Ventilation & VRF Strategies

Rachel Roy, PE

MIAQ & Energy Conference - October 30, 2023

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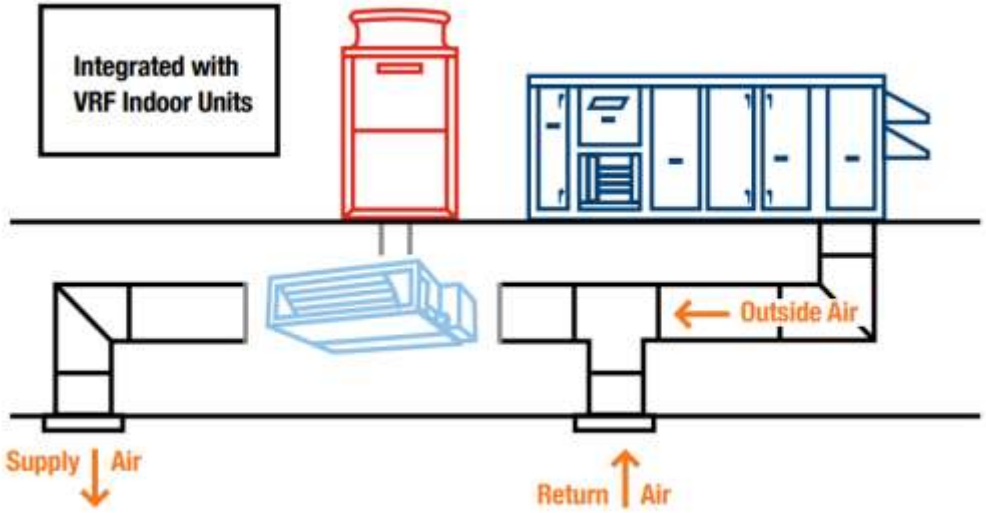
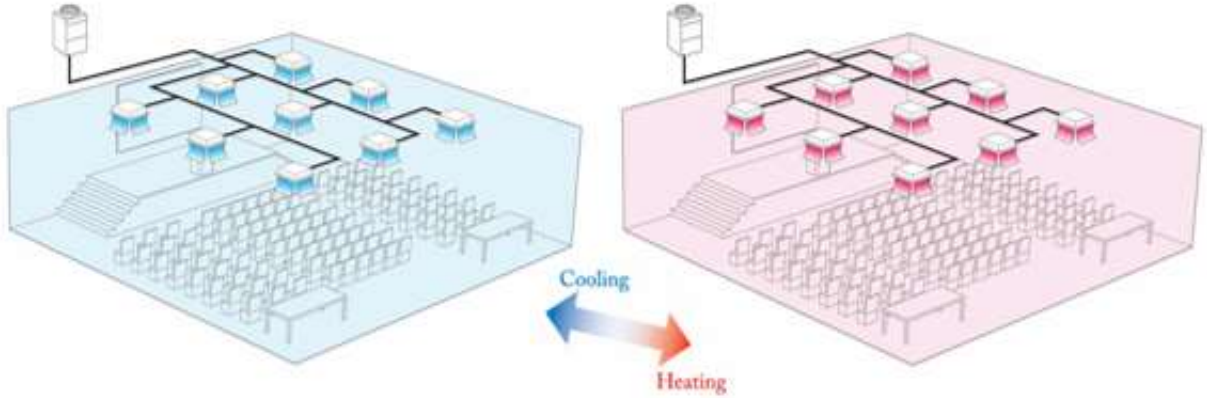
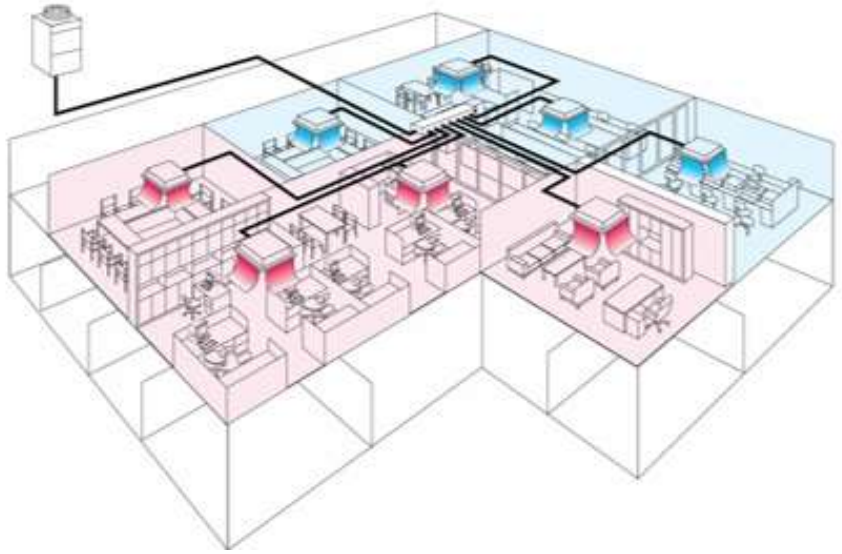


- Variable Refrigerant Flow (VRF)
- Ventilation Overview
- Dedicated Outdoor Air Systems (DOAS) & VRF
- Energy & Heat Recovery Systems & VRF
- Linear Expansion Valve Kits
- Filtration & VRF
- Refrigerant Concerns
- Hybrid VRF

Variable Refrigerant Flow (VRF) Systems

- Available as either heat pump (changeover) or heat pump with heat recover (simultaneous)
- Linear Expansion Valve (LEV) is located in the indoor units.
- This allows more indoor units and longer line lengths than multi-split systems with greater turndown and efficiencies.





Ventilation Requirements

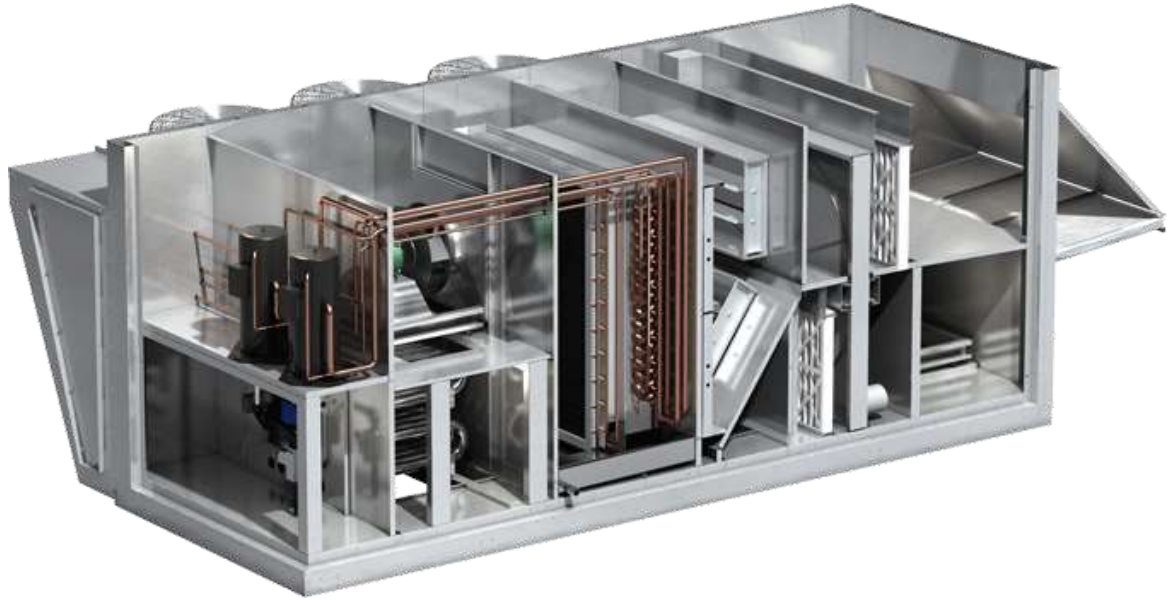
- Building and occupancy type
- ANSI/ASHRAE 62.1 Ventilation for Acceptable Indoor Air Quality
- ANSI/ASHRAE 62.2 Ventilation and Acceptable Indoor Air Quality in Residential Buildings
- ANSI/ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings

Ventilation Equipment: Rooftop DOAS most common

- Advantages:
  - Familiar design / installation
  - Single point for maintenance
- Challenges
  - Considerable time & cost relating to fire-rated shaft(s)
  - Duct losses increase operation costs for life of system

DOAS Systems

- Many sizes available
- Hot gas reheat option
- Indirect gas, hot water, heat pump electric heat options
- Recirculation damper option
- Inclusion of energy recovery wheel or heat recovery core options
- Option to pair with VRF outdoor unit
- Controls can be integrated with VRF system

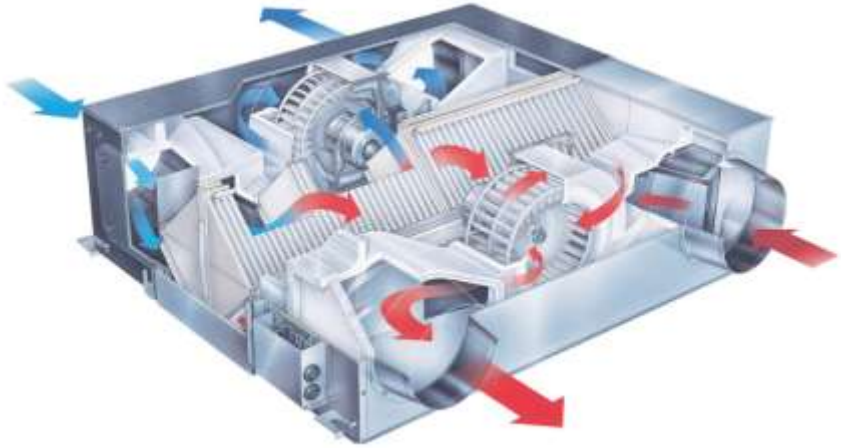


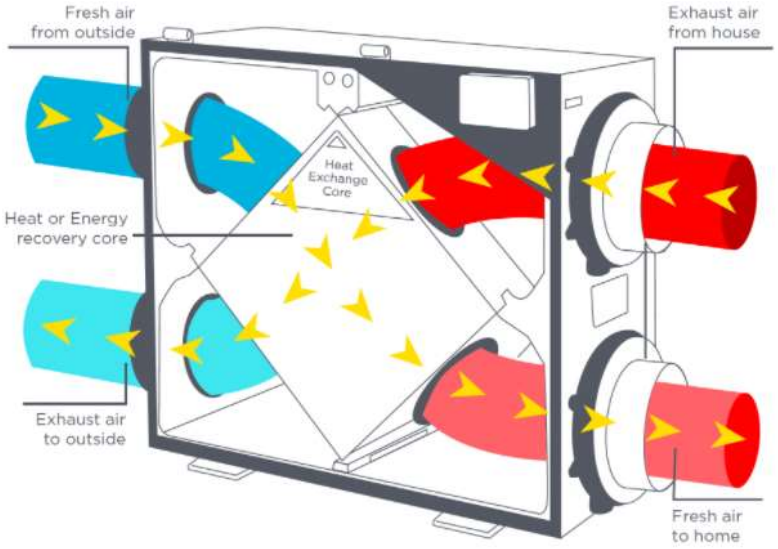
Ventilation Equipment: Floor by Floor is the Future

- Advantages:
- Eliminates costs relating to fire-rated shafts
- Redundancy & energy savings of zoned ventilation
- Compliant with new energy codes limiting reheat to 60F
  - IU in zone can compensate for any over-cooling
- Challenges
- Might be unfamiliar approach

ERV & HRV Systems

- Smaller sized for more flexible installations and duct sizes
- ERVs recover both sensible and latent energy
- HRVs recover sensible energy only, and may be used where dehumidification is needed
- Can be paired with LEV kits
- Can tie into some VRF indoor units to supply fresh air to the space
- Controls can be integrated with VRF





Linear Expansion Valve (LEV) Kit

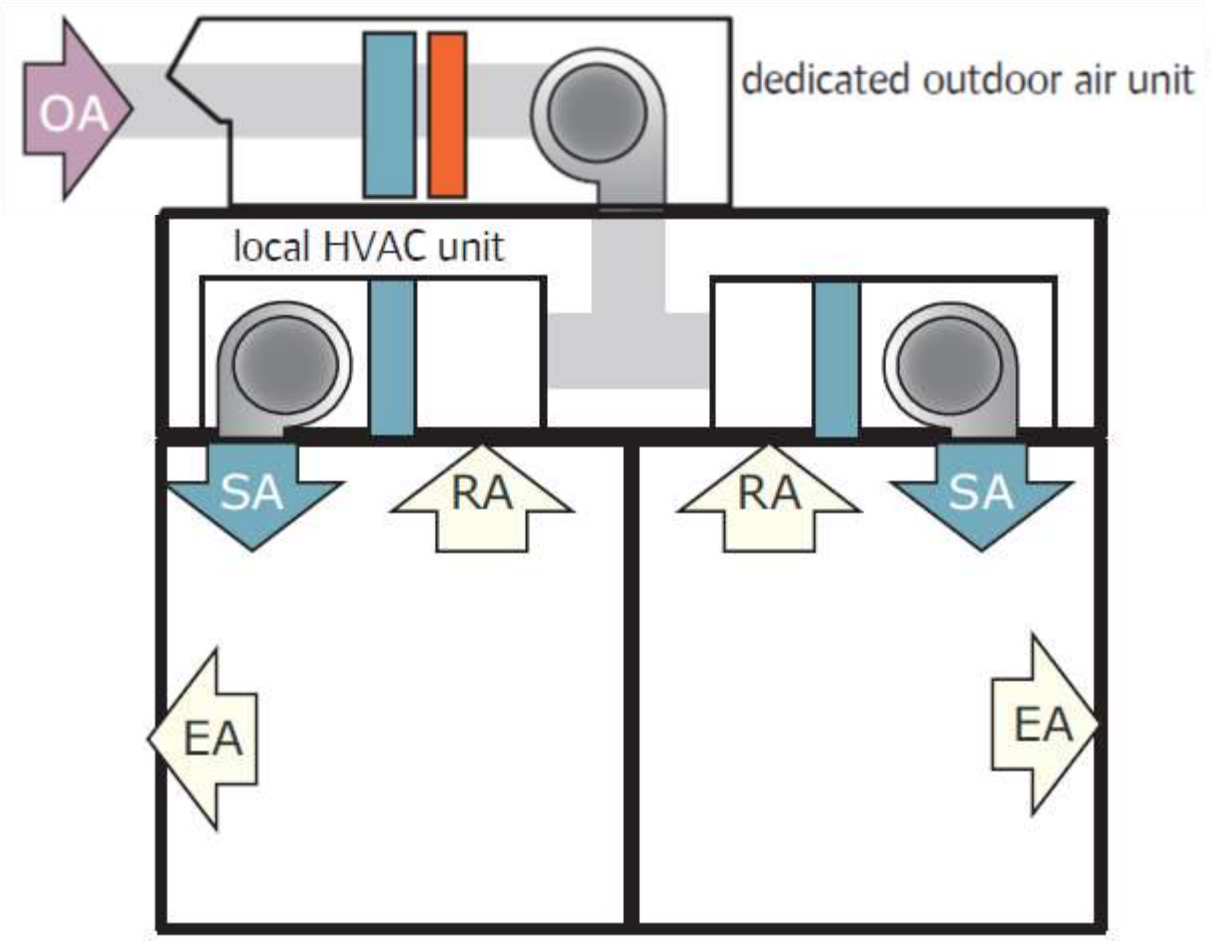
- LEV Kit can be used for ventilation with a range of products:
  - Duct mounted coil
  - Blower coil
  - Unitary AHU
  - Configurable AHU
  - Custom AHU
  - HRV
  - ERV

- Adjustable supply air temperature set point:
  - Cooling: 46°F to 80°F
  - Heating: 63°F to 95°F

- Entering air temperature range:
  - Cooling: 59°FWB to 75°FWB
  - Heating: 0°FDB to 59°FDB

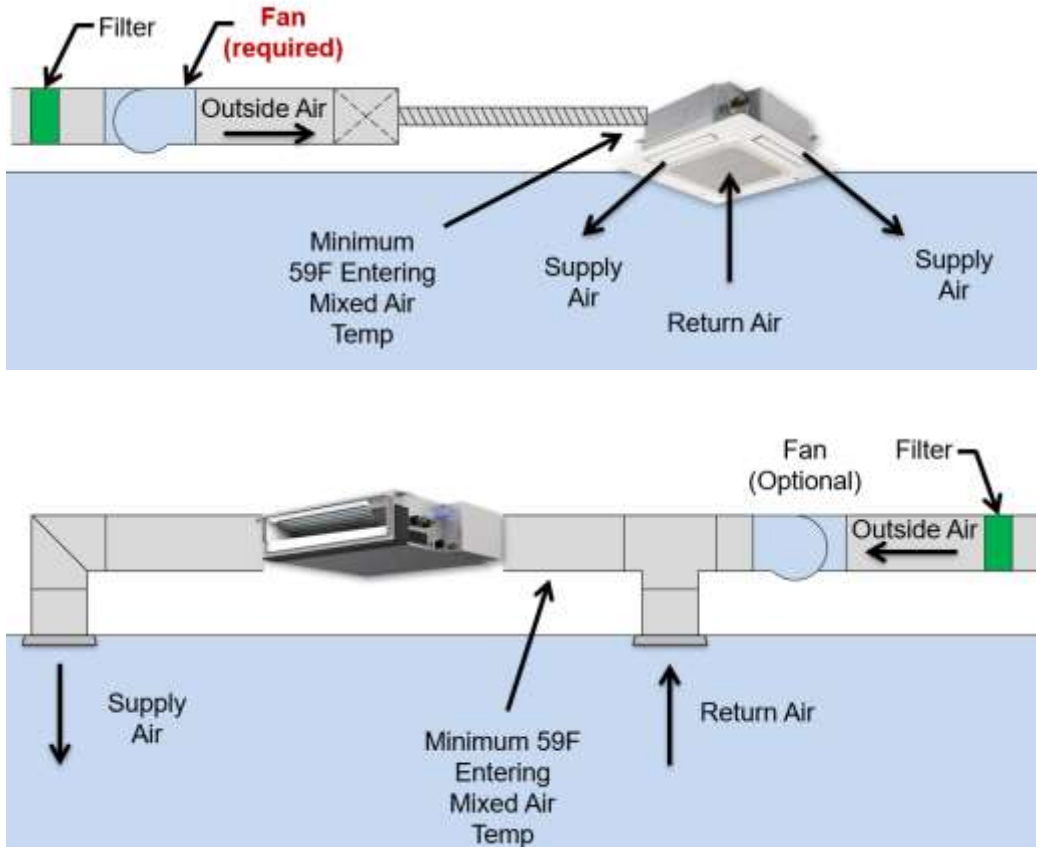
Ventilation Distribution: Direct to Indoor Unit

- Advantages:
- Reduces cost and space for additior duct and diffusers
- Easier to ensure OA is adequately dispersed throughout zone
- Little to no reheat should be require
- Challenges:
- Measurement & balancing more difficult
- IDU fan must operate continuously provide the OA during occupancy
- IDU fan must operate if DOAS syste operates during unoccupied period



Ventilation & VRF Indoor Units

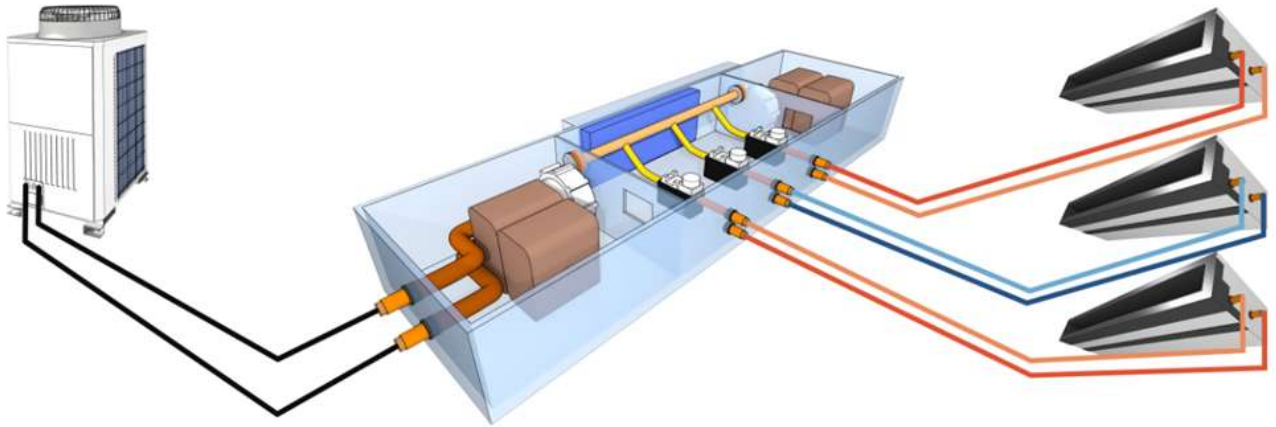
- Fresh air ducts can be connected directly to many ceiling cassettes, fresh air must be powered
- Ducted units can accept fresh air ducted directly to the return air side, no additional fan power needed
- Pay attention to fresh air CFM to ensure it isn't too high for that indoor unit
- Also check the mixed air temp of the fresh air and room return air, often fresh air in our climate requires treatment prior to the coil.



Filtration & VRF Indoor Units

- Schools want MERV-13 minimum filtration for recirculated air
- Best indoor units to accomplish that are ducted units, though you can also add some filtration to ceiling cassettes
- Ceiling cassettes can often add filtration, up to MERV 10-13
- Filter boxes can be added to ducted units for up to MERV 13 filtration

Hybrid VRF



- Definition:
- Hybrid VRF is a unique combination of a Heat Recovery VRF system and a Traditional 4-Pipe Fan Coil system. Hybrid VRF takes the advantages of both system types and puts them together in a single easy to install package with fully integrated controls onboard.

Industry Drivers for HVRF

Updates to ASHRAE 15 / 34 & UL 60355-2-40 Safety Standard

- May Require Built in Detection Systems to Monitor Refrigerant Leakage
- May Require Additional Mitigation Systems

International Mechanical Code 2018

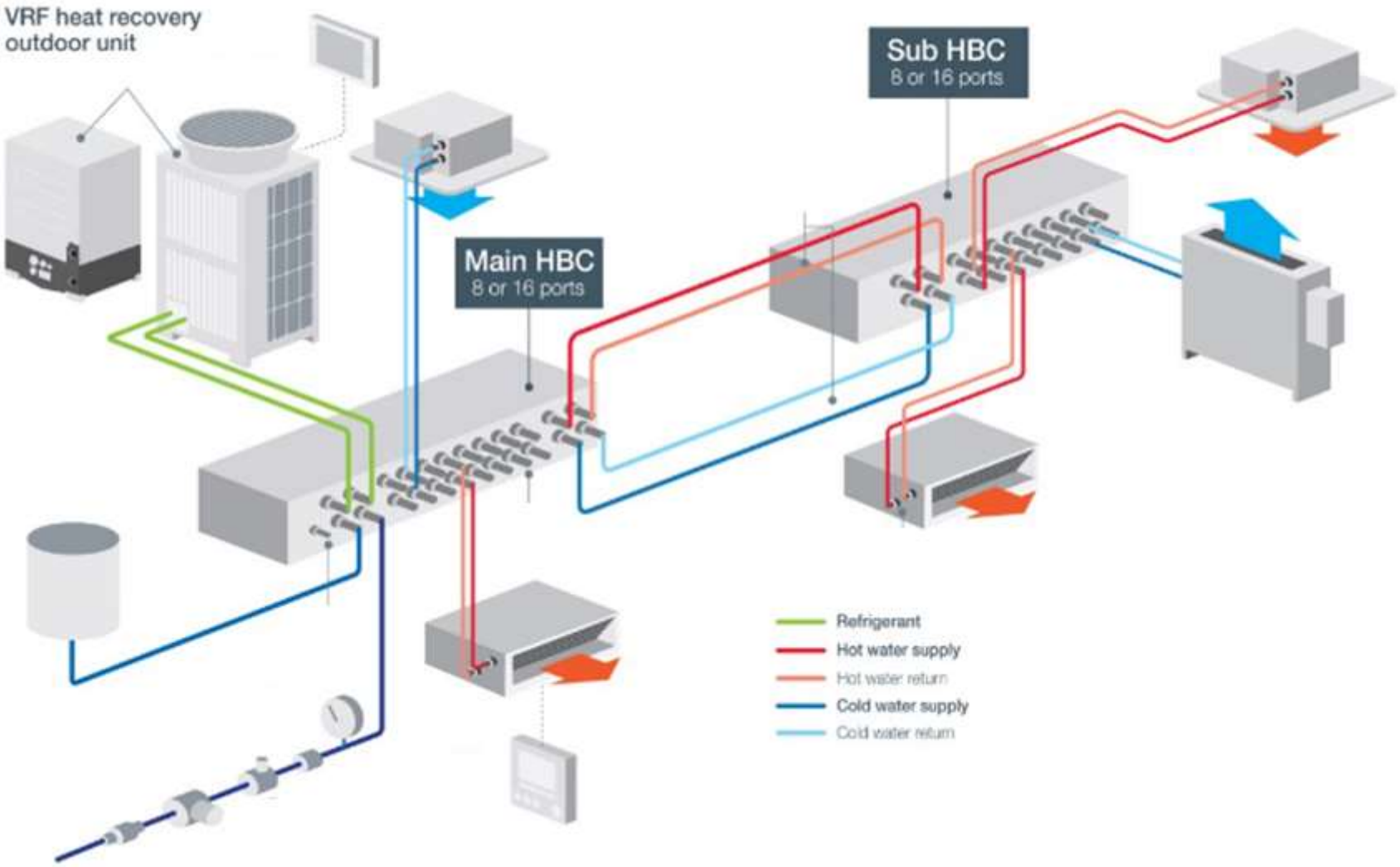
- Adds Restrictions of Refrigerant Piping in Egress Corridors

R-410A Refrigerant Phase Out Starting 2026 (<750 GWP Required)

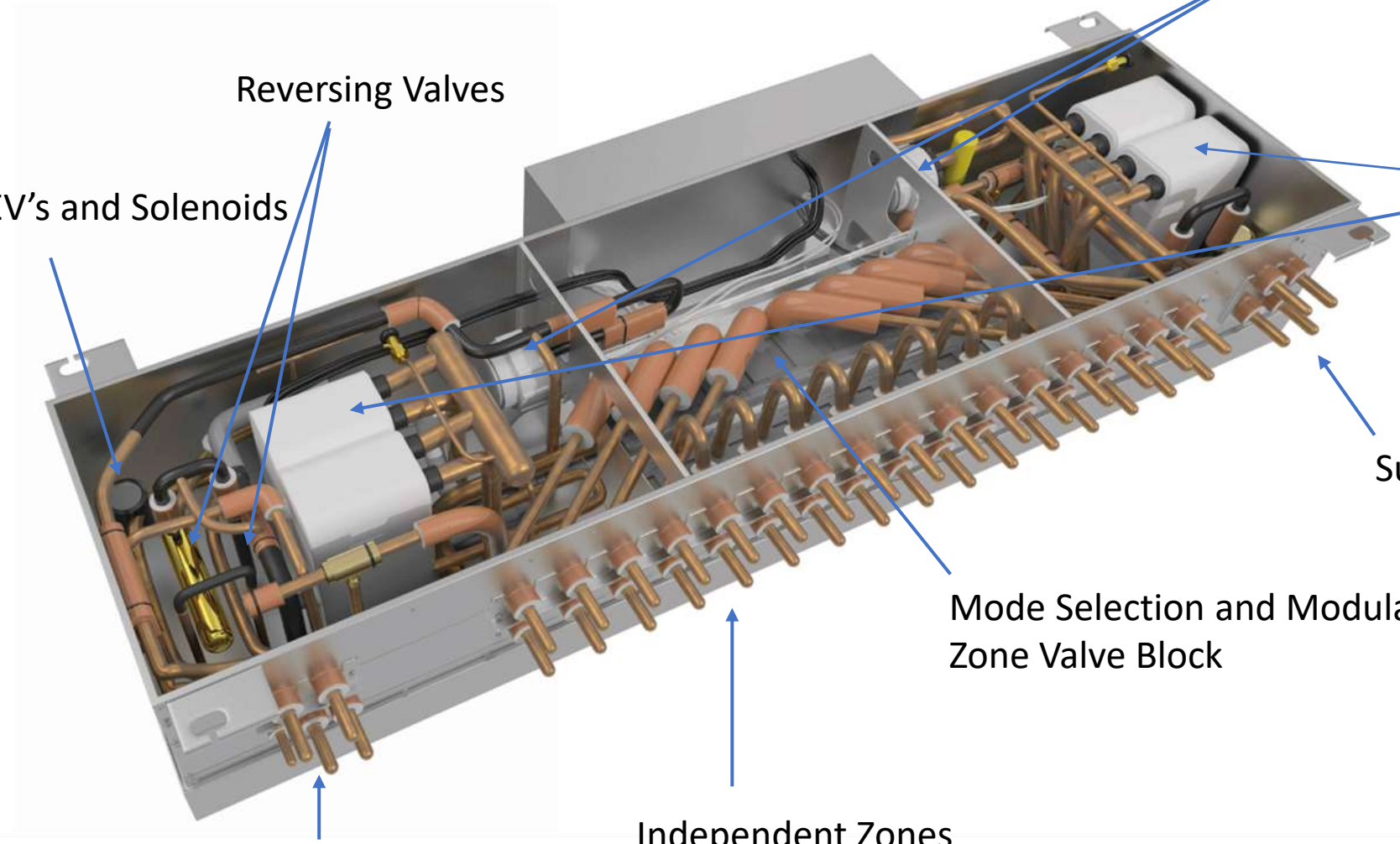
- Forces VRF into Low Flammability A2L Refrigerant
  - (RCL as low as 4.8 lbs / 1000ft^3 vs 26 lbs /1000ft^3 of R410A)
- Other US Markets Following for Low GWP push (2088 GWP -> 466 GWP)

Hotel Standards for VRF Systems – Refrigerant Monitor Requirement or Max ODU Tonnage

Technical Overview



Hybrid VRF Main HBC – Heart of HVRF



Dual Inverter Water Pumps

Reversing Valves

LEV's and Solenoids

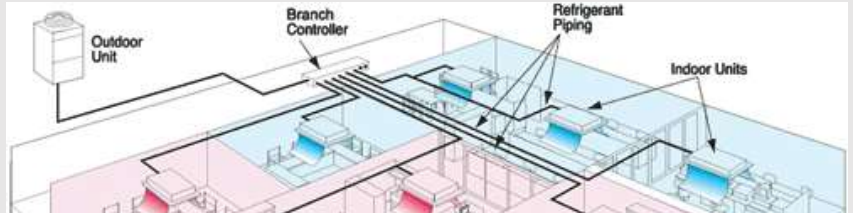
Brazed Plate Refrigerant to Water Heat Exchangers

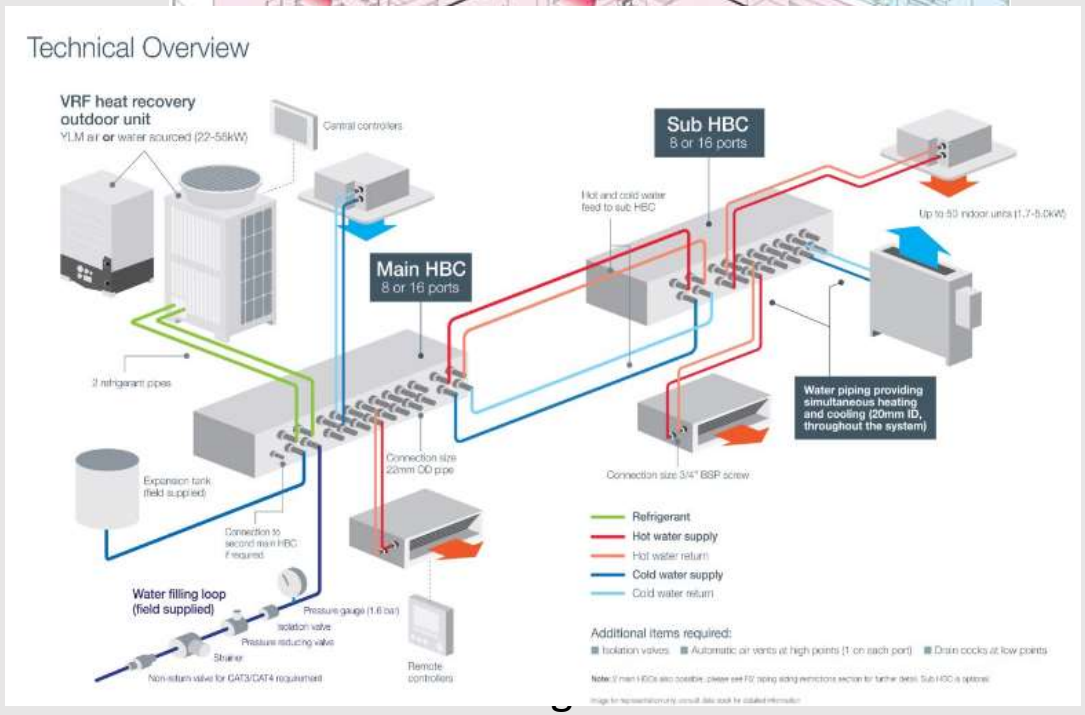
Sub-HBC Water Connections

Mode Selection and Modulating Zone Valve Block

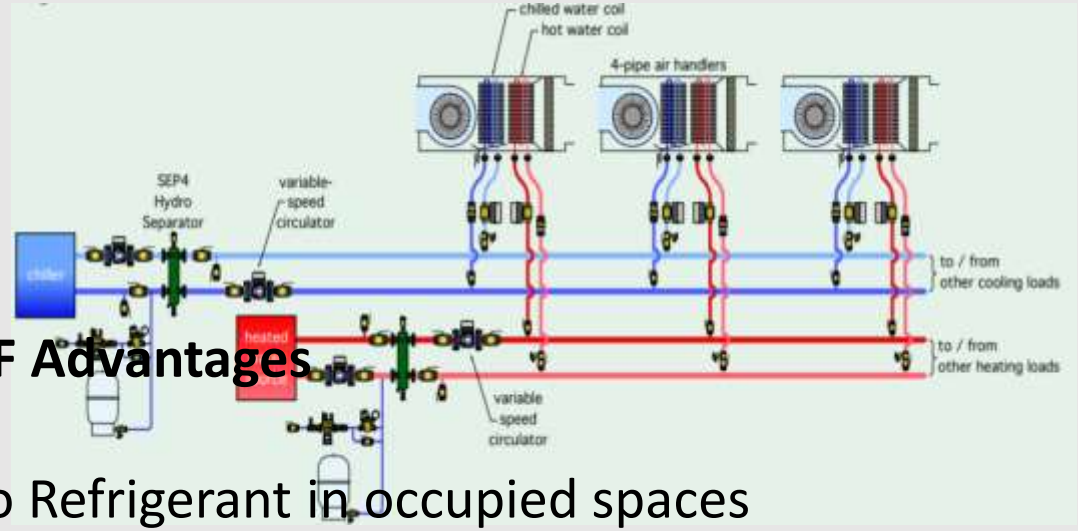
Independent Zones to Indoor Units

ODU, Fill Line, Equalization line Connections





- High Efficiency
- Install and Design Flexibility



HVRF Advantages

- No Refrigerant in occupied spaces
- Tighter Temperature Control
- Quieter Indoor Units w/ No Mode Change Noise
- Similar Efficiency to VRF Systems
- Future Proof of Refrigerant Changes
- Full Integrated Controls Built-In
- Easy Install / Less Risk Due to Poor Installation

4-Pipe Fan Coil Advantages

- Stable Off-Coil Leaving Air Temperatures
- Quiet Mode Transitions between Heating and Cooling
- No / Less Risk Due to Poor Installation
- Needed in Design
- Quiet Operation

Conclusion

Questions?

Rachel Roy, PE
Regional Commercial Sales Manager
ME, NH, VT

Mitsubishi Electric Trane HVAC US LLC
Phone: 207-730-2284
Email: rroy@hvac.mea.com
http://www.metahvac.com