CARD Webinar Audience Questions & Answers

Ductless Cold Climate Heat Pumps for Multifamily Applications

Webinar Date: April 25, 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 aim to post webinar recordings within a month or so of the webinar date, however due to a major website transition within the last year, unfortunately it is currently taking longer.

How did you find and select the buildings? What type of outreach was successful, and what was unsuccessful?
We recruited buildings through existing relationships with multifamily building owners, we engaged utility partners and identified multifamily efficiency programs that worked in similar building categories. These recruitment pathways generate leads. Mechanical contractors are often one of the better routes for leads because they are in communication with buildings and homes looking for replacements and updates for mechanical systems. While that path was still useful here, it was less successful than typical. This is mostly because the electric resistance baseline systems rarely have issues or fail. Buildings with those systems interact with mechanical contractors less frequently.

COVID also caused issues early in this project. Monitoring overlapped with the pandemic, and as such some buildings, especially those with Vulnerable populations, were less interested in participation. That includes three buildings that were recruited initially, but eventually dropped from the project.

Does the PTHP have the same efficiency and temp operating range requirements as the mini split systems? Or does not require low ambient operations since it is indoors?

The PTHP system itself sits more within the envelope than a traditional mini-split, but still transfers heat from the cold outside air into the refrigerant loop. Therefore, it experiences the same temperature performance impacts of a mini-split.

Was weatherization in the envelope recommended or done prior to installing the heat pumps? To reduce stack effect, increase efficiency, etc

Unfortunately, weatherization was not in scope for this project. We installed and monitored the performance of the heat pumps, but an envelope assessment and weatherization work are recommended prior to any heat pump installation. A better envelope will improve heat pump performance and reduce heating loads and bills in general.
The units studied in this project were generally small with lower heating and cooling loads. This meant that standard sized heat pumps were well equipped to meet their loads.

Can you remind us, what floor was the PTHP installed in for this project? I'm thinking about stack effect. Is it worth exploring PTHP on higher floors and ductless ccASHP on lower floors to get the performance needed on lower floors? It sounds like a good future CARD project to me.

The PTHP was installed on a higher floor in the building. With any of these heat pumps, it is important to understand the limitations of the systems and size them appropriately. Currently, PTHP systems are not rated much higher than 1.5 tons. As such, a larger unit with a higher load may not be as good a fit as a mini-split system that is available in larger capacities.

Why did you decide to only partially replace systems with PTHP or DMSHP instead of fully replacing them?

Installation cost and equipment sizing. Many of these units were around 1000 sq. ft., meaning they tended to have one large heating (and cooling) zone in the living space or a connected living, dining, kitchen space. They had smaller zones for bedrooms, bathrooms, etc. Fully replacing these units would mean installing a mini-split head in each room/zone. This causes costs to increase rapidly, and these zones were small, so even though the heat pumps would offset a large fraction (or all) of the resistance heating, the cost savings would be small.

Additionally, in these very small zones the heat pump indoor head may be significantly oversized for the space, just because the heads aren't available in a small enough size. There are solutions for this issue, like mini-ducted heads that can serve multiple zones, but again cost and complexity became issues in this building stock.

In the larger units, multi-head systems were a good option to replace more of the heating load.

Any issues with cleaning coils and fans?

Our project was only at a given site for 18 months, at most. Over that time, we did not see any issues with dirty, clogged, or blocked coils and fans. Manufacturers do recommend a cleaning process for these systems.

You commented that there were some issues of meeting the needed heating demand when both heads of a unit called for heat at the same time? Did this result in failure to meet setpoint, or just require longer run times?

Multi-head systems are sized such that the outdoor unit can provide the necessary capacity to run both heads. If you install two 1-ton indoor units, you don't install a 1-ton outdoor unit. However, as temperatures drop, the heat pump capacity is reduced. At very cold temperatures, the heat pumps installed in this project needed auxiliary heat to meet the loads of the occupied spaces. In a multi-head situation, increasing the load that the system was attempting to meet by running both indoor heads makes it harder for the heat pump to keep up.

Any summer humidity control problems?

Our measurement and analysis mainly focused on the heating season, but we did not hear about any humidity issues during summer months. Some occupants even mentioned increased comfort in the summer. It is important to remember that many of these units relied on window unit AC systems prior to the heat pump installation. The variable speed, improved performance, and higher capacities of the heat pump systems gave the units a far great summer experience than they were used to.

Can you speak a bit more about the split between heat pump utilization and back-up resistance at higher temps and associated financial consequences, in particular? Is addressing these inefficiencies through equipment selection and system commissioning a (very) high priority?

Heat pumps should be able to meet the full heating load with a very high efficiency at moderate to warm heating temperatures. Any back-up heat in those conditions results in lost savings and lost efficiency. Buildings in MN spend more time in warmer heating temperatures than extremely cold ones, so even though the load is less when it is warmer out and the heat pump runs at lower capacity, the savings and efficiency are still important. I think it is a high priority because it is low cost (free!). The heat pump can meet that load, it just needs to be set up to run that way.

Have there been any heat pump developments that have come about during the course of this study that your team is excited about?

Two areas of innovation:

1. *Applications. Variable speed PTHPs were not available when the project started. Heat pumps have expanded to lots of new spaces and sizes: vertical packaged systems (magicpaks), RTUs, window units, multi-head system, and so on. These new systems allow heat pumps to work in more buildings, especially in retrofit applications.*
2. *The DOE heat pump challenge is increasing the cold climate capacity and efficiency of single-family heat pumps. That allows for less back-up heating and more efficient performance.*

I am in Climate Zone 8 (Fairbanks, AK) where it not only gets very cold during deep winter, but electricity currently costs $0.30/kWh. Few, if any buildings, therefore use electric resistance heat. Do you have any information on or recommendations for ASHPs for multi-family units in Fairbanks, given these constraints?

One of the key benefits of heat pumps is their flexibility. Dual fuel systems or ductless heat pumps paired with an alternate heating source are good options for cold climates where electricity gets expensive. These types of installations can be set with an economic switchover temperature that prioritizes heat pump runtime when the system efficiency and the electric rate make it cheaper than the alternative system. Then, when the electric rates increase, it switches to a back-up fueled system that can run in the extreme conditions.