited Substances</u>	<u>Effective Date</u>
<u>Ice Rinks</u>			
<u>Ice Rinks</u>	<u>Refrigeration Equipment (new) and Chillers (new) used in Ice Rinks</u>	<u>Refrigerants with a GWP of 750 or greater</u>	<u>Prohibited as of January 1, 2024</u>
<u>Refrigeration</u>			
<u>Refrigeration Equipment</u>	<u>Refrigeration equipment (new), non-residential, containing more than 50 pounds refrigerant</u>	<u>Refrigerants with a GWP of 150 or greater</u>	<u>Prohibited as of January 1, 2022</u>

Board Meeting Scheduled for July 23 and 24.

CARB Proposal – Existing Retail Food Facilities

<u>Companies with Retail Food Facilities</u>	<u>Requirement</u>	<u>Effective Date</u>
<u>Companies owning or operating 20 or more retail food facilities</u>	<u>Attain a company-wide weighted-average GWP of 2,500 or a 25% reduction in GHGp below 2018 levels</u>	<u>January 1, 2026</u>
	<u>Attain a company-wide weighted-average GWP of 1,400 or a 55% reduction in GHGp below 2018 levels</u>	<u>January 1, 2030</u>
<u>Companies owning or operating fewer than 20 retail food facilities</u>	<u>Attain a company-wide weighted-average GWP of 1,400 or a 55% reduction in GHGp below 2018 levels</u>	<u>January 1, 2030</u>

Proposal developed with industry input; more work needed on definitions and exceptions

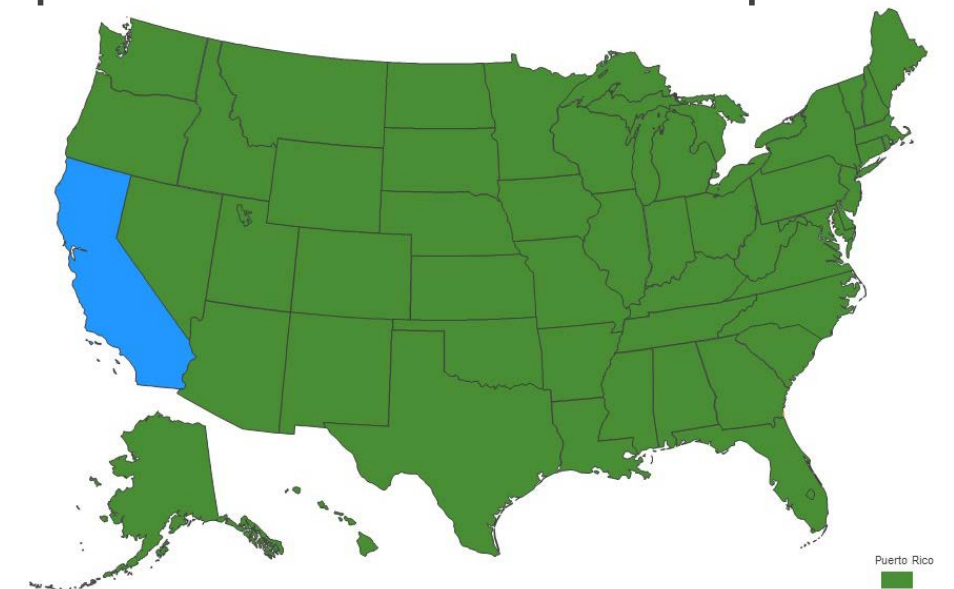
US HFC Phasedown – Federal

- Senate American Innovation and Manufacturing Act of 2019 (S2754)
 - Introduced by Senators John Kennedy (R-LA) and Tom Carper (D-DE)
- House American Innovation and Manufacturing Leadership Act of 2020 (HR5544)
 - Introduced by Representatives Paul Tonko (D-NY), Pete Olson (R-TX), Scott Peters (D-CA), and Elise Stefanik (R-NY)
- Both Bills:
 - Phase down production & consumption of HFCs over 15 years (aligning with Kigali)
 - Authorize EPA to regulate HFCs and establish standards for HFC Management – servicing, repair, recovery, recycle, reclaim, etc.
 - Driven by previous technology investment, innovation, and jobs
 - Would not affect existing equipment and would give allowance for aftermarket servicing needs of industry
 - No federal preemption – does not eliminate state rights
 - Not tied to Clean Air Act

Letters of support from:



A possible result if AIM Act passes?



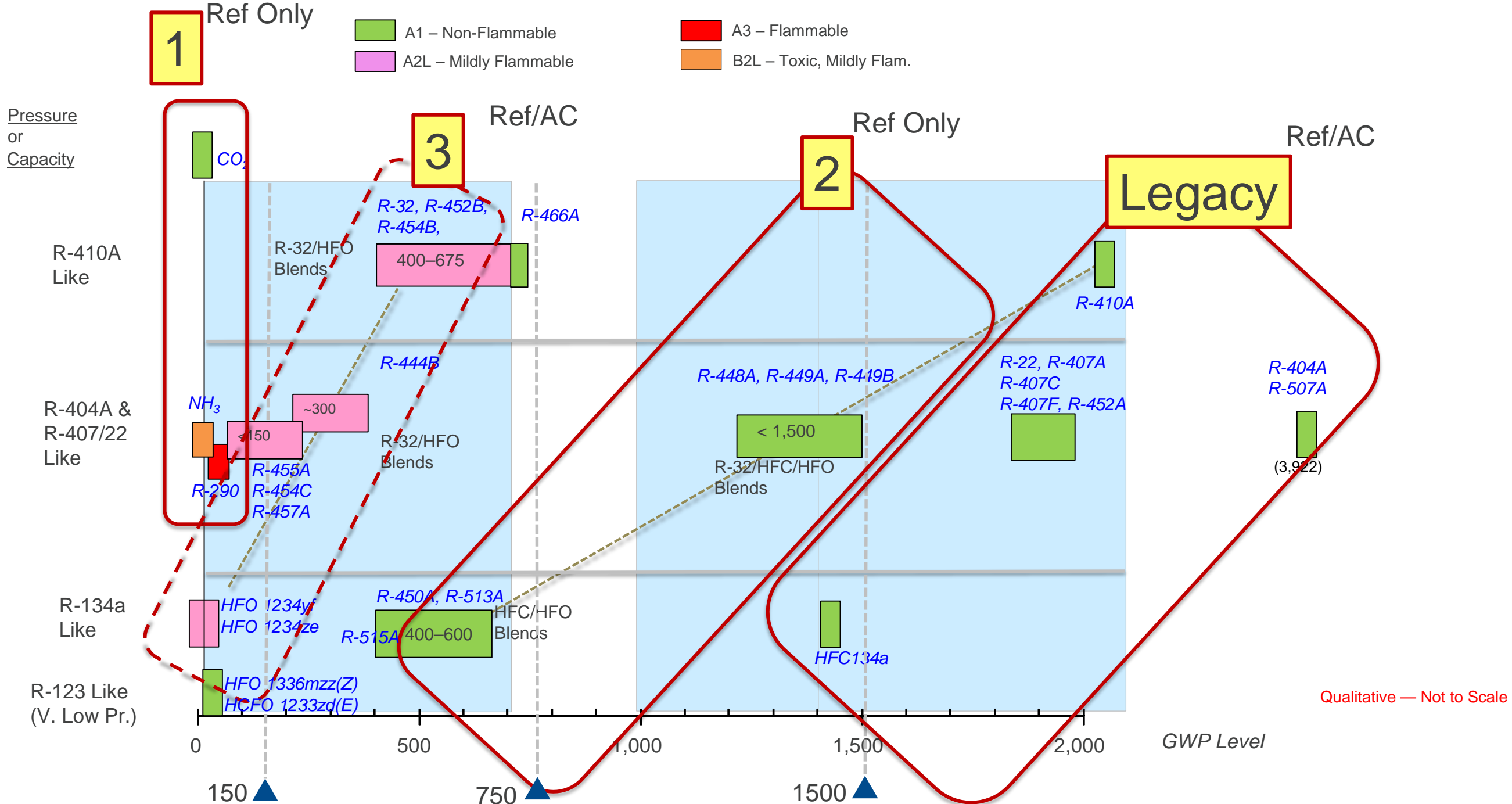
A federal approach could minimize complexity and patchwork of regulations

<https://www.congress.gov/bill/116th-congress/senate-bill/2754/text>

<https://www.congress.gov/bill/116th-congress/house-bill/5544/text?q=%7B%22search%22%3A%5B%22HR+5544%22%5D%7D&r=1&s=1>

Refrigerant Properties of Lower GWP Alternatives

Refrigerant Alternatives Trend Toward Lower GWP



Many of the New Lower GWP Refrigerants are Classified Flammable

- ANSI/ASHRAE Flammability Class 2L vs. 2 Flammability Classification Based on:
 - Burning velocity
 - Maximum velocity at which a flame propagates in a normal direction relative to unburned gas ahead of it
 - Lower burning velocity <10 cm/s = 2L
 - Higher burning velocity >10 cm/s = 2 or 3
- Class 2 vs. 3 Flammability Classification Based on:
 - Heat of combustion and lower flammability limit (LFL)
- Refrigerants like HCFC-22, R-404A, R-410A, and R134a are all classified A1
- Refrigerants like R-32, R-454B, and R-1234ze are A2L, propane A3

Safety Group

↑ Increasing Flammability	Higher Flammability	A3	B3
	Lower Flammability	A2	B2
		A2L	B2L
No Flame Propagation	A1	B1	
	Lower Toxicity	Higher Toxicity	
		→ Increasing Toxicity	

Will require equipment and facility redesign to meet application and safety standards

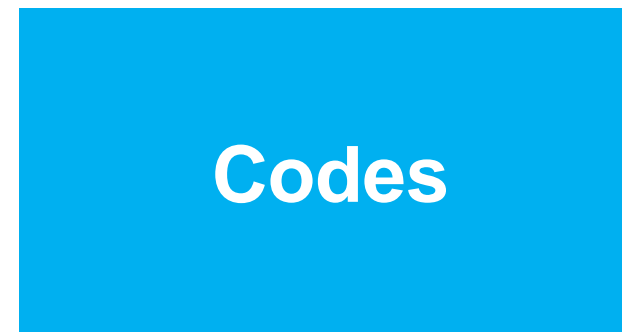
Codes and Standards

Standards and Codes are Being Developed; More Work is Needed

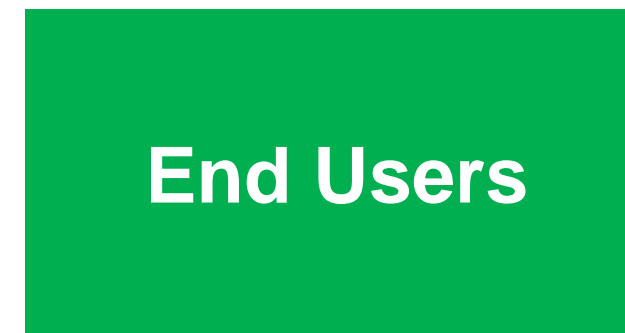
- Provide guidelines on the safest way to use refrigerants and reduce risks
- Establish common practices for application, installation and repair of equipment when using refrigerants
- Create a legal framework for compliance of local and regional laws
- Provide for a technological baseline that will help advance the state of the art



- Created by technical committees
- Heavy on technical/scientific issues



- Created by special trade groups
- Heavy on practical aspects



U.S. Safety Standard Development Continues to be a Work in Progress – Direct/High Probability Systems

In Draft **Complete** **Not Started**

Source: The Alliance for Responsible Atmospheric Policy

ASHRAE 34

Refrigerant Standards

UL 2-89 (in draft) / 2-40 3rd Edition (published)

Equipment Standards

Application Standards

ASHRAE 15 – 2019 (Commercial Ref needs updated, AC published)

Model Codes
2024 (three-year cycle)

- International Mechanical Code (IMC/UMC)
- International Fire Code (IFC)
- International Building Code (IBC)

Local Codes
(may take an additional 1–8 years)

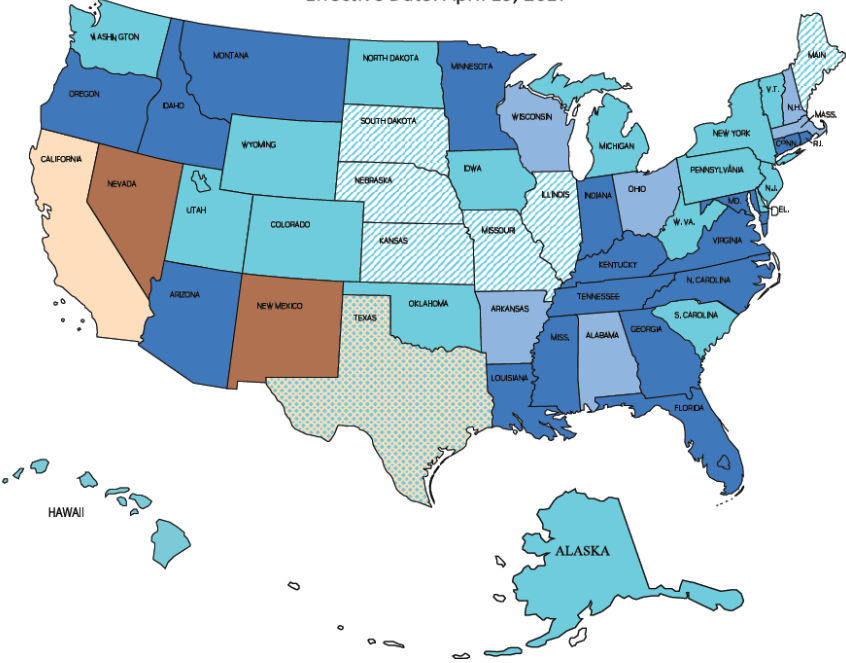
- State, county and local building codes
- Insurance codes
- Adoption

A2L Local Building Code Adoption

- WA – July 1, 2020

2017 State Mechanical Code Adoptions

Effective Date: April 19, 2017



- 2015 ICC International Mechanical Code
- 2012 ICC International Mechanical Code
- 2009 ICC International Mechanical Code
- 2006 ICC International Mechanical Code
- 2015 IAPMO Uniform Mechanical Code
- 2012 IAPMO Uniform Mechanical Code
- No Statewide Adoption
- Predominantly International Mechanical Code
- No Statewide Adoption IMC & UMC

UL-60335-2-40 3rd Edition Safety Requirements for Electrical Heat Pumps, Air-Conditioners and Dehumidifiers

- Recognizes A2L as a separate refrigerant classification
- Increased charge limits for A2L refrigerants vs A2/A3
- Defines mitigation methods for preventing leaks, as well as mitigating the potential of ignition of the refrigerant in the event of a leak:
 - Enhanced tightness to reduce potential sources of leaks
 - Room area limits
 - Continuous air circulation, or air circulation with refrigerant leak detection
 - Natural ventilation
 - Mechanical ventilation

ASHRAE 15 – 2019 Safety Standard for Refrigeration Systems

- Section 7 (2016 Addendum d) allows use of Group A2L refrigerants in comfort cooling
 - Typical equipment includes RTU, residential central air conditioning system
 - Mitigation methods: limit the refrigerant charge or provide leak detect and circulate air/ventilate the space when a leak has been detected.
- Section 8 (2016 Addendum h) differentiates and regulates the use of Group A2L refrigerants used in systems installed within a machinery room.
 - Typical equipment includes chillers and large indirect equipment
 - Mitigation methods: limit the refrigerant charge or provide leak detect and ventilate the space when a leak has been detected.
 - Defines ventilation rate requirements for A2L refrigerants
 - With adequate ventilation, Class 1, Division 2 for electrical installations is NOT required for Group A2L refrigerants.

Application and Safety Standard Updates In Process for Commercial Refrigeration

Because of the timing of lower GWP refrigerant regulations, there is urgency in Creating A2L Equipment & Application Standards for Remote Commercial Refrigeration.

- AHRI Commercial Refrigeration Safety Standards Work Group
 - Modify **UL 60335-2-89 Requirements for Commercial Refrigerating Appliances** to:
 - add Remote Equipment to scope, both cases and high side equipment,
 - enable use of flammables (A2L, A2, and A3) at higher charge limits (Referencing IEC 2-89),
 - pull in electrical and refrigerant safety from UL 1995 which will sunset Jan 1, 2024.
 - Modify **ASHRAE 15 Safety Standard for Refrigeration Systems** to include A2L Commercial Refrigeration application standards for Remote Refrigeration, referencing Europe (EN 378 and IEC 60335-2-40) and Commercial A/C (UL 60335-2-40) work.

Must be done in time for 2024 IMC/UMC update which begins Jan 2021.

AHRI's Safe Transition Task Force

Goals are to **evaluate end-to-end supply chain to enable the safe commercialization of low GWP refrigerants** in a timely manner and support the effort to reverse the **global warming trend**.

- Communications
- Safety Training
- Codes and Standards
- Transportation/Storage/Packaging/Handling
- Bulk Storage and Manufacturing Facilities
- Installation/Operation/Maintenance
- Recovery/Reclaim/ Destruction

Establish structure to ensure continuous improvement

- Incident investigation
- Continuous maintenance standards
- Training upgrades

Leverage learnings around the world

Widespread use of A2L refrigerants already in global HVAC&R industry in European Union, Japan, India and Australia and auto industry (including US and Canada)

Policy > Refrigerant Transition Task Force

AHRI Safe Refrigerant Transition Task Force



AHRI's Safe Refrigerant Transition Task Force has been formed to address every step of the supply chain in the safe refrigerant transition to low global warming potential refrigerants. The task force comprises AHRI members and stakeholders employed with contractors, government agencies, the fire service, unions, training organizations and other businesses.

Participants have established the following working groups:

- Bulk Storage/Manufacturing Facilities
- Codes and Standards
- Communications
- Installation/Operation/Maintenance
- Safety Training
- U.S. Department of Transportation (DOT)/Shipping/Packaging and Handling/Warehouse
- Recovery/Reclaim/ Destruction

Upcoming
Safe Transition October 1 at 1:00p.m.
Communications Working Group October 2 at 2:30p.m.
Installation/Operation/Maintenance October 9 at 10:30a.m.
DOT/Shipping/Packaging & Handling/Warehouse Work October 10 at 10:00a.m.
Contact: Chris Bresee

Task Force Contacts
• Chris Bresee Legal Coordinator
•

WEBSITE: <http://www.ahrinet.org/SafeRefrigerant>

Contact one of the following people if interested in working with the Safe Transition Task Force

Helen Water-Terrinoni HWalter-Terrinoni@ahrinet.org
Christophe Bresee CBresee@ahrinet.org



Refrigerant Transition Summary

- Global and state policy are pushing the industry to transition to lower GWP refrigerants
- Many of these lower GWP options have mildly flammable properties
- A lot of work has been done so far to transition to these new refrigerants, but we are not finished.
- 2020 will be key year in this transition.
 - Ongoing Codes/Standards Work
 - Federal AIM/AIML Acts
 - Continue to monitor State Activity



Beyond Refrigerants: Emerging Trends

Megatrends Abound!

Three to ponder for our industry...

- 1. DECARBONIZATION
- 2. CONNECTIVITY AND COGNITION
- 3. HEALTH AND WELLNESS

What are YOUR Top 3?

Source: The Aspen Institute



Source: Business Wire

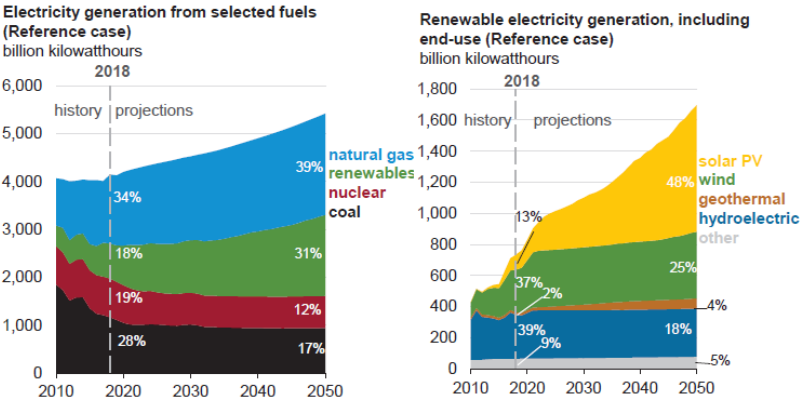


Source: SEL Group Ltd.

How are the Trends Influencing Us?

Electric Utilities Landscape is Pivoting

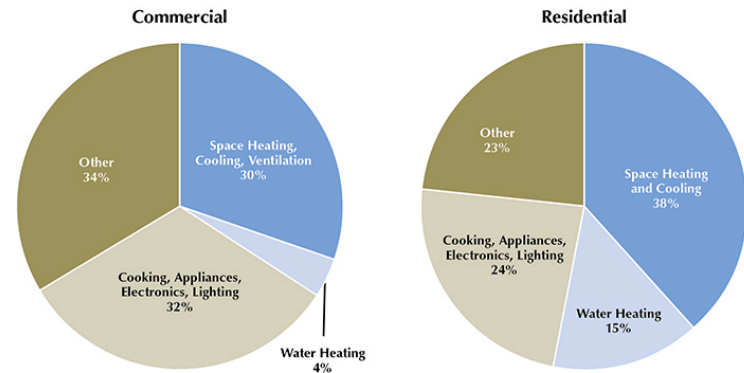
Electricity generation from natural gas and renewables increases, and the shares of nuclear and coal generation decrease—



U.S. Energy Information Administration #AEO2019 www.eia.gov/aeo 21

HVACR Still a Major Emissions Driver

FIGURE 1: Total CO₂ Emissions from the Commercial and Residential Sectors (2016)



"Other" in both the commercial and residential sector includes items such as data servers, medical imaging equipment, ceiling fans, and pool pumps which are categorized as "miscellaneous electric loads" by EIA.
Source: U.S. Energy Information Administration, Annual Energy Outlook 2018 (Washington, DC: U.S. Department of Energy, 2018).
<https://www.eia.gov/outlooks/aeo/>

Connected Devices are Ubiquitous!



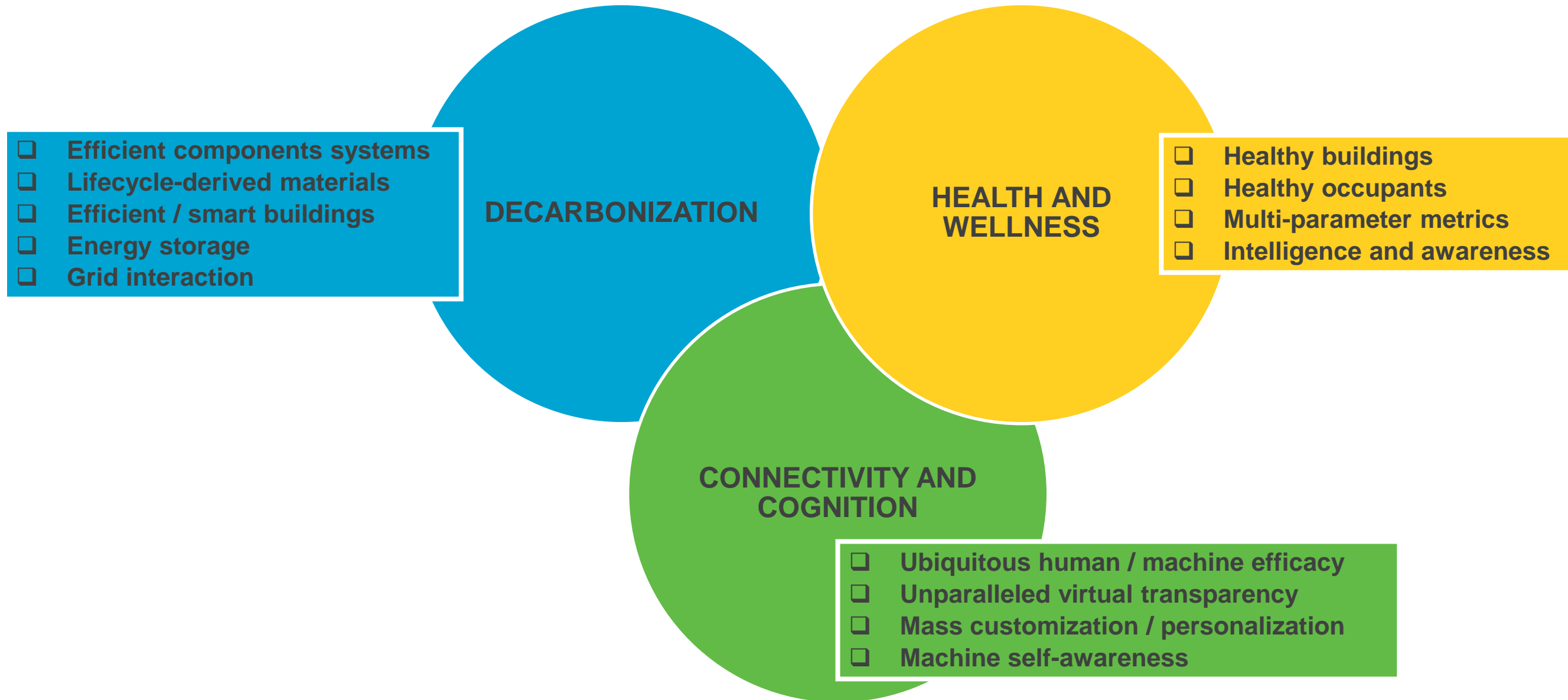
Source: SAS

Wellness as a Value



Source: FMI Corp

What Might HVACR Industry Bring to the Table?



The Future Is Bright For HVACR-led Innovation And Stewardship!

Thank You!



Questions?

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