

Low GWP Refrigerant Transition: Update and Selection



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What's Driving this Refrigerant Transition?

- Previous transitions addressed Ozone Depletion
 - Release of ozone depleting refrigerants caused the layer to thin
 - Allowed the sun's harmful UV rays to reach the surface
- The next transition will address <u>Global Warming Potential</u>
 - A refrigerants "heat trapping" potential
 - Inhibit heat radiating from the earth from escaping back into space
- Today's Dominant Unitary refrigerant, R410A is considered a highly potent GHG¹ due to its high GWP value (2,088)





Unitary Refrigeration Transition

- Past "Unitary" Transitions were driven by Ozone Depletion Potential (ODP)
 - Phase out of R12 and R22
- Replaced with R410A which has a Zero ODP but a higher GWP
- The focus is now on GWP
- Some new Low GWP fluids are referred to as HFO's
 - Hydrofluoroolefins
 - Some HFC's also qualify as Low GWP (R32)





Two Leading "Low GWP" Candidates to Replace R410A

Individual States setting a 750 GWP Max Limit

- Going lower could force industry to hydrocarbons (e.g. propane)
- R32 and R454B
 - Similar performance to R410A
 - Both are classified as mildly flammable (A2L) refrigerants by ASHRAE
 - Neither can be considered a "drop-in" due to flammability / safety issues
 - Fluids can not be mixed for service; different operating characteristics

Some OEM's have publically announced their Unitary choices

- Carrier R454B, Daikin / Goodman R32
- VRF systems will prove more challenging due to larger charge volumes
- Refrigerant Producers continuing to develop new low GWP fluids
 - However they have run out of time for 2025...

	Refrigerant	GWP	ODP
	R-410A	2,088	0
	R-22	1,810	.055
750 GWP Limit	R-407C	1,774	0
1	R-32	675	0
ΑE	R-454B	466	0
	R-290 (propane)	3.3	0
	R-744 (CO ₂)	1	0





B2L

B1

R410A vs R454B vs R32

ASHRAE **Component Mix -**Exposure Operating **Burning** Auto Hot Surface Fluid **GWP** LFL UFL MIE Efficiency Capacity 34 Ratio % Limit Pressure Velocity Ignition **Temperature** CO₂e % v/v % v/v vs R410A vs R410A cm/sec psia mJ ppm R-32/R-125 - 50/50 R410A **A1** 2,088 140,000 434 > 750 -A2L 466 R-32/R-1234vf - 69/31 405 11.8 **R454B** 30,000 21.5 5.2 100-300 498 700 = < 675 R-32 - 100% 444 29.3 **R32** A2L 36,000 14.4 6.7 21-40 648 700

LFL - Lower flamability limit

UFL - Upper flammability limit

MEI - minimum ignition energy

Multiple factors to consider

- Safety, GWP, energy efficiency, capacity, cost, pressures, availability, etc.
- Both options are flammable, A2L's ٠
- Both options have similar performance to R410A ٠
- Both options have similar performance to each other ٠
- Using a lower GWP fluid could exempt a manufacturer from a future transition...

ncreased flame propagation Propogation Lower Higher Toxicity Toxicity **Increased toxicity**

Lower

Flammability

No Flame

The Lower the GWP the better; avoids chances of another refrigerant transition by the end of the decade



A2L

A1

ASHRAE 34



Montreal Protocol, Kigali, AIM Act, Paris Accord, SNAP What does it all mean?

Montreal Protocol

- Addressed Ozone Depleting Substances (ODS) 1987
- **Kigali Amendment**
 - An Amendment to the Montreal Protocol
 - Targets HFC's & GWP (85% reduction by 2047) •
 - Sets a 15 year phase-down target through 2036
 - Ratification currently pending in the US Senate ٠
 - Need to ratify for international cooperation •

EPA SNAP

Publish lists of acceptable and unacceptable substitutes by end-use (e.g. SNAP 20 & 21)

ENVIRONMENTAL



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Paris Accord

AIM Act

very soon from the Biden Admin

Allows EPA to address Service Practices; recovery & reclaim ٠

Limit global warming < 2C, preferably 1.5C by the end of the century

Included in the Dec 2020 Omnibus / COVID Stimulus Bill

Granted EPA authority to regulate on GWP (not just ODP)

US formally rejoined on Feb 19th; expect to see nationally determined contributions

Kigali ratification still needed to gain international influence





The AIM Act will have the most signification impact on the next HFC transition in the USA

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What's the AIM Act Schedule?

2024 will constrict the existing HFC supply ahead of a pending **±** 2025 Unitary Sector Transition



- Authority granted to EPA
- Overall HFC Schedule
- Phase-down, not a Phase-out
- 15% remaining at 2036 will remain indefinitely or until EPA takes additional action
- EPA can take additional actions to ensure the schedule is met
- Opportunity to accelerate but only after formal petition, notice & comment and not before 2024
- Sector based mandates will drive earlier reductions (SNAP)
- "No Preemption" however states can make more stringent

A second "unitary" transition could be required if other sectors don't transition soon or low enough

State HFC Activity

Many states will voluntarily align behind AIM but all must comply with a mandatory EPA sector based transition

California

- Proposals go beyond SNAP 20 & 21 and Kigali
- Final rule still being negotiated
- CA Building codes must be updated
- Service ban rulemaking to start 2021
 - 2025 is a possibility...
 - Could mandate use of reclaimed R410A...



1/1/2024 @ XYZ GWP

- GWP Segregation of chiller varies by discharge temp
- Some segments < 150 GWP





1/1/2025 @ 750 GWP

- Original proposal 2023
- 10% offset required for 2023-24 delay
- Could force reclaim R410A in new products or into service



<u>1/1/2026 @ 750 GWP</u>

 Will require > 15% offset for 2023-24 and 25% for 2025 due to larger charge size – greater potential for leaks

Other States

- ~10 other States have finalized or pending HFC regulations
- None address unitary products at this time (limited to California)
- WA building codes now permit (not mandate) increased quantities of A2L's in direct AC / HP systems in Feb 2021
- New Jersey and a few other states not allowing storage or pass-through of prohibited substances...



Codes and Standards Required for A2L Deployment

While work on the safety standards is well underway the adoption into state / city codes is challenging



- Safety standards currently allow for A2L's however they are limited in quantity and application
- Must change both indoor and outdoor units when converting from an existing A1 to a new A2L system (can't field convert to different classes)
- Existing residential line sets can be reused but must be pressure tested
- Push to remove all mechanical fittings by some jurisdictions (unions)
- States (e.g. Washington St) can bypass the National Codes and directly reference standards into Final State Regulation
- State, Provincial and municipality adoption pose the greatest hurdle (hundreds of different jurisdictions...) – could result in a patchwork rollout despite EPA sector based mandate

Higher **A3 B3** ncreased flame propagation Flammability A2 **B2** Flammable Lower A2L B2L Flammability R454B, R32 No Flame **A1 B1** Propogation R410A Higher Lower **ASHRAE 34** Toxicity Toxicity Increased toxicity

Codes "must" be updated as a Prerequisite to widespread deployment of A2L's

What Does It All Mean?

When taken all together, this refrigerant transition won't be as straightforward as the last two



- The 1/1/2023 DOE efficiency transition will still be dominated by R410A
 - Codes not likely to be updated in all states and provinces in time to support widespread A2L deployment
- New 2023 DOE R410A products may only have a 2 year production run!
 - If EPA acts under AIM and issues a sector transition mandate for a 1/1/2025 @ 750 GWP limit for Unitary
 - If all the necessary codes are updated for A2L's (this is not likely)
- Code adoption at the State, City and municipality level may result in a patchwork of A2L allowances
 - No mechanism for a single, nationwide code update

An EPA Sector Mandate is not implementable without the Codes Being Updated for A2L's

If a national transition does occur in 2025, the Low GWP offering would be the only option

Why JCI Selected R454B?

"Lowest / Best in Class" SNAP approved GWP, Closest Performance to R410A

- Lowest, EPA SNAP¹ approved GWP (466): 78% decrease over R410A
- Greater environmental / sustainability benefits & credits : the lower the GWP the better
- **Best long-term, low GWP solution:** helps to avoid a second, near term transition²
- <u>Closest performance to R410A</u>: allows the use of many existing R410A system components leveraging R410A production scale improving availability and minimizing system cost
- Shortest learning curve: for contractors; very similar pressures and temperatures to R410A
- Lower discharge pressures versus R32: improved system performance without the need for special designs and components (e.g. compressors, oils, etc.)
- Slower flame propagation rate versus R32
- <u>Superior heat pump heating performance</u>: R454B's broader operating envelope at low evaporating temperatures better enables the transition to heat pumps driven by the electrification trend
- Endorsement by other leading OEM's: Significantly improve scale and availability

R454B could help avoid a second, near term transition for unitary equipment

1) Significant New Alternatives Program for high probability, unitary systems (e.g. system in which a leak could enter the occupied space)

2) Within the tenure of the AIM Act phase down schedule, another phase-down could be mandated by EPA / CARB as early as 2030 – only ~5 years from 2025



R454B

R32's GWP Value Raised above 750!

- Latest IPCC¹ (AR6) report raised R32's 100 year GWP Value to 771 (from 675)
- Significant as California & EPA are setting regulatory limits < 750 GWP
- California / EPA regulations specifically reference the lower 675 value
- Thus R32 will not immediately be eliminated from contention for 1/1/2025
- Ultimately this will eliminate R32 as a long term, low GWP solution for unitary
- Supports JCI's R454B choice as the "longer term" Low GWP solution"
- While R454B's 100 year GWP will also rise from 466 (AR4) to 531 (AR6) due to it being 69% R32) it is far below the 750 limits proposed by CARB and EPA
- Leverage our Low GWP marketing collateral (white paper, FAQ's, PPT, etc.)

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May 27, 202	

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What Owners, Engineers, Distributors and Contractors Can Do

- Support A2L Code Adoption at the local, state level & national levels
 - Facilitate a single, national transition on 1/1/2025
- Engineers Review UL 60335-2-40 (3rd edition) look at 4th edition proposals
 - Be prepared for customer questions regarding Low GWP, R410A "drop-ins" (there aren't any...)
- Become familiar with ASHRAE 15 & 15.2P (when finalized)
 - Engineers & Contractors must calculate conditioned space volumes and total charge sizes for A2L's
- <u>Review AHRI Safe Refrigerant Transition Task Force (SRTTF) materials</u>
 - <u>https://www.ahrinet.org/saferefrigerant</u>
 - A2L research and test results, best practices, etc.
- Ensure training occurs on the safe use and handling of A2L's
 - ACCA A2L Refrigerant Training
- Strengthen current refrigerant management practices
 - Ensure EPA 608 certification
 - Implement a cylinder exchange program that will specifically address A2L's
 - Avoid mixing recovered refrigerants in the same cylinder; mixed fluids have less value...
 - Confirm your paperwork / documentation processes (systems < 50 lbs charge will ultimately fall into scope)
- Establish suppliers for reclaim R410A well prior to 2024...

Be prepared for when EPA / states do act to mandate use of reclaim!

A₂L







Appendix

