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Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report 6

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Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) engaged Cadmus in November 2016 to conduct the sixth market progress evaluation report (MPER 6) for NEEA's Northwest Ductless Heat Pump Initiative (initiative). The initiative, which NEEA launched as a pilot in 2008 and at full scale in 2010, encompasses a range of activities to accelerate the adoption of ductless heat pump (DHP) technology by working with upstream and midstream market actors, promoting and supporting effective installation of DHPs in existing homes, supporting initiatives offered by Northwest utilities, and building consumer and market awareness.

This report presents evaluation findings based on several research activities: a web-based survey of homeowners in NEEA's target markets who do not own DHPs, using a choice-based methodology to measure the relative strength of DHP features; in-depth telephone interviews with NEEA's regional utility partners, Initiative staff, and regional distributors; a web-based survey of participating installers; and review and analysis of initiative documentation and data sources.

The initiative tracks market progress in three target markets (TM)—single-family homes with zonal heating (TM1), single-family homes with electric forced air furnaces (TM2), and manufactured homes with electric forced air furnaces (TM3). Since 2008, an estimated 162,333 DHPs have been installed in the region, with 68,253 (42%) installed in NEEA's target markets. Although total annual DHP installations have increased each year since 2008, substantial growth in each of the target markets is needed to meet NEEA's market saturation goals—currently, market saturation is between 5% and 18% of target 2039 maximum saturation for each of NEEA's three market segments.

The following are Cadmus' key findings, conclusions, and recommendations from this market progress evaluation.

Key Findings, Conclusions, and Recommendations

Initiative Data Sources and Tracking

Conclusion: NEEA is adequately capturing available sources of DHP market data; however, opportunities remain for filling minor data collection and analysis gaps. To track DHP market progress, NEEA gathers and synthesizes data from a variety of sources, including distributor sales data, rebate tracking data, utility surveys, and installer surveys. Employing multiple sources means that the existing data vary in scope and granularity, and Cadmus identified two primary gaps and uncertainties—that a portion of total DHP installations and incented target market installations may not be tracked, and detailed installation data are lacking for DHPs installed through utility programs not served by CLEAResult. Despite these gaps and uncertainties, Cadmus determined that there are not other currently accessible and comprehensive sources of market data that NEEA has yet to explore.

Recommendations:

- The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) aggregates distributor sales data for DHPs from its member companies, representing the majority of the United

States market. NEEA should continue working with AHRI to try to acquire these data, which could help fill in gaps regarding total DHP installs in the region. However, these data are typically available only to member distributor and manufacturer organizations and the likelihood of obtaining these data is likely quite low.

- To gather more detailed data on incented installations from utilities not served by CLEAResult, NEEA is considering a data request of these utilities to gather additional information such as head configuration, capacity, and efficiency level. NEEA should compare these data to the CLEAResult rebate tracking data; if there are not significant home and DHP characteristic differences, NEEA may not need to gather these data on an on-going basis. However, if there are substantial differences NEEA should consider fielding this data request annually and incorporating these findings into estimates of market penetration.

Customer Purchase Decision

Conclusion: DHP awareness has remained steady, though more customers are learning about DHPs through the internet. Overall awareness of DHP technology remained about the same as in prior years, with 37% of respondents aware of the technology compared to just over 40% in MPER 5.¹ Similar to prior MPERs, word of mouth continues to be the most common way consumers (who have not purchased a DHP) learn about DHPs; however, a significantly greater proportion of customers learned about DHPs through the internet than in the previous MPER.

Conclusion: Contrary to supply chain market actor and regional partner perceptions stated in prior MPERs, the fact that DHPs must be mounted on an interior wall is not a significant purchase barrier. Prior studies and word-of-mouth feedback from installers have led to conflicting perceptions about whether the fact that DHPs must be mounted on an interior wall poses an important barrier for prospective buyers. This study found that the wall mounted equipment was a mostly neutral attribute, with nearly all consumers considering it neither a very strong benefit nor a drawback relative to other product attributes. This finding confirms the findings from customer surveys from the previous MPER.

Conclusion: Target market consumers find the following DHP features most motivating: that DHPs can reduce monthly heating costs up to 50% and that they provide cooling as well as heating. Emphasizing these messages will be most effective in encouraging consumers to purchase DHPs.

Generally, the most powerful selling points for a DHP were equally important to respondents. However, the study found that a DHP warranty was more important for consumers in rural locations, and for those with an electric furnace. In addition, those with an electric furnace rated the opportunity to use DHPs to supplement existing equipment as more beneficial, and those who were dissatisfied with existing equipment found beneficial DHP features even more beneficial. Though there were no major differences in the relative importance of these features (judged by their rank order), the utility scores were higher among people who were not satisfied.

¹ This difference is not statistically significant.

Respondents identified only three features as real drawbacks to purchasing a DHP—the strongest was that DHP equipment is new to the United States but common in Europe and Asia, followed by DHPs typically requiring professional installation, and the need for periodic maintenance.

Recommendations:

- Disseminate key findings from customer purchase decision research, including the most compelling product attributes, to initiative stakeholders and market actors. These findings can assist regional partners, installers, distributors, and manufacturers in developing the most effective messaging and communication to target market consumers.
- Emphasize the most compelling product attributes in all consumer-facing communication and marketing materials.

Conclusion: DHP price is the dominant factor in purchase intent for consumers with functioning existing HVAC systems; overcoming the cost barrier is still critical for accelerating market adoption.

Through the consumer survey, Cadmus determined that purchase intent had a statistically significant relationship with price point, with respondents much more likely to purchase a DHP at the lowest price scenario presented (\$2,500). Yet, even at the lowest price point, just 14% of respondents reported that they *definitely would buy*, and another 25% said they *probably would buy*, which indicates that the relatively high cost of the system is still a barrier when existing heating systems are still functioning. In addition, Cadmus notes that respondents often overestimate their purchase intention in surveys, so these percentages are likely a high estimate of the true likelihood to buy. Consumers indicated that availability of financing and rebates would increase their likelihood to purchase.

If DHP sales continue at the current pace, NEEA may fall short of its 2039 market saturation goals. Although NEEA has seen year-over-year growth in DHP installations in all three target markets, substantial growth is still needed to reach NEEA's market saturation goals—currently, market saturation is between 5% and 18% of target 2039 maximum saturation for each of NEEA's three market segments.

Recommendation:

The revised NEEA logic model correctly identifies the lack of a triggering event as a barrier to market adoption. The messaging research Cadmus conducted for this MPER clarifies the most compelling product attributes, which should help the initiative and market partners overcome that barrier to some extent. However, because product attributes are only one component of marketing, Cadmus recommends that NEEA consider assessing DHP marketing more comprehensively to identify the most effective approaches for creating urgency (e.g., storytelling; call to action; solution-oriented messaging), in order to address this market barrier.

Current and Emerging DHP Trends

Conclusion: Additional market intervention will be needed to reduce DHP costs.

According to CLEAResult initiative tracking data, the average costs for 1:1 DHP installations (a single outdoor compressor unit paired with a single indoor heating/cooling unit) are increasing,

as is the share of 1:2 installations (a single outdoor compressor paired with more than one indoor unit), which are more costly than 1:1 configurations.

Most surveyed installers believed that installation costs would increase over the next two years, while distributors were split on whether they thought equipment and installation costs would increase or decrease. Some distributors who thought installation costs would increase said installers already have a narrow profit margin, so as newer, more complicated units enter the market, installers would have to charge more for installations. One distributor expected that installation costs would increase due to a shortage of skilled installers. Conversely, distributors who thought installation costs would decrease said that installation costs would be driven down by a more competitive marketplace, better installation accessories (resulting in easier DHP installation), and improvements in installer education about proper installation techniques and sizing.

Regarding installation costs, regional utility partners agreed that installers were charging competitive installation rates. To reduce equipment costs, regional partners suggested that NEEA try to influence manufacturers to reduce costs. For example, one regional partner said that NEEA should consider influencing manufacturers to make more lower-HSPF or lower-capacity DHPs, promoting “the sedans” rather than the “Cadillacs.”

Recommendation:

Consider working with supply chain market actors to encourage increasing the availability of less expensive product. NEEA should continue engaging with lower cost product manufacturers to help bring lower cost products to the market. NEEA could also consider working with distributors to provide installer access to products at a variety of price points, and working with installers willing to assist customers with a CAI (see recommendation below).

Conclusion: Without new or compelling market intervention, the market share of 1:1 displacements is not likely to increase in the future.

NEEA considers the lack of supply chain acceptance for 1:1 displacement to be a critical market barrier to increasing DHP affordability and accelerating consumer adoption of DHPs. Although 1:1 displacements are a focus for the DHP Initiative, findings from installers, distributors, and Initiative tracking data suggest that the share of 1:1 installations is not likely to increase without new or compelling market intervention. Approximately half (52%) of DHP installations reported by surveyed installers were 1:1, (which matches CLEAResult tracking data for incentive installations [54% of installations]), a decrease from 62% to 60% between 2013 and 2015. Similar to installers, interviewed distributors said they anticipate the multi-zone market share of DHP sales will increase in upcoming years.

Recommendation:

If 1:1 displacements continue to be a focus of the Initiative, NEEA should explore additional market interventions to address this barrier. NEEA should continue to support efforts to identify single family homes with zonal heat that are most appropriate for 1:1. Both NEEA and regional partners are considering opportunities to better serve the low-income segment. Cadmus’ customer survey found that both DHP awareness and purchase intent are lower among lower-income customers. There may be opportunities for NEEA to influence installation of lower cost

1:1 units for this segment through building strategic alliances with community action agencies or other organizations to promote and install DHPs that meet the needs of low-income residents or by facilitating bulk purchasing and/or installation of DHPs.

NEEA could also consider developing a definition for the appropriate application of the technology, because 1:1 displacements may not be the most appropriate application in all installation scenarios. Once the appropriate application of the technology is defined, NEEA should assess the sufficiency of existing resources to evaluate the appropriate application of the technology, and if possible, assess the proportion of installs that can be classified as “appropriate technology application” using CLEAResult’s tracking database and updated RBSA data. If current data sources are not sufficient to assess appropriate technology application, NEEA should explore opportunities to gather these data.

Conclusion: Contractor assisted installations (CAIs) represent a potential opportunity for reducing DHP costs; however, NEEA should proceed with caution.

A quarter of installer respondents said they had performed some component of a CAI, and one in five said they would be *somewhat likely* or *very likely* to provide these services in the future. However, the majority of installers expressed strong opposition to CAIs—two-thirds said they were *very unlikely* to provide any of these services and expressed concerns over lack of fit with their business model and profit reduction, liability, warranty issues, equipment performance and reliability, and rebate eligibility. Similarly, distributors also expressed concerns about customer inexperience and poor-quality installation, and the effect it might have on customer’s perception of DHPs overall. No distributors are currently selling quick connect ductless systems, and most are not planning to do so in the future.

Recommendations:

- Continue to explore opportunities to develop the CAI channel outside of the typical HVAC contractor and distributor model.
- Engage HVAC installers and other equipment installers who are receptive to assisting with components of CAIs. If these installers are viable options for utility program involvement place them on the goingductlessGgoingDuctless.com website.

1 Introduction

1.1 Initiative Overview

In 2008, the Northwest Energy Efficiency Alliance (NEEA) launched the Northwest Ductless Heat Pump Project as a pilot to demonstrate the viability of inverter-driven ductless heat pumps (DHPs) to displace electric resistance heat in existing Northwest homes. The DHP Initiative, which NEEA launched at full scale in 2010, encompasses a range of activities to accelerate the adoption of DHP technology by working with upstream and midstream market actors, promoting and supporting effective installation of DHPs in existing homes, supporting initiatives offered by Northwest utilities, and building consumer and market awareness.

1.2 Research Objectives

NEEA has completed five previous market progress evaluation reports (MPERs) for its DHP Initiative. For this sixth MPER, NEEA prioritized five evaluation objectives to augment and expand upon prior research, which this report addresses:

- Review logic model and assess progress toward initiative goals
- Review and assess existing initiative data sources and tracking
- Enhance understanding of the components of customer purchase decisions
- Document regional trends in DHP promotion and incentives
- Identify emerging trends in the residential DHP market

1.3 Organization of this Report

Cadmus organized this report into the following sections:

- Methodology
- Findings
- Conclusions and recommendations
- Appendices

2 Methodology

2.1 Stakeholder Interviews

Cadmus conducted two group interviews with Initiative staff: one with two NEEA staff and another with two CLEAResult implementation staff, all of whom had been involved with the initiative. These interviews explored program goals and progress, emerging trends both regionally and nationally that might impact initiative strategy and logic, the current state of promotional activities and incentives and perceived impacts, and an accounting of initiative challenges and needs related to data sources and tracking initiative performance.

2.2 Logic Model Review

Cadmus reviewed NEEA's DHP Initiative logic model to assess its clarity, relevance, and evaluability and compare its validity to empirical research findings. Cadmus reviewed and assessed initiative documents and gathered additional insights to inform the comprehensive logic model review through interviews with initiative staff, and regional partners, customer surveys, and supply chain partner research.

2.3 Documentation of DHP Market Progress

Cadmus used program tracking data provided by CLEAResult, the initiative implementer, and NEEA and findings from prior MPERs to assess the number of DHP installations over time in the region and the progress toward market saturation goals.

2.4 Assessment of Initiative Data Sources

Cadmus conducted a thorough review of initiative tracking data and materials (including findings from prior MPERs) and conducted stakeholder interviews to document the data sources used by the initiative, identify key data challenges and gaps, and provide guidance on addressing data challenges.

2.5 Customer Purchase Decision Survey

Cadmus conducted an online survey of 520 consumers in the Northwest target market. The survey contained questions about consumer awareness of DHPs (the questions were modeled after the MPER 5). The survey also incorporated two choice experiments—a choice-based conjoint experiment and maximum difference (MaxDiff) scaling—to measure the relative strength of DHP features for consumer messaging and marketing. These analyses are explained in the following sections.

Cadmus conducted an online survey of a sample of homeowners in Idaho, Montana, Oregon, and Washington using customer e-mail addresses from a consumer panel purchased through Qualtrics, a market research firm. The Qualtrics panel was prescreened to ensure homeowners lived in one of the four states and that their home had electric heat.

The survey asked questions to confirm respondents' primary heating system and screened out any who used a heat pump or a non-electric fuel source for their primary heating system. (Respondents who used a non-electric fuel source for a secondary heating system were still eligible to participate.)

The NEEA DHP Initiative sets goals for market penetration in two main target markets: single-family homes with electric forced air furnaces and single-family homes with zonal heat.² Cadmus therefore stratified the sample to obtain an equal number of the two heating system types.

To examine any differences between rural and urban location, Cadmus also tracked respondent zip codes and categorized urban and rural location according to the Rural-Urban Continuum Codes obtained from the U.S. Department of Agriculture (USDA) website (USDA 2013).

Table 1 shows the number of completed surveys by heating type and location.

Table 1. Completed Surveys by Heating Equipment and Locality

Location	Heating Type		Total
	Electric Forced Air Furnace	Zonal	
Urban	193	177	370
Rural	67	83	150
Total	260	260	520

2.5.1 Choice-Based Conjoint Methodology

Conjoint methodology can be used in a variety of applications involving ratings of products, evaluation of product features, or identification of preferred products from a set. For this study, Cadmus applied a choice-based conjoint approach that involved asking respondents to rank their likelihood to purchase a DHP according to a random combination of displayed features at a randomly displayed price.³ Cadmus used the Sawtooth Software modeling platform to design and analyze customer preference for DHPs at various price points.

The survey contained a set of twelve questions. Each question showed a subset of four or five DHP attributes, or features, at random (out of a total of thirteen features) and asked respondents how likely they would be to buy the heating system at one of eight price points—\$2,500, \$2,750, \$3,000, \$3,250, \$3,500, \$3,750, \$4,000, and \$4,250. These DHP attributes are listed in the survey instrument contained in 5Appendix D.

Across questions, the features and the price point shown varied independently, according to an experimental design. Respondents rated each of their twelve questions on a five-point purchase intention scale. The survey treated the choice of *definitely would not buy* as the *none* alternative in the statistical analysis. Cadmus analyzed purchase likelihoods as a function of the prices and DHP features.

2.5.2 Anchored MaxDiff Methodology

Cadmus also used MaxDiff scaling to test which non-price DHP features consumers found most compelling. MaxDiff scaling relies on a statistical model to determine the attribute importance of a particular product.⁴ For each set of four or five DHP features presented, the survey asked

² Includes manufactured homes.

³ The design used was a single-profile choice-based conjoint, with a dual-response allocation none.

⁴ The analysis uses a hierarchical Bayesian mixed logit model.

which one single feature made the respondent want to own the heating system the *most* and which the *least*. The analysis produced a utility score for each of the DHP attributes presented; these scores are the coefficients produced by the conditional multinomial logit model and allowed Cadmus to measure the relative power of each feature.

Cadmus also assessed the *absolute* value from the customer's point of view (that is, which features were positive traits that could increase demand for DHPs and which were negative traits that could dampen demand). To derive the absolute values, Cadmus added an anchoring component to the MaxDiff model by using one additional question that asked respondents to give each of the thirteen features a "pro" or a "con" in their decision-making process. This allowed Cadmus to add a zero point to the MaxDiff utility scale so that beneficial features had positive utility scores and detrimental features had negative utility scores.

2.6 Regional Partner Interviews

To identify regional trends in DHP promotion and incentives, Cadmus conducted in-depth telephone interviews with ten of NEEA's regional utility partners, which consisted of nine public utilities and one program administrator. These utilities represented all states in NEEA's region and were evenly split east and west of the Cascades. Six of these utilities were in Washington, and four of these were qualified utilities under the Washington Clean Energy Initiative (I-937).

These interviews gathered insights about regional partners' perceptions of the impact of market conditions on program offerings and incentives, how they identify and promote DHPs to consumers, and how they engage with installers and other supply chain actors. The interviews also explored recommendations for enhancing DHP Initiative efforts and the support provided by NEEA to regional partners and DHP programs.

2.7 Supply Chain Actor Interviews and Surveys

To identify emerging trends in the DHP market, Cadmus conducted an online survey of participating installers and in-depth telephone interviews with distributors. Cadmus fielded the survey in April and May 2017 and completed surveys with 70 participating installers (including 13 master installers). Cadmus completed the six distributor interviews in May 2017.

These surveys and interviews gathered insights on DHP promotion and marketing, training and initiative communication, equipment sales, and experience with and perceived opportunities for various equipment types and market segments, including the viability of contractor-assisted installations (CAIs).

3 Findings

This section describes study findings for the logic model review, data sources assessment, consumer survey, regional partner interviews, and supply chain partner surveys and interviews.

3.1 Logic Model Review

Cadmus reviewed NEEA's DHP Initiative logic model (Appendix A) and associated market progress indicators.

3.1.1 Logic Model Updates

In 2016, NEEA substantially revised the DHP Initiative logic model, with a focus on reviewing and clarifying associated market progress indicators (MPIs) and updating the model to reflect findings and recommendations from prior MPERs. In addition to multiple refinements to all logic model components—barriers/opportunities, activities, outputs, and outcomes—NEEA made several substantive changes to initiative logic, including barriers and outcomes.

Barriers

NEEA revised the logic model barriers to reflect current market barriers and made the following changes:

- **Removed these barriers:**
 - “Concerns with aesthetics” as a barrier to reflect prior research findings (bolstered by the consumer purchase research conducted for this MPER) that, despite installer, supplier, and utility perceptions, consumers do not consider aesthetics a major barrier to the purchase and installation of DHPs.
 - “Limited customer education on proper DHP operations.”
- **Added these barriers:**
 - “No trigger event” to reflect the initiative’s focus on the displacement market and lower customer motivation to purchase a DHP when their current heating system is functioning.
 - “Utility cost-effectiveness” to incorporate the finding from prior MPERs that regional partners are concerned about changes in savings assumptions for DHPs in the Regional Technical Forum (RTF), which could reduce the cost-effectiveness of their DHP programs and affect their DHP focus in the future.
 - “Existing business model drives higher costs.”

Outcomes:

In 2016, NEEA reviewed and clarified MPIs and made refinements to address current market barriers, including these changes:

- **Removed these MPIs:**
 - “Aesthetic concerns alleviated” because prior MPERs determined that this is not a substantial challenge and therefore does not need to be a focus on the initiative.
 - “DHP in-field performance improves.”
- **Added these MPIs:**
 - “Consumer has sufficient knowledge to demand high performance equipment at competitive price.” NEEA determined that customers need not necessarily be aware

of the details associated with DHPs (given the rarity of HVAC replacement and the importance of the contractor's role in the customer's decision) but rather that they have sufficient resources available to support decision-making and supply chain recommendations.

- “DHP technology is the technology of choice for zonal and electric forced air furnace (eFAF) installations” as a precursor to existing market transformation goal that “DHPs are installed in the majority of electrically heated homes in the target market.”

3.1.2 Logic Model Assessment

Cadmus reviewed the logic model for clarity, relevance, evaluability, and comparison of validity to empirical findings.

Clarity/Relevance

- Cadmus found that the current logic model does not sufficiently address the market barrier of “no trigger event.” It is unclear which, if any, outputs or outcomes are in place to directly address this critical market barrier.
- NEEA revised MPI I in the updated logic model to include “appropriate application for the technology is applied; proper sizing, units, and application.” NEEA is investigating how to define “appropriate application for the technology,” but it does not currently have a clear definition for determining or evaluating appropriate technology application.
- For MPI II in the revised logic model, it is unclear how “reduced time for sales/install process” is defined and how it relates to the increase and acceleration in purchase funnel activity.

Validity to Empirical Findings

- In the revised logic model, NEEA added the barrier of “no trigger event.” However, findings from past and current research suggest that instead of a lack of a trigger event, there are likely multiple motivations for DHP purchase (e.g. a need for cooling in addition to heating, lack of home comfort, high energy bills) with no **primary** trigger event (i.e. equipment failure).
- The first part of MPI I: “Supply chain adoption grows for 1:1/displacement” does not align with current research findings. Prior research, including data from the program tracking database and MPER installer surveys, found that 1:1 displacements represented approximately 60% of DHP installations in the region. The current MPER installer survey found that reported that the share of 1:1 DHP installations had decreased from prior years (52% of 2016 DHP installations), which is in line with CLEAResult's tracking data from 2016 (54%). Additionally, interviews and surveys with supply chain actors in this MPER indicated that this proportion is not likely to increase in the future—both installers and distributors said they expected the share of multi-zone DHPs to increase in the coming years.
- To address the high first cost of DHPs, NEEA has identified the improvement of DHP affordability (MPI VI) as a medium-term outcome. However, these findings from the current MPER suggest that this is not currently occurring in the market— CLEAResult's tracking data show that average costs for incented 1:1 DHPs are increasing (though this represents only approximately 10% of all incented installations), installers believed installation costs would increase, and distributors offered no consensus about whether

costs (equipment and installation) would decrease or increase. The CAI channel, which has the potential to reduce DHP costs, is not currently developing and a majority of installers expressed strong resistance to offering these services. Interviews with NEEA staff indicated that the availability of less expensive DHP equipment from international manufacturers could reduce DHP costs; however, this is not included as an output or MPI in the current logic model.

Evaluability

As part of the revisions to the 2016 logic model, NEEA identified and updated existing data sources, research, and data collection efforts to evaluate MPIs. However, several gaps remain:

- For MPI I, a definition or evaluation protocol for assessing appropriate technology application does not yet exist; however, NEEA is considering developing this definition.
- For MPI II, NEEA is considering testing quarterly surveys to estimate purchase funnel activity, but does not yet have sufficient data to confirm that this approach will support on-going measurement of this MPI.
- For MPI IV, NEEA will continue to review retail opportunities in 2018 to improve price transparency, increase product sales and decrease total install cost through this channel.

3.2 DHP Market Progress

This section provides an overview of market progress for NEEA's DHP initiative.

3.2.1 Target Market

The initiative aims to accelerate the adoption of DHPs in three target markets (TM):

- **TM1.** Single-family homes with zonal heating
- **TM2.** Single-family homes with electric forced air furnace
- **TM3.** Manufactured homes with electric forced air furnace

Since 2008, the initiative has tracked the market progress in target markets over time and reported the results by year in each MPER. This MPER presents the market progress up to and including 2016.

3.2.2 DHP Installations in 2016

As shown in Table 2, NEEA estimated 35,814 DHP installations in 2016, of which 12,914 (36%) were within the initiative's three target markets. The vast majority (98%) of DHP installations that received utility incentives in 2016 were in the target markets, while, not surprisingly, nearly two-thirds of total 2016 DHP installations were outside the initiative's target markets.

Table 2. DHP Installations in 2016

	Incented	Non-Incented	Total
Target Market	9,658	3,256	12,914
Outside Target Market	158	22,742	22,900
Total	9,816	25,998	35,814

Source: NEEA DHP ACE Model, June 2017.

Table 3 shows installations in the initiative's target markets. The 9,658 installations for which utilities provided incentives accounted for three-quarters of the installations in the initiative's target markets. The remaining 3,256 installations did not receive utility incentives.

Of the target market installations, 78% displaced zonal heating in single-family homes (TM1). The remaining units displaced electric forced air furnaces—13% in single-family homes (TM2) and 9% in manufactured homes (TM3).

Table 3. Target Market DHP Installations in 2016

Target Market	Incented	Non-Incented	Total
TM1. Single-Family Zonal	7,613	2,494	10,107
TM2. Single-Family Electric Forced Air Furnace	1,212	456	1,668
TM3. Manufactured Homes Electric Forced Air Furnace	833	306	1,139
Total	9,658	3,256	12,914

Source: NEEA DHP ACE Model, June 2017.

3.2.3 DHP Market Saturation

Table 4 presents the estimated DHP market saturation for each initiative target market.

Table 4. Targeted DHP Market Saturations (2008–2016)

Target Market	Market Size	Target Maximum Saturation*	Cumulative Units (2008–2016)	Market Saturation (2008–2016)	Percent of Target Maximum Saturation
TM1. Single-Family Zonal	505,066	65%	59,346	11.8%	18.1%
TM2. Single-Family eFAF	222,981	20%	6,586	3.0%	15.0%
TM3. Manufactured Homes eFAF	280,585	14%	2,321	0.8%	5.7%
Total			68,253		

Source: NEEA DHP ACE Model, June 2017.

*For the 2016 ACE Model Update, NEEA revised the target maximum saturation for TM1 from 85% to 65%, to reflect recent trends and align with the RTF's Power Plan estimates.

An evaluation metric of market progress is to compare the current market saturation estimates with the target maximum saturation sought. Table 4 shows that TM1's current market saturation (11.8%) is about 18% of its 2039 target maximum saturation of 65%, whereas TM3's market saturation is about 6% of its 2039 target maximum saturation. These results indicate there is still substantial room for growth in each of the target markets.

As shown in Table 5, the market saturation for all target markets increased from 2015. Although TM3 has achieved the lowest percent of target maximum saturation among the three target markets, the year-over-year unit growth in TM3 reached 42.9%, with 797 installations in 2015⁵ and 1,139 installations in 2016. The year-over-year unit growth for TM1 was much lower, at 6.8%, and TM2 achieved the lowest year-over-year unit growth, at 3.2%.

⁵ NEEA DHP ACE Model

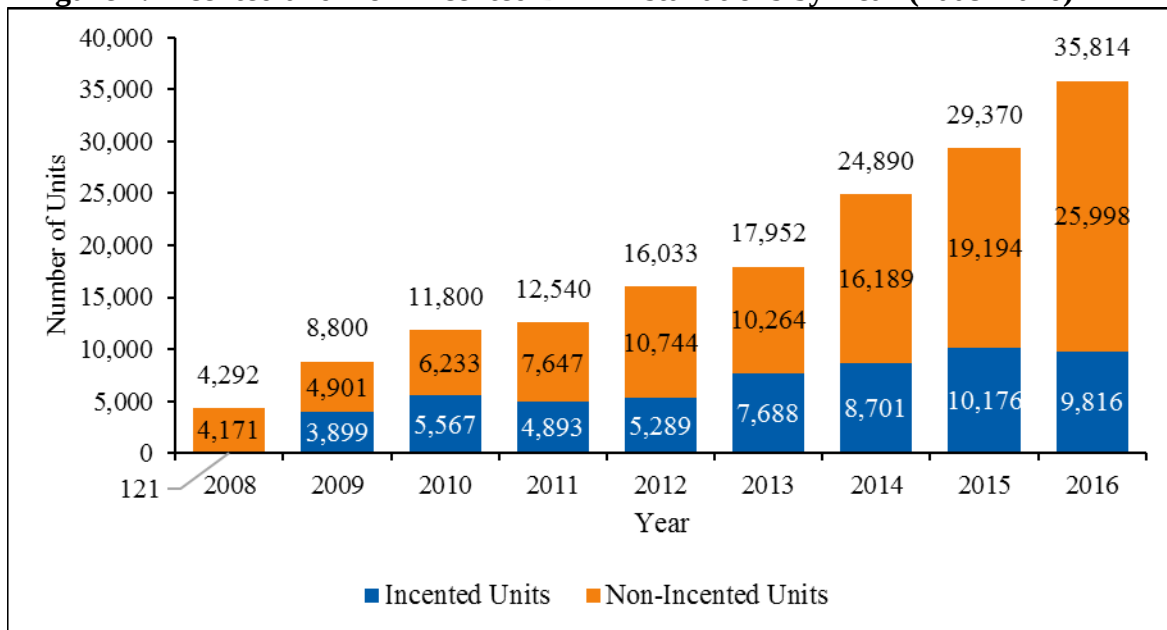
Table 5. Year-Over-Year Target Market Unit Growth (2015-2016)

Target Market	2015	2016	Year-Over-Year Growth
TM1. Single-Family Zonal	9,461	10,107	6.8%
TM2. Single-Family eFAF	1,616	1,668	3.2%
TM3. Manufactured Homes eFAF	797	1,139	42.9%
Total	11,874	12,914	8.8%

Source: NEEA DHP ACE Model, June 2017.

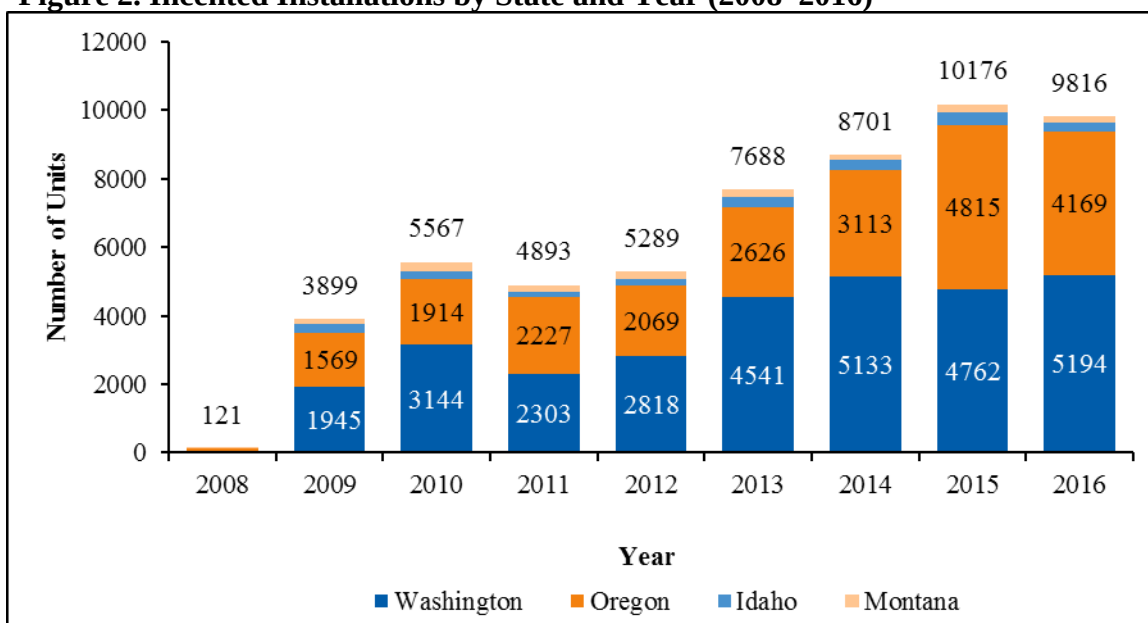
3.2.4 DHP Installations Over Time

NEEA has tracked regional DHP installations since 2008. Figure 1 shows the number of incented and non-incented DHP installations (without differentiating between units inside and outside the target markets) by year. As the figure shows, total DHP installations have increased each year since 2008. As the number of DHP installations increases from year to year, the proportion of incented installations has decreased. In 2016, the proportion of incented installations hit an all-time low at 27%, compared to 35% in 2015. This decrease was mostly attributed to the increase in non-incented installations, which were predominantly outside the target markets and included commercial, new construction, and home additions.

Figure 1. Incented and Non-Incented DHP Installations by Year (2008–2016)

Notes: Source: NEEA DHP ACE Model, June 2017.

Figure 2 presents the incented installations by state and year. The figure shows that, despite an increase of incented installations in Washington, the total number of incented installations decreased from 10,176 in 2015 to 9,816 in 2016. This decrease was mainly attributed to a decrease in installations in Oregon. Incented installations in Idaho and Montana also slightly declined—in Idaho from 372 in 2015 to 265 in 2016 and in Washington from 227 in 2015 to 188 in 2016.

Figure 2. Incented Installations by State and Year (2008–2016)

Source: NEEA DHP ACE Model, June 2017

3.3 Data Sources and Tracking Assessment

To track DHP market progress, NEEA gathers and synthesizes data from a variety of sources. Cadmus assessed the sufficiency of the data sources and documented any data collection gaps and uncertainties by reviewing the data sources and gathering additional information from interviews with NEEA and CLEAResult staff.

3.3.1 Initiative Data Sources and Gaps

Employing multiple sources means that the existing data vary in scope and granularity. Cadmus examined the quality of the data as well as how the data were used. The following discusses the data sources NEEA used to track DHP market progress with their associated gaps and uncertainties.

Distributor Data. To track the total number of DHPs installed in the region, NEEA collects comprehensive sales data by state from distributors.

- Gap/Uncertainty.** NEEA does not have access to official manufacturer data and thus uses distributor data as the best available source for tracking total regional DHP installations. Through on-going interactions with and market intelligence from the national DHP market, NEEA suspects that the distributor data may be underreporting the total number of units in the region by between 10% and 30%. However, NEEA does not currently have access to data to support an adjustment to the total number of units.

CLEAResult Tracking Database. CLEAResult's DHP Initiative tracking database captures detailed rebate processing data for the units incentivized by utilities for which CLEAResult is the program implementer. NEEA uses these data to determine characteristics of incentivized DHP units, including displaced heating equipment, head configurations, heating seasonal performance factor (HSPF) levels, and capacity levels.

- **Gap/Uncertainty.** The CLEAResult tracking database does not track rebated installations, and the associated detailed installation data, for any utilities that are not served by CLEAResult, representing only approximately 10% of all incented DHPs

NEEA Utility Survey. NEEA fields an annual utility survey to record incented units by NEEA's three target markets.

- **Gap/Uncertainty.** According to NEEA, the utility survey captures most utility-incented units in the target markets. However, NEEA acknowledges that a small number of incented DHPs may go unreported due to the timing of the utility survey.
- **Gap/Uncertainty.** CLEAResult's data contains additional information about the installed units; however, utilities not served by CLEAResult do not supply these additional details. NEEA is considering fielding a data request of these utilities to capture the additional market intelligence data.

MPER Installer Surveys. To estimate the number of non-incented DHP installations in each target market, NEEA uses data gathered from DHP MPER installer surveys. The 2014 MPER installer survey asked installers for the number of reported installations that did not receive a utility incentive and the percentage of these installations in each target market (see Table 8 in the Non-Incented DHP Installations section of this report). By combining these results, NEEA estimated the percentage of non-incented installations in each target market. NEEA applied the estimated installation rate of non-incented DHPs in each target market from the MPER installer survey to all units tracked outside of the target market incented units, to derive the number of non-incented units in each target market.

- **Gap/Uncertainty.** To disaggregate the 2016 installations, NEEA uses estimated proportions from the MPER in 2014. The disaggregated results may not reflect 2016 proportions because of the two-year lag in the data.

Residential Building Stock Assessment (RBSA). NEEA uses results from the RBSA to estimate the market size for each of its three target markets. NEEA currently uses the 2009 market size estimates from the 2011 RBSA; however, updated RBSA data will be available in late 2017.

Gap/Uncertainty: To determine market penetration, NEEA compares the cumulative number of units installed in its three target markets against their estimated market sizes. NEEA conducts periodic building stock assessments to adjust market size estimates, as needed, to reflect shifts in the market overtime. The current estimated market sizes reflect the existing equipment stock in 2009, and may be updated when 2017 building stock assessment data are available. As a result, the calculated market penetration rates and the target maximum penetration rates may require updating.

3.3.2 Data Tracking Diagram

Cadmus created a visualization of NEEA's data sources and analysis process for tracking DHPs installed in target markets (Figure 3). The derivation of each block of units is explained after the diagram.

Figure 3. NEEA DHP Tracking Diagram

These are the derivations of each block unit:

- The top bar, which shows all DHP units installed in the region (**A**), is an unknown number but is estimated by NEEA to be 10% to 30% more than are currently tracked through distribution.
- NEEA tracks units in the region with the distributor data—the second bar separates the heating-and-cooling units (**B**) from the cooling-only units (**C**). Cooling-only units are not included in NEEA’s target market.

The third bar shows that data regarding the target market incented units (**D**) comes from NEEA’s utility survey.

- Also in the third bar, the target market non-incented units (**striped**) and heating-and-cooling units outside the target market, combined, are estimated as the target market incented units (**D**) subtracted from the distributor data heating-and-cooling units (**B**).

- The last bar presents the DHP units in the most granular form. Target market incented units (**D**) and target market non-incented units (**striped**) are further categorized by specific target markets. For (**D**), the number of incented units in each target market comes directly from NEEA's utility survey. NEEA disaggregated the target market non-incented units (**striped**) by applying its MPER installer survey's estimated proportions of non-incented DHP installations in each target market.
- The remaining units in the last bar consist of heating and cooling units that are outside of the target markets and the cooling-only units introduced in the distributor data.

3.4 Customer Purchase Decision Survey

This section contains key findings from the survey of 520 consumers. Unless otherwise noted, all statistical significant tests yielded a p-value of less than .05 ($p < .05$).

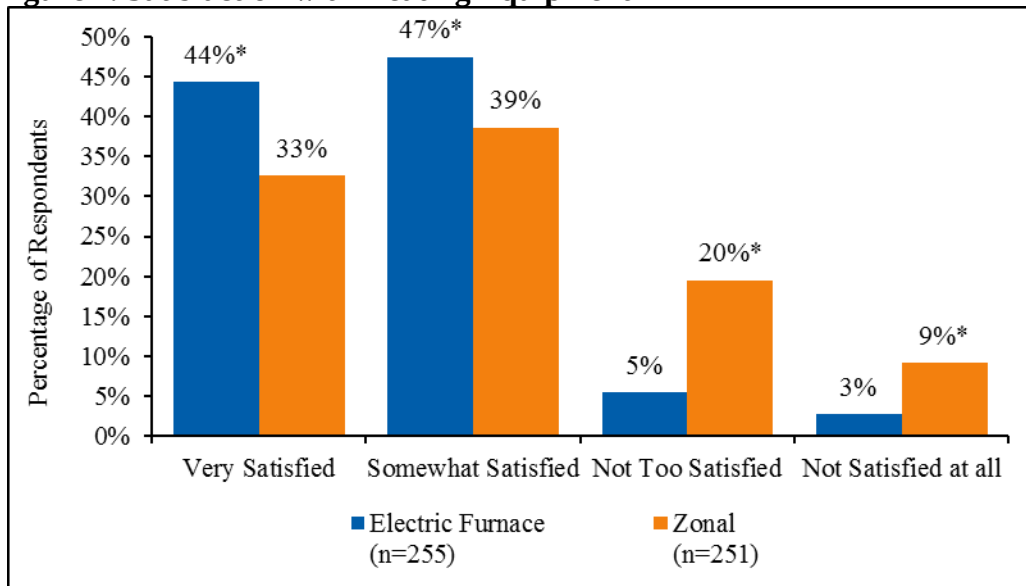
3.4.1 Respondent Demographics

Cadmus stratified the sample by heating type, with respondents equally divided between homes with electric forced air furnaces ($n=260$) and zonal heating ($n=260$) as their primary heating equipment. For zonal heating equipment, wall (Cadet) heaters were the most common type (32%), followed by electric radiant heaters (27%), baseboard heaters (24%), and space heaters (17%). Cadmus included respondent demographics, according to home heating type, in Appendix B.

3.4.2 Satisfaction with Existing Heating Systems

Figure 4 shows respondent's level of satisfaction with their heating equipment by equipment type. Overall, respondents with electric furnaces reported significantly higher satisfaction than respondents with zonal heating equipment; 91% of respondents with electric furnaces said they were at least *somewhat satisfied* compared to 72% of respondents with zonal heating equipment.

Figure 4. Satisfaction with Heating Equipment



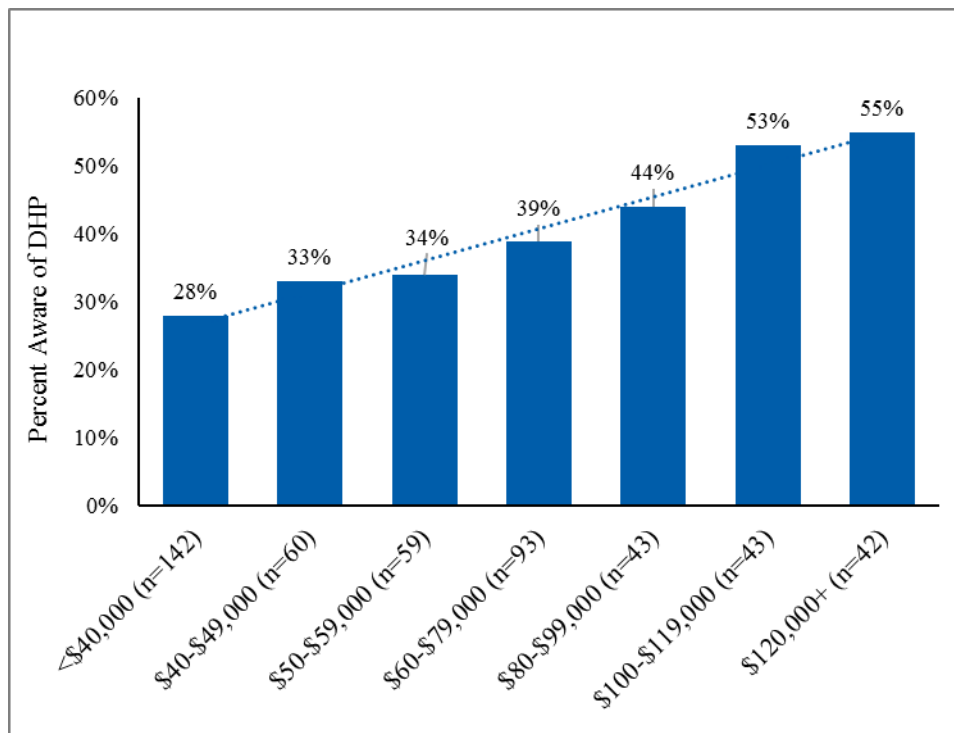
Source: DHP Customer Purchase Survey question A4, “How satisfied are you with your home’s primary heating system?” * $p < 0.05$

3.4.3 Awareness of DHP Technology

Overall awareness of DHP technology remained about the same as in prior years, with 37% of respondents aware of the technology by name (ductless heat pump or mini split) compared to just over 40% in MPER 5.⁶ Although the difference is less pronounced than in the previous study, a greater percentage of respondents with zonal heating equipment (41%) knew of the technology than respondents with electric furnaces (33%).⁷ When prompted with a picture of DHP technology, 32% of respondents who had previously said they were unaware of DHPs reported that they had seen the technology type before.

Awareness of DHP technology did not differ notably between respondents living in rural versus urban areas or by age group. However, respondents with homes built after 2010 were significantly more likely to be aware of DHP technology (63%) than were those living in older homes (34%). There was also a statistically significant relationship between the percentage of respondents who were aware of DHPs and household income (Figure 5).

Figure 5. Awareness of DHPs by Household Income



Source: DHP Customer Purchase Survey question B1, “Prior to this survey, had you heard of a ductless heat pump or mini split?” (n=520) and question E5, “Which of the following categories best represents your approximate annual household income from all sources in 2016, before taxes?” (n=482)

⁶ This difference is not statistically significant.

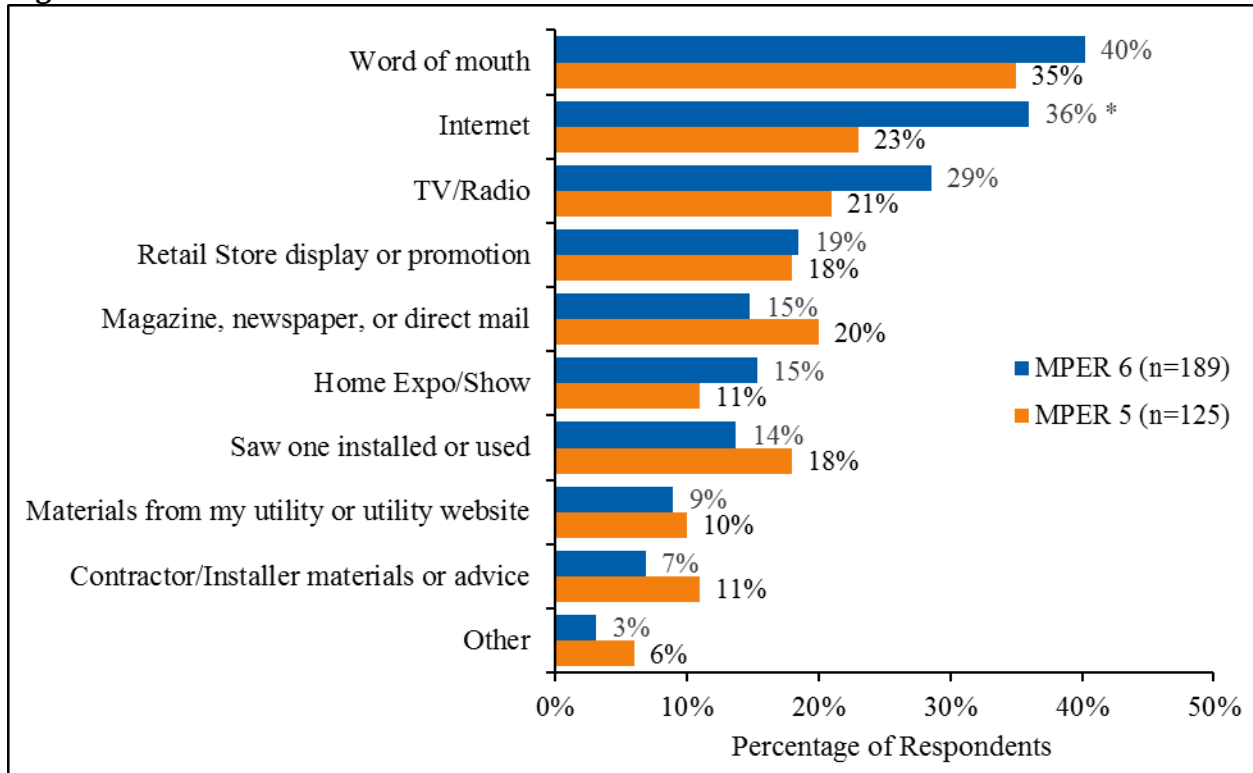
⁷ $p < .1$

How Consumers Learned about DHPs

Figure 6 shows the factors that influenced how respondents learned about DHPs for both the current and the previous MPER. For MPER 6, the most common way that respondents learned about DHPs was word of mouth (40%). This was followed by the internet (36%) and TV or radio (21%). Most notably, compared to the previous MPER, respondents this year were more likely to learn about DHPs through the internet and TV/radio advertisements; though the only statistically significant difference was in the percentage of those who learned from the internet.

How respondents learned about DHPs did not differ by heating equipment type or whether the respondent lived in rural or urban areas.

Figure 6. Awareness Channels



Source: DHP Customer Purchase Survey question B2, “How did you learn about ductless heat pumps?” and MPER 5. Multiple responses were allowed. *p < .05

Where to Purchase

Respondents were asked the degree to which they agreed that they knew where to purchase a DHP on a scale from 1 (completely disagree) to 10 (completely agree). Similar to the previous MPER in which roughly one fifth said they knew where to purchase a DHP, respondents in MPER 6 did not report a strong understanding of where to find DHPs: on average, respondents rated their knowledge as a 5.6. Responses did not differ by urban or rural households or by heating equipment type.

Like overall awareness of DHP technology, respondents with higher household income levels reported greater confidence about where to purchase a DHP. Additionally, respondents who reported that they were satisfied with their current heating equipment were, on average,

significantly more knowledgeable about where to buy a DHP, giving an average rating of 5.7. However, those who were dissatisfied with their existing system rated their knowledge of where to purchase a DHP lower, on average (4.6).

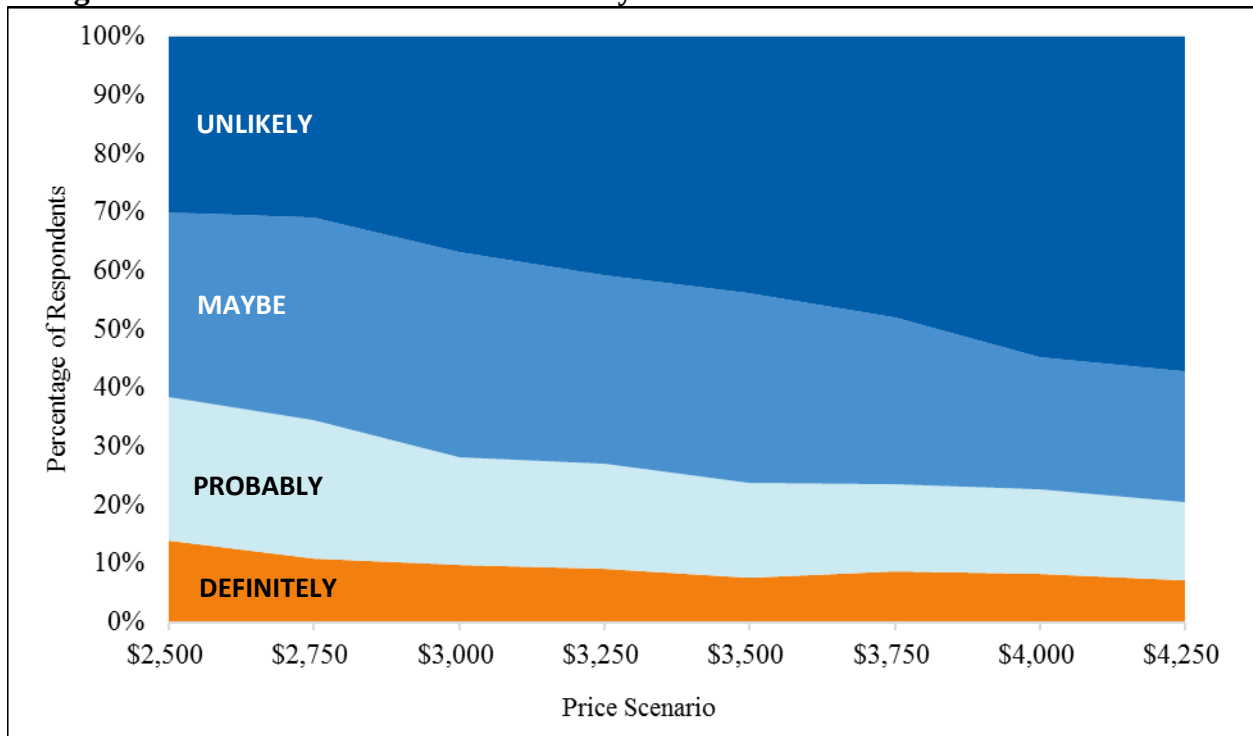
3.4.4 Likelihood to Purchase a DHP

Using the choice-based conjoint experiment, Cadmus asked respondents to rate their likelihood to purchase a DHP at various price points and considering various attributes. Cadmus instructed respondents to think about purchasing a DHP in a scenario in which their current system was still functioning because this is both an important consideration for a customer's likelihood to purchase and a purchase barrier, as stated in the MPER 5.

Cost

As shown in Figure 7, purchase intent had a statistically significant relationship with price point, with respondents much more likely to purchase a DHP at the lowest price scenario of \$2,500. Yet, even at the lowest price point, just 14% of respondents reported that they *definitely would buy*, and another 25% said they *probably would buy*, which indicates that the relatively high cost of the system is still a barrier when existing heating systems are still functioning. Cadmus notes that respondents often overestimate their purchase intention in surveys, so these percentages could be a high estimate of the true likelihood to buy (Urban and Hauser 1993).

Figure 7. Likelihood to Purchase a DHP by Price Point

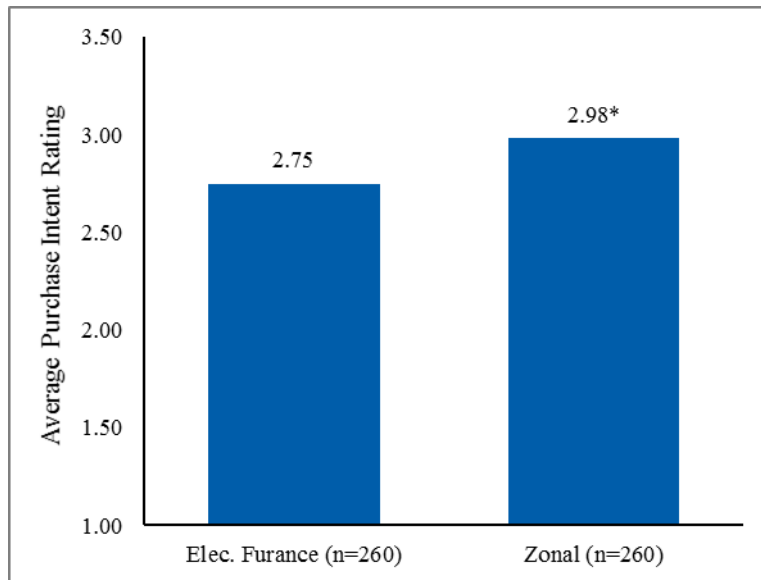


Source: Customer survey (n=520). Data compiled from 12 questions with various price points. See C2: “How likely would you be to purchase the ductless heat pump **described above** in the next 12 months, assuming your heating system is still working, and that it costs [PRICE POINT]?” Responses provided on a 5-point word scale. The “unlikely” category reflects aggregated responses of *Probably would not buy* and *Definitely would not buy*.

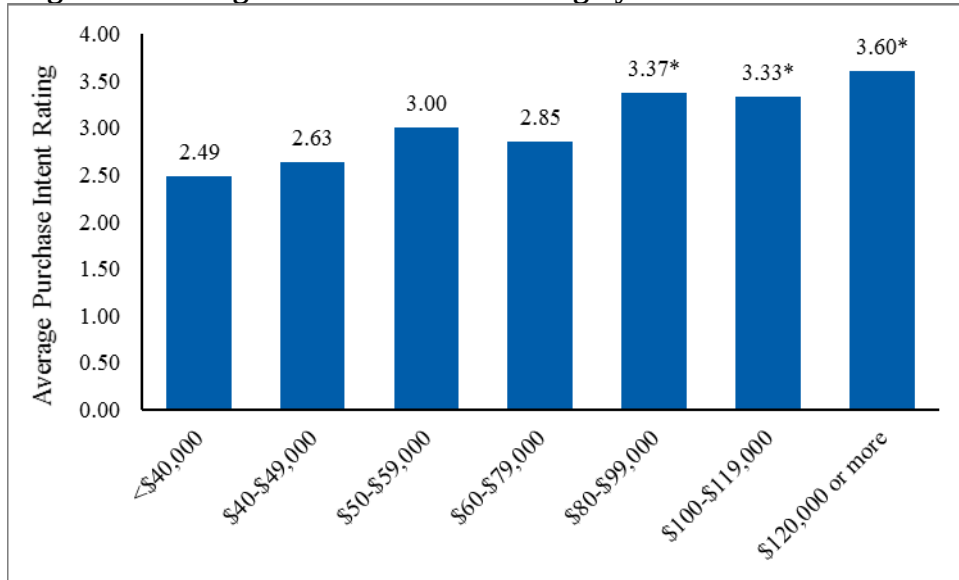
Other Factors Related to Purchase Likelihood

Cadmus reviewed several other respondent characteristics to determine if any had an impact on purchase intent (averaged across price points). Surprisingly, average purchase intent does not differ between respondents who reported they were *very satisfied* or *somewhat satisfied* with their current heating system and those who were dissatisfied. However, purchase intent did vary significantly by heating type and two demographic characteristics. Cadmus found significant differences in purchase intent between respondents with an electric furnace and a zonal heating system (Figure 8) and across income categories (Figure 9) and education levels (Figure 10).

Figure 8. Average Purchase Intent Rating by Home Heating Equipment



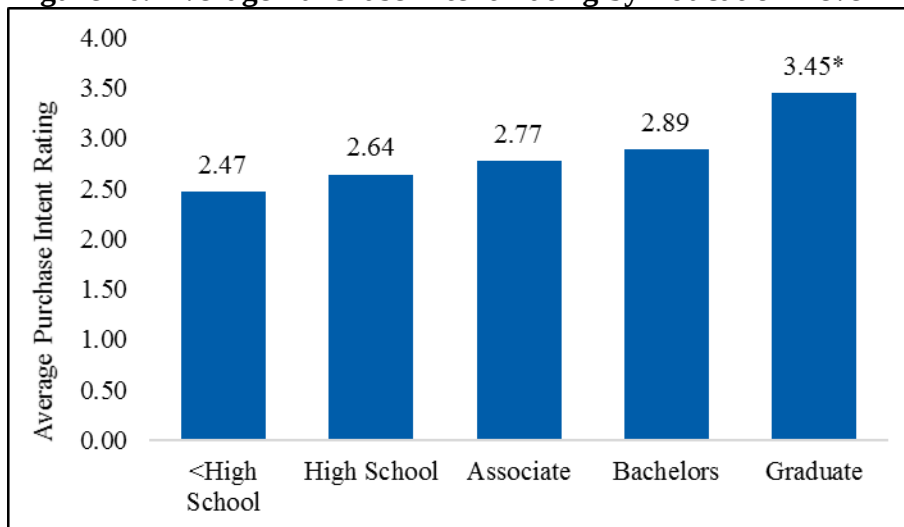
Source: Customer survey (n=520). Data compiled from 12 questions with various price points. See C2. Responses provided on a 5-point word scale, “1”= Definitely would not buy and “5”= Definitely would buy. *p <.05

Figure 9. Average Purchase Intent Rating by Household Income

Source: Customer survey (n=520). Data compiled from 12 questions with various price points. See C2. Responses provided on a 5-point word scale, “1”= Definitely would not buy and “5”= Definitely would buy. *p <.05.

Table 6. Significant Differences

Bracket	Significantly Greater Than
\$80-\$99,000	All lower income brackets
\$100-\$119,000	Households earning less than \$80,000
\$120,000 or more	All lower income brackets

Figure 10. Average Purchase Intent Rating by Education Level

Source: Customer survey (n=520). Data compiled from 12 questions with various price points. See C2. Responses provided on a 5-point word scale, “1”= Definitely would not buy and “5”= Definitely would buy. *p <.05

The output of all variables Cadmus tested are presented in Appendix B. In addition to the key characteristics described above, Cadmus also tested urban versus rural, home type, respondent age, and time spent in home.

Impact of DHP Features on Purchase Intent

The conjoint analysis did not yield meaningful results on how the various features of DHPs may impact a customer's likelihood to buy independent of cost; that is, no statistically significant relationship was found between any DHP features and purchase intent. Cadmus predicted this scenario when designing the experiment—cost is such a strong factor in a customer's decision to purchase it overshadowed any possible customer preferences about the features of the DHP system.

Nevertheless, the MaxDiff analysis generated insights into how customers view DHP features and the relative importance of the attributes in motivating purchase. This is discussed in the following section.

3.4.5 Benefits and Drawbacks of a DHP System

Cadmus used anchored MaxDiff scaling to derive a utility score for each DHP feature and its relative power compared to other DHP features (for more information, see the Customer Purchase Decision Survey section). Figure 11 contains the utility score for each feature Cadmus measured. Benefits have a positive utility score; drawbacks have a negative utility score. The most powerful benefits and drawbacks are represented by their absolute value from zero.

Respondents said that reducing the heating bill was by far the most powerful benefit (utility score of 58.30), followed by the fact that DHPs cool as well as heat the home (utility score of 39.82). Other important benefits were that DHPs heat and cool evenly (compared to zonal heat), do not require duct installation, and typically come with a five-to-seven-year warranty.

Respondents named only three features as real drawbacks to purchasing a DHP. Interestingly, the strongest drawback was that DHPs are not a very common heating system in the United States (average utility score of -14.52). The other drawbacks were that DHPs typically require professional installation and periodic maintenance.

Figure 11. Average Utility Score for DHP Features

DHP Feature	Average Utility Score
Can reduce monthly heating costs by up to 50%	58.30
Provides cooling as well as heating	39.82
Provides more even heating than baseboard or wall heaters	23.86
Does not require duct installation	20.86
Comes with a 5-7 year warranty	20.84
Reduces the risk of fire and burns relative to baseboards and wall heaters	19.66
Can be used to supplement existing equipment, while allowing existing equipment to provide backup	13.47
Includes built in air filters	11.18
Can be adjusted with a remote control	9.31
Equipment is mounted high on an interior wall, typically in your primary living space like this*	2.47
Neutral	0.00
Requires periodic maintenance such as cleaning air filters	-8.52
Typically requires professional installation	-12.46
Equipment is new to the United States but common in Europe and Asia	-14.52

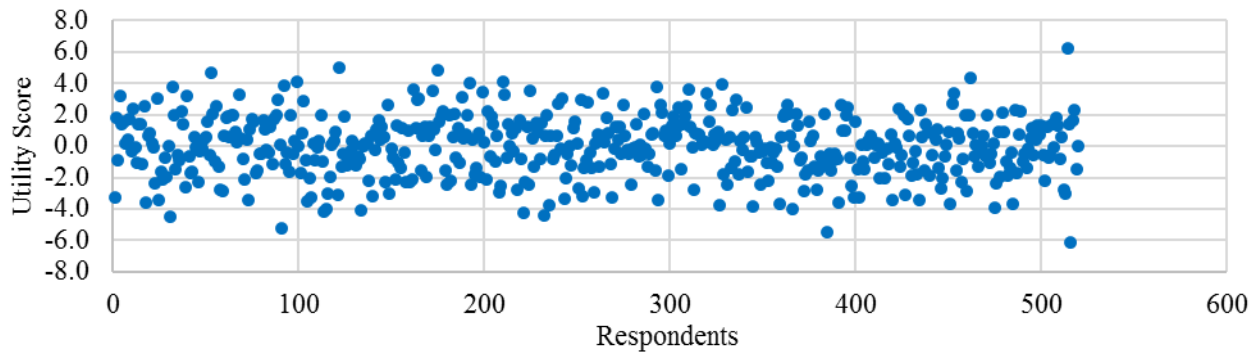
Note: Photo is included in the survey instrument in 5Appendix D.

Perceptions Around the Interior Wall Mount: Pro or Con?

Prior studies and word-of-mouth feedback from installers have led to conflicting perceptions about whether a significant drawback for prospective buyers is the fact that DHPs must be mounted on an interior wall, typically in the primary living space. This study found that customer respondents thought the wall-mounted equipment was a mostly neutral feature, with a utility score of 2.47. This confirms findings from MPER 5, which concluded “The majority of respondents are not concerned with a potentially less visually appealing heating system, the appearance of their heating system or how the DHP would look in their living room.”⁸

Because of the particular interest in this DHP feature, Cadmus examined the utility scores more closely to see if the average utility score could be glossing over consumers’ strong opinions about wall-mounted equipment. That is, for some people wall-mounted equipment may be a significant drawback or even a deal-breaker, while others may find it a very positive feature and therefore the feature’s utility score averages close to neutral. Cadmus found that the distribution of utility scores across respondents did not provide evidence of strong opinions. As shown in Figure 12, the scores are mainly clustered around zero (neutral), with little variability. Only two respondents gave utility scores over a 5.0 for this feature, and only three respondents had utility scores of less than -5.0, suggesting the wall-mounted feature is not a large issue for the potential buyers in NEEA’s target market.

⁸ Illume Advising. 2016. Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.pp. 23.

Figure 12. Distribution of Utility Scores for Wall-Mounted Equipment Feature

Source: Customer survey (n=520). See C1. “Assume you are in the market for a new heating system. For the next 12 questions, you will be asked to evaluate a potential new heating system. Thinking only of these five features, which ONE most makes you want to own a ductless heating system and which ONE least makes you want to own a ductless heating system?” Data represent modeled MaxDiff results for the attribute: “Equipment is mounted high on an interior wall, typically in your primary living space like this,” photo included in the survey instrument in 5Appendix D.

Differences within the Target Market

Cadmus investigated whether utility scores of the DHP features differed among segments of the target market and certain respondent characteristics, such as home heating equipment types, urban or rural location, satisfaction with existing heating equipment, income, home type, and time spent in home. Detailed tables containing the utility scores for each attribute according to these variables are presented in Appendix B.

Generally, the most powerful selling points for a DHP were equally important to respondents. However, the study found that a DHP warranty was more important for consumers in rural locations, and for those with an electric furnace:

- For consumers with an electric furnace, the warranty was the third most positive feature, with a utility score of 23.1. For respondents with zonal heat, the warranty was only the sixth most positive feature, with a utility score of 18.6.
- The warranty was more powerful for rural customers (utility score of 25.9) than for urban customers (utility score of 18.8). (Though regardless of rural or urban location, the top three features—heating cost savings, cooling capabilities, and more even heating and cooling—remained the same.)

Other observations included these:

- **DHPs as supplemental to existing equipment was a more beneficial feature to electric furnace owners.** This feature was the seventh strongest benefit for customers with both types of heating equipment, but, respondents with an electric furnace rated this feature more highly (utility score of 17.0) than did those with zonal heat (utility score of 9.9).
- **Dissatisfaction with existing equipment meant beneficial DHP features were even more beneficial.** Respondents who were dissatisfied with their existing heating equipment seemed to value energy savings, home comfort (more even heating and

cooling), the ease of installation without ductwork, and safety as more important features of a DHP than people who were content with their equipment. Though there were no major differences in the relative importance of these features (judged by their rank order), the utility scores were higher among people who were not satisfied.

3.4.6 Overcoming the Cost Burden

NEEA and Cadmus were interested in assessing consumers' receptivity to financial tools to reduce upfront costs. The survey included questions to investigate any changes in the likelihood of respondents to purchase a DHP with the availability of financing (a plan that allowed payments over time) and utility cash rebates.

Financing

The majority of respondents (68%, n=520) said that the availability of financing options would increase their likelihood of purchasing a DHP. This likelihood varied by income level, with 72% of respondents with an annual household income above \$100,000 (n=64) stating it was *very likely* they would purchase a DHP with the availability of financing compared to 34% of respondents with an annual household income below \$50,000 (n=140); a significant difference.

Utility Rebate

A large percentage of respondents (84%, n=520) reported that the availability of a \$600 to \$1,200 cash rebate would increase their likelihood of purchasing a DHP. Utility rebates had a significantly greater influence on rural and higher-income respondents. Almost half of the rural respondents (46%, n=129) said it was *very likely* they would purchase a DHP with a cash rebate compared to 38% of urban respondents (n=309). Respondents with an annual household income greater than \$100,000 were almost twice as likely to say it was *very likely* they would purchase a DHP with a cash rebate (62%, n=77) than were respondents with an annual household income below \$50,000 (33%, n=162).

3.5 Regional Partner Interviews

To identify regional trends in DHP promotion and incentives, Cadmus conducted in-depth interviews with ten of NEEA's regional utility partners to learn more about the following research objectives:

- Explore current and future regional partner program offerings and marketing efforts
- Review interactions with installers and other supply chain actors
- Identify opportunities for NEEA to improve its support for regional partners
- Record any comments on opportunities to reduce DHP costs

3.5.1 DHP Program Offerings

In 2016, all ten regional partners interviewed offered incentives for DHP installations in NEEA's three target markets: existing single-family home with zonal heating, existing single-family home with electric forced air furnace, and manufactured home with electric forced air furnace.

Of the eight partners that were Bonneville Power Administration (BPA) customer utilities, six said they offered incentive amounts according to BPA's guidelines: \$800 for zonal heating

replacements and \$1,000 for electric forced air furnace replacements.⁹ Two BPA customer utilities offered a fixed incentive regardless of the existing heating system because they believed the fixed incentive was easier for installers and customers to work with.

Seven regional partners offered incentives for DHP installations in multifamily buildings but did not specifically target their marketing to multifamily buildings.¹⁰ Most of these regional partners had a small stock of multifamily buildings, and reported that most DHP installations in multifamily buildings served the low-income population.

Most regional partners offered higher incentives to low-income or moderate-income customers. None of the regional partners specifically targeted the low-income segment, but three reported working with community action agencies (CAAs) or other organizations serving the low-income communities to reach their low-income customers.

Cadmus asked the regional partners about any challenges with the DHP program. Three BPA customer utilities expressed concerns about whether their program offerings truly help participating customers save money, and about the impact on program participation if BPA decreases its incentives for DHP installations in the next few years. Others reported challenges included reaching rural and low-income customers, retaining interested installers, and maintaining quality assurance for DHP installations. Regarding retaining interested installers, one utility found that installers were promoting DHPs less because they preferred other heating equipment; another observed that some installers did not want to participate in trainings.

3.5.2 Marketing

Cadmus asked the regional partners how they promoted their DHP programs. All said they promoted their DHP offerings on their websites, and most had a physical display in their customer service offices. To reach their customers more directly, the regional partners often use newsletters and newspaper ads.

Table 7 shows the number of regional partners that have adopted each marketing method. In addition, three regional partners either conducted studies or planned to conduct studies of customer demographics, heating systems, and consumption to identify customers for targeted marketing.

⁹ One BPA customer utility varied slightly from BPA's guidelines by offering \$1,000 if the heating system was solely electric and \$500 for mixed heating or shifting from other heating sources such as wood stove.

¹⁰ Multifamily buildings are outside NEEA's target markets.

Table 7. Regional Partner Marketing Activities

Market Activity	Regional Partners
Website	10
Displays in the office	7
Newsletters	6
Newspaper ads	6
TV/radio ads	5
Social media	4
Home shows and other events*	3
Direct mailings*	2

* These categories came from verbatim responses.

Source: DHP Regional Partner Interview question A3 “How are you promoting your DHP program(s) to customers? [Probe for direct mailings, newspaper ads, TV/radio, social media, internet, store displays, etc.]” (n = 10; Multiple Responses Allowed)

Most regional partners said their DHP marketing efforts in 2016 was about the same as in 2015. However, some emphasized that although their marketing budget remained at the same level, their marketing strategy had improved or become “smarter.” For example, one regional partner hired a marketing manager and made the transition from running traditional ads to conducting social media campaigns.

For driving customer participation in DHP programs, however, the regional partners said their marketing efforts had less impact than word of mouth (when one hears about DHPs from others who have installed them) and contractor initiative (contractors being aware of the rebates and actively promoting them).

Cadmus also asked regional partners to list the primary drivers of DHP installations in the Northwest market overall. Most regional partners east of the Cascades said comfort was the biggest driver because DHPs meet both heating and cooling needs in a region with hot summers and cold winters. Regional partners west of the Cascades, where the climate is more temperate, reported various drivers—increased savings, affordability, and cooling benefits.

3.5.3 Future of DHP Program Offerings

The regional partners reported an average of 22% in energy savings from DHP installations in their entire residential portfolio in 2016. The reported proportions varied widely, from 5% to 45%, with a standard deviation of 12%.

Most of the interviewed regional partners treated DHPs as a high priority measure, and most expected their programs to increase DHP installations in the next few years. None reported an expected date for ceasing DHP incentives.

None of the interviewed regional partners foresaw any changes to eligibility applications, HSPF requirements, or types of DHP technologies. Nevertheless, some mentioned that the new construction and multifamily market could expand, and some expressed interest in learning more about efficient DHP options that are suited for large homes, such as multi-head configurations. Four of the interviewed partners reported increasing interest in CAI and DIY installations.

3.5.4 Interactions with Supply Chain Actors

All regional partners required their participating installers to complete NEEA's Northwest Ductless Heat Pump Installer Orientation and to comply with NEEA's installer requirements. These qualified installers are listed on NEEA's "GoingDuctless.com" website.¹¹ In addition, a few regional partners required that their participating installers be licensed, bonded, and insured, and even sign a legal participating agreement. Some regional partners directly steered their customers to the "GoingDuctless.com" website for the list of installers, while others advertised their own list on their websites.

To engage with the installers, half of the regional partners said they hosted annual or semiannual meetings. Only three regional partners reported having more frequent contact with installers, such as sending educational emails or speaking with installers on the phone when issues arose. Most regional partners did not identify any challenges with maintaining their list of installers. However, one regional partner had encountered problems with poorly installed DHPs and had difficulties in running quality assurance checks systematically.

Cadmus also asked how the regional partners engaged with other supply chain actors. The regional partners had very limited engagement with retailers; some added that big-box retailers were difficult to engage with. Half of the regional partners reported some engagement with distributors and manufacturers through conferences and meetings; only one regional partner directly contacted distributors if there were contractor or equipment issues.

3.5.5 NEEA's Support for Regional Partners

In 2016, NEEA provided promotional packets and templates for the regional partners to use in marketing DHP programs. Only three regional partners said they handed NEEA's materials directly to customers. Most used information or photos from NEEA's materials to create their own branded marketing materials. They also reported receiving support from NEEA in the form of the "GoingDuctless.com" website and invitations to workgroups and networking events with trade allies.

Overall, the regional partners found NEEA particularly helpful as the facilitator with the supply chain actors. For example, one regional partner appreciated NEEA's role as a conduit—relaying feedback from installers to the manufacturers. The regional partners also regarded NEEA as a source of information on new DHP technologies and best practices.

The regional partners provided suggestions for additional support that NEEA could provide:

- **Facilitating promotions.** Regional partners suggested that NEEA could directly inform installers when manufacturers or distributors have DHP promotions. For example, NEEA could add any new promotion information to its existing marketing materials, so installers could easily distribute them to potential customers.
- **Educating regional stakeholders.** Regional partners also wanted NEEA to inform the BPA, the Regional Technical Forum, and regional partners on any new DHP

¹¹ Ductless Heating & Cooling Systems. "Same Comfort, Up to 50% Less Energy." Accessed July 2017: <https://goingductless.comhttps://goingductless.comhttps://GoingDuctless.com>

technologies or emerging trends. Specific topics regional partners were interested in included installation costs across the region, non-energy benefits, best practices of low-income installations, and suitable sizes of DHP systems for larger homes.

- **Targeting the low-income segment.** Several regional partners said there was potential in targeting the low-income segment. To help them reach this segment, they suggested that NEEA could do the following:
 - Build strategic alliances with community action agencies or other nonprofits to promote lower-HSPF and lower-capacity DHPs that suited the needs of low-income residents—“the sedans,” rather than “the Cadillacs,” according to one regional partner
 - Provide strategies for utilities to educate owners and managers of multifamily buildings about DHPs
 - Facilitate bulk purchasing or bulk installation contracts to reduce installer marketing and installation costs
 - Develop a sales performance incentive fund (spif) program for distributors to encourage sales of DHPs with lower equipment and installation costs

3.5.6 Opportunities to Reduce DHP Costs

Most regional partners said they struggled with making DHPs cost-effective for low-income and moderate-income customers and had identified a few opportunities to reduce DHP costs.

Regarding installation costs, regional partners agreed that installers were charging competitive installation rates. Therefore, some regional partners observed that some customers had decided to reduce installation costs by conducting CAI or customer DIY installations.

Regarding equipment costs, the regional partners suggested that NEEA try to influence manufacturers to reduce costs. One regional partner also emphasized that different market segments required different solutions. For example, as mentioned earlier, this regional partner recommended that NEEA consider influencing manufacturers to increase the supply of lower-HSPF or lower-capacity DHPs for the low-income segment.

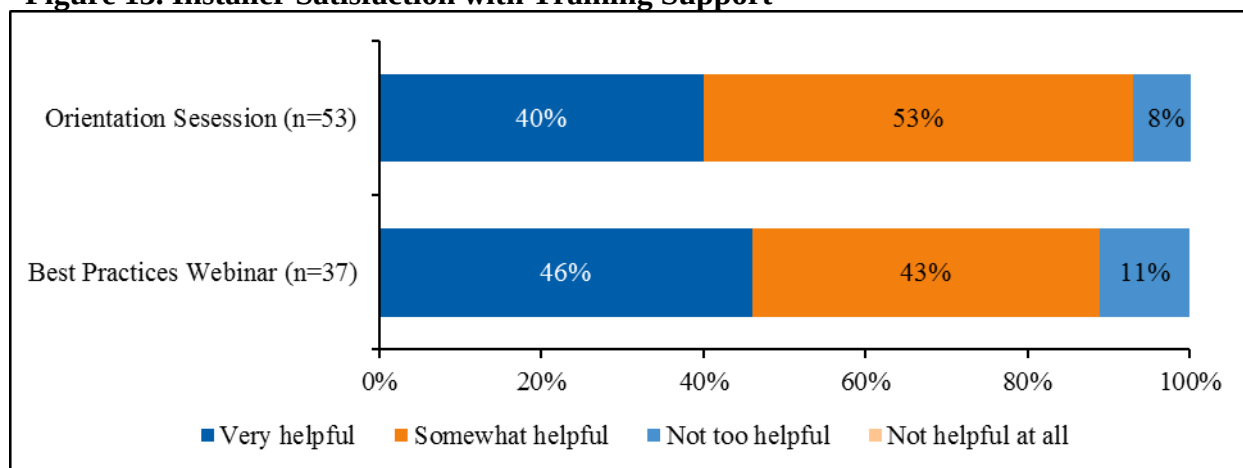
3.6 Supply Chain Actor Interviews and Surveys

NEEA relies on a network of installers and distributors to promote DHPs to potential purchasers and to increase DHP presence and competition in the market. To identify current and emerging trends in the DHP market, Cadmus conducted a survey of 70 participating installers (including master installers) and six in-depth interviews with distributors.

3.6.1 Initiative Support

Cadmus asked both installers and distributors to provide feedback on the support they have received from the DHP Initiative as well the level and nature of their own involvement with the initiative. All but two installers said that they were at least somewhat familiar with the initiative, and 61% (n=69) said that they were *very familiar*.

More than 50% of installers attended both the installer orientation session and the best practices webinar offered through the initiative. Of those who attended, the majority were *somewhat satisfied* or *very satisfied* with the training; 40% said they were *very satisfied* with the orientation session, and 46% were *very satisfied* with the best practices webinar (Figure 13).

Figure 13. Installer Satisfaction with Training Support

Source: Installer Survey questions C3, “How helpful would you say the installer orientation session was?” and C6, “How helpful would you say the installer best practices session was?”

Cadmus also asked installers if they thought the initiative should offer any other types of training or resources. All five installers mentioned that additional system design training or detailed equipment information would be helpful, and three installers said that more frequent updates and/or training sessions should be made available to account for new installer staff and changes in equipment costs.

Distributors reported intermittent involvement with the initiative over the past year. Although three distributors Cadmus interviewed actively participated in recent promotional programs, two other distributors said that contact with NEEA had dropped off from the prior year, with one distributor explicitly mentioning that initiative staffing changes were a new barrier to communication. Distributors reported that the level of their involvement with the initiative was mostly contingent upon their own proactive communication. Of the services and support received from the initiative, distributors said the most useful were newsletters, best practices training resources, and any information or potential leads to help distributors connect with utilities’ electric customers and regional installers.

When asked what other resources the project could provide, two distributors suggested that NEEA more prominently announce its own role in the program to ward off confusion at the distributors’ companies and from installers. Distributors also said the initiative should provide more and updated training resources; detailed utility data, such as total electric customers and identification of high energy usage customers, with which installers and distributors can develop more targeted marketing strategies; and more advertisement and marketing support to cover gaps in the current resource and support offerings. Additionally, nearly all distributors emphasized the importance of consumer education and awareness initiatives.

3.6.2 DHP Marketing and Promotion

Cadmus asked installers how often they recommend DHPs, what proportion of their customers specifically request a DHP, and whether the proportion of customers specifically requesting a DHP had changed from prior years. Most of the 70 installers said they frequently recommend

DHP systems to customers with electric heat—53% said they *always* do and 36% said they *often* do. On average, installers (n=67) reported that 46% of their residential DHP customers specifically requested a DHP in 2016, and 67% of the installers (n=63) said this was a higher percentage of customers than in prior years. Only 5% of these 63 installers reported that the percentage of customers requesting a DHP had decreased in 2016, and the remainder (29%) said that the percentage in 2016 was approximately the same as the previous years.

Cadmus also asked installers and distributors if they had changed anything about how they have promoted and merchandised DHPs in the past two years. Of the 16 installers (23% of all survey respondents) who reported changes, six said they had increased the level or scope of their DHP advertising and five said they now emphasize the benefits of DHPs to a greater extent. Three installers said they had added new brands or models to their DHP inventory.

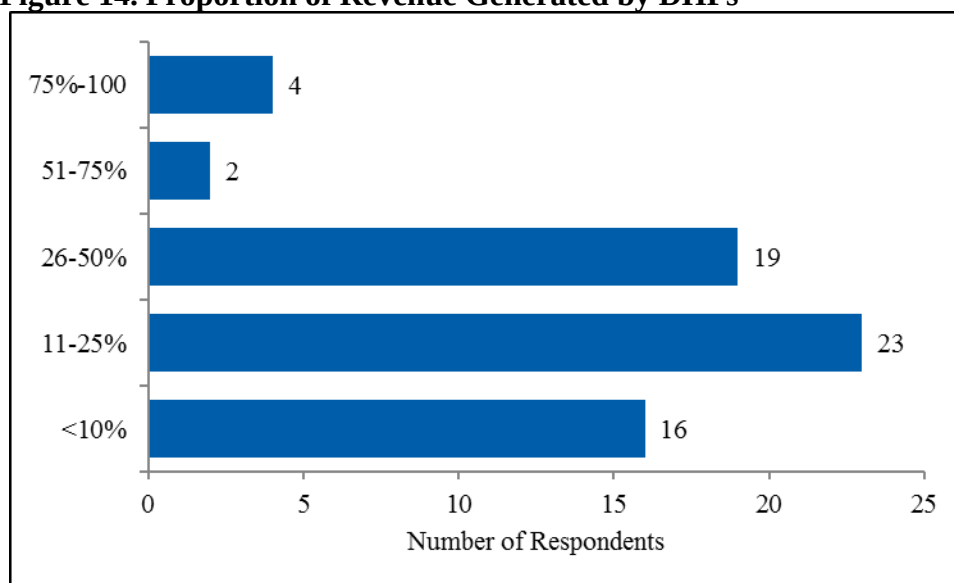
Of the six distributors Cadmus interviewed, two said their company had changed its DHP promotion and marketing in the past two years. One distributor said his company had significantly increased its marketing effort and advertising presence, particularly its involvement with its installer partners. He believed DHPs were “still on the low-end of acceptance” and said that “from a sales perspective, [it was] definitely the top spot to put effort.” Another distributor said his company was more frequently offering and emphasizing financing opportunities to customers.

Four distributors said that compared to 2015 they had increased DHP marketing. One said the company now spends \$100,000 yearly to market DHPs in the Northwest. The typical marketing and promotion activities they identified included standard advertisement channels (such as brochures, web ads), coordination and promotional events with manufacturers, showroom training for contractors, and participation in utility programs.

3.6.3 DHP Sales and Installations

DHP Revenue

Cadmus asked distributors and installers what proportion of their revenue DHPs generated. On average, installers reported that approximately 27% of their overall revenue in 2016 came from DHPs. Some estimated that as much as 95% of their revenue was attributable to DHPs. One noted that its minimal involvement with DHPs meant this equipment accounted for only 5% of total revenue in 2016. Figure 14 shows the distribution of the proportion of revenue installers reported.

Figure 14. Proportion of Revenue Generated by DHPs

Source: Installer Survey questions D1, “Thinking about your business for the past year from a revenue standpoint, of the products you currently carry and install, approximately what percentage of your revenue comes from DHPs? Your best estimate is fine.” (n=64)

Three of the six distributors reported roughly similar revenue proportions as installers, ranging from 5% to 33% of total revenue with a median value of 30%. These three distributors agreed that the proportion of their revenue derived from DHPs had noticeably increased since prior years. One said that in the past year alone, DHP sales had increased 25%, which resulted in a 2% to 5% increase in DHP’s share of the company’s total revenue.

DHP Market Segments

The surveyed installers said that the vast majority (89%) of all DHPs they installed in 2016, including incented and non-incented, were installed in the residential sector. All installers (n=70) said they installed DHPs in single-family homes, 80% installed DHPs in manufactured homes, and 60% installed DHPs in multifamily buildings. Although commercial installations represented on average only 11% of all DHP installations reported, 76% of installers installed DHPs in commercial facilities.

Most distributors said they have limited insight into the end-use placement of the DHPs they sell. Nevertheless, distributors expected to see the most significant growth in the residential new construction and the commercial sectors. To promote growth in these areas, distributors recommended enhancing the efforts to educate homeowners and installers, more incentives for builders, and DHP installation training specific to commercial buildings. Distributors also agreed that DHPs will continue to claim a larger percentage of the residential retrofit and addition market sector, particularly for eFAFs.

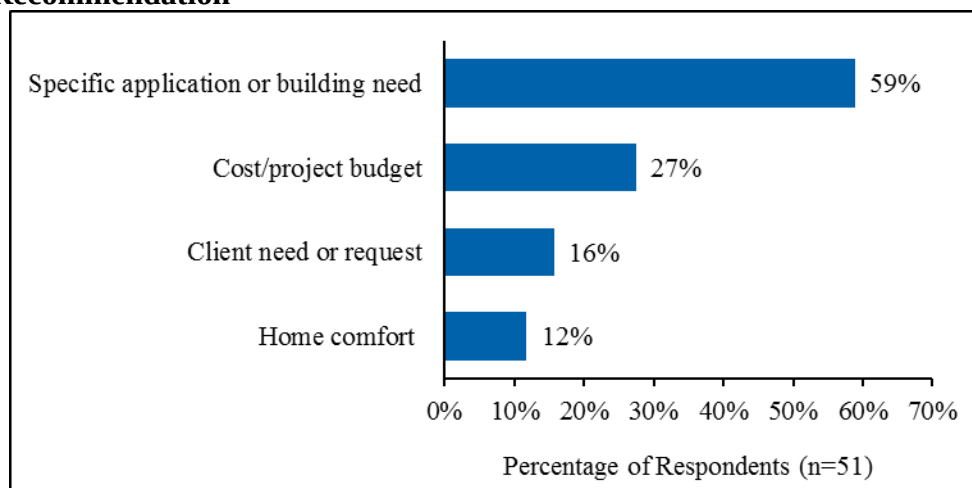
DHP Single-Zone and Multi-Zone Applications

Of all residential installations (n=2,890) reported by the 70 installers, slightly more than half (52%) were installed as a single zone system (that is, a unit with one outdoor compressor and one indoor unit) compared to a multi-zone system.

To appropriately select and size DHP equipment for customers, most installers (70%) said they use Manual J or a similar building load calculation tool, and 40% said they use a general rule of thumb based on areas of space. However, when deciding whether to recommend a single or multi-zone system, installers reported they frequently based their decision on more than just technical sizing calculations.

Figure 15 shows the common factors that 51 installers identified in their decision to recommend a single or multi-zone system. Technical specifications or building needs was the most frequently identified factor (for example, building layout, home structure, home size, refrigerant line accessibility) followed by customer-driven limitations. Installers said their recommendation was influenced by the system cost or project budget (27%), by a specific client need or request (16%), and by home comfort (12%).

Figure 15. Commonly Cited Factors in Single or Multi-Zone Recommendation



Source: Installer Survey question E5, “What factors influence your decision about whether or not to recommend installation of multi-zone DHP systems (versus single-zone systems)?” This was an open-ended question with multiple responses allowed.

Similar to installers, four out of six distributors said they sell more single-zone systems than multi-zone systems, with two acknowledging that they had already seen an increase in the portion of multi-zone systems sales since 2015. Furthermore, these distributors—including one that sells 70% of its DHP systems as multi-zone units—anticipate the multi-zone market share of DHP sales will increase in upcoming years to the extent that sales are evenly divided between single and multi-zone systems or even dominated by multi-zone systems. One distributor noted that since rebate eligibility had changed to allow for multi-zone units, multi-zone sales have dominated and that “contractors have a hard time thinking about selling just one.” The general consensus from distributors was that increases in customer and installer awareness and

acceptance of multi-zone systems combined with the availability of incentives have driven the market towards multi-zone systems.

Non-Incented DHP Installations

Both installers and distributors frequently mentioned the importance of incentives and utility rebates to their sales of DHPs. However, for various reasons, incentives are not offered for all DHP installations. Of all residential DHP installations reported by installers, 27% were installed without a utility rebate. Of these non-incented installs, equal proportions were installed as single-family additions and new construction applications. Compared to non-incented installations in 2014 and 2013, significantly more non-incented DHPs were installed in 2016 as single-family additions and new construction applications ($p < 0.05$) and significantly fewer were installed as single-family retrofit applications.

Table 8 shows all non-incented DHP installations by building type and displaced equipment type for 2016, 2014, and 2013. Compared to non-incented installations in 2014 and 2015, the proportion of each type of displaced heating equipment in 2016 was roughly the same for single family retrofit applications. Equipment proportion differences for multifamily and manufactured home retrofit applications drew from a small sample size (seven and ten respondents, respectively) and are not statistically significant.

Table 8. Non-Incented DHP Installations by Replaced Equipment Type

Installation Application	2016 Percentage (n=1,337 installs)	2014 ¹² Percentage (n=4,681 installs)	2013 ¹³ Percentage (n=1,455 installs)
Total Non-Incented Installations	100%	100%	100%
Commercial	52%	42%	48%
Residential	48%	58%	52%
New Construction (single-family and multifamily)	32%*	27%	21%
Single Family - In new, add-on space	32%*	17%	29%
Single Family - In primary living space	22%*	45%	48%
Displaced electric zonal	47%	41%	51%
Displaced gas heat	26%	30%	26%
Displaced electric furnace	12%	8%	10%
Displaced other heat (including wood, pellet, oil, or kerosene)	16%	21%	13%
Multifamily - In primary living space	4%	7%	1%
Displaced electric zonal	65%	91%	43%
Displaced gas heat	33%	7%	14%
Displaced electric furnace	2%	2%	14%
Displaced other heat (including wood, pellet, oil, or kerosene)	0%	1%	28%
Manufactured Homes - In primary living space	7%	4%	2%
Displaced electric zonal	9%	11%	46%
Displaced gas heat	26%	18%	0%
Displaced electric furnace	60%	60%	54%
Displaced other heat (including wood, pellet, oil, or kerosene)	4%	11%	0%

Source: Installer Survey D7, “You indicated that you installed [number from D6] DHPs that were retrofits to replace/displace existing heating equipment in [single family/multifamily/manufactured] homes. Of those, what percentage originally had the following heating types in the primary living space: electric resistance zonal heat (baseboards, cadet-style, ceiling cable), electric forced air furnace, and gas heat, other (e.g. oil, kerosene, wood or pellet heat)?”

*p <.05

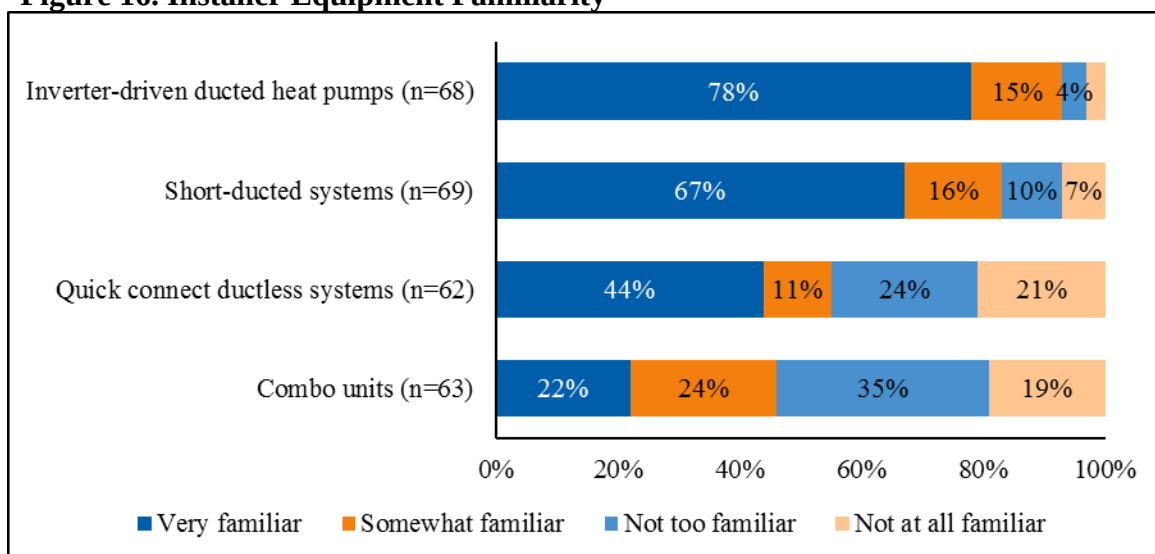
3.6.4 Heat Pump Equipment Sales

To better understand the current DHP market for emerging technologies, Cadmus asked installers to rate their familiarity with other types of heat pump equipment (Figure 16). Overall, with the exception of combo units¹⁴ the majority of installers were at least somewhat familiar with other heat pump technologies and most familiar with inverter-driven ducted heat pumps (78%, n=68, were *very familiar*).

¹² Illume Advising. 2015. Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #4.

¹³ Evergreen Economics. 2014. Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #3.

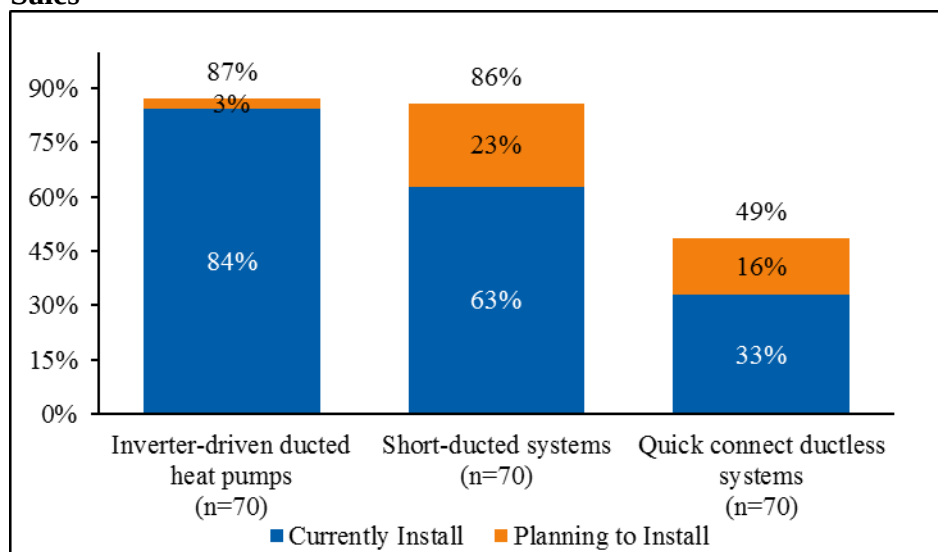
¹⁴ Combo units are a heat pump with combined water heater and air heating/cooling that are not yet currently available on the market

Figure 16. Installer Equipment Familiarity

Source: Installer Survey question F2, "How familiar would you say you are with each of the following types of heat pump equipment?"

Cadmus also asked installers whether they installed these other types of heat pump equipment (with the exception of combo units) and, if not, whether they were planning to do so in the next two years. The percentages of installers who sell these other types of heat pump align with the respective levels of familiarity (Figure 17).

The 70 installers said they most commonly install or are planning to install inverter-driven ducted heat pumps (84% currently install; an additional 3% are planning to install), followed by short-ducted systems (63% currently install; 23% planning to install), and quick connect ductless systems (33% currently install; 16% planning to install). Most installers expect to be selling inverter-driven ducted heat pumps and short-ducted systems in the next two years, but they anticipate quick connect ductless systems will remain less common, with less than half installing or planning to install these systems. Nevertheless, the majority of installers who currently install all equipment types expect their sales to increase in the next two years, including sales of quick connect ductless systems.

Figure 17. Installer Current and Planned Heat Pump Equipment Sales

Source: Installer Survey question F1, “Which of the following types of heat pump equipment do you currently sell or install?” and question F3, “In the next two years, do you anticipate your sales or installation of these heat pumps systems will increase, decrease, or stay the same?”

Similar to the installers, all six interviewed distributors said they currently sell short-ducted systems and inverter-driven ducted heat pumps, and none said they currently sell quick connect ductless systems. Furthermore, only one distributor reported any intention of selling quick connect systems in the future. The other distributors expressed general apprehension with this type of equipment, with one even calling it “frightening” because of how easy it was to “mess up” and the associated risks to both the unqualified installer and the effect it might have on customer’s perception of DHPs overall. The finding that no distributors currently sell quick connect ductless systems, but 33% of installers said they had installed these systems, suggests that installers may either be procuring quick connect systems outside of distributors or have a different understanding or definition of quick connect systems¹⁵.

For short-ducted systems and inverter-driven ducted heat pumps, all six distributors said they expected sales to increase in the next two years. Distributors noted that short-ducted system sales will probably increase because of this system’s ability to effectively fit niche applications, such as narrow hallways that are too small for typical DHPs, and that inverter-driven ducted heat pump sales will increase because of their efficiency, small size, and low noise level.

3.6.5 Contractor Assisted Installations

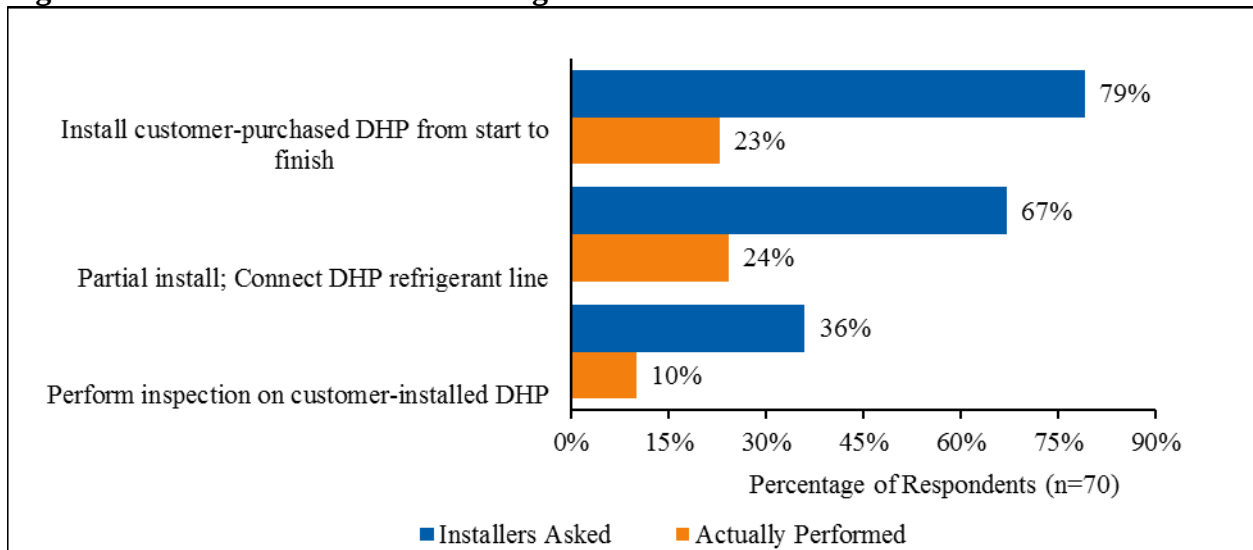
As the regional DHP market has matured, new pathways have emerged through which consumers can acquire and have DHPs installed. Consumers are now able to buy DHPs directly from a retailer or online. They have the option to work with a contractor to install the consumer-purchased system from start to finish, or they may choose to install or partially install the DHP themselves, forgoing the need for a comprehensive installation by a certified installer. To assess

¹⁵ The installer survey included a description of a quick connect ductless system as “a ductless system with pre-charge refrigerant lines.”

the impact of this emerging market trend, Cadmus asked installers whether they had encountered various scenarios in which they were asked to perform specific tasks that typify CAIs.

Figure 18 shows the percentage of installers who said they were asked to perform a specific action by a customer who had directly purchased a DHP and the percentage who completed that action.

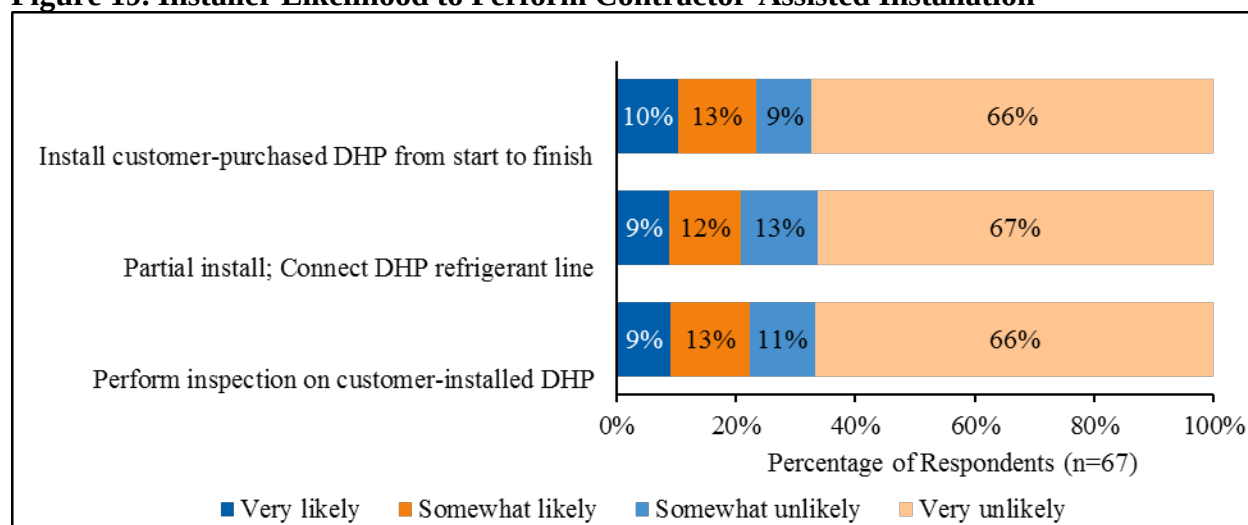
Figure 18. Installer Involvement through a Contractor-Assisted Installation



Source: Installer Survey question F5, “Has a customer ever purchased a DHP on their own (e.g. online or through a home improvement store) and asked you to...; question F5.a, “Did you install the system for any of the customers that purchased a DHP themselves...?” F5.b, “Did you connect refrigerant lines for any of the customers...?” F5.c, “Did you perform the inspection for any of the customers...?”

The majority of installers said they had been asked at some point to fully install a DHP that a customer had purchased directly (79%) and to partially install the DHP by connecting the refrigerant line (67%). Thirty-six percent of installers had been asked to perform an inspection on a system that a customer had completely installed on their own. Most installers had not performed any of these services for customers. Twenty-three percent of installers had installed a customer-purchased DHP from start to finish, and 24% had performed a partial installation. Only 10% of installers had performed only an inspection on a customer-installed system.

Cadmus also asked installers to rate the likelihood that they would perform any of these services in the future. Roughly the same percentage of installers said they would be at least *somewhat likely* to fully install (23%, n=67) or partially install (21%) a customer-purchased DHP system as had installers who actually performed the service (Figure 19). However, a greater percentage (22%) said they would be at least *somewhat likely* to perform an inspection of a customer-installed DHP system compared to those who actually had performed an inspection. Overall, installers were apprehensive in their consideration of CAI services—approximately two-thirds said they would be *very unlikely* to perform any of these services.

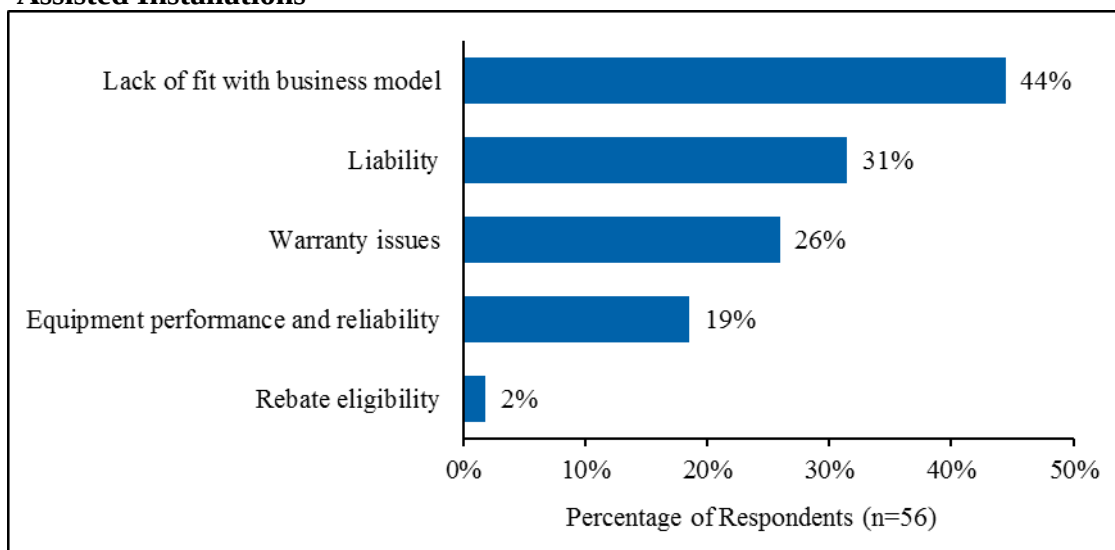
Figure 19. Installer Likelihood to Perform Contractor-Assisted Installation

Source: Installer Survey question F6, “Moving forward, for customers who purchase a DHP on their own (e.g. online or through a home improvement store), how likely would you be to: install the entire system start to finish, connect a refrigerant line on a system a customer partially installed themselves, perform an inspection on a system the customer fully installed themselves?”

Cadmus asked the 54 installers who responded that they were *somewhat unlikely* or *very unlikely* to perform at least one aspect of a CAI what made them unlikely to do so. As shown in Figure 20, installers cited a variety of factors, including these:

- **Lack of fit with business model.** Installers most frequently cited the mismatch between these CAI services and the installer’s set business model (44%). One installer said, “it’s a poor business model to install customer material: a critical part of profit is the margin on equipment.”
- **Liability.** Installers also were concerned about issues of liability and mixing their work with the actions of the customer (31%). They believed they might be held liable for any installation mistakes made by the customer, and this would reflect poorly on the installer’s performance. One installer said, “Too often, if we lay any hands on the system, even with disclaimers as to warranty, we are then believed by the customer to be a contributor to any post-installation issues.”
- **Warranty issues.** Twenty-six percent of installers mentioned concerns over warranty issues. Some of these installers said that some manufacturers, such as Fujitsu, void the warranty if the DHP was purchased through an unauthorized distributor, so they believed that a voided warranty adds to the perceived liability risk.
- **Equipment performance and reliability.** Installers also mentioned equipment performance and reliability (19%) as a factor behind the improbability that they would perform any aspect of a CAI. They found that equipment purchased by a customer was often incorrectly sized and that customers frequently made mistakes when attempting a partial install.
- **Rebate eligibility.** Only 5% of installers mentioned that customers who installed or partially installed DHPs on their own would be ineligible for a utility rebate.

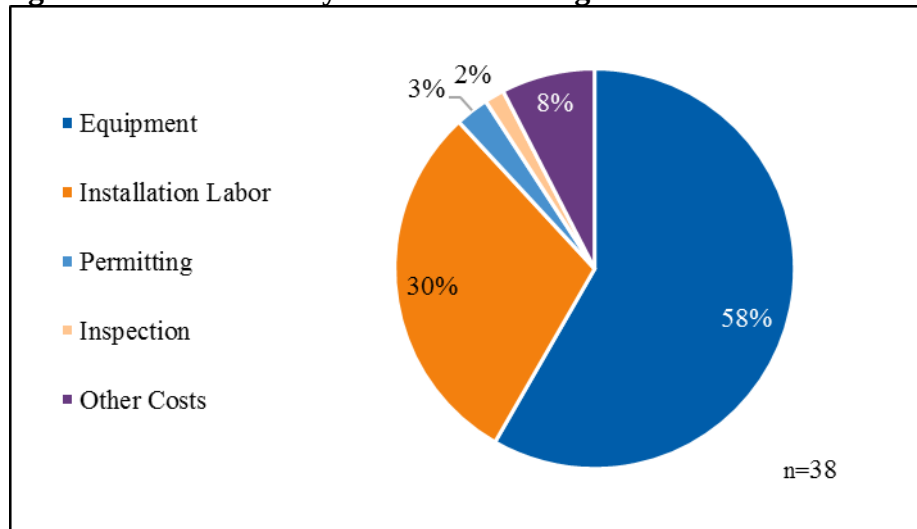
Figure 20. Frequently Cited Factors Influencing Installers Not to Perform Contractor Assisted Installations



Source: Installer Survey question F7, “What makes you less likely?” This was an open-ended question with multiple responses allowed.

3.6.6 DHP Costs

Installers (n=38) reported that the average total cost to install a single-zone DHP system (including labor and equipment costs) before any rebates or credits were applied was roughly \$4,200, comparable to the average cost reported in MPER 5 (\$4,208 for master installers and \$3,828 for other installers) and slightly higher than the costs reported in MPER 4 (\$4,076 for master installers and \$3,864 for other installers). Figure 21 shows the total cost by installation categories—equipment cost, installation labor, permitting fees, inspection, and other costs. Over half of the total cost (58%) was attributed to the equipment, followed by 30% for installation labor, similar to proportion of total cost of incented DHPs for equipment (55%) and installation labor (22%) tracked through CLEAResult’s Initiative tracking database

Figure 21. DHP Costs by Installation Categories

Source: Installer Survey question G2, “For the equipment and labor costs, what is the typical cost break down for the following components?” DHP cost breakdown is summarized only from the 38 respondents who provided categorized cost estimates. The average installation cost of these 38 respondents was approximately the same as for the total installer sample $\approx$ \$4,200.

Table 9 shows the average categorized cost estimates reported by 38 installers. Other cost categories identified by installers include overhead and administrative costs, electrician costs, and additional equipment needed for the installation.

Table 9. Average Component Cost of DHP Installation

Cost Component	Average Cost
Equipment	\$2,422
Labor	\$1,239
Permitting	\$112
Inspection	\$68
Other	\$351
Total	\$4,192

Source: Installer Survey question G2, “For the equipment and labor costs, what is the typical cost break down for the following components?” DHP cost breakdown is summarized only from the 38 respondents who provided categorized cost estimates. The average installation cost of these 38 respondents (\$4,192) was approximately the same as for the total installer sample (\$4,207).

The majority of installers (62%, n=61) said that they anticipated that the average installation cost for DHPs would increase in the next two years, while one-third said they expected costs to stay the same and only 3% said they expected costs to decrease. Distributors, however, varied in their expectations of future installation costs. Three distributors expected installation costs to increase, two expected costs to decrease, and one expected costs to remain the same. Of those who thought that installation costs would increase, two said that installers already have a narrow profit margin, and that as newer, more complicated units enter the market, installers will have to charge more for installations. One distributor expected that installation costs would increase due to a

shortage of skilled installers. Conversely, distributors who thought installation costs would decrease said that a more competitive marketplace in addition to better installation accessories (resulting in easier DHP installation) and improvements in installer education about proper installation techniques and sizing would drive down installation costs.

Distributors were also divided on the trajectory of DHP equipment costs. Three distributors anticipated that equipment costs would increase and cited increasing costs of raw materials and customer demand for more high-end equipment as the cause. Two distributors expected that costs would increase, in part, because they believed that DHP equipment costs had remained steady over the past five years compared to other HVAC equipment types (e.g. unitary systems) and the industry “had been holding them off for a while.” Two other distributors said equipment costs would actually decrease in the next two years because they believed that market competition and more domestic manufacturing (citing a new Daikin plant in Houston) would drive costs down. The one distributor who said that costs would probably remain the same said that increased materials costs will likely be balanced by increased penetration of less expensive DHPs from China.

No installers provided insight into opportunities to decrease equipment or installation costs for homeowners. Several installers said that installation costs cannot decrease any further, so any chance of an overall price decrease would have to be achieved through lowering equipment costs. Distributors were just as skeptical as installers about any opportunities to reduce costs. They did not offer any concrete opportunities but emphasized the importance of incentives and utility rebates and the possibility of some decrease in costs as the regional DHP market matures and grows. One distributor said customer-purchased DHPs (such as those bought through an online retailer) would probably not end up reducing overall costs to the consumer because as long as a professional installation is still required—and because installers’ profit margins are already low—the typical markup on equipment costs would just be shifted to installation costs.

4 Conclusions and Recommendations

This section describes key findings, conclusions, recommendations from this research regarding initiative data sources and tracking, components of customer purchase decisions, and current and emerging trends in the DHP market.

4.1 Initiative Data Sources and Tracking

Conclusion: NEEA is adequately capturing available sources of DHP market data; however, opportunities remain for filling minor data collection and analysis gaps. To track DHP market progress, NEEA gathers and synthesizes data from a variety of sources, including distributor sales data, rebate tracking data, utility surveys, and installer surveys. Employing multiple sources means that the existing data vary in scope and granularity, and Cadmus identified two primary gaps and uncertainties—that a portion of total DHP installations and incented target market installations may not be tracked, and detailed installation data are lacking for DHPs installed through utility programs not served by CLEAResult. Despite these gaps and uncertainties, Cadmus determined that there are not other currently accessible and comprehensive sources of market data that NEEA has yet to explore.

Recommendations:

- The Air-Conditioning, Heating, and Refrigeration Institute (AHRI) aggregates distributor sales data for DHPs from its member companies, representing the majority of the United States market. NEEA should continue working with AHRI to try to acquire these data, which could help fill in gaps regarding total DHP installs in the region. However, these data are typically available only to member distributor and manufacturer organizations and the likelihood of obtaining these data is likely quite low.
- To gather more detailed data on incented installations from utilities not served by CLEAResult, NEEA is considering a data request of these utilities to gather additional information such as head configuration, capacity, and efficiency level. NEEA should compare these data to the CLEAResult rebate tracking data; if there are not significant home and DHP characteristic differences, NEEA may not need to gather these data on an on-going basis. However, if there are substantial differences NEEA should consider fielding this data request annually and incorporating these findings into estimates of market penetration.

4.2 Customer Purchase Decisions

Conclusion: DHP awareness has remained steady, though more customers are learning about DHPs through the internet. Overall awareness of DHP technology remained about the same as in prior years, with 37% of respondents aware of the technology compared to just over 40% in MPER 5.¹⁶ Similar to prior MPERs, word of mouth continues to be the most common way consumers (who have not purchased a DHP) learn about DHPs; however, a significantly greater proportion of customers learned about DHPs through the internet than in the previous MPER.

¹⁶ This difference is not statistically significant.

Conclusion: Contrary to supply chain market actor and regional partner perceptions stated in prior MPERs, the fact that DHPs must be mounted on an interior wall is not a significant purchase barrier. Prior studies and word-of-mouth feedback from installers have led to conflicting perceptions about whether the fact that DHPs must be mounted on an interior wall poses an important barrier for prospective buyers. This study found that the wall mounted equipment was a mostly neutral attribute, with nearly all consumers considering it neither a very strong benefit nor a drawback relative to other product attributes. This finding confirms the findings from customer surveys from the previous MPER.

Conclusion: Target market consumers find the following DHP features most motivating: that DHPs can reduce monthly heating costs up to 50% and that they provide cooling as well as heating. Emphasizing these messages will be most effective in encouraging consumers to purchase DHPs.

Generally, the most powerful selling points for a DHP were equally important to respondents. However, the study found that a DHP warranty was more important for consumers in rural locations, and for those with an electric furnace. In addition, those with an electric furnace rated the opportunity to use DHPs to supplement existing equipment as more beneficial, and those who were dissatisfied with existing equipment found beneficial DHP features even more beneficial. Though there were no major differences in the relative importance of these features (judged by their rank order), the utility scores were higher among people who were not satisfied.

Respondents identified only three features as real drawbacks to purchasing a DHP—the strongest was that DHP equipment is new to the United States but common in Europe and Asia, followed by DHPs typically requiring professional installation, and the need for periodic maintenance.

Recommendations:

- Disseminate key findings from customer purchase decision research, including the most compelling product attributes, to initiative stakeholders and market actors. These findings can assist regional partners, installers, distributors, and manufacturers in developing the most effective messaging and communication to target market consumers.
- Emphasize the most compelling product attributes in all consumer-facing communication and marketing materials.

Conclusion: DHP price is the dominant factor in purchase intent for consumers with functioning existing HVAC systems; overcoming the cost barrier is still critical for accelerating market adoption.

Through the consumer survey, Cadmus determined that purchase intent had a statistically significant relationship with price point, with respondents much more likely to purchase a DHP at the lowest price scenario presented (\$2,500). Yet, even at the lowest price point, just 14% of respondents reported that they *definitely would buy*, and another 25% said they *probably would buy*, which indicates that the relatively high cost of the system is still a barrier when existing heating systems are still functioning. In addition, Cadmus notes that respondents often overestimate their purchase intention in surveys, so these percentages are likely a high estimate of the true likelihood to buy. Consumers indicated that availability of financing and rebates would increase their likelihood to purchase.

If DHP sales continue at the current pace, NEEA may fall short of its 2039 market saturation goals. Although NEEA has seen year-over-year growth in DHP installations in all three target markets, substantial growth is still needed to reach NEEA's market saturation goals—currently, market saturation is between 5% and 18% of target 2039 maximum saturation for each of NEEA's three market segments.

Recommendation:

The revised NEEA logic model correctly identifies the lack of a triggering event as a barrier to market adoption. The messaging research Cadmus conducted for this MPER clarifies the most compelling product attributes, which should help the initiative and market partners overcome that barrier to some extent. However, because product attributes are only one component of marketing, Cadmus recommends that NEEA consider assessing DHP marketing more comprehensively to identify the most effective approaches for creating urgency (e.g., storytelling; call to action; solution-oriented messaging), in order to address this market barrier.

4.3 Current and Emerging DHP Trends

Conclusion: Additional market intervention will be needed to reduce DHP costs.

According to CLEAResult initiative tracking data, the average costs for 1:1 DHP installations (a single outdoor compressor unit paired with a single indoor heating/cooling unit) are increasing, as is the share of 1:2 installations (a single outdoor compressor paired with more than one indoor unit), which are more costly than 1:1 configurations.

Most surveyed installers believed that installation costs would increase over the next two years, while distributors were split on whether they thought equipment and installation costs would increase or decrease. Distributors who thought installation costs would increase said installers already have a narrow profit margin, so as newer, more complicated units enter the market, installers would have to charge more for installations. One distributor expected that installation costs would increase due to a shortage of skilled installers. Conversely, distributors who thought installation costs would decrease said that installation costs would be driven down by a more competitive marketplace, better installation accessories (resulting in easier DHP installation), and improvements in installer education about proper installation techniques and sizing.

Regarding installation costs, regional utility partners agreed that installers were charging competitive installation rates. To reduce equipment costs, regional partners suggested that NEEA try to influence manufacturers to reduce costs. For example, one regional partner said that NEEA should consider influencing manufacturers to make more lower-HSPF or lower-capacity DHPs, promoting “the sedans” rather than the “Cadillacs.”

Recommendation:

Consider working with supply chain market actors to encourage increasing the availability of less expensive product. NEEA should continue engaging with lower cost product manufacturers to help bring lower cost products to the market. NEEA could also consider working with distributors to provide installer access to products at a variety of price points, and working with installers willing to assist customers with a CAI (see recommendation below).

Conclusion: Without new or compelling market intervention, **the market share of 1:1 displacements is not likely to increase in the future.**

NEEA considers the lack of supply chain acceptance for 1:1 displacement to be a critical market barrier to increasing DHP affordability and accelerating consumer adoption of DHPs. Although 1:1 displacements are a focus for the DHP Initiative, findings from installers, distributors, and Initiative tracking data suggest that the share of 1:1 installations is not likely to increase without new or compelling market intervention. Approximately half (52%) of DHP installations reported by surveyed installers were 1:1, (which matches CLEAResult tracking data for incentive installations [54% of installations]), a decrease from 62% to 60% between 2013 and 2015. Similar to installers, interviewed distributors said they anticipate the multi-zone market share of DHP sales will increase in upcoming years.

Recommendation:

If 1:1 displacements continue to be a focus of the Initiative, NEEA should explore additional market interventions to address this barrier. NEEA should continue to support efforts to identify single family homes with zonal heat that are most appropriate for 1:1. Both NEEA and regional partners are considering opportunities to better serve the low-income segment. Cadmus' customer survey found that both DHP awareness and purchase intent are lower among lower-income customers. There may be opportunities for NEEA to influence installation of lower cost 1:1 units for this segment through building strategic alliances with community action agencies or other organizations to promote and install DHPs that meet the needs of low-income residents or by facilitating bulk purchasing and/or installation of DHPs.

NEEA could also consider developing a definition for the appropriate application of the technology, because 1:1 displacements may not be the most appropriate application in all installation scenarios. Once the appropriate application of the technology is defined, NEEA should assess the sufficiency of existing resources to evaluate the appropriate application of the technology, and if possible, assess the proportion of installs that can be classified as "appropriate technology application" using CLEAResult's tracking database and updated RBSA data. If current data sources are not sufficient to assess appropriate technology application, NEEA should explore opportunities to gather these data.

Conclusion: Contractor assisted installations (CAIs) represent a potential opportunity for reducing DHP costs; however, NEEA should proceed with caution.

A quarter of installer respondents said they had performed some component of a CAI, and one in five said they would be *somewhat likely* or *very likely* to provide these services in the future. However, the majority of installers expressed strong opposition to CAIs—two-thirds said they were *very unlikely* to provide any of these services and expressed concerns over lack of fit with their business model and profit reduction, liability, warranty issues, equipment performance and reliability, and rebate eligibility. Similarly, distributors also expressed concerns about customer inexperience and poor quality installation, and the effect it might have on customer's perception of DHPs overall. No distributors are currently selling quick connect ductless systems, and most are not planning to do so in the future.

Recommendations:

- Continue to explore opportunities to develop the CAI channel outside of the typical HVAC contractor and distributor model.
- Engage HVAC installers and other equipment installers who are receptive to assisting with components of CAIs. If these installers are viable options for utility program involvement place them on the goingductless.com website.

5 References

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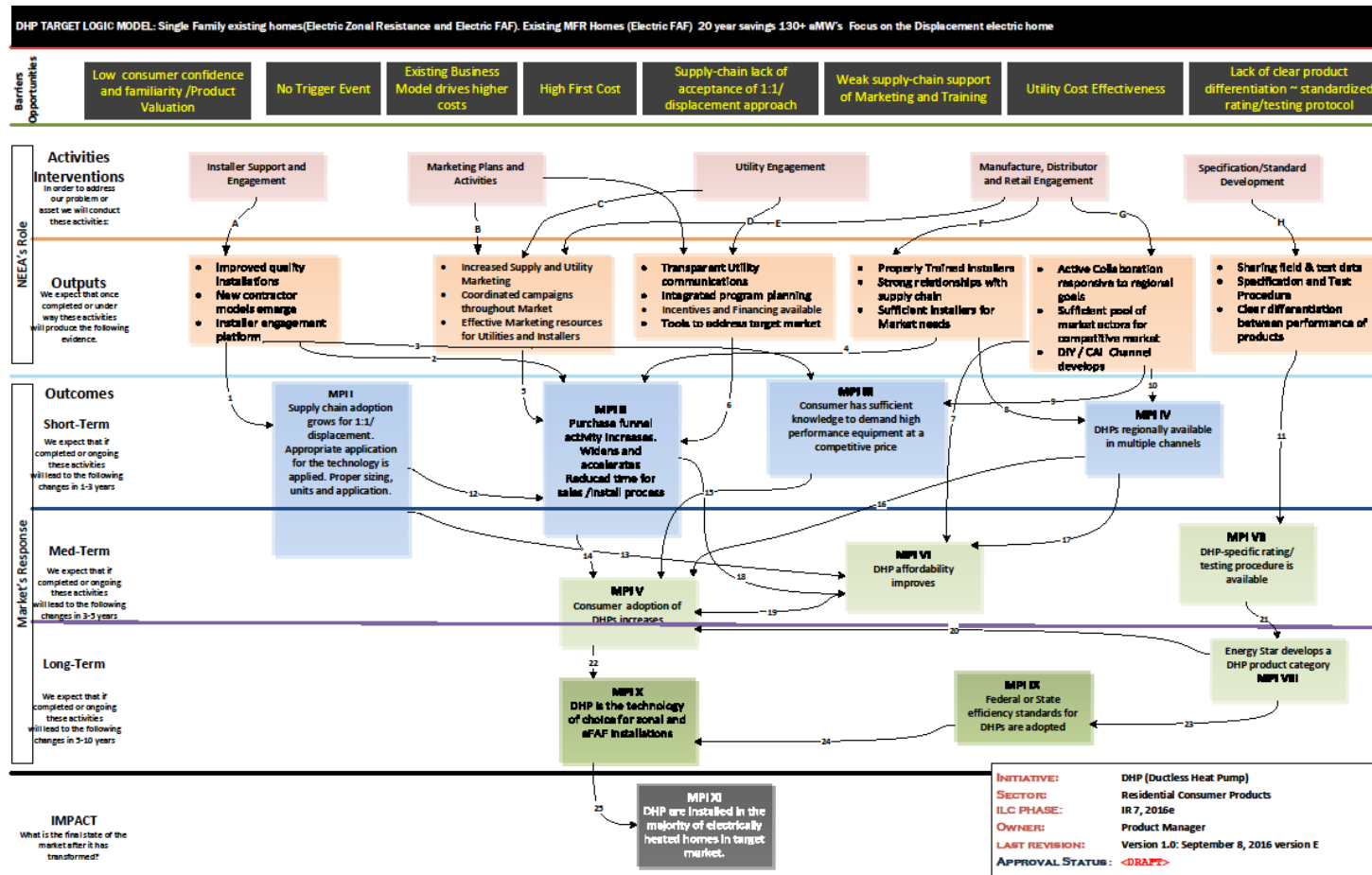
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Appendix A. Initiative Logic Model

Figure 22. NEEA DHP Initiative 2016 Logic Model



Appendix B. Additional Customer Survey Findings

B.1. Respondent Demographics

Table B-1 through Table B-16 contain demographic information for all respondents. Because the sample was composed of an equal number of households with zonal heat and electric furnaces, which is not representative of the population in the Northwest, Cadmus reported demographics separately for each stratum.

Table B-1. Urban/Rural*

	Urban	Rural	Total
Zonal	68%	32%	100%
Electric Furnace	74%	26%	100%
All Respondents	71%	29%	100%

* Based on classification according to the USDA Rural Urban Continuum Codes
n=520

Table B-2. Home Type

	Single-Family Detached	Manuf. Home	Apartment or Condo	Townhome	Uncategorized	Total
Zonal	76%	8%	10%	4%	2%	100%
Electric Furnace	64%	26%	5%	3%	2%	100%
All Respondents	70%	17%	8%	4%	2%	100%

n=520

Table B-3. Income

	<\$40,000	\$40,000-\$49,000	\$50,000-\$59,000	\$60,000-\$79,000	\$80,000-\$99,000	\$100,000-\$119,000	>\$120,000	Total
Zonal	29%	12%	10%	23%	9%	8%	9%	100%
Electric Furnace	30%	13%	15%	16%	8%	10%	8%	100%
All Respondents	29%	12%	12%	19%	9%	9%	9%	99%*

n=482

*Percentages do not add up to 100% due to rounding.

Table B-4. Education

	Some High School, No Diploma	High School Diploma or GED	Associate's Degree	Bachelor's Degree	Graduate or Professional Degree	Total
Zonal	2%	35%	18%	27%	18%	100%
Electric Furnace	3%	33%	22%	24%	17%	99%*
All Respondents	3%	34%	20%	26%	18%	100%

n=515

*Percentages do not add up to 100% due to rounding

Table B-5. Home Vintage

	Before 1939	1940- 1949	1950- 1959	1960- 1969	1970- 1979	1980- 1989	1990- 1999	2000- 2009	2010 or Later	Total
Zonal	8%	6%	5%	9%	20%	15%	16%	13%	8%	100%
Electric Furnace	3%	2%	2%	7%	15%	20%	23%	16%	12%	100%
All Respondents	5%	4%	4%	8%	17%	18%	20%	14%	10%	100%

n=508

B.2. Purchase Intent Ratings by Segment or Characteristic

Cadmus found significant differences in average purchase intent ratings across home heating equipment type, income level, and education level. Those findings are included in section 3.4, Customer Purchase Decision Survey. The following tables contain information on the average purchase intent ratings for other respondent characteristics of interest. Averages derived from a 5-point word scale where “1”= Definitely would not buy and “5”= Definitely would buy.

Table B-6. Urban vs. Rural Location

	N	Average Purchase Intent Rating
Rural	150	2.83
Urban	370	2.88
Total	520	2.86

Table B-7. Home Type

	N	Average Purchase Intent Rating
Apartment	39	2.56
Manufactured Home	88	2.68
Single-Family Detached	364	2.96
Townhome	20	2.80
Other	9	2.11
Total	520	2.86

Table B-8. Age

	N	Average Purchase Intent Rating
18-24	24	3.08
25-44	240	3.23*
45-64	163	2.55
65+	91	2.41
Total	518	2.86

*Significantly greater than ages 65+, p<.01

Table B-9. Years in Home

	N	Average Purchase Intent Rating
Less than 1 yr	50	2.60
1 yr to Less than 5 yrs	164	2.77
5 yrs to Less than 10 yrs	106	3.14*
10 yrs or More	200	2.59

*Significantly greater than all other groups, $p < .05$

Table B-10. Satisfaction with Current Heating Equipment

	N	Average Purchase Intent Rating
Somewhat or Very Satisfied	497	2.80
Not too or Not at all Satisfied	93	2.59
Total	520	2.76

B.3. Utility Scores by Segment or Characteristic

Table B-11. Heating Equipment Type

Feature	Electric Furnace (n=260)	Zonal (n=260)	Total (n=520)
Can reduce monthly heating costs by up to 50%	59.55	57.05	58.3
Provides cooling as well as heating	43.24	36.39	39.82
Comes with an 5-7 year warranty	23.09	18.58	20.84
Provides more even heating than baseboard or wall heaters	22.79	24.92	23.86
Doesn't require duct installation	21.64	20.08	20.86
Reduces the risk of fire and burns relative to baseboards and wall heaters	18.73	20.58	19.66
Can be used to supplement existing equipment, while allowing existing equipment to provide backup	17.03	9.91	13.47
Includes built in air filters	13.3	9.06	11.18
Can be adjusted with a remote control	11.5	7.11	9.31
Equipment is mounted high on an interior wall, typically in your primary living space like this	3.53	1.4	2.47
Anchor	0	0	0
Requires periodic maintenance such as cleaning air filters	-6.11	-10.94	-8.52
Typically requires professional installation	-11.61	-13.32	-12.46
Equipment is new to the US but common in Europe and Asia	-12.23	-16.81	-14.52

Table B-12. Urban Versus Rural Location

Feature	Rural (n=150)	Urban (n=370)	Total (n=520)
Can reduce monthly heating costs by up to 50%	58.54	58.20	58.30
Provides cooling as well as heating	35.86	41.42	39.82
Provides more even heating than baseboard or wall heaters	26.17	22.92	23.86
Comes with an 5-7 year warranty	25.90	18.78	20.84
Doesn't require duct installation	21.44	20.62	20.86
Reduces the risk of fire and burns relative to baseboards and wall heaters	21.31	18.99	19.66
Includes built in air filters	13.96	10.05	11.18
Can be used to supplement existing equipment, while allowing existing equipment to provide backup	11.96	14.08	13.47
Can be adjusted with a remote control	8.13	9.78	9.31
Equipment is mounted high on an interior wall, typically in your primary living space like this	3.52	2.04	2.47
Anchor	0.00	0.00	0.00
Requires periodic maintenance such as cleaning air filters	-8.13	-8.68	-8.52
Typically requires professional installation	-12.81	-12.33	-12.46
Equipment is new to the United States but common in Europe and Asia	-15.59	-14.09	-14.52

Table B-13. Home Type

Feature	Apt. or Condo (N=39)	Manf. Home (N=88)	Single- Family Detached (N=364)	Town- home (N=20)	Other (N=9)	Total (N=520)
Can reduce monthly heating costs by up to 50%	60.83	60.08	57.17	58.85	74.61	58.30
Provides cooling as well as heating	38.73	39.29	39.80	37.25	56.06	39.82
Provides more even heating than baseboard or wall heaters	24.80	20.01	24.56	20.90	35.27	23.86
Reduces the risk of fire and burns relative to baseboards and wall heaters	21.97	14.09	20.44	18.84	34.48	19.66
Comes with a 5-7 year warranty	20.86	20.53	20.25	28.66	30.05	20.84
Does not require duct installation	19.34	19.03	22.22	5.43	24.26	20.86
Includes built in air filters	12.43	10.22	11.17	8.15	22.25	11.18
Can be used to supplement existing equipment, while allowing existing equipment to provide backup	11.97	12.23	14.28	6.65	14.50	13.47
Can be adjusted with a remote control	10.22	8.88	9.62	1.12	14.90	9.31
Anchor	0.00	0.00	0.00	0.00	0.00	0.00
Equipment is mounted high on an interior wall, typically in your primary living space like this	-0.96	-0.56	3.59	0.08	7.05	2.47
Requires periodic maintenance such as cleaning air filters	-10.83	-11.45	-7.56	-10.43	-4.53	-8.52
Typically requires professional installation	-11.10	-19.89	-10.96	-11.45	-8.76	-12.46
Equipment is new to the US but common in Europe and Asia	-13.72	-21.58	-12.58	-20.29	-14.49	-14.52

Table B-14. Income

Feature	<\$40,000 (N=142)	\$40,000- \$49,000 (N=60)	\$50,000- \$59,000 (N=59)	\$60,000- \$79,000 (N=93)	\$80,000- \$99,000 (N=43)	\$100,000- \$119,000 (N=43)	\$120,000 or more (N=42)	Total (N=520)
Can reduce monthly heating costs by up to 50%	64.64	65.22	65.04	58.67	48.89	44.82	43.03	58.30
Provides cooling as well as heating	45.65	40.59	48.48	38.94	31.11	23.36	35.65	39.82
Provides more even heating than baseboard or wall heaters	25.61	27.69	27.24	24.90	23.76	18.67	17.25	23.86
Does not require duct installation	24.33	20.83	24.48	21.06	23.04	14.41	11.92	20.86
Comes with a 5-7 year warranty	21.18	24.22	22.90	22.44	21.85	11.37	23.03	20.84
Reduces the risk of fire and burns relative to baseboards and wall heaters	19.62	21.58	22.19	20.90	19.19	14.33	23.57	19.66
Can be used to supplement existing equipment, while allowing existing equipment to provide backup	16.00	10.62	17.31	11.50	24.77	7.89	7.63	13.47
Includes built in air filters	12.32	11.93	12.05	12.47	14.43	6.55	7.59	11.18
Can be adjusted with a remote control	7.54	6.32	13.34	10.44	18.46	1.99	13.57	9.31
Equipment is mounted high on an interior wall, typically in your primary living space like this	4.36	5.69	3.84	-2.12	5.05	-0.69	11.96	2.47
Anchor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Requires periodic maintenance such as cleaning air filters	-10.26	-10.40	-8.46	-8.78	0.89	-6.42	-4.46	-8.52
Typically requires professional installation	-15.24	-15.20	-12.03	-13.17	-5.54	-5.32	-5.16	-12.46
Equipment is new to the US but common in Europe and Asia	-19.15	-17.00	-14.68	-13.44	3.27	-10.33	-10.85	-14.52

Table B-15. Years in Home

Feature	Less than 1 year (N=50)	1 year to less than 5 (N=164)	5-10 years (N=106)	10 years or more (N=200)	Total (N=520)
Can reduce monthly heating costs by up to 50%	52.51	61.35	53.18	59.96	58.30
Provides cooling as well as heating	33.77	43.01	40.86	38.15	39.82
Provides more even heating than baseboard or wall heaters	23.34	24.70	22.18	24.18	23.86
Reduces the risk of fire and burns relative to baseboards and wall heaters	20.39	21.02	20.89	17.70	19.66
Does not require duct installation	18.91	20.59	22.49	20.70	20.86
Comes with an 5-7 year warranty	15.67	22.90	24.32	18.60	20.84
Includes built in air filters	8.66	11.38	14.00	10.14	11.18
Can be used to supplement existing equipment, while allowing existing equipment to provide backup	5.89	12.71	17.42	13.89	13.47
Can be adjusted with a remote control	5.47	9.85	11.48	8.67	9.31
Anchor	0.00	0.00	0.00	0.00	0.00
Equipment is mounted high on an interior wall, typically in your primary living space like this	-0.05	0.56	9.39	1.00	2.47
Requires periodic maintenance such as cleaning air filters	-9.84	-11.08	0.75	-11.01	-8.52
Typically requires professional installation	-13.23	-15.46	-4.50	-14.03	-12.46
Equipment is new to the US but common in Europe and Asia	-18.72	-14.30	-6.56	-17.87	-14.52

Table B-16. Satisfaction with Current Heating Equipment

Feature	Somewhat or Very Satisfied (N=427)	Not too or Not at All Satisfied (N=93)	Total (N=520)
Can reduce monthly heating costs by up to 50%	56.47	66.68	58.30
Provides cooling as well as heating	39.35	41.94	39.82
Provides more even heating than baseboard or wall heaters	22.21	31.39	23.86
Comes with a 5-7 year warranty	20.88	20.64	20.84
Does not require duct installation	19.50	27.08	20.86
Reduces the risk of fire and burns relative to baseboards and wall heaters	18.58	24.63	19.66
Can be used to supplement existing equipment, while allowing existing equipment to provide backup	14.02	10.95	13.47
Includes built in air filters	11.28	10.71	11.18
Can be adjusted with a remote control	10.08	5.75	9.31
Equipment is mounted high on an interior wall, typically in your primary living space like this	3.13	-0.58	2.47
Anchor	0	0	0
Requires periodic maintenance such as cleaning air filters	-7.33	-14.01	-8.52
Typically requires professional installation	-10.81	-20.06	-12.46
Equipment is new to the United States but common in Europe and Asia	-13.44	-19.46	-14.52

Appendix C. Additional Installer Survey Tables and Figures

The following tables and figures are supplementary findings from the Installer Survey and are referenced in the earlier section Supply Chain Actor Interviews and Surveys.

C.1. Survey Dispositions

Table C-1. Installer Survey Dispositions

	Master	Other	Total
Number of installers	134	894	1028
Less installers with status uncertain	-6	-47	-53
Sampling frame	128	847	975
Ineligible	0	3	3
Total number completed	13	57	70
Response Rate	10%	7%	7%

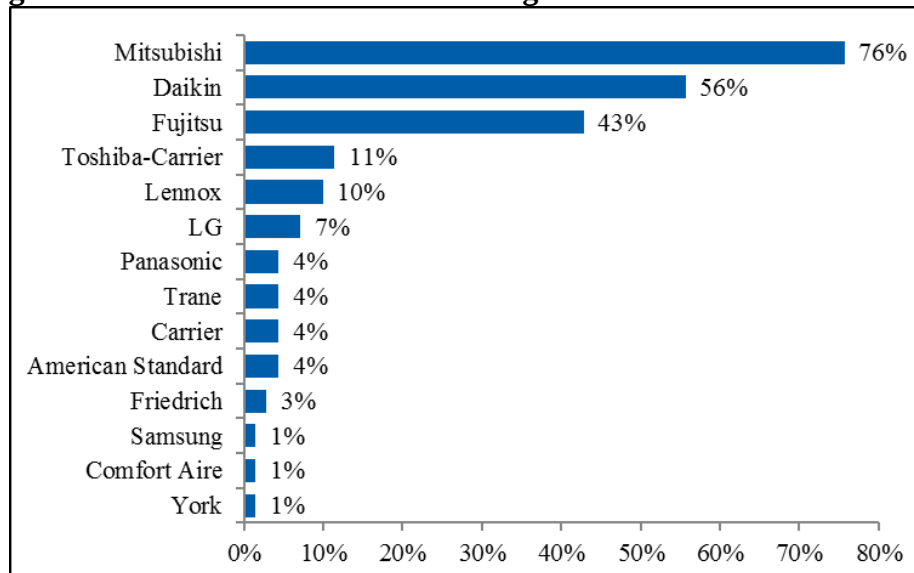
C.2. Installer Background

Table C-2. Installer State and Type

State	Master Installers	Oriented Installers	Total
Idaho	0	6	6
Montana	1	9	10
Oregon	7	23	30
Washington	5	19	24
Total	13	57	70

Source: Installer Survey.

Figure 23. Installer DHP Brand Offerings



Source: Installer Survey question H2, "Which DHP brands does your firm currently offer to customers?" Multiple responses were allowed.

Table C-3. Installer Company Size

Characteristic	Average	Minimum	Maximum
Locations	1	1	2
Employees	7	1	65

Source: Installer Survey questions H5, “How many locations does your company have in the Northwest?” and H6, “How many installers are employed by your company at the location you are based in? Please count part time staff as 0.5. Your best estimate is fine.”

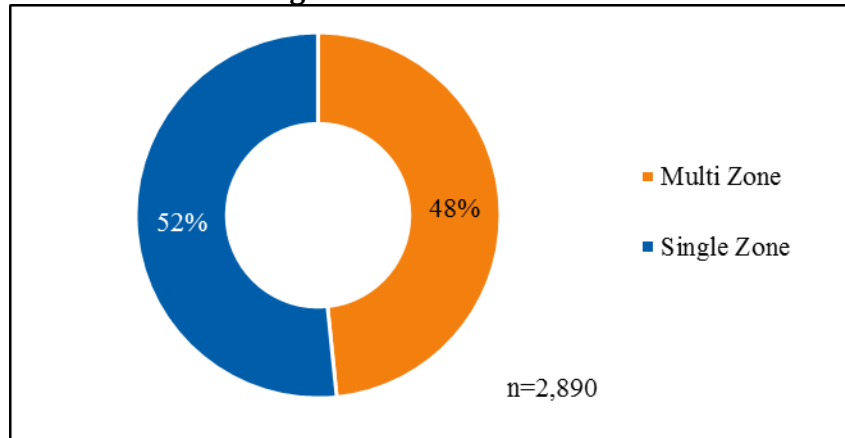
C.3. Initiative Support

Table C-4. Installer Training Attendance

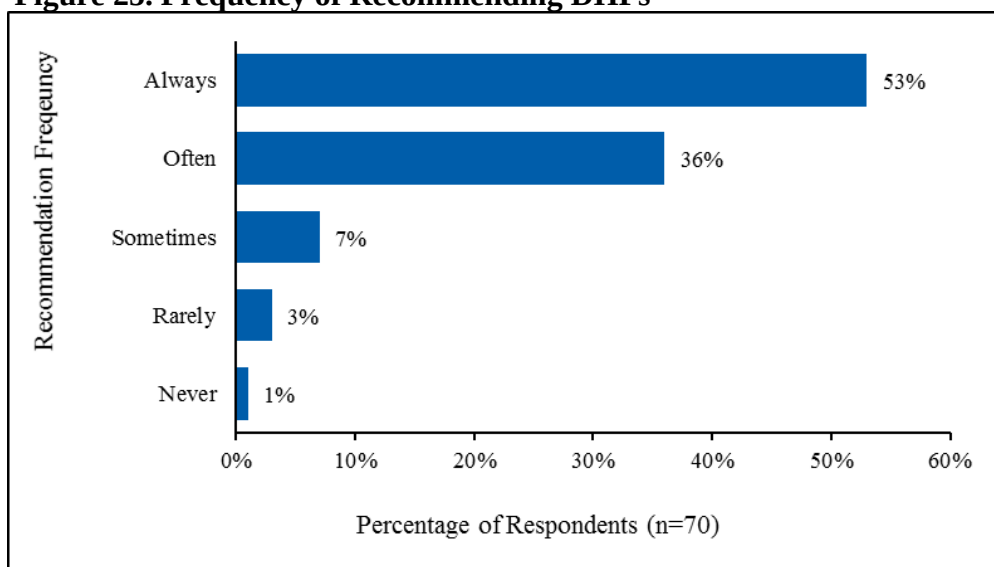
	Attended the Orientation Session (n=67)	Attended the Webinar (n=54)
Yes	91%	70%
No	9%	30%

Source: Installer Survey questions C2, “Have you or has anyone at your company attended the Northwest Ductless Heat Pump Project installer orientation session in person or via webinar?” and C5, “Have you attended the Northwest Ductless Heat Pump Project installation best practices webinar?”

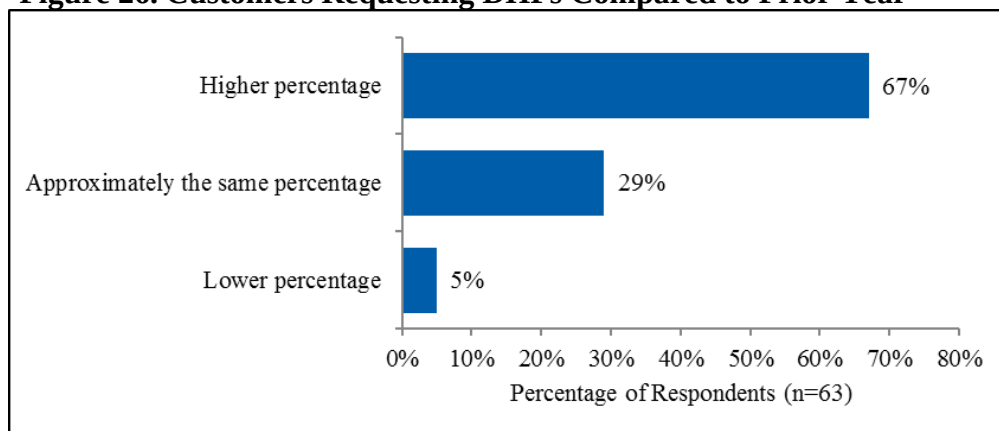
C.4. DHP Sales and Installations

Figure 24 Residential Single Zone versus Multi-Zone Installs

Source: Installer Survey question D3, “Of the [number of] residential DHP installations you performed in 2016, approximately how many were one-to-one or “single zone” systems (i.e. a unit with one outdoor compressor and one indoor unit)?”

Figure 25. Frequency of Recommending DHPs

Source: Installer Survey question E1, “How often do you recommend DHPs to customers with electric heat?”

Figure 26. Customers Requesting DHPs Compared to Prior Year

Source: Installer Survey question E4, “How does this percentage of customers specifically asking for DHPs compare between 2016 and prior years?”

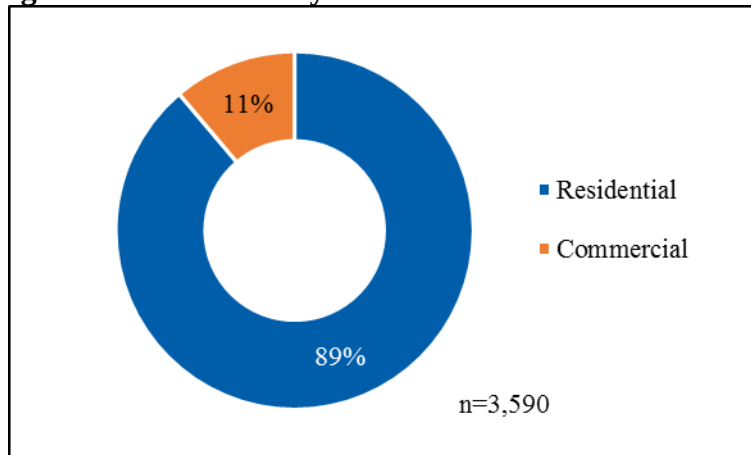
C.5. DHP Marketing and Promotion

Table C-5. DHP Portion of Total Revenue

Average DHP Portion of Total Revenue	Minimum DHP Portion of Total Revenue	Maximum DHP Portion of Total Revenue
27%	5%	95%

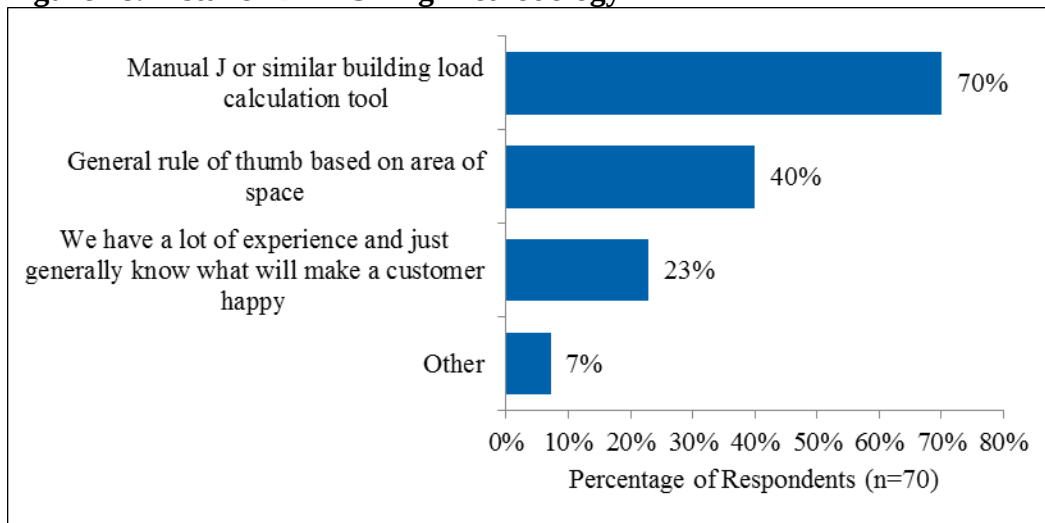
Source: Installer Survey question D1, “Thinking about your business for the past year from a revenue standpoint, of the products you currently carry and install, approximately what percentage of your revenue comes from DHPs? Your best estimate is fine.”

Figure 27. DHP Sales by Sector



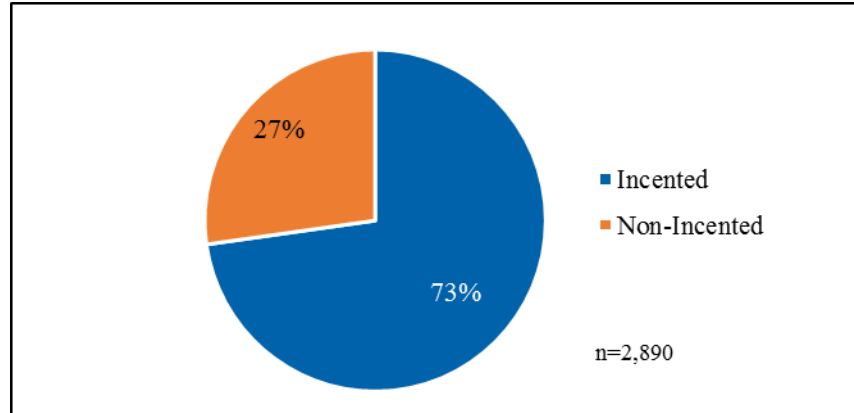
Source: Installer Survey question D2, “Approximately how many residential and commercial DHPs did you install in 2016 (this includes installations in the residential, multifamily, and commercial applications)? Your best estimate is fine.”

Figure 28. Installer DHP Sizing Methodology



Source: Installer Survey E6, “How do you typically select and size equipment for DHP customers?” Multiple responses were allowed.

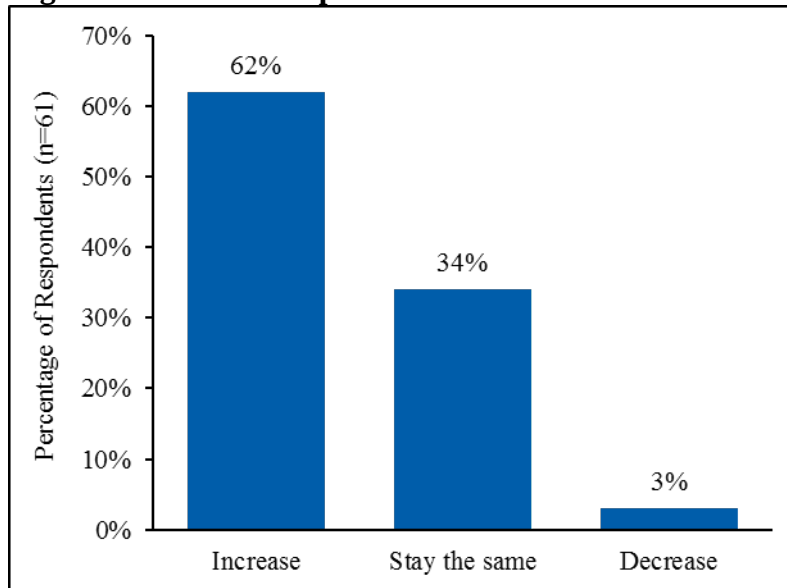
Figure 29. Incented Versus Non-Incited Residential DHP Installations



Source: Installer Survey question D5, “Of the residential DHP installations you performed in 2016, approximately how many did NOT receive a utility rebate?”

C.6. DHP Costs

Figure 30. Installer Expectations for Future Installation Cost



Source: Installer Survey question G3, “In the next two years, do you expect the average installation cost for DHPs to increase, decrease, or stay the same?”

Appendix D. Survey Instruments and Interview Guides

D.1. Customer Purchase Decision Survey

This survey will be programmed into an online format using the Qualtrics and Sawtooth platforms. The survey will be sent to a random sample of single-family, electrically heated homes in ID, MT, OR and WA and responses to A3 (primary system heating type) will tracked during survey fielding to fulfill equipment quotas. The target completes are 250 forced air furnaces and 250 zonal heat.

Objective	Question(s)
Track primary heating system type to fill survey quotas	A5
Assess awareness of DHP technology and information channels	Section B
Assess awareness of purchase locations	B4
Determine utility of DHP attributes through forced choice questions	Section C
Measure price sensitivity	Section C
Assess influence of/desire for financing options	C5
Assess influence of/desire for utility rebates	C6
Track demographics, location, and housing type	Section D
Note: Questions included in MPER #5 are: Section B, D2-D3, 0-D7	

Introduction

Welcome. Thank you for participating in this study about home heating in the Northwest. This survey should take you approximately 10 to 15 minutes. If you'd like to pause your survey and come back to it at any time, please simply close out of the survey, re-click on the link in your email, and pick up where you left off.

A. Screeners

- A1. In what state do you currently reside? **[Show dropdown list of states]**
1. If response=OR, WA, MT, ID **[CONTINUE]**
 2. If response ≠OR, WA, MT, ID **[THANK AND TERMINATE]**
- A2. What best describes your living situation:
1. Own your own home
 2. Rent **[THANK AND TERMINATE]**
 3. Other:____ **[THANK AND TERMINATE]**

- A3. How many years have you lived in your current home?
1. Less than 1 year
 2. 1 year to less than 5 years
 3. 5 years to less than 10 years
 4. 10 years or more
- A4. What type of heating fuel does your home use?
1. Electric only
 2. Gas only **[THANK AND TERMINATE]**
 3. Oil only **[THANK AND TERMINATE]**
 4. Wood heat only **[THANK AND TERMINATE]**
 5. A combination of electric heat and something else
 6. A combination of non-electric heating sources **[THANK AND TERMINATE]**
- A5. What type of equipment do you currently use for your home's primary heating system? **[SINGLE RESPONSE]**
1. Electric forced air furnace
 2. Baseboards
 3. Wall heaters (sometimes called Cadet heaters)
 4. Electric radiant heat (radiant heat can be floor heat, or panels on the wall or ceiling)
 5. Space heaters
 6. None **[THANK AND TERMINATE]**
 7. Other (heat pump, wood stove, fireplace, or something else) **[THANK AND TERMINATE]**

For Quota Tracking:

Electric Forced Air Furnace (n=250)	1
Zonal heat (n=250)	2, 3, 4, 5

Terminate Script: Based on your response we do not need you to complete this survey at this time. Thank you for your time and consideration.

- A6. How satisfied are you with your home's primary heating system?
1. Very satisfied
 2. Somewhat satisfied
 3. Not too satisfied
 4. Not satisfied at all

B. General Awareness & Perceptions of DHP Technology

- B1. Prior to this survey, had you heard of a ductless heat pump or mini split?
1. Yes
 2. No **[SKIP TO B3]**
- B2. How did you learn about ductless heat pumps? (Please check all that apply)
1. From a friend, family member or colleague
 2. Internet
 3. TV/Radio
 4. Retail Store display or promotion (for example Home Depot or the Heat Pump Store)
 5. Saw one installed or used in another home or business
 6. Home Expo/Show
 7. Contractor/Installer materials or advice
 8. Materials from my utility or utility website
 9. Advertisement in magazine, newspaper, or direct mail
 10. There is one in my home – someone else installed it **[TERMINATE]**
 11. Other (SPECIFY):
 12. Don't know

[ASK IF 0=2]

- B3. This is a ductless heat pump. Prior to this survey, had you seen this equipment before?
1. Yes
 2. No



[ASK IF 0=1 OR B3=1]

- B4. On a scale from 1 (completely disagree) to 10 (completely agree), please indicate your assessment of the following statement: “I know where to go to purchase a ductless heat pump.”

Completely disagree

1 2 3 4 5 6 7 8 9 10

Completely agree

C. Customer Choice (MaxDiff and Conjoint)

Note: this section was programmed in Sawtooth Software to allow for a randomized presentation of 12-15 Best/Worst questions that display a combination of 4-5 of the following DHP attributes:

1. Can reduce monthly heating costs by up to 50%.
2. Typically requires professional installation
3. Provides more even heating than baseboard or wall heaters
4. Provides cooling as well as heating
5. Includes built in air filters
6. Reduces the risk of fire and burns relative to baseboards and wall heaters
7. Equipment is mounted high on an interior wall, typically in your primary living space (Provide roll-over photo)
8. Equipment is new to the US but common in Europe and Asia
9. Requires periodic maintenance such as cleaning air filters
10. Can be used to supplement existing equipment, while allowing existing equipment to provide backup
11. Can be adjusted with a remote control
12. Comes with an 5-7 year warranty
13. Doesn't require duct installation

Note: C1-C2 is asked 12 times

- C1. Assume you are in the market for a new heating system. For the next 12 questions, you will be asked to evaluate a potential new heating system.

Thinking only of these five features, which ONE most makes you want to own a ductless heating system and which ONE least makes you want to own a ductless heating system?

<u>Least</u>	<u>Feature</u> [RANDOMIZED LIST of 4-5]	<u>Most</u>
☐	Can reduce monthly heating costs by up to 50%	☐
☐	Includes built in air filters	☐
☐	Comes with a 5-7 year warranty	☐
☐	Can be adjusted with a remote control	☐
☐	Provides cooling as well as heating	☐

Next we will assess respondents' likelihood to purchase a DHP after each display of the above question. Price will be randomized and be either: \$2,500, \$2,750, \$3,000, \$3,250, \$3,500, \$3,750, \$4,000, \$4,250. This question gauges price sensitivity in a displacement scenario.

Likelihood questions will be viewed on the same screen as the prior Best/Worst question.

C2. How likely would you be to purchase the ductless heat pump **described above** in the next 12 months, assuming your heating system is still working, and that it costs **[PRICE POINT]**?

1. Definitely would NOT buy
2. Probably would NOT buy
3. Might or might not buy
4. Probably would buy
5. Definitely would buy

Note: C3-C4 will only be asked once. Data will be used for model calibration.

C3. Ductless heat pumps have the following features:

<i>Can reduce monthly heating costs by up to 50%</i>	<i>Equipment is mounted high on an interior wall, typically in your primary living space</i>
<i>Typically requires professional installation</i>	<i>Equipment is new to the US but common in Europe and Asia</i>
<i>Provides more even heating than baseboard or wall heaters</i>	<i>Requires periodic maintenance such as cleaning air filters</i>
<i>Provides cooling as well as heating</i>	<i>Can be used to supplement existing equipment, while allowing existing equipment to provide backup</i>
<i>Includes built in air filters</i>	<i>Can be adjusted with a remote control</i>
<i>Reduces the risk of fire and burns relative to baseboards and wall heaters</i>	<i>Comes with an (X year) warranty</i>
	<i>Doesn't require duct installation</i>

Knowing these features, how likely would you be to purchase a ductless heat pump in the next 12 months, assuming your heating system is still working, and that it costs **[PRICE POINT]**?

1. Definitely would NOT buy
2. Probably would NOT buy
3. Might or might not buy
4. Probably would buy
5. Definitely would buy

C4. For each of the following features, please indicate whether you consider the feature to be a “**pro**” or “**con**” in your decision-making, or neither. **[CHECK ONE BOX IN MATRIX]**

Feature [RANDOMIZED LIST]	Pro	Con	Neither
Can reduce monthly heating costs by up to 50%			
Typically requires professional installation			
Provides more even heating than baseboard or wall heaters			
Provides cooling as well as heating			
Includes built in air filters			
Reduces the risk of fire and burns relative to baseboards and wall heaters			
Equipment is mounted high on an interior wall, typically in your primary living space (Provide roll-over photo)			
Equipment is new to the US but common in Europe and Asia			
Requires periodic maintenance such as cleaning air filters			
Can be used to supplement existing equipment, while allowing existing equipment to provide backup			
Can be adjusted with a remote control			
Comes with a 5-7 year warranty			
Doesn't require duct installation			

Note: C5 will only be asked once

- C5. Would the availability of financing options, which would allow you to pay for the cost of your new system over time, increase your likelihood to purchase a ductless heat pump?
- Yes
 - No [SKIP TO C7]
- C6. With the availability of finance options, how likely would you be to purchase a ductless heat pump?
- Very likely
 - Somewhat likely
 - Don't know

Note: C7 will only be asked once

- C7. Would the availability of a cash rebate from your utility, in the range of \$600-\$1200, increase your likelihood to purchase a ductless heat pump?
- Yes
 - No [SKIP TO D1]
- C8. With the availability of a cash rebate from your utility, how likely would you be to purchase a ductless heat pump?
- Very likely
 - Somewhat likely
 - Don't know

D. Demographics

D1. Please enter your zip code.

D2. What year was your home built?

1. 2010 or later
2. 2000 - 2009
3. 1990 - 1999
4. 1980 - 1989
5. 1970 – 1979
6. 1960 – 1969
7. 1950 - 1959
8. 1940 - 1949
9. Earlier than 1939
10. Don't know

D3. Which of the following best describes your home?

1. Single-family detached home
2. Manufactured home
3. Townhome
4. Apartment or condominium
5. Other (Specify:_____)

D4. Which of the following best describes your age range?

1. Under 18
2. 18 to 24
3. 25 to 44
4. 45 to 64
5. 65 and over
6. Prefer not to answer

D5. Which of the following categories best represents your approximate annual household income from all sources in 2016, before taxes?

1. < \$40,000
2. Between \$40,000 and \$49,999
3. Between \$50,000 and \$59,999
4. Between \$60,000 and \$79,999
5. Between \$80,000 and \$99,999
6. Between \$100,000 and \$119,999
7. \$120,000 or more
8. Don't know
9. Prefer not to say

- D6. What is your gender?
1. Male
 2. Female
 3. Prefer not to say
- D7. What is the highest level of education you've completed so far?
1. Some high school, no diploma
 2. High school diploma or GED
 3. Associates degree
 4. Bachelors degree
 5. Graduate or professional degree
 6. Prefer not to say

This survey is now complete. Thank you for your time.

D.2. Regional Partner Interview Guide

Key Research Topics/Objectives	Question
Explore interviewee roles and regional partner program offerings and promotions	A1-A7
Explore the future of regional partner program offerings and incentives	B1-B7
Review interactions with installers and other supply chain actors	C1-C2
Identify opportunities for NEEA to improve its support for regional partners	D1-D5
Record any additional comments on the DHP market	E1-E2

Cadmus will conduct 10 half-hour interviews with NEEA's partner utilities and non-utility program administrators, including DHP work group members. We will work with NEEA to identify the appropriate staff from regional partners to interview. These interviews will be coordinated via email in advance of the interview. This in-depth interview guide is designed to achieve the research objectives and address the topics outlined above.

[INTRODUCTION]

Cadmus is conducting the annual evaluation of the Ductless Heat Pump Initiative for NEEA. As part of this project we are interviewing NEEA's utility partners to understand regional trends in DHP promotion and incentives and to identify opportunities for NEEA to further support regional DHP efforts.

Thank you so much for agreeing to talk with me today.

Is now still a good time to talk?

I realize that you may have been contacted about other market progress evaluations taking place around this time of the year. Please know that we appreciate your assistance with this effort and will do our best to be respectful of your time.

Your answers will be kept confidential and will be grouped with other respondents for reporting in aggregate form only. Neither your name nor utility will be mentioned in any reports or documents.

A. DHP Marketing and Promotion

First, I'm going to ask you some questions about [REGIONAL PARTNER]'s DHP program.

A1. To start off, please describe your role in [REGIONAL PARTNER]'s DHP programs.

7. Program manager of _____ program.
8. Residential sector manager or planner.
9. Other: _____.

A2. Can you tell me more about your DHP program offering(s)? What rebates are you offering?

Market Segments	Is there an offering?	What is the incentive?
Single-family zonal		
Single-family electric forced air furnace		
Manufactured electric forced air furnace		
Multi-family		

A3. How are you promoting your DHP program(s) to customers? *[Probe for direct mailings, newspaper ads, TV/radio, social media, internet, store displays, etc.]*

Method	Yes/No
Direct mailings	
Newspaper ads	
TV/radio ads	
Social media	
Website	
In-store displays	
Other [Specify]	

10. Have your DHP promotion and marketing efforts increased, decreased, or stayed the same compared to 2015? What are your reasons for increasing or decreasing promotional efforts?

A4. Are you targeting specific customers, market segments, or housing types through these promotions and marketing? *[Probe for specific market segments such as the single family zonal market, single family electric forced air furnace market, and/or manufactured home's electric forced air furnace market].*

11. **[IF RESPONSE TO A2 INCLUDES MULTIFAMILY]** Are you targeting the multifamily segment through these promotions? If so, how?

A5. What aspects of your program do you think have the most impact on driving customer participation? *[Probe for rebates, marketing, technical training, contractor referrals, financing, etc.]*

- A6. What do you think are the primary drivers of DHP installations in the Northwest market overall?
- A7. What challenges have you faced in reaching your target customers or achieving your savings goals?
[Probe for challenges such as meeting cost-effectiveness requirements, customer confidence, installation obstacles, supply chain, or challenges for specific segments such as income level, etc.]

B. Future of Program Offerings and Incentives

Next I'd like to learn more about the direction your DHP program will likely take in the future.

- B1. Do you expect the DHP program to expand, contract, or remain the same in the next few years?
[Prompt for program budget increases or decreases, changes in rebate amounts, # of rebates, etc.]
 - 12. Why do you think this is likely to happen?
- B2. What other changes do you expect to see in your program?
 - 13. Do you plan on adding or dropping offerings for certain building types? *[Probe for multi-family, small commercial buildings, or low-income.]*
 - 14. Do you plan on including other DHP technologies? *[Probe for short-run ducted, unitary, etc.]*
 - 15. Do you plan on changing HSPF requirements for your offerings?
- B3. About what proportion of **[REGIONAL PARTNER]**'s residential savings were achieved through the DHP program in 2016?
 - 16. Do you expect this proportion to increase, decrease, or remain the same in the next few years? *[Probe for expected change in number of installations.]*
 - 17. Why do you say that?
- B4. Are DHPs currently a high priority measure for the **[REGIONAL PARTNER]**?
- B5. What is **[REGIONAL PARTNER]**'s long-term vision for DHPs? Will DHPs be a high priority measure in the next few years?
- B6. Do you have an expected time frame for when **[REGIONAL PARTNER]** will no longer offer DHP incentives?
- B7. **[IF TIME ALLOWS AND IF 0 = 8]** At the regional level, do you think the percent of overall market installs being rebated will increase or decrease in the next couple of years (the short term)?
[If applicable, probe for comments on specific markets: single family zonal market, single family electric forced air furnace market, and/or manufactured home's electric forced air furnace market.]

C. Interactions with Supply Chain Actors

Let's move on to a few questions about your interactions with the DHP supply chain.

- C1. What kinds of engagement activities does your program have with DHP installers? How do you promote your DHP program to installers?
 - 18. What about for other supply chain actors (manufacturers, distributors, and retailers)?
- C2. Do you have an existing installer/trade ally network for the DHP program?
 - 19. **[IF YES]** What are the requirements for installers?
 - 20. **[IF YES]** What support do you provide to DHPs installers through the trade ally network? *[Probe for resources and training.]*
 - 21. **[IF YES]** What challenges are associated with maintaining the installer network?
 - 22. **[IF YES]** Do you see any opportunities for enhancing or expanding the installer network? If yes, what could NEEA provide to help you achieve this?

D. NEEA's Support for Regional DHP Efforts

Next I'd like us to dig deeper into the role NEEA plays in supporting regional DHP programs.

- D1. NEEA provides promotional packets for utilities to use in promoting DHP programs. How, if at all, have you been using these promotional packets?
 - 23. What value do these packets add to your DHP program's promotional efforts?
- D2. What other DHP tools or support has NEEA provided for your organization? *[Probe for manufacturer promotion packets, marketing templates, the goingductless.com website, webinars, etc.]*
 - 24. Are there any tools or support from NEEA that stand out as being particularly helpful?
- D3. What additional support, if any, could NEEA provide to **[REGIONAL PARTNER]** in promoting DHPs or implementing the DHP program? *[Probe for specific ideas such as marketing support, supply chain, research, data analysis and sharing, pilots]*
- D4. NEEA is exploring opportunities to reduce DHP costs. What opportunities do you see for reducing the cost of purchasing DHPs? What about opportunities to help reduce the costs associated with DHP installation? *[Probe for specific ideas such as internet and retail sales, bulk purchasing, focusing on 1:1 installations versus 1:2, using Quick Connect installation system to reduce time, using electricians instead of HVAC installers, etc.]*
 - 25. How can NEEA help to realize these opportunities?
- D5. How can NEEA engage with **[REGIONAL PARTNER]** differently? How could NEEA's DHP Initiative better support your program?

E. Closing

- E1. Are there any emerging or new activities in the DHP market this year that would be good for us to understand as we continue talking to folks involved in delivering DHPs to the region?
- E2. Do you have any other thoughts you would like to share regarding NEEA's DHP Initiative or the regional DHP market?

Thank you for sharing your perspective and taking the time to participate. Your input is greatly appreciated.

D.3. Installer Survey Instrument

Research Objectives	Related Questions
Assess installer awareness of the DHP Initiative	C1
Explore gaps in information provided through training/network communication.	C2-C8
Explore installer sales process for DHPs	E1-E5
Document current sales/ opportunities in different market segments (multifamily, small commercial, new construction, additions).	D6-D7
Understand current sales/ opportunities in multi-head vs 1:1 system installations, including "whole home" solutions.	D3;D8;E5
Assess installer experience with/interest in different types of equipment (short-ducted, combo unit, quick connect, inverter driven heat pumps for electric forced air furnaces).	F1-F4
Assess installer willingness to install directly purchased systems through contractor-assisted installations (CAIs).	F5-F6
Explore installer barriers and motivations to offering CAIs	F7
Identify opportunities to reduce equipment and installation costs.	G1-G4
Gather firmographic information	H1-H5

Target Quota = 115 (45 Master Installers, 70 Oriented Installers)¹⁷

* Denotes survey questions from MPER 4 or 5

~ Denotes similar questions to MPER 4 or 5 that were revised for this survey

Sample Variables:

[EMAIL_ADDRESS] = Installer's email address

[COMPANY] = Name of Installer's company name

[TYPE] = Master Installer or Other

Survey Invitation E-mail Message for Installers

To: [EMAIL ADDRESS]

¹⁷ Cadmus will attempt to complete 115 surveys with a mix of master installers and other installers, which will facilitate achieving greater than $\pm 10\%$ precision with 90% confidence. We will aim to complete a total of 45 surveys with master installers and 70 surveys with other installers registered with the initiative. However, given the relatively small population of master installers, we anticipate that it may not be feasible to achieve the target complete of 45 surveys.

From: NWDuctlessHeatPumpProject@qualtrics-survey.com

Subject: The NW DHP Project needs your expertise! Help us improve support for installers.

Reply-To: Hanna.Lee@cadmusgroup.com

Dear [NAME]:

The Northwest Energy Efficiency Alliance (NEEA) is interested in hearing from installers, like yourself, who participate in the Ductless Heat Pump (DHP) Project. Your insight is very valuable to us and we'd like to know more about your experiences so we can make improvements to the program better serve installers and customers.

During this survey, we will ask you a few questions about the number of DHP installations you performed this year. You are welcome to review your sales records prior to or during the survey, but please note that this is not required—we are just looking for your best estimates on the number of installations.

We know your time is valuable, so we have kept this survey as short as possible. This survey should take approximately 15 minutes of your time.

Follow this link to the survey: [SURVEY LINK]

Or copy and paste this URL into your internet browser: [SURVEY LINK]

NEEA has asked The Cadmus Group to administer this survey. If you have any questions about the survey, please feel free to contact me. Thank you in advance! NEEA greatly appreciates your participation.

Sincerely,
Hanna Lee
The Cadmus Group, Inc
Hanna.lee@cadmusgroup.com
503-467-7110

Follow the link to opt out of future emails:
\${l://OptOutLink?d=Click here to unsubscribe}

A. Survey Start Screen

Welcome! Thank you for participating in our survey. Your responses are automatically saved and you can resume the survey by clicking on the link provided in the email. The responses you provide are kept confidential and anonymous.

During this survey, we will ask you a few questions about the number of DHP installations you performed this year. You are welcome to review your sales records prior to or during the survey, but please note that this is not required—we are just looking for your best estimates on the number of installations.

B. Screening Questions

- B1. *Does your company install ductless heat pumps, also known as DHPs or mini-splits, or do you only supply them for others to install?
1. Yes, we install DHPs
 2. No, we do not install DHPs [THANK AND TERMINATE]
 3. Don't know [THANK AND TERMINATE]
- B2. *In what types of buildings do you install DHPs? (Select all that apply)
1. Manufactured homes
 2. Single-family homes (site built)
 3. Multifamily buildings such as apartment buildings or condos, or senior or assisted living
 4. Commercial facilities
 5. Other [THANK AND TERMINATE IF B2 ≠ 1, 2, or 3]

C. DHP Training and Resources/Support

- C1. *Most of the electric utilities in this region participate in the Northwest Ductless Heat Pump Project. How familiar are you with the Project?

The NW Ductless Heat Pump Project partners with utilities, manufacturers, distributors, and installers to increase sales and quality installations of ductless heating and cooling systems. For installers, the Project offers marketing materials, image library, sales tools, and technical training and support as well as a listing on the "going ductless" website's Installer Finder page.

1. Very Familiar
2. Somewhat Familiar
3. Not too Familiar
4. Not at all familiar
5. Don't know

- C2. *Have you or has anyone at your company attended the Northwest Ductless Heat Pump Project installer orientation session in person or via webinar? (Select all that apply)

This training is required in order for installers to become oriented Northwest Ductless Heat Pump Project installers and covers project objectives, participation requirements, and strategies for expanding your business in the growing DHP market. Oriented installers are listed on the Installer Finder at GoingDuctless.com and is required by several utilities for installers to offer utility rebates to homeowners.

1. I attended the session
2. Others from my company attended the session
3. No [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]
4. Don't know [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]

[Ask if C2=1]

C3. How helpful would you say the installer orientation session was?

Very helpful (4)	Somewhat helpful (3)	Not too helpful (2)	Not at all helpful (1)	Don't know 98
------------------------	----------------------------	---------------------------	------------------------------	---------------------

[Ask if 0=2 or 1]

C4. What else could be added or changed to make the training more helpful?

1. [OPEN RESPONSE]

C5. Have you attended the Northwest Ductless Heat Pump Project installation best practices webinar?

This webinar provides information and suggestions to help installers achieve greater success in ductless system installations. It is required for those installers wishing to be part of the Master Installer program.

1. Yes
2. No
3. Don't know

[Ask if C5=1]

C6. How helpful would you say the installer best practices session was?

Very helpful (4)	Somewhat helpful (3)	Not too helpful (2)	Not at all helpful (1)	Don't know 98
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[Ask if 0=2 or 1]

C7. What else could be changed or added to make the installation best practices training more helpful?

1. [OPEN RESPONSE]

C8. What other types of training or resources should the NW DHP Project offer to installers?

1. [OPEN RESPONSE]

D. Installations

D1. *Thinking about your business for the past year from a revenue standpoint, of the products you currently carry and install, approximately what percentage of your revenue comes from DHPs? Your best estimate is fine.

1. [RECORD PERCENTAGE]
2. Don't know

D2. Approximately how many residential and commercial DHPs did you install in 2016 (this includes installations in the residential, multifamily, and commercial applications)? Your best estimate is fine.

Sector	Description	Number of DHP Installations
a. Residential	Includes single family, multifamily, and manufactured homes	[RECORD NUMBER]
b. Commercial	Non-residential buildings such as hotels, restaurants or stores	[RECORD NUMBER]

Residential DHP Installations

- D3. Of the [INSERT NUMBER FROM D2a] residential DHP installations you performed in 2016, approximately how many **were one-to-one or “single zone” systems** (i.e. a unit with one outdoor compressor and one indoor unit)?

1. [RECORD NUMBER]

- D4. Of the [INSERT NUMBER FROM D2a] residential DHP installations you performed in 2016, approximately how many were a “whole home” solution?

By “whole home” solutions we mean a DHP application that replaces/displaces an existing system and acts as the primary temperature control for the **entire residential unit**. This can be achieved through installing single outdoor unit, single indoor head systems; single outdoor unit, multiple indoor head systems; or multiple outdoor and indoor units.

1. [RECORD NUMBER]

- D5. Of the [INSERT NUMBER FROM D2a] residential DHP installations you performed in 2016, approximately how many **did NOT receive a utility rebate**?

1. [RECORD NUMBER]

The next several questions are specifically about the residential DHP installations you performed in 2016 **that did NOT receive a utility rebate**. We define residential as either single family, multifamily, or manufactured homes.

- D6. Of the [INSERT NUMBER FROM D5] residential DHP installations you performed in 2016 that did **not** receive a utility rebate, approximately how many were installed in the following building types? Your best estimate is fine.

Residential Building Type		Description	DHPs Installed
Single-Family and Multifamily	a. New Construction	Newly built single family or multifamily homes	[RECORD NUMBER]
	b. Single-Family Additions	Newly heated areas of single-family home – like new additions, garages or bonus room with no space conditioning	[RECORD NUMBER]
Single-Family	c. Single-Family Retrofit	Retrofit to replace/displace existing equipment in primary living space	[RECORD NUMBER]
	d. Multifamily Retrofits	Retrofit to replace/displace existing equipment in a multifamily unit	[RECORD NUMBER]
Manufactured Homes	e. Manufactured Home Retrofits	Retrofit to replace/displace existing equipment in a factory-made prefabricated single family home	[RECORD NUMBER]

The next question asks about the original heating type of the systems that DHPs supplemented or replaced in your customers' homes.

[Ask for each retrofit building type below]

- D7. You indicated that you installed [INSERT NUMBER FROM D6] DHPs that were retrofits to replace/displace existing heating equipment in [single family/multifamily/manufactured] homes.

Of those, what **percentage** originally had the following heating types in the primary living space?

Residential Building Type	Single-Family Retrofit	Multifamily Retrofits	Manufactured Home Retrofits
Number of Installations Reported	[INSERT NUMBER FROM D6.c]	[INSERT NUMBER FROM D6.d]	[INSERT NUMBER FROM D6.e]
Heating Type			
a. Electric resistance zonal heat (baseboards, cadet-style, ceiling cable)	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]
b. Electric Forced Air Furnace	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]
c. Gas Heat	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]
d. Other (e.g. oil, kerosene, wood or pellet heat)	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]

Commercial DHPs

Next I have a question specifically about the **commercial DHPs** you installed in 2016. Commercial installations would include installations in non-residential buildings such as hotels, restaurants or retail stores.

- D8. ~Of the [INSERT NUMBER FROM D2b] commercial DHP you installed in 2016, approximately how many were one-to-one or “single zone” systems (i.e. a unit with one outdoor compressor and one indoor unit)?
1. [RECORD NUMBER]

E. DHP Promotion and Sales

The next few questions are about how you promote and recommend DHPs to your customers

- E1. How often do you recommend DHPs to customers with electric heat?

Always (5)	Often (4)	Sometimes (3)	Rarely (2)	Never (1)	Don't Know (98)	N/A (99)
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- E2. In the last two years, what, if anything, have you changed with respect to how you promote and merchandise DHPs?

1. [OPEN RESPONSE]

- E3. *In 2016, about what percentage of your residential DHP customers came to you specifically seeking a DHP? (As opposed to customers who were trying to improve their heating or cooling in general, but didn't specifically request a DHP)
1. [RECORD PERCENTAGE]
 2. Don't know

[Ask if E3>0]

- E4. ~How does this percentage of customers specifically asking for DHPs compare between 2016 and prior years?
1. A higher percentage specifically requested a DHP in 2016
 2. A lower percentage specifically requested a DHP in 2016
 3. Approximately the same percentage specifically requested a DHP in 2016 compared to prior years
 4. Don't know
- E5. What factors influence your decision about whether or not to recommend installation of multi-zone DHP systems (versus single-zone systems)?
1. [OPEN RESPONSE]
- E6. How do you typically select and size equipment for DHP customers? (Select all that apply)
1. Manual J or similar building load calculation tool
 2. General rule of thumb based on area of space
 3. We have a lot of experience and just generally know what will make a customer happy
 4. Other (Specify _____) [FORCED TEXT ENTRY RESPONSE]
 5. Don't Know

F. Heat Pump Equipment

This section will ask you about some different types of heat pump equipment.

- F1. Which of the following types of heat pump equipment do you currently sell or install?

Heat Pump Type	Description	Select All That Apply
a. Short-ducted systems	A mini-split system with minimal ductwork connecting flush-mounted vents or a multi-zone system	
c. Quick connect ductless system	Ductless system with pre-charged refrigerant lines	
d. Inverter-driven (variable speed) ducted heat pumps	Variable speed heat pump that uses existing ductwork and replaces an existing electric furnace with a higher efficiency heat pump	

F2. How familiar would you say are you with each of the following types of heat pump equipment?

Heat Pump Type	Very Familiar (4)	Somewhat Familiar (3)	Not Too Familiar (2)	Not At All Familiar (1)	Don't Know (98)	N/A (99)
a. Short-ducted systems						
b. Combo units						
c. Quick connect ductless system						
d. Inverter-driven (variable speed) ducted heat pumps						

[Ask If 0.a, b, c, or d=1]

F3. In the next two years, do you anticipate your sales or installation of these heat pumps systems will increase, decrease, or stay the same?

Heat Pump Type	Increase (3)	Decrease (2)	Stay the Same (1)	Don't Know (98)	N/A (99)
[Ask If 0a=1] Short-ducted systems					
[Ask If 0b=1] Combo units (water heater and air heating/cooling)					
[Ask If 0d=1] Inverter-driven (variable speed) ducted heat pumps					

[Ask If 0a, b, c, or d=0]

F4. Which of the following heat pumps, if any, is your company planning to sell or install in the next two years? (Select all that apply)

Heat Pump Type	Select All That Apply
[Ask If 0a=0] Short-ducted systems	
[Ask If 0c=0] Quick connect ductless systems	
[Ask If 0d=0] Inverter-driven (variable speed) ducted heat pumps	

- F5. The next question is about a scenario you may have encountered where a customer purchased a DHP on their own.

Has a customer ever purchased a DHP on their own (e.g. online or through a home improvement store) and:

Select All That Apply
a. Asked you to install the entire system from start to finish?
b. Partially installed the system themselves and asked you to connect the refrigerant line?
c. Installed the entire system themselves and asked you to perform an inspection on their installation?

[Ask if F5.a=1]

1. **Did you install the system for any of the customers** that purchased a DHP on their own and asked you to install the entire system from start to finish?

[Ask if F5.b=1]

2. **Did you connect refrigerant lines for any of the customers** that partially installed the system themselves and asked you to connect the refrigerant line?

[Ask if F5.c=1]

3. **Did you perform the inspection for any of the customers** that installed the entire system themselves and asked you to perform an inspection on their installation?

- F6. Moving forward, for customers who purchase a DHP on their own (e.g. online or through a home improvement store), how likely would you be to:

	Very Likely (4)	Somewhat Likely (3)	Somewhat Unlikely (2)	Very Unlikely (1)	N/A 99
a. Install the entire system from start to finish					
b. Connect a refrigerant line on a system a customer partially installed themselves					
c. Perform an inspection on a system the customer fully installed themselves					

[Ask if F6.a, b, or c = 1 or 2]

- F7. What makes you less likely?
1. **[OPEN RESPONSE]**

G. Installation Cost

- G1. *Including all **equipment and labor** costs, what is the total cost for your customers, on average, to install a **one-to-one or “single zone”** DHP system before any rebates or tax credits are applied? Your best estimate is fine.
1. [RECORD NUMBER]
 2. Don't know
- G2. For the [INSERT RESPONSE FROM G1] equipment and labor costs, what is the typical cost break down for the following components?

Cost Components	Average Cost (\$)
Equipment (box/unit with single-head)	[RECORD NUMBER]
Labor associated with installation	[RECORD NUMBER]
Labor associated with permitting/paperwork	[RECORD NUMBER]
Labor associated with inspection	[RECORD NUMBER]
Other	[RECORD NUMBER]

- G3. In the next two years, do you expect the average installation cost for DHPs to increase, decrease, or stay the same?

Increase (3)	Decrease (2)	Stay the Same (1)	Don't Know (98)	N/A (99)
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- G4. What opportunities do you see to decrease the costs associated with DHP equipment or installation?
1. [OPEN RESPONSE]

H. Installer Background

You're almost finished with the survey! These last few questions are just to gather some background information about your firm for classification purposes only.

- H1. What area(s) does your company specialize in? (Select all that apply)
1. Commissioning services
 2. Electrical/lighting
 3. Energy assessments, diagnostics, or ratings
 4. HVAC equipment
 5. Other mechanical systems
 6. Insulation/building envelope
 7. New building construction
 8. Refrigeration
 9. Renewable energy
 10. Renovations
 11. Training/consulting
 12. Other [Specify_____] [FORCED TEXT ENTRY RESPONSE]
 13. Don't know [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]

- H2. *Which DHP brands does your firm currently offer to customers? (Select all that apply)
1. Comfort Aire
 2. Daikin
 3. Friedrich
 4. Fujitsu
 5. Lennox
 6. LG
 7. Mitsubishi
 8. Panasonic
 9. Quietside
 10. Samsung
 11. Sanyo
 12. Toshiba-Carrier
 13. York
 14. Haier/GE
 15. Other [Specify_____] [FORCED TEXT ENTRY RESPONSE]
 16. Don't know [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]

[SKIP IF H2=16]

- H3. *Are you planning to add any other DHP brands in the next 12 months?
1. Yes
 2. No
 3. Don't know

[IF H3 = 1]

- H4. *Which brands are you planning to add? (Select all that apply)
1. Comfort Aire
 2. Daikin
 3. Friedrich
 4. Fujitsu
 5. Lennox
 6. LG
 7. Mitsubishi
 8. Panasonic
 9. Quietside
 10. Samsung
 11. Sanyo
 12. Toshiba-Carrier
 13. York
 14. Haier/GE
 15. Other [FORCED TEXT ENTRY RESPONSE]
 16. Don't know [ANSWER LOGIC: CANNOT BE SELECTED ALONG WITH OTHER ANSWERS]

- H5. *How many locations does your company have in the Northwest?
1. [RECORD NUMBER]

2. Don't Know

H6. *How many installers are employed by your company at the location you are based in? Please count part time staff as 0.5. Your best estimate is fine.

1. [RECORD NUMBER]
2. Don't Know

[END OF SURVEY MESSAGE]

Success! Your responses have been submitted. Thank you for your time today.

D.4. Distributor Interview Guide

Research Objectives	Questions
Explore gaps in information provided through training/network communication	B1-B3
Identify opportunities for NEEA to improve its support for distributors	B3
Explore distributor promotion and sales process for DHPs	C1-C1
Document opportunities in different market segments (multifamily, small commercial, new construction, additions).	C3
Understand current sales/opportunities in multi-head vs 1:1 system installations	D3
Assess distributor sales and experience with different types of equipment (short-ducted, quick connect, inverter driven ducted heat pumps).	D1-D2
Identify opportunities to reduce equipment and installation costs.	E1-E3

* Denotes interview questions from MPER 5

~ Denotes similar questions to MPER 5 that were revised for this interview guide

Cadmus will conduct six half-hour interviews with distributors who engage with NEEA's Northwest Ductless Heat Pump (DHP) Project. We will work with NEEA to identify the appropriate distributors to interview. These interviews will be coordinated via email in advance of the interview. This in-depth interview guide is designed to achieve the research objectives and address the topics outlined above.

[INTRODUCTION]

Hello, my name is _____. I'm calling from Cadmus on behalf of the Northwest Energy Efficiency Alliance (NEEA). We are currently conducting the annual evaluation of the Northwest Ductless Heat Pump Project for NEEA. Right now we're interviewing participating distributors to better understand the DHP market and to gather feedback on the Project.

Thank you so much for agreeing to talk with me today.

Is now still a good time to talk?

This interview will take approximately 30 minutes. Your answers will be kept confidential and will be grouped with other respondents for reporting in aggregate form only.

I. Introduction/Background

- I1. To start off, please tell me a little bit about your role at your company.
- I2. What are the main types of HVAC equipment you sell [*Probe for common equipment types other than DHPs*]? What brands of HVAC equipment do you sell?

1. About what portion of your total sales would you say are installed in residential properties? Commercial?
- I3. Does your company work at all with retailers to sell and stock DHPs? Why or why not?
- I4. About what percentage of your total sales are direct to installers? To builders? To retailers?

J. NW DHP Project Resources and Support

- J1. *What involvement have you had with the NW DHP Project in the past year?
- J2. What DHP tools or support has the NW DHP Project provided for your organization? *[Probe for marketing support, assistance with promotions or contractor training, training resources support/development, meetings or updates on market opportunities]*
 1. Are there any tools or support that stand out as being particularly helpful?
 2. Are there any tools or support that were not particularly helpful or could have been more helpful *[probe for specifics]*?
- J3. Are there any gaps in the current communication, resources, or support provided by the Project?
 1. What additional support, if any, do you think the Project should provide for distributors? *[Probe for specific ideas such as marketing support; installer training; market research, data analysis and sharing]*

K. DHP Sales and Promotion

- K1. How do you typically promote and merchandise DHPs? *[Probe: any other ways/activities?]*
- K2. In the last two years, what, if anything, have you changed with respect to how you promote and merchandise DHPs? *[Probe as needed: any other changes?]*
 1. Why did you make those changes? *[Probe for impact of NW DHP Project on DHP promotion]*
 2. Have your DHP promotion efforts increased, decreased, or stayed the same compared to 2015? What are your reasons for increasing/decreasing promotional efforts?
- K3. In the last two years, what, if anything, have you changed about how you stock and purchase DHPs? *[Probe as needed: any other changes?]*
 1. Why did you make those changes? *[Probe for impact of NW DHP Project on DHP stocking practices]*
- K1. *Thinking about your business for the past year from a revenue standpoint, of the products you currently carry, approximately what percentage of your revenue comes from DHPs? Your best estimate is fine.
 1. Has this changed from prior years? If so, how?
- K2. ~ Thinking about your organization's sales in Oregon, Washington, Idaho and Montana specifically what proportion of your sales are one-to-one or "single zone" systems (i.e. a unit with one outdoor compressor and one indoor unit) versus multi-head or multi-zone systems?
 1. Do you expect this proportion to change in the future? If yes, how?

- K3. In what market segment(s) do you expect to see the most growth in DHPs over the next 3-5 years?
[Probe for: single family, multifamily, manufactured homes, small commercial, new construction; retrofits vs additions; zonal vs eFAF]
1. Why do you expect to see the most growth in those market segments?
 2. What opportunities do you see for increasing sales in specific market segments?

L. Heat Pump Equipment

My next few questions are about some different types of heat pump equipment.

- L1. Which of the following types of heat pump equipment do you currently sell?
1. **[If not currently selling, ask]** Are you planning to sell this equipment in the next two years?

Heat Pump Type	Description	Currently Selling?	Planning to Sell?
a. Short-ducted systems	A mini-split system with minimal ductwork connecting flush-mounted vents or a multi-zone system		[Ask If D1a=0]
b. Quick connect ductless system	Ductless system with pre-charged refrigerant lines		[Ask If D1b=0]
c. Inverter-driven (variable speed) ducted heat pumps	Variable speed heat pump that uses existing ductwork and replaces an existing electric furnace with a higher efficiency heat pump		[Ask If D1c=0]

[Ask if D1 a, b, c, or d=1]

- L2. For each of the technologies you currently sell, I'd like to know whether you anticipate your sales of these heat pumps systems will increase, decrease, or stay the same over the next two years.
1. Let's start with **[INSERT EQUIPMENT TYPE FROM TABLE BELOW]**. Do you anticipate the sales of these heat pumps will increase, decrease, or stay the same over the next two years?
 2. Why do you expect the sales of this technology to increase/decrease/stay the same?

Heat Pump Type	Increase	Decrease	Stay the Same	Don't Know	Why?
[Ask If D1a=1] Short-ducted systems					
[Ask If D1b=1] Quick connect ductless systems					
[Ask If D1c=1] Inverter-driven (variable speed) ducted heat pumps					

M. DHP Costs

Finally, I'd like to discuss the costs associated with purchasing and installing DHPs.

- M1. Do you expect the average costs for **DHP equipment** to increase, decrease, or stay the same over the next two years? Five years? Why do you say that?

- M2. And what about **installation costs**? Do you expect the average costs for DHP installations to increase, decrease, or stay the same over the next two years? Five years? Why do you say that?
- M3. What opportunities do you see for reducing the cost of DHPs for homeowners? What about opportunities to help reduce the costs associated with DHP installation? *[Probe for specific ideas such as internet and retail sales, bulk purchasing, focusing on 1:1 installations versus 1:2, etc.]*
1. Is there anything you think NEEA can do to help to realize these opportunities?

N. Closing

- N1. What emerging or new trends in DHP technologies or in the DHP market do you anticipate?
- N2. What other thoughts would you like to share regarding the NW DHP Project or the regional DHP market?

Thank you for sharing your perspective and taking the time to participate. Your input is greatly appreciated.

