CARD Webinar Audience Questions & Answers

Optimized Installations of Air Source Heat Pumps for Single Family Homes

Webinar Date: December 13, 2023

Do these heat pumps require a small backup natural gas fueled heating system? What is the payback period for the installation cost?

Most Minnesota installations of centrally ducted heat pumps will require some type of supplemental heat. The most common supplementary systems are natural gas furnaces or electric resistance booster heaters. High-performance homes with great insulation and low heating and cooling loads may be good candidates for heat pumps without backup. Paybacks vary dramatically based on installation costs, electric rates, and the fraction of the heating load heat pumps can meet in the home. In general, heat pumps deliver installed efficiencies around 2x that of typical existing systems (furnaces or electric resistance).

Can you also comment on FED/State Tax credits if available for these installations?

*IRS allows tax credits on **federal** tax returns of 30%, up to $2000 per year, for qualifying home improvements using heat pumps. Review the IRS Energy Efficient Home Improvement Credit (https://www.irs.gov/credits-deductions/energy-efficient-home-improvement-credit) or contact the IRS for qualification information on specific heat pumps or how to claim the credit.*

*Commerce is not aware of any **MN state** tax credits for heat pump installation. Readers should check with the Minnesota Department of Revenue (https://www.revenue.state.mn.us/contact-us), the state agency which handles state-tax related questions.*

The Minnesota Department of Commerce tracks and publicizes energy-related funding opportunities. Stay current by watching Commerce's Energy Related Funding Opportunities webpage (https://mn.gov/commerce/energy/industry-government/federal-funding-opportunities/). Send questions related to federal funding opportunities via email to fedquestions.commerce@state.mn.us .

Commerce is developing and implementing new energy programs. Stay current by watching Commerce's New Energy Programs webpage (https://mn.gov/commerce/energy/consumer/energy-programs/). Send energy related questions via email to energy.info@state.mn.us or by calling the Energy Info-Line at Local: 651-539-1886 | Greater MN: 1-800-657-3710.

When trying to optimize the HP/furnace switchover temperature, does it make any sense to use the daily HP kwh used (as reported by the HP/thermostat) and compare it to the HDD data for the same day? Or is there a better way to do this?

In a central heat pump installation with a heat pump and a furnace (either gas or electric), the switchover temperatures can be set based on heat pump capacity or operating costs. An installation that seeks to minimize energy use and maximize decarbonization benefits should set the switchover at the lowest temperature for which the heat pump can still deliver the necessary capacity to the site. If you have access to the pre-installation energy use of the heating system in the home, that data can be used to characterize the heating energy use with respect to outdoor temperature, and the home's design load

can be calculated and compared to heat pump capacity curves provided by the manufacturer. The switchover should be set to the point at which the heat pump can no longer deliver the heat needed to maintain temperature in the home. To set the switchover temperature based on cost, you would need to know the electric and gas utility cost rates and the efficiency of both the heat pump and backup system. The heat pump efficiency will decrease as the temperature lowers outside. If electric rates are twice that of gas rates, the heat pump can be operated cost effectively down to the temperature that the heat pump's efficiency drops to 2x that of the gas furnace.

Is it best to use gas below 20? Aren't there some ASHP systems that say they work even at below 20 degrees?
Most variable speed heat pumps (often referred to as cold climate systems) can operate at cold temperatures, often well below 0 °F. So, in cases where the backup is electric resistance or propane, running heat pumps below 20°F is a good idea. Similarly, if decarbonization is the goal of the system, they should be run well below 20°F.

Did you compare estimates of Life Cycle Cost (maintenance included) in the economic analysis?
Long-term maintenance is difficult to estimate with one to two years of installed operation. Many manufacturers of variable speed heat pumps claim longer lifetimes and less maintenance compared to single speed air conditioners. Variable speed compressors can run at lower speeds, increasing runtimes and reducing on/off cycles that strain compressors. Additionally, warranties offered for heat pumps are similar to those offered for the same category of air conditioner. However, these claims were not quantified or verified in this work.

Are the ASHPs studied suitable for existing construction with existing duct work, or is it ordinarily intended for new construction?
All installations were retrofitted into existing properties. Existing ductwork should be inspected to ensure that heat pumps are compatible with the existing distribution system.

What is the minimum OAT for ASHP to actually operate with less emissions than natural gas (boiler or furnace)?
The specific heat pump performance and the grid conditions for a specific installation have a significant impact.

Can you provide more detail on the control mode descriptions of slide 35?
Specific descriptions of each control mode and more detailed results will be available in the final report of which is planned to be posted to the Department's Conservation Applied Research and Development website (https://mn.gov/commerce/energy/conserving-energy/applied-research-development/) early 2024.

Understand that this study focuses mainly on replacing electrical resistance heating. However given your expertise in this area, are ccASHPs currently available to replace residential natural gas?
In homes with central forced air natural gas furnace systems, dual fuel cold climate ASHP systems that keep a natural gas furnace as a backup or auxiliary heating system are the most straight forward

solution. Complete furnace replacement with a heat pump is feasible, but the home must have a very efficient envelope in most cases.

Does the annual COP represent both heating and cooling? What was the spread between ducted, multizone, and single zone ductless annual COP?
In this presentation, annual COPs shared were for the heating-only heat pump operation. System COPs (including backup) and cooling performance were not the focus of this research, but some discussion will be included in the final report.

Do you have a list of the specific brands and models used for each location?
Yes, this information will be included in the final report of which is planned to be posted to the Department's Conservation Applied Research and Development website (https://mn.gov/commerce/energy/conserving-energy/applied-research-development/) early 2024.

Are heat pump installations ideally sized for heating load or cooling load?
Well designed heat pumps can be sized for both heating and cooling. It is important to understand the intent of the application before deciding on a sizing approach. Typically, dual fuel heat pumps with natural gas backup are best sized for cooling, while systems with electric and/or propone should be sized for heating. However, as discussed in this research, site-specific details should be considered before a final choice is made.

What methodology was used for system sizing? Manual J? Something in addition?
Contractors often employ sizing estimates, which can include Manual J, and existing system capacities to size systems. In the case of this research, utility bills and measured data from the existing heating system were collected and analyzed to determine whole house and zone loads to confirm sizing choices.

What does COP mean?
COP, or coefficient of performance, is a ratio of energy input to energy output. Energy input is the electrical consumption used by the system to operate, and the energy output is the delivered energy to the space in the form of heat or cooling.

For a 3600sqft home, with ASHP with Air to Water to Air use, have you done research on how cost effective they are when leveraging existing air handler ducting?
This is outside of the scope of this research project.

Have you looked at systems like the ones from Canada that leverage a hot water storage tank to store heat and for use with homes that have both 'in floor' system and a forced air system? I.e. can the heat storage augment enough to address below zero?
This is outside of the scope of this research project.

Are there any consumer consulting and financing resources you could share?
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Some other Minnesota resources include:

- *Minnesota Air Source Heat Pump Collaborative - Overview — Minnesota ASHP Collaborative (mnashp.org) (https://www.mnashp.org/for-homeowners)*
- *University of Minnesota, Clean Energy Resource Teams – https://www.cleanenergyresourceteams.org/ashp*

Will a recording of this presentation be available? Will it be available along with the presentation slides?
Yes, the presentation was recorded and will be made available on the Department's Conservation Applied Research and Development website (https://mn.gov/commerce/energy/conserving-energy/applied-research-development/). Typically, webinar recordings are available within a month of the final broadcast, but the Department's website went through a major transition and is currently under construction which has delayed 2023 webinar postings.

Webinar slides are planned to be shared with all webinar broadcast registrants within a couple weeks of the broadcast webinar.

Will this information be available online to share with contractors I may be working with?
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Where can I find heat pump installers that have done this and believe in heat pumps, many just say "they'll never work"?
The Minnesota Air Source Heat Pump Collaborative manages the Preferred Contractor Network (https://www.mnashp.org/preferred-contractor-network-homeowners) which can help Minnesota homeowners find experienced HVAC contractors committed to quality heat pump installations and maintenance.