HVAC Market Actor Profile

Small-to-Medium Commercial HVAC Project Decision Making

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Executive Summary

This report presents findings from research into the decision-making processes underlying small-to-medium (less than 25 tons) commercial HVAC installations from the perspective of HVAC contractors, architects, and engineers. This research was supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources, through the Conservation Applied Research and Development (CARD) program, which is funded by Minnesota ratepayers. EcoMetric and its partners, Apex Analytics, LLC and the Center for Energy and Environment, conducted this research between 2021 and 2022.

HVAC programs will be a key source of savings for Minnesota Conservation Improvement Program (CIP) programs in the coming years as market transformation reduces the savings potential of lighting programs and as utilities and municipalities look to electrification as a way to manage an increasing amount of distributed energy resources. Past research has identified energy efficiency program opportunities in upgrading small-to-medium commercial HVAC systems in Minnesota. For example, the 2018 Small Commercial Characterization study identified program opportunities in upgrades and replacement of commercial rooftop units (RTUs) and leveraging existing contractor networks to influence the installation of residential HVAC equipment types in commercial buildings. Past research has further investigated the RTU stock and market in Minnesota and found opportunities to expand utility program offerings in this area.

Research Objectives

The primary objective of this research was to gather in-depth data on the motivations and barriers that drive the decisions of individual HVAC installers working in residential and smaller commercial buildings. The resulting information should ensure program interventions are meaningful to decision-makers and responsive to market conditions.

Our primary data collection will significantly add to the body of knowledge about the specific market barriers for small commercial HVAC contractors, distributors, and manufacturers. Research activities focused on identifying barriers and best program intervention channels through understanding the path to purchase and critical decision points.

Decision-making processes can vary substantially between small-to-medium commercial HVAC installations. Program opportunities and strategies to influence a plan and specify new construction installation, in which a third-party engineer designs the HVAC system and installers bid on implementing that design, are very different from the opportunities and strategies to influence a contractor-led equipment replacement installation. This research identifies the types of projects likely to take each approach and the opportunities to influence efficiency in each situation, allowing utilities to target their program offerings and tailor their interventions most effectively.

The main objectives of this research are:

1. To understand the motivations, information sources, and decision-making processes of workers involved in HVAC installations; and
2. To understand the “business side” of HVAC installation and design companies.

The EcoMetric team reviewed existing literature and gathered primary data from HVAC market actors, including installers, distributors, architects, and engineers, to address the research objectives. Primary

data collection consisted of focus groups, interviews, and ride-alongs. The EcoMetric team conducted three focus groups and nine in-depth interviews with HVAC installers. The team also conducted five in-depth interviews with HVAC distributors and architectural and engineering (A&E) firms.

Key Findings and Recommendations

Market Actor Characteristics

The main focus of this study is HVAC market actors and their significant role in determining the type and efficiency of the RTUs they design and install for their customers. Therefore, it is important to understand what drives them and where they get their HVAC information.

1. Most A&E firms interviewed reported that the majority of projects they work on are in large commercial buildings. However, small-to-medium commercial buildings make up at least 25% of the buildings each firm works on.
2. Architects and engineers described two key sources of satisfaction in their work: designing systems to achieve sustainability and decarbonization goals and solving problems for customers.
3. The two primary motivators that contractors described – and related pain points – focused on achieving customer satisfaction and solving technical problems. Further emphasizing this point, contractors see building and maintaining relationships with end-use customers and general contractors as central to their business development approach.
4. HVAC suppliers (including distributors, manufacturer's representatives, and manufacturers) are a primary source of information for HVAC contractors, although contractors turn to different supplier sources for different types of information.
5. When HVAC contractors need to learn about the equipment they recommend, they primarily turn to their vendors.
    a. Contractors reported relying on manufacturers to a greater degree for technical information related to specific installations as the complexity of equipment has increased.
    b. Contractors also described the internet as a significant source for technical information, referencing sites including HVAC-related message boards (e.g., HVAC-talk.com), social media such as Facebook groups for those in the industry, and online manufacturer product manuals.
6. All four A&E respondents look to ASHRAE and distributor/manufacturer seminars for information and training on the HVAC market. Specifically, A&E respondents were interested in learning about new HVAC technologies, solutions, and market trends.

HVAC Project Decision-Making

In addition to understanding HVAC market actors' motivations and information sources in general, it is important to understand how their decision-making can be dictated by the context in which a specific project occurs. This study assesses HVAC market actor decision-making in the context of three main HVAC project types: plan and specify, design/build, and equipment replacement.

1. Among the three installation types, design/build projects require that contractors have the broadest capabilities, including system design, planning, and project management skills.

2. Experienced HVAC company staff – often the owners of smaller companies – typically lead the process of designing the HVAC system in design/build projects. HVAC contractors also reported relying heavily on manufacturers and distributors for support in designing systems in design/build projects. Contractors reported turning to distributors for recommendations on specific equipment for a given application.
3. HVAC contractors described three broad considerations in designing systems that are part of design/build projects: physical characteristics of space, use of space, and customer budgets.
4. Contractors described equipment replacement projects as generally straightforward, with the biggest complications around matching equipment types.
    a. HVAC contractors rarely suggested changes to equipment type or system design in equipment replacement projects, instead typically replacing equipment like for like.
5. Despite challenges with rental properties, HVAC contractors suggested that customers were more likely to invest in efficient equipment in equipment replacement installations rather than in new construction.
    a. Contractors explained that, in a new construction scenario, the HVAC system competes for a limited budget with multiple other building systems. Often, contractors noted, building developers look to cut costs on the HVAC system rather than aspects of the building that are more visible to occupants.
6. HVAC contractors have the least system design input in plan and specify projects, in which their role is to install a system designed by a third party (typically an engineer contracted to the general contractor or building developer).
7. HVAC contractors indicated that efficient systems were generally no more difficult to install than standard systems, but commissioning and completing rebate applications could increase the time required for efficient installations.
    a. A&E firms also indicated that efficient systems were generally no more difficult to design than standard systems; it is just a matter of selecting the correct equipment.
8. HVAC contractors 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.
9. A&E firms frequently worked with conservation programs that provide technical support and incentives to encourage energy efficiency in building designs, including the HVAC system. All four A&E respondents reported that these programs were helpful in their efforts to include more efficient HVAC systems in small-to-medium commercial buildings.
10. HVAC contractors and engineers described two key factors that increase the likelihood a project will include efficient equipment: owner-occupied facilities and publicly-owned or subsidized buildings.

Business Considerations

1. Interview findings suggest that most contractors do not view competing to offer the lowest prices as a sustainable, long-term strategy.
2. Contractors also emphasized the importance of building strong relationships and maintaining positive professional reputations with clients and partners, like general contractors, in winning plans and specifying work.

3. HVAC contractors most often reported it was difficult to find skilled workers.

Recommendations

1. Develop case studies showcasing the energy and non-energy benefits to customers of efficient technologies. These case studies should emphasize the potential to increase customer satisfaction and solve problems that standard efficiency RTUs may not be equipped to solve.
2. Promote workforce training with a focus on high-efficiency HVAC equipment. Contractors know the benefits of well-trained employees, which could motivate them to encourage their employees to participate in training.
3. HVAC contractors typically rely on distributors and manufacturers for information and training on high-efficiency HVAC units, so look for these existing relationships to leverage when designing midstream and upstream programs.
4. Work to strengthen relationships with distributors. Articulate the value proposition to distributors of marketing high-efficiency RTUs and how it will improve their business outcomes. Help distributors drive sales of high-efficiency RTUs with the following methods:
    a. Help distributors provide technical training to help contractors become more comfortable with high-efficiency RTUs
    b. Sales training for distributors' staff to encourage them to proactively talk to HVAC contractors about high-efficiency RTUs and how they can be profitable for them to install
    c. Consider developing a group of qualified/approved contractors that have been trained on the installation of high-efficiency RTUs and can help drive customer confidence in installing these units[1]
5. Move rebates for high-efficiency RTUs upstream. Providing midstream rebates (at the distributor level) has several advantages over providing downstream rebates. These include working with many fewer market actors than downstream rebates while still having close contact with HVAC contractors through distributors. This approach also takes the administrative burden off HVAC contractors and end users, which is a common barrier to program participation. To compensate distributors for their increased administrative burden, consider providing them with a monetary incentive.
6. Recognize that there may be limitations to the midstream approach, especially with "Plan and Specify" projects. With these projects, mechanical engineering and/or architectural firms specify what equipment the contractor will install. There is very little chance that contractors or distributors will recommend changing the specifications in any way. Therefore, it is important to also reach mechanical engineering and architectural firms early and often with messaging to promote their specification of high-efficiency RTUs.

[1] NMR Group, Inc. and Apex Analytics, Characterization of HVAC Supply Chains in Northern Illinois, November 12, 2019

7. Incentivize early replacement of RTUs. Program managers interviewed by the EcoMetric team reported that 80 – 90% of existing RTUs are replaced on failure. As described above, this scenario most often results in a code minimum efficiency RTU being installed as a replacement. Offering a higher incentive for customers who replace a working RTU may entice customers to consider replacing their RTU with a high-efficiency unit and would allow for the additional time often required for the delivery and installation of those units.
8. Minnesota program managers reported that the savings they see from RTUs in their programs were relatively low. The reason cited is that baseline cooling efficiency for RTUs has risen over the years. Depending on the application, high-efficiency RTUs typically do not result in large cooling savings in Minnesota's climate. With the passage of the Energy Conservation and Optimization Act of 2021, Minnesota utilities will have more opportunities to achieve greater savings from RTUs through the deployment of technologies such as heat pump RTUs, as well as cross-selling RTUs with demand response programs, which were cited by several utility program managers as potential opportunities.
9. Commercial efficiency programs should pursue contractor-focused market intervention strategies for technologies likely to be installed in smaller, owner-occupied commercial buildings. Doctors' and dentists' offices and some restaurants and retail spaces often meet the conditions that provide contractors the greatest opportunity to promote efficiency. Strategies that engage design teams and market actors further upstream, like distributors and manufacturers' representatives, may be more effective than contractor outreach in influencing HVAC installations in other types of facilities.
10. Commercial efficiency programs should include financial support for HVAC tune-ups and other pathways for contractors to increase their touchpoints with customers and provide opportunities to promote efficient equipment.

Introduction

This report presents findings from research into the decision-making processes underlying small-to-medium (less than 25 tons) commercial HVAC installations from the perspective of HVAC contractors, architects, and engineers. This research was supported by a grant from the Minnesota Department of Commerce, Division of Energy Resources, through the Conservation Applied Research and Development (CARD) program, which is funded by Minnesota ratepayers. EcoMetric and its partners, Apex Analytics, LLC and the Center for Energy and Environment, conducted this research between 2021 and 2022.

HVAC programs will be a key source of savings for Minnesota Conservation Improvement Program (CIP) programs in the coming years as market transformation reduces the savings potential of lighting programs, and as utilities and municipalities look to electrification as a way to manage an increasing amount of distributed energy resources. Past research has identified energy efficiency program opportunities in upgrading small-to-medium commercial HVAC systems in Minnesota. For example, the 2018 Small Commercial Characterization study identified program opportunities in upgrades and replacement of commercial rooftop units (RTUs) and in leveraging existing contractor networks to influence the installation of residential HVAC equipment types in commercial buildings. Past research has further investigated the RTU stock and market in Minnesota and found opportunities to expand utility program offerings in this area.

Existing research efforts have a common gap in that they lack focus on the manufacturers and distributors supplying and contractors installing HVAC systems in small-to-medium commercial facilities. These actors can play a critical role in determining whether and how to present energy-efficient options to project decision-makers. As a result, HVAC installers and their supply chains are critical partners for Minnesota utilities seeking to take advantage of the small-to-medium commercial HVAC efficiency opportunities.

This research will help Minnesota utilities engage with HVAC market actors and align programs with their business models in two ways. First, understanding HVAC market actors' motivations, information sources, and business strategies will allow utilities to effectively communicate with HVAC market actors and develop program offerings that present a compelling value proposition. Second, understanding the decision-making processes underlying a small-to-medium commercial HVAC installation will allow utilities to identify the greatest opportunities for program influence and most effectively target their offerings.

Decision-making processes can vary substantially between small-to-medium commercial HVAC installations. Program opportunities and strategies to influence a plan and specify new construction installation, in which a third-party engineer designs the HVAC system and installers bid on implementing that design, are very different from the opportunities and strategies to influence a contractor-led equipment replacement installation. This research identifies the types of projects likely to take each approach and the opportunities to influence efficiency in each situation, allowing utilities to target their program offerings and tailor their interventions most effectively.

Research Objectives

The primary objective of this research was to gather in-depth data on the motivations and barriers that drive the decisions of individual HVAC installers working in residential and smaller commercial buildings.

The resulting information should ensure program interventions are meaningful to decision-makers and responsive to market conditions.

Our primary data collection adds to the body of knowledge about the specific market barriers for small commercial HVAC contractors, distributors, and manufacturers. Research activities focused on identifying barriers and best program intervention channels through understanding the path to purchase and critical decision points.

Table 1 lists the research objectives and associated research questions.

Table 1: Research Objectives

Objective	Research Question
To understand the motivations, information sources, and decision-making processes of workers involved in HVAC installations	Motivations
	1. What motivates installers, architects, and engineers?
	2. What are installers' favorite installations to do, and why? What are architects' and engineers' favorite systems to design, and why?
	3. What brings them to work every day?
	4. What are their pain points?
	Information
	5. Where do they get information?
	6. Are employees required to get continuing education credits? If so, where do they find these opportunities?
	Decision Making
	7. What is the path to purchase and installation? How are employees in different roles involved in the path to purchase?
	8. Do they select projects? If so, how do they select them?
	9. Who makes decisions about what throughout the entire path to purchase and installation? Are there differences in the approach or decision-making process based on building type (new construction vs. retrofit, medium vs. small, etc.)?
	10. When would an HVAC installation be likely to be "above code" and why? What are the up and downsides of working above code by individual and role?
To understand the "business side" of HVAC	Business Model
	1. What does a typical day look like?
	2. What sells, and why?
	3. What influences in the marketplace inform their decisions (e.g., what their competitors are doing)?

Objective	Research Question
installation and design companies	4. Why do they sell particular products/manufacturers? What is the history of their manufacturer relationships?
	5. Do they partner with other firms for some jobs? If so, what do the partners contribute? Why those particular partners?
	6. How do firms structure a project so that they make money? What are essential rules they must follow to be profitable?
	Staffing and Talent Pipeline
	7. To what extent are companies experiencing a shortage of skilled workers? What are drivers of any such shortage? What are companies doing in response?
	8. Do companies prefer to hire skilled workers or to hire unskilled workers and train them in house?

Methodology

The EcoMetric team reviewed existing literature and gathered primary data from HVAC market actors, including installers, distributors, architects, and engineers, to address the research objectives. Primary data collection consisted of focus groups, interviews, and ride-alongs. This section summarizes each of these activities.

Literature Review

A 2017 CARD study performed by Seventhwave and CEE estimated that over 80% of commercial buildings in Minnesota (approximately 20,700) have roof-top units (RTUs) serving their HVAC requirements. The total number of RTUs serving these buildings was estimated to be about 136,000, with the median cooling capacity being 5 tons.[2] Despite the ubiquity of small commercial RTUs in Minnesota, there is limited understanding of how the decision makers involved influence the efficiency of the RTUs installed. This literature review consolidates existing market research reports, information from popular industry websites, and primary interviews to provide insight into the small commercial RTU market and lay the foundation for additional exploration into how utility programs can influence the selection of high-efficiency RTUs through this project's focus groups, interviews, and ride alongs.

For this research effort, the EcoMetric team started by reviewing both national and Minnesota-specific research reports that focused on the HVAC market. Market assessment reports published by the Northwest Energy Efficiency Alliance were particularly helpful, in addition to a 2017 CARD study published by Seventhwave and CEE that provided extensive information specific to the Minnesota market. The team also reviewed several leading HVAC industry websites that HVAC professionals are known to frequent. The website review consisted of analyzing both the content of posts and articles and the frequency a given topic was mentioned. Finally, a nontraditional component that the team added to the literature review was information the team collected directly through five interviews with utility program managers nationally and within Minnesota.

Primary Data Collection

Market Actor List Development and Sampling

The EcoMetric team leveraged several datasets to develop a list of commercial HVAC contractors and distributors in Minnesota for focus groups, interviews, and ride-alongs. First, the team queried Mergent Intellect's online industry databases using North American Industry Classification System (NAICS) and Standard Industrial Classification (SIC) codes targeting small-to-medium HVAC contractors. The primary industry target for contractors is NAICS code 238220: Plumbing, Heating, and Air conditioning Contractor.[3] Detailed SIC codes helped eliminate non-HVAC firms focused on piping, fire protection, irrigation, sheet metal, or other plumbing-only related work. EcoMetric removed likely plumbing-only firms by utilizing keyword checks and then validated this effort by performing a check on a random

[2] Seventhwave and CEE, Commercial Roof-top Units in Minnesota: Characteristics and Energy Performance, March 2017

[3] NEEA, Rooftop HVAC Market Characterization Study, February 16, 2017

sample pulled from the resulting list. The team also removed SIC-identified plumbing firms that did not contain HVAC terms in their company name, such as “Heating”, “Cooling”, and “Mechanical.”

The final small-to-medium HVAC company sample frame included 4,140 statewide contractors.

In order to create a sample that represents different areas of the state, EcoMetric added additional geographic and climate zone fields to the contractor sample frame to stratify the population by three geographic and climate zone designations:

- Twin Cities Metro (Southern Climate Zone)
- Northern Minnesota (Norther Climate Zone)
- Southern Minnesota (Southern Climate Zone)

Geographic segmentation enables recruiting that ensures diverse statewide representation. The EcoMetric team expected the greater Minnesota regions to achieve equipment fuel source representation (i.e., the team expected a greater number of electric HVAC equipment contractors in northern Minnesota, where gas is less available). Figure 1 shows the three geographic regions by county.

Figure 1: Geographic Sample Zones by County

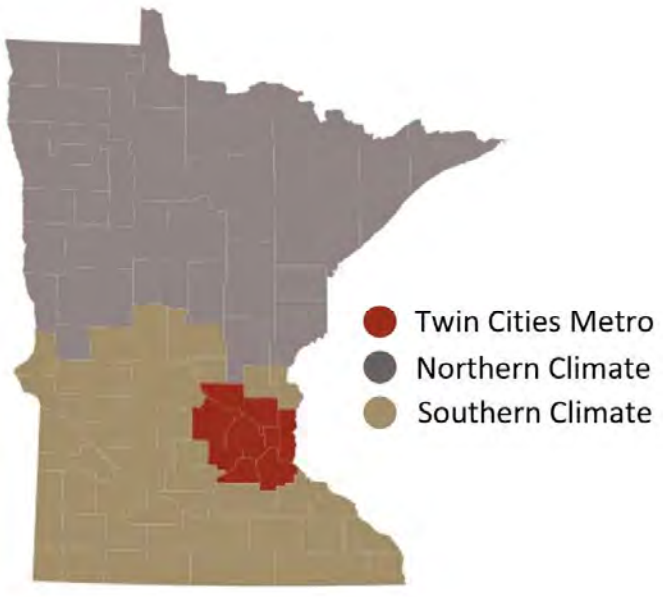


Table 2 shows the counts and distribution of HVAC contractors across the three geographic zones. The team recruited contractors for all three research activities (in-depth interviews, focus groups, and ride-alongs) from the segmented master list of 4,140 contractors. The team randomized the lists within each segment and recruited respondents separately for each data collection activity.

Table 2: Count of HVAC Contractor Firms by Geographic/Climate Zones

Region	HVAC Firms	Distribution
Twin Cities Metro	1,981	48%
Northern MN	901	22%
Southern MN	1,254	30%
Total	**4,140**	**-**

For the HVAC distributor interviews, the EcoMetric team also leveraged the Mergent Intellect industry databases using the NAICS code 423730: Warm Air Heating and Air Conditioning Equipment and Supplies Merchant Wholesalers. This resulted in 158 distributors in Minnesota. As these distributors supply large regions covering all of Minnesota, the team did not stratify the distributor list by geographic region or climate zone.

EcoMetric relied on local contacts and connections to develop a list of architectural and engineering (A&E) firms in Minnesota for in-depth interviews.

Respondent Recruiting

The EcoMetric team contracted a global recruiting firm, Schlesinger Group, to conduct the recruiting efforts for the focus groups and in-depth interviews with contractors and distributors. Recruiting efforts began in September 2021 to maximize outreach in the shoulder season between the summer peak and winter seasons. Schlesinger's recruiting team attempted at least three emails and five phone calls to each contractor firm.

The recruiting team first worked to fill the focus groups. In the initial phone call, the recruiters screened the firms for study eligibility to ensure they have sufficient experience installing small-to-medium commercial HVAC systems and are involved in decision-making surrounding those installations. Firms must have completed at least ten installations of commercial equipment ≤25 tons in the past year to be eligible for the focus groups. To participate in an interview, commercial HVAC installs of ≤25 tons must represent at least 20% of the firms' installs in the past year. Contractors that were not interested in participating in the focus groups were asked if they were interested in participating in an in-depth interview and/or ride-along.

To incentivize participation, contractors were offered a $200 gift card for participating in a focus group or $150 for participating in an in-depth interview. The recruiting team found difficulty filling the targeted number of interviews with many contractors uninterested or too busy to participate. In October 2021, the EcoMetric team increased the in-depth interview incentive to $250 in an attempt to improve the participation rate. There was a short-term improvement in the participation rate, but the EcoMetric team failed to meet its goal of 36 in-depth interviews. Due to the lower-than-expected participation rate for HVAC contractors, the EcoMetric team added commercial architects and engineers to the study. Architects and engineers provide a crucial point of view in the HVAC market as they work closely with commercial customers to design and specify HVAC equipment in commercial buildings across the State of Minnesota. Architects and engineers are able to speak on customer decision-making processes regarding the size and efficiency of HVAC systems across many commercial building types.

For the A&E firm's in-depth interviews, the EcoMetric team conducted the recruitment via direct email and phone calls. The A&E firms were also offered a $250 gift card for their participation in an interview. Due to the smaller number of targeted interviews (5), this approach was well-suited for the A&E recruitment and resulted in a much-improved participation rate compared to the contractor interviews.

Online Focus Groups

The EcoMetric team conducted three online focus groups with contractors involved in the installation and sales of small-to-medium commercial HVAC. Table 3 shows that the EcoMetric team segmented the focus groups by company size and geographic location. In total, 9 HVAC contractors participated in the focus groups, which took place on September 28, September 29, and October 4, 2021, and lasted 90 minutes each. Initially, the EcoMetric team had planned to conduct separate focus groups with companies working in Northern and Southern Minnesota. However, the team was unable to recruit any companies working primarily in Northern Minnesota, so one focus group was held with two companies primarily working in Southern Minnesota.

Table 3: Number of Participants by Focus Group

Company Type	Respondents
Large Company, Twin Cities (≥10 employees)	5
Small Company, Twin Cities (<10 employees)	2
Companies working in Southern Minnesota (non-metro)	2

In-depth Interviews

The EcoMetric team conducted in-depth telephone interviews with nine HVAC contractors providing small-to-medium commercial HVAC installation services. The team also conducted one interview with an HVAC distributor that supplies the small-to-medium HVAC sector in Minnesota. The EcoMetric team conducted interviews between September and October 2021. Interviews generally lasted between 30 and 45 minutes. As summarized in Table 4, the EcoMetric team segmented the contractor interviews by company size and geographic location.

Table 4: Number of Interviews Completed by Location and Size

Region	Small Firms (<10 employees)	Large Firms (≥10 Employees)	Total
Twin Cities Metro	3	3	**6**
Northern MN	1	1	**2**
Southern MN	1	-	**1**
Total	**5**	**4**	**9**

The EcoMetric team screened interview respondents to ensure they had sufficient experience with small-to-medium commercial HVAC installations as well as sufficient exposure to project decision-

making. The team also screened respondents to ensure that HVAC installation, as opposed to maintenance and repair, constituted a significant share of the respondents' business. The original target of completed interviews was 30 for contractors and 10 for distributors. The team scheduled the recruitment around the "shoulder season" for the HVAC industry, where contractors are usually less busy with emergency calls during the summer and winter. However, the EcoMetric team and their recruiting contractor found that, despite the monetary incentive to participate, many contractors and distributors were too busy or uninterested in participating in the interview. As such, the team expanded their efforts to reach other market actors in the HVAC industry for a more comprehensive view of the decision-making process behind HVAC projects.

To add the perspectives of another HVAC market actor, the EcoMetric team also interviewed four architecture and engineering firms that provide design services in Minnesota. The team conducted these interviews, generally lasting 45 minutes to an hour, in March and April 2022. The EcoMetric team screened the firms to ensure they had significant experience with small-to-medium commercial HVAC projects in the State of Minnesota. Most of the firms had experience in several states, but the team asked the respondents to focus on their experiences in Minnesota.

Ride-Alongs

The EcoMetric team also conducted a ride-along with an HVAC contractor providing small-to-medium commercial HVAC installation services in the Twin Cities area. In recruitment, the EcoMetric team used screening criteria similar to those for focus groups and interviews. As part of the interviews described in the section above, the team asked respondents if they were interested in participating in a ride-along for an additional incentive. The ride-along consisted of a member of the EcoMetric team following an HVAC contractor to the site of a small-to-medium commercial HVAC project. The EcoMetric team's goal for the ride-along was to observe the interactions between the contractor and their commercial client, including system design and installation discussions. Due to contractors' busy schedules and COVID-19 restrictions, the EcoMetric team had difficulty finding more contractors interested in participating in ride-alongs.

Discussion of Results

Market Overview

Rooftop Units (RTUs) are typically segmented into small commercial and large commercial sizes by cooling capacity measured in tons. HVAC units of 25 tons or less are generally considered to make up the small commercial market, while the large commercial market consists of 25+ ton HVAC units.[4] In Minnesota, the average cooling capacity of an RTU is 10.7 tons, indicating that the vast majority of RTUs, in terms of the total number, fall into the small commercial category. As of 2017, Minnesota's RTUs had an average age of approximately 13 years, and about 75% were manufactured by just three manufacturers (Carrier, Lennox, and Trane).[5]

Every year in Minnesota, approximately 6,400 RTUs are shipped to commercial buildings. Of these, 40% are installed in new construction projects, and 60% serve as replacements of existing units. This amounts to nearly $100 million of RTU sales every year, with about half of those expenditures paying for minimum efficiency, code-compliant RTUs.[6] These thousands of small commercial RTUs installed every year in Minnesota typically flow through the wholesale distributor supply channel. This generally follows a hub and spoke model with the RTUs moving from manufacturer to distribution centers, and then to distribution branches before finally being shipped to commercial customers for installation. Contractors do not typically stock RTUs themselves. Rather, they order the delivery of RTUs to customer sites from the distribution branches as needed.[7]

Of the 60% of the market made up by replacement RTUs, approximately 80-90% are installed upon the failure of the existing unit, making expediency one of the top priorities for the selection and installation of a replacement unit. Furthermore, the upfront cost is commonly cited as the main deciding factor for both replacement and new construction installations. Building owners pursuing an RTU-based HVAC system are generally less interested in life cycle costs and are, therefore, less likely to view the investment in more efficient equipment as worthwhile.[8] The short turnaround times often required for RTU installations, and the focus on first costs are significant barriers to increased penetration of high performance RTUs.

Market Actor Characteristics

This section describes the characteristics of contractors and A&E firms designing and installing small-to-medium commercial HVAC systems, including their motivations, "pain points", and the sources they turn to for industry information and continuing education.

[4] NEEA, Rooftop HVAC Market Characterization Study, February 16, 2017

[5] Seventhwave and CEE, Commercial Roof-top Units in Minnesota: Characteristics and Energy Performance, March 2017

[6] Ibid.

[7] NMR Group, Inc. and Apex Analytics, Characterization of HVAC Supply Chains in Northern Illinois, November 12, 2019

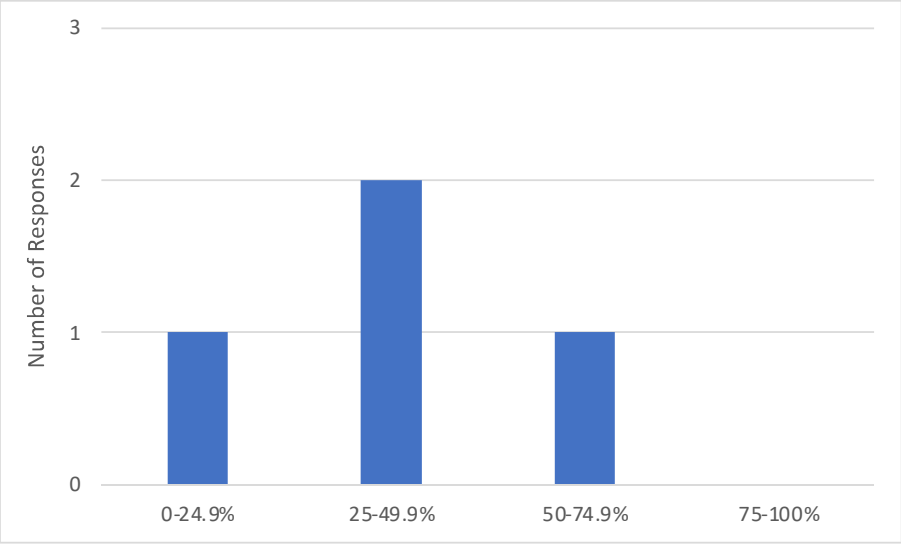
[8] Seventhwave and CEE, Commercial Roof-top Units in Minnesota: Characteristics and Energy Performance, March 2017

Company Characteristics

A&E firms working in Minnesota's commercial HVAC sector are generally larger firms that provide a wide variety of services beyond HVAC system design. These services include mechanical engineering, electrical engineering, plumbing, commissioning, energy modeling and sustainability services, fire protection, and information technology systems. All of the A&E firms interviewed tout expertise in sustainability and energy efficiency services.

Most A&E firms interviewed reported that the majority of projects they work on are in large commercial buildings. However, small-to-medium commercial buildings make up at least 25% of the buildings each firm works on (Figure 2).

Figure 2: Share of Interviewed A&E Firms' Projects in Small-to-Medium Commercial Buildings



Three of the four A&E firms interviewed focus on new construction projects, with retrofits and remodels making up a smaller share of their commercial projects. The types of buildings that the A&E firms work on varied greatly and included office buildings, retail, biotechnology, civic/institutional, multifamily, and senior living homes.

While all of the large HVAC contractors participating in focus groups complete residential and small-to-medium commercial installations, most firms focused on either the residential or commercial sector. Only one firm reported completing more than 25 installations in each market sector in the past year. This firm was also notably larger than the other focus group participants, with more than 100 employees, even within the large firm category. The others were split between those completing more than 100 small-to-medium commercial installations and fewer than 10 residential installations and those completing more than 100 residential installations and between 10 and 24 small-to-medium commercial installations. Large contractors completing more small-to-medium commercial installations also reported completing large commercial installations, while those focused on residential installations reported rarely installing large commercial equipment.

Smaller contractors most often reported focusing more heavily on the residential sector, with eight of the nine small contractors recruited for focus groups reporting more residential than small-to-medium commercial installations. Some contractors who were recruited for focus groups and provided background information during the focus group screening process did not ultimately participate in the groups. None of the small contractors reported completing substantial numbers of large commercial installations.

Motivations

The main focus of this study is HVAC market actors and the significant role they play in determining the type and efficiency of the RTUs they design and install for their customers. Therefore, it is important to understand what drives them. Although profit is certainly a driving factor for HVAC contractors, they are also motivated by the potential to achieve customer satisfaction. Previous interviews performed for a market research report published by NEEA revealed that HVAC contractors receive gratification from knowing that they increased a customer's comfort and allowed the customer to focus on their work without thinking about their HVAC system. They also enjoy the opportunity to solve problems and overcome technical challenges.[9]

Contractors and Distributors

The sources of job satisfaction that HVAC contractors described were closely related to the pain points in their work: pain points were large factors that impeded contractors from achieving their sources of job satisfaction. **The two primary motivators that contractors described – and related pain points – focused on achieving customer satisfaction and solving technical problems.**

Customer Satisfaction

HVAC contractors reported they were motivated by their customers enjoying, and expressing gratitude for, the results of their work. One contractor described a thankful customer who recommended their company to two neighbors and gifted the contractor "a bouquet of flowers out of his garden to say thank you, that he loved working with us in our process." Satisfying the customer, as the contractor put it, is "[W]hat I like doing." Given the importance of referrals and repeat customers as a source of business for many HVAC contractors, achieving customer satisfaction can also have financial benefits. One contractor described customer satisfaction as a way to set their business apart from larger competitors, saying: "As a smaller business, we try to be more personable with customers. We are more in tuned with customer service. We do what we can to find out anything for customers."

Further emphasizing this point, contractors see building and maintaining relationships with end-use customers and general contractors to be central to their business development approach. These relationships are built over the long term by providing exceptional customer service, completing tasks on time and on budget, and ensuring that the equipment they install functions properly. To meet their profit and customer satisfaction motives, contractors seek to minimize callbacks as a result of issues with the RTUs they install. Callbacks can result in the elimination of profits earned for a given project and may decrease customer satisfaction. Therefore, contractors may be conservative in the equipment

[9] NEEA, HVAC Market Actor Profile Report, October 15, 2020

they recommend in order to maintain a high level of confidence that the equipment they install will meet their customers' needs.[10]

Contractors described dissatisfied customers as a pain point in their work, noting that some customers had unreasonable expectations or would disregard their advice. For example, one contractor noted that some customers "Don't want to pay for the full repair. They want a Band-Aid, and then the Band-Aid didn't work – and we warned them it was not going to work – then they post a bad review." This contractor elaborated that "it's never fun when somebody says something bad about you, because I work really hard with my team to give the best service I can." Contractors noted that increasing HVAC equipment prices due to supply chain disruptions and inflation provided an additional potential source of customer dissatisfaction.

Problem Solving

HVAC installations and repairs present discreet tasks and challenges that require HVAC contractors to apply their specialized knowledge. Contractors reported finding satisfaction in completing those tasks, particularly when doing so provides an opportunity to solve a problem for the customer. One contractor reported that the ability to "go into a mess and clean it up and stand back and listen to the customer say how nice it looks" was a source of satisfaction. This contractor elaborated that customers appreciate their problem-solving efforts even if the customer does not understand the technical aspects of the system, saying, "A lot of times, they don't even have any idea what it does, but they sure know when it's a mess."

Even when not solving existing problems, HVAC contractors reported satisfaction in having all of the elements of a project come together to allow for a successful installation. As one contractor explained, "A good day is when everything goes as planned," elaborating that "Just having a productive day set up for success from the start is my good day." Another contractor reported finding satisfaction in "Just a successful day of running calls and everything sort of got handled. Taking names off that board back there, that's always rewarding, and something's getting done."

HVAC contractors described factors that prevent them from completing installations as planned as pain points in their work. Often these complications came from dependencies on other providers, services, and suppliers. Contractors discussed the frustrations of wanting to move forward but facing obstacles that prevented their ability to work steadily. As one contractor explained, "those [delays] are pretty frustrating because then a lot of things get put on the back burner and then you're scrambling to keep busy. You got a lot of work to do, but you can't do it yet. That's the most frustrating thing right there…"

Contractors cited several examples of instances in which the need to coordinate with other trades in new construction projects had delayed their projects. Respondents noted that wiring or plumbing for fire sprinklers may run through the same areas where they want to place ducts, and since the ducts are slower to install than pipes or wiring, HVAC contractors often must work around these fixtures. Contractors also noted that improperly installed carpentry work could delay projects. In equipment replacement projects, contractors described delays from needing to hire engineers to ensure that a building's structure was strong enough to support the weight of the proposed HVAC equipment or contract with sheet metal workers to alter the ductwork to support the new equipment.

[10] Ibid.

The COVID-19 pandemic exacerbated these existing challenges by making staffing less predictable while, at the same time, reducing equipment availability due to supply chain issues. One contractor reported that "Scheduling stuff has been pretty tough because supply chain issues and then COVID infections shutting down job sites, and so you end up with one trade that goes down in a job site, the job just gets held up because they can't keep going without the other guys there." Larger companies were able to buy equipment and stockpile to lessen challenges around equipment availability, but smaller companies ordered as needed. Larger projects for either size company could take months to collect supplies.

Architects and Engineers

Architects and engineers described two key sources of satisfaction in their work: designing systems to achieve sustainability and decarbonization goals and solving problems for customers.

> *"Engineers are stewards of the community, providing guidance to create an environment so customers can be successful. In our job, can we look at decarbonization, can we find ways for our customers to be more efficient?"*
> *-Minnesota Engineer*

All four of the A&E respondents interviewed mentioned that working closely with customers to solve engineering and building problems was one of the most rewarding things they do on a day-to-day basis. Most respondents stated that the COVID-19 pandemic affected their ability to meet and work closely with customers on-site, but that they were able to adapt through virtual meetings to continue this important interaction to understand and meet their clients' needs.

Pain points and frustrations for A&E respondents did not follow a single theme but included managing project budgets, impacts of COVID-19 on client interactions, and overly complicated software used for energy modeling. Similar to contractors, several A&E respondents expressed frustration with supply chain issues and equipment availability negatively affecting their commercial HVAC projects.

Education and Sources of Information

Contractors and Distributors

HVAC suppliers (including distributors, manufacturer's representatives, and manufacturers) are a primary source of information for HVAC contractors, although contractors turn to different supplier sources for different types of information.

> *Distributors often have the most comprehensive view of the market and may be particularly well suited to influence it.*

Of the vendors that provide information to HVAC contractors about HVAC technologies, distributors occupy a central role. They sit between the manufacturers who design and manufacture RTUs, and the contractors who work with end-use customers to make their equipment decisions. Distributors base their stocking decisions largely on market demand, and most of the contractors who buy from them tend to install standard-efficiency equipment, particularly in the small commercial market.[11] Distributors have reported that while higher-efficiency equipment sales may offer greater margins for both distributors and contractors, that advantage can be negated if high-efficiency RTUs fail to turn over quickly and, as a result, take up valuable warehouse space.[12]

When HVAC contractors need to learn about the equipment they recommend, they primarily turn to their vendors. This includes manufacturers, manufacturers' representatives, and distributors. This information could come in the form of online videos, brown-bag lunches hosted by the vendors, or more formal continuing education programs. Asked about this in a previous study, HVAC contractors reported that vendors typically provide in-person seminars 3 to 4 times per year, either at the contractor's location or an alternative venue arranged by the vendor.[13] This suggests that vendors providing education about high-efficiency RTUs as well as marketing them aggressively to HVAC contractors is a viable avenue to increasing the number of high-efficiency RTUs installed.

Table 5 summarizes the information sources contractors turn to for different types of information.

[11] NMR Group, Inc. and Apex Analytics, Characterization of HVAC Supply Chains in Northern Illinois, November 12, 2019

[12] Ibid.

[13] NEEA, HVAC Market Actor Profile Report, October 15, 2020

Table 5: Information Sources by Topic Area

Information type	Sources	Notes
New products, industry trends & product updates	Distributors Manufacturer meetings/trade shows & webinars Manufacturer rep trainings Trade magazines	Some contractors select a small number of their most frequently installed products and focus on remaining up to date on those. Contractors value opportunities to interact directly with manufacturer engineers at meetings and trade shows.
Technical information to trouble-shoot specific problems	Manufacturer technical support Internet searches	Given the increasing complexity of equipment, manufacturer technical support becomes critical in the field. Staffing shortages increase wait times, with callbacks occasionally coming when the contractor is no longer at the jobsite. Contractors increasingly use web searches instead.
Promotional material to share with customers	Manufacturers	The amount of printed promotional material manufacturers provide has decreased, but it is still valuable with some customers.

Multiple HVAC contractors reported that they struggled to stay updated on advancements, as one explained, “That's why I rely on my suppliers all the time. I can't keep on top of the rooftop units because they change.” Another contractor described self-education on the constant technological changes as a “full time job.” Contractors noted that manufacturers also kept them up to date on changes to regulations around refrigerants and other equipment requirements.

Contractors reported relying on manufacturers to a greater degree for technical information related to specific installations as the complexity of equipment has increased. As one contractor explained, “You pretty much have to be on the phone [with the manufacturer’s tech support] when you are working with some of these pieces of equipment because they are very complicated.” Similarly, another respondent reported that “The days of having the service guy come over and all of your problems are over [are gone]. No, I come over, I get on my phone, and I call the guys that build them.”

Contractors also described the internet as a significant information source for technical information, referencing sites including HVAC-related message boards (e.g., HVAC-talk.com), social media such as Facebook groups for those in the industry, and online manufacturer product manuals. One contractor stated that “I probably spend more time in front of a screen than I want to, researching stuff.” Multiple contractors spoke of Googling to access product information and manuals while on the job, for example, to confirm product compatibility.

In addition to looking to their vendors for information, HVAC contractors may also review information published on popular industry websites such as ACHR News, HVAC & Refrigeration Insider, and HVACR Business Magazine. The EcoMetric team reviewed these websites and the articles posted to glean information about what contractors were learning from them. The dominant themes at the time of

review were company acquisitions and partnerships, product launches and technology features, and coronavirus coverage. The articles and pages specific to individual technologies often highlighted their use in a given case study and emphasized what applications they performed well in. However, they did not typically include in-depth training or detailed instructions related to deploying those technologies, suggesting that contractors typically need to follow up with their distributors or manufacturers to learn more about a given technology.[14,15,16]

There was relatively little information on any of the reviewed sites that focused on the efficiency of HVAC technologies and even less information specifically about RTUs. In fact, the only information identified during our review that specifically pertained to RTUs was an article discussing the commercial roof-top unit roadshow organized by Johnson Controls and York. The lack of information related to RTUs and efficiency suggests that other product launches and coverage of the economic and customer impacts of the coronavirus epidemic are seen as more newsworthy and are what HVAC contractors are learning about when they visit these sites.[17]

Prior research found that some manufacturers require HVAC contractors to maintain certain certifications to be authorized dealers for their products.[18] Distributors and manufacturers offer the training contractors need to maintain these certifications, as do professional organizations, unions, and governments. Contractors participating in focus groups indicated that, while they value these types of certifications and continuing education, it has become less of a priority due to labor shortages. According to one contractor, "Right now, I need guys in the field. I'll take somebody that breathes that knows how to do mechanicals. I don't care if they are NATE certified at this point. I need them to work, and we'll work on the NATE certification [later]."

One potential source of information that HVAC contractors do not appear to have a clear reliance on is utility representatives. Program managers reported that they hold occasional events to educate contractors about their programs and that the rest of the contractor outreach is typically performed by utility account managers or trade ally representatives. That these outreach efforts are not typically cited by HVAC contractors as significant sources of information suggests that additional efforts on the part of utility programs may be required. However, there may be confusion on the part of the HVAC contractors as to the trade allies' relationship with program managers and the utilities. HVAC contractors may not connect the information they receive from trade ally representatives back to the program outreach efforts. Moreover, programs and trade ally networks vary in size and budget across Minnesota resulting in very different experiences with educational resources and program outreach amongst HVAC contractors in the state.

Architects and Engineers

All four of the A&E respondents look to ASHRAE and distributor/manufacturer seminars for information and training on the HVAC market. Specifically, the A&E respondents were interested in

[14] ACHR News (Website), September 2021.

[15] HVAC & Refrigeration Insider (Website), September 2021

[16] HVACR Business Magazine (Website), September 2021

[17] Ibid.

[18] NEEA, HVAC Market Actor Profile Report, October 15, 2020

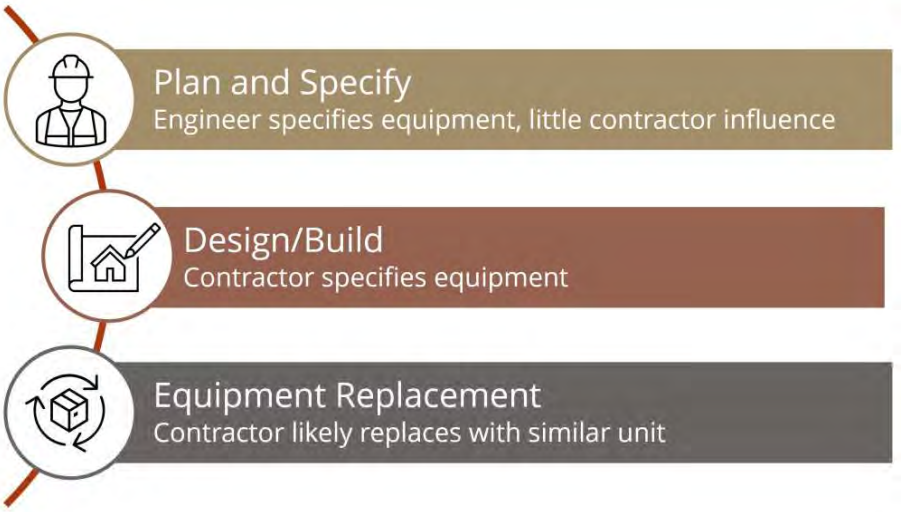
learning about new HVAC technologies, solutions, and market trends. Most A&E respondents heard of the seminars and training through direct newsletters and emails. When discussing continuing education and market information, A&E respondents were less concerned with "how to" and technical troubleshooting information than compared to the contractors interviewed.

HVAC Project Decision-Making

Path to Purchase and Installation

In addition to understanding HVAC market actors' motivations and information sources in general, it is important to understand how their decision making can be dictated by the context in which a specific project occurs. This study assessed HVAC market actor decision-making in the context of three main HVAC project types, as depicted in Figure 3.

Figure 3: HVAC Project Types



1. **Plan and specify** (often referred to as plan and spec): In plan and specify projects, a third party – typically an engineer or architect – designs the HVAC system and specifies the equipment. The HVAC contractor's role is to procure and install the specified system. Plan and specify approaches primarily occur in new construction or major renovation scenarios, although they can also be applied to equipment replacement.
2. **Design/build**: In design/build projects, the contractor responsible for installing the HVAC equipment also designs the HVAC system and specifies the equipment. The HVAC contractor may hire and manage subcontractors to assist in any aspects of the design or installation that are beyond their internal capabilities. This study focuses on design/build projects in the context of new construction or major renovations.
3. **Equipment replacement:** Projects in which HVAC contractors replace existing equipment pose a unique set of considerations and challenges, as the installation must consider existing infrastructure like ducting and roof curbs. While the installation contractor typically specifies the

equipment for an equipment replacement project, these considerations make the decision-making process distinct from design/build projects in new construction or major renovations.

The following sections detail the contractor decision-making process and the path to purchase and installation for each installation type.

Design/Build New Construction or Renovation

Among the three installation types, design/build projects require that contractors have the broadest capabilities, including system design, planning, and project management skills. As one contractor explained, plan and spec projects can be easier than design/build projects "because I don't have to worry about spending days finding equipment, suppliers, and part numbers. All that stuff was all laid out for me." Design/build projects also require contractors to take on more risk than other project types. In plan and spec projects, the contractor is responsible only for the installation; they are not responsible for any problems stemming from the system design. In equipment replacement projects, contractors can base their equipment recommendations on the performance of the existing equipment.

Reflecting the need for these additional skills and willingness to take on additional risk, interview findings suggest that some contractors specialize in design-build projects, while design/build projects make up a small share of work for others. Four of the seven interviewed contractors estimated design/build projects to be at least 75% of their work, while the rest estimated design/build projects made up 20% of their installations or fewer. All of the contractors who reported doing less design/build work represented smaller companies.

Consistent with findings from prior studies, interviews, and focus group findings indicate that design/build projects tend to be in smaller commercial properties operated by private businesses or multiunit residential projects. One HVAC contractor described that much of their work came from adapting existing commercial spaces to clinic spaces, which they noted comprised much of their work.

Roles in System Design

Experienced HVAC company staff – often the owners of smaller companies – typically lead the process of designing the HVAC system in design/build projects. HVAC contractors also reported relying heavily on manufacturers and distributors for support in designing systems in design/build projects. Contractors reported turning to distributors for recommendations on specific equipment for a given application.

Turning to distributors reduced the need for small-to-medium contractors to conduct their own research and become product experts. This was especially helpful within the context of a market with frequent product changes. As one contractor who installed many air source heat pumps and geothermal heat pumps said, "We do take care of all that, a lot of our pump sizing and stuff for jobs... But it's with the help of wholesalers that have all the books on the pump curves and everything." This contractor explained that it was more efficient to seek their distributors' support than to conduct the calculations in-house, saying, "you're not real profitable sitting in behind the computer, figuring out what exact pump you should use rather than just calling up [our distributor] and saying, 'This is what I have. What do you think I should do?'"

Contractors also drew on manufacturers and distributors as resources for engineering and technical knowledge. Small-to-medium HVAC contractors, particularly those without in-house engineering

capabilities, would refer questions to manufacturers with a larger skilled staff. For example, one contractor reported that none of their staff members could operate heat loss calculation software. When a project requires the use of the software, they would bring in the wholesaler: "Anything on that, we will involve one of our wholesalers as well, that has somebody that that's all they do every day."

Design Considerations and Constraints

HVAC contractors described three broad considerations in designing systems as part of design/build projects:

1. **Physical characteristics of space:** HVAC contractors stated that characteristics like building square footage, window type and placement, insulation type, and existing features like the placement of ductwork were necessary to consider for system design. Seeing the location of utilities, for example, allowed one contractor to be able to "make it easier to run ducts."
2. **Use of space:** HVAC contractors shared that the purpose of the building was an important determinant of system design. The specific type of business affects HVAC load calculation and the resulting equipment size. In multifamily buildings, one contractor noted differences in configurations for general housing versus for senior living facilities. Different uses of the space also had different planning guidelines, such as fresh air recommendations for offices versus residential spaces. One contractor led their approach to design by considering the building's intended functions: "We usually look at the application of the space. What's the design scope? Then, select our products from there, our equipment from there."
3. **Customer budgets:** HVAC contractors considered cost and their client's budgets during the process of designing HVAC systems. For many, the cost was the primary consideration though certain projects and clients had more budget flexibility than others. Contractors balanced the limits of clients' budgets with their motivation to install quality equipment. Contractors preferred to install quality equipment to avoid the risk of "callbacks" when dealing with inexpensive equipment. As one explained, installing inexpensive, low-quality equipment "is just a bad idea. I won't even do it. I mean, I'll say get somebody else. Because I know they're going to call me to fix it." Contractors also reported relying on manufacturers and brands with which they had positive experiences in the past to avoid preventable customer repairs. One HVAC contractor named their most preferred brand, and the reason they gave was "less callbacks" with their equipment.

One contractor reported that multifamily projects were often particularly financially constrained and required careful judgement. According to this contractor, “We're not going to put in complete junk, but at the same time, we're probably not going to recommend that they put in a variable refrigerant flow (VRF) system into the building because it's going to cost them three times as much.” The cost was especially factored into customers' choices of efficient products, and contractors reported that available rebates modified customer choices toward efficiency in some cases. Contractors also reported that the ability to communicate the need for and benefits of certain types of equipment was important to gaining customer buy-in on installing the equipment and ultimately achieving customer satisfaction.

Equipment Replacement

Contractors described equipment replacement projects as generally straightforward, with the biggest complications being around matching equipment type. The three (of seven) interviewed contractors who reported design/build projects made up a minority of their work primarily by completing equipment replacement projects, with some reporting that as much as 90%+ of their installations were replacements. All three of these contractors represented smaller companies (<10 employees), with fewer resources to devote to the time and labor of designing and planning new construction projects.

Larger HVAC contractors reported their equipment replacement work typically came from existing relationships with their customers, including long-term maintenance contracts with commercial and/or multifamily properties. Some—typically smaller companies interviewed—were direct maintenance contractors of entities like apartment complexes, or subcontractors hired on emergency replacement occasions by internal maintenance groups. HVAC contractors also reported their new construction installations could lead to equipment replacement work, as one contractor noted building occupants would sometimes decide, "Well, if they installed it, we'll just let them keep maintaining it for now."

Roles in System Design

HVAC contractors rarely suggested changes to equipment type or system design in equipment replacement projects, instead typically replacing equipment like for like. Multiple respondents described the process as "just swapping equipment." Contractors indicated that these like-for-like replacements were at lower risk of customer dissatisfaction than larger system changes. According to one contractor, "I just want to make sure the BTUs are the same, the tonnage is the same…I don't want to go to work and install a system for eight hours, and then they are calling saying that their AC is not working, their heat is not working."

Contractors suggested that, given the limited need for system design, equipment replacement projects, particularly rooftop unit replacements, could be relatively easy and profitable. According to one contractor, "I would love to do two rooftop [unit replacements] every day. That is good business, good money, easy."

HVAC contractors reported they would typically suggest changes to equipment type in a replacement scenario only when the existing equipment was obsolete, which most often occurred in residential installations, or if the use of the space had changed substantially, most commonly in commercial buildings. For example, contractors described replacing HVAC equipment serving IT server rooms, where "the load has drastically been reduced over time because they don't have a hundred square feet of servers chugging away and we [no longer] need $50,0000, $100,000 worth of cooling equipment."

HVAC contractors noted that, in some cases, there were few or no opportunities to offer alternative system types at a reasonable cost in a replacement scenario. For example, one focus group respondent noted that installing an alternative system in place of hydronic heating was typically prohibitively expensive. Another reported there were few options for changing system types in rooftop unit replacements, noting that they would like to offer a dual fuel, air source heat pump, and natural gas package unit, but none were available.

HVAC contractors reported a limited need to draw on outside experts like engineers in equipment replacement installations. One HVAC contractor noted that engineers would occasionally be involved if an installation required stamped plans for a replacement rooftop unit of different weight. In

replacement projects, contractors spoke mostly to manufacturers and distributors to obtain products. Most integral to the replacement process was ensuring that equipment was the appropriate size and load, as well as in stock.

Design Considerations and Constraints

Building owners tended to invest more in equipment replacement, while rental properties usually went "with the cheapest route" available. HVAC contractors reported that their clients replacing equipment in owner-occupied buildings typically planned "on holding onto the building" and viewed their investments in new equipment on longer timescales. As a result, these building owners found the potential savings of efficient equipment more compelling. In addition to the typical split incentive barrier, in which owners of rental properties where tenants are responsible for the utility costs are not motivated to invest in efficiency, HVAC contractors suggested that even commercial renters who both pay the utility bill and purchase equipment are often not motivated to invest in efficiency. As one large contractor explained, in the case of these renters, "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?'"

Despite challenges with rental properties, HVAC contractors suggested that customers were more likely to invest in efficient equipment in equipment replacement than in new construction installations. Contractors explained that, in a new construction scenario, the HVAC system competes for a limited budget with multiple other building systems. Often, these contractors noted, building developers look to cut costs on the HVAC system rather than aspects of the building that are more visible to occupants. As one contractor explained, in new construction, "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 to be furniture, there have 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." In comparison, equipment replacement has a narrower scope and cost, and the HVAC contractor is more often working directly with the building owner.

Plan and Specify New Construction or Renovation

HVAC contractors have the least system design input in plan and specify projects, in which their role is to install a system designed by a third party (typically an engineer contracted to the general contractor or building developer). HVAC contractors typically win plan and specify work by placing a competitive bid. In some cases, clients will post an open request for these bids, inviting any qualified firm to bid. The interviewed contractors and focus group participants reported they generally avoided these open bids. One contractor stated that "We don't do much work if it's a public [bid]... too many bids. They are usually looking for the cheapest." Rather, contractors more often reported pursuing plan and specify installations when they are included in a smaller group of contractors that a client invites to submit a bid. The invited contractors often had past working relationships with the general contractors and or engineers seeking bids for HVAC installation. A&E firms prefer to work with contractors they have worked with in the past and have a good working relationship with.

HVAC contractors reported that buildings like restaurants, hotels, daycares, assisted living homes, and publicly-owned facilities were among their sampling of projects that utilized a plan and specify as an approach to equipment installation.

Roles in System Design

The majority of small-to-medium commercial HVAC projects that A&E respondents work on in Minnesota are plan and specify projects where their firm designs the system and contracts an installer. However, smaller, simpler HVAC projects can often take the design-build approach, where the A&E firm works with an HVAC installer with design capabilities. Larger, more complex HVAC projects require more engineering and design work, and those are most often handled by the A&E firms.

HVAC contractors have limited opportunity to suggest changes to the specified system in plan and specify projects. In some cases, contractors reported offering equipment alternatives or suggesting opportunities to either reduce upfront costs or long-term, operational costs as a way to set their bids apart from their competitors in plan and specify projects. As one contractor explained, “if everybody is going to throw a number, we’re not going to be the lowest. So, we give them options to either improve or cut the [installation] costs or cut the long-term costs.”

Once their bid was selected, HVAC contractors had a limited, additional opportunity to offer input on the system design. In some cases, contractors reported that they would offer suggestions because they believe alternative equipment types or design choices would work better. As one contractor said, "usually the [blue]print is just a general guideline." In other cases, contractors reported they would be asked to suggest changes as part of a value engineering process to cut costs. In some cases, contractors reported they would suggest products based on the availability of efficiency rebates.

Contractors indicated that the strength of their relationships with the client determined the likelihood that their suggestions to modify plan and specify projects would be accepted. One contractor stated that "It's based on past relationships and the trust you had with them, how they know your recommendations are sensible. Maybe there's a simpler way to run something. It could save time, save money."

All A&E respondents named the owner of the building as the main factor affecting their considerations and constraints when designing a commercial HVAC project. The owner and the requirements of their buildings are the most important considerations, while the most common constraint is the owner’s budget.

Relationships among Market Actors

HVAC contractors partnered most frequently with engineers and general contractors. While small-to-medium HVAC contractors were in regular contact with manufacturers and distributors, the content of these interactions was product-focused compared to other market actors.

Engineers

HVAC contractors work with engineers on larger and more complex HVAC installations that require an engineer’s review and stamp. Some contractors staffed an in-house engineer that could provide the engineering stamp but most consulted an external engineer to sign off on plans. External engineers were also hired at times to draft formal prints and drawings of the HVAC company’s design plans. Interviews and focus group findings suggest that smaller companies were less likely to pursue projects that required an engineering stamp.

HVAC contractors feel they bring a valuable, applied perspective to HVAC system design and that their input can make installations more effective. As one contractor described, “When it's all by the drawings and by the architects and engineers, it's a nightmare. We've done them that way, too. We've pushed through it and it's like, ‘See, this doesn't work, this doesn't work.’” Another contractor described a frustrating experience on a plan and specify project with an engineer who thought “that they know everything and what needs to go in the system,” leading to conflicts with the HVAC installer. A&E firms reported that they prioritize inputs and perspectives on system designs coming from their clients over contractors. Maintaining high levels of satisfaction for customers and clients is key to project success for these firms.

Knowledge of energy efficiency rebates was one area in which HVAC contractors felt their applied perspective could contribute to system design. One contractor stated that when working with engineers, “Sometimes they don't know the rebates that are available from the gas company. I might be able to save them some money because of rebates on a high-efficient system, so I try and fill that. But the engineer or the architect has no clue about that.”

General Contractors

General contractors often subcontract to HVAC contractors, and as noted above, HVAC contractors reported working to maintain positive relationships with general contractors. Maintaining these relationships involved performing well and being flexible with the project process, particularly in coordinating their work with other trades simultaneously working on an installation. One HVAC contractor noted that COVID-related equipment and labor shortages had made this more difficult, with some general contractors “pointing the finger, blame game.” Contractors reported that it had become more important to “follow up every conversation now with an email, so there's some sort of a paper trail” to avoid being blamed for a delay that was outside of their control.

Energy Efficiency Considerations

Some contractors and A&E firms reported a large majority of their small-to-medium commercial HVAC installations exceeded code, while, for others, above-code installations were a notable minority. Three of the seven HVAC contractor interview respondents estimated that at least 75% of their small-to-medium commercial HVAC installations were more efficient than the energy code required. The remaining contractors reported that between 25% and 50% of their installations were more efficient than code. Three of the four A&E firm respondents estimated that over 50% of their installations were more efficient than code, while one estimated that 25% exceeded code.

Contractors reported that in the past few years, efficient systems grew in popularity. One contractor commented on the recent popularity in above code configurations and stated that “Efficiency is a big thing now. Customers are more mindful of efficiency.” Another contractor echoed the sentiment, seeing the change among their clients over the years: “It used to be, we could never talk anybody into even going from an 80% AFUE furnace to a 92%, and now I don't remember the last time I put in an 80% furnace. It's been three or four years. I would say that most of the stuff we put in is running at 96%, even in the boilers."

Rebates can drive both customer demand for and contractor recommendations of efficient equipment. Contractors reported that rebates could drive customers to adopt efficient equipment, particularly when the rebates offset the full, incremental cost or more, making the efficient option the least expensive. One contractor suggested that these types of high rebates were necessary to motivate

customers who are focused on price, saying, “If the energy programs aren’t there to make an energy efficient system less costly, so it is competitive with the basic system without any rebates, you are just spinning your wheels.” Another contractor said that all of their installations of efficient equipment are “rebate driven,” noting that, with incentives and low-interest loans available, “you can really sell the top end stuff.”

Recognizing the potential of rebates as a sales tool, contractors reported that rebates had the potential to influence their equipment recommendations. According to one contractor, “I would say a lot, 90% of our business is driven by following the rebates…around.” Contractors also described assisting customers with the rebate application process as a way to differentiate themselves from their competitors and increase customer satisfaction. One contractor said, “People love rebates, and they love it if you take care of them because that’s [rare]. Most every one of our competitors just [says], ‘here is your furnace,’ and then they walk away.”

Technical and Business Considerations

HVAC contractors indicated that efficient systems were generally no more difficult to install than standard systems, but commissioning and completing rebate applications could increase the time required for efficient installations. Contractors indicated that the difference in effort between installing a standard and a high-efficiency system was negligible as efficient equipment was largely interchangeable with standard equipment. As one contractor described it, “higher efficiency in the same box.” Another contractor expressed a similar view, saying, “For the most part, commercial rooftop units are designed and installed the same [as standard rooftop units]. No effect [on the difficulty of installation].” The only differences HVAC contractors reported were due to some brands’ efficient units being larger than their standard units. A&E firms also indicated that efficient systems were generally no more difficult to design than standard systems; it is just a matter of selecting the correct equipment.

Beyond the installation itself, some contractors noted that tasks like commissioning and completing rebate applications could increase the effort involved in providing efficient equipment. One HVAC contractor explained, "On the install side, it is more time-consuming because if they're going high efficiency, then everything's got to be sealed especially well. They don't want any leaks." Another contractor estimated that between commissioning and documentation to support rebate applications, an efficient installation could require a few hours of additional labor. They stated, "You've got the extra forms to fill out for the field tech that you've got to document what the pressures are, what the temperatures are, the amp draws that you're showing something."

Approaches to Selling Efficiency

While almost all contractors recommend energy-efficient options, they also inform customers about increased maintenance needs and repair costs that can be associated with those options. HVAC contractors suggested that selling efficient equipment was more profitable for them than standard equipment. Contractors typically apply a constant percentage markup on the equipment they sell; as a result, that markup generates more revenue when the contractor sells more expensive, efficient equipment. Contractors also described energy efficiency as an appealing feature for their customers. According to one contractor, "We recommend [efficient equipment] every time because it saves the customer a lot of money in the long run." Given the combined benefits of efficiency in increasing contractor profits and providing an appealing feature for customers, nearly all contractors reported including high-efficiency options within their general sales approach to clients. As one contractor

described, "when I give them the option for the higher efficiency, I give them also what their savings is, look for rebates that are available, if there are some, show them to give them an idea."

While most HVAC contractors recommend efficient equipment, they also reported informing customers about potential drawbacks of the equipment in terms of increased maintenance needs and repair costs. As noted above, contractors are motivated to achieve high levels of customer satisfaction. As a result, they seek to avoid any unexpected problems with the equipment they install.

Contractors noted that efficient equipment like Lochinvar boilers and geothermal heat pumps may fail prematurely if they do not receive regular maintenance. One HVAC contractor explained that "We make sure our customers know right up front, especially on the geothermal, that it is mandatory that you do annual maintenance. Their maintenance costs will be higher on the geo, and we don't hide that from them." Contractors also noted that repair costs can be higher for energy-efficient equipment, which may include more circuit boards or more expensive components like ECM motors. According to one contractor, "It is a little easier to sell the furnace when you have a 10-year parts warranty, and the replacement motor isn't $800. I was a little leery on the first few I sold because I was like, 'I don't want to go to their house when it is 15 years old and tell them they are going to have a $1,000 bill putting in a blower motor." This contractor noted that the costs of efficient motors had come down since he began installing them.

When working with customers, A&E firms approach energy efficiency in their designs in a holistic manner, not just focusing on the efficiency of a specific HVAC unit. One engineer said, "[energy efficiency] is a mindset we have that we are here for the long haul. We want to give [the customer] value, so we look outside of the box of HVAC to become more efficient, including windows, envelope, and orientation. Our goal is to get holistic buy-in."

Electrification Opportunities

Some contractors reported recommending air source heat pumps when replacing air conditioners, noting that the incremental cost of installing a heat pump was small relative to the cost of a central air conditioner. Contractors were more reluctant to recommend heat pumps when replacing heating systems. 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.”

HVAC contractors 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. Focus group participants reported that environmental considerations were 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 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 anticipated that demand for heat pumps would grow in the coming years. Contractors 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 of their customers installed

solar PV systems. One 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."

Contractor concerns about the complexity of efficient equipment applied to heat pumps. 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 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. Another 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."

HVAC contractors indicated that energy efficiency programs can play an important role in driving the uptake of heat pumps through rebates and education. Contractors reported that substantial heat pump rebates had motivated their customers to install them, with one saying, "heat pumps…had really good rebates this year…so it penciled for [customers] to upgrade."

Contractors also reported that there is a need for customer education to ensure that efficient HVAC equipment, including heat pumps, is operated properly. As one explained, "if you are installing [high-efficiency equipment], you need to do a better job of educating [customers], but at the same time, we don't have hours in the jobs just to show maintenance people things like that." Customers saw providing education on heat pump technologies as an important role in efficiency programs that can encourage the 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.

Working with Conservation Programs

A&E firms frequently worked with conservation programs that provide technical support and incentives to encourage energy efficiency in building designs, including the HVAC system. Most of the A&E respondents were quick to name Xcel Energy's Energy Design Assistance program as one they had frequently worked with. All four A&E respondents reported that these programs were helpful in their efforts to include more efficient HVAC systems in small-to-medium commercial buildings. Other A&E respondents mentioned how these programs help the projects' return on investment which is always a key factor their clients are considering.

> *One engineer stated, "[conservation] programs provide funding for the engineer to do studies on more efficient systems and **help us encourage [building] owners to pursue more efficient solutions in a holistic way and not just focus on one piece of equipment**."*

A common pain point for working with conservation programs was the pace of the program and communication from program representatives. Several A&E respondents said that the program often moved too slowly to fit their project cycle, and modeling required for some programs was time intensive and burdensome.

General commercial buildings like offices and retail reportedly work best with Minnesota's conservation programs. A&E firms reported that commercial buildings with process-driven consumption patterns can be difficult to navigate through the programs as many processes can't be changed to meet program requirements.

Customer and Project Types Adopting Efficient Systems

HVAC contractors and engineers described two key factors that increase the likelihood a project will include efficient equipment:

1. **Owner-occupied facilities:** As noted above, contractors and engineers reported that clients who own their facilities typically plan to stay in those facilities longer and are more willing to invest in efficient, higher-cost systems that would provide cost savings over time.
2. **Publicly-owned or subsidized buildings (such as income-controlled multiunit housing):** HVAC contractors and engineers reported that government-funded projects like installations in schools and municipal government buildings were likely to opt for energy efficiency beyond code. Contractors also noted that subsidized multifamily housing was subject to requirements and tax incentives that motivated more efficient installations, while market-rate multifamily buildings would be unlikely to pursue higher efficiency. Contractors reported that private commercial buildings were less likely to exceed energy code requirements unless they sought sustainable building certifications like LEED or ENERGY STAR, or the business wanted to otherwise demonstrate their commitment to sustainability.

Business Considerations

Profitability and Business Metrics

HVAC contractors ensured profitability by tracking hours and other project costs. One contractor stated that, "When I bid a job, I go through my steps of calculating costs, labor, and profit." Most contractors noted having procedures of estimating project hours, tracking actual hours, noting material costs, and factoring in equipment markup margins to judge if a project was profitable. Some contractors keep a database of estimated project labor hours and associated costs to refer to. However, obstacles and surprises could come up that rendered projects less profitable—for example, slower installation with interruptions or having to pause work when servicing alongside other contractors at a site. Other cost factors are considered as well in the process, such as keeping low overhead (including avoiding significant travel and fuel use) and competitive labor pricing to ensure a flow of business.

Interview findings suggest that most contractors do not view competing to offer the lowest prices as a sustainable, long-term strategy. Price competition could require contractors to sacrifice quality, which would, in turn, impair their ability to build the relationships with customers and general contractors that drive their business through repeat projects and referrals. As one contractor explained, "you have to

price based on what you need to do to keep your business operating, not necessarily what the other guy needs to do, because he might be wrong."

HVAC contractor respondents indicated they seek to avoid competing purely based on project cost. However, it can be difficult for contractors to differentiate themselves in plan and specify projects when all competitors are bidding on the same specified system. As noted above, in some cases, HVAC contractors would make value engineering suggestions to differentiate their bids.

Contractors also emphasized the importance of building strong relationships and maintaining positive professional reputations with clients and partners, like general contractors, in winning plan and specify work. HVAC contractors reported that, with a relatively small pool of general contractors and other potential clients for future projects, managing their impressions of their *current* clients would help appeal to clients for future projects. An HVAC contractor described their company's effort to be flexible and agreeable: "If we're really difficult to work with, saying, 'No, I'm here today. I will get my job done. These guys are in my way. You need to move now'—we're not going to be back on the next job." By being professional and accommodating to work within the present, contractors maintained their professional reputations and advertised themselves as appealing contractors for the future.

Project Selection and Differentiation

Contractors pick and choose what projects to take on to maintain profitability. One contractor stated that the "Number of jobs don't matter so much. We won't take it on if it's not profitable." For example, contractors discussed turning down projects that required too much travel since fuel costs and travel time would drive down profitability. Other contractors discussed limiting the services they offered based on their in-house technical knowledge and the value of investing in learning new technologies and skills. For example, one contractor determined that it would not be worthwhile for their staff to learn to work with alternative refrigerants for existing systems using R-22 as R-22 is phased out of the market, anticipating that customers would ultimately need to replace those systems. This contractor stated, "If somebody's got R-22 repair and they need refrigerant, they'll have to hire somebody else because we've got too much more to learn that will be better for our business." This contractor reported, however, that they viewed the time investment necessary to address code requirements in neighboring municipalities worthwhile since they opened up additional markets.

Employee Recruiting and Retention

HVAC contractors most often reported it was difficult to find skilled workers. Two contractors reported that unskilled labor was available, but contractors most often suggested they prefer to hire skilled staff. As one explained, "you can only have so many apprentices; you have to have somebody that you can just throw out there." A minority of contractors reported they preferred to hire and train less skilled staff. One contractor reported they seek staff with mechanical aptitude but limited experience, saying, "we don't like too much experience because they come with bad habits. If they come from another company, they will be set in their old ways, and we have our own ways." Multiple contractors suggested that the COVID-19 pandemic had contributed to the difficulty of finding skilled workers by reducing the opportunities for training and trade school. One contractor also attributed labor shortages to a broader stigma against trade work, saying, "I think it is mostly because trades have been looked down upon…Kids in high school were told they need to go to college and get a desk job and weren't aware of the trades." This contractor saw this stigma easing in recent years.

HVAC contractors described two related strategies to attract and retain employees: providing recognition and providing perks and compensation. One interviewed contractor noted that recognizing and appreciating the efforts of newer employees could help build their confidence in their work. In some cases, recognition of staff efforts involved compensation, as one contractor described as "trying to make the jobs nobody wants more attractive" by paying double time for after-hours calls. Other perks included time off and scheduling flexibility, as well as providing company vehicles and cell phones.

Multiple smaller HVAC contractors noted that their firms were family-run, and the majority of the staff were family members. These respondents indicated they face unique challenges when seeking to expand their firms beyond the immediate family. As one contractor explained, with "my nephew, I can walk up behind them and slap them back of the head or kick them in the butt and say, 'What did you do?' It's a little different with the two non-related employees."

Recommendations

The research completed by the EcoMetric team provided valuable insights into the HVAC market and HVAC contractors' motivations. The core objective of this research was to understand what are best practices that utility program managers can implement in order to encourage the installation of a greater number of high-efficiency RTUs. This section outlines best practice recommendations that utilities should consider for their HVAC programs.

1. Develop case studies showcasing the energy and non-energy benefits to customers of efficient technologies. These case studies should emphasize the potential to increase customer satisfaction and solve problems that standard efficiency RTUs may not be equipped to solve.
2. Promote workforce training with a focus on high efficiency HVAC equipment. Contractors know the benefits of well-trained employees, which could motivate them to encourage their employees to participate in these trainings.
3. HVAC contractors typically rely on distributors and manufacturers for information and training on high-efficiency HVAC units, so look for these existing relationships to leverage when designing midstream and upstream programs.
4. Work to strengthen relationships with distributors. Articulate the value proposition to distributors of marketing high-efficiency RTUs and how it will improve their business outcomes. Help distributors drive sales of high-efficiency RTUs with the following methods:
    a) Help distributors provide technical trainings to help contractors become more comfortable with high-efficiency RTUs.
    b) Provide sales training for distributors' staff to encourage them to proactively talk to HVAC contractors about high-efficiency RTUs and how they can be profitable for them to install.
    c) Consider developing a group of qualified/approved contractors that have been trained on the installation of high-efficiency RTUs and can help drive customer confidence in installing these units.[19]
5. Move rebates for high-efficiency RTUs upstream. Providing midstream rebates (at the distributor level) has several advantages over providing downstream rebates. These include working with many fewer market actors than downstream rebates while still having close contact with HVAC contractors through distributors. This approach also takes the administrative burden off HVAC contractors and end users, which is a common barrier to program participation. To compensate distributors for their increased administrative burden, consider providing them with a monetary incentive.
6. Recognize that there may be limitations to the midstream approach, especially with "Plan and Specify" projects. With these projects, mechanical engineering and/or architectural firms specify

[19] NMR Group, Inc. and Apex Analytics, Characterization of HVAC Supply Chains in Northern Illinois, November 12, 2019

what equipment the contractor will install. There is very little chance that contractors or distributors will recommend changing the specifications in any way. Therefore, it is important to also reach mechanical engineering and architectural firms early and often with messaging to promote their specification of high-efficiency RTUs.

7. Incentivize early replacement of RTUs. Program managers the EcoMetric team interviewed reported that 80 – 90% of existing RTUs are replaced on failure. As described above, this scenario most often results in a code minimum efficiency RTU being installed as a replacement. Offering a higher incentive for customers who replace a working RTU may entice customers to consider replacing their RTU with a high-efficiency unit and would allow for the additional time often required for the delivery and installation of those units.
8. Minnesota program managers reported that the savings they see from RTUs in their programs were relatively low. The reason cited for this is that baseline cooling efficiency for RTUs has risen over the years and that depending on the application, high-efficiency RTUs typically don't result in large cooling savings in Minnesota's climate. With the passage of the Energy Conservation and Optimization Act of 2021, Minnesota utilities will have more opportunities to achieve greater savings from RTUs through the deployment of technologies such as heat pump RTUs, as well as cross-selling RTUs with demand response programs, which were cited by several utility program managers as potential opportunities.
9. Commercial efficiency programs should pursue contractor-focused market intervention strategies for technologies likely to be installed in smaller, owner-occupied commercial buildings. Doctors' and dentists' offices and some restaurants and retail spaces often meet the conditions that provide contractors the greatest opportunity to promote efficiency. Strategies that engage design teams and market actors further upstream, like distributors and manufacturers' representatives, may be more effective than contractor outreach in influencing HVAC installations in other types of facilities.
10. Commercial efficiency programs should include financial support for HVAC tune-ups and other pathways for contractors to increase their touchpoints with customers and provide opportunities to promote efficient equipment.

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Appendix A: Data Collection Instruments

Focus Group Screener and Guide

My name is **[NAME]**, calling from **[COMPANY]**. We're conducting research on behalf of the Minnesota Department of Commerce that will help Minnesota utilities like Xcel, CenterPoint, and OtterTail, just to name a few, improve their energy efficiency programs.

We are planning to hold online focus groups with commercial HVAC contractors to learn about your work. We want to understand how you approach projects and the decisions you make so that utilities can design efficiency programs that fit better with the way you do your work. We value your experience and opinions and would really appreciate the chance to include you.

We expect the focus group to take 90 minutes. We will provide an electronic gift card for $200 in appreciation for your time and input. Would you be interested in joining us for this type of discussion with other HVAC contractors?

[IF CONCERNED ABOUT LEGITIMACY] If you have questions about this study, you can reach out to **[CONTACT NAME]** at **[EMAIL]**.

Screening

[IF INTERESTED IN PARTICIPATING] Great, I'd like to ask just a few short questions to make sure you would be a good fit for a focus group.

[ASK ALL]

S1. About how many HVAC systems did your company install in each of the following types of buildings in the past year?

Building Type	Less than 10	10 to 24	25 to 99	100 or more
Residential	-	-	-	-
Commercial, 25 tons or less	-	-	-	-
Commercial, greater than 25 tons	-	-	-	-

[IF COMMERCIAL, 25 TONS OR LESS = LESS THAN 10, GO TO TERMINATION SCRIPT]

[ASK ALL]

S2. How are you typically involved in commercial HVAC projects, installing equipment 25 tons or less. Are you involved in:

a. Sales

b. Advising on or recommending equipment types

c. Installation

d. What other ways are you involved?

[IF NOT INVOLVED IN SALES, RECOMMENDING EQUIPMENT TYPES, OR INSTALLATION]

S3. We would really like to speak with people who are more closely involved in decisions around which types of HVAC equipment are installed in commercial projects and how that equipment is installed. Is there someone else in your company involved in sales or installation for small-to-medium commercial projects that might be able to participate in our discussion?

A. Yes **[ASK TO SPEAK WITH THAT PERSON AND RETURN TO INTRODUCTION; IF NOT AVAILABLE, LEAVE MESSAGE AND RECORD CONTACT INFORMATION]**

b. No **[GO TO TERMINATION SCRIPT]**

Classification

Great, I would like to gather a few details about your company to help us make sure we get a representative group.

[IF LOCATION = SOUTHERN MN]

S4. What proportion of your commercial HVAC installations for systems 25 tons or less take place in the Twin Cities metro area?

a. [RECORD OPEN-ENDED RESPONSE – IF ≥50% ASSIGN TO TWIN CITIES]

[ASK ALL]

S5. Does your company operate from more than one location?

a. Yes

b. No

[ASK ALL]

S6. How many employees does your company have at your location?

a. [RECORD OPEN-ENDED RESPONSE – IF SINGLE LOCATION AND ≥10 ASSIGN TO LARGE COMPANY GROUP; IF SINGLE LOCATION AND <10 ASSIGN TO SMALL COMPANY GROUP]

[IF MULTIPLE LOCATIONS]

S7. How many employees does your company have across all its locations?

a. [RECORD OPEN-ENDED RESPONSE – IF ≥10 ASSIGN TO LARGE COMPANY GROUP; IF <10 ASSIGN TO SMALL COMPANY GROUP]

[ASK ALL]

S8. Do you or your customers installing commercial HVAC systems 25 tons or less receive rebates from utilities for installing energy efficient systems?

a. Yes

b. No

c. Don't know

[IF RECEIVE REBATES]

S9. What utilities provide those rebates?

a. [RECORD OPEN-ENDED RESPONSE]

[IF RECEIVE REBATES]

S10. Roughly what proportion of the commercial HVAC systems you install that are smaller than 25 tons receive rebates?

a. [RECORD OPEN-ENDED RESPONSE]

Closing

[ASK ALL]

S11. It sounds like you would be a great fit for our research. We are planning on holding discussions with groups of about six contractors, using video conferencing software. Do you have access to reliable internet and a web camera, and are you comfortable participating in that type of discussion?

a. Yes

b. No

[IF NOT ABLE/COMFORTABLE]

S12. What type of support, if any, could we provide that would enable you to participate? **[IF PARTICIPANT HAS CONFIDENTIALITY CONCERNS, INFORM THEM THAT, WHILE THE DISCUSSION WILL BE RECORDED, THE RECORDING WILL NOT BE AVAILABLE PUBLICLY, AND REPORTING WILL NOT IDENTIFY ANY INDIVIDUAL RESPONDENTS.]**

a. [OPEN-ENDED RESPONSE]

Thank you for the information you have given us so far. We will consider whether we can provide the support you need and reach out to you if we can.

[IF ABLE/COMFORTABLE]

S13. We are planning to hold our discussion on **[DATE]** from **[START TIME]** to **[END TIME]**. As a reminder, you would receive $200 in appreciation for your time and input. Are you available to participate?

a. Yes

b. No

[IF NOT AVAILABLE]

S14. Is there someone else in your company involved in sales or installation for commercial HVAC projects 25 tons or less that might be able to participate in a focus group?

a. Yes **[ASK TO SPEAK WITH THAT PERSON AND RETURN TO INTRODUCTION; IF NOT AVAILABLE, RECORD CONTACT INFORMATION AND LEAVE MESSAGE]**

b. No

[IF NOT AVAILABLE]

S15. These discussions are part of a larger research project, and we will be reaching out to contractors to participate in other ways. Like with the focus groups, we will offer a monetary incentive for your time and input. May we contact you about other opportunities to participate in this research?

a. Yes

b. No

Thank you very much for your time. **[IF AGREED TO FURTHER CONTACT]** We will reach out again about our other research opportunities.

[IF AVAILABLE]

S16. Thank you very much, we look forward to having you be part of our discussion. **[PROVIDE PARTICIPATION DETAILS IF AVAILABLE]. [NAME]** from our research team will be in touch with you soon to give you additional details about how to participate. Please provide the best e-mail address and phone number for us to reach you:

a. Email: **[RECORD E-MAIL ADDRESS]**

b. Phone: **[RECORD PHONE NUMBER]**

Termination

Thank you very much for taking the time to speak with me today. Unfortunately, we're limiting the study to people who work in specific places and roles in HVAC installation. We regret that our current study is not a good match for you.

Pre-Group Questionnaire

Thank you for participating in our discussion. As we wait for everyone to arrive, please answer the following questions to give us some additional background information about your business.

1. What proportion of your commercial HVAC installations for systems 25 tons or less fall into each of the following categories? **[*Check that responses total 100%, probe if they do not*]**

Project Type	**% of Commercial Installations 25 Tons or Less**
Equipment replacement: Installing new equipment to replace existing equipment or an existing system that may or may not still be functional.	-
Plan and specify new construction: Installing a new system where one did not previously exist or has been completely removed, based on a design and specifications provided to you.	-
Design/build new construction: Installing a new system where one did not previously exist or has been completely removed, based on a design you develop.	-
Other: [*Probe on any "other" responses*]	-

Introduction (5 min, start at 0:00)

Hello everyone, and thanks for joining us today. My name is **[NAME]**. As we mentioned when we reached out to you about joining this conversation, we're conducting research on behalf of the Minnesota Commerce Department that will help utilities in the state improve their energy efficiency programs. The goal of our research, and this conversation, is to better understand what it is like to be a commercial HVAC contractor. We'd like to learn about the different steps that go into a commercial HVAC project, what decisions get made along the way, and what you need to take into consideration as you make those decisions. Our goal is to help utilities design programs that fit better with the realities of the commercial HVAC industry.

Before we get started, there are a few housekeeping items I need to go over:

1. I know there are lots of distractions and it's tempting to multitask, but I want everyone to stay focused on the discussion, just like you would if we were in a room together.
2. Also, I'd like to ask everyone to assume positive intent during our discussion. We don't know each other, and conversations online can be a little awkward. So, we will need to give each other a little extra slack and patience.
3. That said, it's OK to respectfully disagree with someone. Our goal isn't to arrive at a consensus. We want to learn about how things work differently as well as what is similar for each of you. We welcome different opinions.
4. It is my job to make sure we hear from everyone, so if you haven't spoken up in a while, I might call on you. Or, if you have been talking a lot, I might ask you to give someone else a turn. I appreciate your understanding and cooperation in making sure everyone gets to speak.
5. Our discussion will take 90 minutes. We will take a five-minute break partway through, but if you need to step away at any time, that's OK. We hope you will come back as soon as you can.

6. If there is background noise where you are, please mute yourself when you are not speaking.
7. Some people will be listening-in to our discussion today. Some of my colleagues and [LIST ANY OBSERVERS FROM THE DEPARTMENT AND/OR UTILITIES] are on the line.
8. As I mentioned, our goal is to learn from your experience and expertise, and we appreciate your honesty. Nothing you say tonight is going to have any impact on your relationships with utility programs or anything like that.
9. We will be video and audio recording the conversation today. We may share the recordings with the people who are observing, but we won't make them available publicly.
10. Our report will not include any information that identifies individual respondents.

Any questions before we begin?

Warm-Up Question (5 min, start at 0:05)

Q1. First, I would like to go around and have everyone tell us your name and one way your work has changed due to the pandemic that you hope won't go back to the way it was before as things slowly return to normal. This is one of the few times that I'm going to call on people and ask everyone to talk – most of the time we can let the conversation flow more naturally.

Motivations (10 min, start at 0:10)

Q2. To start with, please quickly take me through a typical day: How is it structured? What kinds of things are you doing?

   a. Is that the same for everyone? How is the structure of your day different?

   b. How much variation is there in the kinds of things you do from one day to the next?

Q3. What makes a day a good day for you?

   a. What are the most rewarding parts of your job?

   b. Are there some types of installations you like more than others?

Q4. And what makes a bad day?

   a. What is the most challenging part of your job?

   b. What is the most frustrating part of your job?

Project Decision-Making

Equipment Replacement (15 min, start at 0:20)

Q5. Now I'd like to talk about how you make decisions around the system design and equipment to recommend for different types of installations. Let's start with an equipment replacement scenario. **[REFERENCE SCREENER/PRE-GROUP QUESTIONNAIRE DATA ABOUT FREQUENCY OF PROJECTS BY TYPE]**

How do you typically find equipment replacement work? **[IF NEEDED, PROBE ON: MAINTENANCE CONTRACTS, RELATIONSHIPS WITH EXISTING CUSTOMERS, REFERRALS, MARKETING, ETC.]**

Q6. How often do you recommend the equipment to install in a replacement scenario, as opposed to having it specified by someone else?

a. Who typically specifies the equipment in a replacement scenario if it is not you?

b. Are there certain types of projects or certain types of customers where it is more likely that someone else will specify the equipment for a replacement?

Q7. What, if anything, would lead you suggest a type of equipment other than the existing equipment type in a replacement scenario?

a. What prevents you from suggesting different equipment types more often?

b. When, if ever, would you suggest customers switch from gas equipment to electric equipment in a replacement scenario? How often does that occur?

Q8. What about the efficiency of the equipment itself: how often do you suggest equipment that has a higher efficiency level in a replacement, as opposed to one that just meets code?

a. In what types of projects or for which types of customers are you more likely to recommend high efficiency equipment?

b. What prevents you from recommending higher efficiency systems more often?

c. How receptive are customers to higher efficiency systems when you suggest them?

Q9. Who do you look to for information to inform your recommendations in an equipment replacement scenario?

a. What information do you look for from the end-user?

b. What role does your distributor play in helping identify options to recommend?

c. When would you bring in an engineer? Do you have that capability on your staff? If not, how would you find one?

Plan & Spec New Construction (10 min, start at 0:35)

Q10. Now let's talk about plan and spec new construction projects. **[REFERENCE SCREENER/PRE-GROUP QUESTIONNAIRE DATA ABOUT FREQUENCY OF PROJECTS BY TYPE]**.

How do you typically find plan and spec work? How often are you responding to open bids, as opposed to more limited requests for proposals?

a. What, if anything, do you do to differentiate your proposals in plan and spec work, or is the competition just based on price?

b. What types of customers or types of buildings are more likely to take a plan and spec approach?

Q11. Who typically specifies the equipment in the plan and spec projects you work on?

Q12. In what types of situations might you suggest changes to the equipment or design specified in a plan and spec project?

a. How often does that happen?

b. Who do you make those recommendations to? A general contractor? The building owner?

c. How receptive are they, typically, to your suggestions?

Q13. How do you work with distributors on a plan and spec project? **[IF NEEDED]** What, if anything, do they do beyond providing pricing and filling the order for the equipment?

Design/Build New Construction (15 min, start at 0:45)

Q14. And finally, let's talk about design/build projects. How do you typically find design/build work?

a. What types of customers or types of buildings are more likely to do design/build projects?

Q15. What are your most important considerations when you are deciding what type of system to recommend in a design/build project?

a. What information do you need to decide what type of system to recommend?

b. How do you get that information?

c. How do you decide what fuel type to use (gas or electric) when you are designing a system for a design/build project? What might lead you to select an efficient electric option over gas?

Q16. Who is involved in designing the system for a design/build project?

a. What design capabilities do you have internally, and what would you have to look for outside advice on? Who would you look to for that advice?

b. **[IF NOT ADDRESSED]** What information or advice, if any, would distributors provide?

c. **[IF NOT ADDRESSED]** When would you seek advice from an engineer? How would you find an engineer to help with that?

Q17. And what about selecting the specific equipment, once you have settled on a system design: What are your most important considerations in that step?

a. What information do you need to select specific equipment types?

b. How do you get that information?

c. What role do distributors play in selecting the specific equipment to recommend?

Break (5 min, start at 1:00)

Now I'd like to take a quick break. Feel free to get something to eat or drink, use the bathroom, or just take a break from looking at the screen for a few minutes. Please be back promptly in five minutes, at **[TIME]**. Before we start back up, I'd like everyone to answer a quick poll:

Poll Question: How frequently do you install equipment that is more efficient than energy code requires in each project type?

Project Type	Never or almost never	Rarely	About half the time	Often	Always or almost always
Equipment Replacement	-	-	-	-	-
Plan & Spec New Construction	-	-	-	-	-
Design/Build New Construction	-	-	-	-	-

Energy Efficiency (15 min, start at 1:05)

Q18. It looks like people are most likely to install efficient equipment in **[DISPLAY AND REFERENCE POLL RESPONSES]**. Why is that?

Q19. And it looks like people are less likely to install efficient equipment in **[REFERENCE POLL RESPONSES]**. What prevents you from installing efficient equipment more often in those types of projects?

Q20. Beyond project type, in what situations are you more likely to install a system that is more efficient than code?

a. Are there certain types of customers that are more likely to install above-code systems?

b. Are there certain types of equipment where you are more likely to install above-code options?

Q21. When you are recommending equipment, do you always recommend an above-code option?

a. **[IF NOT]** How do you decide when to recommend an above code option?

Q22. How does installing a more efficient system compare to a system that just meets code from a business perspective?

a. Are there greater business risks with an efficient system, in terms of things that might reduce the profitability of the installation or reduce customer satisfaction?

b. Are there greater business benefits with an efficient system, in terms of things like profits, customer satisfaction, and building relationships?

Information Sources (10 min, start at 1:20)

Q23. Before we wrap up, I'd like to talk a little bit about where you get information. How important is it to you to be knowledgeable about all the HVAC technologies available and stay up to date on the latest developments? Why do you say that?

a. How do you get information about HVAC technologies?

b. How easy or difficult is it to find the information you are looking for on HVAC technologies? What types of information are harder to find?

Q24. And what about technical questions: What did you do the last time you were in the field and a question came up, for example troubleshooting a technical issue?

a. Is that what you would typically do in that situation? If not, what would you typically do?

b. How often does that kind of situation come up?

Q25. Finally, what kinds of continuing education opportunities do you find the most valuable?

a. How easy or hard is it to find those types of opportunities?

Q26. And to close, I'd like to go around the group again and have everyone tell us one or two ways you think the commercial HVAC market is likely to change going forward as a result of the pandemic.

Thank you very much for your time. This discussion has given us a lot of great information that will help inform future efficiency program designs. We will send your gift cards to the email addresses we have been using to communicate with you in the next few days.

Contractor Interview Screener and Guide

Screening

Hello, my name is **[NAME],** calling from Schlesinger Group on behalf of EcoMetric Consulting and the Minnesota Commerce Department, or "Department." EcoMetric is interviewing commercial HVAC contractors to learn more about your work. You may have received an email from the Department regarding this research. The information we gather will help the Department and Minnesota electric and gas utilities design programs that more effectively work with HVAC contractors. We expect the interview to take about 45 minutes, and EcoMetric will provide an electronic gift card for $150 in appreciation of your time and input. Would you be interested in being part of that type of discussion?

[*If yes, continue to screener. If refusal, thank them for their time.*]

[*If concerned about legitimacy:*] If you have questions about the study, you can reach out to Laura Silver at the Minnesota Commerce Department at laura.silver@state.mn.us.

Background/Screener

[*If interested in participating:*] Great, before I schedule a time for our interviewer to call you, I have a few short questions to make sure you would be a good fit for our research.

[ASK ALL]

S1. Roughly what proportion of the HVAC systems your company installs are each of the following types?

a. Residential

b. Commercial, 25 tons or less **[IF LESS THAN 20%, GO TO TERMINATION SCRIPT]**

c. Commercial, greater than 25 tons

[ASK ALL]

S2. Thinking about your small commercial HVAC work, what proportion of it is…

a. Maintenance

b. Repairs

c. Replacement of existing equipment **[IF NEEDED: IF THEY ARE MOSTLY A MAINTENANCE/REPAIR SHOP]**

d. New construction or major renovations **[IF REPLACEMENT + NEW CONSTRUCTION < 20%, GO TO TERMINATION SCRIPT]**

[ASK ALL]

S3. What is your role in a typical small-to-medium, meaning 25 tons or less, commercial HVAC installation project?

a. Sales [PROCEED TO S5]

b. System design/specification [PROCEED TO S5]

c. Installation [PROCEED TO S5]

d. Reception only – no decision role [PROCEED TO S4]

e. Other with no decision role [PROCEED TO S4]

[IF NOT INVOLVED IN SMALL COMMERCIAL DECISION-MAKING]

S4. We would like to speak with people who are closely involved in decisions around which types of HVAC equipment are installed in commercial projects and how that equipment is installed. Is

there someone in your company involved in sales or installation for small-to-medium commercial projects that we could speak with?

a. Yes **[*Ask to speak with that person and return to introduction; if not available, leave message and record contact information*]**

b. No **[GO TO TERMINATION SCRIPT]**

[IF INVOLVED IN SMALL COMMERCIAL DECISION-MAKING]

S5. How many employees does your company have across all its locations?

a. [NUMERIC RESPONSE]

[IF INVOLVED IN SMALL COMMERCIAL DECISION-MAKING AND SIZE/GEOGRAPHY QUOTA NOT FILLED]

S6. It sounds like you would be a great fit for our interview. Let's schedule a convenient time for you. As a reminder, the questions generally take about 45 minutes. **[*Schedule and record interview time*]**

Termination

Unfortunately, we're limiting the study to people who work in specific roles in commercial HVAC installation. We regret that our current study is not a good match for you. Thank you very much for taking the time to speak with me today.

Interview Lead-in

Thanks for taking the time to talk with me. As we mentioned when we scheduled this interview, we're working to help the Minnesota Commerce Department, and Minnesota's electric and gas utilities, better understand the small commercial HVAC business so they can more effectively work with contractors. Our focus will be on the decisions that go into a typical small-to-medium commercial HVAC installation, and by small-to-medium, I mean systems less than 25 tons. I'll also ask some questions about your business. Do you have any questions before we begin?

I'll be taking notes as we talk today. Do you mind if I also record our conversation? The recording is only to help with my notetaking and won't be shared with anyone. And we won't report any findings in our written report in a way that would identify individual respondents.

Q1. First of all, please describe how Covid-19 has impacted your business? **[*Note: Keep this section short and focused on current status*]**

a. **[PROBE]** Did the type or volume of projects you work on change, both in the beginning of the pandemic and now? Please explain.

HVAC Project Decision-Making

Thanks, now I would like to learn about how things work under normal (non-pandemic) circumstances.

Q2. First, please tell me about what a typical day is like for you.

a. How much does the structure of your day vary?

b. What is the most rewarding thing you do on a day-to-day basis?

c. What aspects of your day-to-day work are the most challenging or frustrating?

Q3. Please walk me through the path from HVAC system decision, to purchase, to installation for a small-to-medium commercial project.

a. **[*If not answered in Q2*]** At what point in that process do you typically come in?

b. How is this path different based on the size of HVAC system? What about new construction vs. replacement? **[*Probe for if/how key decisions are different for different size projects*]**

Q4. On what proportion of your small commercial HVAC installations is the system design **already done** by the time you come onto the project?

Enter numeric value ____%

a. In those cases, who designs the system?

b. In those cases, do you have an opportunity to suggest changes to the system if you feel there is a better solution?

i. How frequently do you make suggestions?

c. Please describe the types of customers or projects that are most likely to design the system **before** bringing in the installer?

d. **[*If not addressed*]** Are these "plan + spec" new construction projects, or are there other projects where the system is designed before you are involved?

Q5. On what proportion of your small commercial HVAC installations is **your firm** in charge of designing the system?

Enter numeric value ____%

a. Please describe the types of projects where you're more likely to design the HVAC system. **[*If multiple project types (e.g., design/build new construction and replacement), probe on each in follow-up questions*]**

b. In those cases, who specifically, including people at your company, external partners or subcontractors, distributors, or others, is involved in the system design? **[*List people involved for each type*]**

i. Plan + Spec

ii. Design/Build

iii. New construction

iv. Equipment

c. **[*If they design systems*]** What factors lead you to design an HVAC system one way rather than another?

i. How is the design process different between new construction and equipment replacement?

Q6. About what proportion of your small-to-medium commercial projects require "stamping" by an engineer?

a. What determines whether a project will need stamping?

b. What role, if any, does the engineer play in developing the design?

Q7. What proportion of your installations meet code, what proportion exceed code, and for what proportion does code not apply?

a. Meet ____%

b. Exceed ____%

c. Code does not apply ____%

d. When does code not apply?

Q8. In what situations are you more likely to install a small-to-medium commercial HVAC system that is more energy efficient than code?

a. **[*If needed*]** Are there certain types of businesses that are more likely to install above-code systems? Certain types of projects?

b. Who generally decides whether an HVAC system will be more efficient than energy code requires? What motivates them to choose an above code system?

c. How, if at all, does your work change when you are installing a system that is more efficient than energy code requires?

Q9. Once the system is designed, what are the most important decisions you make <u>while installing</u> a small-to-medium commercial HVAC project?

a. What information do you need to make those decisions?

b. Where do you get that information?

Q10. What kinds of commissioning and QA/QC happen after the equipment is installed?

a. How, if at all, is this documented? Do you report it to anyone?

Q11. Who is in charge of the final approval, confirming that the job is done?

Q12. **[*If not addressed*]** How, if at all, are manufacturers or distributors involved in the decisions that go into small-to-medium commercial HVAC projects? What information or advice to they provide, if any?

Q13. Are there particular distributors you typically work with? Why?

Q14. **[*If Q13=YES*]** Would you be willing to provide their contact information to us? We are also hoping to speak with distributors and manufacturer's representatives to learn more about their work as part of our research.

Q15. Are there particular manufacturers or brands of equipment that you prefer? Why?

Business Models

I'd like to shift a bit to talk about where you get your industry information and the business side of HVAC installation.

Q16. Where do you go to get up-to-date information on the HVAC industry?

a. What kind of information do you typically look for from those sources? **[*Probe for information about new technologies, trends in the industry, practical "how-to" information for technical tasks, business or management advice, websites, online forums, etc.*]**

Q17. What kinds of training or continuing education do you participate in? **[*If needed, probe on continuing education for licensing, distributor training, utility training*]**

a. Where do you find those opportunities?

Q18. What types of business metrics does your company track? Are there targets you try to hit, as a company?

a. What about individual employees – How does your company evaluate installers' job performance? What metrics do you use? What about sales staff?

b. How does that performance structure impact the way people approach projects?

Q19. Are there any types of small- to mid-size commercial system solutions that are particularly popular with your customers? If so, what?

a. Why do you think that is?

Q20. Do you pay attention to what your competitors are doing?

a. Why or why not?

b. **[*If so*]** How do you learn about what your competitors are doing?

c. **[*If so*]** How do you use that information?

Q21. What, if anything, do you do to make sure your deals/installations will be profitable?

a. Are there any rules of thumb you follow to help the profitability of a project? What are they?

Q22. What does your company do to attract and retain workers?

a. Do you try to hire skilled workers, or do you hire unskilled workers and train them? Why?

b. Have you had trouble finding workers?

c. Has Covid affected the talent pipeline? Do you think the pandemic will have an impact on the talent pipeline going forward? Why or why not?

Closing

In closing, I have a couple more questions.

Q23. In response to Covid, how, if at all, will your business change going forward?

Those are all the questions I had prepared. Is there anything we haven't covered that you think it's important for NEEA and other program administrators to know?

[*If interview went well and the interviewee seems engaged and possibly interested in participating in a ride-along*]

Q24. We are planning to conduct ride-along interview/observation sessions with commercial HVAC contractors to learn about the how your approach the various decision points involved in your work. As an active HVAC installer, we would like to invite you to participate in this research effort. The ride-alongs we have planned are slated to take place in October and November 2021. In appreciation for your time and input, you will receive an additional $150 for your participation. Would you be interested in participating this research?

Q25. ***[If unavailable]*** Is there someone else in your company involved in sales or installation for small-to-medium commercial projects that might be able to participate in a ride-along?

Thank you again for your time today! This has been very valuable information. Take care.

Distributor Interview Screener and Guide

Introduction

Hello, my name is **[NAME]**, calling from Schlesinger Group on behalf of EcoMetric Consulting and the Minnesota Commerce Department, or "Department." EcoMetric is interviewing representatives of commercial HVAC manufacturers and distributors to learn more about the commercial HVAC market and energy efficient HVAC equipment. The information we gather will help the Department and Minnesota electric and gas utilities design programs that more effectively work with HVAC contractors.

We expect the interview to take about 45 minutes, and EcoMetric will provide an electronic gift card for $150 in appreciation of your time and input. Would you be interested in being part of that type of discussion?

[If yes, continue to screener. If refusal, thank them for their time.]

[If concerned about legitimacy:] If you have questions about the study, you can reach out to Laura Silver at the Minnesota Commerce Department at laura.silver@state.mn.us.

Background/Screener

[If interested in participating:] Great, before I schedule a time for our interviewer to call you, I have a few short questions to make sure you would be a good fit for our research.

[ASK ALL]

S7. Roughly what proportion of the HVAC systems your company distributes in Minnesota are each of the following types?

a. Residential

b. Commercial, 25 tons or less

c. Commercial, greater than 25 tons

[ASK ALL]

S8. Do you have a geographical area that you primarily work with commercial HVAC contractors in? **[Probe for Twin Cities, Northern (non-metro), Southern (non-metro)]**

Interview Lead-in

Thanks for taking the time to talk with me. As we mentioned when we scheduled this interview, we're working to help the Minnesota Commerce Department, and Minnesota's electric and gas utilities, better understand the small commercial HVAC business so they can more effectively work with contractors. Our focus will be on the decisions that go into a typical small-to-medium commercial HVAC installation, and by small-to-medium, I mean systems less than 25 tons. I'll also ask some questions about your business. Do you have any questions before we begin?

I'll be taking notes as we talk today. Do you mind if I also record our conversation? The recording is only to help with my notetaking and won't be shared with anyone. And we won't report any findings in our written report in a way that would identify individual respondents.

Q26. First of all, please describe how Covid-19 has impacted your business? **[*Note: Keep this section short and focused on current status*]**

a. **[PROBE]** Did the type or volume of contractors you work with change, both in the beginning of the pandemic and now? Please explain.

HVAC Project Decision-Making

Thanks, now I would like to learn about how things work under normal (non-pandemic) circumstances.

Q27. Do you provide advice or information to contractors on specific small-to-medium commercial HVAC installations?

a. **[*If yes*]** What type of information do you provide?

b. **[*If* yes]** At what point in the project do you typically become involved?

c. **[*If yes*]** How, if at all, does your role in a small-to-medium commercial HVAC installation differ based on the type of project or contractor?

Q28. Do you assist contractors with the system design for small commercial HVAC installations?

a. **[*If yes*]** What role do you play in system design? Do you have an opportunity to suggest changes to the system if you feel there is a better solution?

b. **[If yes]** How frequently do you make suggestions?

c. Please describe the types of customers or projects that are most likely to design the system **before** bringing in the installer?

d. **[*If not addressed*]** Are these "plan + spec" new construction projects, or are there other projects where the system is designed before you are involved?

Q29. What proportion of your small commercial HVAC units distributed in Minnesota meet code, what proportion exceed code, and for what proportion does code not apply?

a. Meet ____%

b. Exceed ____%

c. Code does not apply ____%

d. When does code not apply?

Q30. In what situations are you more likely to suggest a small-to-medium commercial HVAC system that is more energy efficient than code?

a. **[*If needed*]** Are there certain types of businesses that are more likely to install above-code systems? Certain types of projects?

b. Who generally decides whether an HVAC system will be more efficient than energy code requires? What motivates them to choose an above code system?

c. How, if at all, does your work change when you are selling a system that is more efficient than energy code requires?

Q31. How do you think the commercial HVAC market is likely going to change going forward?

Business Models

I'd like to shift a bit to talk about the business side of HVAC distribution and how you build relationships with contractors.

Q32. First, please tell me about what a typical day is like for you.

- a. How much does the structure of your day vary?
- b. What is the most rewarding thing you do on a day-to-day basis?
- c. What aspects of your day-to-day work are the most challenging or frustrating?

Q33. How do you typically find and build relationships with commercial HVAC contractors?

Q34. Where do you go to get up-to-date information on the HVAC industry?

- a. What kind of information do you typically look for from those sources? **[*Probe for information about new technologies, trends in the industry, practical "how-to" information for technical tasks, business or management advice, websites, online forums, etc.*]**

Q35. Do you provide education and training to commercial HVAC contractors?

- a. **[*If Yes*]** What does typical contractor educational and training entail?

Q36. Do you provide information to contractors on selling efficient, above code HVAC units to their customers?

- a. **[*If Yes*]** What does that entail?

Q37. Does your company track any metrics or have any targets related to selling energy efficient equipment?

- a. If so, what are they?
- b. If not, how, if at all, do the metrics or targets you have impact staff members' likelihood to recommend efficient equipment?

Q38. Are there any types of small- to mid-size commercial system solutions that are particularly popular with your customers? If so, what?

- a. Why do you think that is?

Q39. Do you pay attention to what your competitors are doing?

- a. Why or why not?
- b. **[*If so*]** How do you learn about what your competitors are doing?
- c. **[*If so*]** How do you use that information?

Q40. What, if anything, do you do to make sure your deals will be profitable?

a. Are there any rules of thumb you follow to help the profitability of a project? What are they?

Closing

In closing, I have one last question.

Q41. In response to Covid, how, if at all, will your business change going forward?

Those are all the questions I had prepared. Is there anything we haven't covered that you think it's important for the Department and HVAC program administrators to know?

Thank you again for your time today! This has been very valuable information. Take care.

Architect and Engineer Interview Guide

Interview Lead-in

Thanks for taking the time to talk with me. As we mentioned when we scheduled this interview, we're working to help the Minnesota Commerce Department, and Minnesota's electric and gas utilities, better understand the small commercial HVAC business so they can more effectively work with contractors and specifiers. Our focus will be on the decisions that go into a typical small-to-medium commercial HVAC system design and installation, and by small-to-medium, I mean systems less than 25 tons. I'll also ask some questions about your business. Do you have any questions before we begin?

I'll be taking notes as we talk today. Do you mind if I also record our conversation? The recording is only to help with my notetaking and won't be shared with anyone. And we won't report any findings in our written report in a way that would identify individual respondents.

Q1. First of all, for some background, please tell me a little bit about the work that you do in small-to-medium commercial buildings. [***Probe to understand:***]

a. What is your typical role in a small-to-medium commercial building project?

b. What share of your work do small-to-medium commercial buildings make up? What other types of buildings do you most often work on?

c. What types of small-to-medium commercial buildings do you work on most often? Do you specialize in particular building types? If so, what is unique about the needs of those buildings?

d. How much of your work is in new construction buildings, relative to remodel or retrofit situations? Are you ever involved more limited HVAC equipment replacement projects?

Q2. How has Covid-19 impacted your business? **[*Note: Keep this section short and focused on current status*]**

a. **[PROBE]** Did the type or volume of projects you work on change, both in the beginning of the pandemic and now? Please explain.

HVAC Project Decision-Making

Thanks, now I would like to learn about how things work under normal (non-pandemic) circumstances.

Q3. First, please tell me about what a typical day is like for you.

a. How much does the structure of your day vary?

b. What is the most rewarding thing you do on a day-to-day basis?

c. What aspects of your day-to-day work are the most challenging or frustrating?

Q4. What are your most common considerations or goals for the small-to-medium commercial buildings you work on?

a. How do you determine the considerations or goals for each project?

b. How do those considerations or goals affect the way you approach HVAC system design?

Q5. I know the HVAC system design for commercial projects can take different approaches: either a plan and spec approach, where someone like you designs the system and contracts for an installer, or a design-build approach, where you would work with an HVAC installer that also has design capabilities. How frequently do your small-to-medium commercial projects take each approach?

a. [***If use both:***] How do you determine which approach to take?

b. Are there certain types of projects or buildings that are more likely to use one approach or another?

Q6. Please walk me through the process of designing an HVAC system for a small-to-medium commercial project.

a. At what point in the process of a small-to-medium commercial project do you begin considering the HVAC system?

b. What are the most important variables that impact the process of designing an HVAC system for a small-to-medium commercial project? For example, does it vary by building type? The size of HVAC system? What about new construction vs. replacement? **[*Probe for if/how key decisions are different for different projects*]**

Q7. How do you go about selecting an HVAC contractor?

a. Do you put out an open call for bids, or do you reach out to a select group of contractors?

b. How do you decide which contractor to choose?

c. How does that vary between plan and spec and design/build projects?

Q8. What factors lead you to design an HVAC system one way rather than another?

Q9. **[*If needed*]** When you bid a plan-and-spec project, how much opportunity is there, if any, for contractors to suggest changes to the system design?

a. Please describe the types of customers or projects that are most likely to suggest changes.

b. Please describe the types of changes customers or contractors suggest. ***[Probe for efficiency, size]***

Q10. How are your clients involved in the process of designing HVAC systems for small-to-medium commercial buildings?

a. Do they review and approve the HVAC system design specifically? If so, what are their most important considerations?

b. Do your clients ever suggest changes to the HVAC system design?

c. What types of clients are most engaged with the HVAC system design? What types are least engaged?

Q11. **[*If needed*]** How do you handle suggestions from customers or contractors in your small-to-medium commercial HVAC designs?

Q12. What proportion of your system designs meet code, what proportion exceed code, and for what proportion does code not apply?

a. Meet ____%

b. Exceed ____%

c. Code does not apply ____%

d. When does code not apply?

Q13. In what situations are you more likely to design a small-to-medium commercial HVAC system that is more energy efficient than code?

a. **[*If needed*]** Are there certain types of businesses that are more likely to install above-code systems? Certain types of projects?

b. Who generally decides whether an HVAC system will be more efficient than energy code requires? What motivates them to choose an above code system?

c. How, if at all, does your work change when you are designing a system that is more efficient than energy code requires?

Q14. Utilities offer energy efficiency programs that provide technical support and incentives to encourage energy efficiency in building designs, including the HVAC system. Have you worked with those types of programs?

a. How, if at all, were those programs helpful in your efforts to include more efficient HVAC systems in small-to-medium commercial buildings?

b. What, if anything, was challenging about working with those programs?

c. Are there certain types of projects or certain types of buildings that seem to work better than others with those types of programs? If so, which ones and why?

d. What types of buildings or projects do not work as well with those types of programs? Why?

Q15. What would be the most important things energy efficiency programs could do that would allow you to increase the energy efficiency of your small-to-medium commercial HVAC system designs?

Q16. How, if at all, do you work with HVAC equipment manufacturers or distributors in designing small-to-medium commercial HVAC projects? What information or advice to they provide, if any?

Q17. Have you worked on projects that involved HVAC system installation for any state or local government clients?

a. ***[If "Yes"]*** Did you design the HVAC systems in those cases? ***[If "No"]*** who did?

b. ***[If "Yes"]*** How, if at all, was it different from other types of small-to-medium commercial projects?

c. ***[If "Yes"]*** How, if at all, were the goals for the HVAC design in those projects different from other projects?"

Q18. Are there particular manufacturers or brands of HVAC equipment that you prefer? Why?

Business Models

I'd like to shift a bit to talk about where you get your industry information and the business side of HVAC system design and engineering.

Q19. How closely do you track changes in the HVAC industry, including updates on HVAC technologies or system design approaches?

Q20. Where do you go to get up-to-date information on the HVAC industry?

a. What kind of information do you typically look for from those sources? ***[Probe for information about new technologies, trends in the industry, practical "how-to"***

information for technical tasks, business or management advice, websites, online forums, etc.]

Q21. What kinds of training or continuing education do you participate in? ***[If needed, probe on continuing education for licensing, distributor training, utility training]***

a. Where do you find those opportunities?

Q22. Are there any types of small- to mid-size commercial system solutions that are particularly popular with your customers? If so, what?

a. Why do you think that is?

Closing

In closing, I have a couple more questions.

Q23. In response to Covid, how, if at all, will your business change going forward?

Those are all the questions I had prepared. Is there anything we haven't covered that you think it's important for the Commerce Department and other program administrators to know?

Thank you again for your time today! This has been very valuable information. Take care.