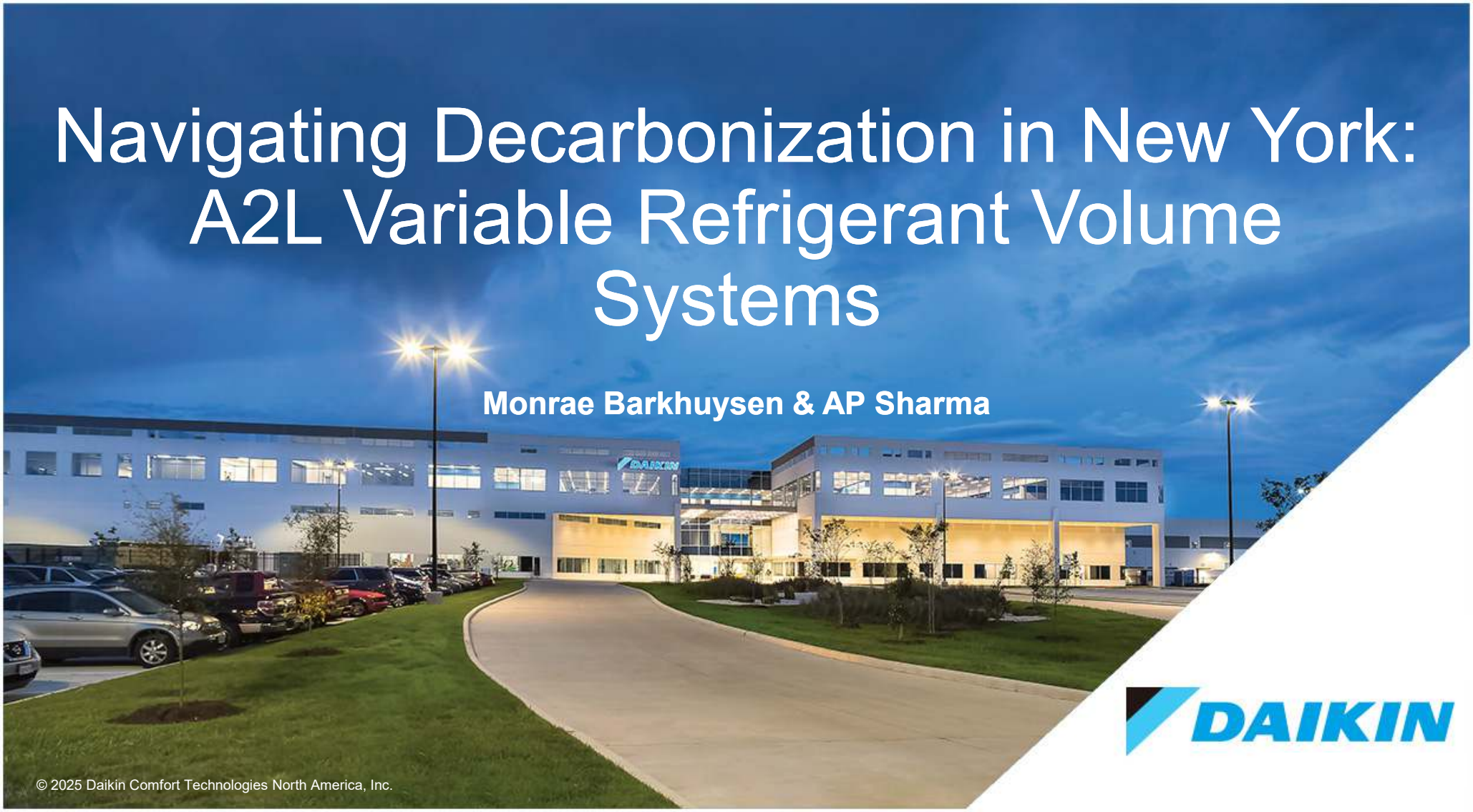
Navigating Decarbonization in New York: A2L Variable Refrigerant Volume Systems

Monrae Barkhuysen & AP Sharma



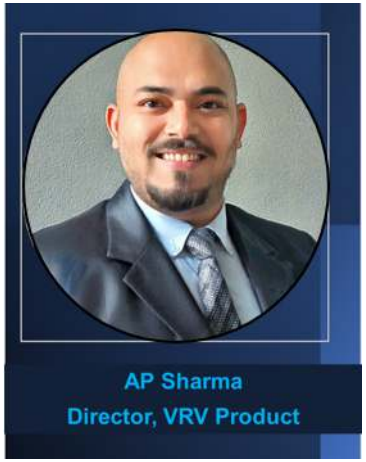
Introduction

Monrae Barkhuysen

- 23 years in the industry
- 12 years with Daikin, focusing on VRV sales and design.
  - Started in South Africa, then Europe as an engineering consultant.
  - Joined Daikin North America in 2021

AP Sharma

- 15 years in the industry
- Graduated from Arizona State (MS-Mechanical)
- With Daikin since 2012
  - Joined Product Marketing (1st Apr 2023)
  - Worked in Design for over 10 years, with over 6 years leading Design Engineering team



Agenda

- VRV R-32 Code & Regulation Overview (Monrae Barkhuysen)
  - EPA and DEC Phaseout schedules
  - ASHRAE 15 and UL240 Overview

- VRV R-32 Relaunch (AP Sharma)
  - VRV Technology through A2L Transition
  - Code Compliance & Smoother Transition
  - Daikin's VRV Product Differentiators & Refrigerant Advantages
    - R-32 VRV 3-Phase Emerion Lineup
    - Features and Benefits
    - Future Roadmap

VRV R-32 Code & Regulation Overview

Monrae Barkhuysen

AIM Act: Law Passed Dec. 2020 | EPA Rulemaking Status

The AIM Act gives authority to the EPA to phase down HFC refrigerants in the US

Old news: EPA must write rules to *phase down* production and consumption of bulk HFCs to 15% of baseline, maximize reclamation, minimize releases from equipment and facilitate transition through sector-based restrictions

PHASEDOWN

via CO2eq Allocations of Bulk HFCs

(Supply Side constraints)

TECHNOLOGY TRANSITIONS

Sector based controls

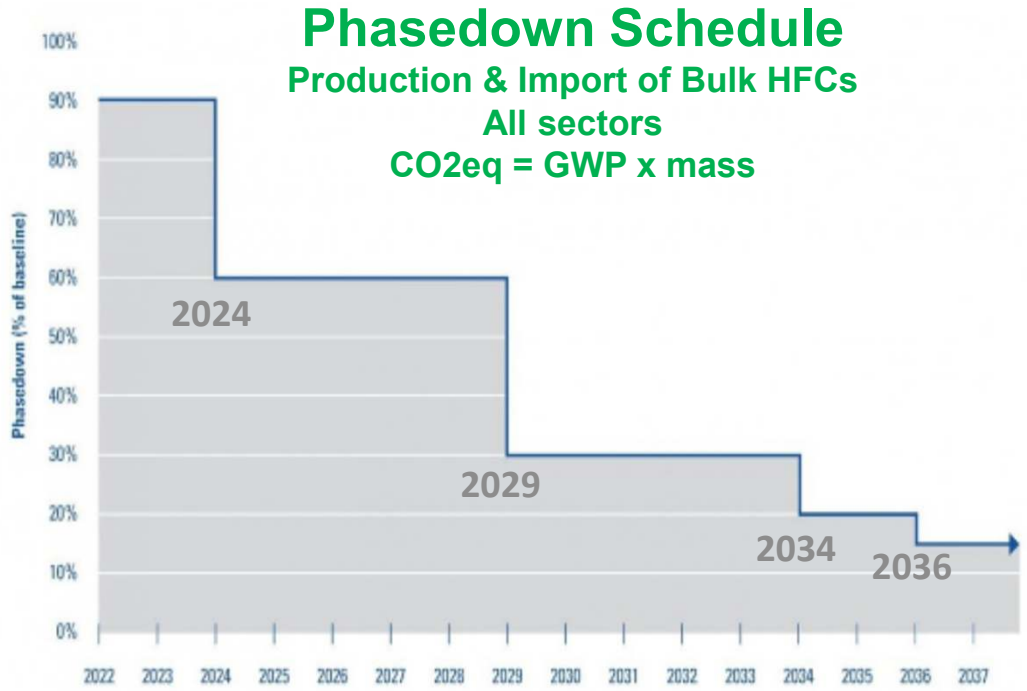
SNAP restrictions

REFRIGERANT MANAGEMENT

Minimizing leaks

Maximizing recovery & reclamation

AIM Act: EPA Phasedown and Allocations



CO2eq Phasedown

- Baseline over 300 million metric tonnes CO2 equivalency
- Phases down creating supply shortage of HFCs

Not refrigerant specific – not a phaseout

- All bulk virgin HFCs in all sectors
- Produced in USA and imported

Existing equipment may be serviced

- Installed base can be serviced
- Will need to transition to lower GWP refrigerants

AIM Act: EPA Technology Transition

General

NEW equipment only

HVAC: 700 GWP limit and various deadlines
Refrigeration, Industrial Process, Foams, Aerosols: Various GWP limits and deadlines

Labeling, Recordkeeping & reporting requirements for OEMs

Products

Factory-charged equipment

Chillers, RTUs, WSHP, PTAC: 1/1/25 MFG/Import deadline
Datacenter: 1/1/27 MFG/Import deadline

3 year sell-through deadline

Systems

Field-charged equipment: Split systems, breakdown units

Res & Light Comm: 1/1/25 MFG/import and 1/1/26 installation deadlines
*VRF: 1/1/27 installation deadline (1/1/28 with approved building code issued before 10/5/23)
Datacenter: 1/1/27 installation deadline

Installation definition

Components

Repairs of existing equipment is allowed

Components can be replaced: Condensers, Compressors, Evaporator units, Evaporators

Label needed: “For servicing existing equipment only”

Installation definition:

1. Assembling a system for the first time from new or used components;
2. Increasing the cooling capacity, in BTU per hour, of an existing system; or
3. Replacing 75 percent or more of evaporators (by number) and 100 percent of the compressor racks, condensers, and connected evaporator loads of an existing system.

***Installation deadlines means charging the refrigeration circuit to full charge**

NEW: Value chain responsibilities (OEMs –Sales –Contractors –Owners)

New York State Regulations, Effective Jan 9, 2025

GWP Restrictions

Cooling only Chillers	Ban R134a, R410A, R407C, others GWP 100 AR4 > 700* GWP 20 AR6 > 20	1/1/2024 1/9/2025 1/1/2030
Heating chiller	GWP 100 AR4 > 700* GWP 20 AR6 > 20	1/9/2025 1/1/2034
Residential and light commercial AC & HP	GWP 100 AR4 > 700* GWP 20 AR6 > 10	1/1/2026 1/1/2034
VRF	GWP 100 AR4 > 700* GWP 20 AR6 > 10	1/1/2026 1/1/2030
Other residential HVAC	GWP 20 AR6 > 10	1/1/2027
Other commercial HVAC	GWP 20 AR6 > 10	1/1/2034
Datacenter	GWP 20 AR6 > 2690 GWP 20 AR6 > 10	1/1/2026 1/1/2030
Ice Rink	GWP 20 AR6 > 580 GWP 20 AR6 > 10	1/1/2026 1/1/2030
Industrial Process Refrigeration chillers	GWP 20 AR6 > 2690 GWP 20 AR6 > 10	1/1/2026 1/1/2030

* Follows EPA Technology Transition regulation for current phasedown

- Usual exemptions. Ex. Military, spacecraft, etc.
- Prohibitions tied to (1) Manufacturing date for self-contained “Products” and (2) Installation dates for field-charged “Systems”
- Sell-through to installation for “products” ends on 1/1/2027 (EPA TT is 1/1/2028)
- No installation period for R-410A systems past 1/1/2026 (EPA VRF 1/1/2027)
- “Systems” may have extra year sell-through, but only if the building permit was secured before 1/9/2025; and, that only allow installs until 1/1/2027
- Installation definitions for systems including VRF appear the same as EPA TT Reg
- Considered “New” if replace outdoor unit in a one to one system
- “Regulated substance” is any refrigerant or blend with GWP 20 AR6 > 10
- The VRF definition is not the same as EPA – it does not utilize the EPA 65k btu threshold, which means all VRF systems stay with a 2030 date versus a 2034 date for future GWP restrictions

Deviations from EPA

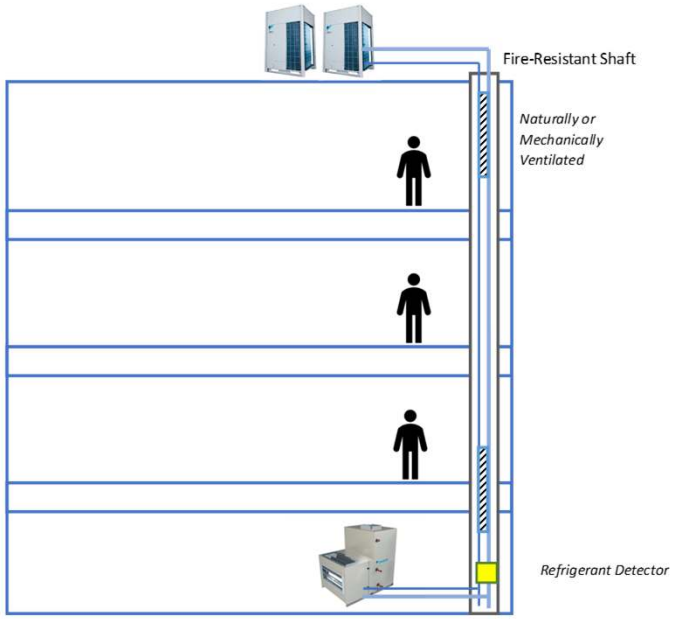
Summarizing DEC Part 494

- Longer Term:
  - DEC accelerated the EPA phase down timeframe by lowering the GWP limits for different classes of systems

Refrigeration, Air-Conditioning and Heat Pump Equipment		
Subsector	**GWP Limit (20-year AR6)**	**NYSDEC Prohibition Date**
Air-conditioning chillers	20	January 1, 2030
Heat pump chillers	20	January 1, 2034
Residential and light commercial AC and HP equipment	10	January 1, 2034
Variable refrigerant flow (VRF/VRV)	10	January 1, 2030

- **NY SB-235 and AB-3661 is legislation that would require NYS to comply/mirror EPA phase out dates**
  - **Seeks to align NYS with EPA regulations**
  - **This is making its way through committees and hopefully will go to vote (results unknown)**
  - **AHRI is supporting this bipartisan bill package.**

Refrigerant Piping: UMC, IMC, NYC



[NY] 1109.2.5 Refrigerant pipe shafts. Refrigerant piping that penetrates two or more floor/ceiling assemblies shall be enclosed in a fire-resistance-rated shaft enclosure. The fire-resistance-rated shaft enclosure shall comply with Section 713 of the *Building Code of New York State*.

Exceptions:

1. *Refrigeration systems* using R-718 refrigerant (water).
2. Piping in a *direct refrigeration system* where the refrigerant quantity does not exceed the limits of Table 1103.1 for the smallest occupied space through which the piping passes.
3. Piping located on the exterior of the *building* where vented to the outdoors.

2024 MECHANICAL CODE OF NEW YORK STATE 123

REFRIGERATION

1109.2.6 Exposed piping surface temperature. Exposed piping having surface temperatures greater than 120°F (49°C) or less than 5°F (-15°C) with *ready access* to nonauthorized personnel shall be protected from contact or shall have thermal insulation that limits the exposed insulation surface temperature to a range of 5°F (-15°C) to 120°F (49°C).

[NY] 1109.2.7 Pipe identification. Refrigerant pipe located in areas other than the room or space where the refrigerating *equipment* is located shall be identified. The pipe identification shall be located at intervals not exceeding 20 feet (6096 mm) on the refrigerant piping or pipe insulation. The minimum height of lettering of the identification label shall be $^1/_2$ inch (12.7 mm). The identification shall indicate the *refrigerant designation* and safety group classification of refrigerant used in the piping system. For Group A2L and B2L refrigerants, the identification shall also include the following statement: "WARNING—Risk of Fire. Flammable Refrigerant." For Group A2, A3, B2 and B3 refrigerants, the identification shall also include the following statement: "DANGER—Risk of Fire or Explosion. Flammable Refrigerant." For any Group B refrigerant, the identification shall also include the following statement: "DANGER—Toxic Refrigerant."

Exception: For *refrigeration systems* used in residential *occupancies* serving only a single *dwelling unit* or *sleeping unit*, pipe-identification shall not be required.

1109.3 Installation requirements for Group A2L, A2, A3, B2L, B2 or B3 refrigerant. Piping systems using Group A2L, A2, A3, B2L, B2 or B3 refrigerant shall comply with the requirements of Sections 1109.3.1 and 1109.3.2.

1109.3.1 Protection against physical damage. In addition to the requirements of Section 305.5, aluminum, copper and steel tube used for Group A2, A3, B2 and B3 refrigerants and located in concealed locations where tubing is installed in studs, joists, rafters or similar member spaces, and located less than $1^1/_4$ inches (32 mm) from the nearest edge of the member, shall be continuously protected by shield plates. Protective steel shield plates shall cover the area of the tube plus the area extending not less than 2 inches (51 mm) beyond both sides of the tube.

1109.3.1.1 Shield plates. Shield plates shall be of steel material having a thickness of not less than 0.0575 inch (1.46 mm) (No. 16 gage).

[NY] 1109.3.2 Shaft ventilation. Refrigerant pipe shafts with systems using Group A2L or B2L refrigerant shall be naturally or mechanically ventilated. Refrigerant pipe shafts with one or more systems using any Group A2, A3, B2 or B3 refrigerant shall be continuously mechanically ventilated and shall include a refrigerant detector. The shaft ventilation exhaust outlet shall comply with Section 501.3.1. Naturally ventilated shafts shall have a pipe, duct or conduit not less than 4 inches (102 mm) in diameter that connects to the lowest point of the shaft and extends to the outdoors. The pipe, duct or conduit shall be level or pitched downward to the outdoors. Mechanically ventilated shafts shall have a minimum airflow velocity in accordance with Table 1109.3.2. The mechanical ventilation shall be continuously operated or activated by a refrigerant detector. Systems utilizing a refrigerant detector shall activate the mechanical ventilation at a maximum refrigerant concentration of 25 percent of the lower flammable limit of the refrigerant. The detector, or a sampling tube that draws air to the detector, shall be located in an area where refrigerant from a leak will concentrate. The shaft shall not be required to be ventilated for double-wall refrigerant pipe where the interstitial space of the double-wall pipe is vented to the outdoors. For *refrigeration systems* used in residential *occupancies* serving only a single *dwelling unit* or *sleeping unit*, shaft ventilation shall not be required where the pipe or tube is continuous without fittings in the shaft.

Spaces with refrigerant piping must be included in EDVC calculations except:

- Areas that contain only continuous refrigerant piping
- Areas that contain only joints and connections that have been **tested in accordance with Section 9.13**

Refrigerant piping requires special construction per Section 9.12. Some examples (there are more):

- Refrigerant piping **that penetrates two or more floor/ceiling assemblies shall be enclosed in a fire-resistance-rated shaft enclosure**.
- Refrigerant pipe shafts with systems **using only Group A2L or B2L refrigerants shall be naturally or mechanically ventilated**.
- Refrigerant pipe shafts with one or more systems using any Group A2, A3, B2, or B3 refrigerant shall be continuously mechanically ventilated and shall include a refrigerant detector.
- Continuous protection via shield plates for concealed piping may be required for non-A1 and non-B1 refrigerants per 9.12.2.1

Piping Shafts

Are shafts required?

ASHRAE 15
ADDENDA A - Approved and Published

- "Shaft Alternative – Shaft enclosure shall not be required for the refrigerant piping for any of the following:"
- "Continuous refrigerant pipe for tube, including joints and connections, that have been tested in accordance with section 9.13"

If we have a shaft, are we required for it to be ventilated?

ASHRAE 15
ADDENDA B – Subcommittee for Rewording

- Shaft Ventilation – "The shaft shall not be required to be ventilated where all the refrigerant pipe or tube is continuous and has been tested in accordance with Section 9.13"
- "The shaft shall not be required to be ventilated for systems using only Group A2L or B2L refrigerants where there are no hot surfaces exceeding 1290F (700C) in the shaft and the pipes, tubes, joints, or connections have been tested in accordance with Section 9.13"

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Plan For Ridged Copper

2022: HPD

Plan for rigid copper layouts (2022 NYC Mech 1107.3)

- A2L refrigerant piping must be protected from puncture and damage from nails/screws
- Soft/flexible pre-insulated linesets are typical in apartments for r410a multi-splits, but with A2Ls, a rigid pipe conduit or metal enclosure is required. (eg. Inabadenko slimduct-RD metal pipe enclosure)
- Rigid copper linesets (common for large commercial VRF) is the alternative for apartment branches.

2025

SECTION 1107—PIPING MATERIAL

1107.1 Piping. Refrigerant piping material shall conform to the requirements in this section.

1107.2 Used materials. Used pipe, fittings, valves and other materials that are to be reused shall be clean and free from foreign materials and shall be *approved* for reuse.

1107.3 Materials rating. Materials, joints and connections shall be rated for the operating temperature and pressure of the *refrigeration system*. Materials shall be suitable for the type of refrigerant and type of lubricant in the *refrigeration system*. Magnesium alloys shall not be used in contact with any halogenated refrigerants. Aluminum, zinc, magnesium and their alloys shall not be used in contact with R-40 (methyl chloride).

[NY] 1107.4 Piping materials standards. Refrigerant pipe shall conform to one or more of the standards *listed* in Table 1107.4. For *refrigeration systems* used in residential *occupancies* serving only a single *dwelling unit* or *sleeping unit*, refrigerant piping and tubing shall be limited to aluminum, copper, and copper alloy. The exterior of the pipe shall be protected from corrosion and degradation.

TABLE 1107.4—REFRIGERANT PIPE

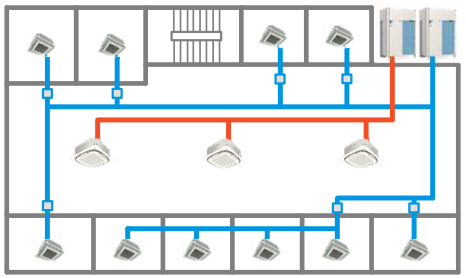
PIPING MATERIAL	STANDARD
Aluminum tube	ASTM B210, ASTM B491/B491M
Brass (copper alloy) pipe	ASTM B43
Copper linesets	ASTM B280, ASTM B1003
Copper pipe	ASTM B42, ASTM B302
Copper tube[a]	ASTM B68, ASTM B75, ASTM B88, ASTM B280, ASTM B819
Steel pipe[b]	ASTM A53, ASTM A106, ASTM A333
Steel tube	ASTM A254, ASTM A334

a. Soft annealed copper tubing larger than $1^{3}/_{8}$ inch (35 mm) O.D. shall not be used for field-assembled refrigerant piping unless it is protected from mechanical damage.
b. ASTM A53, Type F steel pipe shall only be permitted for discharge lines in pressure relief systems.

Applying ASHRAE15 When Designing a System

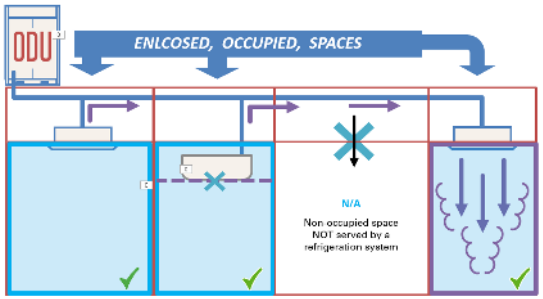
STEP 1

Layout the system



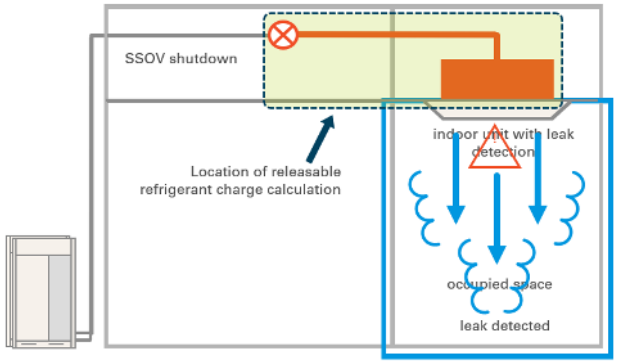
STEP 2

Determine size of occupied space(s) to be measured



STEP 3

Calculate the releasable charge



Applying ASHRAE15 When Designing a System: Continued

STEP 4

Verify the system complies with ASHRAE15 requirements

Calculate Maximum Refrigerant Charge

To verify the system complies, the refrigerant charge, or *RELEASABLE REFRIGERANT CHARGE (**Mrel**)* calculated in Step 3, must not exceed the *EFFECTIVE DISPERSAL VOLUME CHARGE (**EDVC**)*

The equation for ***EDVC*** to calculate the maximum allowable charge for R32 systems:

$$EDVC = V_{eff} \times LFL \times CF \times F_{occ}$$

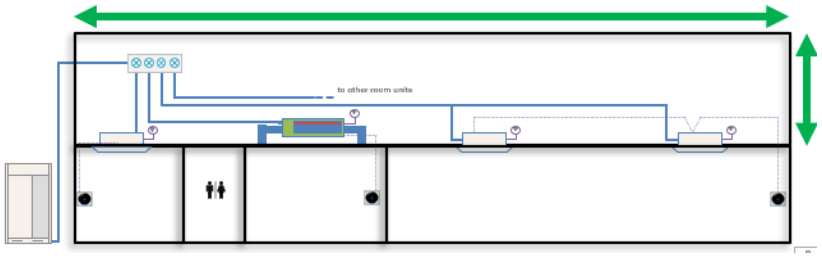
- *Effective Dispersal Volume* — ***Veff*** The volume of a space or connected spaces
- *Lower Flammability Limit* — ***LFL*** ASHRAE 34 sets R32 LFL at **19.1 lbs**/1000ft³
- *Concentration Factor* — ***CF*** For systems with air circulation, CF value = **0.5** (without = 0.25)
- *Occupancy adjustment Factor* — ***Focc*** For all occupancies other than institutional, **F**occ has a value of **1.0** (For institutional occupancies, **F**occ has a value of 0.5)

Mrel ≤ EDVC

UL 60335 Part 2-40: Branch Selector Box Locations

OPTION 1: OPEN VOID SPACE

Non-occupied space: **4.8lbs**/1000ft³



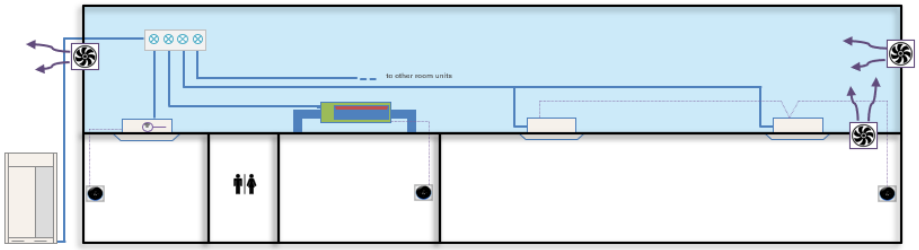
OPTION 2: CONNECTED SPACES

Connect other spaces (e.g. with false grilles)

$$A_{vent} = \frac{m_{rel} - m_{room}}{\text{LFL} \times 0.417} \times \sqrt{\frac{A}{g \times m_{room}}} \times \frac{M_r}{M_r - M_a}$$

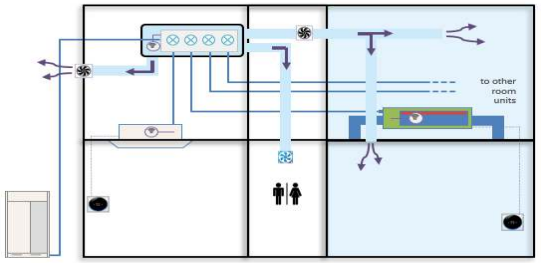
OPTION 3: CONTINUOUS VENTILATION

Continuous operation exhaust & make-up: 77cfm



OPTION 4: ON DEMAND (11cfm MIN)

7.6.4* Mechanical Ventilation. *Mechanical ventilation for refrigerant safety mitigation shall comply with this section. Where a ventilated enclosure is provided to control a refrigerant leak, the refrigeration system and ventilated enclosure shall be listed and installed in accordance with UL 60335-2-40*



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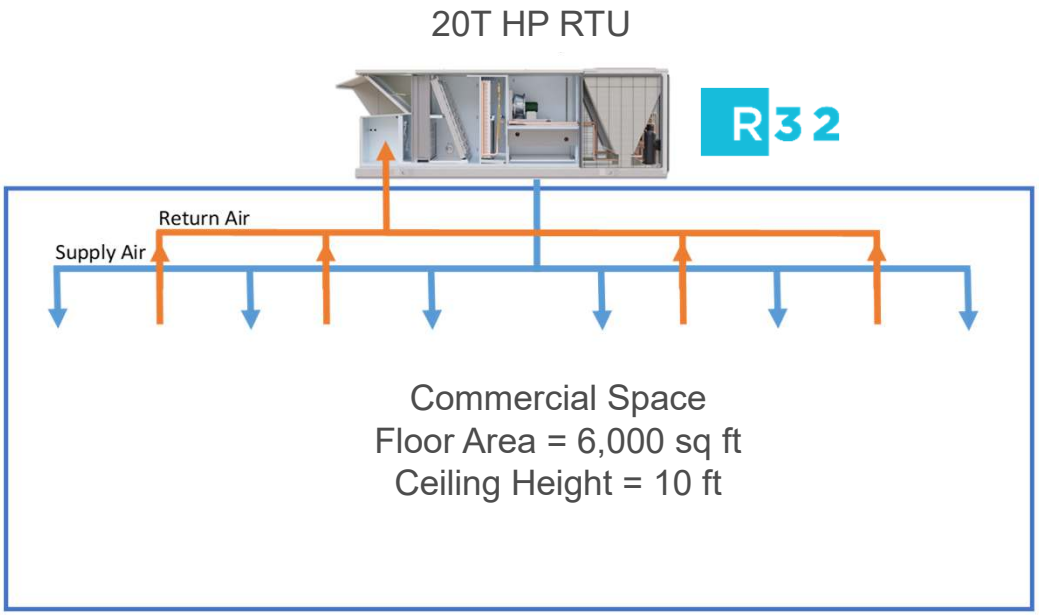
Refrigerant Limits: Example EDVC: RTU

1

- Identify:
  - Occupancy classification: **Commercial, F_{occ} = *1.0***
  - Refrigeration system classification: **High probability**
- Look up:
  - Refrigerant LFL in ASHRAE Standard 34, Table 4-1 = **0.0191 lb/ft^3**
- Determine the releasable refrigerant charge, m_{rel}
  - **m_{rel} = 31.2 lb**
  - Calculate EDVC per ASHRAE Standard 15, Section 7.6.1.1, where unit has air circulation initiated by refrigerant detection



$$EDVC = Veff \times LFL \times CF \times Focc$$

$$EDVC = \mathbf{573\ lb}$$

$$EDVC = 60{,}000\ ft^3 \times 0.0191 lb/ft^3 \times 0.5 \times 1.0$$

VRV Relaunch: R-32 Product Features

AP Sharma

Questions About the Future of VRV

- **VRV Technology through A2L Transition**
  - What benefit does VRF technology bring?
  - Is VRF technology still relevant?
- **Code Compliance & Smoother Transition**
  - How do VRF systems with R32 meet ASHRAE 15, 34, and UL 60335?
  - What are the charge limits in occupied spaces, and how are they managed?
  - What safety features make A2L refrigerants acceptable in VRF applications?
  - How are leak detection, ventilation, and shutoff integrated into VRF systems?
  - Will compatible tools and servicing equipment be available?
- **Daikin's VRV Product Differentiators & Refrigerant Advantages**
  - How does Daikin VRV solution standout from competitors with A2Ls?
  - Will engineers and contractors face redesign challenges?
  - What benefits does R32 offer vs. R410A?
  - How does R32 improve system performance and operating cost for end users?
  - What is the best solution in terms of sustainability?

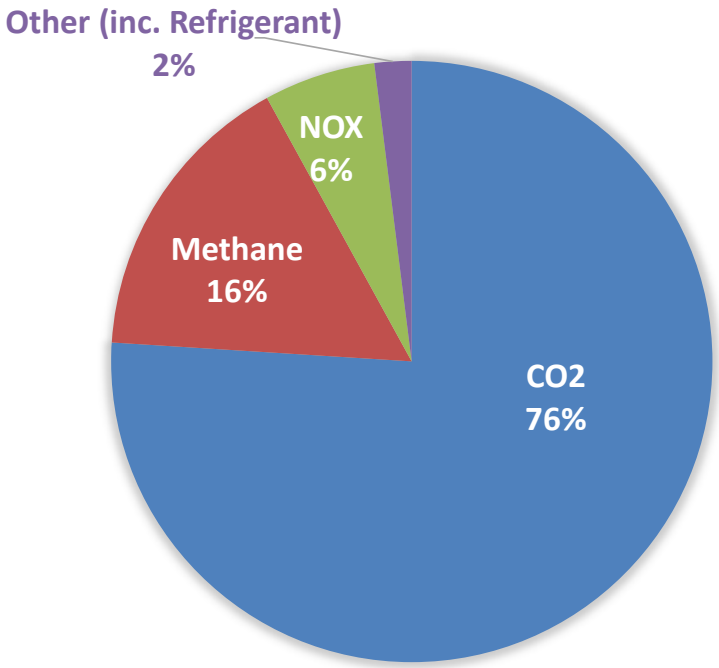
VRV Technology Relevance in this Transitional Market

A2L Transition - Sustainability at the Core

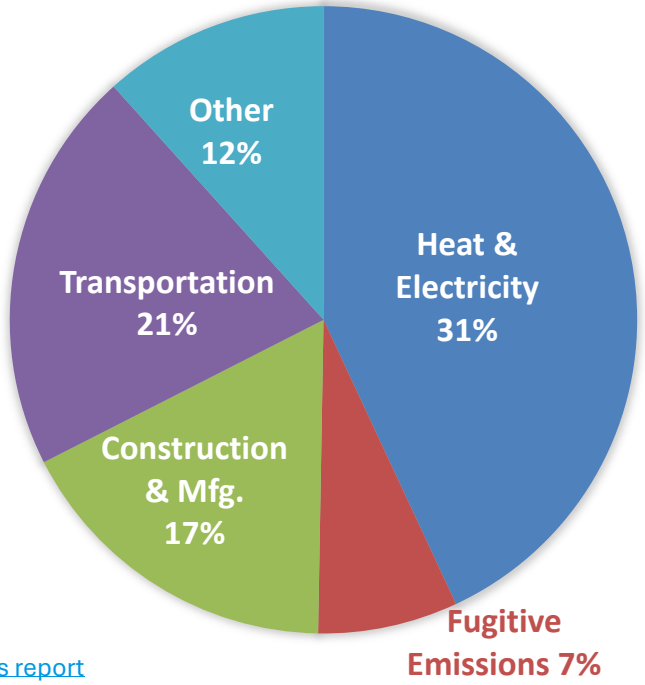
Low GWP
NO ODP

Sustainability – Sources of Greenhouse Gas Emissions

Greenhouse Gas Emissions (CO_2Equivalent)

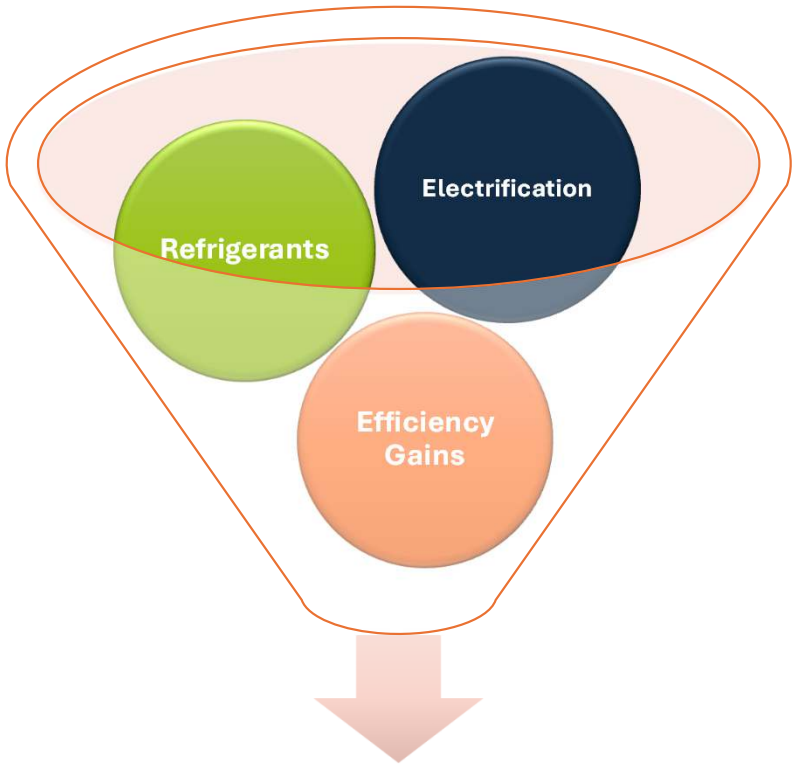


Carbon Dioxide Sources



Data Source: CES Emissions report

Decarbonization in HVAC



Electrification

- Convert fossil fuel equipment/processes to electric
- Dependent on clean power grid

Efficiency improvements

- Greatest impact with dirty grid
- Reduces as grid converts to renewable but still impactful

Refrigerants

- Can have much higher global warming potential per pound than CO_2
- Life Cycle Climate Performance (LCCP): combines direct and indirect effect into one metric

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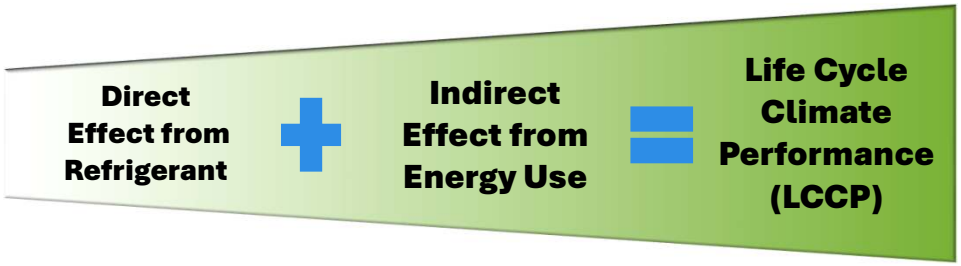
Life Cycle Climate Performance (LCCP)

LCCP is calculated with the direct impact from refrigerant leaks in use, refrigerant disposal and Indirect Impact from energy use in unit/refrigerant production



- LCCP looks at the total climate impact of an HVAC system, not just the refrigerant's GWP.
- It combines **direct effects** (Refrigerant leaks and end-of-life emissions) with **indirect effects** (CO_2 from the electricity used to run the system).
- **LCCP balances both**, showing that while refrigerant choice matters, improving **system efficiency and reducing energy use** usually has the bigger long-term climate benefit
- Since energy use usually dominates a system's lifetime impact, LCCP gives a more realistic overall picture than GWP alone, showing how efficient systems deliver real climate benefits across their entire life cycle.

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Sustainability with VRV and R-32

INVERTER

Variable Refrigerant Temperature

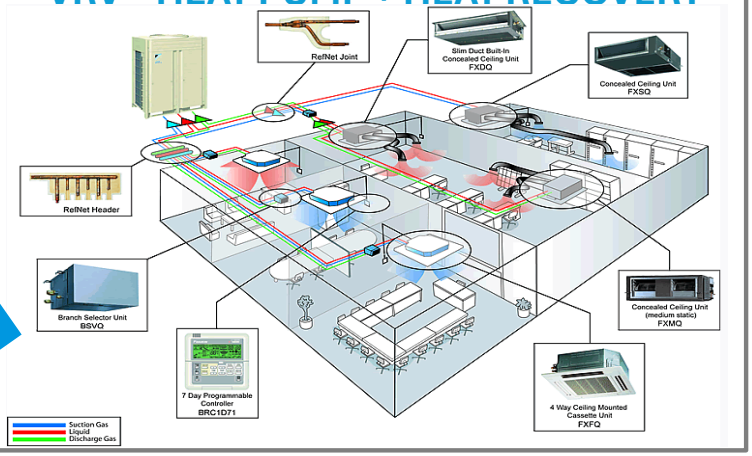
REFRIGERANT

	R-410A Benchmark	R-32	R-454B
Global Warming Potential (GWP) [1]	2,088	675	466
Total Emissions (kg CO_2-eq.) [14]	17,263	14,916 (13.6% lower)	15,008 (13.1% lower)
Composition	R-32 50% R-125 50%	R-32 100%	R-32 68.9% R-1234yf 31.1%
Refrigerant Safety Classification [2]	A1	A2L	A2L
Temperature Glide [5]	Yes	No	Yes
System Capacity [3,4]	100%	>110% [7]	>97% [8]
System Efficiency [3,4]	100%	>107% [7]	>102% [8]
Refrigerant Charge Size [6]	-	Up to 40% smaller [10]	Up to 10% smaller [11]
Proprietary	No	No	Yes

LCCP - Life Cycle Climate Performance

What is the best solution in terms of sustainability?

VRV – HEAT PUMP + HEAT RECOVERY



ALL ELECTRIC SOLUTION

Technology	Heat Pump Solutions	Other Heating Types	Other Heating Types
Chiller /Fan Coils /AHU's	<5%	>95%	Boiler + Cooling Tower
Large RTU	<5%	>95%	Gas Heat or Electric resistance
Light Commercial/RTU	20%	80%	Gas Heat or Electric resistance
WSHP	<20%	>80%	Boiler + Cooling Tower
VRV/VRF	***100%***	***0%***	

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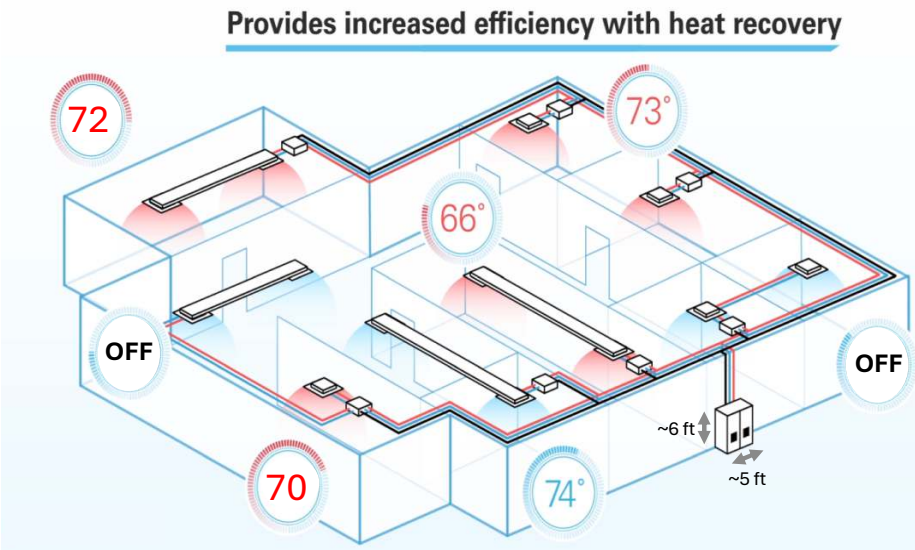
Why VRV? - Benefits of a VRV/VRF System

Compact Inverter-driven system designed to optimize comfort, energy consumption and total cost of construction. Ideal for retrofits and new construction

- **All Electric Heat Pump**
  - High heating performance down to -22°F
- **Optimized Comfort**
  - Zoned indoor units adjust to provide the required cooling and heating capacity to each space, saving energy & increasing comfort
- **High Energy Efficiency**
  - Each space can be turned off or when not in use to further reduce energy
  - VRV/VRF can also simultaneously cool and heat the space making use of wasted exhaust heat and save more energy (heat recovery)

VRV = Daikin Registered trademark
VRF = Industry term



Why VRV? - Benefits of a VRV/VRF System

Compact Inverter-driven system designed to optimize comfort, energy consumption and total cost of construction. Ideal for retrofits and new construction

- **Modular Design**
  - Easily scalable to meet the needs of the building or application
- **Sound Levels**
  - Quiet indoor and outdoor operation ideal for mixed-use or residential
- **Space Savings**
  - Compact system footprint allowing additional usable space + additional flexibility for tight space designs
- **Installation Flexibility**
  - Diverse offering of indoor units to match specific needs in the field

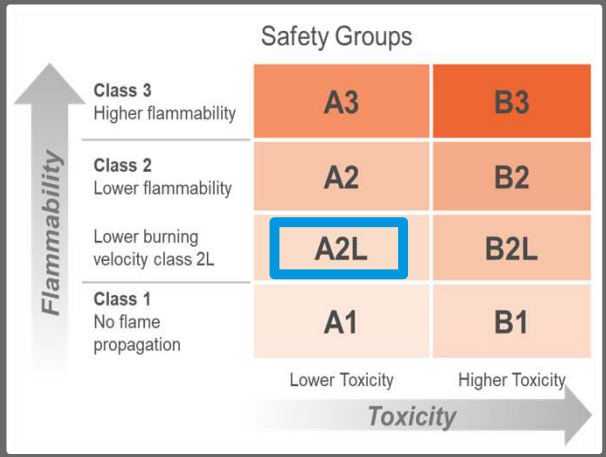
Future Proofing with A2L Code Compliance: Tools and Products that Empower a Smooth Transition

A2L Codes and Standards

- AIM ACT – Phase down of currently used HFC
- Move towards low GWP refrigerants – ***R32*** GWP lower than EPA Limit

ASHRAE 34
Designation & Safety Classification of Refrigerants

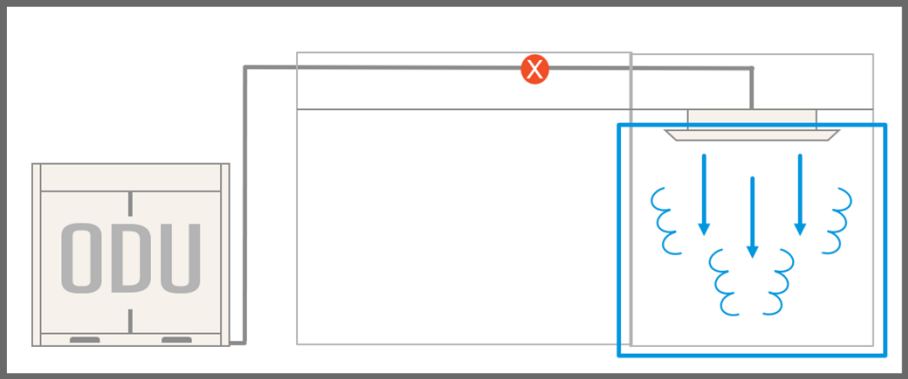
- Classifies refrigerants by flammability and toxicity



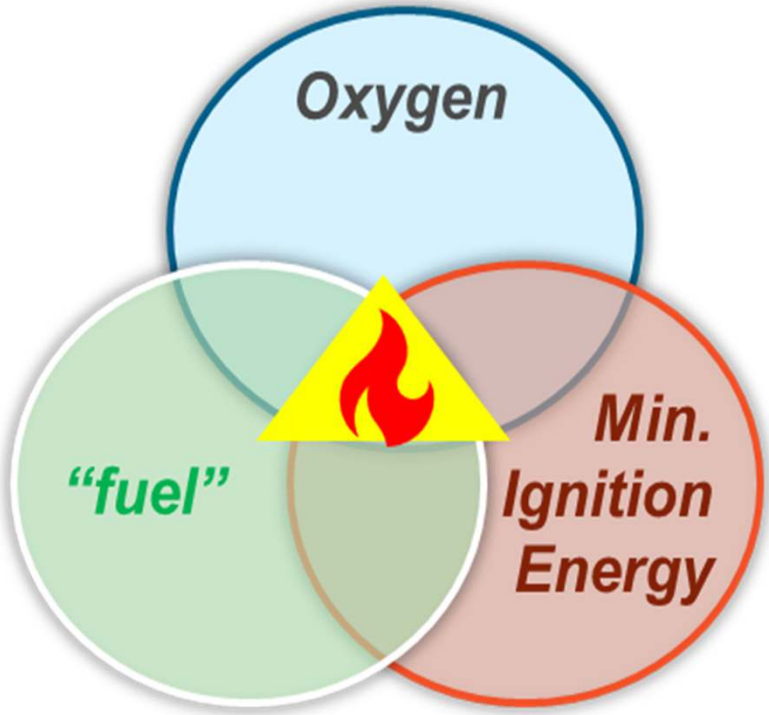
- Defines lower flammability limits and refrigerant concentration limits for refrigerants

ASHRAE 15
Safety Standard for Refrigeration Systems

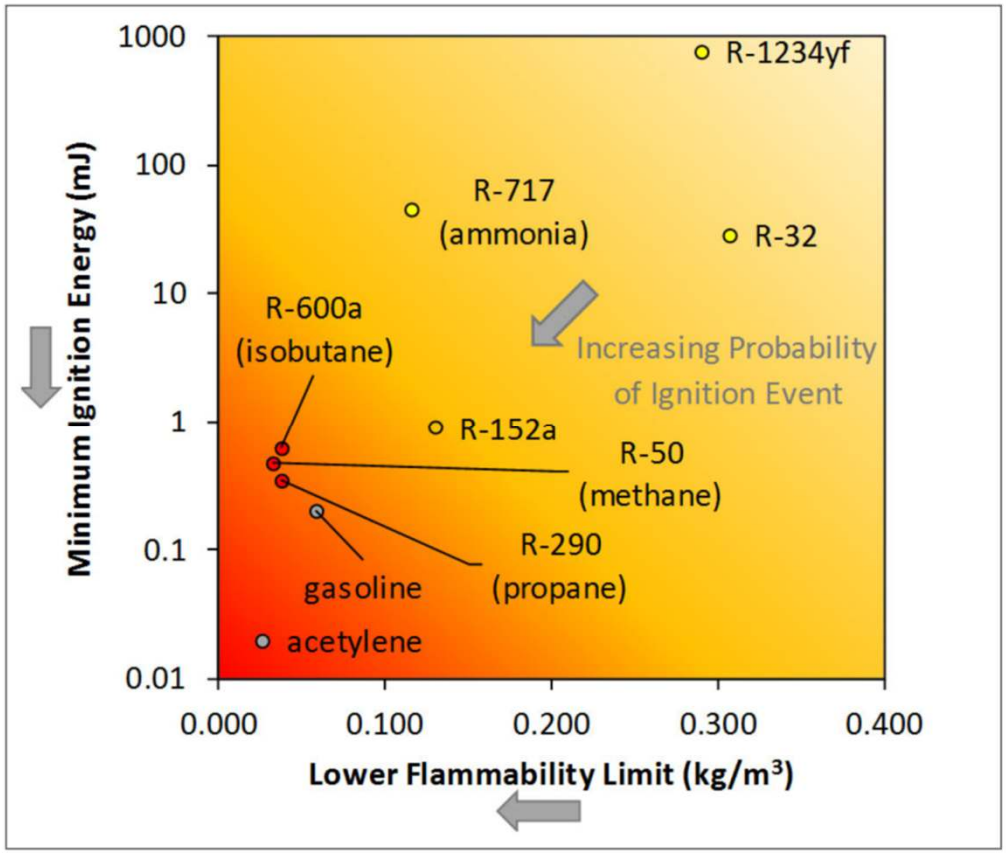
- Focused on design, installation and implementation of refrigeration systems in buildings
- Establishes releasable charge and leak mitigation limits



A2L Refrigerants are Difficult to Ignite



Classification	Refrigerant Type	Refrigerant mix
A2L	R32	14% or higher
A3	Propane	<2%



- LFLs 6-8x higher for A2Ls than A3s
- MIE's are about 100x higher for A2Ls

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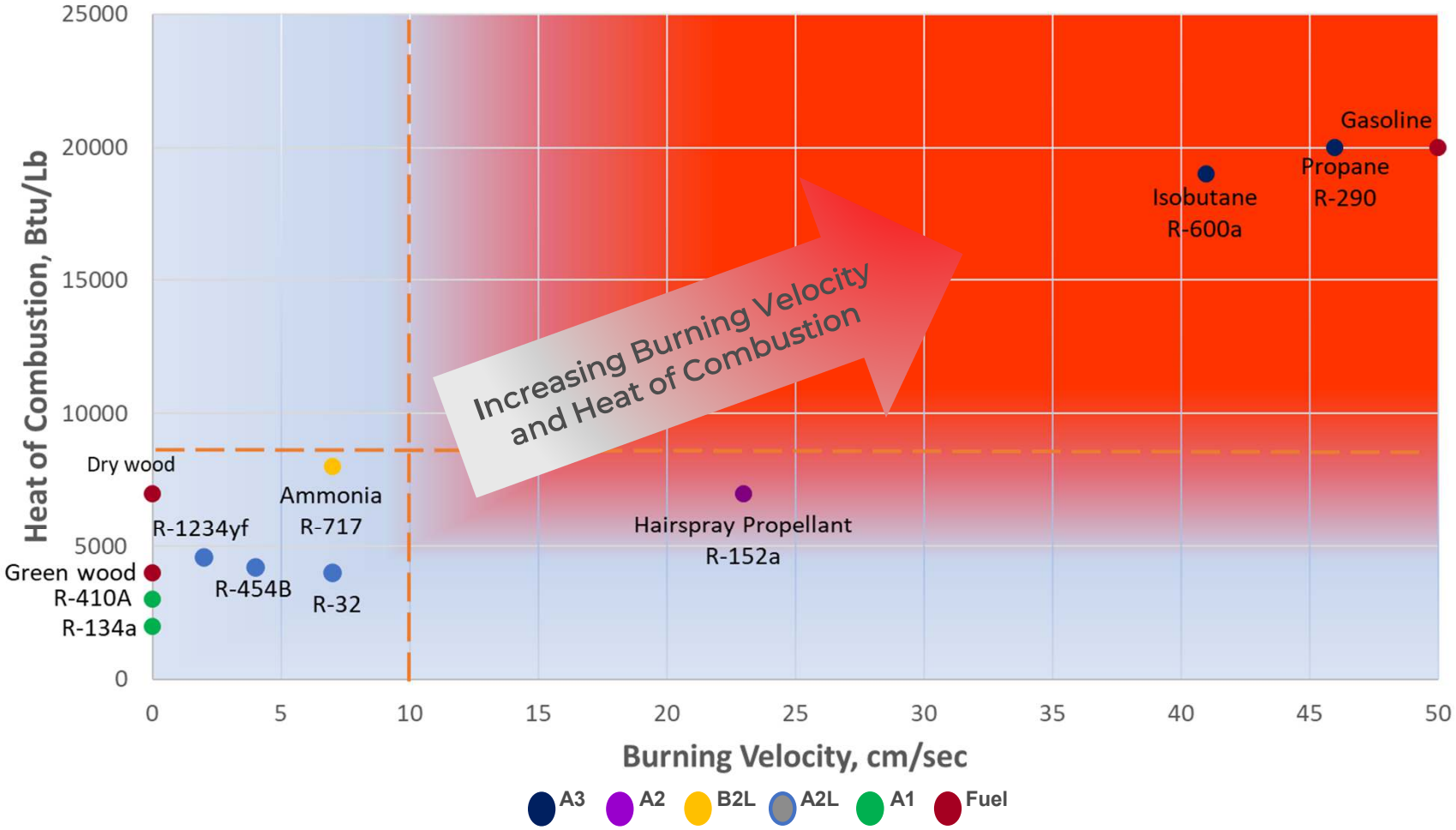
A2Ls are Much Like A1s

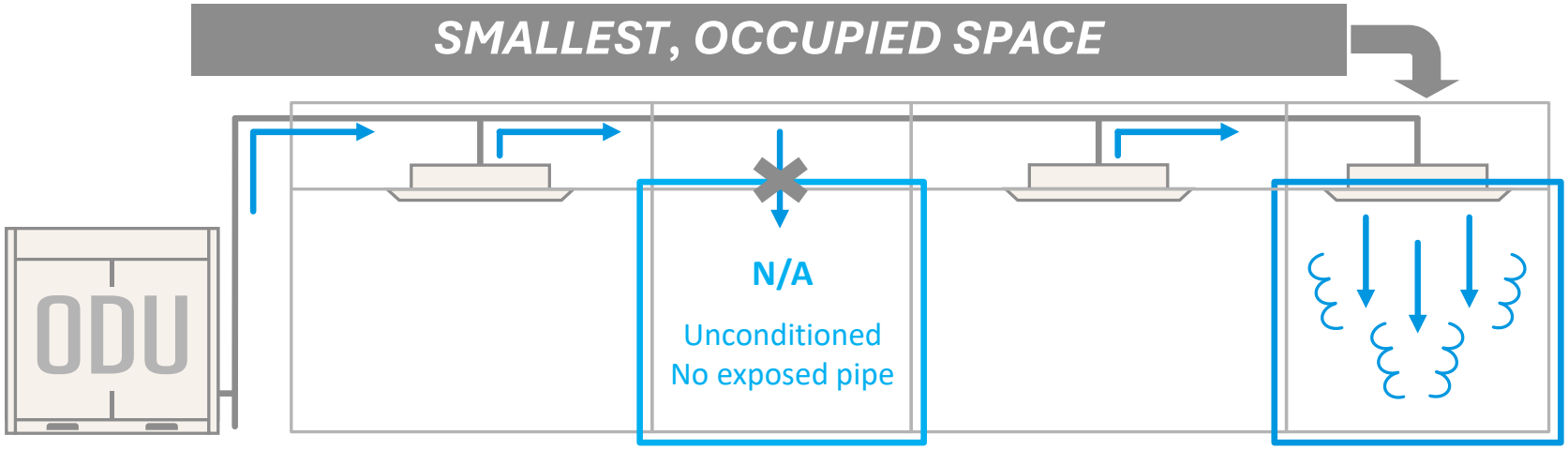


Burning Velocity – Image of Timing Over 3 FT

6.7cm/sec

46 cm/sec

Releasable and Allowable Charge Requirements



Mrel = Releasable Charge

- In the event of a leak, how much charge can be released into the space
- Total charge of the system unless safety shut off valve limits charge

EDVC = Allowable Charge

- How much charge can be released into the space and still be within a safe concentration of refrigerant
- Function of volume of room, circulation of airflow, charge amount

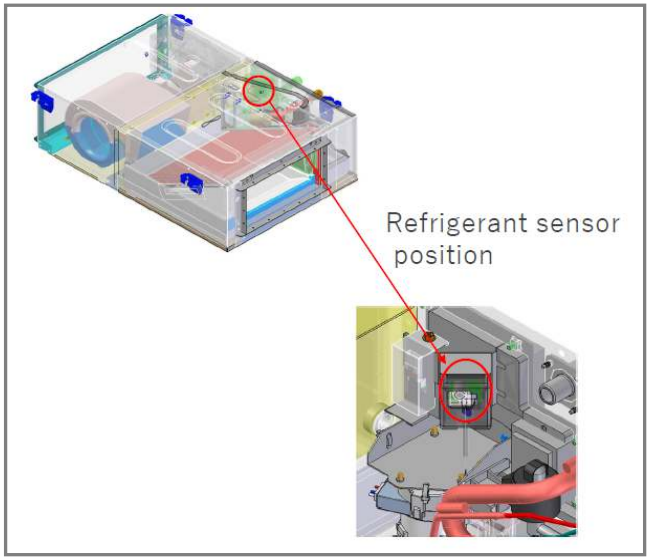
A2L Simplified!

- **Detection**
- **Dispersal**
- **Dilution**
- **Diversion**

VRV R32 Compliance Features

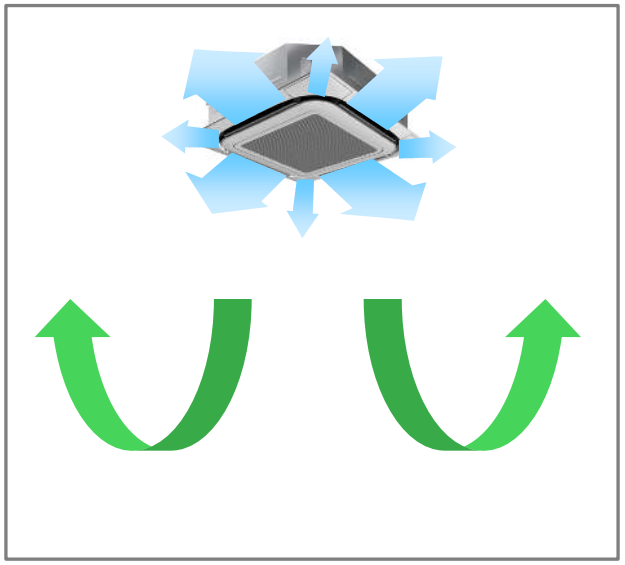
- Features built into the design from the factory to make it easy to comply with standards

Integrated Refrigerant Sensor



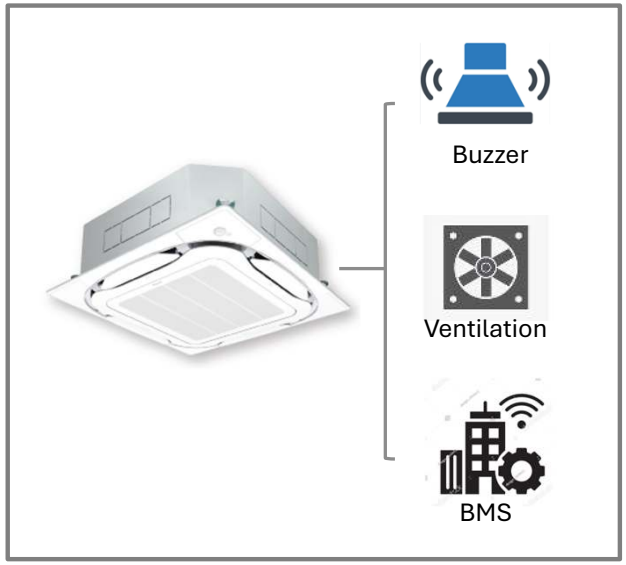
Detect

Full Circulation Mode



Disperse

Output Signal to External Device



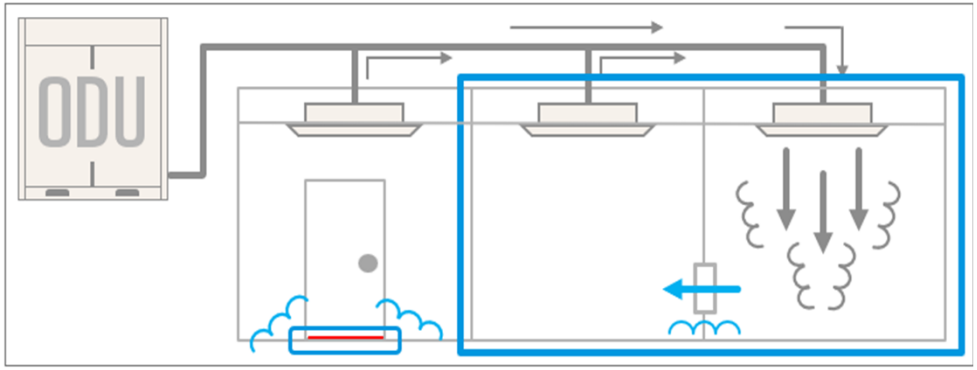
Dilute (Ventilation)

- Outdoor unit sequence factory ready with sequence of operation built in to comply with UL and ASHRAE code

Cases where Charge is Higher than EDVC

Ventilation — Dilute

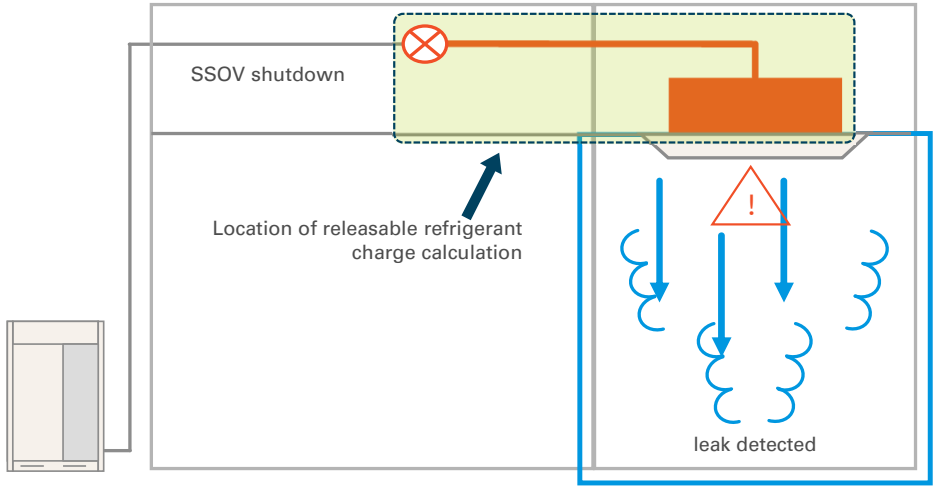
- Natural ventilation may be used per code requirements



- On demand or continuous ventilation complying with code requirements

Safety Shut off Valves — Divert

- Restrict the amount of charge that can be released into the space
- Calculation for charge downstream of the valve needs to be considered



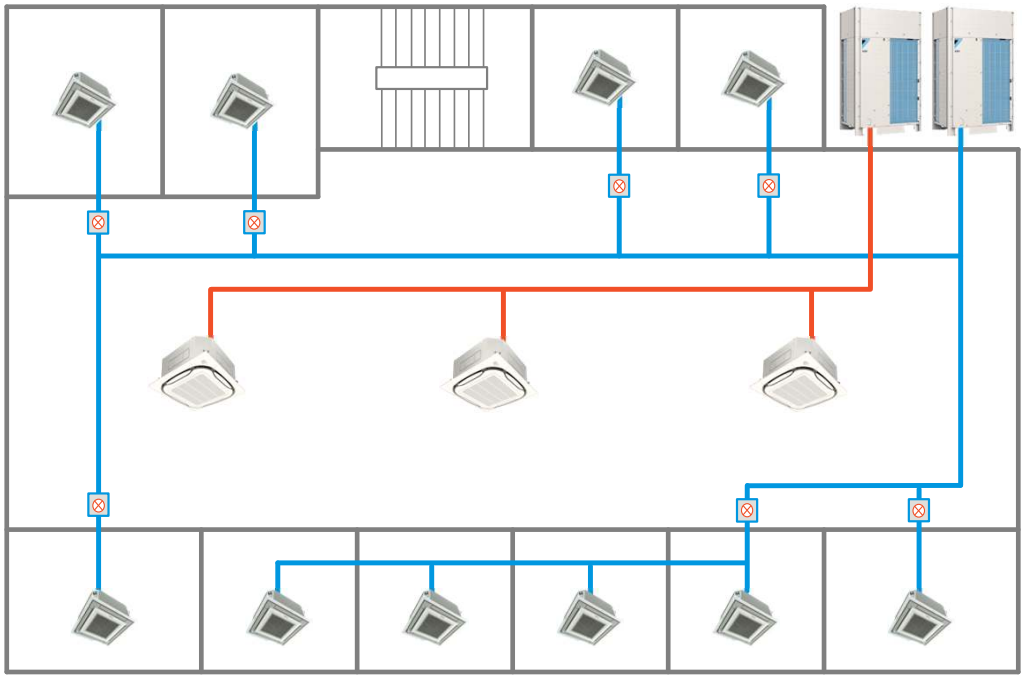
Safety Shut-off Valves

Already integrated in all branch selector boxes as standard

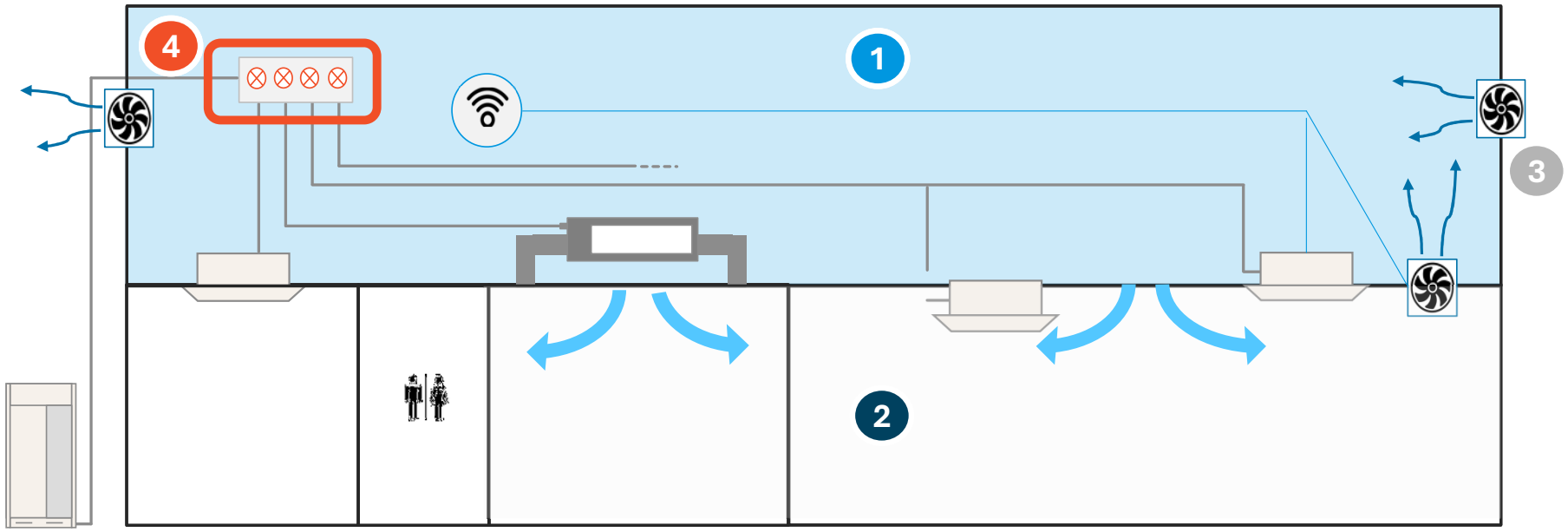
- Heat Recovery Applications – available in every BSB

Dedicated Safety Shut off Valve Box for when needed in Heat Pump Applications

- Heat Pump Applications – use SSOV when needed



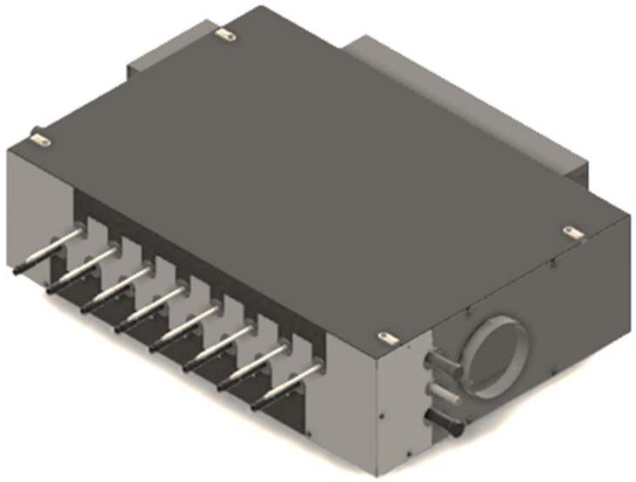
Safety Shut-off Valves

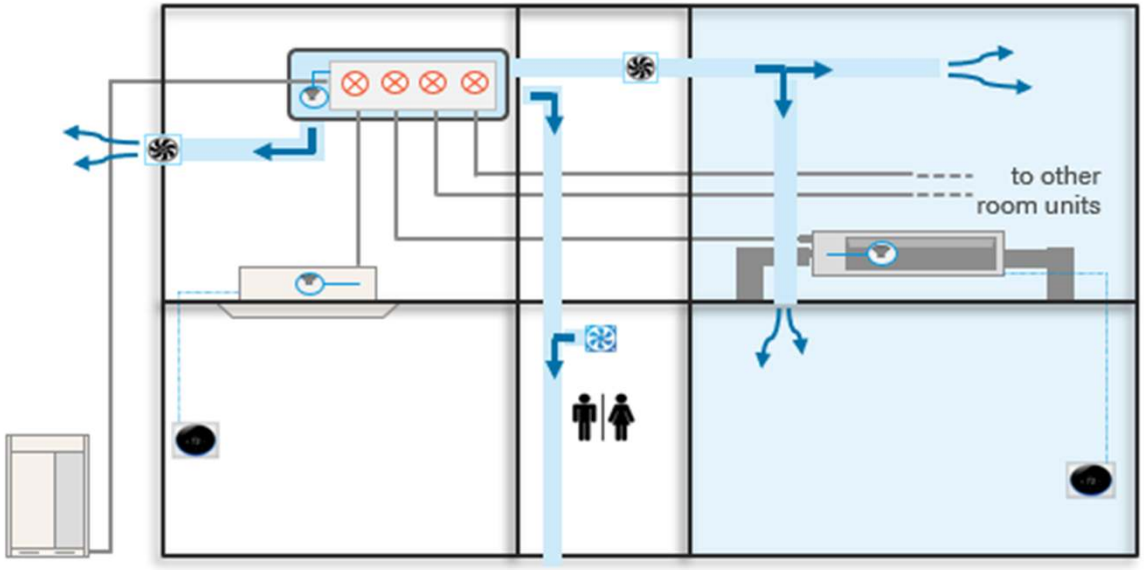


1. Space enough for releasable charge
2. Natural ventilation
3. Mechanical ventilation
4. Enclosure box

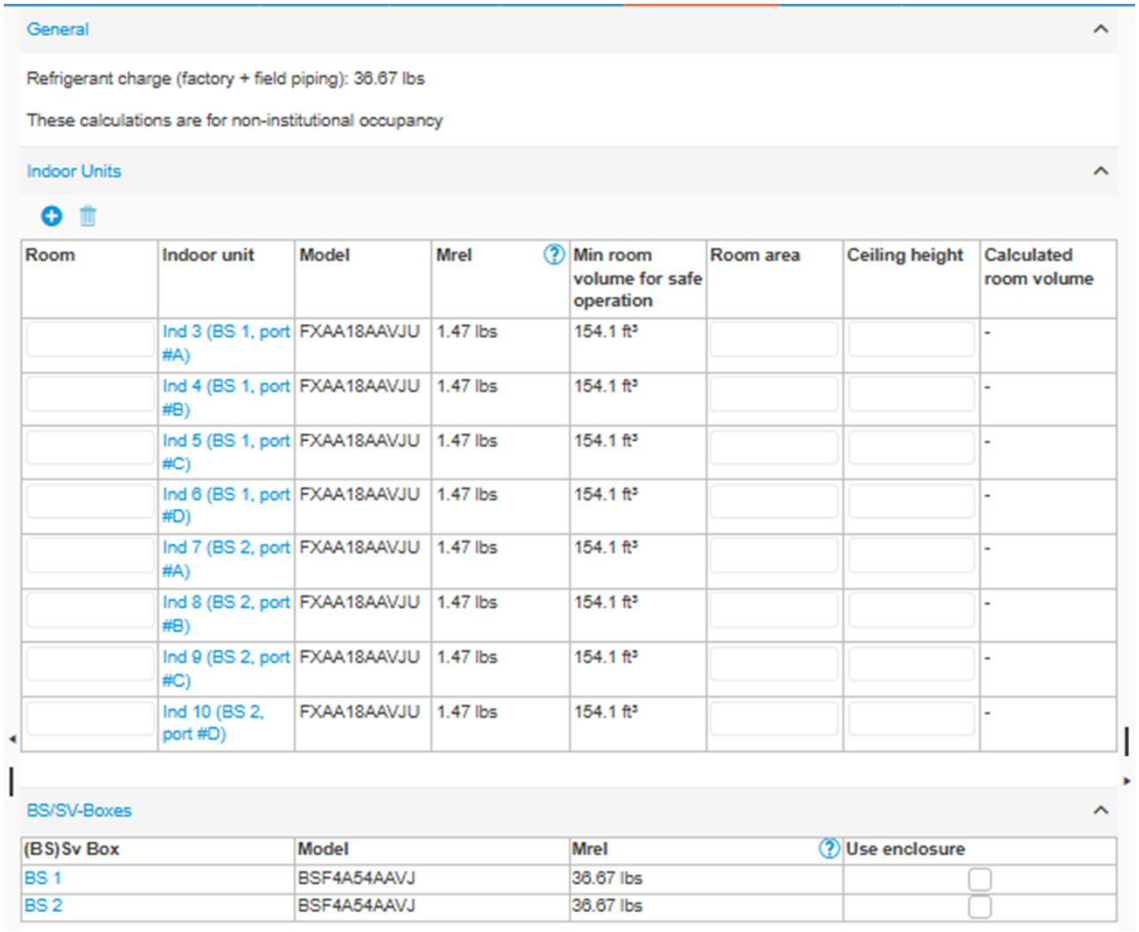
Branch Box Enclosure

- Enclosure option provided if this path is required





VRV WebXpress – Simplify the Selection Process



General

Refrigerant charge (factory + field piping): 36.67 lbs

These calculations are for non-institutional occupancy

Indoor Units

Room	Indoor unit	Model	Mrel	Min room volume for safe operation	Room area	Ceiling height	Calculated room volume
	Ind 3 (BS 1, port #A)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-
	Ind 4 (BS 1, port #B)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-
	Ind 5 (BS 1, port #C)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-
	Ind 6 (BS 1, port #D)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-
	Ind 7 (BS 2, port #A)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-
	Ind 8 (BS 2, port #B)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-
	Ind 9 (BS 2, port #C)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-
	Ind 10 (BS 2, port #D)	FXAA18AAVJU	1.47 lbs	154.1 ft³			-

BS/SV-Boxes

(BS)Sv Box	Model	Mrel	Use enclosure
BS 1	BSF4A54AAVJ	36.67 lbs	☐
BS 2	BSF4A54AAVJ	36.67 lbs	☐

Making Design Simple

- A2L Measures Tab to support A2L specific code compliance through the transition
- Does all the math for you!
- Calculates allowable room sizes
- Helps determine where additional safety measures such as safety shut off valves are required
- Easy drag and drop functionality
- Eliminate the guesswork

Product Differentiators: VRV R-32 Advantage

Introducing R-32 3-Phase VRV EMERION

ENERGY EFFICIENCY

COMFORT

DESIGN FLEXIBILITY

CLOUD SOLUTIONS

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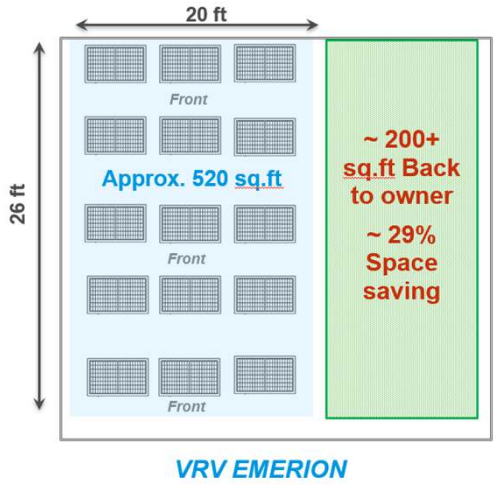
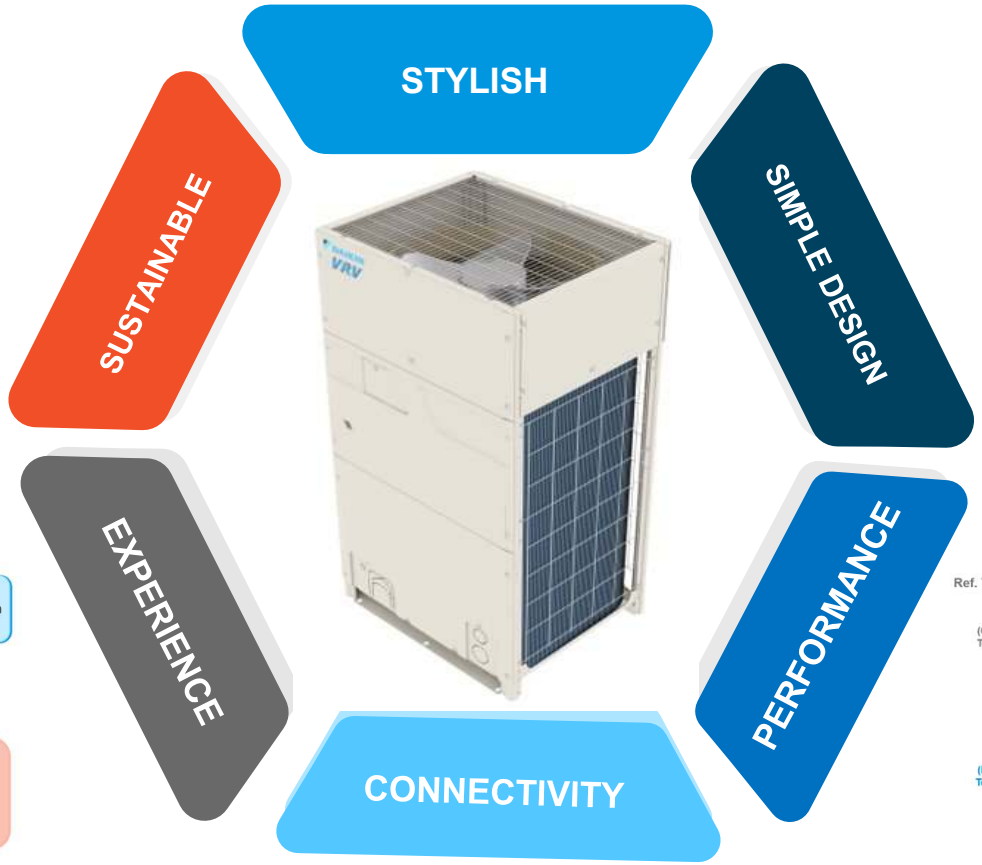
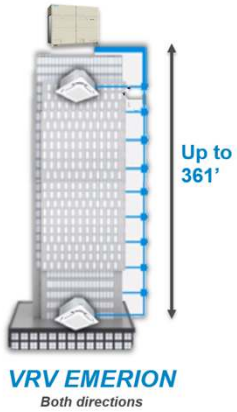
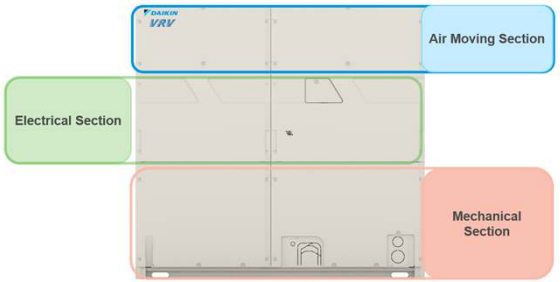
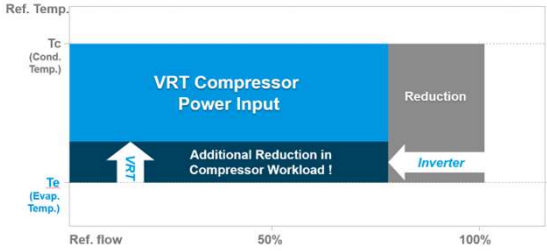
The R-32 VRV Advantage











Code Ready
- Features required for ASHRAE, UL Compliance available
- Lower total refrigerant in the system with refrigerant charge optimization

Performance
Expanded Heating Operation Range
Low Ambient Cooling for HP

Connectivity
- New D4 Communication Protocol
- Remote Field Settings Capability

A2L Simplicity
- Simple to Design with Sales Tools
- Simple to Install new A2L features when needed
- Simple for R410A Retrofit with Piping and Design Features

The R-32 VRV Advantage

Expanded low ambient cooling operation **down to -4°F** (-20°C) with a field setting and air adjustment grille

Expanded heating operation **down to -22°F** as standard.

New improved D4 net with remote monitoring, remote field setting and auto addressing features

Built-in data recorder to store up to **45 minutes of operational data**

Improved performance – Higher qualification ability for rebates and incentives

Ability to use **existing R410A pipe sizes** through field setting

Energy Savings and Enhanced Comfort with new Smart VRT Technology

Enhanced Comfort with individual Te control at each indoor unit

R32 system with **lower Global Warming Potential (GWP)** with better performance and lower charge

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The R-32 VRV Advantage - Nomenclature

Heat Pump

R	X	Y	Q	*	*	A	A	*	*	*

R	X	Y	A	*	*	A	A	*	*	*

Heat Recovery

R	E	Y	Q	*	*	A	A	*	*	*

R	E	Y	A	*	*	A	A	*	*	*

Flex BS Boxes

B	S	F	*	Q	*	*	T	V	J

B	S	F	*	A	*	*	A	A	V	J

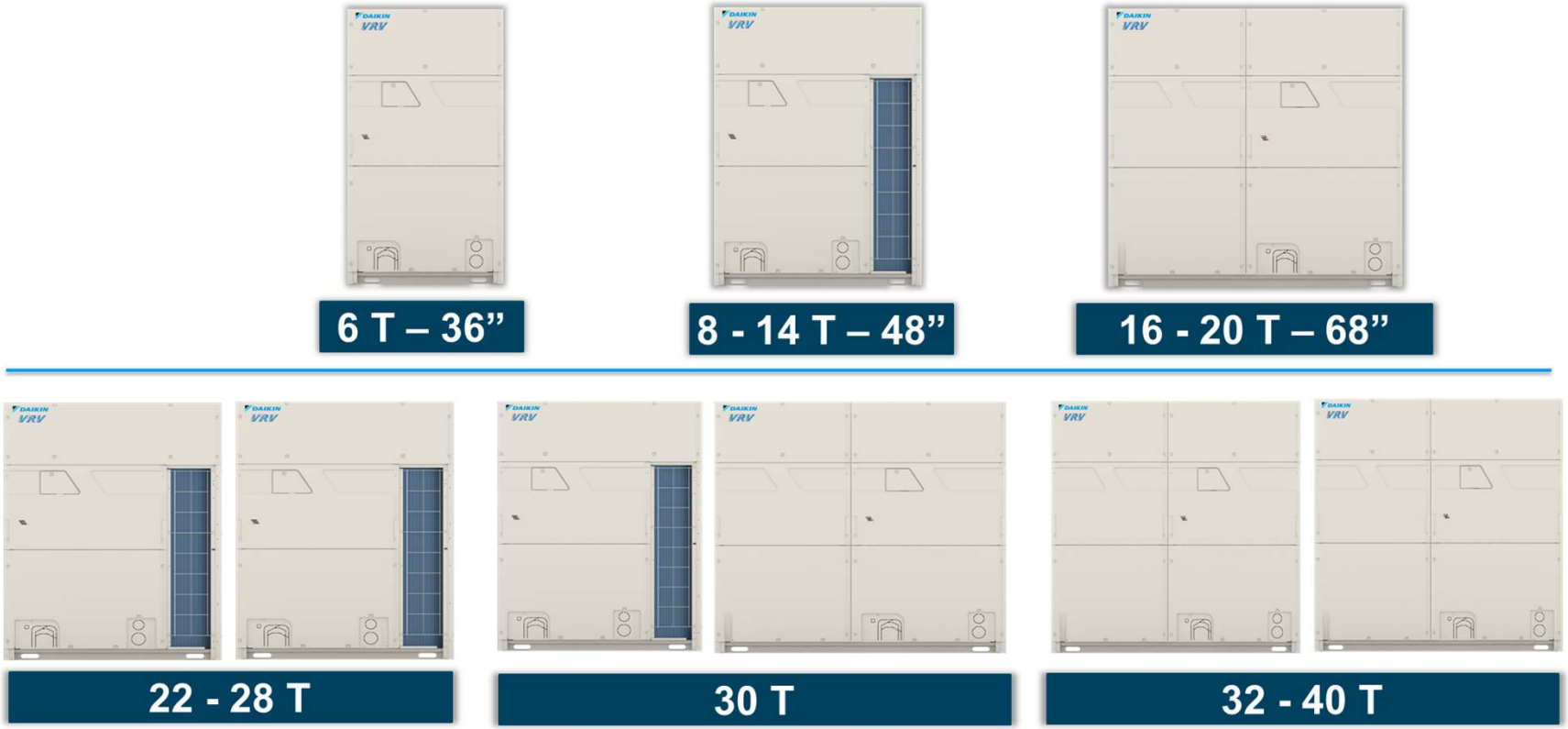
Single Port BSB and Safety Shut OFF Valves

B	S	Q	*	*	T	A	V	J

B	S	A	*	*	A	A	V	J
S	V	A	*	*	A	A	V	J

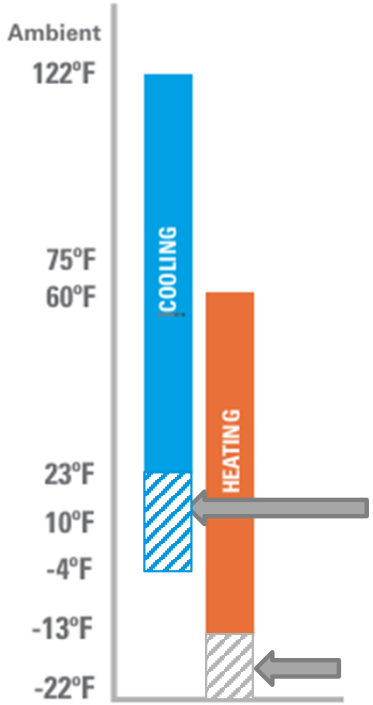
The R-32 VRV Advantage - Lineup

Same lineup as 3ph VRV EMERION (R410A)



The VRV R-32 Advantage – VRV 3-Phase

Expanded Operation



Cooling operation down to -4°F with HR or HP with SSOV

Heating operation down to -22°F with R32 VRV

- Cooling operation range is **extended** for R32 models from 23F to **-4°F**.
- This applies to both Heat Recovery and **Heat Pump** models and can be implemented by connecting new Branch Selector/ Safety Shut off Valve unit and snow guard for ODU*

Cooling Range			
	410A	→	**R32**
Standard	23F -122F DB		23F - 122FDB
Low Ambient	X		**-4F** - 122FDB

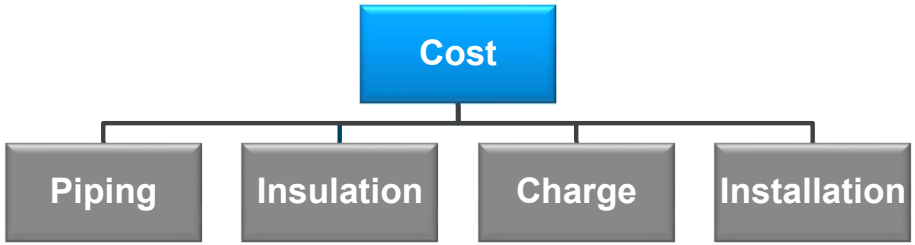
- Heating operation range for Std. model is **extended** in comparison to R410A model.

Heating Range			
	410A	→	**R32**
Heating	-13F -60F WB		**-22F** -60F WB

*Refer to design and installation manuals for details

Reduced Piping Diameter

- Uses smaller piping diameter compared to R410A
  - Lower installation cost
  - Lesser refrigerant charge per length of pipe



Pipe Size (HP)

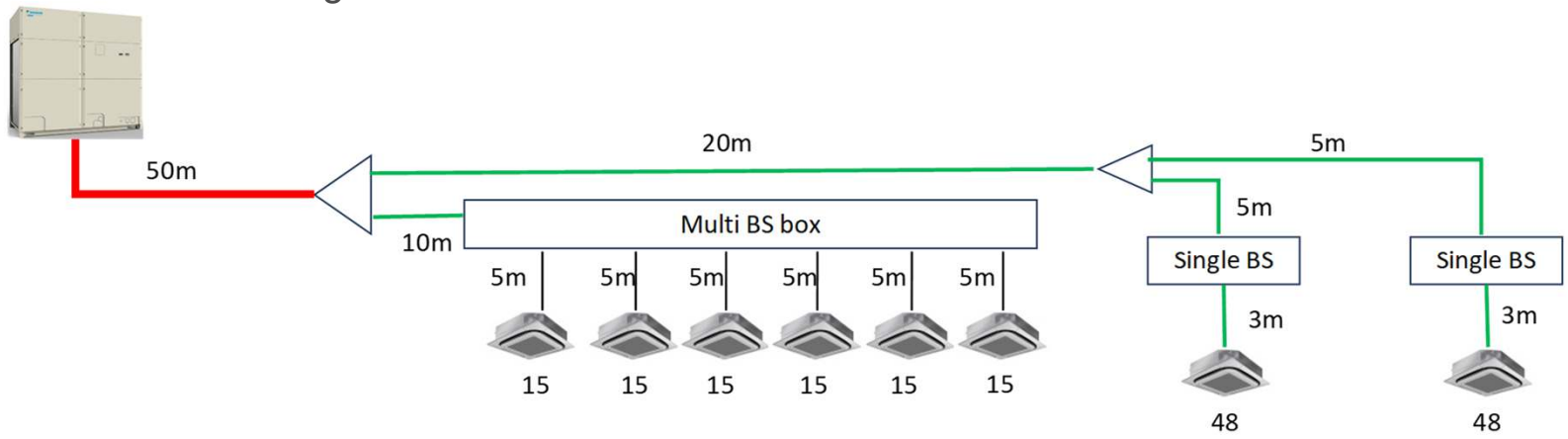
Ton	Gas (in.)		Liquid (in.)	
	R410A	R32	R410A	R32
6	3/4	3/4	3/8	3/8
8	7/8	7/8		
10	1/1/8	7/8	1/2	1/2
12		1/1/8	5/8	1/2
14				
16				
18				5/8
20	1/3/8	1/1/8	3/4	5/8
22				
24		1/3/8		
26				
28				
30	1/5/8	1/3/8		
32				
34		1/5/8		3/4
36				
38				
40				

Pipe Size (HR)

Ton	Suction Gas (in.)		H/L Gas (in.)		Liquid (in.)	
	R410A	R32	R410A	R32	R410A	R32
6	3/4	3/4	5/8	5/8	3/8	3/8
8	7/8	7/8	3/4	5/8		
10	1/1/8	7/8		3/4	1/2	1/2
12		1/1/8	7/8	3/4		
14				7/8	5/8	1/2
16			1/1/8	7/8		
18						5/8
20	1/3/8	1/1/8			3/4	5/8
22				1/1/8		
24		1/3/8				
26						
28						
30	1/5/8	1/3/8	1/3/8	1/1/8		
32						
34		1/5/8				3/4
36						
38						
40						

The VRV R-32 Advantage – Lower Charge with R-32

Depending on the combinations of units, pipe lengths and configurations, we can expect **82.5% charge** compared to the same configuration in R410A



		R32		R410A		
ODU	Factory		11.7		11.7	90%
	Field charge		12.0		14.5	
BS	Single		0.2		0.2	100%
	Multi		0.85		0.85	100%
Pipe	**50m**	1/2	5.2	5/8	9.4	56%
	46m	3/8	2.5	3/8	2.8	90%
	30m	1/4	0.624	1/4	0.7	91%
Total	**126m**		33.1		40.1	**82.5%**

O/D Unit: Factory Charge Amount=90%

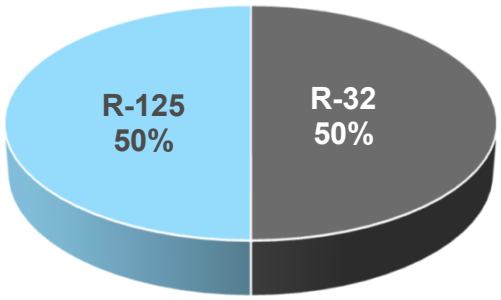
BS: Additional Charge=100% (Same current)

Main piping: 1 size down

Up to 17.5% reduction vs 410A

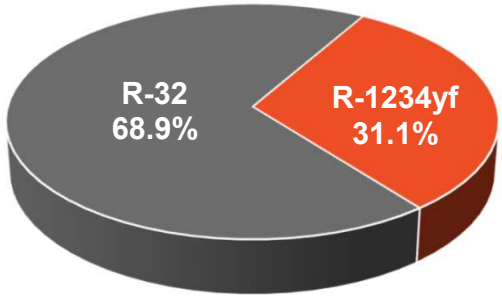
Amount of R-32 in a VRV System

R-410A



Out of 40.1 lbs, 20.5 lbs is R-32

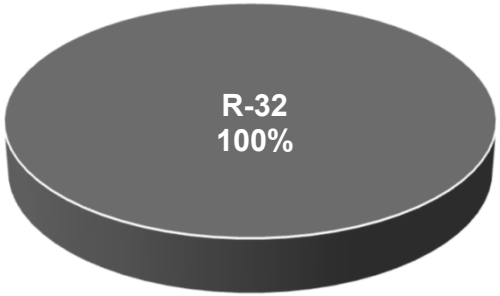
R-454B



Proprietary blend, single manufacturer

36 lbs of R-32

R-32



Single component, multiple manufacturers

33.1 lbs of R-32

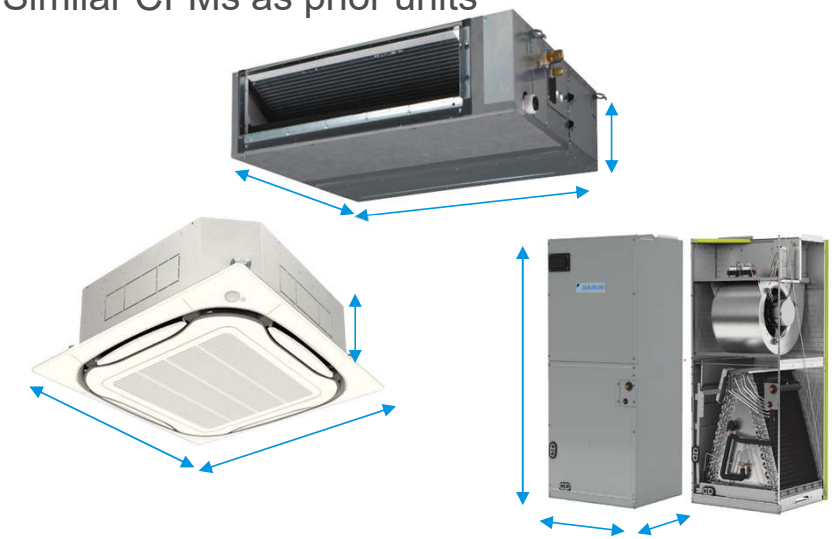
Design Features to Simplify the A2L Transition

Retrofit Piping

- Cases where R410A systems are being replaced and piping can be reused
- Field setting allows using R410A piping sizes with the new R32 equipment
- Significant material and labor cost savings

R32 Indoor Units

- Easy design change to R32 with same IDU spec as current + Added safety functions
- Same ductwork connections, ceiling cutouts, space required, maintenance clearances
- Similar CFMs as prior units



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The VRV R-32 Advantage – D4 Net

Current D3 Net

D4 Net

Larger Data Volume
&
Faster Speeds

Remote Software Update

Convenience, Cost Savings, Improved Support

Remote Field Setting

Easy setup for IDU/ODU unit setting such as addressing and field setting

Improved Data Monitoring

DIV provides more data and hence enhances failure prediction

Smart Variable Refrigerant Temperature

Current VRT

Step 1: Assess all ΔT

Step 2: Use max ΔT to select Te

- System Te may be determined by one IDU
- Slower response time to Te changes

+28% Seasonal Cooling Efficiency

New Smart VRT

Step 1: Every FCU calculates capacity needed based on ΔT and temp trend

Step 2: Requests Te target from ODU

Step 3: Assessing all requests from IDUs, ODU operates at optimum Te

Step 4: Now operating at the new Te, each IDU unit adjusts fan speed to regulate capacity

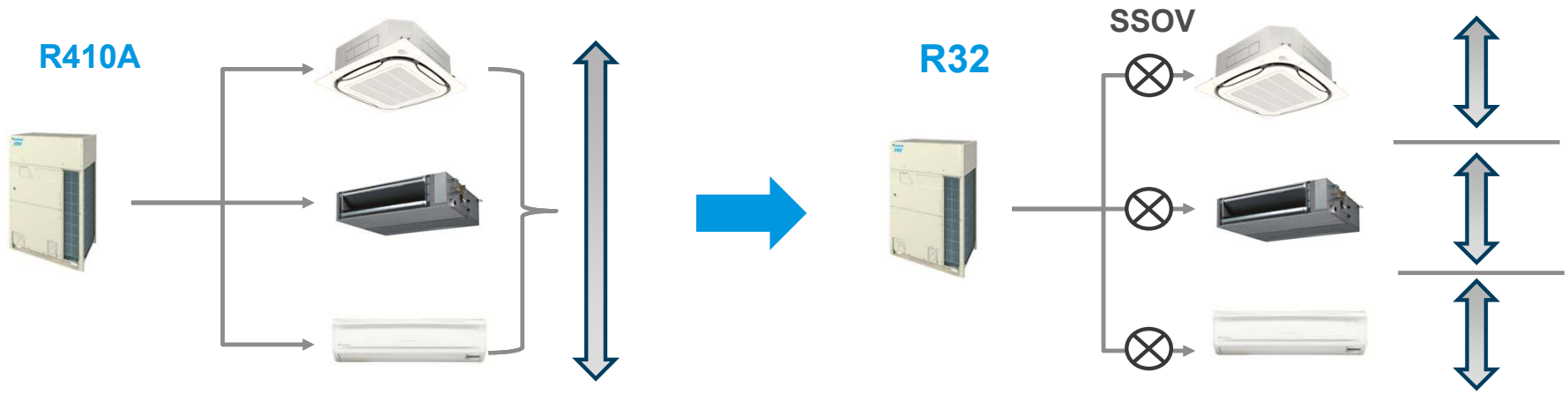
Smart VRT Strategy

- **Optimal** evaporator temperature is set and is possible through varying the IDU **fan speeds** at each unit.
- No field setting (mild, quick, powerful) - Automatic

Result:

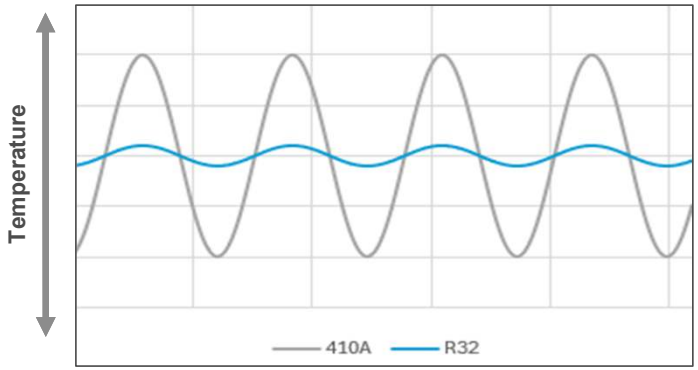
1. **Energy savings** by operating at optimal Te
2. **Enhanced comfort** through less thermal off units

Individual Control of Evaporator Temperature



Enhanced Comfort

- When space temperature is almost met, rather than turning the compressor off, system can increase Te depending on the load to prevent thermostat on/off
- Even greater comfort for users with even milder temperature swing



The VRV R-32 Advantage – Indoor Unit Features

Condensation Prevention through Discharge Air Control (Ducted Units)

- Intelligently keeps discharge air temperature above the dew point temperature of the room
- Minimizes condensation at the duct supply grilles
- Fewer complaints from customers – end users typically point at the system
- Condensation could also drop on the floor creating hazards. This function minimizes this risk and nuisance (restaurants, grocery stores for example)
- Prevents mold growth cause by condensation at grilles

Humidity Control (Ductless Units)

- Enhanced comfort with humidity control
- Helps address humidity level swings in higher humidity areas

Branch Boxes and Safety Shut off Valves

Branch Selector Box

- Valves standard in Heat Recovery Branch Boxes
- Follow same capacity limitations per Branch Selector Box specifications

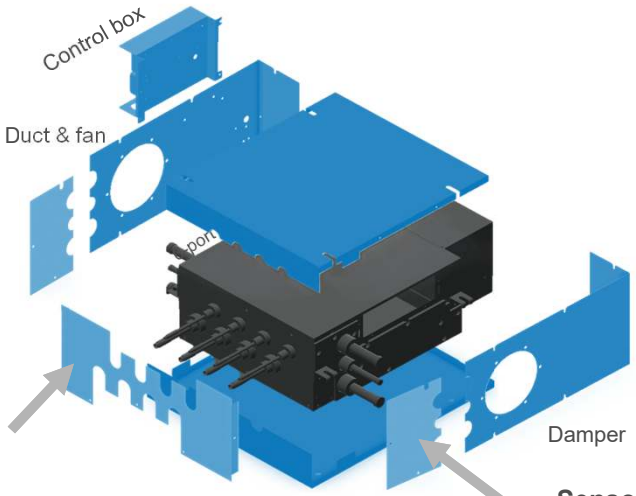
HP Safety Shut off Valves

- Up to 96 MBH capacity – multiple IDU can be connected into one SSOV to reduce complexity and cost

- Backup Power supply to meet code already integrated into branch box and SSOV. In case of power failure, valves will close using backup power.
- Internally insulated – no drain pan, drain line, float switch, secondary line required
- Offer additional features:
  - Low ambient cooling in Heat Pump
  - Individual control of Te for increased comfort

BSB and SSOV Enclosure

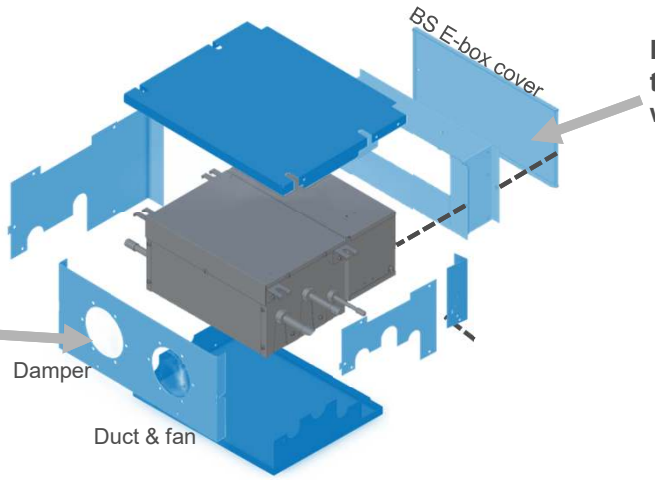
Multi Port



Can be installed with or after BSB install

Sensor easily installed on panel

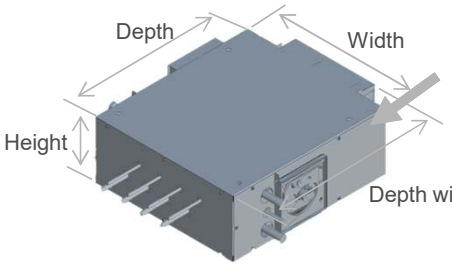
Single Port



Easy access to Ebox even with enclosure

Connections for Damper and Fan

Model Name			BS-EBSVA-AA	BS-EBF04-AA	BS-EBF07-AA	
Applicable BS Model			Single	4 port	6 port	8 port
Power supply			Single phase 208/230V 60Hz			
Weight		lbs.	14.3	29.1	41.6	
Dimensions	Height	in.	8.7	10.8 (274)		
	Width	in.	19.7	23.8 / 26.9 w PCBs	38.3 / 41.4 with PCBs	
	Depth	in.	21.9	26.6 / 29.9 with BS		
Vent hole size		In.	4.125	6.125		

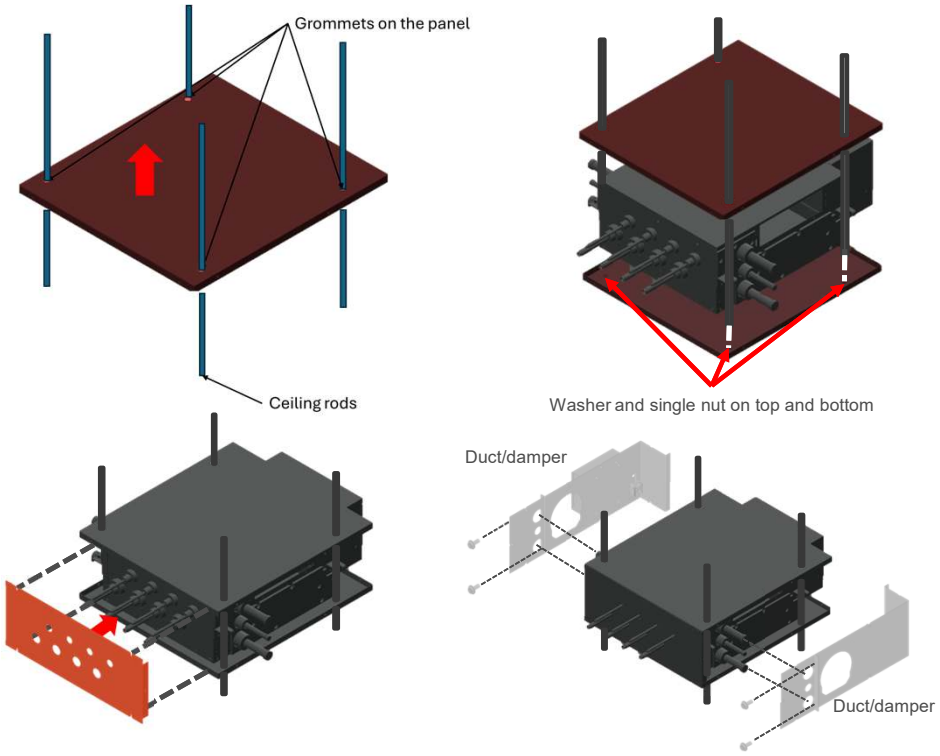


Minimal increase in size over BSB (~1" on each side)

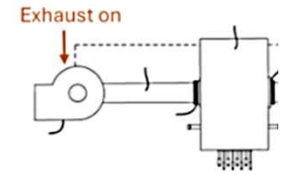
BSB and SSOV Enclosure

Enclosure Installation

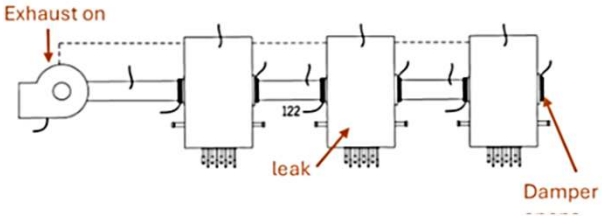
8 panels, 20 screws, easy installation within minutes



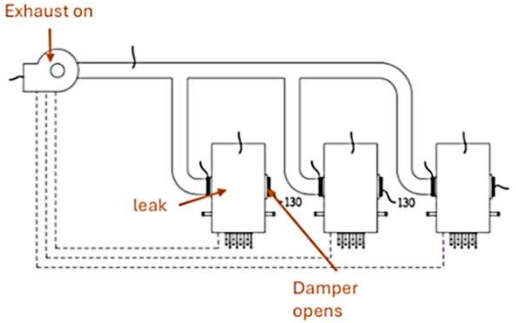
Ventilation Options



Separate - 1 to 1 Installation



Series Installation



Parallel Installation

VRV Roadmap

Already Released


FXTA


FXMA – HSP Ducted


FXSA – MSP Ducted


FXFA – 3x3


FXAA – Wall Mount


VRV-S


VRV-S Aurora

	Year		2025			2026												2027					
	Model	Description	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
Outdoor	R32 Emerion	3PH Standard				Jan 26																	
	R32 Aurora	3PH Cold Climate										Jul 26											
	R32 Emerion 575V	3PH Std. 575V																Jan 27					
	R32 Aurora 575V	3PH CC 575V																				May 27	
	RWEA	Water Cooled Std												460V Nov 26				230V Jan 27					
	RWEA 575	Water Cooled 575V																					Dec 27
Indoor	FXZA	2x2 Cassette						Mar 26															
	FXUA	4-Way Under Ceiling													Oct 26								
	FXMA 72/96	Large Cap Ducted						Mar 26															
	FXKA	Single Way Blow													Oct 26								
	FXDA	LSP Ducted																					Jun 27
BSB/SSOV	BSB Flex and Single	4,6,8 Port and Single				Jan 26																	
	SSOV 60, 96	Single Port				Jan 26																	
	Enclosure	Ventilated Enclosure				Jan 26																	
AHU	AHU Valve Kits	Valves only	Oct 25																				
	AHU Control Box	Z/W and D Boxes				Jan 26																	

Takeaways

- **VRV Technology is more relevant than ever through this transition**
  - LCCP, Decarbonization
- **VRV Products have several features that enable easy compliance with ASHRAE 15 and UL Codes**
  - Built in refrigerant sensors and sequences of operations for A2L mitigation
  - BSBs have integrated safety shut off valves; Separate SSOV for heat pump
  - Enclosure box option where needed
- **Daikin's VRV Product Differentiators – In developing the new R32 product, there are several new features**
  - Better performance, Expanded Offering, Wider Operation Ranges
  - Smart VRT, Humidity control, Condensation Reduction

QUESTIONS?