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HFC Refrigerants in Heat Pumps

The EPA & ASHRAE have spoken!

Tuesday, March 28th, 2023

10:30am – 11:30am

Presenter: JS Rancourt
Js.rancourt@dxseng.com

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Disclaimers

1. *Our description of ASHRAE 15 2019 and 2022 is our interpretation, and engineers should always refer to the actual standard for design purposes.*

2. *The 2022 edition of ASHRAE 15 and the latest EPA rulings were only released last Fall, and we are still discussing and evaluating some clauses, and our opinions on all sections may not be final and is subject to change*

3. *Any and all snapshots from ASHRAE standards are property of ASHRAE and should not be copied or re-used without reference to ASHRAE.*

Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)

Heat pumps require high pressure HFC refrigerants, and reducing their GWP increases their flammability rating

ASHRAE/UL Standards needed to evolve, and now need to be adopted to allow these low GWP refrigerants in buildings

- ASHRAE 15 – 2019
- ASHRAE 15 – 2022

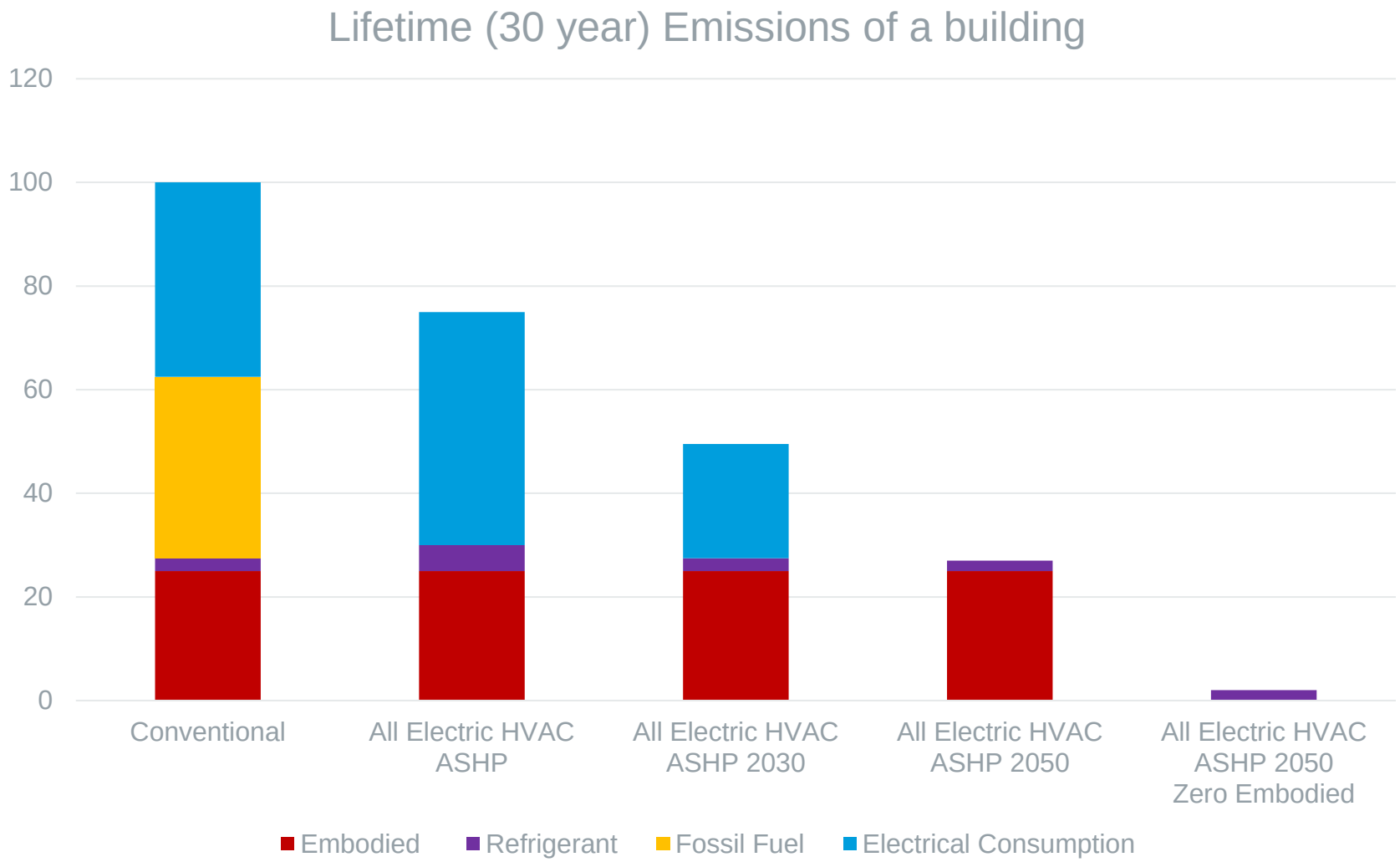
Reducing emissions from refrigerant leaks

Legislations on phasing down / out high GWP HFCs

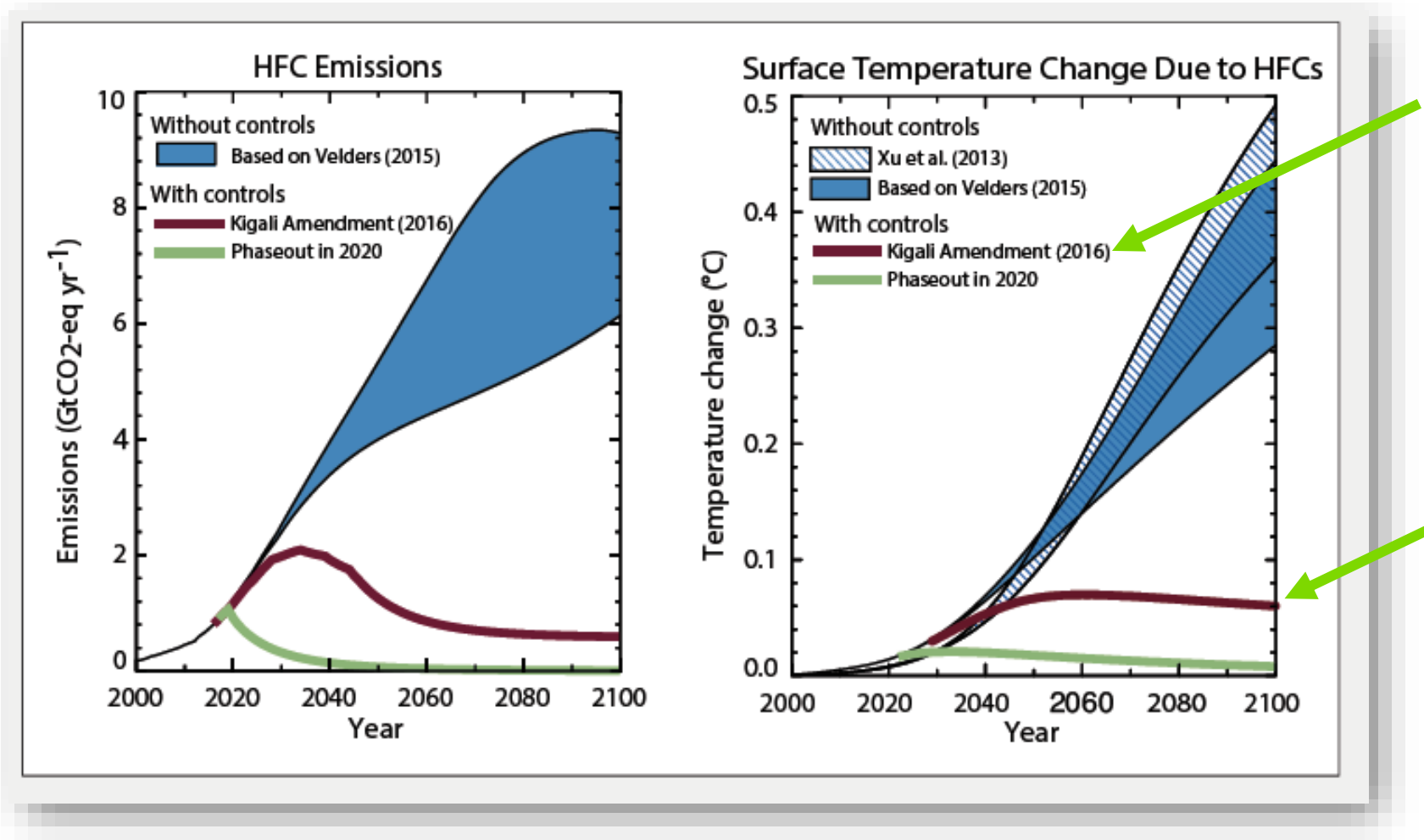
Other ways of reducing refrigerant emissions

Impacts on HVAC equipment designs and decisions today

Reducing Emissions from our Built Environment



Looking at refrigerant emissions in isolation



Still very important to address!

https://www.ccacoalition.org/en/blog/global-agreement-addressing-ozone-depletion-will-also-bring-large-climate-benefits#&gid=1&pid=1

What is more important in reducing Emissions

Electrification
&
Energy Efficiency

VS

Reducing emissions from refrigerant leaks

***The answer is**: Both are important, but make sure decisions consider overall lifetime emissions impact, and not just impacts from one potential source (such as refrigerants)*

***Hint**: Refrigerant choice can have major impacts on overall HVAC system efficiency, their ability to heat, complexity and resulting emissions*

Reducing Emissions from our Built Environment

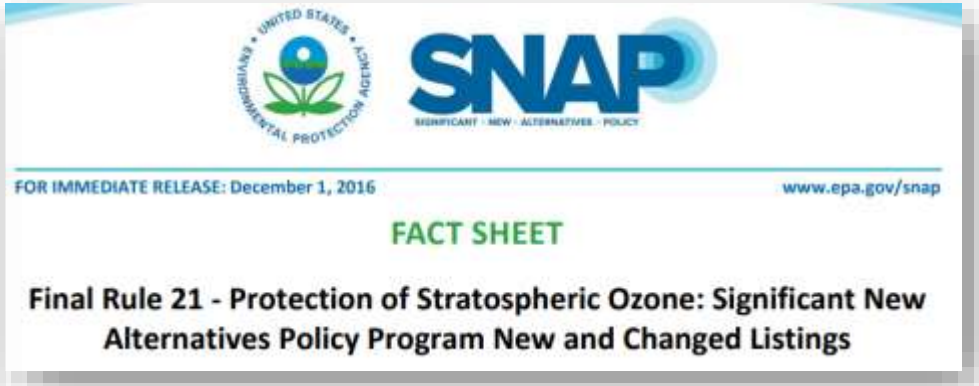
Energy efficiency & electrification (fossil fuel to heat pump conversion)

Reducing emissions from refrigerant leaks

- **Legislations on phasing down / out high GWP HFCs**

EPA History, and HFC Phase Down attempts

- Under Clean Air Act (CAA); EPA was directed to identify and evaluate substitutes for ozone-depleting substances, resulted in the phase-out of CFCs & HCFCs
- Rule 20 (2016) and 21 (2017) attempted to introduced HFC phase downs based on GWP
- These were shut down in court and were never adopted (EPA did not have the authority under the CAA)



21: Deemed a long list of HFCs unacceptable for chillers (only) starting January 1st 2024 (including R-410a)

(No reference to ASHPs or VRV)

https://www.epa.gov/sites/production/files/2016-12/documents/snap_action_scr2_factsheet.pdf
https://www.sciencedirect.com/science/article/pii/S1631071318301147#fig0015

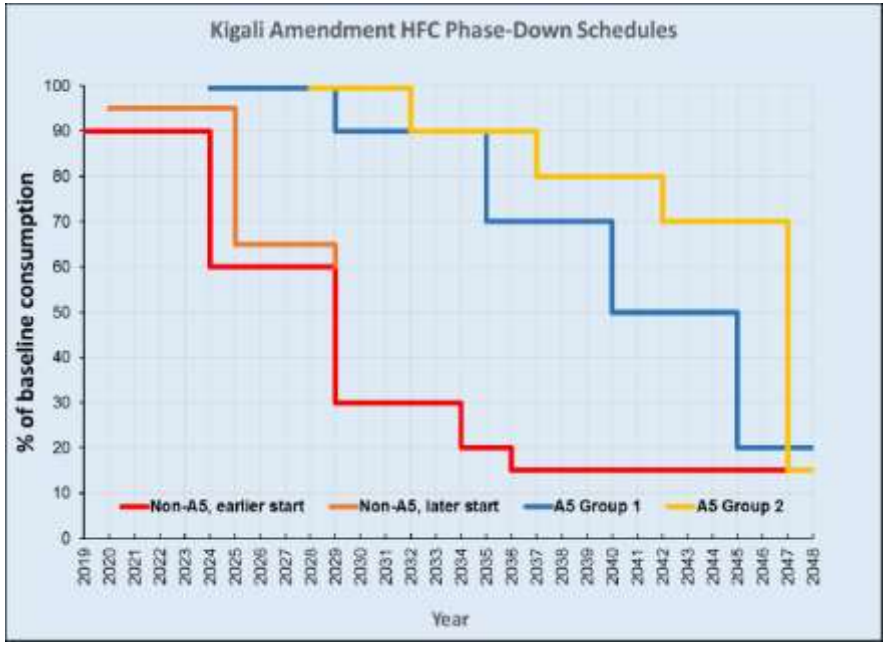
The Kigali Amendment

- Amendment to the Montreal Protocol to globally phase down HFC's (85% reduction in CO_2 tons equivalent) due to their Global Warming Potential (GWP)
- U.S. has been in and out (Obama – Trump – Biden)
- No direct legislative impact in the U.S. (until the AIM Act…)

2016
- Signed October 15th 2016 (28th meeting of the Montreal Protocol)

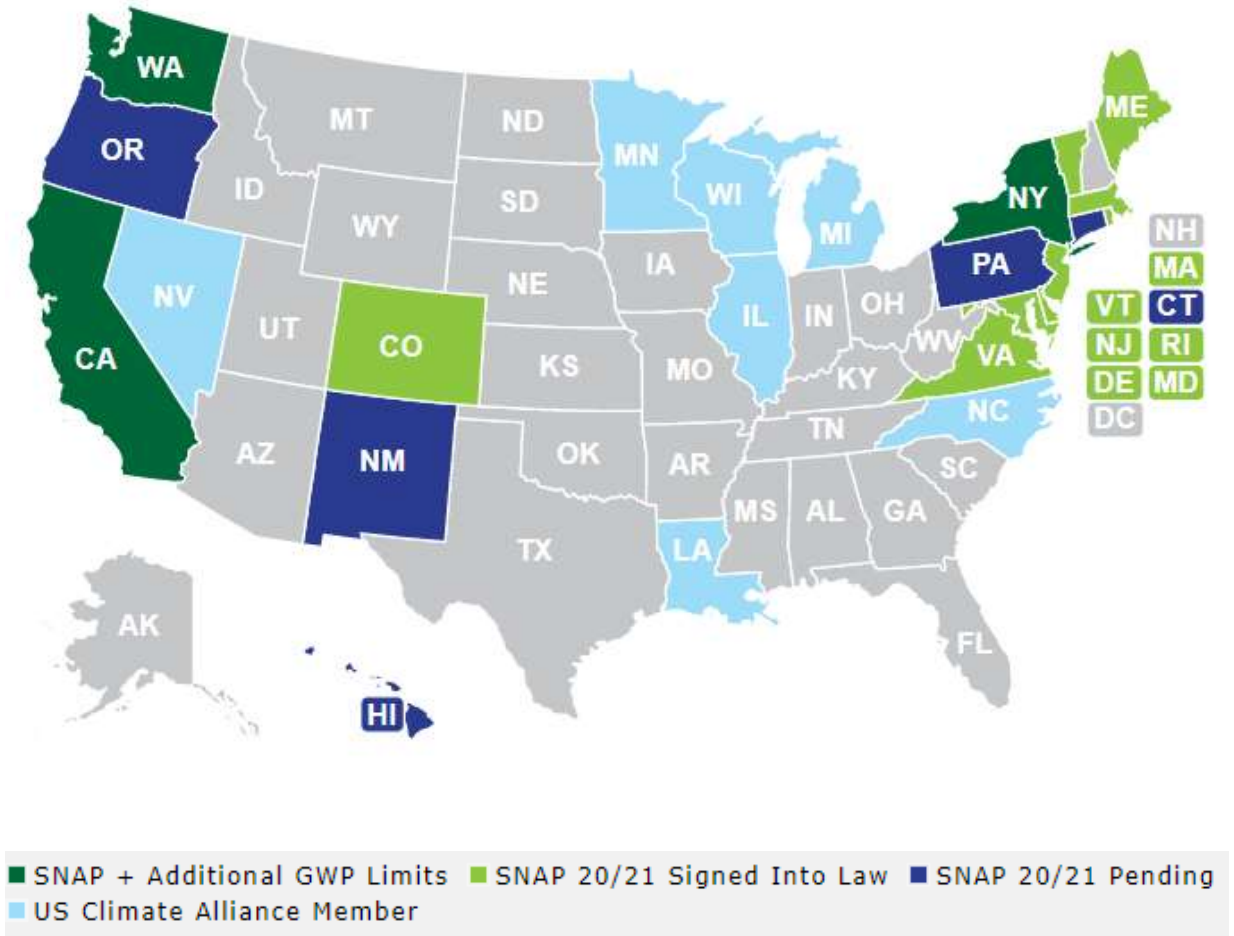
2019
- Start of the phase down for developed countries (including USA

2036
- Phase down of developed countries (including USA) by 85%



3%	Solvents, Aerosols, etc.
5%	Foams
1%	Residential refrigeration
7%	Mobile AC
32%	Stationary AC
52%	Ind/Comm refrigeration

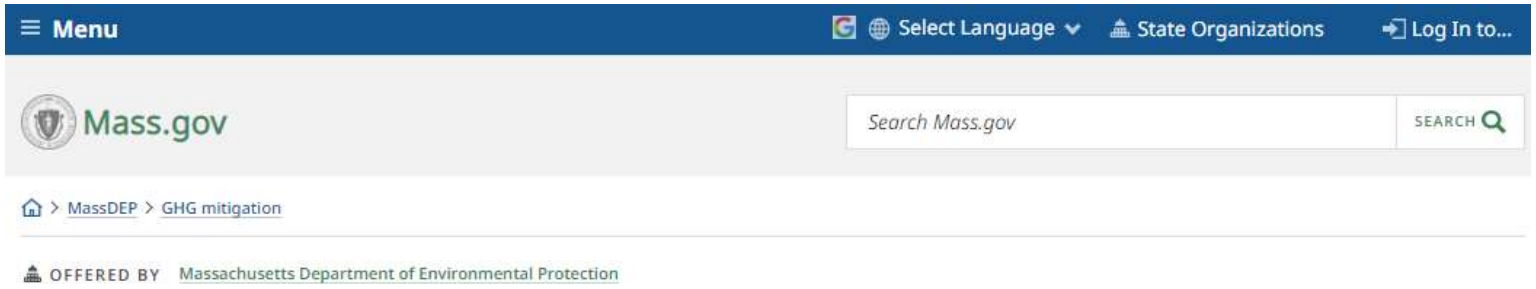
State level activity (for HFC phase downs)



- U.S. Climate Alliance states started taking matters into their own hands
- Many followed the SNAP 20/21 guidelines
- Some States are still continuing with their phase down / phase out plans in parallel to the EPA
- Both EPA rules and State rules can apply in certain States!

https://nasrc.org/hfc-policy

Massachusetts 310 CMR 7.76



Prohibitions on the Use of Certain Hydrofluorocarbons (310 CMR 7.76)

Massachusetts is phasing in bans on certain hydrofluorocarbons (HFCs) in aerosol propellants, chillers, foam, and stationary refrigeration end-uses through January 2024.

End-Use Category: Air Conditioning		
Centrifugal chillers (new)	FOR12A, FOR12B, HFC-134a, HFC-227ea, HFC-236fa, HFC245fa, R-125/ 134a/ 600a (28.1/70/1.9), R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-423A, R-424A, R-434A, R438A, R-507A, RS-44 (2003 composition), THR-03	January 1, 2024
Positive displacement chillers (new)	FOR12A, FOR12B, HFC-134a, HFC-227ea, KDD6, R125/ 134a/ 600a (28.1/70/1.9), R-125/ 290/ 134a/ 600a (55.0/1.0/42.5/1.5), R-404A, R-407C, R-410A, R-410B, R-417A, R-421A, R-422B, R-422C, R-422D, R-424A, R-434A, R-437A, R438A, R-507A, RS-44 (2003 composition), SP34E, THR-03	January 1, 2024

https://www.mass.gov/service-details/prohibitions-on-the-use-of-certain-hydrofluorocarbons-310-cmr-776

- These MA regulations are still coming into affect, and are 1 year earlier than EPA's latest rules (which cover a wider range)
- Heating only heat pumps are not included in this language
- VRV/VRF and mini/multi splits are not included in this language
- Jury is still out on whether reversible heat pumps (that also make chilled water) are included

Finally, federal direction under the AIM Act

The AIM Act

S.2754 – The American Innovation and Manufacturing Act of 2019

The AIM Act provides a highly limited and discrete grant of authority to EPA to phase down HFCs.

The Act cannot be used for any purpose other than phasing down HFCs.

The AIM Act supports a transition to next generation refrigerant technologies in 3 primary ways:

1. HFC production

HFC production and consumption is phased down over a 15-year period via a closed allowance allocation and trading program. This provides for an orderly and market- and consumer-friendly transition from HFCs.

2. EPA authorization

EPA is authorized to establish standards for the management of HFCs used as refrigerants, such as in equipment servicing and repair, and for the recovery of "used" HFCs for purification and resale, known as reclaim. This helps ensure an adequate supply of HFCs for servicing existing equipment.

3. Sector-based use restrictions

EPA can establish sector-based use restrictions, as a way to facilitate transitions to next generation refrigerant technologies. These restrictions would complement the broader production and consumption phase down, aiding sectors able to transition more quickly away from HFCs and providing more flexibility for those sectors in need of more time to complete a transition.

EPA Rules (Old news – from 2021)

- **Focuses on part 1 of 3 of AIM**: Phase down of HFC production and consumption to 15% of the 2011-2013 average by 2036
  - Follows Kigali, gets the US back on track by 2024

- **How**: Implementing HFC allowance allocation and trading program
  - 10% reduction started 1/1/2022
  - 40% reduction starting 1/1/2024

EPA Rules (Old news – from 2021)

***No* limitations on domestically reclaimed HFCs, which promotes reclaiming and recycling refrigerants. Follows CARB.**

Unfortunately, HVAC equipment not manufactured in the U.S., and imported, do not have any restrictions refrigerants.

EPA Rules (Hot news – Fall 2022)

FACT SHEET

Proposed Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act

What Does This Rule Propose?

Consistent with the AIM Act, EPA is proposing to restrict the use of certain higher-GWP HFCs in aerosols, foams, and refrigeration, air conditioning, and heat pump products and equipment. The proposed restrictions are listed by sector and subsector in Table 1 and Table 2 at the end of this document. The proposed rule would prohibit manufacture and import of products containing restricted HFCs by January 1, 2025, in most cases, and would prohibit the sale, distribution, and export of products containing restricted HFCs a year later, which in most cases would be January 1, 2026.

https://www.epa.gov/system/files/documents/2022-12/TT%20Rule%20NPRM%20Fact%20Sheet%20Final.pdf

EPA Rules (Hot news – Fall 2022)

Sectors and Subsectors	Proposed GWP Limit	Compliance Date
Automatic commercial ice machines – self-contained with refrigerant charge capacities of 500 grams or lower	150	January 1, 2025
Transport refrigeration – intermodal containers	700	January 1, 2025
Residential refrigeration systems	150	January 1, 2025
Chillers – industrial process refrigeration	700	January 1, 2025
Chillers – comfort cooling	700	January 1, 2025
Residential and light commercial air conditioning and heat pump systems	700	January 1, 2025
Residential and light commercial air conditioning – variable refrigerant flow systems	700	January 1, 2026
Residential dehumidifiers	700	January 1, 2025

https://www.epa.gov/system/files/documents/2022-12/TT%20Rule%20NPRM%20Fact%20Sheet%20Final.pdf

EPA Rules (Hot news – Fall 2022)

***The result**:*

- *VRV/VRF industry needs to shift to a refrigerant below a GWP of 700 by 1/1/26*
- *R410a VRF can be manufactured / imported until 1/1/26, and the sale and distribution can continue until 1/1/27*
- *Building codes across the country need to adopt the latest standards by then (hopefully sooner)*

https://www.epa.gov/system/files/documents/2022-12/TT%20Rule%20NPRM%20Fact%20Sheet%20Final.pdf

EPA Rules (Hot news – Fall 2022)

CARB Regulation Final

Product	Production Date
PTAC	1/1/2023
All AC/HP except *VRV*	1/1/2025
VRV	1/1/2026

GWP limit: 750

VS

EPA Regulation *EXPECTED*

Product	Production Date
All except *VRV*	1/1/2025
VRV	1/1/2026

GWP limit: 700

https://www.epa.gov/system/files/documents/2022-12/TT%20Rule%20NPRM%20Fact%20Sheet%20Final.pdf

EPA Rules (Future – existing systems)

***Rules regarding existing systems and replacements expected in 2023**:*

- *AIM act specifically protects existing systems, ensuring they can be operated, maintained, repaired and even replaced (with some restrictions) without forcing a refrigerant change*
- *CARB rules expected to come out soon, and EPA expected to align*
- *We expect a big R-410A VRV market to continue feeding this replacement industry*

https://www.epa.gov/system/files/documents/2022-12/TT%20Rule%20NPRM%20Fact%20Sheet%20Final.pdf

Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

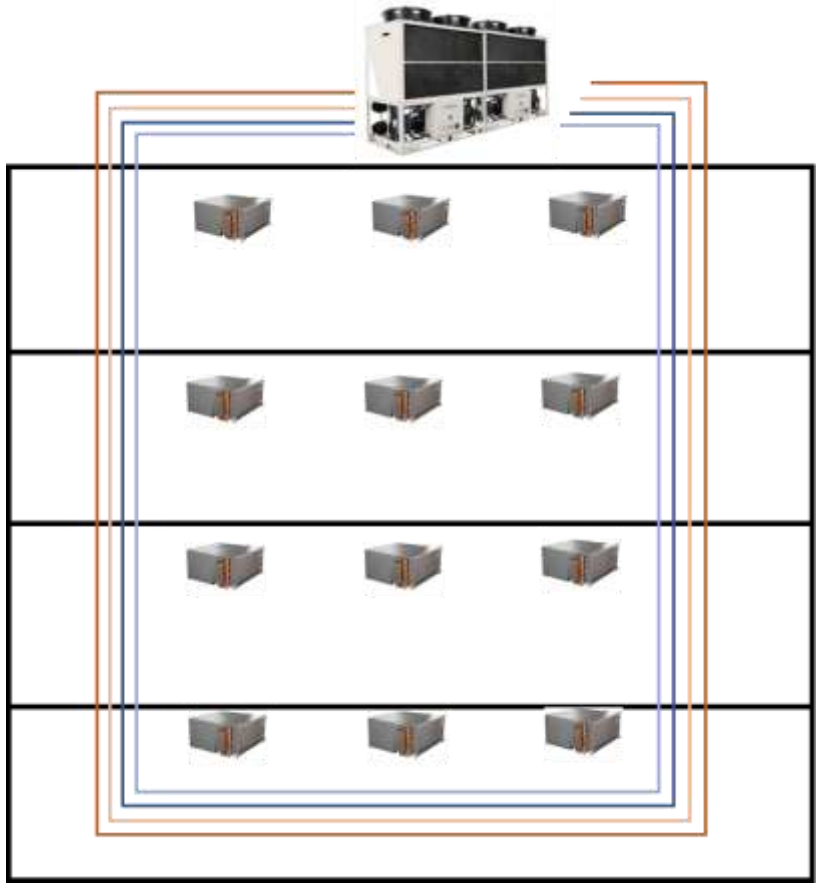
- **Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)**

Reducing emissions from refrigerant leaks

- Legislations on phasing down / out high GWP HFCs

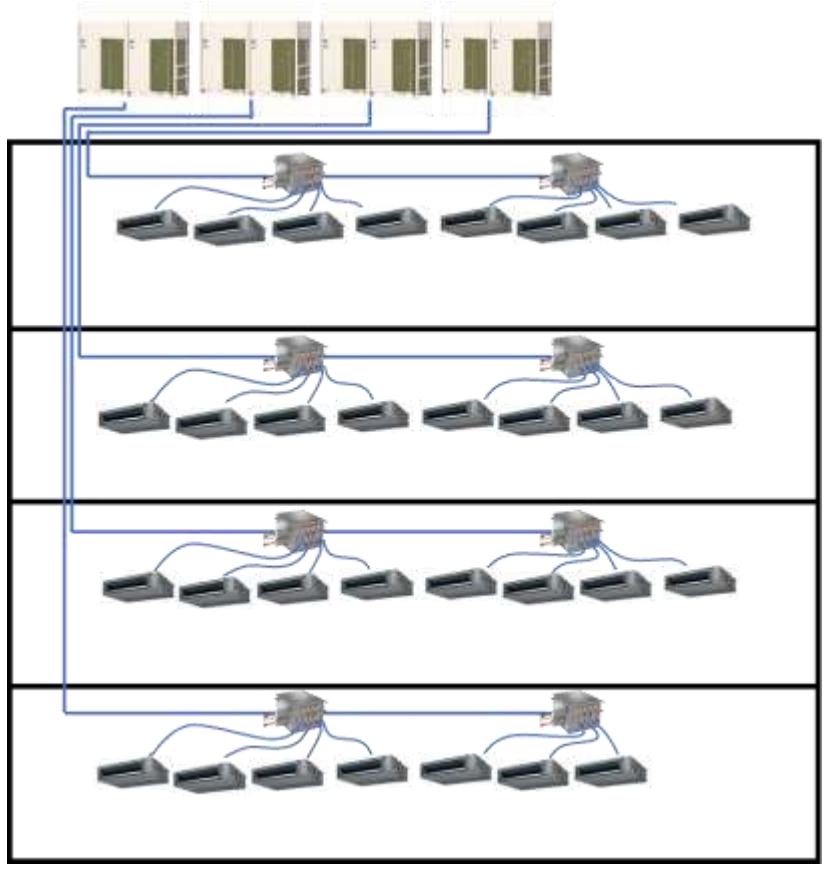
Transferring heat to water VS Direct refrigerant distribution

(Hydronic ASHP systems)



Ie. ASHP chillers to HXs to 2/4 pipe fan coils

(VRV/VRF and mini/multi splits)



Ie. VRV/VRF to Branch boxes to fan coils

Transferring heat to water VS Direct refrigerant distribution

(Hydronic ASHP systems) (VRV/VRF and mini/multi splits)

Potential Refrigerant Emissions → *More refrigerant*
Field install

← Lifetime Operational Emissions
(cold climates, until our grid is perfect)

Cold climate
Heating efficiency
No / little backup heat

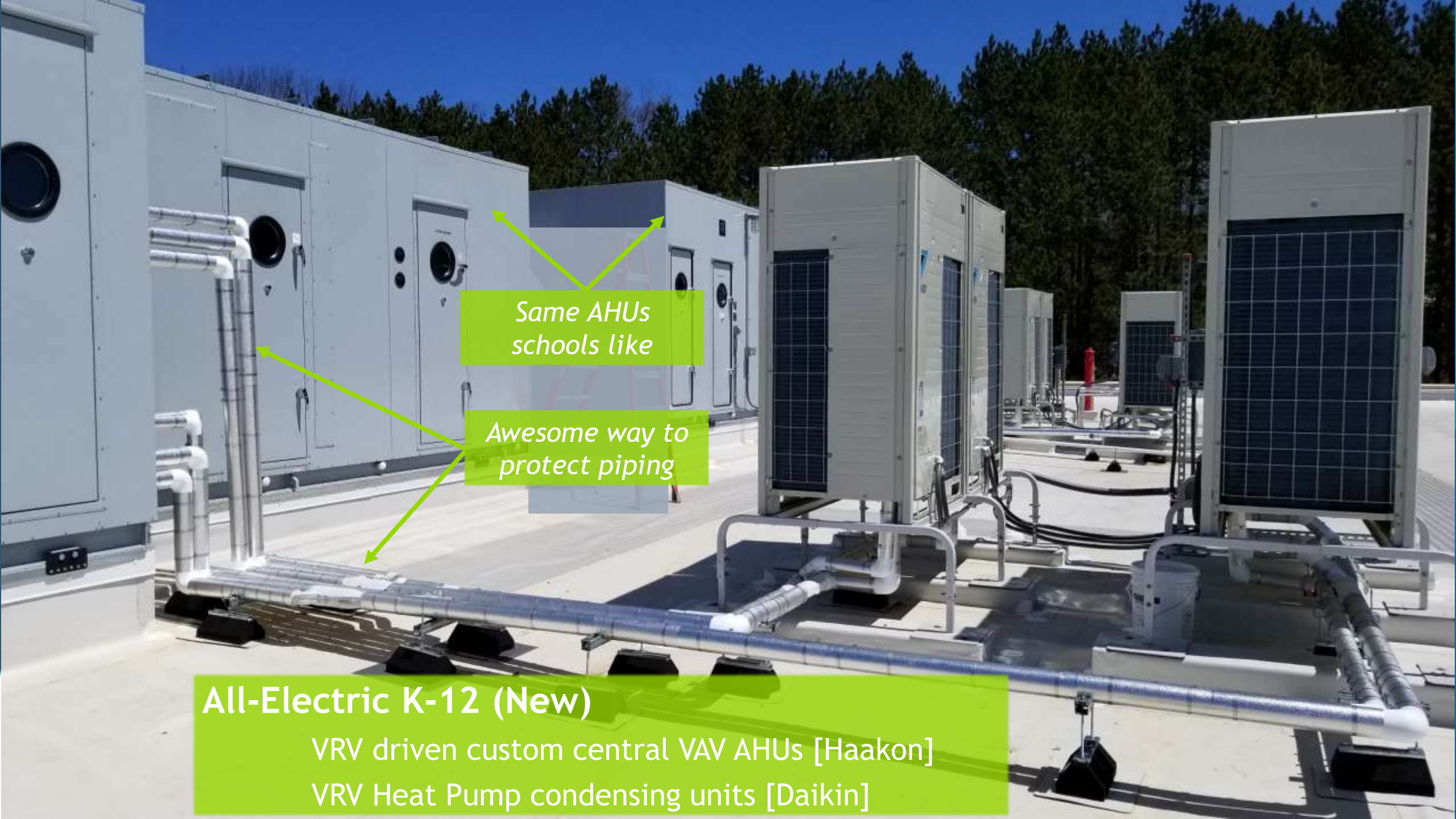
Design & Install complexity
Maintenance
Comfort
Sound
Retrofit flexibility

← Capital costs

Apples-to-apples
With VRF contractor

Other all-electric options with less refrigerant

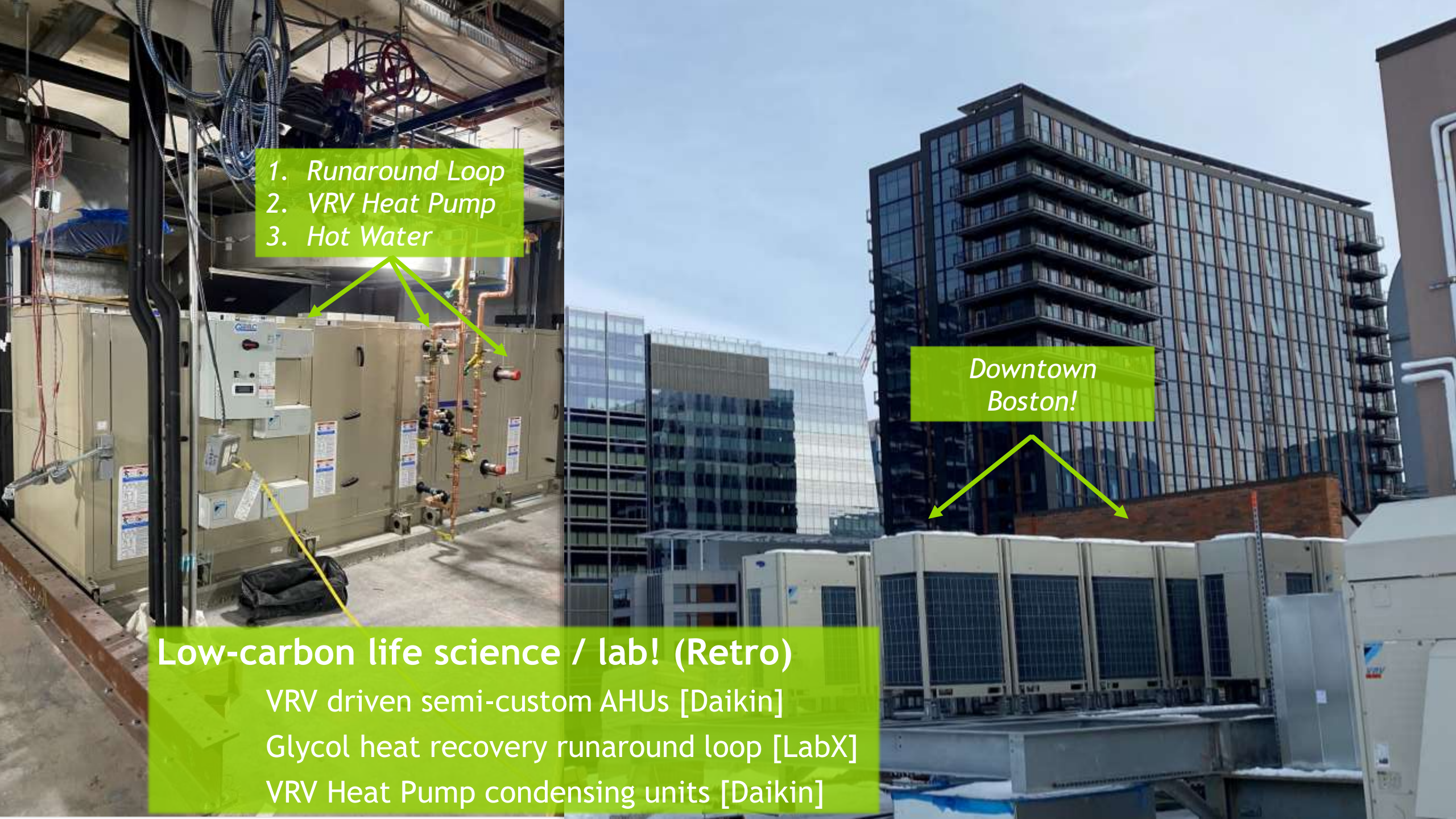
- Central Air Handling driven by VRV or Hydronic ASHPs (schools, labs, some commercial)



All-Electric K-12 (New)

VRV driven custom central VAV AHUs [Haakon]

VRV Heat Pump condensing units [Daikin]



Low-carbon life science / lab! (Retro)

- VRV driven semi-custom AHUs [Daikin]
- Glycol heat recovery runaround loop [LabX]
- VRV Heat Pump condensing units [Daikin]

Other all-electric options with less refrigerant

- Central Air Handling driven by VRV or Hydronic ASHPs (schools, labs, some commercial)
- Packaged terminal heat pump units, and all-in-one units (mainly multi-residential)


Packaged
Terminal Heat
Pump (PTHP)


PTHP with
integral ERV
(All-In-One)


Packaged
Terminal Heat
Pump (PTHP)
Vertical AHU
With integral ERV

Other all-electric options with less refrigerant

- Central Air Handling driven by VRV or Hydronic ASHPs (schools, labs, some commercial)
- Packaged terminal heat pump units, and all-in-one units (mainly multi-residential)
- Geothermal system feeding central or distributed WSHPs, or water-source VRV

Water-Souce Geothermal VRV condensing units

Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)

Heat pumps require high pressure HFC refrigerants, and reducing their GWP increases their flammability rating

Reducing emissions from refrigerant leaks

Legislations on phasing down / out high GWP HFCs

ASHRAE Standard 34 – Designation and Safety Classification of Refrigerants

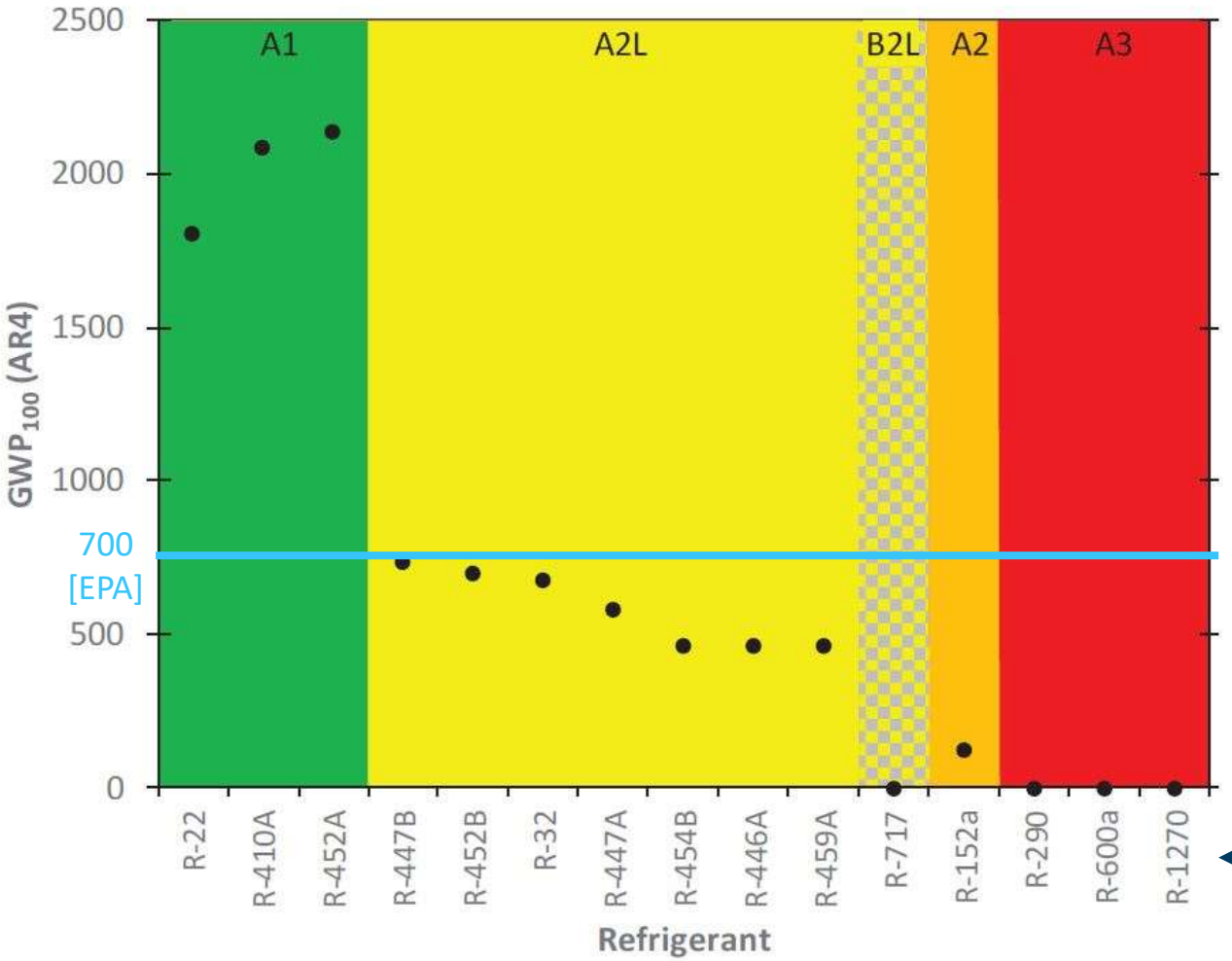
Higher Flammability	A3	B3
Lower Flammability	A2	B2
	R-32 R-454B A2L*	B2L*
No Flame Propagation	R-410A A1	B1
	Lower Toxicity	Higher Toxicity

- All refrigerants can be combusted when put into a high-energy situation such as a fire
  - *There is no class called "non-flammable"*

- **Class 1**: no flame propagation (at testing standard of 140F)
  - *Class 2 & 3 have flame propagation at 140F*
- **Class 2**: lower flammability
- **Class 3**: higher flammability (LFL < 0.10 kg/m3 or Heat of Combustion HOC > 19 kJ/g)

*New flammability subclass for class 2 refrigerants that burn very slow
- *2L have slow velocities; <10 cm/sec ~ 20ft/minute*

Why is transitioning (high pressure HFCs) to low GWP so hard?



- Flammability and GWP are essentially <u>inversely proportional</u>

GWP vs Flammability

- More Fluorine results in more stables chemicals. Great to reduce flammability, bad for GWP as it doesn't breakdown

High Pressure Refrigerants

A1 vs A2L Flammability comparison

R-410A, the most common air conditioning refrigerant in use globally today, is not actually "non-flammable." It is ASHRAE-listed as an A1 refrigerant, meaning that it has no flame propagation at 63°C.

R-410A behaves very similarly to R-32 especially when exposed to higher temperatures (e.g., a fire impacting AC equipment).[2 3]

As confirmed by AHRI research[4], it takes three failures in a system to ignite an A2L refrigerant used in air conditioning equipment. Failures required include the following:

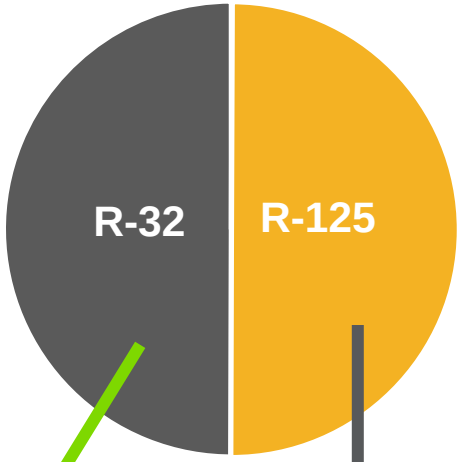
a. There would have to be a significant refrigerant leak.
b. The leak would have to be sufficient to reach the lower flammability limit (LFL) concentration. LFL concentrations for A2Ls are above 10%.
c. There would have to be an open flame or a high energy ignition source where the concentration is sufficient to ignite A2L refrigerants.

http://www.ahrinet.org/App_Content/ahri/files/Resources/AHRI_SRTTF_Low_GWP_Refrigerants_FAQs.pdf

R-410a Alternatives

R-410A

2088 GWP



Class: A1

Awesome refrigerant

Something less awesome, but results in an A1 classification

R-32

675 GWP

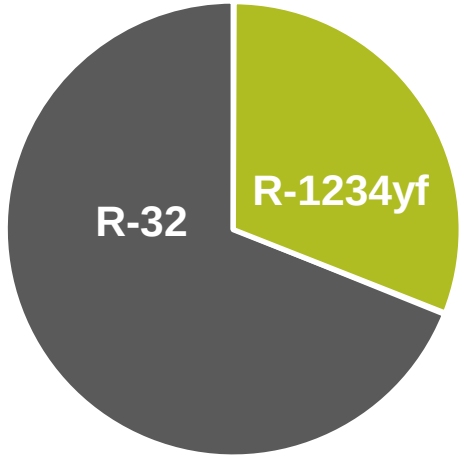
Class: A2L

vs R-410a

- Capacity (quantity)
- Efficiency
- Not a blend
- Availability
- Ownership / Patent
- 190M global installs
  60 OEMs in 120 countries

R-454B

466 GWP



Class: A2L

vs R-32

- Capacity (quantity)
- Efficiency
- Availability
- Ownership / Patent
- Equipment in dev
- Blend

R-32: Non-proprietary, open to the world

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Home / World News / Daikin VRV brings R32 to the larger build

Daikin VRV brings building

5 NOV 2021

BELGIUM: Daikin Europe has released details of VRV 5 He lower flammability refrigerant R32 in medium to large bui

ACR new

NEWS FEATURES JOBS TRAINING

Product News

30 June 2022

The drive for effective Daikin's VRV R32 heat

To drive the decarbonisation of buildings fo direct and indirect CO2eq impact. Daikin ha efficiency in real life conditions, minimisin market-leading seasonal efficiency, with a the previous generation. Additionally, Daiki system, which allows simultaneous cooling control as well as virtually free heating by t cooling to those that need heating.

VRV 5 Heat Recovery has been engineered sp Potential (GWP) refrigerant R-32. The GWP and also carries heat more effectively, together leading up to a 71% reduction in the system's potential direct carbon dioxide equivalent (CO2eq) emissions. R-32 is also a

Home World News

Home / News Headlines / Daikin gives free access

Daikin gives fr patents

10 SEP 2015

JAPAN: In a move to encourage the adoption refrigerant, Daikin is to offer rival manufacture worldwide free access to its patents.

The patents on the production of R32 have al expired, but Daikin holds a large number of p governing the use of the lower GWP refrigera conditioning systems. The emerging markets have free access to these patents, and now, in unprecedented move, Daikin is offering comp worldwide similar free access to 93 separate R patents.

COOLING POST

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Home / World News / Daikin releases more R32 patents

Daikin releases more R32 patents

1 JUL 2021

JAPAN: Daikin has released a further 123 patents related to the manufacture and use of R32 refrigerant in air conditioners.

Daikin's latest announcement enables a total of 299 of its R32 patents to be used free of charge without the need for prior permission or contract.

VRV/VRF in Europe (R-32 Alignment)

New R32 VRF air conditioning provides complete solution

Mitsubishi Electric has launched new
first complete range of lower Global W

The R32 City Multi YNW range is avai
conditioning systems. For the first time
complete building or an entire network

Potential (GWP)
and also carries
system's potenti

les.mitsubishielectric.co.uk/products/air-conditioning/city-multi-vrf/vrf-outdoor/heat-recovery-outdoor-unit

MITSUBISHI ELECTRIC Changes for the Better | UNITED KINGDOM

HOMEOWNERS | INSTALLERS | SPECIFIERS | END USERS | HOUSING DEVELOPERS | PRODUCTS | Contact | Search for

Heat Recovery Outdoor Unit

Many buildings require a mix of simultaneous heating and cooling. The outstanding City Multi R2 system meets this requirement by distributing surplus heat from cooling operations (and vice versa) to rooms where it is needed. This efficiency can result in energy savings of up to 30% over conventional systems.

Make an Enquiry

R2 Series High Efficiency Heat Recovery (YNW)

R32 VRF heat recovery outdoor units available from 22-34kW, compliment the widest range of innovative VRF solutions available on the market. They deliver lower GWP solutions and offer customers the ability to use one single refrigerant across a complete building or an entire network.

Available in: 22.0kW, 28.0kW, 34.0kW

View Product

R2 Series Standard Heat Recovery (YNW)

R32 VRF heat recovery outdoor units available from 22-34kW, compliment the widest range of innovative VRF solutions available on the market. They deliver lower GWP solutions and offer customers the ability to use one single refrigerant across a complete building or an entire network.

Available in: 22.4kW, 28.0kW, 34.0kW

View Product

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ASHRAE/UL Standards needed to evolve, and now need to be adopted to allow these low GWP refrigerants in buildings

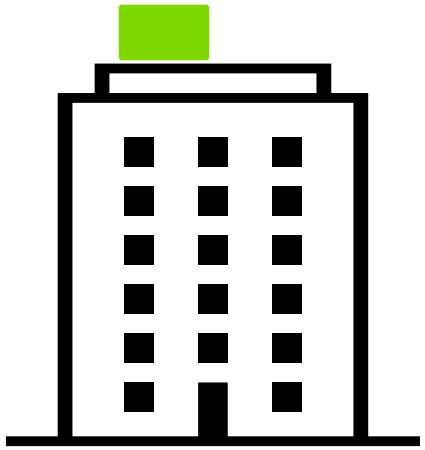
- **ASHRAE 15 – 2019**

Reducing emissions from refrigerant leaks

Legislations on phasing down / out high GWP HFCs

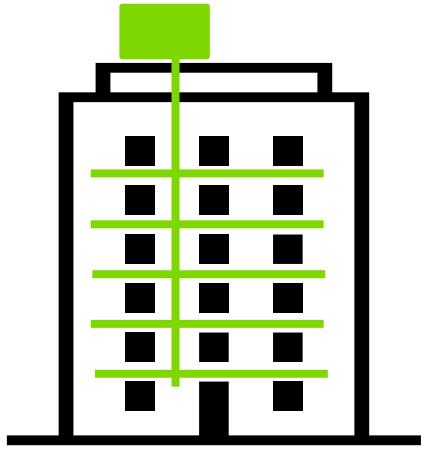
ASHRAE Standard 15

- Application standard for refrigerant systems with a focus on health & safety
- Version currently followed by *most* U.S. building codes (2013 or 2016) does NOT allow class A2L refrigerants in occupied spaces (or A2, A3, B1, B2, B3)



Outdoor chillers: A2L's OK
- Not high-probability

Very small systems: A2L's OK
- Very low refrigerant charge



VRV / ASHP: A2L's not ok (yet)
- High-probability

ASHRAE Standard 15 – 2019

7.6 Group A2L *Refrigerants* for Human Comfort. High-probability systems using Group A2L *refrigerants* for human comfort applications *shall* comply with this section.

7.6.1 *Refrigerant Concentration Limits*

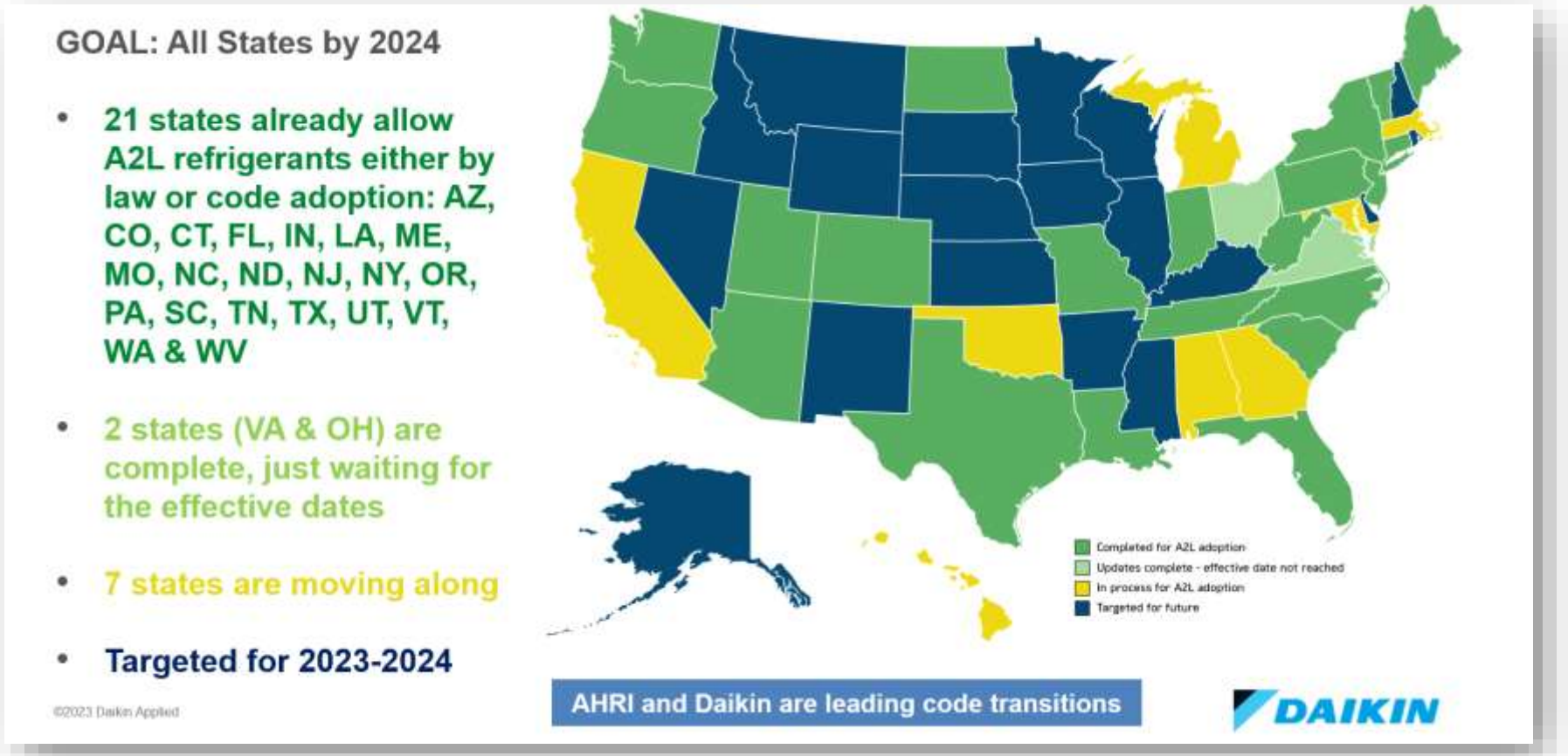
7.6.1.1 *Occupied spaces shall* comply with Section 7.2.

A2L

The 2019 version of the standard partially allows the use of A2L refrigerants in buildings

(basically limited to systems below 4.1 lbs of A2L refrigerant)

ASHRAE Standard 15 – 2019 (Code Adoption)



- Some States have already adopted ASHRAE 15 – 2019, others are on their way
- Some were done by legislation while others advanced through the normal code change process
- ASHRAE 15 – 2019 is carried in IMC **2021** (MA: 10th Edition Building Code 7/1/23)

ASHRAE Standard 15 – 2019

DAIKIN

News Release

Contact: Marc Bellanger - Director of Marketing & Communications - 713.263.5505 DaikinMedia@DaikinComfort.com

Daikin Announces Daikin *ATMOSPHERA* with *R-32 Refrigerant*

The first single zone system with R-32 in North America features impressive efficiency gains while reducing emissions vs. R-410A

HOUSTON, December 21, 2021 – For the first time in North America, Daikin is launching a home comfort product featuring R-32, a refrigerant with one-third the Global Warming Potential (GWP) of the most common refrigerants currently being used in the United States and Canada.

The new Daikin *ATMOSPHERA* system featuring R-32 refrigerant from Daikin North America LLC is a single zone, ductless system that gains impressive efficiencies over its R-410A predecessor line, the LV Series, with up to 27.4 SEER, 13.8 HSPF and 16.3 EER ratings for ultra-efficient cooling and heating. Four sizes of indoor and outdoor heat pumps are available, from 9,000 to 24,000 BTU.

"Daikin has sold over 33 million R-32 systems in more than 100 countries and regions," said Takayuki (Taka) Inoue, Executive Vice President and Chief Sales and Marketing Officer. "We are excited to be the first to bring this proven technology to North America. With an estimated 160 million R-32 systems sold by Daikin combined with other manufacturers worldwide, we are confident R-32 has the all-around performance benefits to make it the ideal replacement for R-410A."

Job Name:	
Tag#	

DAIKIN

Submittal Data Sheet	FTXM24VVJU / RXM24VVJU
2-Ton Wall Mounted Heat Pump System	

12 YEAR PARTS LIMITED WARRANTY

Complete warranty details available from your local dealer or at www.daikincomfort.com. To receive the 12 Year Parts Limited Warranty, online registration must be completed within 60 days of installation. Online registration is not required in California or Quebec. *If product is installed in a commercial application, limited warranty period is 5 years.*

Efficiency

Cooling		Heating	
SEER	22	HSPF	12.5
EER	12.5	COP	3.54

Performance

Cooling (Btu/hr)	
Rated (Min/Max)	21,600 (9,000 / 26,000)
Sensible @ AHRI	16,200
Standard Operating Range	50°F – 114.8°F
Extended Operating Range*	-4°F – 114.8°F

Rated Cooling Conditions: Indoor: 80°F DB/67°F WB; Outdoor: 95°F DB/75°F WB

*With field settings and wind baffle

Heating (Btu/hr)	
1: @ 47° Rated (Min/Max)	24,000 (9,000 / 32,200)
2: @ 17° Rated	16,000
3: @ 5° Max: Capacity / COP	24,000 / 1.8
Operating Range	-13°F – 64.4°F

1: Rated Heating Conditions: Indoor: 70°F DB/60°F WB; Outdoor: 47°F DB/43°F WB

2: Rated Heating Conditions: Indoor: 70°F DB/60°F WB; Outdoor: 17°F DB/15°F WB

3: Heating Conditions: Compressor Operating at Max Frequency: Indoor: 70°F DB/60°F WB; Outdoor: 5°F DB/5°F WB

Indoor Specifications

	Cooling		Heating	
	H	M	H	M
Airflow Rate (cfm)	845	652	845	606
	L	SL	L	SL
	498	451	498	451
Sound (dBA) H / M / L / SL	51 / 44 / 37 / 34		51 / 42 / 37 / 34	
Dimensions (H × W × D) (in)	11-3/4 × 43-5/16 × 10-13/16			
Weight (Lbs)	33			

Outdoor Specifications

Compressor	Hermetically Sealed Swing Type			
Refrigerant	R-32			
Factory Charge (Lbs)	2.98			
Refrigerant Oil	FW68DA			
	Cooling		Heating	
Airflow Rate (cfm)	H	2,179	H	2,119
	SL	1,833	SL	1,833
Sound Pressure Level (dBA)	55 / 56			
Dimensions (H × W × D) (in)	28-15/16 × 34-1/4 × 12-5/8			
Weight (Lbs)	132			

Electrical

	208/60/1	230/60/1
System MCA	19.8	19.8
System MFA	20	20
Compressor RLA	19.25	19.25
Outdoor fan motor FLA	.58	.58
Outdoor fan motor W	123	123
Indoor fan motor FLA	.46	.46
Indoor fan motor W	61	61

MFA: Max. fuse amps MCA: Min. circuit amps (A) FLA: Full load amps (A) RLA: Rated load amps (A) W: Fan motor rated output (W)

Piping

Liquid (in)	1/4
Gas (in)	5/8
Drain (in)	5/8
Max. Interunit Piping Length (ft)	98.5
Max. Interunit Height Difference (ft)	82.02
Chargeless (ft)	49.2
Additional Charge of Refrigerant (oz/ft)	.22

Daikin North America LLC 5151 San Felipe, Suite 500 Houston, TX 77056

(Daikin's products are subject to continuous improvements. Daikin reserves the right to modify product design, specifications and information in this data sheet without notice and without incurring any obligations)

Submittal Creation Date: August 2021

Page 1 of 4

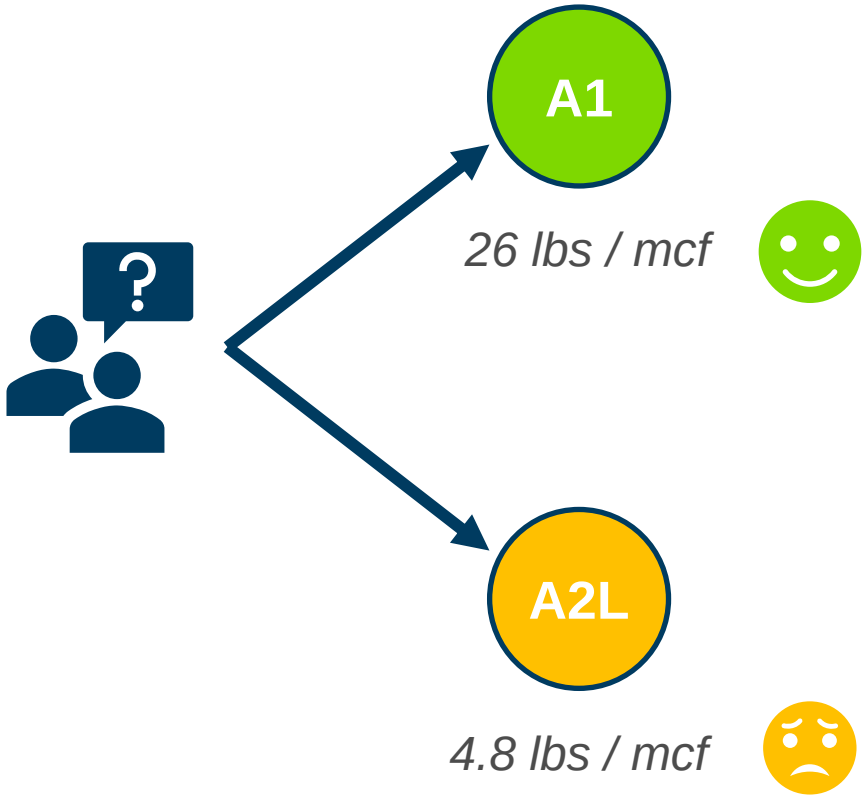
ASHRAE Standard 15 – 2019 (RCL Issue)

7.3 Volume Calculations. The volume used to convert from *refrigerant concentration limits* to *refrigerating system* quantity limits for *refrigerants* in Section 7.2 *shall* be based on the volume of space to which *refrigerant* disperses in the event of a *refrigerant* leak.

7.3.1 Nonconnecting Spaces. Where a *refrigerating system*, or a part thereof, is located in one or more enclosed *occupied spaces* that do not connect through permanent openings or HVAC *ducts*, the volume of the smallest *occupied space shall* be used to determine the *refrigerant* quantity limit in the system. Where different stories and floor levels connect through an open atrium or mezzanine arrangement, the volume to be used in calculating the *refrigerant* quantity limit *shall* be determined by multiplying the floor area of the lowest space by 8.2 ft (2.5 m).

7.3.2 Ventilated Spaces. Where a *refrigerating system*, or a part thereof, is located within an air handler, in an air distribution *duct* system, or in an *occupied space* served by a mechanical ventilation system, the entire air distribution system *shall* be analyzed to determine the worst-case distribution of leaked *refrigerant*. The worst case or the smallest volume in which the leaked *refrigerant* disperses *shall* be used to determine the *refrigerant* quantity limit in the system, subject to the following criteria.

7.3.2.1 Closures. Closures in the air distribution system *shall* be considered. If one or more spaces of several arranged in parallel can be closed off from the source of the *refrigerant* leak, their volumes *shall not* be used in the calculation.



Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)

Heat pumps require high pressure HFC refrigerants, and reducing their GWP increases their flammability rating

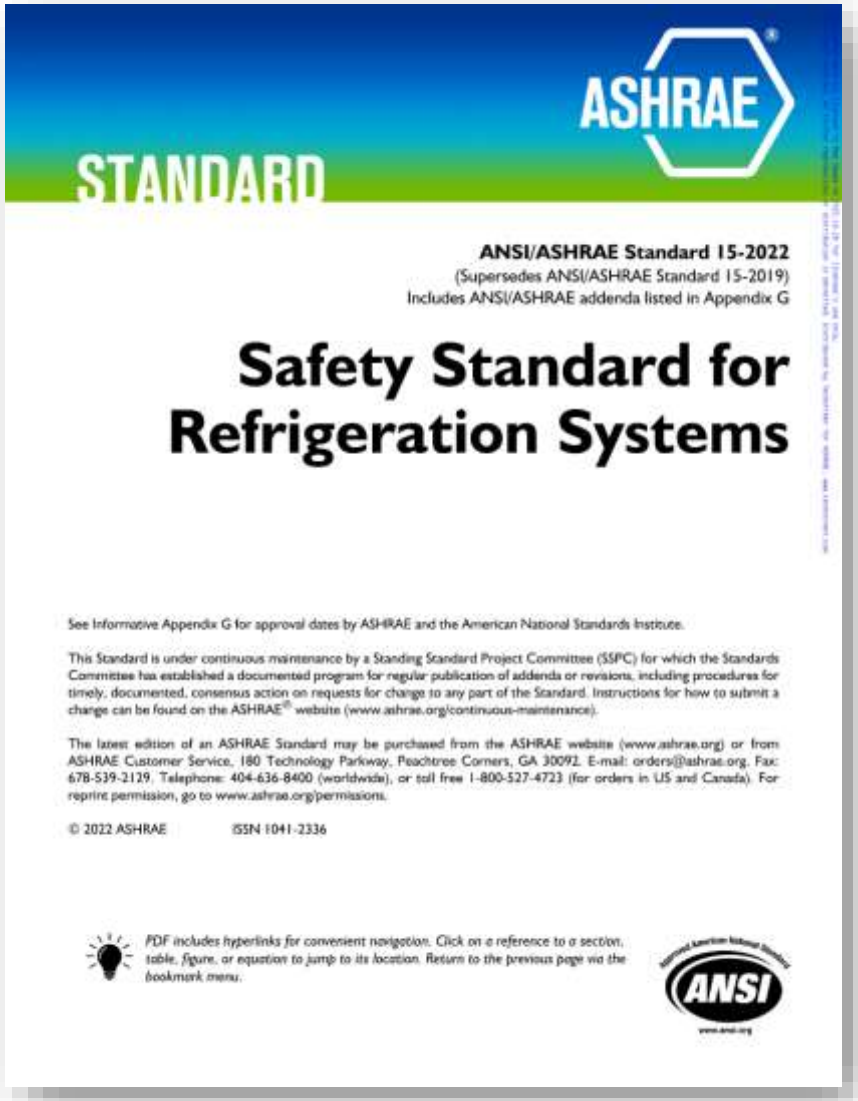
ASHRAE/UL Standards needed to evolve, and now need to be adopted to allow these low GWP refrigerants in buildings

- ASHRAE 15 – 2019
- **ASHRAE 15 – 2022**

Reducing emissions from refrigerant leaks

Legislations on phasing down / out high GWP HFCs

ASHRAE Standard 15 - 2022


STANDARD

ASHRAE

ANSI/ASHRAE Standard 15-2022
(Supersedes ANSI/ASHRAE Standard 15-2019)
Includes ANSI/ASHRAE addenda listed in Appendix G

Safety Standard for Refrigeration Systems

See Informative Appendix G for approval dates by ASHRAE and the American National Standards Institute.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the Standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

The latest edition of an ASHRAE Standard may be purchased from the ASHRAE website (www.ashrae.org) or from ASHRAE Customer Service, 180 Technology Parkway, Peachtree Corners, GA 30092. E-mail: orders@ashrae.org. Fax: 678-539-2129. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada). For reprint permission, go to www.ashrae.org/permissions.

 ISSN 1041-2336

PDF includes hyperlinks for convenient navigation. Click on a reference to a section, table, figure, or equation to jump to its location. Return to the previous page via the bookmark menu.

ANSI

- The ASHRAE Standard 15 committee did a fantastic job! Released Fall 2022
- The standard has multiple long-awaited clarifications and definitions for the VRF industry
- The standard provides different options for the application of A2L refrigerants
- Results in increased safety for VRF systems
- Results in a reduction in refrigerant leakage and associated emissions
- Alignment with IEC 60335-2-40

https://www.ashrae.org/technical-resources/bookstore/ashrae-refrigeration-resources

ASHRAE Standard 15 - 2022

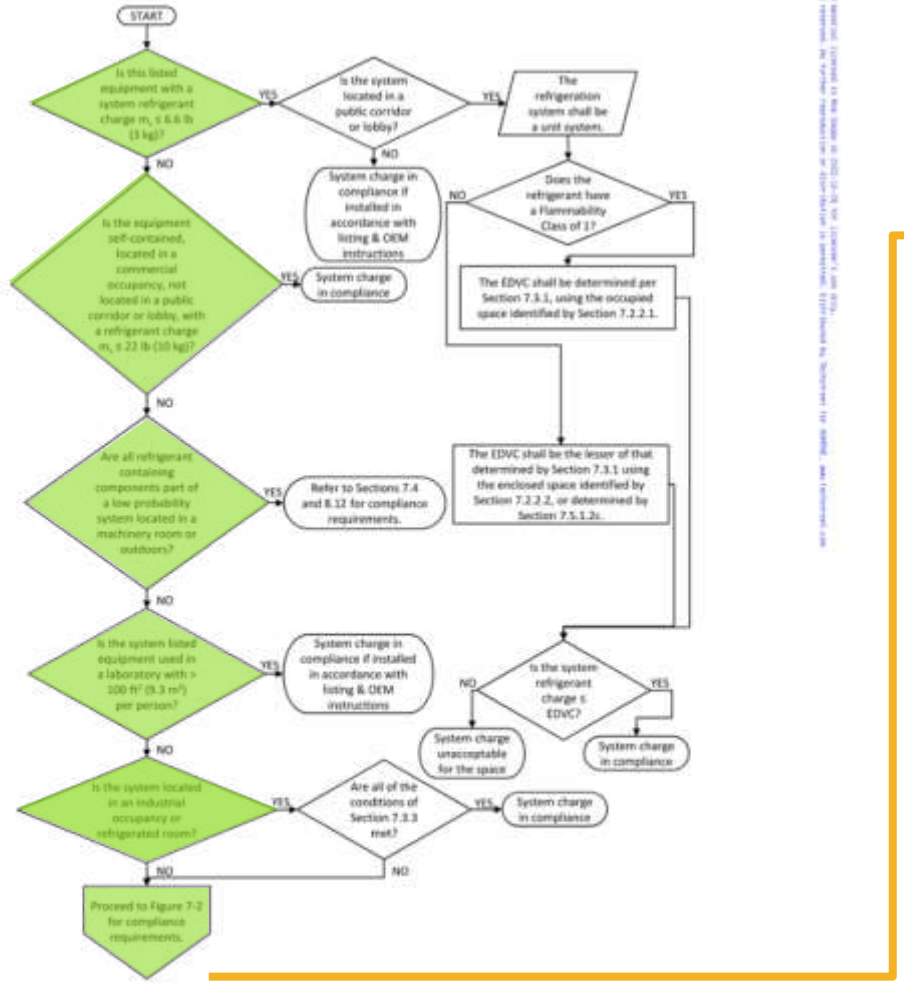


Figure 7-1 Refrigerant system charge limit compliance path—Part 1.

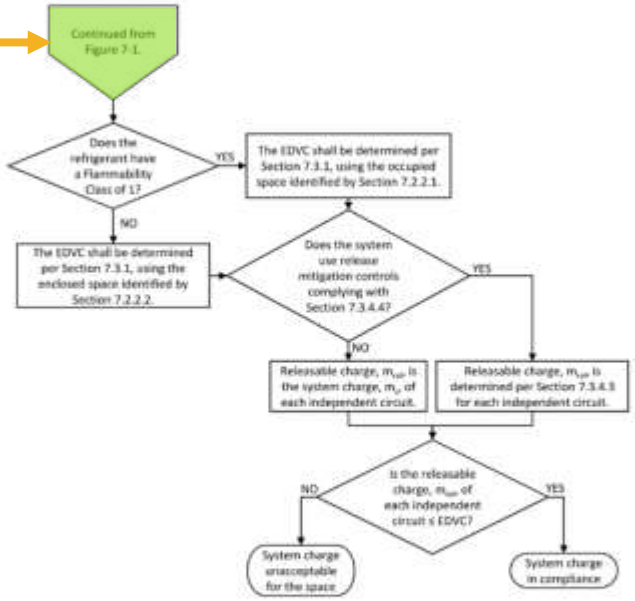
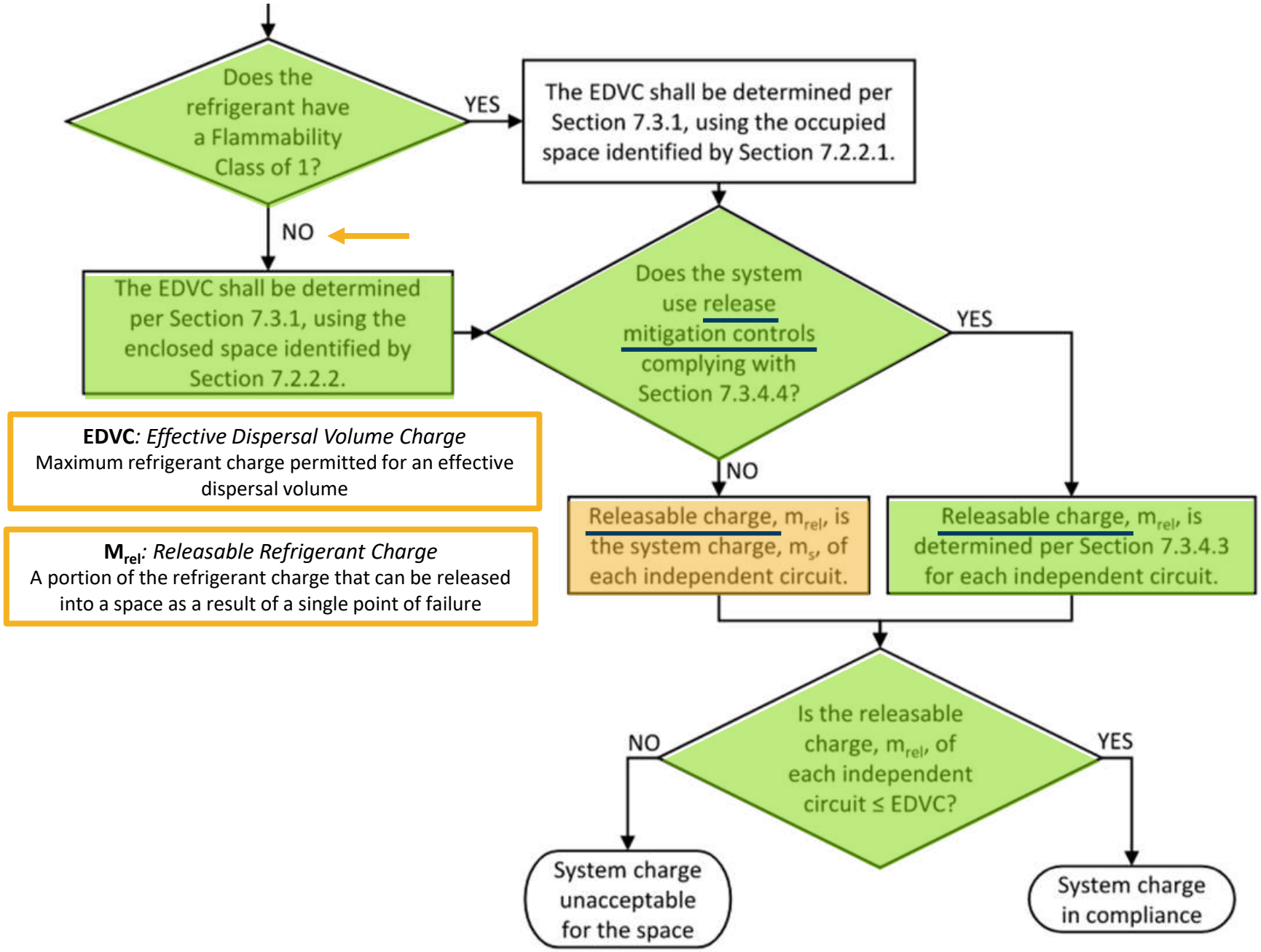


Figure 7-2 Refrigerant system charge limit compliance path—Part 2.

https://www.ashrae.org/technical-resources/bookstore/ashrae-refrigeration-resources

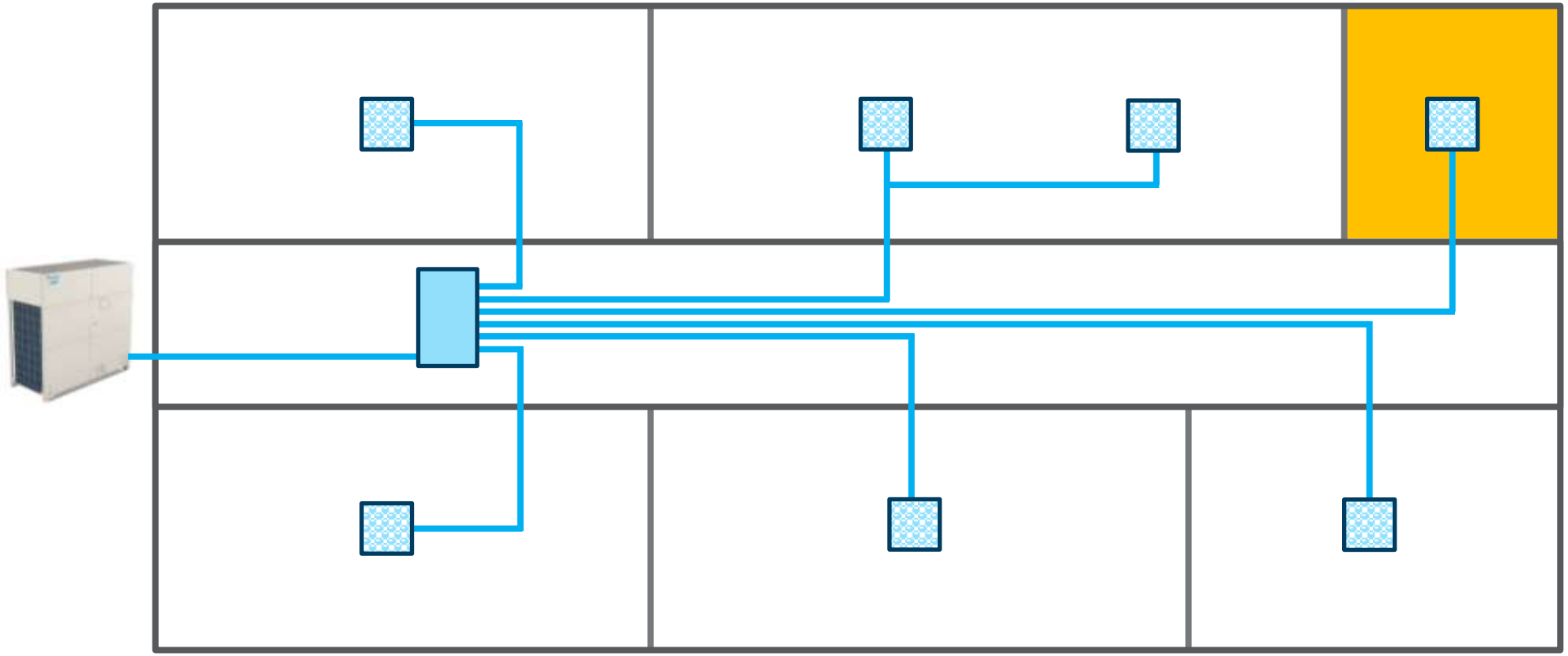


EDVC: *Effective Dispersal Volume Charge*
Maximum refrigerant charge permitted for an effective dispersal volume

M_{rel}: *Releasable Refrigerant Charge*
A portion of the refrigerant charge that can be released into a space as a result of a single point of failure

ASHRAE Std 15 – 2022 (Our interpretation!)

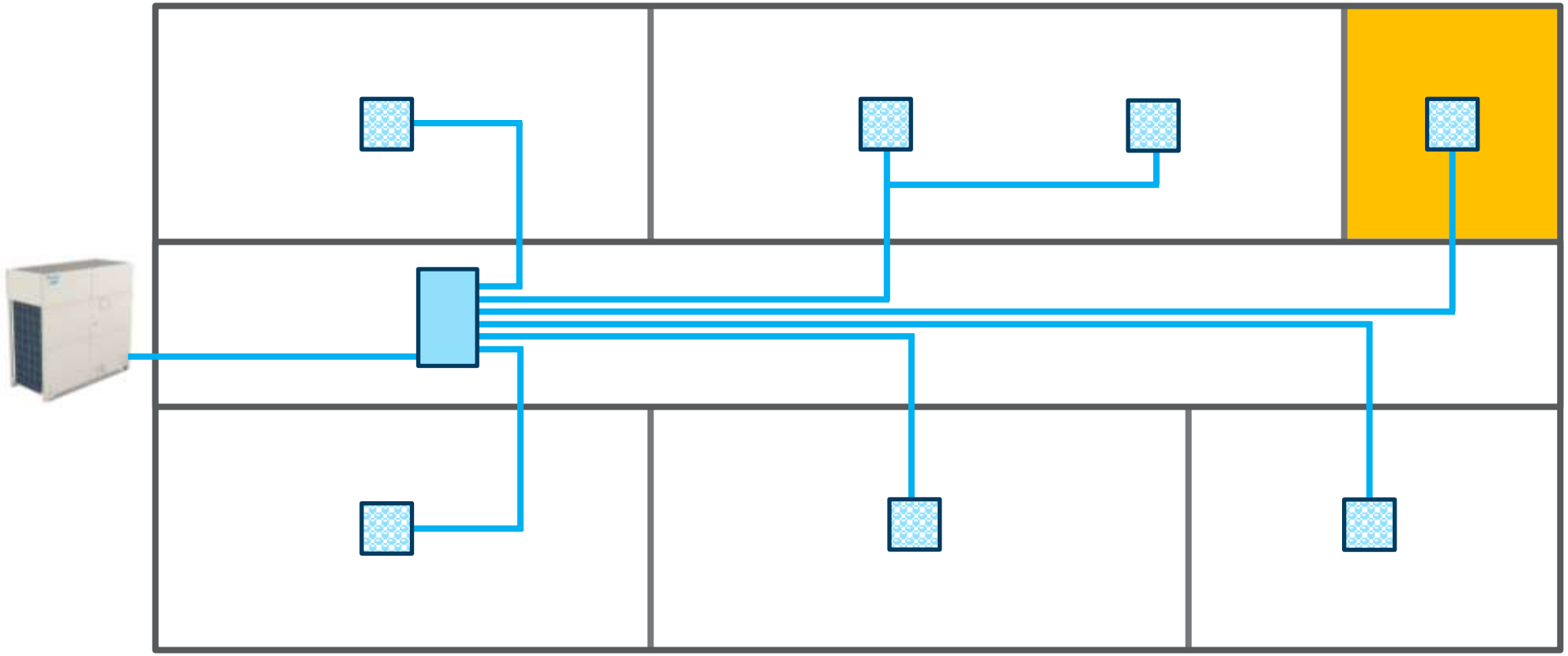
R-410A



1. Smallest room: 15’ x 15’ x 8’ = 1,800 cubic feet
2. Allowable charge = volume x RCL = 1,800 x **26** / 1000 = 46.8 lbs or R-410A
3. Releasable charge = full system charge = 40 lbs
4. 40 < 46.8 system in compliance

ASHRAE Std 15 – 2022 (Our interpretation!)

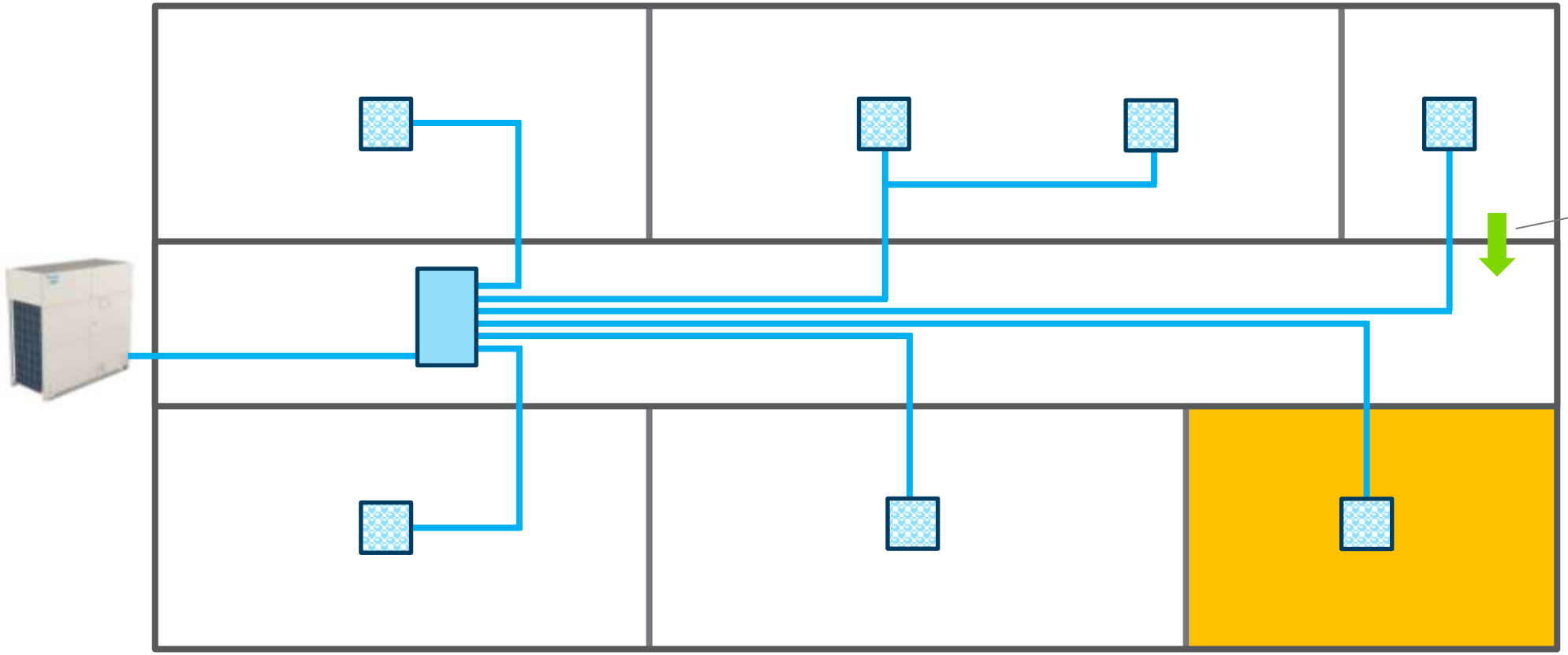
R-32



1. Smallest room: 15’ x 15’ x 8’ = 1,800 cubic feet
2. Allowable charge (with air circulation) = volume x RCL = 1,800 x **9.6** / 1000 = 17.28 lbs or R32
3. Releasable charge (no SSOVs) = full system charge = 30 lbs
4. 30 > 17.28 system not in compliance

ASHRAE Std 15 – 2022 (Our interpretation!)

R-32

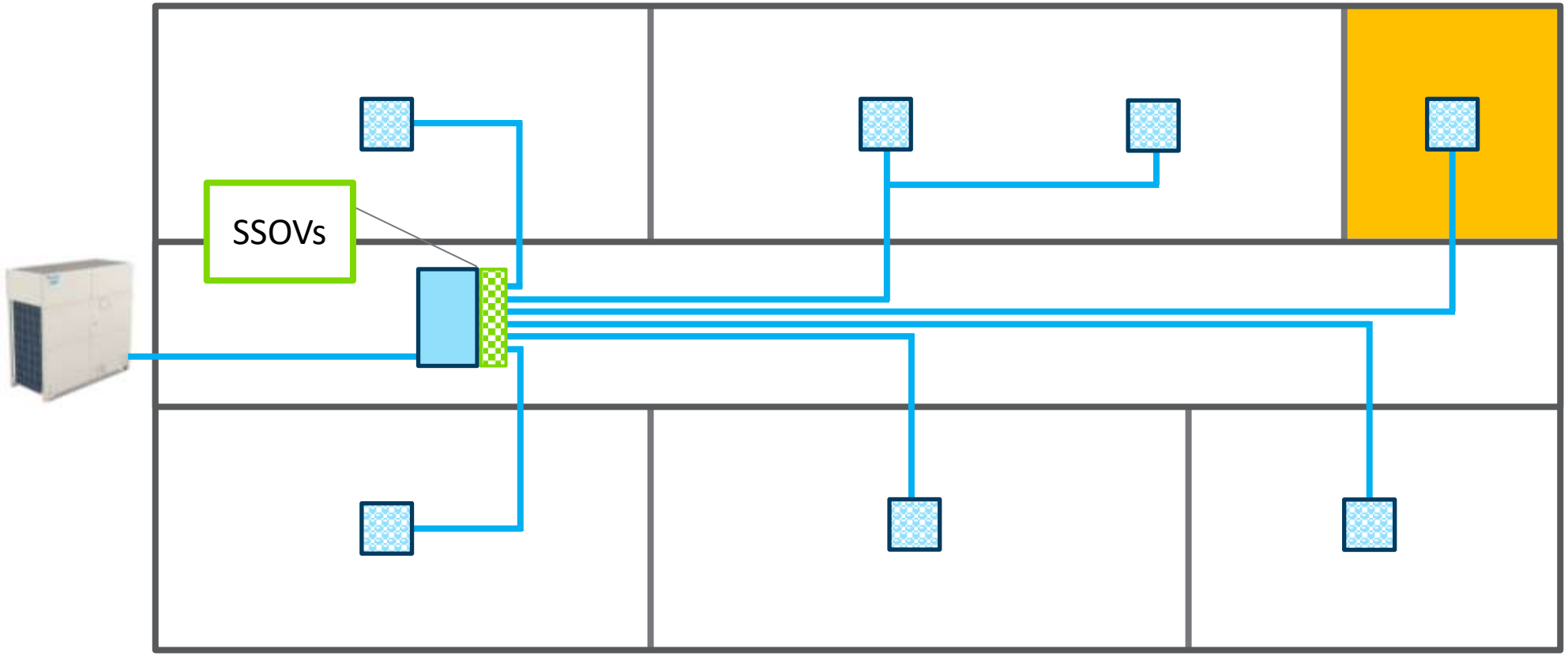


Spaces connected via Natural Ventilation using Formula (transfer grill below 12”)

1. Smallest room: 18’ x 24’ x 8’ = 3,456 cubic feet
2. Allowable charge (with air circulation) = volume x RCL = 3,456 x 9.6 / 1000 = 33.2 lbs or R32
3. Releasable charge (no SSOVs) = full system charge = 30 lbs
4. 30 < 33.2 system not in compliance

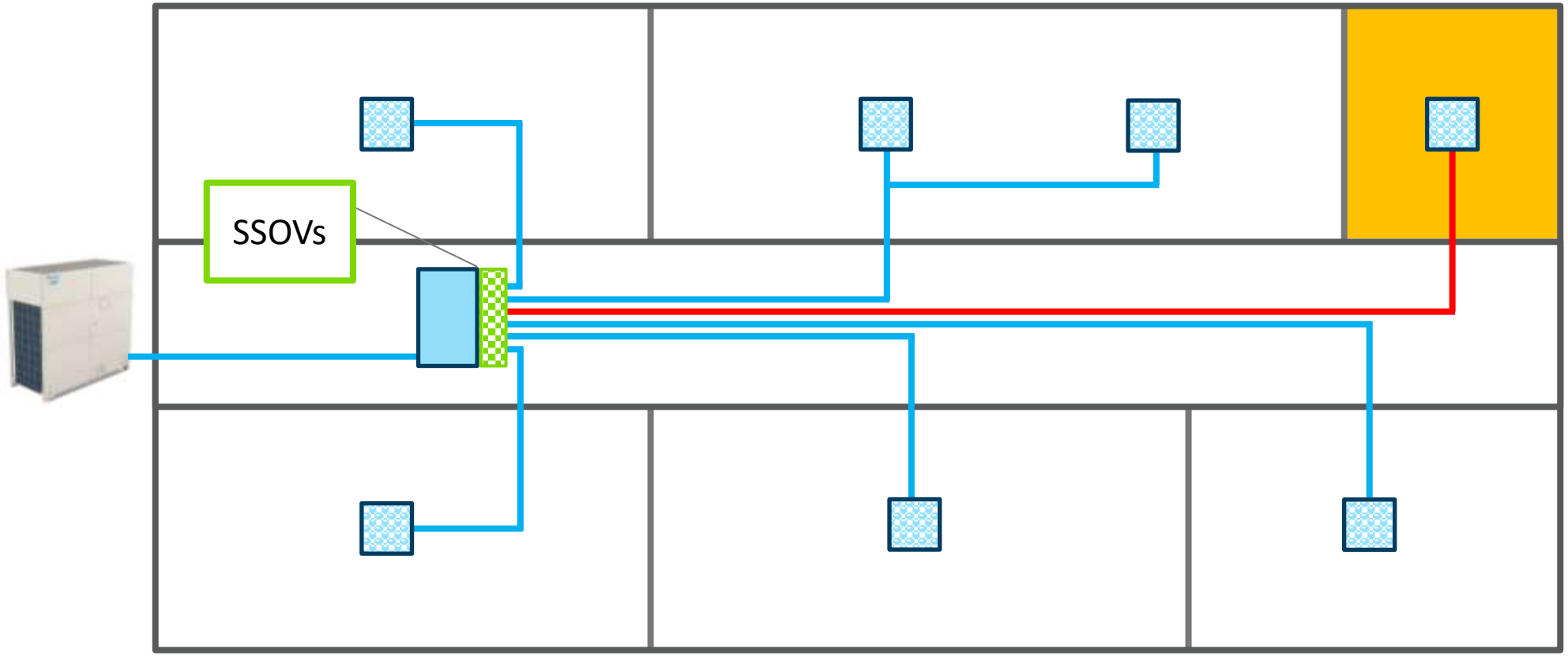
ASHRAE Std 15 – 2022 (Our interpretation!)

R-32



ASHRAE Std 15 – 2022 (Our interpretation!)

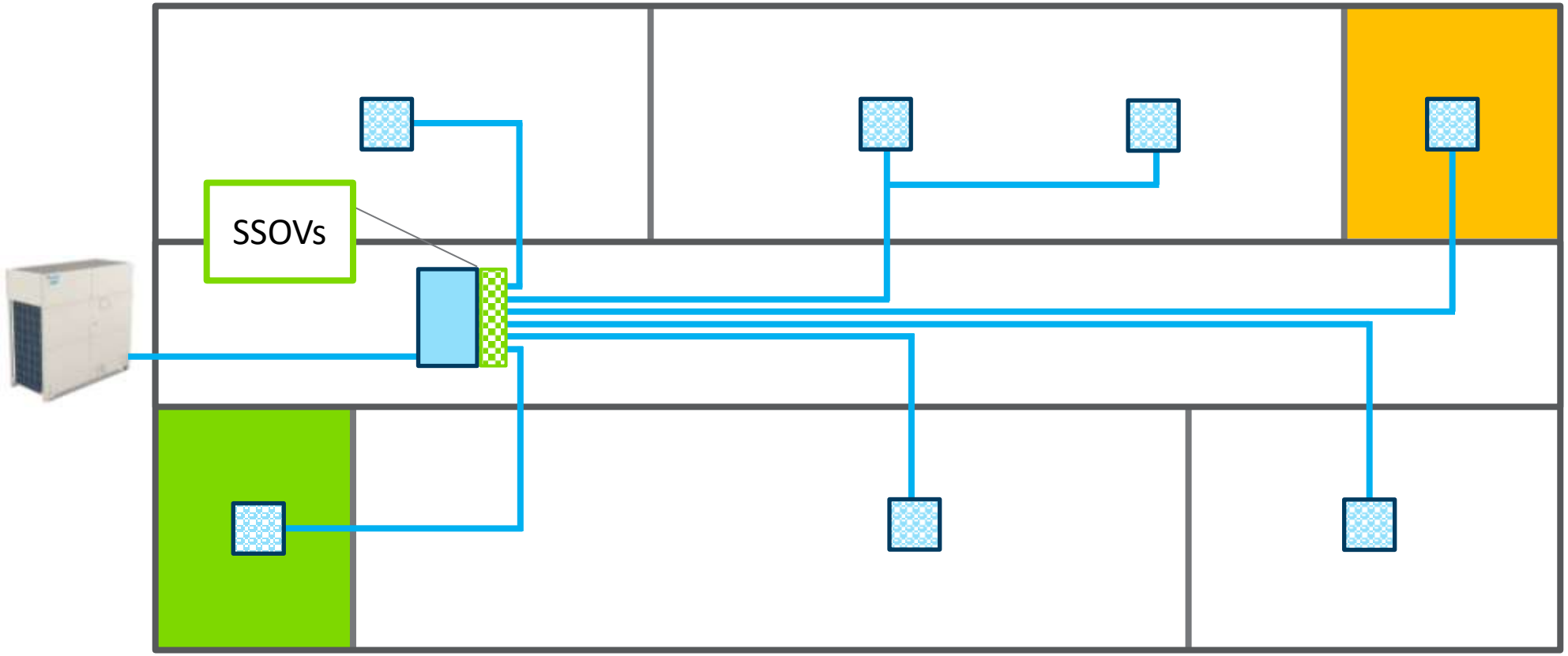
R-32



1. Smallest room: 15’ x 15’ x 8’ = 1,800 cubic feet
2. Allowable charge (with air circulation) = volume x RCL = 1,800 x 9.6 / 1000 = 17.28 lbs or R32
3. Releasable charge (beyond SSOV) = 12 lbs
4. 12 < 17.28 system not in compliance

ASHRAE Std 15 – 2022 (Our interpretation!)

R-32



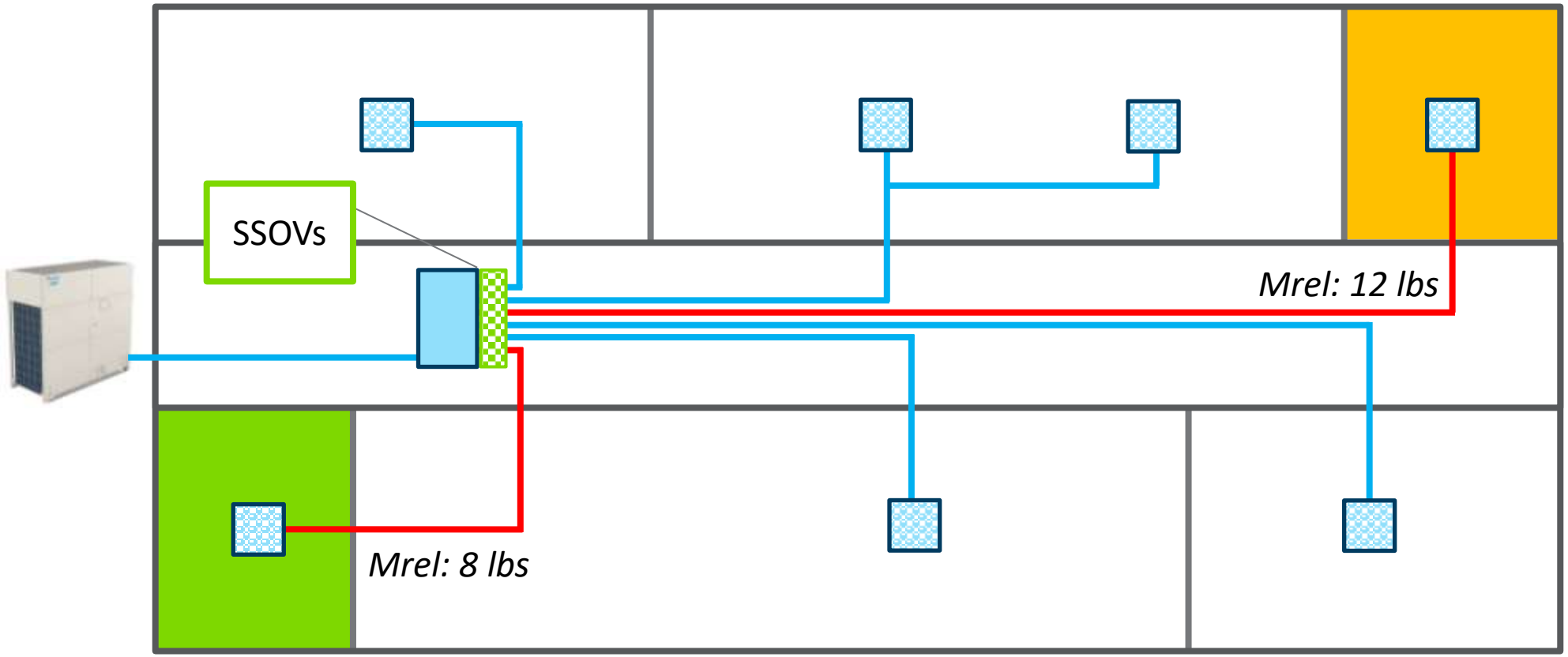
Warning: Check each run!

Smallest space may be okay (close to an SSOV)

A larger space further away may not be

ASHRAE Std 15 – 2022 (Our interpretation!)

R-32



Warning: Check each run!

Smallest space may be okay (close to an SSOV)

A larger space further away may not be

ASHRAE Standard 15 - 2022

Other items

- 7.5.1.2 Public corridors and lobbies limited to “Unit systems”
  - Regarding what can and can’t be placed in those areas
- 7.6.2.4 Requirements of detection systems
  - Access, self-diagnosis, energize air circulation automatically, output signal within 30 seconds of exposure
- 7.6.2.5 Mitigation Action Requirements
  - Energize fans, open any zone dampers, de-energize electric resistance heat in air-duct, activate SSOV
- 7.6.3 Ignition sources in ductwork
  - No open flames, No “unclassified” electrical devices in ductwork, Nothing above 1290F unless flow proved
- 9.12.1.3 Prohibited locations [of refrigerant piping]
  - Similar to previous version of standard
- 9.12.1.5 Pipe Shafts: fire-resistance-rated shafts
  - Similar to previous version of standard
- 9.12.1.8 Pipe identification
  - Need to label piping, in spaces that are not where the IDU is, with “WARNING – Risk of Fire. Flammable”
- 10.1.1 Install Identification
  - Each system shall have a very legible sign. We expect our refrigerant stickers to change.

NOT COVERED TODAY

Reducing Emissions from our Built Environment

Energy efficiency & electrification (fossil fuel to heat pump conversion)

Distributing heat directly from outdoors to indoors with refrigerant is advantageous (efficiency, emissions, cost)

Heat pumps require high pressure HFC refrigerants, and reducing their GWP increases their flammability rating

ASHRAE/UL Standards needed to evolve, and now need to be adopted to allow these low GWP refrigerants in buildings

- ASHRAE 15 – 2019
- ASHRAE 15 – 2022

Reducing emissions from refrigerant leaks

Legislations on phasing down / out high GWP HFCs

Other ways of reducing refrigerant emissions

Other ways of reducing refrigerant emissions

- Pay attention to refrigerant charge (reduce where possible)
- **Keep. Refrigerant. In. Systems. (reduce the risk of leaks)**
  - Who is installing the systems? *(Certifications, not just of the contractor, but of who on site is physically doing the work)*
  - Who is (truly) witnessing the pressure test? Who is inspecting the install?
  - Where is the equipment being procured from? *(Engineering rep firms with training, experience, and service / QC / Commissioning capabilities)*
  - Advanced on-going monitoring systems

Also a major contributor to reduced failures and down time, and overall project success

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Other ways of reducing refrigerant emissions

Impacts on HVAC equipment designs and decisions today

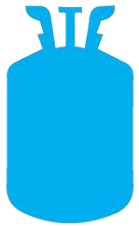
Impact on HVAC design & decisions

Desire to reduce refrigerant emissions? Consider lifetime emissions of the entire HVAC system

In the next decade, converting fossil fuel heating into heat pumps is the leading way to decarbonize, followed by focusing on energy efficiency to reduce electrical consumption and resulting emissions

Do pay attention to refrigerant charge, and design systems keeping in mind the future refrigerant transition of that system

Electrification & Energy Efficiency



Reducing emissions from refrigerant leaks

THANK YOU!

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DXS

CONTROL TECHNOLOGIES

HFC Refrigerants in Heat Pumps

The EPA & ASHRAE have spoken!

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