Memorandum

To: Joan Wang, Bonneville Power Administration

From: Dulane Moran and Lucas Judson, Cadeo

Date: July 2, 2021

Subject: 2020-2021 HVAC Market Research Interview Summary

Summary

Bonneville contracted with Cadeo to collect information from market actors involved in the HVAC supply chain to build upon existing information about market position and supply chain dynamics. This memorandum describes the results of 27 interviews conducted to enhance understanding of the distributor sales data collected and analyzed through a regional effort each year. The interviews reflect a market increasingly focused on meeting multiple objectives associated with performance, efficiency, electrification and climate change policies, and pandemic-driven attention on air quality.

> **Finding:** Interviewees described equipment in both the residential and commercial markets as increasingly inverter-driven, variable capacity, and efficient.

The focus on variable speed equipment permeated interviews and emerged as a trend observed by respondents of all types. Interviewees reported that heat pump technology is increasingly popular and positioned for a diverse set of homes and commercial buildings. The increased interest in heat pumps is attributable to several trends, including electrification policies and innovations in the product overall.

There is no straightforward way to track sales and discern trends associated with variable speed equipment. The current efficiency ratings, Heating Seasonal Performance Factor (HSPF) and Seasonal Energy Efficient Ratio (SEER), are based on test procedures that are not well correlated with the performance of variable speed equipment because they do not account for the control algorithms of variable capacity equipment. The Northwest Energy Efficiency Alliance (NEEA) recently launched a new initiative to improve test procedures and rating system for variable speed heat pumps and to accelerate the adoption of these systems.[1]

Terminology: Inverter-driven, variable capacity and variable speed equipment

Market actors used these terms interchangeably, as does this memo. This equipment is distinct from other types of heat pumps because the compressor and fans vary their speeds to meet heating and cooling demand. This operational efficiency provides energy savings. Variable speed equipment is found in an increasing number of heat pump applications.

[1] For more information see https://neea.org/img/documents/Q1-2021-RPAC-Agenda-Packet.pdf#page=9

Implication / Recommendation: As the market shifts towards more variable speed equipment, it will be increasingly important to track sales and impact of these systems on the region's energy consumption. Before new industry rating systems are established, Bonneville could consider using existing resources such as the Cold Climate Air Source Heat Pump (ccASHP) Product List and program tracking data to identify variable speed heat pumps in the distributor sales data.

Finding: Innovations in variable speed systems include customized "mix-and-match" products for homes, where inverter-driven outdoor units historically associated with ductless heat pumps are paired with a variety of product types such as ductless indoor units, ducted fan coil units or more traditional ducted central air handling units. described equipment in both the residential and commercial markets as increasingly inverter-driven, variable capacity, and efficient.

In the past, analyses of distributor sales data could confidently assign outdoor units to a specific system type. That is less likely to be true in the future. With manufacturer product lines increasingly mixing and matching equipment, outdoor units (especially inverter-driven outdoor units) could be paired with a variety of systems, making it harder to identify the specific application for these compressor units. However, these "mix-and-match" products are just emerging and do not yet represent the bulk of market sales.

Limitations of HSPF & SEER

HSPF and SEER measure the efficiency of residential electric equipment during heating and cooling, respectively. The metric is a ratio of heat output, in BTUs, over the heating or cooling season to the electricity used, in watt-hours. The higher the HSPF or SEER, the higher the efficiency, however, since HSPF and SEER do not reflect part load efficiencies, the metric does not fully capture efficiency gains from variable capacity equipment.

Implication / Recommendation: The region should continue to monitor the emergence of "mix-and-match" systems and ensure that program tracking, field research, and market research verify both the installed outdoor unit and what it is paired with. If these "mix-and-match" solutions become more prevalent, understanding the energy consumption of these systems will become increasingly important.

Interviews also revealed a market hyper aware of the electrification and climate policies expected to affect their market and their products. In general, market actors are interested participants in these changes, acknowledging the climate change impact of HVAC products and perhaps seeing opportunity in policies that could spur widespread efforts to upgrade inefficient equipment and replace refrigerants.

Implication / Recommendation: Climate change and associated mitigation strategies are increasingly resonating with HVAC market actors. Therefore, program marketing and trade ally recruitment should emphasize opportunities to be prepared for shifts associated with climate change mitigation policies and offer meaningful support to help trades adapt.

The commercial product supply chain is more nuanced and includes hybrid "super" reps that straddle distribution and manufacturer rep services. Commercial systems are often specified and sold outside of the traditional general supply houses operated by distributors of residential equipment. The dearth of commercial equipment in the HVAC distributor data set likely reflects the types of organizations participating in that effort and could limit the usefulness of those data to inform commercial market characterization.

> **Implication / Recommendation:** Given the limited historical participation from entities operating in the commercial market, the regional HVAC sales data collection sponsors will likely need to target the hybrid "super" rep entities to obtain robust data on the commercial market. Improving market coverage will likely require new strategies that establish a value stream centered on commercial market actors.

Table 1: Summary of Interview Findings by Research Topic

Research Question	High Level Summary
How representative is the HVAC sales data collected from distributors?	The regional HVAC distributor dataset includes a mix of regional and national distributors, but local distributors are underrepresented, particularly if commercial products are included. Interviewed distributors report increased sales in natural gas furnaces and DHPs that may not be represented in the distributor dataset.
Are we missing a substantial portion of the ASHP market? What could expand our coverage of this market?	Interviewed distributors viewed BPA's total market sales estimates as reasonable, indicating that the distributor dataset's market coverage remains below 40% of the market. Contacts expect trends underway will lead to increased sales for ASHP. Expanding the coverage of the ASHP market in distributor data collection will require targeting additional high-volume ASHP distributors.
Do electrical distributors sell a substantial portion of zonal equipment (including DHPs)?	HVAC distributors do not typically sell zonal heating equipment (baseboard and wall heaters). Many electrical distributors do not sell HVAC equipment; those that do sell legacy zonal equipment and a small volume of DHPs.
What is the prevalence of end-user purchased equipment? What are the sales channels, installation, practices, cost difference or other important differences?	Interviews reflect consensus that online and retail sales are increasing; however, the precise volume may be unknowable without access to sales data from retail and online channels. Online sales are flowing directly to contractors and, to a lesser extent, homeowners. While estimates are difficult to make, market observers report these sales could be 10% or more, particularly for DHPs. Future data collection should consider capturing sales of DHPs and other HVAC equipment through online and retail channels.
How much of the market share is manufacturer-direct, particularly for commercial VRF, DHP and ASHP? Do manufacturers sell residential equipment directly to customers also?	Distributors are largely unable to estimate the portion of sales that occur outside of their market (sales they are not part of). Respondents believe manufacturer-direct sales occur occasionally in the commercial sector, but less so for non-custom equipment such as VRF, DHP and ASHP. The low volume of non-custom sales in the distributor sales data likely reflect the specific distributors participating, not the entire market. Manufacturers do not sell residential equipment directly to customers but may sell directly to major retail or online sales channels.

Research Question	High Level Summary
Can we shed light on key trends: trends in equipment cost, overall sales for each technology, or trends within specific distributors or manufacturer product lines?	The most prominent trends in the residential market include an increased focus on heat pumps and inverter-driven technology, and anticipation of the effects of electrification policies. Identifying a strategy for tracking mix-and-match central compressor and variable speed products will become increasingly important to accurately assessing the market. In the commercial market, distributors typically focus on high-volume products that can be ordered without customization; however, some are investing in new staff expertise (including engineering or mechanical system design) to expand services for the commercial market. Changes in refrigerant rules are expected to affect systems in all markets. Manufacturers are anticipating this, however the effect on specific product lines remains uncertain.
What are the known/likely impacts of COVID-19 on 2020 sales and market trends?	Increased investment in quality residential systems as people work and school from home, increased focus on air quality through ventilation, and disruptions in the supply chain all affected the market in 2020. Stay-at-home orders affected sales, which bounced back substantially as markets began to open back up by mid-2020. Product supply continues to be unpredictable.
How do contacts describe the smart thermostat market?	Contacts universally reported smart thermostat sales have increased, although not always to their expectations. A small subset sold line-voltage thermostats, however most had never heard of smart line-voltage thermostats.

Introduction

Bonneville contracted with Cadeo to collect information from market actors involved in the HVAC supply chain to build upon existing information about market position and supply chain dynamics from those involved. This work is expected to augment our understanding of the ongoing regional HVAC distributor data collected through a coordinated effort led by NEEA and CLEAResult, which has resulted in a detailed HVAC distributor dataset for the years 2016-2019. Prior research projects included interviewing market actors at the International Air-Conditioning, Heating, and Refrigerating Exposition (AHR Expo),[2] which did not occur in 2021 due to the global Covid-19 pandemic.

An overall objective is to improve understanding of the representativeness of the HVAC distributor dataset by investigating several questions raised by stakeholders in prior rounds of analysis and to investigate trends in sales, product lines, and the overall market. The Covid-19 pandemic emerged during this research and, to some extent, likely affected respondent perspectives. Ultimately, results from these qualitative interviews will also inform Bonneville's subsequent update of the Residential HVAC Market Model[3] in 2021. The Market Model relies on several data sources, including data on regional housing stock and the regional HVAC distributor dataset used to establish the efficiency mix for the most common

[2] https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/2020_BPA_AHR_Expo_Findings_Presentation.pdf
[3] https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/190601_Res_HVAC_Model_Methodology_Report.pdf

residential heating and cooling technologies. An analysis of the regional HVAC distributor dataset is discussed in a separate memo, but occasionally referred to in this document.

This memo is organized into the following sections:

- A description of the overall approach to the research and description of the distributor market
- Residential market insights, including adjustments in market structure, and trends in distribution, manufacturing and equipment costs
- Residential equipment insights, providing a brief summary of market actor perspectives by equipment
- Commercial market insights, providing a brief summary of commercial market trends as reported by interviewees

Approach

Bonneville and Cadeo (the team) developed a list of 166 key contacts using a variety of sources including previously developed contact lists, input from regional study stakeholders, as well as LinkedIn and Internet searches to fill in contact information gaps for manufacturers, HVAC distributors, electrical distributors, and retail professionals. The team determined that 11 of the originally identified contacts worked for commercial HVAC design+build, and specification companies and categorized them as unqualified to answer the primary research questions. With these contacts removed from recruitment, the final sample frame contained 155 contacts from 79 unique organizations.

Outreach focused on the following respondent categories:

- **Manufacturer representatives.** Manufacturer reps are contacts that act as local sales representatives on behalf of a specific HVAC equipment manufacturer, including several manufacturers that focus primarily on commercial equipment sales. Some manufacturer reps are also closely associated with specific distributors. Manufacturer reps work directly with commercial customers and design engineers; they also influence the products distributors promote.
- **HVAC distributors.**
    - **Traditional HVAC distributors.** These are companies that sell HVAC equipment wholesale through general supply houses that are open to contractors and others to purchase a variety of HVAC or ancillary equipment. The population frame included contacts from all HVAC distributors known to project stakeholders, which includes distributors that may have participated in the regional data collection managed by NEEA.
    - **Hybrid "super" reps.** This population includes a subset of distributors who are also manufacturer reps and sell equipment directly to contractors or design+build firms. These entities differ from traditional HVAC distributors in that they do not operate a general supply house and typically provide design services. They differ from manufacturer reps in that they will also sell equipment. They operate almost exclusively in the commercial market.
- **Electrical distributors.** Electrical distributors do not typically sell HVAC equipment, instead focusing specifically on products for electricians. However, some electrical distributors sell zonal heating equipment including baseboards, wall heaters and ductless heat pumps (DHPs), and may

also sell thermostats. The team confirmed via its outreach that most electrical distributors (ten of 14 contacted) do not sell HVAC equipment, and disqualified them for the interview.

- **Key informants.** These contacts tend to be associated with trade associations, energy efficiency programs, or market development research. They do not work directly for those that sell or make HVAC equipment, but offer a market-wide view of trends and product lines.
- **Retail contacts.** The team sought to complete interviews with corporate-level retail contacts to better understand the volume of HVAC sales flowing through retail organizations like Home Depot or Lowe's. Ultimately, the team was unable to reach cooperative contacts or complete interviews with retail contacts.

Interviews occurred from October 2020 through January 2021, and ranged from 15 to 45 minutes, depending on the number of products a given contact was qualified to discuss and their willingness to discuss trends and observations in depth. Table 2 displays the results of this outreach and the final disposition by contact type.

Table 2: Final Interview Disposition

Disposition	Manufacturer Rep	HVAC Distributor	Electrical Distributor	Key Informant	Retail Contact	Total
Complete	7	11***	1	8	0	**27**
Refused	3	9	3	3		**18**
List error*	11	18				**29**
Not qualified			10			**10**
Non-contact**	29	19	3	16	3	**70**
Not attempted		1				**1**
Total	**50**	**58**	**17**	**27**	**3**	**155**

**List errors include bad numbers, retired contacts, or those that were otherwise unreachable.*
***Non-contact includes records for which outreach occurred, but no response or contact resulted.*
****Includes one respondent with limited distribution, focused on installation.*

The Interview Data

Interviews resulted in a mix of categorical and qualitative data, collected using an instrument programmed in Qualtrics and coded thematically post data collection. The interview guide reflected the project's overall context: testing and confirming hypotheses from prior analyses, investigating emerging trends and obtaining market reaction to estimated regional sales volumes. Given the myriad topics included, interviewers only asked questions about specific equipment to participants that reported tracking or selling that type of equipment and asked everyone high-level questions exploring trends in the market and emerging products.

The team sought to touch on several aspects of the HVAC market, with a primary focus on investigating residential product sales and trends. In the scoping process, the team identified several high-level questions about commercial product flow. The interview guide asked respondents to indicate if they worked primarily with residential or commercial products, or if they worked in both markets. As shown in Table 3, most of the market actor respondents (distributors and manufacturer reps) answered questions about both markets, while the key informants tended to focus on one market.

Table 3: Respondent Type by Market Segment

Market	Market Actors (n=19)	Key Informants (n=8)
Residential	14	2
Commercial	13	6

The HVAC Distributor Market

One overarching research objective for this work is understanding the representativeness of the NEEA-collected regional HVAC distributor sales data relative to the market. With improved understanding, the team can more confidently assess the quality of the data and identify strategies for filling specific gaps. To provide a structure for understanding the overall market and thus the representativeness of the distributor data, the research team mapped the distributors to a simple taxonomy, described below.

To support this effort, the team prepared a list of 26 HVAC distributors (excluding manufacturer reps and electrical distributors but including hybrid "super" reps) representing the bulk of the region's HVAC distributor market and categorized each one by noting:

- If they sold products for the residential, commercial, or both markets.
- If their distribution area can best be described as local (within a single state), regional (across the Northwest), or national (including and beyond the Northwest).
- If the entity operated a general supply house (13 of 26 do).

As shown in Table 4, most distributors sell both residential and commercial HVAC equipment. However, one-third of the market only sells commercial equipment; this population includes a substantial number of hybrid "super" reps that provide design assistance as part of their sales in the commercial market. These hybrid "super" reps have generally not participated in NEEA's regional distributor data collection effort.

Table 4: HVAC Market Actors by Sector (n=26)

Sector	Distributor Population	Participating Distributors
Residential	4% (1)	11% (1)
Commercial	31% (8)	11% (1)
Residential & Commercial	65% (17)	78% (7)

As shown in Table 5, the group of participating distributors matched the overall distribution market with its proportion of regional distributors. However, the participating distributors over-represent national distributors relative to local distributors.

Table 5: Geographic Coverage (n=26)

Coverage	Distributor Population	Participating Distributors
Local	27% (7)	11% (1)
Regional	42% (11)	44.5% (4)
National	31% (8)	44.5% (4)

Residential Market Insights

To investigate trends in the residential market, the research team screened each respondent to ensure they answered questions only about equipment they were familiar with. Fourteen market actor respondents answered questions about the residential market overall, with subsets answering questions about specific equipment. The team asked these contacts about trends they are observing in the overall market. Contacts provided an optimistic assessment of the future; particularly as complementary trends seem to support wider heat pump adoption.

Increasing residential sales: Eight contacts specifically noted that sales of residential HVAC equipment are increasing because of increased investment in construction (both new construction and renovations) and because families working and schooling from home are investing in comfort and efficiency.

More interest in air quality and ventilation: Two respondents specifically mentioned improving air quality as an emerging trend in the residential HVAC market. One contact noted that people "*weren't even changing their filters*" and are now interested in additional air quality technologies such as UV light or advanced filtration. Another discussed the challenges associated with promoting effective ventilation, even with supportive codes:

- *"The builders are finally understanding that houses need ventilation, but they are going about it backwards. For example, the Washington market requires they have a damper in the furnace, so it just brings in raw air and the furnace has to work very hard to condition that air before it gets into the house. We sell heat recovery ventilators, and they bring in air and heat and cool it before it gets into the house. But builders have pushed back because of the cost. A damper is $100 and the ERV is about $3000."*

Electrification as catalyst: "*The electrification movement is gaining traction,*" said one of the three interviewees that emphasized electrification as a residential HVAC trend, particularly in areas of the Northwest influenced by codes and policies designed to combat climate change. This is consistent with last year's AHR Expo findings,[4] which predicted an increased impact of electrification.

- *"We have 99% furnace and 28 SEER furnace on the market right now. Being involved in some states (like California, New York) with incentivized carbon goals using heat pumps and switching from gas to electric, there is a push toward heat pumps more than we've ever seen happening this past year."*

[4] https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/2020_BPA_AHR_Expo_Findings_Presentation.pdf

Market Structure

As part of a 2016 market intelligence project,[5] Cadeo developed a market diagram illustrating the primary flow of dollars and equipment in the residential and commercial HVAC markets. Informed by this round of interviews (discussed in more depth in subsequent sections), the research team updated this diagram by separating the sectors and adding elements to the diagram to reflect nuanced information collected from the interviews.

Figure 1 provides a high-level diagram of the market structure for residential HVAC products. The primary path is for products to flow from manufacturer to distributor, be purchased by a contractor and installed in a home. Occasionally manufacturers will establish their own distribution centers; however, most distributors are independent companies that sign agreements enabling them to sell products from multiple manufacturers. Distributors provide a variety of additional services to their customers—the contractors and installers who purchase equipment from them. These services include training and certification, credit or financing for contractors to manage their cash flow or offer to their customers, and delivery directly to a job site. Interviews indicate a small but growing portion of sales are flowing through online and retail vendors who market commodity HVAC equipment directly to contractors and, to a lesser extent, homeowners. This path is added to the bottom of Figure 1.

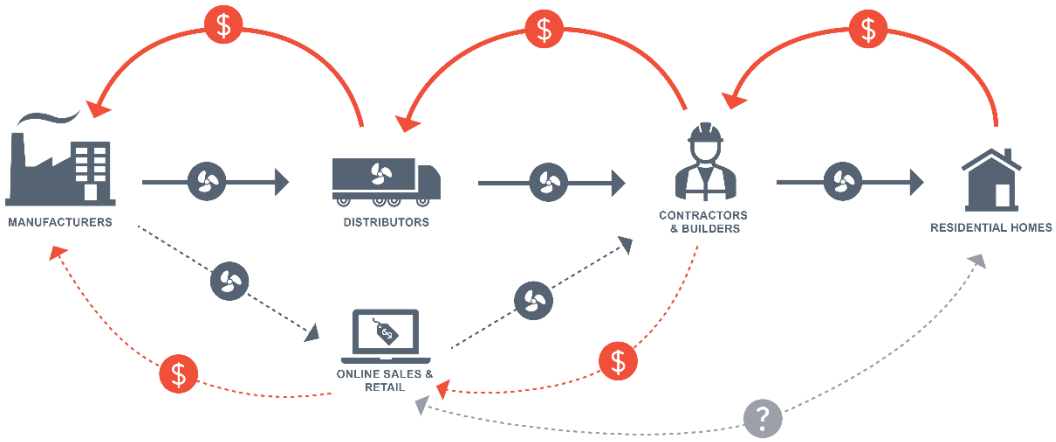

Figure 1: Residential HVAC Supply Chain

Respondent perspectives on this retail and online sales trend are discussed in more depth in the discussion below. Estimates of the product volume flowing through this channel vary by product, with DHPs and central air conditioners (CAC) most commonly mentioned. None of the interviewees could confidently report the portion of sales flowing through this path.

[5] https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/2016_HVAC_Market_Intelligence_Booklet.pdf

Shifts in Distribution

The team asked respondents about changes in distributor positioning or in the distribution market overall. Among the 12 market actors that discussed residential product distribution, half reported no major shifts or adjustments. The other respondents offered a mix of notable changes:

Equipment and parts shortages. This issue emerged as part of supply chain disruptions and work slowdowns associated with the COVID-19 pandemic's effect on global production and shipping. According to one contact:

- *"It used to be a race to match lower prices, now it's just trying to meet demand. We are staying loyal to our regular dealers and they stay loyal to us. We are not selling to just anyone like we used to. I have to turn people away because goods are harder to come by… good luck getting a horizontal coil right now."*

Market Consolidation. Several contacts described consolidation, noting that large distributors had acquired several smaller entities and that manufacturers had positioned themselves as distributors—selling products directly to contractors. One contact described this as a profound change:

- *"[The manufacturers] are going to sell through their own distribution channel. I think we are going to see more and more of this. I have been in the industry for 40 years. There were all these little wholesalers everywhere, and now they have been sucked up by the big guys, and the big guys are being sucked up by the manufacturers."*

The team also discussed distribution and supply trends with key informants, who confirmed consolidation among several distributors. In 2018, the family that owns Gensco purchased Slakey Brothers. Slakey continues to operate as a sister distribution company in California and Southern Oregon. Thrifty Supply bought Blacks Wholesale in 2018. Heating Supply transitioned to Geary Pacific.

New competition. Several market actors confirmed observations from key informants about the potential disruption from online-to-contractor sales particularly for DHPs. Perspectives on this trend varied substantially, with distributors alternatively acknowledging this sales path and disparaging it, consistent with last year's AHR Expo findings. The comments from some distributors revealed opposition to online-to-contractor sales, characterizing this path as lacking warranty protection and associated with inferior installation.

Shifts in Manufacturing

In discussing trends in manufacturing, contacts described increased options for efficient, inverter-driven/variable speed products, expanding DHP options, and climate policies likely to lead to new refrigerants, consistent with past AHR Expo findings.

Efficiency as a driver. Several contacts described an increased focus on efficiency among manufacturers, a trend that includes a focus on inverter-driven, variable speed, multi-stage equipment. This trend is driven by an expectation of increasing efficiency requirements and by manufacturers promoting new technology and applications. Contacts specifically mentioned Daikin, Trane and Mitsubishi as examples of manufacturers focused on promoting air source heat pumps (ASHPs) and CACs with variable speed/inverter technology.

- *"Getting the biggest, baddest inverter and not having it be super big while bringing on apps and more user-friendly interface to the homeowner. This is what I see on the residential side."*
- *"Everybody is really focused on ductless and inverter technology. I see inverters getting more popular, whether it be unitary or ductless."*

More customized solutions. Key informants noted that manufacturer product lines do not always conform to the categories used by efficiency programs and are increasingly promoting whole house heat pump solutions that provide a customized solution for any given home. Manufacturers are increasingly agnostic about the specific type of product they sell for a given home (e.g. ducted or ductless), and central multi-position air handlers[6] are providing flexibility in retrofit system configurations.

- *"Whatever your house is, they will get you what you need, all ductless, ducted, a hybrid—they don't care. Some companies have a universal compressor now that is designed with refrigerant flow, reversal valves, and inverter compressors that handle any of the four product strategies."*

Expanding DHP options. Contacts described having more options for ductless products that enable installation in more homes through more flexible solutions. Respondents repeatedly discussed an observed shift toward more customized, integrated heat pump solutions. Past AHR Expos saw this trend on the trade show floor at the manufacturer level, but the interviews indicate this trend appears to have reached distributors and installers. Several contacts provided examples for how this trend is affecting DHP installations:

- *"We have shifted to meet demands for ductless that do not hang on the wall. We have one product that goes between the floor joist or trusses in the ceiling. You'll see the grill only as you would on a traditional unitary system."*
- *"All the major brands now have a ductless offering. Some took a decade to get there. The NW and the NE are still hotspots for the whole country. Out here we do about $4-5 million in ductless, and that was zero about 10 years ago. It allows us to provide very efficient solutions. We can do jobs we couldn't do before (townhomes, condos, slab on grade). We can go in with 1-3 port, do the whole house, and save enough on electric bills they can take out a loan to buy the system. You can cut the electric bill in half."*

[6] Central, multi-position air-handlers can be installed in different configurations – either vertically or horizontally—providing more flexibility in retrofit scenarios with space constraints in ducted homes.

Refrigerant changes. While the prospect of refrigerant changes have dominated AHR Expo discussions for several years, an increased focus on combating climate change is expected to result in code changes that encourage better refrigerants. Contacts mentioned expectations for refrigerant change in both residential and commercial products, noting that the focus on heat pumps has encouraged manufacturers to prepare for refrigerant rules that will prioritize products based on their global warming potential (GWP).

Refrigerant status

R-22: HCFC, common in residential equipment, being phased out by 2030 in the US.

R-410A: HFC, most common alternative to R-22, common in VRF systems, proposed to "phase down" in the 2020's.

R-32: Lower GWP alternative to R-22 and R-410A, in use in Europe, starting to enter the US market through limited residential products, mildly flammable which limits commercial applications.

Trends in Equipment Costs

Fourteen contacts answered questions about residential equipment cost trends, most of whom reported that costs have increased as expected. Nominal cost increases tend to follow typical year-over-year increases that range from 3-7%. Contacts noted that increases in raw materials (steel, plywood, and refrigerants) and transportation costs often drive cost increases, as do manufacturer innovations that increase product features. As one contact explained, "*it's kind of like computers, the price doesn't necessarily come down, but you get more for your buck… you get better technology and higher efficiency for a similar price.*" Another distributor described the challenge of manufacturers raising prices amidst supply constraints, *"I just saw a 5-7% increase. We don't even have product right now. How are these guys trying to increase the product price when we can't even get it?"*

Residential Equipment Insights

The team asked contacts to indicate if they sold or manufactured each residential technology listed in Table 6. Contacts then answered specific questions about each product with which they had experience, including trends in sales or equipment supply. Contacts with residential product experience also discussed overall trends in the market and emerging equipment trends.

Table 6: Residential Respondents: Equipment Sold (n=14)

Product	Count of Market Actors
Air source heat pumps (ASHP)	10
Zonal equipment (wall heaters and baseboards)	2
Ductless heat pumps (DHP)	13
Thermostats	11
Natural gas furnaces	10
Electric furnaces	7
Central air conditioning (CAC)	10

Ducted Air-Source Heat Pumps

Air-source heat pumps (ASHP) are central electric heating and cooling systems that condition an entire home by distributing conditioned air with a fan and system of ductwork. Major manufacturers include Carrier, Goodman, Lennox™, Nordyne, Rheem, Trane® and York®.[7] ASHP are an important technology for energy efficiency efforts as ASHP equipment can provide high efficiency electric heating. The Residential HVAC Market Model estimates approximately 60,000 ASHPs sold in the Northwest in 2018.[8] The research team asked the ten contacts involved in sale or manufacture of this product to respond to this estimate. Six of the 10 confirmed it seemed accurate and noted that the Northwest sells a substantial volume of heat pumps. The four remaining contacts reported having insufficient information to judge the accuracy of the estimate.

The team asked market actor respondents if ASHP sales had increased, decreased, or stayed the same in 2019 relative to 2018. Seven of the ten market actors answering questions about ASHPs confidently reported that sales had increased, while three indicated sales had stayed the same. One respondent described the trend as a *"push toward heat pumps more than we've ever seen happening this past year."*

The team also asked the ten market actor contacts with ASHP experience to describe trends in variable speed heat pumps, particularly over the past three-to-five years. All ten contacts confirmed that sales of variable speed heat pumps increased in recent years, consistent with past AHR Expo findings. One respondent said that *"this is the single biggest emerging market trend in residential HVAC right now."* Another mentioned that variable speed technology is increasing across many equipment types in addition to ASHPs, including DHPs, VRF, hydronic systems, fans, inverter-driven unitary AC, geothermal, and water heating.

Interviews with key informants also explored trends in the ASHP market. According to one respondent, the market reflects an increased "clustering" in the middle efficiency levels. Figure 2 displays the heating efficiency mix obtained from four years of regional HVAC distributor data analysis. As the lowest efficiency units have dropped off with changes in Federal standards, there is not a corresponding increase in the highest efficiency units. Another noted the sales volume and efficiency trends could be affected by changes in Washington residential energy code that favor the selection of heat pumps.[9]

ASHP are usually marketed on HSPF and sold for heating efficiency; the SEER for these products are quite stable and somewhat higher than for standalone CAC. Higher HSPF products tend to also provide efficient cooling.

[7] BPA HVAC Technology Guide. Available at https://www.bpa.gov/EE/Sectors/Commercial/Documents/BPA_HVAC_Technology_Guide.pdf
[8] https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/2016-2021_Res_HVAC_Model_Results_Tables.xlsx
[9] The 2018 Washington State Energy Code requires any electric zonal heating be paired with a DHP and limits the total kWh of the heating capacity. The 2018 code also has carbon emission limits and performance paths that will shift homes towards heat pumps.

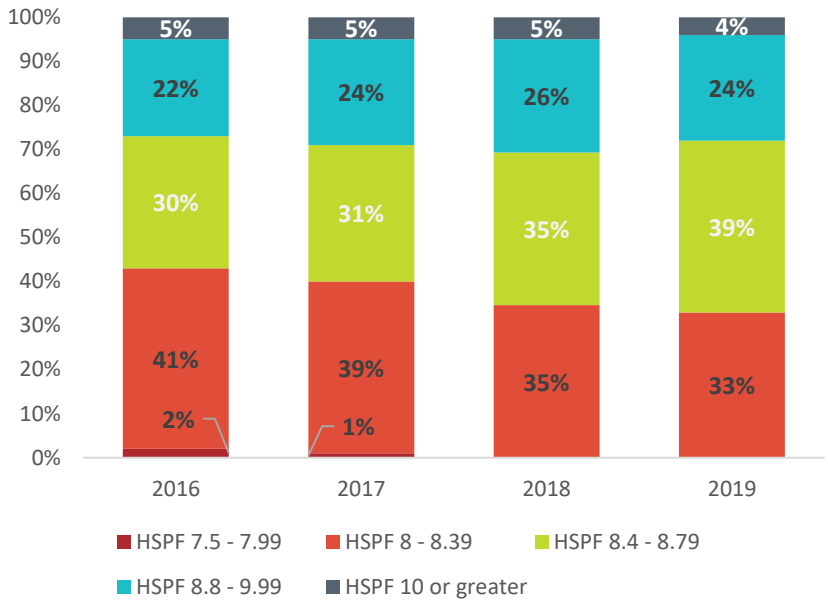

Figure 2: ASHP Heating Efficiency Mix 2016-2019

Regarding cooling efficiency as measured by SEER ratings, 80% or more of all sales have been at SEER 14 for four years in a row. The top bin, SEER 16 has been stable at 18% for three years in a row.

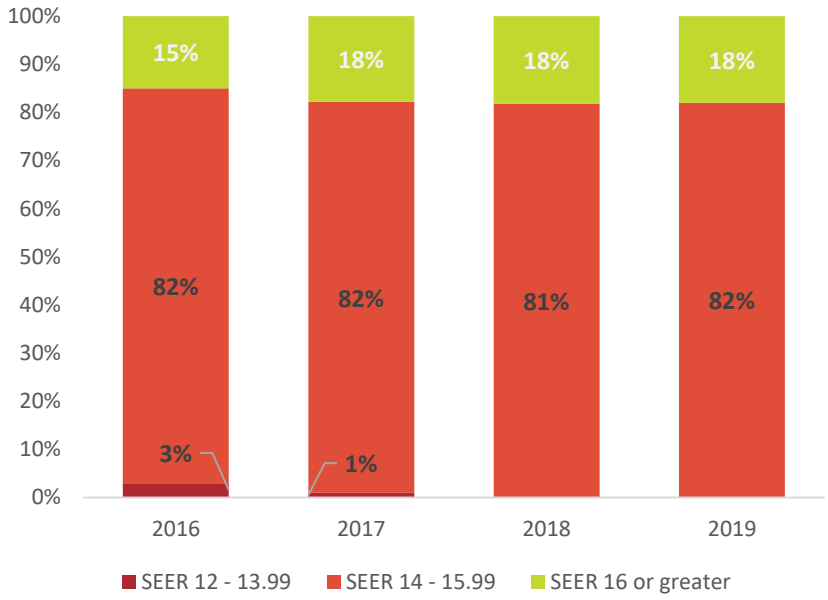

Figure 3: ASHP Cooling Efficiency Mix 2016-2019

According to key informants, the central system ASHP market is affected by several trends:

Demand for improved ventilation. An increased focus on the benefits of indoor air quality has increased interest in the ventilation capability of ASHP. This trend emerged in recent years during Northwest wildfire events and has accelerated with the Covid-19 pandemic.

Policies are encouraging heat pump applications. Electrification and carbon reduction policies have increased the focus on heat pumps as a path to achieving sustainability goals. State and local energy codes are one element of this trend; the inclusion of points-based or performance codes can nudge builders to include higher efficiency equipment than mandated by Federal standards.

New options in the heat pump market, including extended capacity cold climate heat pumps. Seven of the ten market actors reported selling cold-climate heat pumps and described increasing interest in and sales of cold-climate models over the past few years. One respondent noted that incentives contributed to this increase, while another reported the increased sales occur primarily east of the Cascades. These products increase the feasibility of heat pumps in colder climate zones east of the Cascades, but contacts reported they are also selling well on the west side. While the climate is milder west of the Cascades, there are still days every year where it gets very cold or very hot. Concerns about performance during extreme weather can encourage installations in Seattle, Portland, and Eugene. Ultimately, this also supports carbon reduction policies by reducing the use of oil, propane, or natural gas back up heating.

Increased availability and promotion of variable speed equipment. While efficiency and innovation in the heat pump market emerged in a variety of points during market actor interviews and in conversations with key informants, it is important to acknowledge the effect of equipment pricing as well. According to one key informant, single stage heat pumps remain a substantial portion of the market because of their low cost relative to variable speed equipment and installers are equally likely to sell single stage heat pumps as they are to promote variable speed equipment.

Ductless Heat Pumps

A DHP is a form of heat pump that does not rely on duct work to distribute the conditioned air. DHPs provide heating and cooling to a central area of a home, or a zone. For this reason, DHPs can be considered a "zonal" product. However, their substantially different energy consumption profile and use of heat pump technology distinguishes them from more typical (and inefficient) zonal equipment like baseboard or wall heaters. The primary manufacturers for DHPs in the U.S include Mitsubishi, Fujitsu, Daikin, Sanyo, LG, Samsung, EMI Retroaire, Goodman, Heil, and Unionaire.[10]

The Residential HVAC Market Model estimates that approximately 40,000 DHPs were sold in the Northwest in 2018. Ten of the thirteen market actor contacts (distributors and manufacturer reps) active in the DHP market reported this estimate seemed reasonable, however several noted it was on the lower end of their expected sales range. Two additional contacts specifically referenced their own company's sales data during the interview and used that data to bolster their case for a higher overall sales estimate.

[10] From BPA HVAC Technology Guide. Available at https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/2018_BPA_HVAC_Technology_Guide.pdf

As one noted *"it should be much higher, DHP is a big deal."* All 13 respondents reported that DHP sales increased from 2018 to 2019 and continued to do so in 2020.

Contacts with experience in DHP sales were asked to estimate the portion of their DHP sales that end up in commercial buildings. Eight contacts provided estimates, which ranged from 5% to 35%, noting that 2020 disrupted commercial investment more than residential. The respondents offering the highest estimates included several reporting substantial sales in multifamily buildings:

- *"Both residential and commercial are increasing separately, but commercial DHPs are increasing at a faster rate."*
- *"It's becoming more common for DHPs to go into commercial space. I think 30% of the DHP market is commercial."*
- *"It's going like crazy. This year our commercial mini-split sales were up 25%. A lot more is going into multifamily projects… and grow rooms. They do go into offices and such, but the uptick is mostly associated with multifamily and grow rooms."*

As consistent with past AHR Expo findings about cold-climate DHPs, ten respondents confirmed an increase in sales of these equipment over the past few years, particularly in the colder climate zones east of the Cascades and in areas with supportive program activity.

The heating efficiency mix for DHPs is presented in Figure 4. Similar to ASHP, there is a clustering of sales in middle efficiency units. Market share for higher HSPF units is flat or declining, while nearly 80% are in the HSPF 9.0-11.0 bin (code minimum is 8.2, and not set to increase until 2023).

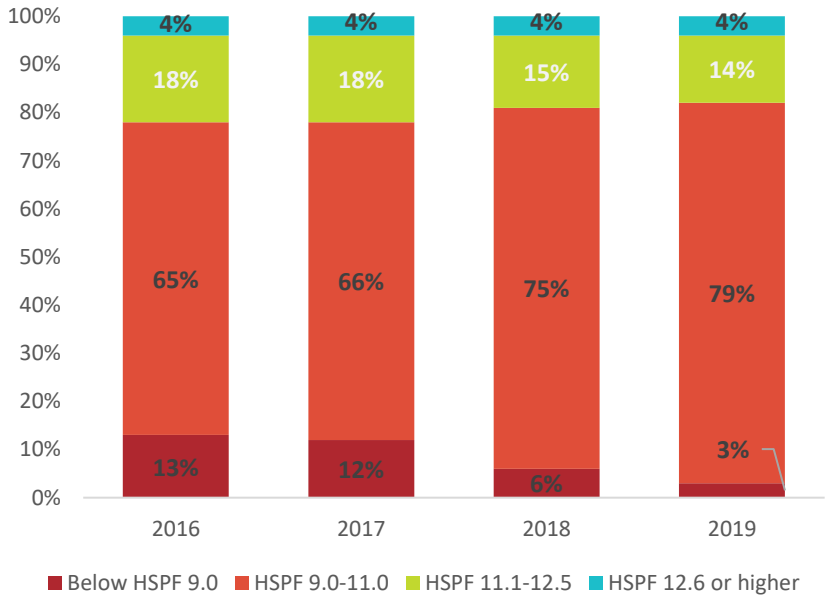

Figure 4: DHP Efficiency Mix 2016-2019

Role of Electrical Distributors in DHP Sales

The team sought information on the role of electrical distributors in the DHP market, asking the distributors with DHP experience to describe the share of DHP sales that might flow through electrical distributors. The 12 HVAC distributors and manufacturer reps reported the portion of DHPs sold through electrical distribution to be quite low, with four reporting the portion at or near zero and another four estimating 5% are sold this way. Three respondents offered estimates at 10% or higher, including an electrical distributor estimating 25% are sold through electrical distributors. (Note that the screening process conducted to recruit electrical distributors indicated most do not sell heating or cooling equipment.) DHPs are available from a limited number of electrical distributors and most HVAC distributors do not see this as a major sales opportunity for those in electrical distribution. Several went further, noting that electrical wholesalers should not be selling DHPs, as they lack the training, parts, and infrastructure to support quality installation.

Role of Online and Big-Box Retail in DHP Sales

Another area of ongoing uncertainty for DHP (and other HVAC equipment) is the portion sold online or direct-to-consumer via big-box retail. It is important to note that online sales do not always flow directly to homeowners—many are purchased by HVAC contractors. Most of the 13 market actors with insight into DHP sales could not provide a specific estimate of the portion sold this way. The most common answer, given by five, was simply that the portion is "low." Two market actors and one key informant providing an estimate offered a range of 10-20%, noting that smaller sized units are sold this way. Past AHR Expos also estimated low but growing online sales.

- *"Consumers are educating themselves and the portion is probably higher than you would think. I would put it at 15-20% sold online or customer direct. They purchase it and ask their contractor to install it for them."*
- *"Online [sales] are probably more than electrical or plumbing distributors. I think online is higher than you think, maybe 10-20%."*

The team probed further to understand the portion of DHP sales purchased directly by a customer intending to install the equipment. Market actors reported that very few customers install DHPs on their own, even if they originally intend to. Most contacts could not provide an estimate, with a few offering "low," "zero," "1%," and "5%."

- *"[This estimate] is the same as online sales—nobody knows. Our contractor partners get calls from homeowners who buy stuff online and can't put it in."*
- *"There are brands like Mr. Cool that don't require an HVAC company to install. Sometimes homeowners do it because it doesn't require special tools. I'm seeing more and more of it."*

Natural Gas Furnaces

A gas forced air furnace requires a home designed to accommodate a central air system, with ducting to each conditioned space. The Residential HVAC Market Model estimates just over 100,000 natural gas furnaces sold in the Northwest in 2018. The team asked the ten contacts with experience selling natural gas furnaces about that market estimate. Seven contacts reported this estimate seemed reasonable, while three argued that the estimate is too low. Comments arguing that the estimate is low included:

- *"I think this number is a little bit low. I would guess 110-120 thousand units. I have the market report here… we have 12% market share across the four Northwest states, Q2 2020 shipments were initially 40,000 for natural gas furnaces. So, you are actually looking at closer to 160,000."*
- *"It could be twice this estimate [of 100,000]."*

The team then asked the ten market actor contacts about sales trends for natural gas furnaces. They indicated that natural gas furnace sales have increased (six respondents) or stayed the same (four respondents). Contacts noted that the increase in gas furnace sales are bolstered by low natural gas prices and existing residential gas infrastructure.

- *"We thought DHPs would be taking over… and they are a little bit… for the time being natural gas furnaces are staying about the same."*
- *"I sell a lot of gas furnaces because we are in Portland. Going into Washington it is more electric. Down in Salem, it's different again. I couldn't tell you as a region."*

For natural gas furnaces, the efficiency trend is somewhat different than for heat pumps. In Figure 5 a bifurcated market is visible, where most sales are above 95% AFUE, and a stubborn 30% stay below 90% AFUE.

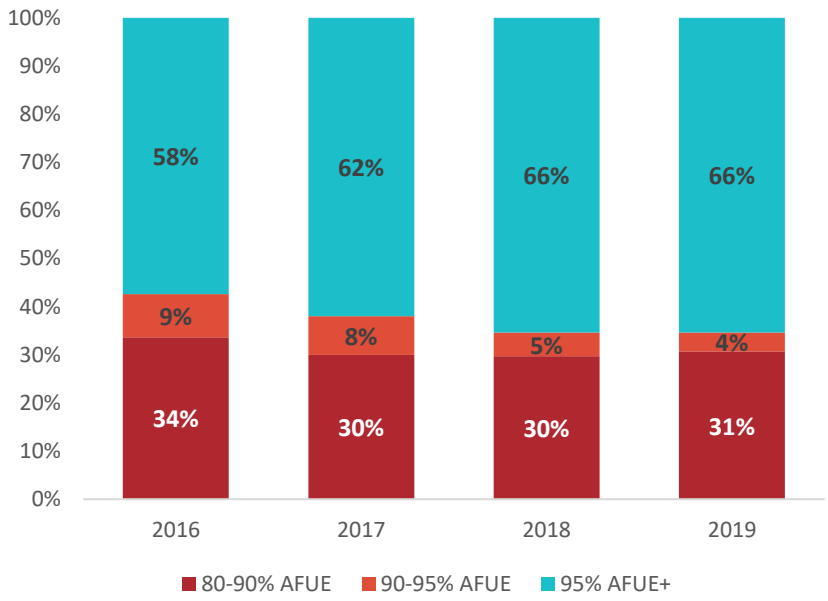

Figure 5: Natural Gas Furnace Efficiency Mix 2016-2019

Central Air Conditioning

Central air-conditioning (CAC) systems provide cooled air to an entire building or home using the vapor compression refrigeration cycle to transfer heat energy from indoor spaces. The Residential HVAC Market Model estimates 76,000 CAC systems sold in the Northwest in 2018. Ten interviewed market actors sold CAC systems, of the eight offering an assessment of the market sales estimate, six agreed it was reasonable. One market actor estimated that about 60%-70% of the volume would be for replacements.

Sales trends for CAC equipment are unclear. Most contacts (seven of the nine describing trends) indicated that CAC sales had increased over the past few years, consistent with past AHR Expo findings. However, three of them noted that CAC sales are not increasing as fast as heat pump sales (which can provide both heating and cooling).

Figure 6 presents the efficiency mix for CAC systems as reported in the HVAC distributor data collected by NEEA. The trends show an encouraging shift toward higher efficiency products, although sales at the highest tier remain flat (SEER 13 is the current federal minimum, set to increase in 2023).

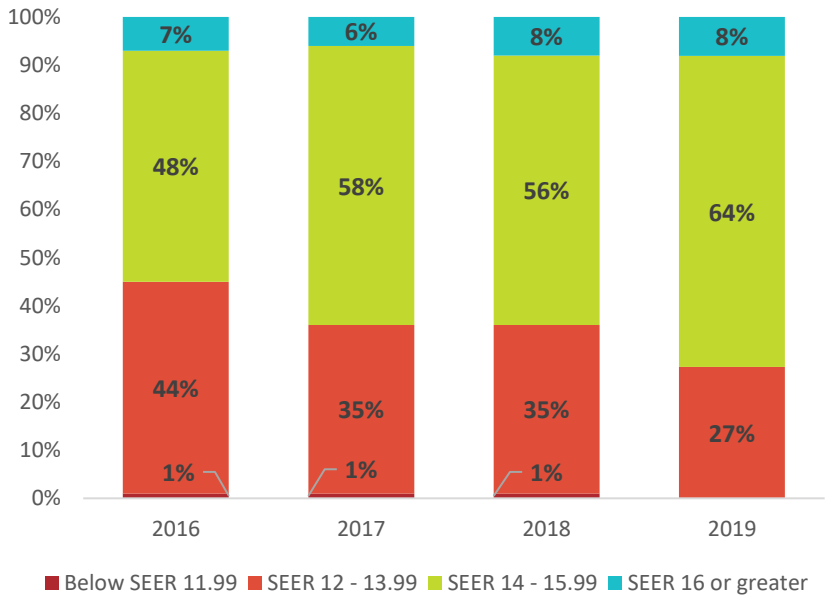

Figure 6: CAC Efficiency Mix: 2016-2019

Other Residential Equipment

The products described above represent four key technologies in the Residential HVAC Market Model and the technologies most commonly installed in Northwest homes. To provide insight into several legacy technologies that continue to serve certain types of homes, the research team sought information on zonal equipment and electric forced air furnaces (eFAF). NEEA's distributor sales data includes a limited number of eFAF, but not zonal equipment (most commonly sold by electrical distributors). The analyses developed from these data did not include regional sales estimates of zonal or eFAF equipment, so instead the team asked contacts for open ended insight into sales trends for these products.

Zonal

Zonal electric resistance equipment (baseboard and wall heating units) uses convection or infrared radiation to directly heat occupants and other objects in the path of the unit. They are inexpensive to install but inefficient to operate. Zonal equipment does not include compressors, drives, or ducting, and is typically sold via electrical distributors or directly from manufacturers. Because the research primarily focused on HVAC distributors and manufacturers, very few contacts reported experience with zonal equipment, consistent with past AHR Expo findings.

The research team interviewed one HVAC distributor and one electrical distributor that sold zonal equipment. The HVAC distributor said that electrical distributors handle the big bids and HVAC distributors will only step in when a design+build firm is not putting the project out for bid. The electrical distributor confirmed that electrical distributors "*sell more than half of the baseboards and wall heaters.*" The fact that only two respondents had experience selling zonal equipment indicates electrical distributors are the primary path for zonal equipment sales.

Contacts reported zonal sales have remained constant over the past five years and expect this trend to continue.

Electric Forced Air Furnaces

Electric forced air furnaces (eFAF) use electric resistance coils to heat warm air circulated throughout the central ducting system. These systems are relatively uncommon in single family homes but are present in more than half of manufactured homes.[11] Manufactured homes are assembled in factories and components are often procured by the suppliers and integrated into the home on the factory floor. The somewhat unique supply chain for manufactured homes means that these units are not typically captured in sales data from traditional HVAC distributors.

EFAF equipment is not a major focus of efficiency programs, other than as a target for replacement. For this reason, the research team asked a limited set of questions on eFAF equipment—focused primarily on trends and expectations for the future. Seven respondents answered questions about eFAF equipment, providing conflicted accounts of market trends—three contacts believe sales will increase, if only slightly and four believe they will decline. As one contact noted: *"EFAF will continue to decrease. Why have an electric furnace when you can have a heat pump?"* Past AHR Expo findings reported a decrease in eFAF sales and a predicted continued decline.[12]

Smart Thermostats

The market research team included a few brief questions to better understand the smart thermostat market trends in the Northwest region. Interviews asked specifically about thermostats with "advanced" smart thermostat features: direct occupancy sensing, heat pump optimization, and a capacity to predict occupancy. It is possible that respondents conflated sales of "smart" and "advanced smart" thermostats in their responses. Other sources of market information (manufacturer or retail sales data) that will be incorporated into the Residential HVAC Market Model later in 2021, are expected to bolster the limited data reported here.

Eleven contacts reported selling smart thermostats, seven of whom provided additional detail on sales trends and availability. These contacts universally reported smart thermostat sales continue to increase, consistent with past AHR Expo findings, although two noted sales have not met their expectations.

- *"We sell a lot of Ecobee thermostats. We also have proprietary thermostats [we can] pair with our high efficiency equipment."*

[11] See BPA HVAC Technology Guide. https://www.bpa.gov/EE/Sectors/Commercial/Documents/BPA_HVAC_Technology_Guide.pdf
[12] https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/2020_BPA_AHR_Expo_Findings_Presentation.pdf

- *"Smart thermostat adoption is definitely increasing. I am seeing consumer demand (they like connected technologies in their homes) as well as utility support with incentives ranging from $75-$100 for the purchase and installation of a smart thermostat."*
- *"They are starting to pick up, but not as much as we would like."*

Line voltage thermostats are typically used for direct-wired electric furnaces, baseboard heaters, or other electric resistance applications. Five market actors reported selling line-voltage thermostats, however only one (an electrical distributor) sold smart line-voltage thermostats. In fact, the other four had either never heard of smart line-voltage thermostats or could not confirm existence or availability.

Commercial Market Insights

The team asked a more limited set of questions on the commercial market, as this research was designed primarily to inform the residential market. Table 7 presents the commercial equipment market actors reported selling. Instead of asking about sales trends for each type of equipment, interviewers asked a series of questions to obtain a high-level perspective on the commercial market. The team asked contacts with commercial product experience to discuss how the sales paths differ from residential products, the role of distributors in the commercial market, prevalence of manufacturer-direct sales, and overall trends in equipment costs and product offerings.

Table 7: Commercial Respondents: Equipment Sold (n=13)

Product	Count of Market Actors
Rooftop units	11
Commercial split systems (air conditioning and heat pump)	9
Packaged terminal heat pump, packaged terminal air conditioning (PTHP/PTAC)	8
Variable refrigerant flow systems (VRF)	9
DHPs for commercial applications	9
Energy recovery ventilators/heat recovery ventilators	8

Market Structure

The commercial HVAC product supply chain includes more types of market actors than those seen in the residential market. The diagram below updates a supply chain map from previous market intelligence research,[13] placing a hybrid "super" rep solidly in the center with manufacturer-specific representatives and traditional supply house distribution on the edges. Hybrid "super" rep type organizations provide design services as part of their role and will also sell equipment directly from a variety of manufacturers. These entities operate in the commercial market, where traditional HVAC distributors play a smaller role,

[13] https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/2016_HVAC_Market_Intelligence_Booklet.pdf

particularly if they are not offering system design services. See the *Approach* section for definitions of these entities.

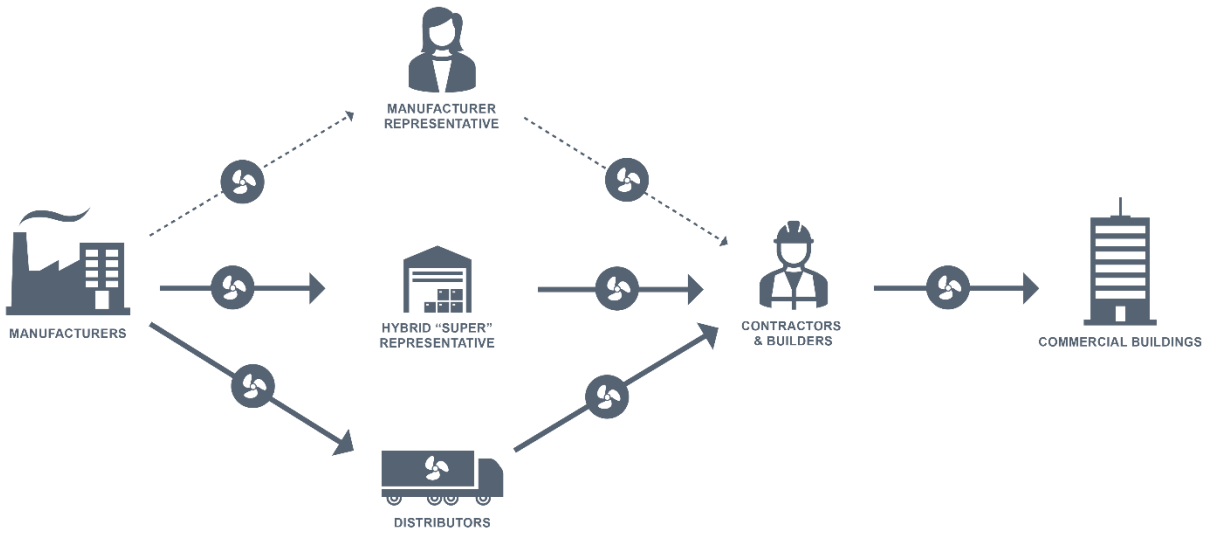

Figure 7: Commercial HVAC Market Supply Chain

Based on the interviews conducted for this project, the most common path for commercial HVAC equipment used in designed systems (which are custom, and often more complex), and likely the largest dollar value stream as well, is the center path in the diagram where a mechanical contractor obtains pricing and design assistance and purchases commercial systems directly from a full-service "super" representative. These entities straddle the line between distribution and manufacturer rep services, offering engineering assistance and custom product selection to meet a variety of complex HVAC project requirements. Less complex commodity products (such as rooftop units, or RTUs) often flow through the lower path, where a contractor purchases the equipment from a distributor supplied by a manufacturer. In this path the manufacturer rep is not involved directly in the transaction; however, manufacturer reps often influence distributor stocking and promotion through direct contact with the distributor. Note that the team cannot estimate the precise portion of products that flow through each path, as it will vary by product type and purchaser.

Role of Distributors

The team asked all interviewees with commercial market experience to comment on the role of distributors. Key informants and market actors both reported that distributors' role in commercial equipment sales tends to be focused on non-custom, commodity (off-the-shelf, mass-produced) packaged equipment often purchased from a catalog or similar. Packaged systems, retrofit kits, and any unitary HVAC equipment under 5 tons typically flow through distribution, as do smaller/packaged systems and code-minimum equipment. Distributors may also carry kits to accomplish some add-ons, or stock economizers. Single- or multi-head DHPs and simple RTUs are often sold through distributors. In

comparison, manufacturer reps are more involved in sales of complex or custom equipment to design+build or mechanical contractors.

Market actors described their specific experience with commercial products in traditional HVAC distribution:

- *"Distributors typically sell cataloged products off the shelf. As manufacturer reps, the majority of what we do is not stocked in warehouse but is ordered and shipped directly to a job site; we do cataloged products and also a lot of custom equipment."*
- *"Packaged rooftop units are most commonly sold through distribution. There are so many in the existing stock, and you need to replace units as they fail."*
- *"All of the equipment [listed by the research team] are flowing through traditional HVAC distribution. Rep firms come in when you get into very large mechanical equipment—like large chillers."*

The path to market can be mixed. Some products, for example VRF systems, are available from both distributors and manufacturer reps. Market actors described mixed availability of VRF equipment from distributors, noting that some distributors are set up to sell VRF, while others still need training. Contacts speculated that a design firm might use manufacturer reps because they need extra help, while an experienced contractor might have the confidence to select and install the equipment without any consultation from distributors or manufacturer reps. Another contact confirmed this, noting that the main differentiation might not be the equipment, but the designer. Regardless of complexity, systems designed by an engineer are more likely to flow through manufacturer reps.

DHPs are another type of equipment that could flow through either sales stream. However, key informants estimate distributors sell 80-90% of DHPs, as most DHPs are residential sales. DHPs only go up to 5 tons—a size insufficient for many commercial spaces but are popular solutions for small retail spaces. Cooling only DHPs (also referred to as ductless air conditioners) are common in new construction, particularly for spaces that require zonal cooling (e.g. equipment rooms, commercial kitchens). Contacts noted that manufacturer reps could be involved in selling these units, if they are part of a larger sale. When the load requires 6–10-ton equipment, VRF equipment is more common than a single zone DHP.

Manufacturer Direct Sales

While contacts agreed that complex and custom systems are typically scoped through manufacturer reps, they offered more discussion on manufacturer direct sales. Some manufacturers are set up for direct sales, operating with a distribution presence and directly representing their own products. In addition to this scenario, contacts also explained that manufacturer direct sales could occur in several other scenarios, including:

- Equipment with a large footprint—particularly equipment that cannot easily be stocked at a local warehouse. "Distributors do not have space for these sorts of things."
- Sales associated with large national accounts, where a single contact might order equipment for multiple facilities. Large companies like Target, Wal-Mart, Google, or Amazon will have a direct relationship with a manufacturer.

- PTAC units ordered in large quantities (for a new hotel or similar project), which may prevent a distributor from "*just dropping it to a contractor and having them install it*" and thus are more likely a manufacturer-direct sale.
- Chillers, cooling towers, or commercial boilers, as opposed to the products listed in the interview (See Table 7).

Contacts did not necessarily have the same perspective on manufacturer direct sales. According to one manufacturer rep: *"There isn't really manufacturer direct sales yet. It should go manufacturer to manufacturer rep to distributor. But the manufacturers are starting to buy up distribution so it will eventually be controlled by one company until it goes to contracting."*

Trends in Equipment Costs

Key informants noted that product costs tend to increase about 3% per year, and that trend has held in recent years. Price increases from tariffs and supply chain disruptions from Covid-19 are non-routine events affecting pricing, but no one suggested a specific numeric impact.

One contact noted the upfront costs have declined on approaches like VRF and dedicated outside air systems (DOAS), as the equipment becomes less expensive and upgrade costs are absorbed in tenant improvements undertaken to free up floor area for other uses.

Market actors working in the commercial sector described relatively stable trend of annual cost increasing approximately 3-7% each year. Five out of ten market actor respondents reported that commercial equipment costs had increased in recent years. Factors affecting equipment costs included tariffs, increased transportation costs, the increasing cost of raw materials (steel, aluminum, galvanized steel, and copper) and increased demand for efficient products, particularly variable speed technologies.

Other Trends

Commercial Manufacturer Product Trends

Key informants described an increasing focus on chilled water and energy recovery, as well as efforts to improve refrigerants such as reducing leaks and lowering global warming potential of new refrigerant options. Market actors repeated several of the overarching trends discussed throughout interviews, with a particular emphasis on high efficiency options in general and VRF equipment specifically.

Increased popularity of VRF: A majority of contacts emphasized the increased popularity and sales of VRV/VRF equipment, consistent with the past several years of AHR Expo findings. The Northwest is a hotspot for VRF heat recovery systems, providing efficient solutions for contractors and customers. Key informants noted that VRF continues to increase in the new construction market as manufacturers and distributors are pushing these products, helped by energy efficiency incentives. VRF equipment is also increasing in retrofit applications, including cases in which the existing infrastructure can be modified to add a variable speed compressor to a variable speed air handler. Because the technology can heat and cool simultaneously and distribute the conditioned air correctly by zone, it is increasingly attractive. Said one market actor: "*In 2017 we did a 14-story downtown building with VRF and this was the biggest purchase in our company's history for a commercial job.*"

Energy and Heat Recovery Ventilators are emerging: As ductless systems became more popular, energy and heat recovery ventilators (ERV/HRVs) also followed suit, consistent with past AHR Expo trends. Key informants noted that smaller energy recovery ventilation devices are emerging, specifically noting Ventacity units, which had "*moved the bar on both energy recovery efficiency and fan efficiency.*" Three of the 13 market actors mentioned ERV/HRVs as an emerging technology in response to the increased demand and emergence of DOAS systems. Respondents noted that this trend will continue to increase as demand for outside air and energy efficiency persist in the region.

New heat recovery chiller offerings: Chillers that can make hot and cold water simultaneously provide a benefit that is creating demand. New manufacturers are entering the market with chillers, including competitive pressure from overseas. These nontraditional suppliers are providing more "high speed" chillers.

Emphasis on air filtration and air quality: Air quality emerged in numerous points during interviews, both in residential and commercial markets. Bipolar ionization, air filtration and UV light are products manufacturers are integrating into new equipment.

More on DOAS…

A dedicated outside air system (DOAS) consists of two separate, parallel systems: A dedicated system for delivering outdoor air ventilation and a separate system to handle the building's primary heating and cooling.

VRF and hydronic systems are the most common DOAS designs since the HVAC system is naturally decoupled with the ventilation system, unlike air-source systems. Pairing these systems with heat or energy recovery on the ventilation system offers a higher efficiency design than code-minimum DOAS systems.

Controls help troubleshoot issues: Cloud-based controls that enable direct communication and diagnostics with commercial systems are increasingly positioned as a solution to help identify and correct a problem before it creates a performance issue, consistent with past AHR Expo findings.

Integrated Design: One key informant described an increasing trend toward integrating envelope and HVAC components, a trend noted in past AHR Expos. Using elements like exterior shading and operable windows, integrating ceiling fans and reducing the emphasis on mechanical HVAC components are all parts of this approach. This approach can also enable decoupled zonal heating systems.

Solutions for electrification: Noting that policies limiting access to natural gas are only now taking effect, market actors described manufacturers working to provide a suite of electric heating and cooling products that can meet customer comfort expectations with efficient solutions. "*Public agencies and municipalities are looking more closely at their carbon footprint and there are avenues for using alternatives for electrification*," said one market actor. Another noted that the gas industry is working on low emission gas heating equipment: "*We are cleaning up combustion more now… oftentimes, trends start in the residential sector first because there is so much volume, then commercial tends to follow.*" While the market had not yet started seeing electrification impacts at last year's AHR trade show, interviewees predicted its growing impact, which appears to have arrived.

Emerging technologies: Several contacts mentioned specific equipment or strategies emerging as new market trends. One of them is the Ephoca HPAC 2.0—a heat pump manufactured in Italy that requires no

outdoor condensing unit—that is described as an alternative for electric wall heaters and a "glorified PTAC" by one contact. Also noted was CO2 hot water heating, including units from Mitsubishi and Sanden that can be deployed to provide domestic hot water or hydronic heating at up to four times the efficiency of electric or gas fired water heating equipment. Finally, contacts mentioned European Union regulations forcing the development of new refrigerants with lower global warming potential, like R32.

Commercial Distributor Positioning Trends

According to key informants, distributor positioning reflects their commitment to efficiency and to efficiency programs. Some distributors are quite engaged in promotion and others specifically align with efficiency in their positioning. Many are looking for ways they can add value or become more vertically integrated—for example supporting design+build professionals, or integrating manufacturer rep services directly, or expanding product lines to include combination systems, tankless water heaters or similar. Others have expanded into other sectors (for example, moving beyond residential systems into commercial equipment supply).

Market actors had less to say about how distributors are adjusting their positioning for commercial sales. Those that offered insight focused on increased professionalization and the on-going relationship adjustments that occur behind the scenes among competitors.

- *"Distributors have had to increase their technical ability. Instead of a standard sales force it is becoming more important to have more technical sales. Degreed engineers, consulting engineers, folks who understand the technology on a more advanced level. It is becoming more and more important to have this expertise in house."*
- *"There is a lot of relationship building and leveraging those relationships to get deals and loyalty. Lots of regional influence."*