CARD Webinar Unanswered Broadcast Audience Questions & Answers

Cold-Climate Variable Refrigerant Flow Demonstration and Market Research

Webinar Date: December 11, 2024

Will a recording of this webinar be available after we are complete?
Yes, the webinar was recorded and will be posted on the Department's website. We try to post webinar recordings within a month or so of the webinar date.

For thermal comfort issues, does the study address how these discomfort concerns could be resolved? Was the unit inappropriately sized, or was there an equipment malfunction, or did the occupants simply have the HVAC in unoccupied mode?
We do touch on this. The Multifamily Building was only rated to -13˚F and that might have been part of it. Unfortunately, we did not get access to controls data to understand modes or setpoints on very cold days, or when get a sense for how heavily the spaces were occupied to better understand the operation of the system. We only measured the temperature and humidity of the space.

Could you please comment on what the billing results might mean from the perspective of multi-family building residents who might end up paying for heating through individual utility bills versus their rent with the switch to the VRF? E.g., where are the costs potentially going to lead to surprises for residents?
Every multifamily building manager we've talked to has chosen to pay for the outdoor unit electricity and then just split it evenly into tenant rent. Indoor units can be wired to tenant electrical panels. Manufacturers do make software that allocate outdoor unit usage based on the indoor unit operation so landlords can bill tenants, but every multifamily manager I've talked to said that it's a lot more work to bill the tenants that way. They prefer to split it evenly in their rent calculation.

What steps can be taken to get this going prior to Jan. 1, 2026?
Start with education programs and partnering with manufacturers to start a requirement for VRF installer training.

Were any of the VRF systems equipped with vapor injection?
All the ccVRF sites: Small Office A, Multifamily Building A, Large Office A, Small Office B.

Were refrigerant leakages included in the emissions analysis?
No, though we did reference an exercise Slipstream performed for a similar study that looked at the emissions of a 3.8% leak as a percentage of energy-related emissions saved. We found a R-410A leak at 3.8% would offset 50% of the annual energy emission savings of the VRF system.

What kind of load profile do some of these devices have and can they be safely shed during peak events?
I'm not sure if the system operation lends itself to peak load shedding, particularly because the controls are so proprietary. Building Automation Systems (BAS) tend to just turn then on and off and change setpoints.

Did you have any information on cost savings for multifamily in the reduction in building costs vs the extra costs for the vrf system?
No, we did not, BUT this is a really good point and is a big reason why the first costs may be less than other systems and less than what we used in the study. This question is referring to how VRF systems can result in savings by taking up less area in the plenum or other spaces in the building. I mentioned why this is important for retrofits, as it's easier to run the refrigerant lines in existing buildings, while in new construction buildings you could potentially make the building shorter and therefore less expensive because it takes up less ceiling space and doesn't need large mechanical space if the outdoor units are outdoors. For expediency, we only considered mechanical costs, but this means we did not consider these broader building costs and that may mean we are not considering some of the first cost savings. Excellent question.

What types of VRF system installations are you recommending incentives? Should it be limited to condensing units that are outside? Should it include penthouse installation? Also what about water-cooled VRF condensing units that are tied into a water loop that is more like a water-loop heat pump system? Any limitations on back-up heat?
I do specifically say in the report that Multifamily buildings may not be the best application in Minnesota given the difficulties we saw with installation issues. I would recommend either VRF with supplemental heat (dual-fuel) or ccVRF, but in either case the fuel-switching requirements of the ECO Act need to be addressed. Water-loop systems were not part of this study, so I don't have recommendations for that. I don't think there should be limitations on back-up heat unless there's a fear that it will be used as supplemental heat.

Is there an outdoor reset control to stop any set back the thermostats may call for during low temps?
I have not seen any outdoor reset on VRF controls. It could be implemented through a BAS that integrates the VRF.

Regarding impact of losing the refrigerant, that it reduce the impact the GHG savings from operational energy efficiency, is this for the year or for the lifetime of the system?
Our study looked at loss of refrigerant during one year just for emissions calculations. If there is refrigerant loss, the energy efficiency of the VRF system will decrease like other air-conditioning systems. We do cite a study by Purdue University that looked at the energy efficiency loss at different percentages of refrigerants for air conditioning units. If the refrigerant is not replaced, then it will be less efficient, and potentially damaged due to lack of oil return, until the refrigerant is replaced.

Where are we with training certification?
The manufacturers in the VRF marketplace longer have more mature training. One offers an extended warranty to contractors who are certified. Another Manufacturer representative in Minnesota has said they will only offer warranty if they meet their training and inspection requirements. Newer and smaller manufacturers have less training and on-site support.

What about hybrid systems that may run through a computer server room or hot water storage tank?
Good question, but we did not consider those systems in the study. There are more air-to-water options, some using VRF outdoor units but to heat or cool water, that are beginning to make it to the market.

Mass measurement and subcooling/superheat are units they use to check charge when the heat pump system is retired -- they collect the refrigerant, right? this must be the law?
Yes, there are laws to collect refrigerant when they are retired.