Turning the Wrenches of Beneficial Electrification: Understanding HVAC Contractor Decision-Making

Joe Van Clock, Apex Analytics
Brian Tholl, Fort Collins Utilities
Laura Silver, Minnesota Department of Commerce
Jake Fuller, EcoMetric Consulting

ABSTRACT

The electrification of space heating systems will play a central role in reducing greenhouse gas emissions from buildings. However, to bring about conversions of gas systems to efficient electric options, program administrators will need to gain the support of the people who recommend and install those systems. The authors have conducted focus groups with HVAC contractors in Colorado and Minnesota to understand the considerations and decision-making processes that guide the decisions they make about what equipment to recommend in different situations.

This research has explored contractor decision-making from both a technical and business perspective and yielded valuable insights to inform efficiency programs seeking to bring about building electrification. These insights include: 1) The importance of contractor education to overcome the risk of callbacks in more complex installations of electric equipment; 2) Potential opportunities for manufacturer engagement, both as a channel to provide installer training and to ensure equipment quality; 3) Opportunities to segment contractor business models and identify those most likely to have the capabilities and willingness to engage with efficiency programs. This paper details these and other key findings and places them in the broader context of HVAC contractor considerations and decision-making. These findings will help program administrators develop offerings that complement the business models of HVAC contractors, who are key program partners.

Introduction

States and municipalities across the country are increasingly setting goals to reduce greenhouse gas emissions. Achieving these goals will require efficiency program administrators and others to adopt more aggressive, community-wide distributed energy resource strategies, including promoting electrification of end-uses like space heating. Both public and investor-owned utilities across the country have developed significant, electrification-focused incentives. A review of 22 programs across the country that the authors conducted as part of their research for Fort Collins Utilities in Colorado (described further, below) found that air source heat pump heating and cooling equipment (including both central, ducted units and ductless split systems) were the measures for which these programs most frequently offered incentives.

Successfully delivering electrification programs requires program administrators to collaborate effectively with the HVAC contractors who decide when to recommend efficient electric heating equipment and present those recommendations to their customers. This paper integrates findings from research the authors conducted with HVAC contractors to support electrification efforts in two jurisdictions: the cities of Fort Collins and Longmont, Colorado, and

across the state of Minnesota. The research efforts in both jurisdictions sought to address similar research objectives:

- How contractors make decisions about what type of equipment to recommend in a given situation and in what types of situations they would be more or less likely to recommend heating electrification.
- What are the most important business considerations for HVAC contractors, and how those considerations might impact the types of equipment they recommend.
- How knowledgeable contractors are of electrification and what their attitudes are toward electrification of heating equipment.
- How customers have responded to electrification opportunities.

The findings presented in this paper primarily draw on focus groups the authors conducted with HVAC contractors in both jurisdictions. Table 1 provides details of the focus groups the authors conducted as part of each research effort. Colorado focus groups primarily focused on contractors' work in residential applications, and focused on contractors' installation of heat pumps specifically, including screening contractors for heat pump installation experience. Minnesota focus groups primarily focused on contractors' work in small-to-medium commercial applications, and, while they explored electrification as a topic, sought to understand contractor decision-making around efficient equipment broadly. Both sets of groups, however, included contractors that worked in both commercial and residential buildings.

Table 1: Focus Group Responses

Location	Number of Groups	Respondent Type	Number of Respondents	Screening Criteria
Fort Collins and Longmont, Colorado	Group 1	Residential contractors	4	Experience installing HVAC systems, including heat pumps, in single-family homes
	Group 2		3	
Minnesota	Group 1	Commercial contractors, large firms in Twin Cities Metro	5	Experience installing small-to-medium commercial HVAC systems
	Group 2	Commercial contractors, small firms in Twin Cities Metro	2	
	Group 3	Commercial contractors outside Twin Cities Metro	2	

An experienced focus group moderator led all groups over video conferencing software. Each focus group lasted 90 minutes, and focus group participants received incentives for their participation.

While this paper primarily draws on focus group findings from each study, both studies included additional elements. In addition to the focus groups, the Colorado study included the

program review referenced above, as well as a survey of households, including those that installed (gas or electric) HVAC equipment and received an energy efficiency program rebate (n=20), those that installed HVAC equipment without a program rebate (n=50), and those who had not recently installed HVAC equipment (n=70). The Minnesota study supplements the focus group findings with individual interviews with six contractors, one distributor, and five architects and engineers involved in specifying HVAC equipment.

The remainder of this paper describes findings from contractor focus groups in Colorado and Minnesota. It examines contractors' response to electrification opportunities, including their awareness and attitudes, business considerations and response to efficiency programs. It also examines contractor feedback on key barriers customers face to electrification and describes building characteristics that are more or less likely to support electrification.

Contractor Response to Electrification

Awareness and Interest

Attitudes toward heat pumps varied between contractors and between installation types. The largely residential contractors that participated in Colorado focus groups reported they typically recommend heat pumps when installing air conditioning systems. According to one contractor, "I wouldn't ever not recommend a heat pump. There are many situations where installing a heat pump in a centrally ducted system is not going to handle the entire heat load…But there's no reason not to throw a heat pump in there."

Some Minnesota contractors expressed similar views, noting that the incremental cost of installing a heat pump was small relative to the cost of a central air conditioner. Minnesota contractors were more reluctant to recommend heat pumps, however, particularly when replacing heating systems.[1] As one contractor explained, "Let's face it, in Minnesota, you can't rely on an air source heat pump all the time. I mean, the last two winters, three winters, we have had a stretch of weather where we have hit 45 below zero and propane isn't boiling in the tanks and air source heat pumps certainly aren't going to do anything in that weather."

Some contractors' limited enthusiasm for heat pump technologies likely reflects limited demand from customers. Contractors in both Colorado and Minnesota reported that a small but growing group of customers were familiar with heat pumps. Contractors stated that customer interest in heat pumps comes primarily from environmental/carbon motivations. One Colorado focus group participant described an instance in which customers requested a heat pump, saying, "Their views and their ideals and their desire to reduce their carbon footprint outweigh the cost benefits of what natural gas can bring. So, they were adamant."

Minnesota focus group participants reported that environmental considerations were also the primary driver for commercial customers seeking to electrify heating equipment. Respondents noted that these customers were more interested in receiving green building certifications and supporting clean energy than in cost savings. Two contractors noted that, in some cases, out of state corporations would specify heat pumps when building locations in Minnesota. According to one, "Usually we have to almost talk them out of it a little bit because

[1] Minnesota has a more extreme climate than Fort Collins and Longmont, Colorado. The Twin Cities area of Minnesota averaged 7,400 heating degree days per season (30 year average, 1992-2021) (MN DNR 2022), while Fort Collins averages 5,756 (CSU 2022). Over the same period, Minnesota's Twin Cities averaged 843 cooling degree days per season, while Fort Collins averaged 629.

they're from a climate that is not used to our weather, and they think one size fits all and it doesn't."

Focus group participants in both Minnesota and Colorado anticipated that demand for heat pumps would grow in the coming years. Contractors in both locations noted that heat pumps were more cost effective for customers with solar photovoltaic (PV) systems and anticipated that heat pump demand would increase as more homes installed solar PV systems. One Minnesota contractor said, "I think there are going to be a lot more electric options because there are so many buildings now putting out solar panels. They are going to be thinking more about, 'how can I use the power I am generating as opposed to just selling it all back to the utility and then buying some back."

Colorado contractors also reported that some customers were interested in heat pumps due to gas price uncertainty. According to one contractor, "Now, with the speculation on natural gas prices, I think people are going to maybe lean more toward that…because they don't know what prices are going to do either way. It gives them the option of switching back and forth if they want."

Business Considerations

Given their anticipated growing share of the HVAC market, some contractors participating in Colorado focus groups saw heat pumps as an opportunity to differentiate and grow their business. According to one contractor, "We'll never see [the furnace] market go away, but we'll see a lot more heat pumps. We'll see a lot more solar potential. And, you know, I look at it as an opportunity to drive different components to our business."

Other contractors took a more measured approach but still saw benefits in offering heat pumps in order to provide a wide range of options to their customers. For these contractors, it will be important to frame messaging around displacing, not replacing, gas heat, at least initially. One contractor said, "I think that it's not a bad thing to be offering heat pumps and electric options as efficiency and technologies change, but I think the notion of going away from gas completely is just not an option." A separate study conducted with HVAC contractors in New York came to a similar conclusion, suggesting that dual fuel systems could be part of a phased approach to electrification (CMC Energy Services 2020).

The primary business concern that contractors in both Colorado and Minnesota reported regarding heat pump installations were related to the complexity of the equipment. Contractors reported that heat pumps can be more complex than other system types and often include newer technologies, which can make it difficult to identify and address problems. As one Minnesota contractor described, "It's not an air conditioner, it's a computer that cools your house, and it is way more of a computer than it is a piece of equipment." Similarly, a Colorado contractor said heat pumps are "pretty high-end pieces of equipment. A lot of sensors, a lot of circuit boards. You get chasing a ghost problem with one of those, it can rack up pretty quick on the warranty." Another Minnesota contractor agreed that technicians often need outside support to address issues with heat pumps due to their complexity, saying "the days of having the service guy come over and all your problems are over [are gone] – no, I come over, I get on my phone, and I call the guys that build them."

Beyond the complexity of the equipment itself, contractors in both states reported that heat pump installation can require more planning to properly design the system and more effort to commission the system after installation. Nonetheless, contractors reported that the installation itself is not significantly more difficult than installation of other system types for a trained

installer. Contractors noted that ensuring installers are properly trained is important to avoid installation errors and resulting callbacks, which are the biggest threat to the profitability of their heat pump installations.

Finally, contractor focus groups suggest that limited availability is a potential risk to offering heat pumps, with pandemic-related supply chain disruptions compounding availability challenges. While some contractors reported heat pumps were no more difficult to obtain than other equipment types, others reported significant delays due to the pandemic. According to some contractors, while distributors typically stock heat pumps or can obtain them in approximately a week, pandemic-related delays had led to waits up to five weeks for a heat pump. Contractors reported that ensuring an adequate supply was available would be important to the success of programs promoting heat pumps. As one contractor said, "You know, we can promote this all day long, but if we don't have the equipment from the distributors to install it, we're on the eight ball again."

Efficiency Programs

Contractors indicated that efficiency program incentives could play a significant role in influencing the types of equipment they recommend to customers, including recommending heat pumps. Contractors noted that rebates need to be substantial to have this effect, however, likely exceeding incremental costs from the baseline equipment to the program-supported equipment. According to one Minnesota contractor, "A lot of products…the rebate is about the same as the price difference. So, we don't see a lot of interest in that, but heat pumps…had really good rebates this year…so it penciled for [customers] to upgrade." Contractors noted that low- or zero-interest loans paired with substantial rebates further helped them to sell electrification improvements.

While incentives can play an important role in driving contractors to promote electrification, Colorado focus groups indicated that it is important for program administrators to communicate the motivations behind their electrification efforts clearly and consistently. Contractors described confusion around the program administrator continuing to offer gas efficiency incentives while promoting electrification. Contractors believed electrification efforts also led to a "mixed-message" perception among customers who had recently transitioned to time-of-day rates, with limited electric capacity as a perceived motivation for the shift in rate structures. According to one contractor, "It's like you're telling people 'we don't have enough power to support [standard rates],' then telling them to use more [through electrification]."

Contractors in both Colorado and Minnesota agreed that providing education on heat pump technologies to both customers and contractors is an important role efficiency programs can play to encourage adoption of this technology. Minnesota contractors also noted that utilities can be a valuable source of technical support as they consider heat pumps and other electrification technologies in different applications.

Customer Barriers

As the market actors that directly present HVAC equipment options to end-users or other project decision-makers, HVAC contractors have a unique perspective on the barriers that prevent greater customer demand for heat pumps and other electrification technologies. Focus groups with contractors in Colorado and Minnesota identified four key customer barriers to heating electrification.

Costs

Contractors participating in Colorado focus groups reported that cost was a barrier for some customers, with one contractor saying, "We had a customer who was very, very adamant about the heat pump technology and he wanted a specific one. But once he saw the return on investment, he goes, 'I guess my carbon footprint can wait. It's not that important.'" A customer survey conducted as part of the same Colorado study supported this assessment.[2] Customers most often (55%) cited the total cost of purchasing and running HVAC equipment over its lifetime (lifecycle cost) as an important consideration in their purchase decisions and a majority (63%) perceived heat pump installation to be more expensive than other equipment. Most survey respondents perceived heat pump operating costs to be less, although nearly one-third (31%) also believed heat pumps would be more expensive to operate.

Minnesota focus group participants described cost barriers in relation to commercial installations, and particularly new construction. Contractors explained that HVAC systems are unseen by most building users. As a result, general contractors and developers faced with multiple expenses may target HVAC systems as a way to cut costs. According to one contractor, "The general [contractor] has a certain profit margin they want to make, so they are going in on heating and cooling equipment as cheap as possible. Because there has got to be furniture. There have got to be certain countertops. They want certain fixtures in the bathrooms. So we're competing with all of that, and we don't get a chance to talk to the building owner about efficiency and rebates that are available."

Contractors reported it was easier to promote efficient equipment in replacement scenarios, where the client was typically more focused on the long-term operation of the building and there was greater opportunity to promote the added value of efficient equipment. Contractors are also more constrained, however, in their equipment choices in replacement installations, since any new equipment must be compatible with existing infrastructure like ducting and roof curbs to avoid significantly increasing project costs.

Performance

Likely reflecting their more extreme winter temperatures, Minnesota contractors were more skeptical of the potential for heat pumps to meet their customers' heating needs. As noted above, contractors reported that even cold climate heat pumps do not work well in the types of extreme cold that Minnesota occasionally experiences. Colorado contractors reported that, while they see heat pumps as regulating temperatures as effectively as other system types, some customers may perceive them to provide less comfort because the temperature of the air coming out of the vents is lower than that of a forced-air furnace. One Minnesota contractor also acknowledged this, reporting that they are reluctant to recommend heat pumps because of the longer time required to warm a space to the desired temperature.

Minnesota contractors reported that there is a need for more customer education to ensure that efficient HVAC equipment, including heat pumps, is operated properly. One contractor stated that project budgets typically do not account for this education need, saying "if you are installing [high efficiency equipment], you need to do a better job of educating [customers], but

[2] The survey, conducted as a web survey with email invitation, included responses from 140 residential electric customers, including program participants, customers installing equipment outside the program, and customers not installing equipment.

at the same time, we don't have hours in the jobs just to show maintenance people things like that."

Contractors noted that, without this education, improper operation can impair the performance, and potentially reduce the lifetime of efficient equipment. Maintaining a reputation for dependable and reliable work is important for HVAC contractor success, and these types of equipment problems can lead to customer dissatisfaction and damaging a contractor's reputation.

Aesthetics

Contractors in Colorado cited aesthetics as another potential barriers that can prevent a customer from installing a heat pump, particularly for a ductless heat pump. One contractor said, "A lot of people don't want that look [a ductless indoor unit] on their wall…there's some people that just say, 'Oh, I've seen those in Mexico when I'm on vacation. That works great there. I don't want it in my house.'" In-ceiling cassettes are available but cost more to install due to an increase in labor, and they do not work in all homes. Contractors also noted that some customers have noise concerns related to heat pumps, as the greater air flow and high compressor speeds needed in winter can lead to more noise, and different noises, than customers are used to.

Split Incentives

Finally, contractors reported that split incentives, where the owner or manager of a property pays for the equipment installation, but the tenant pays the energy bill, can be a barrier to heat pump installation. One contractor described this problem in rental housing, saying, "usually the landlord wants the cheapest option for that place, and I wouldn't recommend [a heat pump] unless there's some sort of incentive that would be driving them to spend the money on the rental property that way."

Contractors in Minnesota described similar challenges in multifamily and commercial buildings. Contractors noted that multifamily building owners typically prioritize the lowest-cost solutions over energy savings, noting that these building owners often plan to sell the building after only a few years, further reducing their motivation to invest in efficient equipment. Contractors reported that, depending on lease terms, even commercial customers responsible for both installing equipment and paying energy costs may not be motivated to install efficient equipment. These contractors noted that customers with relatively short lease terms may be uncertain that they will remain in the space long enough for the energy savings to justify the increased upfront costs. As one contractor explained, "They're looking at it going, 'well, my lease is only good for five years, tops. Why would I drop extra money now for a long-term commitment that I may not even be around for?'"

Building Characteristics

Building characteristics and existing infrastructure can be a key determinant of the types of equipment that are practical to install in an equipment replacement situation. A study of HVAC contractors conducted in the Northwest found that contractors develop their businesses by building and maintaining strong relationships with customers and partners like general contractors. As a result, contractors prioritize customer satisfaction. This prioritization of customer satisfaction combined with the potential for callbacks to address issues after an installation is complete to eliminate their profit margins can make HVAC contractors risk averse

(Apex Analytics 2020). As a result, the New York study cited above found that contractors will recommend heat pumps only when the building characteristics and other considerations make them the best choice for the customer (CMC Energy Services 2020). Building characteristics can both serve as barriers to electrification of heating systems and can make electrification more attractive in certain buildings.

Challenges

During Colorado focus groups, in particular, the moderator probed into home characteristics that could pose challenges to heating electrification. Contractors described two key characteristics of a home that can pose barriers to installation of a heat pump: the electrical infrastructure and the capacity of existing ducts. Challenges in either area can greatly increase the cost of a heat pump installation. Contractors reported that upgrading a home's electrical panel or service to accommodate heat pump loads could increase installation costs by $3,000 to $10,000. According to one contractor, "A 100-amp panel in a lot of cases isn't going to support the 30- or 40-amp condensing unit and the 50- or 60-amp heat strip that we have to go with it. So that is one of the challenges that we've see with people that scares them away a little bit, that can be a very expensive upgrade."

Contractors also reported that a home's existing ducts often have too little capacity for a heat pump to function effectively. This is most common in older homes where the ducts were originally sized for a gas furnace, which requires less air flow for heating than a heat pump. Contractors reported that, for these homes, potential solutions include either modifying the ducts or installing a secondary heating system in conjunction with a smaller heat pump, both inconvenient options that could at least double the cost of the heat pump installation.

Opportunities

While electrical infrastructure and existing ducts pose barriers to heat pump installation, contractors also noted a number of housing characteristics that can improve the heat pump return on investment. These include solar PV, propane, weatherized homes, and newer or moderately aged homes. Table 2 describes each of the characteristics and how each can impact the return on investment.

Table 2. Housing Characteristics Can Improve Heat Pump Return on Investment

Aspect	Impact	Quote
Solar PV	Reduced cost of electricity, increased economic benefit of heating with a heat pump	*"A house that's got a small enough heat load that a single pump can handle it and they've already invested in solar, is kind of a no-brainer for heat pumps at this point."*
Propane	Higher cost than natural gas, improved return on investment for heat pump	*"If they're on propane, it's a little easier to show a good return on investment at $2 a gallon versus $0.60 a therm."*

Weatherized homes	Reduced heat loss, which limits heat pump run time and energy consumption	*"The tighter house is running on average anywhere between 35% and 40% consistently, where the leakier house, I've seen it run up 60%, 70%...It will make sense financially for the folks who were running it 35% the majority of the time. These other folks, they're forking out some money right now on electricity, a lot more than they were with gas."*
Newer or moderately aged homes	More likely to have necessary electrical and ducting infrastructure, likely improved weatherization	*"The leakier, older homes - forget it."*

Equipment Selection

Various types of heat pumps provide potential solutions to electrify heating systems. Colorado contractors described the types of heat pumps they would recommend in different situations, as summarized in Table 3.

Table 3. Technology Adoption Varies by Application (Colorado contractors)

Equipment Type	Ideal Situation
Centrally-ducted air-source standard (non-cold climate) heat pump	Lower cost option when heat pump is not primary/only source of heat (e.g., dual fuel system with in-floor radiant heat); incentives may drive installation of standard heat pump for AC replacement
Centrally-ducted air source cold climate heat pump	Homes with propane heating and/or solar generation, homes in higher elevations with more extreme climates
Centrally-ducted geothermal heat pump	Homes in the mountains without propane tanks or other gas service where colder temperatures would reduce efficiency of air source heat pumps
Ductless heat pump	Homes without existing duct work or targeted home spaces

A Minnesota contractor supported the Colorado contractors' assessment of situations in which a geothermal heat pump works well, noting that small businesses most often opted for geothermal heat pumps when their facilities were on large properties and used propane as their existing heating fuel.

Conclusion

The authors draw two key conclusions from this research: education will be key to electrification program success, and solutions that offset, rather than fully replacing, gas heat may be a worthwhile intermediate step.

Education efforts, directed at both contractors and end-users, will be important to successful promotion of heating electrification.

HVAC contractors obtain much of their work through referrals and relationships with general contractors and other partners. As a result, maintaining a positive reputation for reliably meeting their customers' needs is critical to their business success. In addition, callbacks to address equipment issues pose one of the greatest risks to the profitability of individual HVAC installations. As a result, contractors are motivated to be risk-averse, recommending equipment they are confident they can install successfully and will meet customers' needs.

This risk aversion has the potential to make HVAC contractors reluctant to recommend complex, efficient heat pump systems, which require specialized knowledge to install, commission, and repair. Programs can help overcome this reluctance by providing training to increase contractors' familiarity with heat pump systems and confidence in installing them. End-user focused education efforts could also be beneficial. By informing end-users how to use their heat pumps most effectively, programs can help improve end-users' experience with, and the longevity of, the equipment, which would, in turn, further address contractor concerns with heat pumps. There may also be opportunities to provide contractors with materials to pass on to end-users to help inform them on the operation of their heat pumps.

Solutions that offset, rather than fully replacing, gas heating may provide a valuable, intermediate step to broader electrification.

Installing efficient electric equipment to offset gas heating, rather than fully replacing it, has the potential to mitigate some of the largest barriers that contractors cited to electrification of heating equipment. For example, Minnesota HVAC contractors expressed concerns about heat pumps' ability to meet customers' needs during times when cold temperatures were most extreme. Installing heat pumps but maintaining gas heat as a backup may be a valid solution for these situations, allowing customers to continue using gas in extreme cold conditions, while drawing on heat pumps during large portions of the year when temperatures are less extreme.

This type of solution could also help to overcome some of the barriers to electrification that Colorado contractors described, like the need to replace electrical infrastructure or ducts, since many of these improvements are needed when the heat pump faces its greatest heating load. For example, maintaining some gas heat could eliminate the need to install backup heating coils, reducing the need to upgrade electrical service, while still allowing the home to draw on the heat pump for heating until the backup heat source becomes necessary.

Using heat pumps to partially offset gas heat in this way would require controls to determine when the system should transition from the heat pump to the gas system that remains as a backup, potentially increasing the complexity of the installation for the contractor. Customer education may also be necessary to ensure the gas backup heat is used as designed. These will be important elements for programs promoting partial electrification solutions to address.

References

Apex Analytics, LLC. 2020. HVAC Market Actor Profile Report. Portland, OR: Northwest Energy Efficiency Alliance. Accessed 6/11/2022 from: https://neea.org/resources/hvac-market-actor-profile-report

CMC Energy Services. 2020. Engaging New Markets: HVAC Contractor Roundtable Results and Recommendations. Albany, NY: New York State Energy Research and Development Authority. Accessed 6/11/2022 from: https://portal.nyserda.ny.gov/servlet/servlet.FileDownload?file=00Pt000000SMpXmEAL

CSU (Colorado State University). 2022. Colorado Climate Center Monthly Data Access. Accessed 6/11/2022 from: https://climate.colostate.edu/cgi-bin/monthlydata.pl

MN DNR (Minnesota Department of Natural Resources). 2022. Minneapolis/St. Paul Climate Data: Historical Climate Listings. Accessed 6/11/2022 from: https://www.dnr.state.mn.us/climate/twin_cities/listings.html