

# IS A VRF SYSTEM RIGHT?

SERIES ON SUSTAINABILITY 4 of 6

## WHY SHOULD I CONSIDER A VRF SYSTEM?

**What is VRF?:** VRF or VRV stands for Variable Refrigerant Flow or Variable Refrigerant Volume and is a relatively new type of HVAC technology that uses a refrigerant (typically R-410A) in place of air or water as a cooling and heating medium. In simple terms, a VRF system is a large scale duct-less HVAC system that can perform at high capacity. They give the designer the ability to connect multiple indoor units to a single condensing unit through either a heat pump configuration or a heat recovery configuration.

### VRF PLANT TYPES:

#### Air Cooled:

- Cheaper to install
- Less maintenance
- Very energy efficient above 35°F
- Operating range between -13°F - 122°F

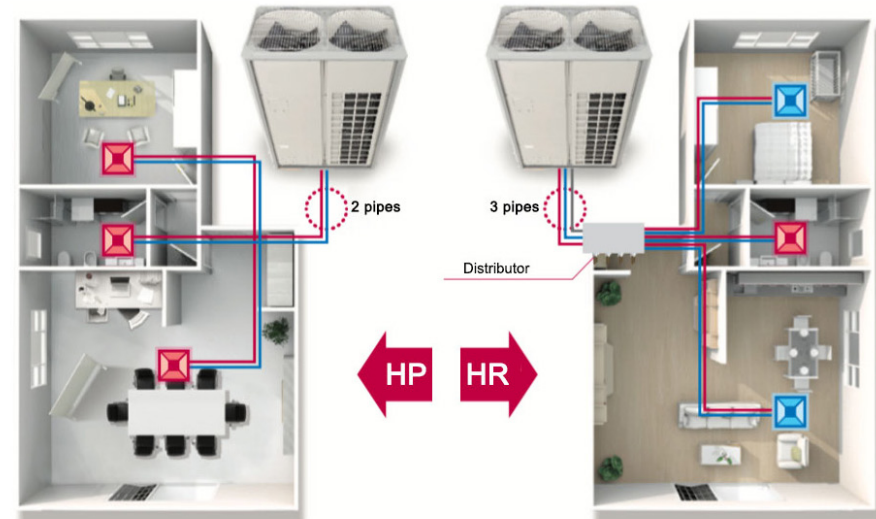
#### Water Cooled:

- More expensive
- More maintenance
- Very energy efficient at all outdoor temperatures
- Allows compressor heat recovery

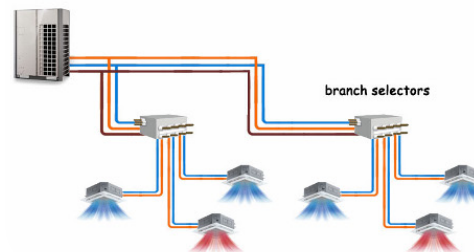
### VRF SYSTEM CONFIGURATIONS:

#### Heat Pump:

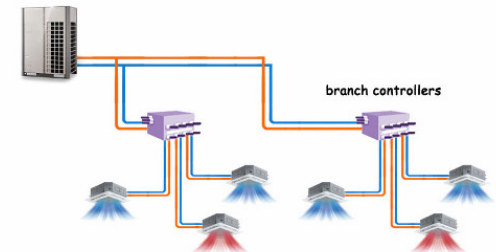
- Either in heating mode or cooling mode
- No branch selectors/controllers
- Cheaper to install
- Less energy efficient
- Ideal when all spaces need heating or cooling (small buildings)



3 PIPES HEAT RECOVERY



2 PIPES HEAT RECOVERY



#### Heat Recovery:

- Simultaneous heating and cooling
- Typically more expensive, but more energy efficient
- Ideal when exterior spaces need heating while interior spaces need cooling (large buildings)
  - **Two-Pipe configuration:** Two refrigerant pipes from condensing unit to branch controllers; requires condensate pipe from branch controllers to drain
  - **Three-Pipe configuration:** Three refrigerant pipes from condensing unit to branch controllers



### WHY CHOOSE VRF:

- Energy Efficiency: often 20%-30% more efficient than conventional equipment
- Cheaper than other system types with similar energy efficiency
- Low operating costs
- Heat and Cool Simultaneously: offices, multifamily, hotels
- Controllability
- Low profile = more space and less ductwork
- Quiet (if no condensate pump)
- No outdoor wall-mounted grilles
- Built-in metering/usage capabilities within manufacturer software
- Thermal comfort
- Design assistance through manufacturer's representative
- Vast variety of compatible indoor units

### WHY NOT VRF:

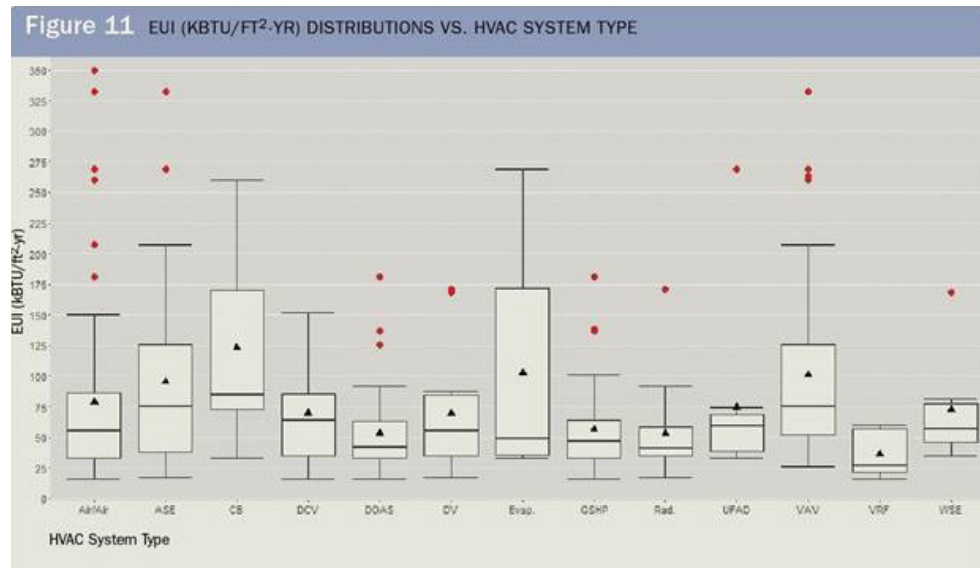
- Higher cost than conventional systems - Heat Pump (20% to 30%); Heat recovery (40% to 50%)
- Requires additional ventilation system (dedicated outdoor air unit or heat recovery ventilator)
- Not good with high-ventilation requirements
- Not good in high latent-load environments (gymnasiums, pools, etc.)

### PITFALLS WITH VRF SYSTEMS:

- Design requires engineer and manufacturers rep to work closely together. Select a rep you trust
- Over or under sizing the VRF equipment can have a drastic effect on energy efficiency (combination ratio between 80% - 120%)
- Long refrigerant piping runs have a drastic effect on energy efficiency (>100ft = 10% reduction in efficiency)
  - Air cooled systems will require supplemental heat in climate zone 6
- A VRF system paired with a minimum efficiency ventilation system will not see the advertised energy savings
- Heat recovery configurations need to have rooms with different peak times. Serving four south facing offices with one branch controller defeats the purpose of heat recovery; a branch controller should serve two south offices and two east/north offices

### LARGE OFFICE COMPARISON OF 3 HVAC SYSTEM TYPES WITH VRF

SYSTEM TYPE	UNIT	MIAMI	PHOENIX	ATLANTA	NEW YORK	CHICAGO	AVERAGE
VRF WITH HEAT RECOVERY	ENERGY COST PER SQ. FT.	\$0.64	\$0.68	\$0.60	\$0.96	\$0.74	
CHILLED WATER, VAC ELECTRIC REHEAT	ENERGY COST PER SQ. FT.	\$1.07	\$0.93	\$0.93	\$1.63	\$1.15	36%
	SAVINGS PER SQ. FT. WITH VRF	\$0.43	\$0.25	\$0.33	\$0.67	\$0.41	
	PERCENT SAVINGS WITH VRF	40%	27%	35%	41%	36%	
RTU, GAS HEAT	ENERGY COST PER SQ. FT.	\$1.18	\$1.18	\$1.22	\$1.73	\$1.84	49%
	ENERGY COST PER SQ. FT.	\$0.54	\$0.50	\$0.62	\$0.77	\$1.10	
	PERCENT SAVINGS WITH VRF	46%	42%	51%	45%	60%	
WATER-SOURCE HEAT PUMP	ENERGY COST PER SQ. FT.	\$0.73	\$0.74	\$0.73	\$1.15	\$0.81	13%
	SAVINGS PER SQ. FT. WITH VRF	\$0.09	\$0.06	\$0.13	\$0.19	\$0.07	
	PERCENT SAVINGS WITH VRF	12%	8%	18%	17%	9%	



### Most Energy Efficient:

- Office
  - Water cooled heat recovery VRF plant served by a geothermal field / Dedicated Outdoor Air Unit with energy recovery served by VRF plant with demand control ventilation / Indoor ductless units served by VRF plant
- Multifamily
  - Water cooled heat recovery VRF plant served by a geothermal field / Heat recovery ventilators paired with indoor fan coil units served by VRF plant

