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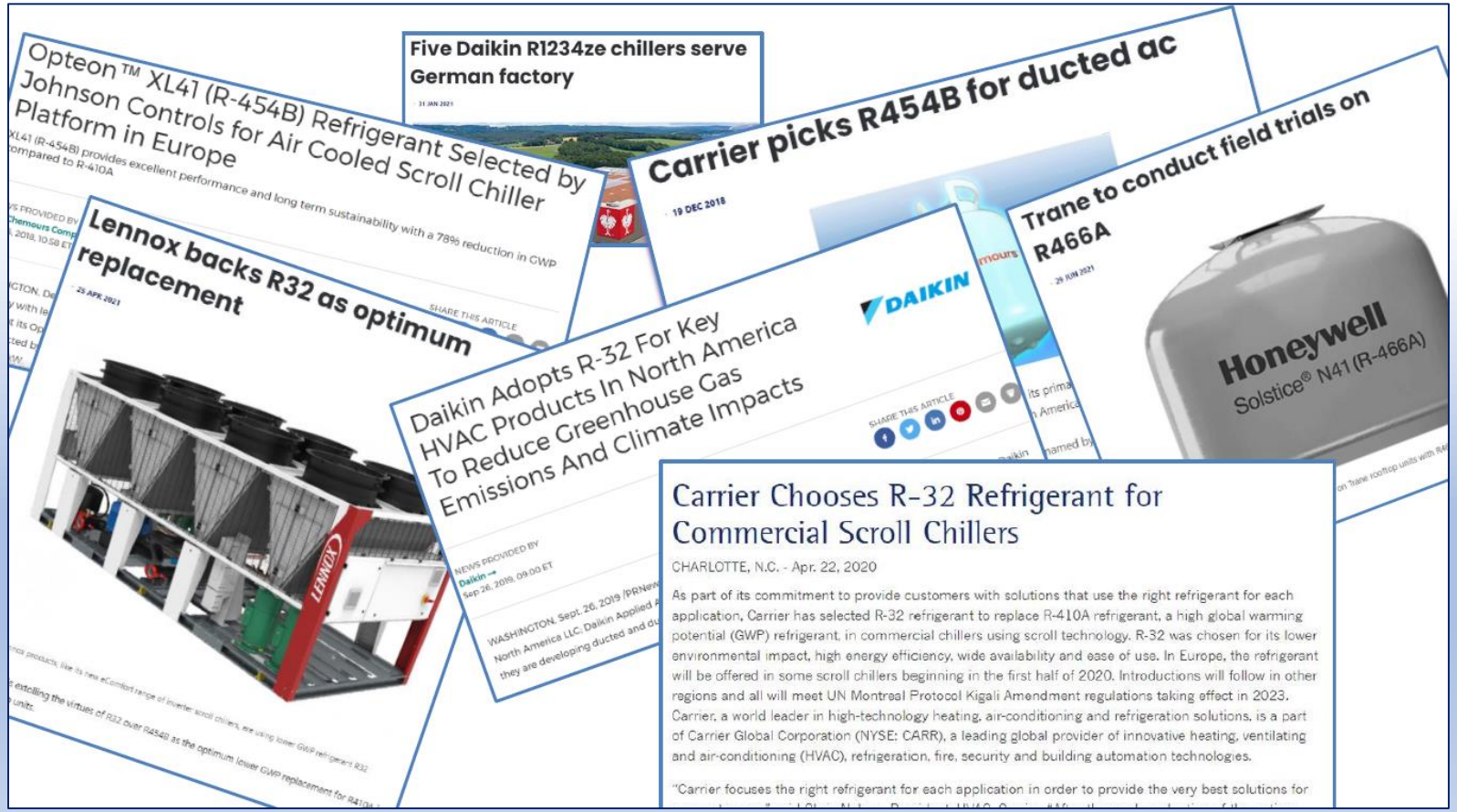
Transition
Low GWP Refrigerants

Pushpinder Rana, Mitsubishi Electric Sales Canada Inc.

September

2022

Industry Buzz



ASHRAE 34 Refrigerant Classification

Higher Flammability	A3	B3
Flammable	A2	B2
Lower Flammability	A2L	B2L
No Flame Propagation	A1	B1
	Lower Toxicity	**Higher Toxicity**

Lowering the GWP, results in increasing flammability properties

R-410A = 2,088 GWP (50% R-32 / 50% R-125)
R-454B = 466 GWP (69% R-32 / 31% R-1234yf)

- Lower flammability or A2L refrigerants are characterized as having a low flame speed (BV < 10 cm/sec) and lower heat of combustion (HOC)
- Higher flammability refrigerants (A3) include hydrocarbons such as propane and butane that have higher flame speeds and HOC

Key Points about the Transition to Low-GWP Refrigerants

What's similar? Safety and Use

- Oxygen Deprivation is possible in tight and enclosed spaces
- Frostbite is possible due to quickly releasing any liquid refrigerant
- Hydrogen fluoride gas is formed upon combustion of any fluorinated refrigerant
- Personal protective equipment should be used by firefighters and technicians

What's different?- Flammability characteristics

- Lower (A2L) and higher (A3) flammability refrigerants will be used to comply with regulations
- A2L refrigerants are characterized as having a low flame speed (BV < 10 cm/sec) and low heat of combustion (HOC)
- A3 refrigerants (e.g., propane) have high flame speeds and HOC

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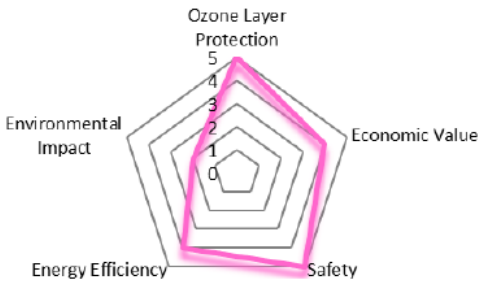
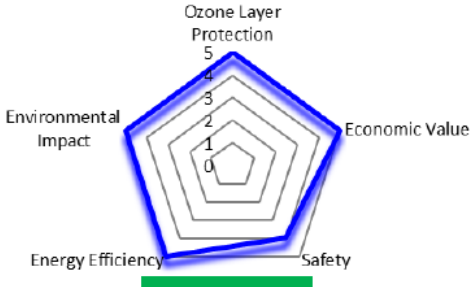
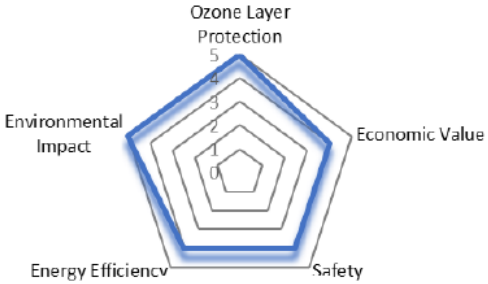
R410A Replacements – Possible



R-410A



R-32

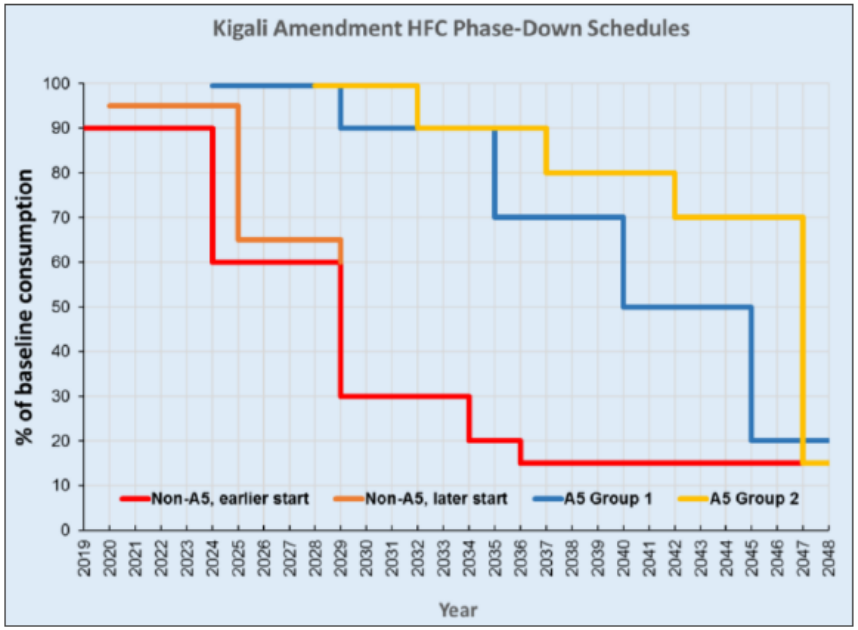


R-454B

LCCP：Life Cycle Climate Performance, LCA: Life Cycle Analysis

Refrigerant	Composition	ASHRAE 34 Classification	RCL (g/m^3)	GWP_{100} (AR4)	Glide (K)	Efficiency	Capacity
R410A	50% R32 / 50% R125	A1	420	2088	< 0.5		
R32	Pure 100% R32	A2L	77	675	0		
R454B	68.9% R32 / 31.1% R1234yf	A2L	76	466	1.5		

Canadian Regulation



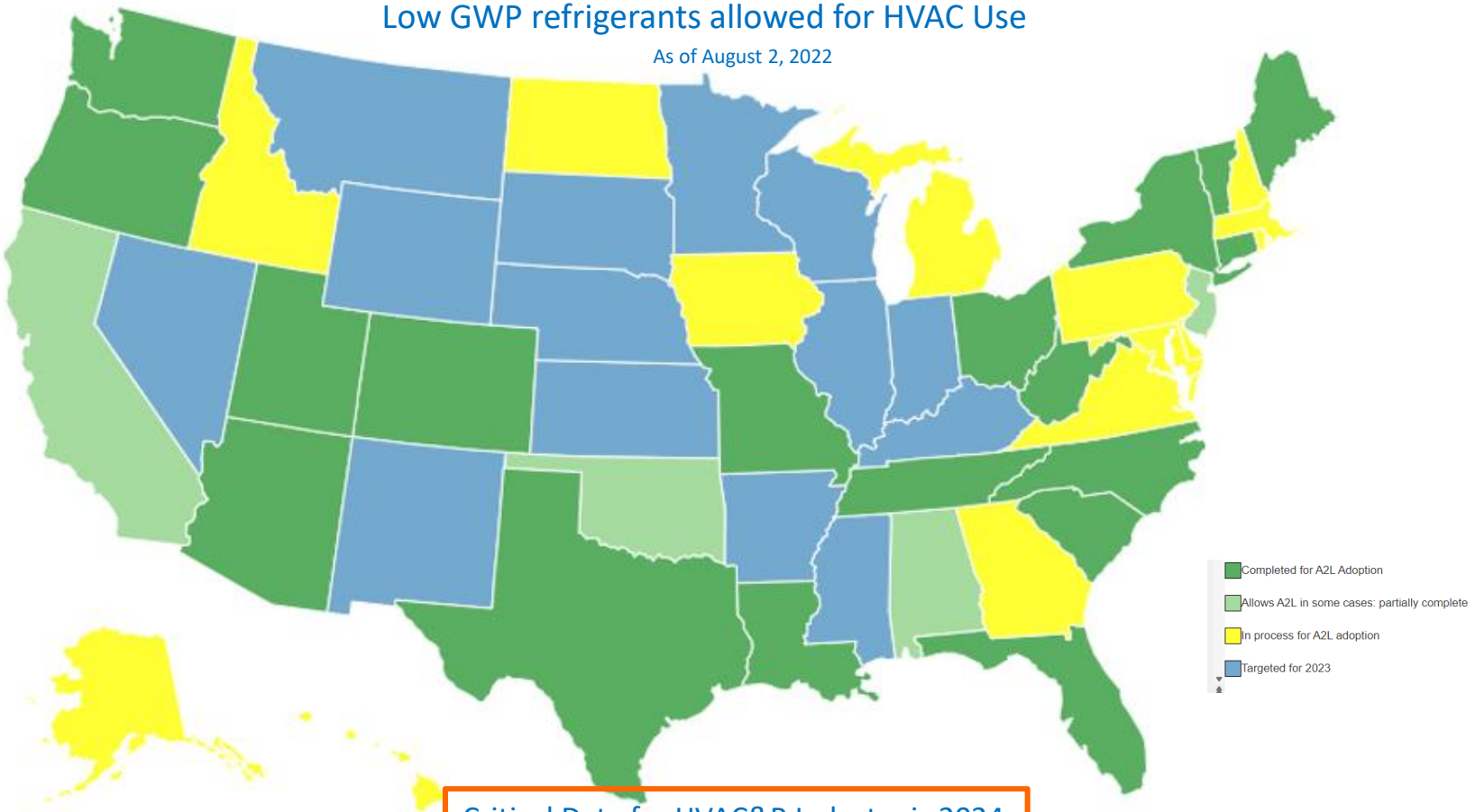
- Canada ratified the Kigali Amendment to the Montreal Protocol
- Environment and Climate Change Canada
  - Chillers less than 750 GWP by Jan, 2025
  - No regulations yet for direct HVAC systems

Will Canada align with USA for HFC phasedowns?

Current State Adoption Status

Low GWP refrigerants allowed for HVAC Use

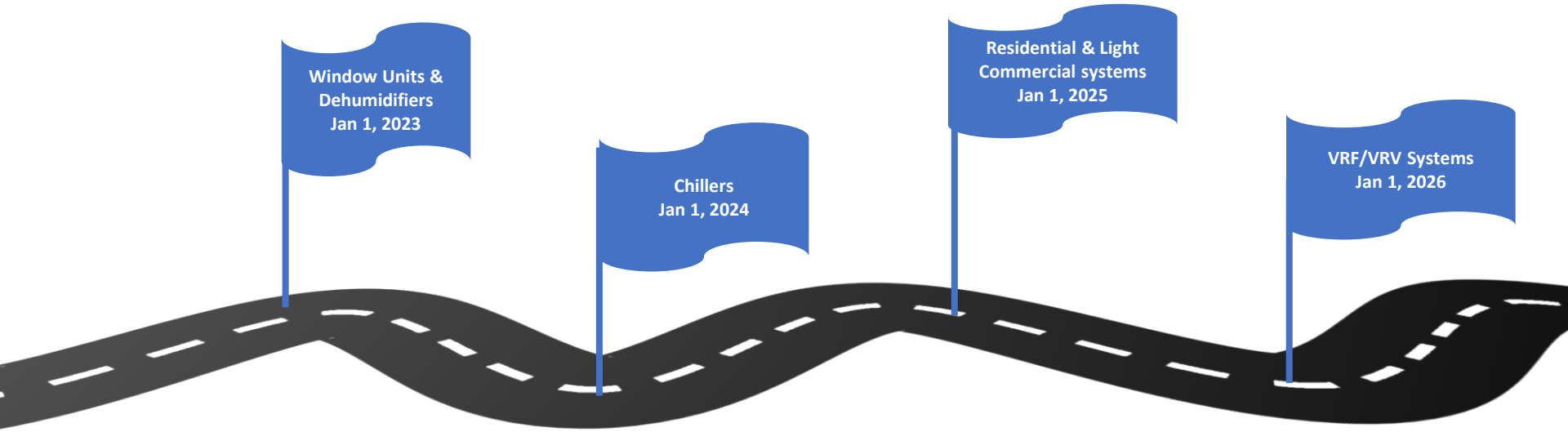
As of August 2, 2022



Critical Date for HVAC&R Industry is 2024

California Air Resources Board (CARB)

750 GWP limit for **new** systems



Commercial & Industrial Refrigeration also have impending regulations.

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Current CSA B52 (12th Edition)

Table 3
Maximum permissible quantities of refrigerants for high-probability systems
(See Clause 4.5.2.)

	Maximum permissible quantities for specified occupancy, kg (lb)			
Type of refrigeration system	**Institutional**	**Public assembly**	**Residential**	**Commercial**
Unit system in a location other than a public hallway or lobby	0 (0)	0 (0)*	3 (6.6)	10 (22)

** A quantity of 3 kg (6.6 lb) shall be allowed for systems installed in kitchens, laboratories, and mortuaries.*

National Building Code (NBC 2020)

- Limited information/guidelines on equipment with A1, A2L, A3 refrigerants
- A2L Leakage mitigation?

9.36.3.4. Piping for Heating and Cooling Systems

1) Piping for heating and cooling systems shall be designed and installed in accordance with Subsection 9.33.8. (See Note A-9.36.2.10.(5)(b).)

2) Except for high-temperature refrigerant piping, all piping forming part of a heating or air-conditioning system shall be located

a) inside the plane of insulation, or

b) within or outside the plane of insulation, provided the piping is insulated to a thermal resistance not less than that required in Subsection 9.36.2. for exterior above-ground walls.

(See Note A-9.36.3.4.(2).)

9.36.3.5. Equipment for Heating and Air-conditioning Systems

1) Equipment for heating and air-conditioning systems shall be located

a) inside the plane of insulation, or

b) outdoors or in an unconditioned space, provided the equipment is designated by the manufacturer for such installation.

(See Note A-9.36.3.5.(1).)

NBC - 2020

- Directs toward CSA B52

9.33.5.2. Installation Standards

1) Except as provided in Articles 9.33.5.3. and 9.33.5.4., the installation of heating and air-conditioning equipment, including mechanical refrigeration equipment, and including provisions for mounting, clearances and air supply, shall conform to applicable provincial or territorial regulations or municipal bylaws or, in the absence of such regulations or bylaws, to

a) CSA B51, "Boiler, pressure vessel, and pressure piping code,"
b) CSA B52, "Mechanical refrigeration code,"
c) CSA B139 Series, "Installation code for oil-burning equipment,"
d) CSA B149.1, "Natural gas and propane installation code,"
e) CSA C22.1, "Canadian Electrical Code, Part I," or
f) CAN/CSA-C448 Series, "Design and installation of earth energy systems."

(See also Sentence 9.33.5.3.(1).)

Next Steps & Challenges

- ASHRAE Std. 15.2 - 2022 (residential) now published
- ASHRAE Std. 15- 2022 (expected publication end Sept./early Oct.)
- Updated references in CSA B52 is pending (expected publication date 2023)
    - New Refrigerant Tables & Safety guidelines (Installation and Maintenance)
    - Revised Table 3 for A2Ls
- Suitable revisions in the National Building Code (NBC)

- Manufacturers need sufficient time to modify their product range to adopt to A2L and also meeting ETL's safety and AHRI performance requirements same time.
- Fundamental change in equipment design and manufacturing, new parts sourcing etc. amidst current global supply chain woes.
- DOE M1/Tier 2 and new UL-60335-2-40 adoption needs to happen within same timeframe.
- Readiness of training programs for contractors, design engineers & consultants.
    - System design and selection
    - Equipment installation, and service and maintenance
    - New tools and gears
    - A2L Storage, Handling and Transport (HRAI driven – TC)

A2L Refrigerants Canada

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Coming Soon!

Next Steps - Challenges

- Unlike R22, R407C and R410A, A2L adoption will be GWP driven, offering many choices of A2Ls that manufacturer can pick and offer.

- Availability of multiple A2L based equipment in the industry, customers' reaction?

- Why's isn't the path of A2L adoption timeline etc. in Dx systems set for Canada yet?

- Are the concerned authorities, regulatory bodies fully aware of the path set in the US?

- Delayed decision would result in products being non-compliant – limited choices for Canadian customer and business loss for the whole industry.

UL 60335-2-40 Compliance

UL 60335-2-40 Compliance

- Currently there are several standards used in the HVAC industry:
  - UL 1995, CSA C22.2 #236 (Heating and Cooling Equipment)
  - UL 484, CSA C22.2 #117 (Room Air-conditioners)
  - UL 474, CSA C22.2 #92 (Dehumidifier)
  - UL 60335-2-40/CSA C22.2 No. 60335-2-40

- As of 1st January 2024, UL 60335-2-40/CSA C22.2 No. 60335-2-40 will replace all of these standards, becoming the primary/harmonized standard for HVAC equipment in North America.

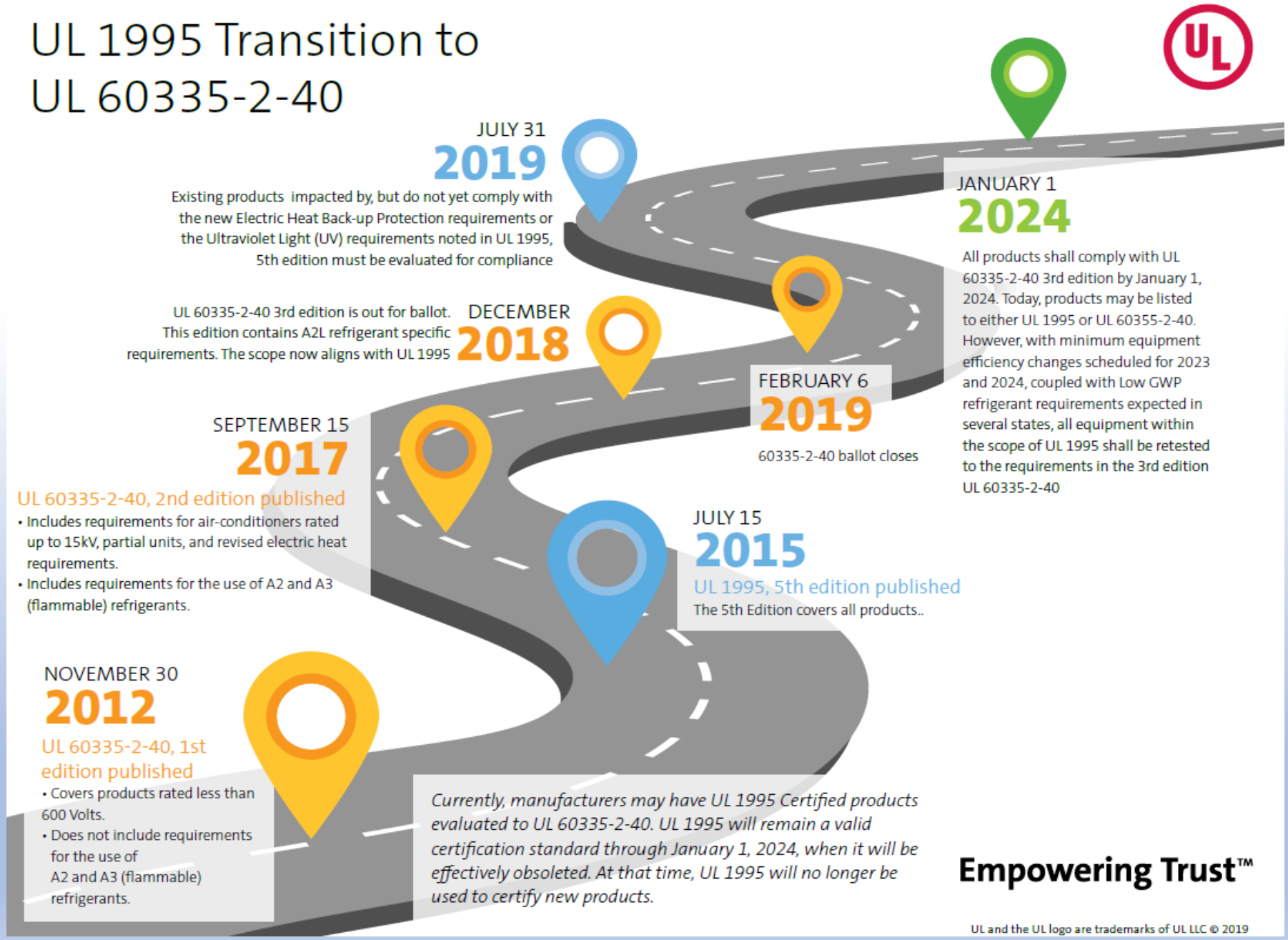
- Products certified to previous standards **will not** be grandfathered to UL 60335-2-40, meaning both new and existing products will eventually need to be tested to the new standard.

- Electric heat pumps, hot water heat pumps, air conditioners, dehumidifiers, and hydronic fan coils units utilizing refrigerants classified A2, A2L, or A3 per ASHRAE 34 shall not be certified to UL 1995 or CSA C22.2 No. 236.

- Equipment utilizing these refrigerants must be certified to a more rigorous UL 60335-2-40 / CSA C22.2 No. 60335-2-40.

- New/additional safety tests/evaluation to deal with A2, A2L or A3 refrigerants.

UL 1995 Transition to UL 60335-2-40



JULY 31 2019

Existing products impacted by, but do not yet comply with the new Electric Heat Back-up Protection requirements or the Ultraviolet Light (UV) requirements noted in UL 1995, 5th edition must be evaluated for compliance

JANUARY 1 2024

All products shall comply with UL 60335-2-40 3rd edition by January 1, 2024. Today, products may be listed to either UL 1995 or UL 60355-2-40. However, with minimum equipment efficiency changes scheduled for 2023 and 2024, coupled with Low GWP refrigerant requirements expected in several states, all equipment within the scope of UL 1995 shall be retested to the requirements in the 3rd edition UL 60335-2-40

UL 60335-2-40 3rd edition is out for ballot. This edition contains A2L refrigerant specific requirements. The scope now aligns with UL 1995

DECEMBER 2018

FEBRUARY 6 2019

60335-2-40 ballot closes

SEPTEMBER 15 2017

UL 60335-2-40, 2nd edition published

- Includes requirements for air-conditioners rated up to 15kV, partial units, and revised electric heat requirements.
- Includes requirements for the use of A2 and A3 (flammable) refrigerants.

JULY 15 2015

UL 1995, 5th edition published

The 5th Edition covers all products..

NOVEMBER 30 2012

UL 60335-2-40, 1st edition published

- Covers products rated less than 600 Volts.
- Does not include requirements for the use of A2 and A3 (flammable) refrigerants.

Currently, manufacturers may have UL 1995 Certified products evaluated to UL 60335-2-40. UL 1995 will remain a valid certification standard through January 1, 2024, when it will be effectively obsoleted. At that time, UL 1995 will no longer be used to certify new products.

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Option B

UL 1995 5th edition/CSA C22.2 No. 236-15

- A band aid approach. However, if one needs to open the report past Jan 1, 2024, for any reason, it's forced to update to the 60335-2-40 std.

Example: Due to unreliable supply chain issue, if any part/component needs to be changed, then opening and updating UL 1995 – 5th edition file is prohibited and forced to update to 60335-2-40 std.
One cannot sell the product until the certification has been updated to 60335-2-40 and thus causing delayed sales or potentially risk losing the sale.

- For any product that uses electric heater, there are additional requirements added to the 5th edition to comply with, requiring additional evaluation.
- Cheaper and easier approach.

- Perhaps more suitable for the products going to the end of life in 2025, riding it out.

- Does not cover flammable refrigerants!

Thank you– Questions?

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