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Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #8

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Table of Contents

1. Executive Summary

In 2008, NEEA launched the Northwest Ductless Heat Pump Project as a pilot to demonstrate the viability of DHPs to displace electric resistance heat in existing Northwest homes. Since then, the DHP Initiative, which NEEA launched at full scale in 2010, has made substantial progress in accelerating the adoption of DHP technology through a range of market interventions, such as 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.

As part of NEEA's market transformation initiative life cycle, when there is sufficient evidence that the market will continue to grow in the absence of direct NEEA intervention, NEEA transitions its initiatives out of active market development and into long-term monitoring and tracking (LTMT). NEEA has completed eight market progress evaluation reports (MPERs) for its ductless heat pump (DHP) initiative. The approach to this MPER differs from previous MPERs by providing a holistic look at the program's history and evaluating DHP initiative readiness to exit the market and transition to LTMT.

The following are Cadmus' conclusions with respect to program transition readiness and recommendations to ensure ongoing market transformation.

Conclusion 1: Findings from this MPER suggest that the market for DHPs in the Northwest will continue to transform without direct support from NEEA.

Prior to the launch of the pilot, a limited number of manufacturers were producing and distributing products for the U.S. market, HVAC installers had low awareness and capability to install DHPs, and consumer awareness of DHPs was limited. The initiative sought to address critical market barriers—product availability, customer awareness, and cost—by encouraging and providing resources to utilities to create DHP programs, influencing manufacturers and distributors to expand distribution to the Northwest, educating and training installers on how and why to sell DHPs and installation best practices, and supporting supply chain actors with consumer-focused marketing. Today DHPs are widely available to purchase, and there are trained DHP installers throughout the Northwest region. Over the past decade, DHP sales and installations have increased each year. A total of 101,395 DHPs have been installed in NEEA's target markets[1] since 2008. There is also strong utility support for DHPs—108 utilities currently offer DHP rebates and, to date, 82,702 DHPs installations have received a utility rebate.

[1] NEEA aims to accelerate the adoption of DHPs in three target markets: Single-family homes with zonal heating, single-family homes with electric forced air furnace, and manufactured homes with electric forced air furnace

Conclusion 2: Although it is likely that the market for DHPs will continue to grow across the region, gaps remain in NEEA's understanding of installer practices and the market for DHPs in cold climates.

Slowed or stalled market growth outside the I-5 corridor, particularly in cold-climate regions primarily concentrated in Idaho and Montana, was identified by interviewees and stakeholder workshop participants as a potential significant risk to LTMT transition. Utilities, distributors, and manufacturers interviewed for this MPER generally agreed that the market would continue to transform west of the Cascades; however, several utilities and a few supply chain actors said more work may be needed to prevent backsliding outside of the I-5 corridor.

Some utilities noted that cold climate heat pump technology was not available or as widespread early in the initiative when NEEA was most actively working with the supply chain. As a result, they believed installers (as well as customers) were not as aware of or familiar with cold climate DHP applications and therefore installers were not promoting the technology for heating in colder climates. Additionally, research has shown that consumers have indicated significantly higher awareness of DHPs in Oregon than in Montana and Idaho[2].

Despite these concerns, Cadmus found evidence of DHP availability and prevalence in cold climates. In general, the manufacturers and distributors Cadmus interviewed said that cold climate heat pumps are available for purchase throughout the Northwest. Although a smaller proportion of installers in Montana install DHPs than the other three states in the region, the vast majority of HVAC installation companies Cadmus surveyed in Montana (88%, n=71) and Idaho (97%, n=68) install DHPs. Furthermore, 90% of the DHP installations reported by surveyed DHP installers located in heating zone (HZ) 3 (primarily encompassing Idaho and Montana) were cold-climate heat pumps (compared to 39% in HZ 1). Most surveyed DHP installers in HZ 3 (87%, n=16) also said they always or often promote DHPs to their customers who use electric heat.

However, while the research concluded that the vast majority of installers in Montana and Idaho install DHPs, Cadmus was only able to investigate DHP promotion and installation practices among a small sample of 16 installers located in HZ 3, 14 of whom had received program orientation through the Northwest DHP project. As such, these installer survey results cannot be considered representative of the general population of DHP installers in the region, particularly in Montana where Cadmus found that only 19% of DHP installers are oriented installers[3].

- **Recommendation:** Prior to or as part of transitioning the initiative to LTMT in Idaho and Montana, NEEA should consider additional research to:

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[2] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7.* Prepared for NEEA. September 20, 2018. https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

[3] NEEA uses the term "oriented installers" for those who have completed NEEA's Northwest DHP Project Installer Orientation training.

  - Investigate or validate the availability of cold climate heat pumps in the Northwest
  - Assess installer perceptions and promotion of cold climate DHP technology (with a focus on non-oriented installers)
  - Gauge the prevalence of cold-climate specific market barriers to adoption, such as consumer perceptions of poor performance by cold climate heat pumps.
- **Recommendation:** As identified in the stakeholder workshop, NEEA should address cold-climate DHPs on the goingductless.com website to ensure resources specific to cold-climate heat pumps are available.

Conclusion 3: Continuing to track DHP costs in LTMT and DHP sales will be critical for indicating signs of backsliding in the market.

A critical challenge and ongoing focus of the initiative has been the affordability of DHPs for target market consumers. NEEA has explored and implemented a variety of strategies aimed at cost containment, including exploring opportunities for lower-cost installation pathways and retail sales channel development, working with manufacturers to introduce lower-cost products, exploration of unique partnerships supporting and promoting lower cost and single-head installations, and a variety of consumer targeting and customer purchase decision support tools. NEEA has had some success in partnering with manufacturers and distributors, for example on limited time promotions to reduce product cost, which the supply chain now regularly offers without program support and sometimes directly in partnership with utilities. Nevertheless, DHP cost to the consumer has not decreased in recent years and, in fact, this MPER found that costs had increased from MPER 6.

High DHP costs may continue to be a barrier to accelerated customer adoption in NEEA's target markets, particularly in displacement scenarios where customers' existing heating equipment is still functioning. Rising DHP costs may also hinder utilities from offering DHP programs. Rising DHP costs and diminished savings mean that DHPs are not cost-effective for some utilities. Utilities may therefore discontinue their DHP programs, further impacting accelerated DHP adoption. However, despite the first-cost barrier, sales of DHPs continue to grow in target markets and in the region overall. DHP installations in NEEA's target market saw year-over-year growth of 16% in 2018. Two of NEEA's three target markets met or exceeded 2018 forecasted saturation, and are on track to achieve target maximum saturation by 2039.

Even so, given the potential for increasing price to impact the rate of diffusion, DHP cost will remain an important indicator to assess through LTMT. Tracking DHP cost in tandem with DHP sales will provide valuable context on market conditions, particularly if LTMT evaluation results show a decline in market growth.

- **Recommendation:** NEEA was unable to complete a cost analysis for this MPER due to challenges in accessing robust and representative cost data. However, once these data are available, NEEA should assess DHP costs to the consumer to provide a baseline for LTMT. NEEA may also triangulate these cost data with data provided by installers through the biannual installer survey, which NEEA will continue to conduct in LTMT.

2. Background and Methodology

2.1. Introduction

2.1.1. DHP 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.

2.1.2. Initiative Transition

As part of NEEA's market transformation initiative life cycle, when there is sufficient evidence that the market will continue to grow in the absence of direct NEEA intervention, NEEA transitions its initiatives out of active market development and into long-term monitoring and tracking. To assess market readiness for this transition, NEEA contracts a third party to complete a comprehensive retrospective narrative that summarizes the program theory, market interventions, and evaluations of market progress to date. This MPER, provides this holistic look at the program's history and evaluates DHP initiative readiness to exit the market and ability to monitor continued market transformation after a transition to long-term monitoring and tracking (LTMT).

2.2. Research Approach

NEEA prioritized three evaluation objectives to assess this initiative's readiness for LTMT:

- Provide a summative story of the initiative
- Document the current state of key market progress indicators (MPIs)
- Identify distinct diffusion indicators to track in LTMT

The research objectives and associated research activities are listed in Table 1.

Table 1. High-Level Research Objectives and Associated Research Activities

Research Activity	Research Objectives		
	Provide Summative Story of Initiative	Identify Distinct Diffusion Indicators to Track in LTMT	Document Current State of key MPIs
Literature Review	✓		
Logic Model Review	✓	✓	✓
Interview Stakeholders/Supply Chain Partners	✓	✓	✓
Identify Diffusion Indicators and Develop Evaluation Plan		✓	
Conduct Stakeholder Workshop	✓	✓	
Market Update			✓
Installer Research			✓

2.2.1. Literature Review

Cadmus reviewed previous DHP MPERs, market research deliverables, and emerging technology reports to document the history of the DHP initiative, including key milestones, events, and intervention strategies.

2.2.2. Logic Model Review

Cadmus reviewed all iterations of the DHP Initiative logic model to document key Initiative activities and shifts in Initiative thinking over time (e.g., approach, key barriers, MPIs) and support an assessment of progress towards MPIs.

2.2.3. Stakeholder Interviews

In preparing this preliminary retrospective narrative of the DHP initiative, Cadmus conducted 26 individual and group interviews with a total of 38 DHP initiative stakeholders:

- ***Current and former NEEA staff*** with members of the DHP initiative team (such as the program manager and product manager) and current and former NEEA staff who were influential in developing and deploying the DHP initiative
- ***Regional utility staff*** with DHP work group members who have served an important role in the initiative
- ***Supply chain partners*** with manufacturers and distributors with whom NEEA has established strategic partnerships

Table 2 lists interview sample sizes.

Table 2. Stakeholder and Supply Chain Partner Interview Sample Sizes

Stakeholder Group	Completed Interviews	Total Number of Interviewees*
Current and Former NEEA Staff	7	15
Regional Utility Partners	9	13
Manufacturers	5	5
Distributors	5	5
Total	**26**	**38**

* Completed interview column does not match total number of interviewees due to group interviews.

Through these interviews, Cadmus explored:

- **History of initiative activities,** including timeline of key milestones and events and intervention strategies
- **Drivers of DHP adoption,** including interventions that were and were not successful and activities and conditions that have had the greatest impact on initiative results
- **Market progress,** including status of MPIs, market progress over time, and remaining barriers
- **Risk assessment,** including the potential risks and impacts to market diffusion and the region resulting from a NEEA transition out of DHP market development

2.2.4. Diffusion Indicators and LTMT Plan

Cadmus identified distinct diffusion indicators for LTMT. Diffusion indicators are metrics (qualitative and quantitative) that can be tracked over time to assess ongoing progress in market adoption. With input from NEEA staff and stakeholders, Cadmus identified and adapted a subset of diffusion indicators from the current market progress indicators (MPIs) identified in the logic model and tracked these with prior MPERs.

To assess potential diffusion indicators to track during LTMT, Cadmus addressed these questions:

- How important is this indicator as evidence of market transformation and ongoing product diffusion?

- What will this indicator tell us about how product diffusion is progressing or faltering in LTMT?
- What level of investment would be required to track this indicator in LTMT?

As part of selecting diffusion indicators, Cadmus has also developed an LTMT evaluation plan to support the ongoing measurement of diffusion. The LTMT evaluation plan includes the following details:

- Summary and rationale of each diffusion indicator to be tracked
- Metrics, data sources, and expected analysis outcomes
- Ranking of indicator importance to quantify ongoing product diffusion (high, medium, low)
- Ranking of difficulty to gather data and track the indicator (high, medium, low)

2.2.5. Stakeholder Workshop

In June 2019, Cadmus and NEEA facilitated an in-person stakeholder workshop at NEEA's offices in Portland, Oregon with more than 20 NEEA funders and stakeholders. Employing a combination of presentations, small-group exercises, and facilitated group discussions, Cadmus and NEEA sought to address these workshop objectives:

- Develop a shared understanding of NEEA's approach to market transformation and LTMT
- Confirm and gather additional input on the potential risks and impacts of LTMT transition
- Develop a shared understanding of the development and role of diffusion indicators in LTMT
- Share and gather feedback on NEEA's draft DHP diffusion indicators and LTMT evaluation plan

2.2.6. Market Update

Cadmus used data provided by 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.

2.2.7. Installer Research

To assess ongoing progress in enhancing market competition and improving DHP availability, Cadmus contacted HVAC businesses in the Northwest via brief "call down" surveys to assess the proportion and distribution of DHP installers in the region. Cadmus also fielded a more comprehensive online survey with DHP installers. Cadmus fielded the online survey in June and July 2019 and completed surveys with 87 installers. This survey gathered insights on DHP sales and installations, installer promotion of DHPs, and equipment and installation costs.

3. Detailed Findings

3.1. DHP Initiative History and Evolution

This section is an overview of the history and evolution of the DHP initiative.

3.1.1. Pre-Launch

In 2006, several Asian manufacturers began offering "a new generation of inverter-driven mini-split heat pumps into the North American market."[4] NEEA recognized that unique product features of the DHP technology, which promised "high levels of energy efficiency" as well as "increased comfort, low-noise, and ease of installation,"[5] could transform the previously underserved market of approximately one million detached, owner-occupied single-family electrically heated homes in the Northwest.[6,7]

To test the technical viability for DHPs in the Northwest, NEEA spearheaded two demonstration projects consisting of just under 20 homes in the fall of 2006 and summer of 2007. The demonstration project sample size was too small to extrapolate the findings. Consequently, in fall of 2007, the Regional Technical Forum established a provisional deemed savings estimate so that large utility programs could participate in a pilot generating a large enough population to support statistical analysis of savings.

In October 2008, NEEA, Bonneville Power Administration (BPA), and regional utilities launched a large-scale pilot project intended to validate the provisional savings estimate and simultaneously demonstrate market acceptance and delivery of DHPs in residential homes that already used electric resistance zonal heating systems. A total of 3,899 DHPs were installed in 59 utility territories across the Northwest.[8]

The pilot sought to remedy residential consumers' unfamiliarity with DHP technology and weak distribution networks of DHPs (at the time, few manufacturers were producing and distributing DHP

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4 Ecotope Inc. *Final Summary Report for the Ductless Heat Pump Impact and Process Evaluation.* Prepared for NEEA. February 19, 2014. https://neea.org/img/uploads/e14-274-dhp-final-summary-report-final.pdf

5 Ibid.

6 Evergreen Economics. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #3.* Prepared for NEEA. April 24, 2014. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-3.pdf

7 The initiative first targeted single-family homes that used electric resistance zonal heating systems as the primary home heating source. In MPER 5, this was expanded to three target markets—single-family homes with zonal heating, single-family homes with electric forced air furnaces, and manufactured homes with electric forced air furnaces. NEEA added manufactured homes because DHPs were thought to be particularly suitable for replacing noisy and obtrusive furnaces in primary living areas.

8 Ecotope Inc. *Final Summary Report for the Ductless Heat Pump Impact and Process Evaluation.* Prepared for NEEA. February 19, 2014. https://neea.org/img/uploads/e14-274-dhp-final-summary-report-final.pdf

products for the U.S. market). An assessment of the pilot found that "DHPs have a strong consumer acceptance, a workable integration with existing market actors and supply chains, a reasonable level of agreement between manufacturers' claims and actual performance and, finally, a performance that integrates well with the space conditioning needs of the utility customer."[9]

3.1.2. Early Initiative (2010 – 2013)

Based on pilot results—especially strong customer acceptance and technological performance that integrates well with the space conditioning needs of Northwest customers—NEEA moved forward with funding and launching a full DHP initiative in 2010. The initiative was publicly promoted as the Northwest Ductless Heat Pump Project.

Product availability was one of the first and most critical market barriers NEEA sought to address. Historically, DHP manufacturers had thought the U.S. was a limited market for residential DHP sales. When NEEA's initiative began, these manufacturers perceived DHPs as a solution only for problem zones, bonus rooms, or add-ons rather than for whole-house heating and cooling systems. In addition, the previous generation of DHPs did not provide heating below 40°F. Therefore, manufacturers did not promote DHPs as an energy efficiency measure or as an alternative to zonal electric heat.[10] At the beginning of the initiative, one particular barrier to DHP adoption, especially in Idaho, Montana, and Eastern Washington, was that there was a question as to whether the DHP technology available at the time could provide adequate heat in colder temperatures.[11]

Prior to the pilot, DHPs were "virtually unknown" to the Northwest market,[12] so lack of customer awareness was the second barrier the project sought to address. As of 2008, public awareness of DHPs was only 5% nationwide, and DHPs represented only 1% of the commercial and residential market for HVAC equipment.[13] In addition, NEEA's initiative sought to convince installers, those who had been successfully delivering ducted systems to customers, to make a change and adopt ductless technology.

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9 Ecotope Inc. *Final Summary Report for the Ductless Heat Pump Impact and Process Evaluation.* Prepared for NEEA. February 19, 2014. https://neea.org/img/uploads/e14-274-dhp-final-summary-report-final.pdf

10 Research Into Action. *Northwest Ductless Heat Pump Pilot Project MPER #2*. Prepared for NEEA. March 28, 2010. https://neea.org/img/uploads/northwest-ductless-heat-pump-pilot-project-market-progress-evaluation-report-2.pdf

11 Ibid.

12 Ecotope Inc. *Final Summary Report for the Ductless Heat Pump Impact and Process Evaluation.* Prepared for NEEA. February 19, 2014. Page 5. https://neea.org/img/uploads/e14-274-dhp-final-summary-report-final.pdf

13 National Association of Home Builders Research Center. *Ductless Heat Pump Market Research and Analysis*. June 2008.

To increase product availability, expand consumer awareness, and help encourage DHP adoption, the initiative focused on these market interventions:

- Form relationships with supply chain market actors and encourage them to incorporate DHPs into their product offerings by explaining the market growth opportunity in the Northwest
- Establish channels of communication among utilities and between supply chain market actors and utilities
- Train and provide resources to installers, manufacturers, and distributors to help them sell and install DHPs in homes using electric resistance heating
- Perform quality assurance inspections in the field and share findings with installers, distributors, manufacturers, and utilities in order to continuously improve quality of installations and build and strengthen knowledge of best practices throughout the region
- Market DHPs through direct consumer marketing (e.g., television and radio public service announcements [PSAs], the website goingductless.com, online marketing) and create marketing tools and sell sheets for market actors and utilities to use when communicating with their customers

As a result of NEEA's activities, manufacturers viewed the "Northwest as an important market for DHPs" and reported that that availability of DHPs increased in the Northwest (including the most up-to-date cold-temperature products, which manufacturers had previously offered almost exclusively in Scandinavia).[14] The number of contractors installing DHPs in the region also increased. Some utilities began training contractors and developing their own approved installer lists. Furthermore, high consumer satisfaction led to substantial word of mouth promotion for DHPs. According to several utilities, despite a slight reduction in marketing efforts in 2010, consumer demand continued to grow.[15]

3.1.3. Mid-Initiative (2014 – 2016)

The initiative continued to influence DHP installations and, by 2014, a total of 36,158 utility incented units had been installed and another 48,152 heating and cooling DHP units were installed without incentives in Northwest homes.[16] By 2014, NEEA had developed strategic relationships with five manufacturers and five distributors. More than 300 installers participated in the initiative in 2014.[17] Additionally, the initiative had created an infrastructure of supply chain actors supporting the

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[14] Research Into Action. *Northwest Ductless Heat Pump Pilot Project MPER #2.* Prepared for NEEA. March 28, 2010. https://neea.org/img/uploads/northwest-ductless-heat-pump-pilot-project-market-progress-evaluation-report-2.pdf

[15] Ibid.

[16] ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #4.* Prepared for NEEA. July 23, 2015. https://neea.org/img/uploads/ductless-heat-pump-market-continues-to-increase-dhp-mper-4.pdf

[17] Ibid.

participation of over 100 Northwest utilities that implemented local DHP programs and offered incentives to their customers to encourage DHP adoption.[18]

However, despite progress, some barriers to adoption of ductless technology remained. These include high installed cost, low installer and consumer awareness, and limited product availability. NEEA aimed to address all three barriers by conducting the following activities:

- Collaboration with utility partners, supply chain actors, and suppliers on lead-generating promotions. NEEA partnered with utilities that directly marketed to customers and negotiated temporarily reduced costs from distributors and installers in exchange for greater sales volumes.
- Continued focus on expanding manufacturer and distributor sales by delivering training and sales tools
- Effort to raise the number of engaged installers by rewarding trained installers who completed the Master Installer Program with priority listings on goingductless.com
- Continued inspection of installer installations to ensure quality and homeowner satisfaction

Continued support of utility programs by creating new marketing resources and facilitation of strategic partnerships between utilities and supply chain actors

3.1.4. Later Initiative (2017 – Today)

By 2017, an estimated 83,700 DHPs had been installed in NEEA's target markets,[19,20] and further signs of market transformation were evident. As early as 2012 the market was showing significant changes. Manufacturers were designing new products to the initiative's expectations and adopting NEEA's messaging in their marketing. Market share had increased "in areas where [manufacturers] have worked with NEEA and utilities on coordinated marketing and rebate campaigns."[21] As the initiative continued its support, supply chain actors began to exhibit self-sustaining capabilities and, in 2017, reported significant sales growth while the utilities reported flat or declining rebate redemptions. In addition,

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[18] ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #4.* Prepared for NEEA. July 23, 2015. https://neea.org/img/uploads/ductless-heat-pump-market-continues-to-increase-dhp-mper-4.pdf

[19] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7*. Prepared for NEEA. September 20, 2018. https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

[20] NEEA aims to accelerate the adoption of DHPs in three target markets: Single-family homes with zonal heating, single-family homes with electric forced air furnace, and manufactured homes with electric forced air furnace

[21] Evergreen Economics. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #3.* Prepared for NEEA. April 24, 2014. Page i. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-3.pdf

most promotions took place without the initiative's support—another sign that the market was "growing under its own power."[22]

By 2017, several market barriers had been addressed. MPER 7 found that "the market for DHPs is strong, or improving, in the areas of supply chain adoption and product availability."[23] However, barriers related to cost remained.

NEEA has explored and implemented a variety of strategies aimed at cost containment, including exploring opportunities for lower-cost installation pathways and retail sales channel development, working with manufactures to introduce lower-cost products, exploration of unique partnerships supporting and promoting lower cost and single-head installations, and a variety of consumer targeting and customer purchase decision support tools. Nevertheless, DHP cost has not decreased in recent years and may continue to be a barrier to accelerated consumer adoption and utility cost-effectiveness.

Appendix A includes a detailed history of the DHP initiative. The remainder of this report provides a market update for 2018, an assessment of market progress indicators, an accounting of the potential risks and impacts identified through stakeholder interviews and a stakeholder workshop, and Cadmus' proposed diffusion indicators for tracking in LTMT and associated evaluation plan.

3.2. Market Update

This section provides an overview of market progress for NEEA's DHP initiative. 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 (added in 2014)
- **TM3.** Manufactured homes with electric forced air furnace (added in 2014)

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 2018.

3.2.1. DHP Installations in 2018

Table 3 shows installations in the initiative's target markets. NEEA estimated 17,696 DHP installations in the initiative's combined three target markets, by incented and non-incented. The majority of DHP installations in the target markets (80%) received utility incentives in 2018.

Of these installations, 79% displaced zonal heating in single-family homes (TM1). The remaining units displaced electric forced air furnaces—14% in single-family homes (TM2) and 7% in manufactured homes (TM3).

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[22] CLEAResult. *2017 Annual Report.* Prepared for NEEA. March 2018.

[23] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7.* Prepared for NEEA. September 20, 2018. https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

Table 3. Target Market DHP Installations in 2018

Target Market	Incented	Non-Incented	Total	Percent of Total
TM1. Single-Family Zonal	11,293	2,745	14,038	79%
TM2. Single-Family eFAF	1,754	707	2,461	14%
TM3. Manufactured Homes eFAF	1,196	0	1,196	7%
Total	**14,243**	**3,453**	**17,696**	**100%**

Source: NEEA DHP ACE Model, July 2019.

Note: NEEA estimated non-incented target market installations in 2018 based on the 2016 percentage of non-incented target market installations in each target market from MPER 6. For MPER 8, NEEA also applied a downward adjustment to its estimate of non-incented units to account for newly reported incented DHP utility programs that had not been reported to NEEA prior to 2018, indicating the percentage of non-incented units had likely been over-estimated in 2016.

3.2.2. DHP Market Saturation

Table 4 presents the estimated DHP market saturation for each of the initiative's target markets. An evaluation metric of market progress is to compare the current market saturation estimates with the target maximum saturation sought by 2039. As the table shows, TM1's current market saturation (17%) is about 26% of its 2039 target maximum saturation of 65%, whereas TM3's market saturation is about 11% of its 2039 target maximum saturation of 14%. These results indicate there is still substantial room for growth in each of the target markets

Table 4. Target Market DHP Saturations (2008-2018)

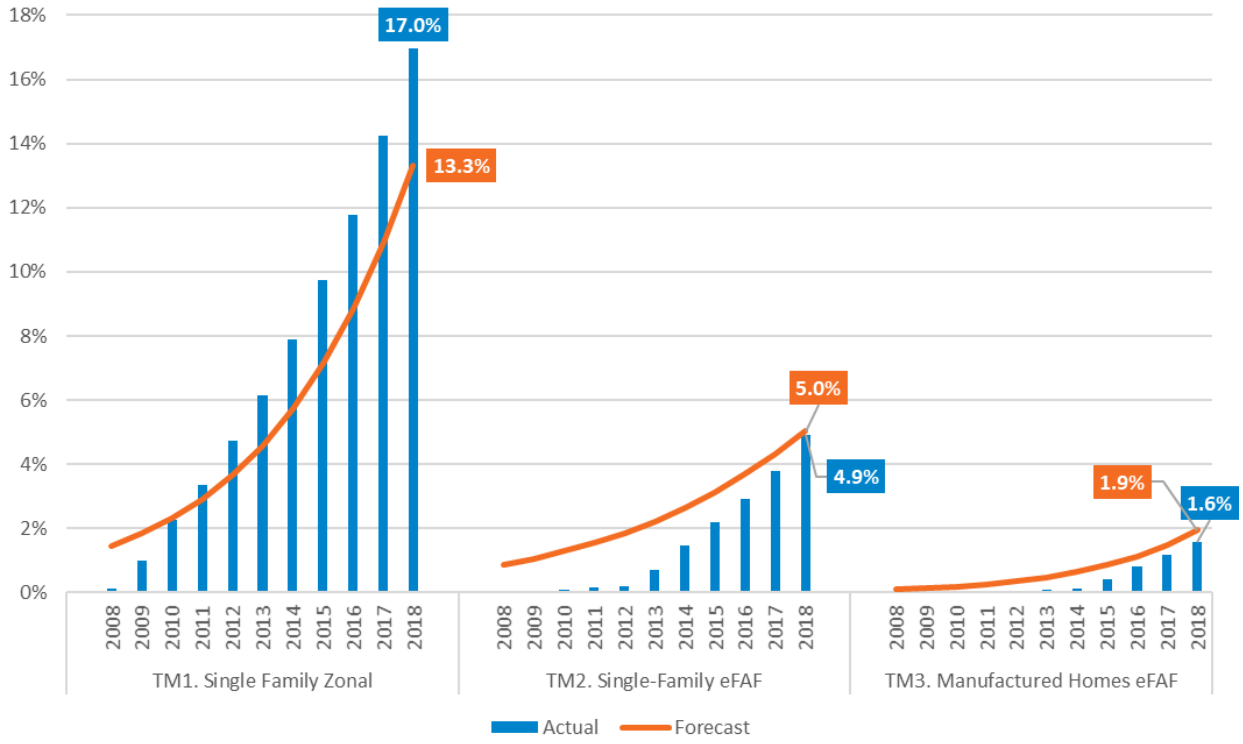
Target Market	Market Size*	Target Maximum Saturation by 2039	Cumulative Units* (2008-2017)	Market Saturation (2008-2017)	Percent of Target Maximum Saturation
TM1. Single-Family Zonal	505,066	65%	86,009	17.0%	26%
TM2. Single-Family eFAF	222,981	20%	10,928	4.9%	25%
TM3. Manufactured Homes eFAF	280,585	14%	4,458	1.6%	11%
Total			**101,395**		

Source: NEEA DHP ACE Model, July 2019.

* NEEA estimated the market size as the existing housing stock at the end of 2008 when NEEA began the DHP Initiative, based on the Residential Building Stock Assessment (RBSA) in 2012.

NEEA forecasts annual market saturations for each target market from 2008 to 2039 to project the path each target market will take to achieve the target maximum saturation by 2039. Figure 1 charts NEEA's forecasted market saturations for each target market from 2008 to 2018 and compares them against estimates of actual market saturation in those years. As of 2018, TM1's market saturation of 17% has exceeded the forecasted 2018 saturation of 13.3%; TM2 and TM3 almost reached their 2018 forecasted saturations. This indicates that TM1 and TM2 are on track to meet NEEA's target maximum saturation by 2039, while TM3's 2018 market saturation (1.6%) is lagging behind the 2018 target (1.9%) by approximately 1,000 units (16%).

Figure 1. Forecast and Actual Market Saturations by Target Market (2008-2018)



Source: NEEA DHP ACE Model, August 2019.

As shown in Table 5, the market activity in all three target markets increased from 2017. The year-over-year unit growth for TM3 was highest, at almost 30%. This growth in TM3 occurred largely in utility-incented units (as opposed to non-incented units), suggesting an increase in utility program activity such as in BPA's low-income incentive program. TM2 also achieved a high year-over-year unit growth, at 25%.

Table 5. Year-Over-Year Target Market Unit Growth

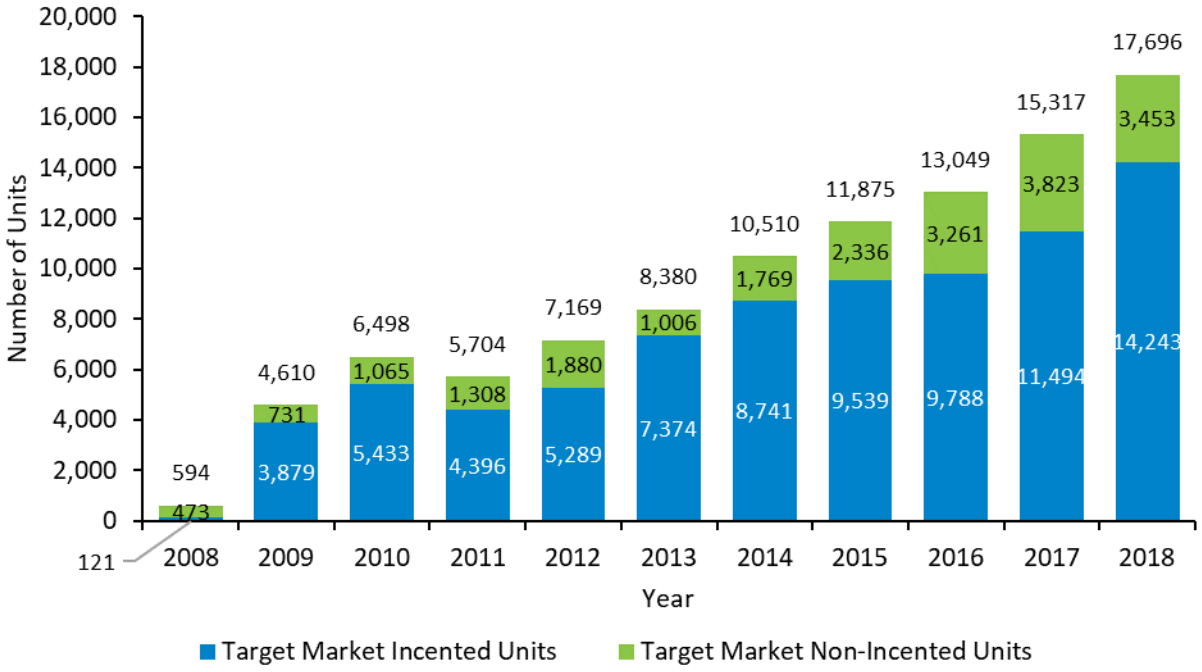
Target Market	2017 Installations	2018 Installations	Year-Over-Year Growth
TM1. Single-Family Zonal	12,416	14,038	13%
TM2. Single-Family eFAF	1,969	2,461	25%
TM3. Manufactured Homes eFAF	931	1,196	28%
Total	**15,317**	**17,696**	**16%**

Source: NEEA DHP ACE Model, July 2019.

3.2.3. DHP Installations Over Time

NEEA has tracked regional DHP installations since 2008.[24] Figure 2. shows the number of incented and non-incented DHP installations in target markets by year. From 2011 to 2018, total target market DHP installations have increased each year, with 14,243 units in 2018. The number of target market incented units tracked from 2008 and 2018 cumulate to 80,297.

Figure 2. Target Market Incented and Non-Incented Installations by Year

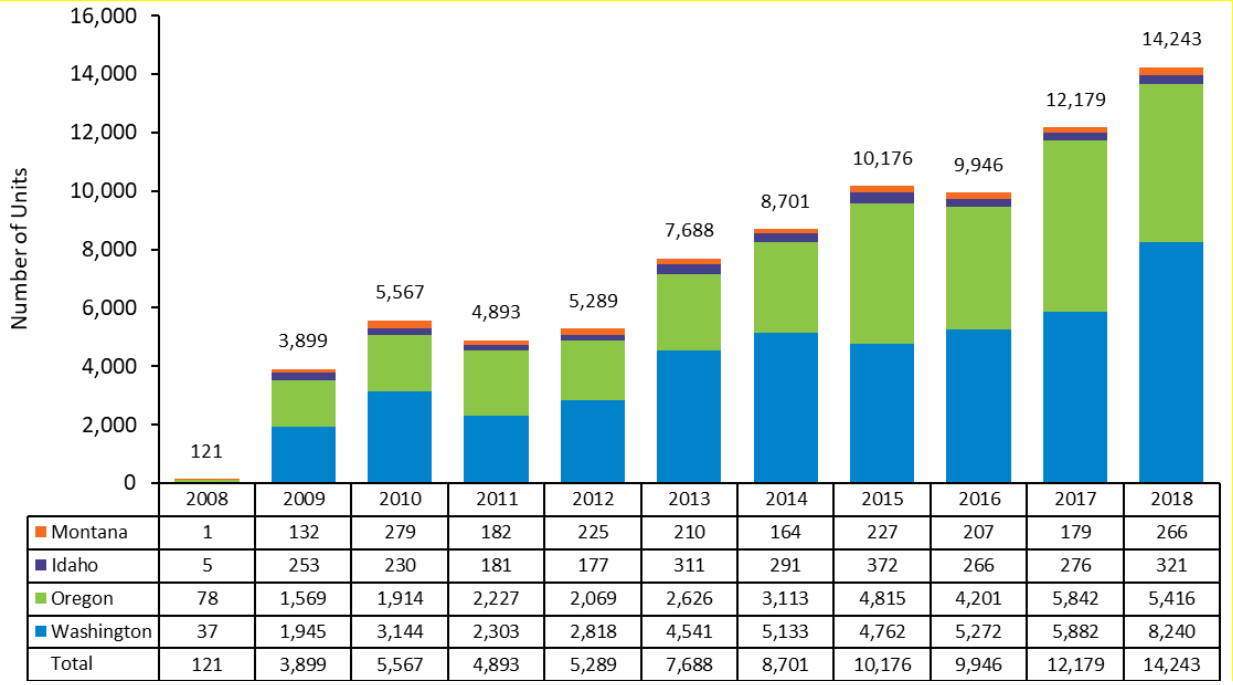


Source: NEEA DHP ACE Model, July 2019.

Figure 3. presents the incented installations by state and year and shows that total incented installations increased from 12,179 in 2017 to 14,243 in 2018. This increase was mainly attributed to increases in installations in Washington, followed by Montana and Idaho. After a large increase in incented installations in Oregon from 2016 to 2017, incented installations in Oregon decreased slightly in 2018. This change in Oregon may be partially attributable to the discontinuation of Oregon's Residential Energy Tax Credit Program at the end of 2017

[24] NEEA could not estimate the total number of DHP installations in the region in 2018 due to insufficient data and thus could not assess how the overall regional DHP market grew in 2018.

Figure 3. Incented Installations by State and by Year



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Montana	1	132	279	182	225	210	164	227	207	179	266
Idaho	5	253	230	181	177	311	291	372	266	276	321
Oregon	78	1,569	1,914	2,227	2,069	2,626	3,113	4,815	4,201	5,842	5,416
Washington	37	1,945	3,144	2,303	2,818	4,541	5,133	4,762	5,272	5,882	8,240
Total	121	3,899	5,567	4,893	5,289	7,688	8,701	10,176	9,946	12,179	14,243

Source: NEEA DHP ACE Model, July 2019.
Note: Incented installations in this figure includes installations within and outside target markets. Therefore, they may not match with the *target market* incented installations displayed in the previous figure.

3.2.1. DHP Installations by Head Configuration

NEEA also tracked DHP installations by head configuration (e.g., single-head or multi-head). NEEA received head configuration information from a subset of utilities whose incented installations represented about 58% of all incented DHP installations. These reported data showed that single-head installations represented about 60.5% of all single-family incented installations regardless of existing equipment type, a drop from 67% in 2017.

For incented installations in manufactured homes, single-head installations represented a share of 83%, identical to the share in 2017. Table 6 compares the percentage of single-head units by target market incented installations between 2017 and 2018 (based on reported data from the subset of utilities).

Table 6. Percentage of Single-Head Units in Target Market Incented Installations in 2017 and 2018

Target Market	2017		2018	
	% Single-Head	Total Installations	% Single-Head	Total Installations
TM1. Single Family Zonal	67%	9,411	61%	11,293
TM2. Single-Family eFAF	65%	1,400	60%	1,754
TM3. Manufactured Homes eFAF	83%	683	83%	1,196
Total	**68%**	**11,494**	**62%**	**14,243**

Source: MPER 7; NEEA DHP ACE Model, July 2019.

3.3. Stakeholder and Supply Chain Perspectives on Potential Risks and Impacts of LTMT Transition

As NEEA has begun to consider a DHP initiative transition to long-term monitoring and tracking, Cadmus gathered feedback through individual and group interviews from utilities, manufacturers, and distributors on the possible risks and impacts. Cadmus and NEEA also gathered additional input from utility representatives during the in-person stakeholder workshop, through a combination of small-group exercises and facilitated group discussion.

During the in-depth interviews, utility interviewees expressed concerns about what the LTMT transition will mean, including worry over loss of NEEA's pressure on supply chain actors to keep costs low, training for installers, ensuring quality installation standards, and sharing information through utility workgroup meetings and the goingductless.com website. Interviewees and stakeholder workshop participants identified two primary risks and several additional concerns related to LTMT transition, which are described in the following sections.

3.3.1. Slowed or stalled market growth outside the I-5 corridor

Utilities, distributors, and manufacturers generally agreed that the market would continue to transform west of the Cascades; however, several utilities and a few supply chain actors said more work may need to be done to prevent backsliding outside of the I-5 corridor. Reasons for anticipating slowed or stalled growth east of the Cascades include the following:

- **High DHP cost.** Utility interviewees and stakeholder workshop participants noted that high DHP costs continued to impact customer willingness to purchase as well as possibly a utility's ability to offer DHP programs.
- **Diminished savings.** One utility said that changes made by the Regional Technical Forum that lowered the savings rate for DHPs has resulted in DHPs not being cost effective for his utility.
- **Insufficient installer workforce.** Three utility interviewees said they thought there was an insufficient supply of installers trained through the initiative and/or of contractors installing DHPs in their service territory. One manufacturer and two distributors also mentioned barriers to installer training specific to the rural areas east of the Cascades. One distributor said rural contractors cannot get to training due to "windshield time." Although this distributor has tried to remedy this by providing mobile training, some contractors cannot spare any of their workforce to attend.
- **Insufficient market progress on cold-climate heat pumps.** Two utility interviewees noted that cold climate heat pump technology was not available or as widespread early in the initiative when NEEA was most actively working with the supply chain. As a result, they believed installers (as well as customers) were not as aware of or familiar with cold climate DHP applications and therefore installers were not promoting the technology for heating in colder climates. Stakeholder workshop participants also echoed this concern. As further evidence of the lack of focus on cold climate heat pumps, one utility representative also noted that NEEA had not provided sufficient resources specific to cold climate heat pumps (e.g., materials suggest using

backup heat below freezing temperatures even though cold climate heat pumps are effective at these temperatures, which most customers in the service territory would experience most of the year). During the stakeholder workshop, NEEA and workshop participants agreed that NEEA should address cold climate DHPs on the goingductless.com website, which would help to mitigate this issue.

In general, manufacturers and distributors said that cold climate heat pumps are available for purchase throughout the Northwest. However, two utilities, two manufacturers, and one distributor said NEEA may need to intervene further to support cold climate heat pump technology and support market transformation for DHPs east of the Cascades. These interviewees suggested that NEEA apply lessons learned from accelerating DHP adoption in the I-5 corridor to areas east of the Cascades, with a special focus on cold climate heat pumps. In addition, manufacturers and distributors said that it would be helpful for a third-party, such as NEEA, to validate manufacturers' claims about the performance of their technology in cold climates. This would help inspire confidence and reduce the perception they see by some installers that ductless technology does not perform in cold climates.

3.3.2. DHP cost may continue to rise

Several utility interviewees and stakeholder workshop participants said more work is needed to contain DHP costs and that, without NEEA exerting pressure on the supply chain, these costs were likely to increase. Rising DHP costs could threaten both consumer adoption of DHPs and the utility's ability to offer DHPs:

- **Consumer purchase barriers.** Interviewees and stakeholder workshop participants said DHP cost continues to be a barrier to customer purchase of DHPs, and increasing costs could hinder DHP adoption. Prior research has shown price is a barrier to purchase for most consumers when existing heating systems are still functioning.[25]
- **Cost-effectiveness.** Utilities interviewed said they plan to continue their programs if DHPs remain cost-effective. If DHP costs rise and savings diminish, DHPs may not be cost-effective for utilities. Utilities may therefore discontinue their DHP programs, further exacerbating a purchase barrier to DHP adoption. Stakeholder workshop participants also identified DHP cost-effectiveness as a significant potential threat to both utility DHP programs and market transformation. One utility interviewee said single-head installations are not currently cost-effective in its service area because a large proportion of homes use wood heat; nevertheless, the utility has kept offering incentives hoping NEEA's cost-containment strategies would be successful. Without NEEA's continued work, this utility may no longer be justified in offering incentives for DHPs. Another utility noted that cost-effectiveness (along with low saturation of electric resistance heat) was a primary reason it was unable to offer a DHP program.

[25] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #6.* Prepared for NEEA. January 17, 2018. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-6.pdf

In general, utilities said NEEA needs to continue its work to further bring down costs. Although some utilities said they did not know what else could be done, two offered the following suggestions:

- One utility said NEEA should encourage a "rogue" manufacturer or one that has not worked previously in the Northwest to sell a cheaper unit in the region. Stakeholder workshop participants identified a similar approach, suggesting that NEEA should continue its work to identify more cost-effective DHP units.
- One utility said NEEA can go to the Northwest Power and Conservation Council and suggest that it revise its methodology for assessing cost-effectiveness.

During the stakeholder workshop, NEEA and workshop participants also said prioritizing DHP installations with the highest energy savings potential was another opportunity to ensure cost-effective installations. Specifically, they suggested that utilities target incentives toward a specific (higher performing) technology and that utility incentives be narrowed to screen for and incent only installations in target market homes.

3.3.3. Additional Risks and Impacts

During the stakeholder workshop and interviews, utilities identified several additional potential risks and impacts of initiative transition, including the following:

- Integrated DHP controls might not advance without support and influence from NEEA
- Installation quality would decrease, as a result of less training for contractors and quality control support

Furthermore, during the interviews utilities expressed some concerns about what would happen if NEEA's support diminished for smaller utilities reliant on NEEA's information and marketing support.

3.4. Installer Research

Over the past decade, initiative activities have included a strong focus on installer recruitment and training to increase DHP market availability and promote greater growth in market diffusion. NEEA has sought to increase the availability (both the number and geographic distribution) of trained DHP installers throughout the Northwest region to ensure that residents in all locations have access to qualified installers. To assess ongoing progress in ensuring an adequate DHP installation workforce, enhancing market competition, improving DHP availability—and to fill in knowledge gaps regarding installer availability outside the I-5 corridor—Cadmus completed brief "call-down" surveys with Northwest HVAC businesses and fielded a more comprehensive online survey with DHP installers.

This section provides results of the installer surveys. Details regarding Cadmus' installer research methodology are provided in Appendix B

3.4.1. Installer Call Down Results

Distribution of DHP Installers

To assess the geographic distribution and availability of DHP installers in the Northwest, Cadmus and NEEA sought to understand if any counties in NEEA's funders' service territories had no DHP installers. Cadmus reviewed the locations of NEEA's oriented installers (installers who have participated in NEEA's training) and determined that, of the 162 counties in the Northwest that are served by NEEA funders, 59 counties do not have any oriented installer companies. Therefore, Cadmus called businesses (identified in a third-party list as plumbing, heating, and air-conditioning contractors[26]) in 50 of the 59 counties (nine counties had no plumbing, heating, and air-conditioning companies listed) to determine if at least one DHP installer was present in each county.

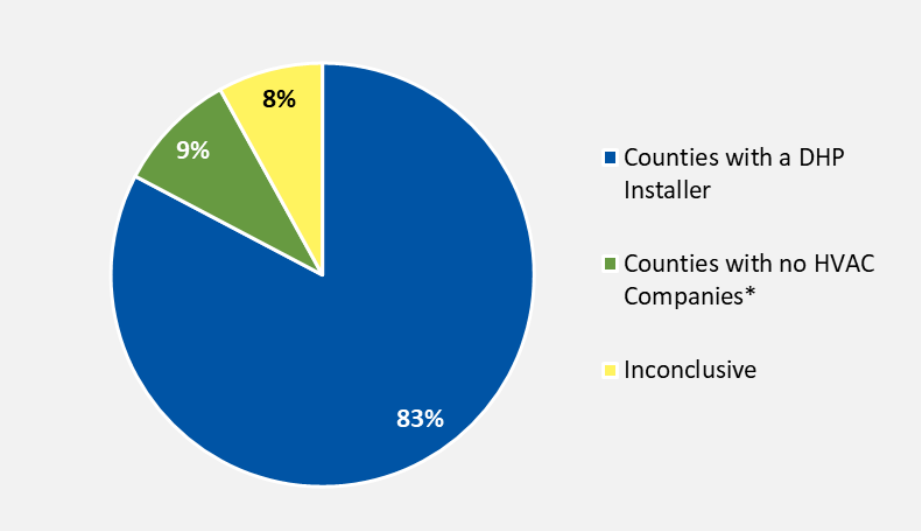
Of the 162 counties that overlap with a NEEA funder service territory, Cadmus was able to confirm that 134 counties—103 with oriented installers—had at least one DHP installer present.

Among the remaining 28 counties, results were inconclusive for 13 counties (i.e., Cadmus was unable to find a DHP installer but also was unable to make contact with all companies on the list after repeated contact attempts to definitively prove whether or not the county had any DHP or HVAC installers). The other 15 counties either have no HVAC companies listed (nine counties) or, after contacting all companies on the list, Cadmus determined that none were HVAC installers (six counties).

Table 7 presents the distribution of results across three categories: counties with a DHP installer (including oriented and non-oriented installers), counties with no HVAC companies, and counties where results were inconclusive.

[26] Cadmus identified the population of potential businesses as plumbing, heating, and air-conditioning contractors (identified by the NAICS code 238220 in a third-party provided list). Not all businesses in this population sell residential HVAC equipment. Additionally, Cadmus acknowledges that not all HVAC installation companies are represented by this NAICS code, and there may be additional companies that sell DHPs that were not included in this analysis.

Table 7. Percentage of Counties in NEEA Funder Service Territories with a DHP Installer

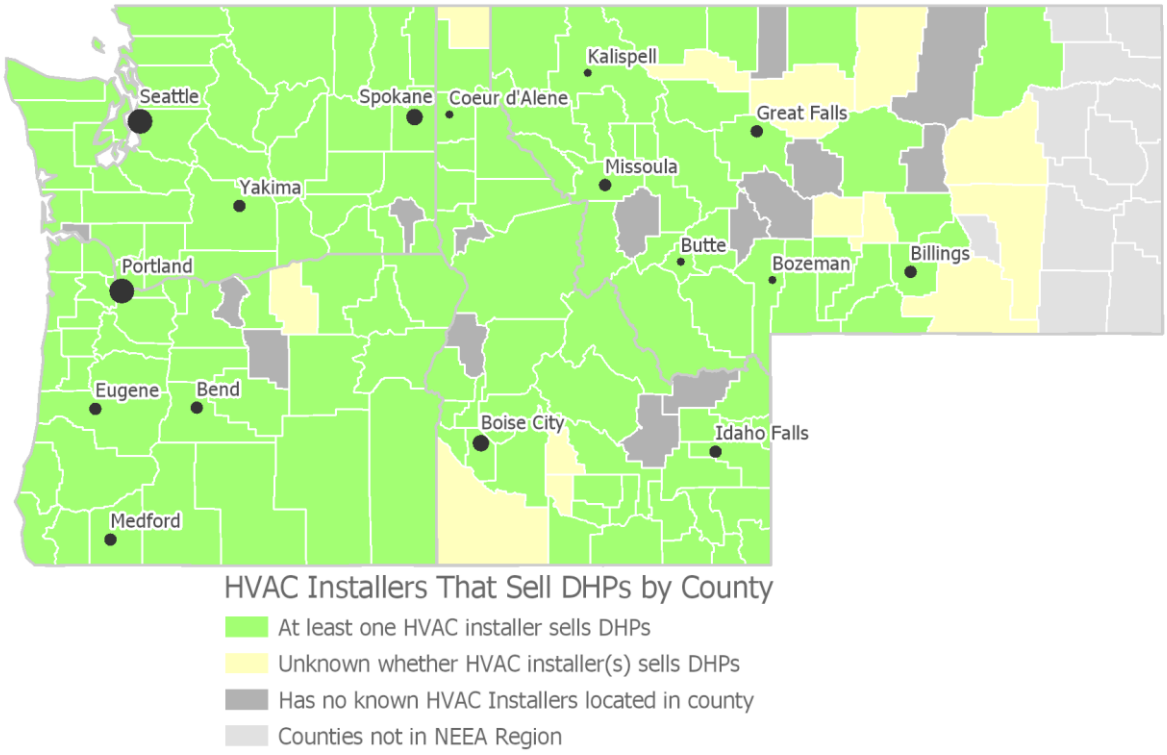


N=162

* This category includes counties where no HVAC company was listed and where Cadmus confirmed that none of the listed businesses were HVAC installation companies.

Figure 4 shows the distribution of the 134 counties with DHP installers. In rural areas of Oregon, Idaho, and Montana Cadmus identified gaps where results were either inconclusive or there were no known HVAC installers located in a county. With the exception of the 13 counties where results were inconclusive, in every county that Cadmus confirmed the presence of an HVAC installer, Cadmus also identified at least one DHP installer. There are no NEEA funders present in Eastern Montana, therefore Cadmus did not include these counties in its analysis.

Figure 4. Distribution of Counties with DHP Installers



Source: NEEA

Proportion of DHP Installers

To assess the proportion of DHP installers, Cadmus conducted a subsequent call-down survey of a representative sample of HVAC installers in each state. Cadmus determined that the vast majority—96%—of residential HVAC businesses in the Northwest install DHPs. Idaho, Oregon, and Washington had the highest penetration of DHP installers, with 96% to 97% of HVAC businesses installing DHPs, while in Montana, 88% of HVAC businesses install DHPs. Cadmus also found that between 42% and 59% of DHP installers in Idaho, Oregon, and Washington were oriented installers (trained through NEEA's Northwest Ductless Heat Pump Project). Montana again had the lowest proportion of oriented installers at 19% of DHP installers. Table 8 shows the presence of DHP installers.

Table 8. Proportion of DHP Installers by State

State	Adjusted Population Size Estimate*	Achieved Sample Size (90/10)	Number DHP Installers	Percentage DHP Installers	Number Oriented Installers	Percentage Oriented Installers**
ID	529	68	66	97%	28	42%
MT	302	71	63	88%	12	19%
OR	922	68	65	96%	34	52%
WA	1,576	70	68	97%	40	59%
Total	**3,329**	**277**	**262**	**96%*** **	**114**	**50%*** **

*Population size adjusted to reflect the proportion of businesses contacted in each state deemed ineligible (i.e., those contacted that indicated they do not sell residential HVAC equipment)

**Percentage of DHP installers that are oriented installers

*** Percentage weighted to reflect installer population by state

3.4.2. Installer Online Survey Results

Cadmus conducted an online survey with DHP installers to gather insights to assess DHP sales and installations, explore installer promotion of DHPs, and document DHP equipment and installation costs.

For MPER 8, NEEA was particularly interested in gathering data to develop a better understanding of DHP installations in HZ 3. Given the smaller population of contractors in HZ 3, and therefore small sample size target, Cadmus conducted an oversample to provide robust results within this heating zone.[27] Where appropriate, results are presented by heating zone.

Although Cadmus attempted to field the online survey with a broader group of HVAC installers in the region than DHP oriented installers (which has historically comprised the installer survey sample frame in prior MPERs), the vast majority of installers who completed the survey—87%—were oriented installers. As such, these installer survey results should not be considered representative of the general population of DHP installers in the region.

DHP Market Segments

The surveyed installers said that the vast majority (83%) of all DHPs they installed in 2019, including incented and non-incented, were installed in the residential sector. Almost all installers (99%) said they installed DHPs in single-family homes, 76% installed DHPs in manufactured homes, and 70% installed DHPs in multifamily buildings. Although commercial installations represented on average only 17% of all DHP installations reported, 80% of installers said they installed DHPs in commercial facilities.

Residential DHP Installations

DHP Single-Zone and Multi-Zone Applications

Of the 5,099 residential DHP installations, including incented and non-incented installations, reported by the 87 installers, more than half (60%) were installed as a single zone system (that is, a unit with one

[27] Cadmus applied sample weights in the analysis of survey results to account for the oversample in HZ 3.

outdoor compressor and one indoor unit) compared to a multi-zone system (Figure 5). Installers in HZ 2 reported a significantly greater percentage of single-head DHP installations than installers in HZ 1 or HZ 3.

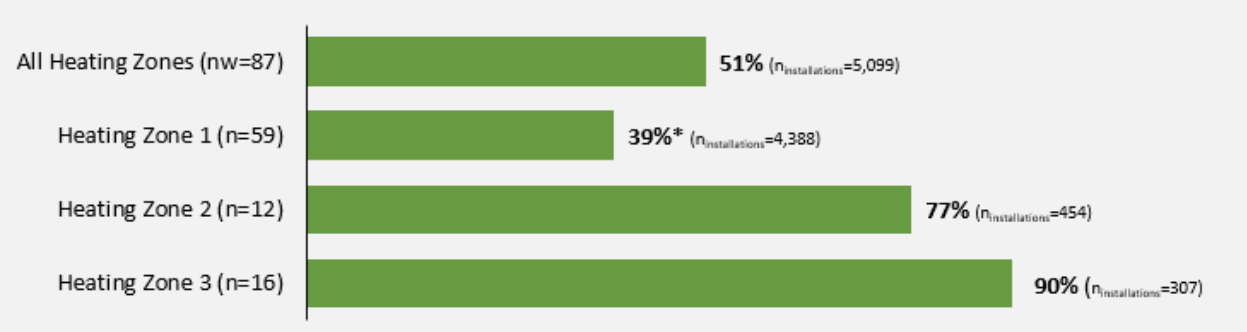
Figure 5. Single Zone DHP Installations, by Heating Zone

Source: Installer Survey question C2, "Of the [number of] residential DHP installations you performed in the last 12 months, approximately how many were one-to-one or "single zone" systems (i.e., a unit with one outdoor compressor and one indoor unit)?"
Notation "nw" indicates a sample weight applied due to oversampling installers in HZ 3.
* Significantly higher based on a two-sample t-test (p-value<0.05)

Cold Climate DHPs

Figure 6 shows of the 5,099 residential DHP installations reported by the 87 installers, slightly more than half (51%) were cold climate heat pumps (that is, a DHP designed to operate efficiently at colder temperatures). Not surprisingly, the highest percentage of cold-climate heat pump installs were in HZ 3. Installers in HZ 1 reported a significantly lower percentage of cold climate DHP installations than installers in HZ 2 or HZ 3.

Figure 6. Cold Climate DHP Installations, by Heating Zone



Source: Installer Survey question C3, "Of the [number of] residential DHP installations you performed in the last 12 months, approximately how many were cold climate DHPs?"
Notation "nw" indicates a sample weight applied due to oversampling installers in HZ 3.
* Significantly lower based on a two-sample t-test (p-value<0.05)

Non-Incented DHP Installations

In 2019 installers reported a higher percentage of non-incented residential DHP installations out of all residential installations compared to the 2016 MPER. In 2019, installers reported that 37% of their

residential DHP installations did not receive a utility rebate, compared to 27% in 2016. The percentage of non-incented residential DHP installations were similar by heating zone, as shown in Figure 7. No significant differences were found in non-incented DHP installations by heating zone.

Figure 7. Non-Incented DHP Installations, by Heating Zone

Source: Installer Survey question C4, "Of the [number of] residential DHP installations you performed in the last 12 months, approximately how many did NOT receive a utility rebate?"
Notation "nw" indicates a sample weight applied due to oversampling installers in HZ 3.

Table 9 shows all non-incented DHP installations by building type and displaced equipment type for 2019, 2016, 2014, and 2013. In 2019, there were notably more non-incented residential installations (65%) reported than in 2015 (48%). Of the non-incented residential installations, there was a higher proportion of new construction (single and multifamily) reported in 2019 (42%) than 2016 (32%) and a lower proportion of single-family additions in 2019 (15%) compared to 2016 (32%). However, significance testing was not performed to test for differences in percentages between 2016 and 2019 due different data sources used in sampling.

Table 9. Non-Incented DHP Installations by Replaced Equipment Type

Installation Application	2019 Percentage (n = 2604 installs)	2016 Percentage (n=1487 installs)	2014 Percentage (n=4,681 installs)	2013 Percentage (n=1,455 installs)
Total Non-Incented Installations	100%	100%	100%	100%
Commercial	35%	52%	42%	48%
Residential	65%	48%	58%	52%
New Construction (single and multifamily)	42%	32%	27%	21%
Single Family - In new, add-on space	15%	32%	17%	29%
Single Family - In primary living space	29%	22%	45%	48%
Displaced electric zonal	33%	47%	41%	51%
Displaced gas heat	36%	26%	30%	26%
Displaced electric furnace	11%	12%	8%	10%
Displaced wood or pellet heat	16%	16%*	21%*	13%*
Displaced oil or kerosene heat	4%			
Multifamily - In primary living space	7%	4%	7%	1%
Displaced electric zonal	60%	65%	91%	43%
Displaced gas heat	18%	33%	7%	14%
Displaced electric furnace	7%	2%	2%	14%
Displaced wood or pellet heat	0%	0%*	1%*	28%*
Displaced oil or kerosene heat	15%			
Manufactured Homes - In primary living space	5%	7%	4%	2%
Displaced electric zonal	25%	9%	11%	46%
Displaced gas heat	8%	26%	18%	0%
Displaced electric furnace	61%	60%	60%	54%
Displaced wood or pellet heat	5%	4%*	11%*	0%*
Displaced oil or kerosene heat	1%			
Other	2%	3%	NA	NA

Source: Installer Survey C6, "You indicated that you installed [number from C4] 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, gas heat, wood or pellet, oil or kerosene.

* Alternative heating types of DHPs were combined in one category in 2013, 2014, and 2016, but were broken down into wood/pellet and oil/kerosene in 2019

Heating Zone 3 Analysis

Table 10 shows 2019 non-incented DHP installations by building type and displaced equipment type for HZ 3

Table 10. 2019 Non-Incented DHP Installations by Replaced Equipment Type: HZ 3 Comparison

Installation Application	Heating Zone 3 2019	
	n*	Percentage**
Total Non-Incented Installations	180	100%
Commercial	68	38%
Residential	112	62%
New Construction (single and multifamily)	27	24%
Single Family - In new, add-on space	13	12%
Single Family - In primary living space	48	43%
Displaced electric zonal	27	56%
Displaced gas heat	7	14%
Displaced electric furnace	7	15%
Displaced wood or pellet heat	7	14%
Displaced oil or kerosene heat	1	2%
Multifamily - In primary living space	7	6%
Displaced electric zonal	4	57%
Displaced gas heat	3	36%
Displaced electric furnace	1	7%
Displaced wood or pellet heat	-	0%
Displaced oil or kerosene heat	-	0%
Manufactured Homes - In primary living space	12	11%
Displaced electric zonal	3	25%
Displaced gas heat	1	10%
Displaced electric furnace	8	65%
Displaced wood or pellet heat	-	0%
Displaced oil or kerosene heat	-	0%
Other	5	4%

Source: Installer Survey C6, "You indicated that you installed [number from C4] 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, gas heat, wood or pellet, oil or kerosene.

*n is the number of installations by heating zone and installation type. It is calculated as the total number of installations multiplied by a percent distribution by HZ and installation type, therefore the number of installations in each group may not be a whole number.

**Percentage is weighted therefore the percentages cannot be recreated using the unweighted installation counts.

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 87 installers said they frequently recommend DHP systems to customers with electric heat—53% said they always do and 40% said they often do. There are no significant differences between the percentage of installers who often or always recommend DHPs to their customers by heating zone (Figure 8).

Figure 8. Percent of Installers That Often Or Always Recommend DHP Systems, by Heating Zone

Source: Installer Survey question D1, "How often do you recommend DHPs to customers with electric heat?"
Notation "nw" indicates a sample weight applied due to oversampling installers in HZ 3.

On average, installers (n=84) reported that 58% of their residential DHP customers specifically requested a DHP in 2019, and 62% of the installers (n=81) said this was a higher percentage of customers than in prior years. Only 8% of these 81 installers reported that the percentage of customers requesting a DHP had decreased in 2019, and the remainder (30%) said that the percentage in 2019 was approximately the same as the previous years.

Cadmus also asked installers if they had changed anything about how they have promoted and merchandised DHPs in the past two years. Of the 17 installers (20% of all survey respondents) who reported changes, 15 said they had increased the level or scope of their DHP advertising, with one installer emphasizing having trained staff to be able to educate customers on DHP benefits. One said they added a new parts and labor warranty, and another said they stopped advertising due to too much demand.

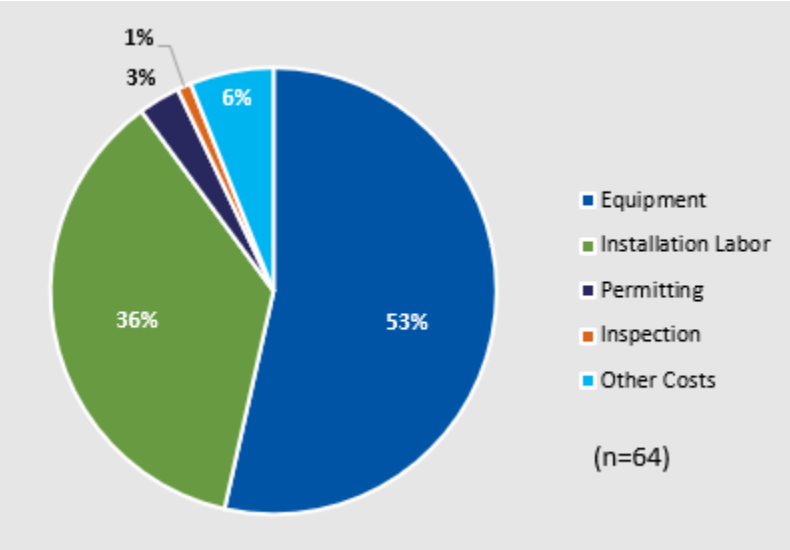
Cadmus asked which DHP brands the installers currently offer customers, whether they are planning to add any other brands in the next 12 months, and which brands specifically they might add. The top three brands installers (n=87) said they offer include Mitsubishi (67%), Daikin (61%), and Fujitsu (38%). Most installers (89%, n=79), said they are not planning to add any brands to their customer offer in the next year. Among those that said they are planning to add brands (n=8), Daikin was mentioned three times, Samsung twice and Mitsubishi, Comfort Aire, Friedrich, Samsung, Fujitsu and LG were all mentioned once. The final respondent to the question said they were not sure what brand they planned to add.

DHP Costs

Installers (n=64) 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 $4,765, higher than the average cost reported in MPER 6 ($4,200), MPER 5 ($4,208), and MPER 4 ($4,076).[28]

Figure 9 shows proportion of the total cost reported by installers by categories—equipment cost, installation labor, permitting fees, inspection, and other costs. Over half of the total cost (53%) was attributed to the equipment, followed by 36% for installation labor.

Figure 9. DHP Costs by Installation Categories



Source: Installer Survey question E2, "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 64 respondents who provided categorized cost estimates. The average installation cost of these 64 respondents was approximately the same as for the total installer sample ≈ $4,680 (n=85).

Table 11 shows the average categorized cost estimates reported by 64 installers for this MPER compared to MPER 6. Other cost categories identified by installers include overhead and administrative costs, profit, and additional equipment needed for the installation. Compared to MPER 6, installers reported a significant increase (40%) in labor costs.

[28] These numbers have not been adjusted for inflation.

Table 11. Average Component Cost of DHP Installation

Cost Component	MPER 8 Average Cost^	MPER 6 Average Cost
Equipment	$2,528	$2,422
Labor	$1,731*	$1,239
Permitting	$154	$112
Inspection	$67	$68
Other	$284	$351
Total	**$4,765***	**$4,192**

MPER 8 Source: Installer Survey question E2, "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 64 respondents who provided categorized cost estimates. The average installation cost of these 64 respondents was approximately the same as for the total installer sample ≈ $4,680 (n=85).

MPER 6 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.

^ Sample weight applied due to oversampling installers in HZ 3.

* Significantly higher based on a two-sample t-test (p-value<0.05)

3.5. Assessment of Initiative Market Progress Indicators (MPIs)

NEEA's current initiative tracks 11 short-, medium-, and long-term outcomes, as stipulated in the logic model. The initiative's theory of market transformation posits that if these outcomes are achieved, the market for DHPs will continue to transform and will persist without NEEA's continued intervention in the market. Table 6 lists the logic model outcomes, their corresponding MPIs, and an assessment of progress for each. As in the prior MPER, Cadmus determined that the market has made significant progress in achieving outcomes related to strength of the supply chain, product availability, and consumer demand. However, despite implementing a variety of strategies aimed at cost containment, described in detail in Appendix A, DHP cost to the consumer remains an ongoing challenge.

Table 12. DHP Initiative MPI Assessment

MPI Number	Outcome	MPI Description	Metrics	Progress Assessment	Rationale/Progress Made
I	**Strong Supply Chain Adoption**	Number of distributors offering DHPs is increasing.	Number of DHP distributors in region	Significant Progress	• Distributors did little to encourage DHP sales prior to initiative launch. In 2019, NEEA identified 27 distributors who carry DHPs. As of 2019, NEEA maintained distributor relationships with 10-12 regional DHP distributors who are actively promoting DHPs in the region.
II	**Number of Competent Installers Increases and New DHP-Focused Business**	Number of installers that are trained to install DHPs and are delivering quality installations is increasing.	Number of master installers Number of quality installs	Significant Progress	• As of 2019, 219 installers are currently certified through the Master Installers Program. • In assessments of the initiative, customers have shown extremely high satisfaction with DHP technology.*
III	**Utility Programs Support DHPs**	Utilities continue to promote DHPs, as appropriate.	Number of utility DHP programs that offer incentives Average and median amount of incentives Volume of incentives Number of utilities with a DHP focused website	Significant Progress	• When the initiative launched, 59 utilities signed on to offer DHP rebates. As of 2018, 108 utilities were offering DHP incentives. • As of 2018, a total of 82,702 DHPs in the region have received an incentive in NEEA's target markets since 2008.
IV	**Strong Supply Chain and Retailer Marketing Presence**	DHP manufacturers sustain a robust investment of marketing dollars.	Number of manufacturer and distributor promotions in the region	Significant Progress	NEEA has had success in partnering with manufacturers and distributors on limited-time promotions to reduce product cost, which the supply chain now regularly offers with and without utility partnerships. For example, in 2018, there were four manufacturer or distributor led promotions meeting the initiative's criteria to be published on the goingductless.com website.
V	**Variable Capacity Test Procedure Becomes Available**	The Canadian Standards Association makes progress toward publishing a test procedure, CSA-EXP-07.	CSA-EXP-07 draft; CSA-EXP-07 technical review; CSA-EXP07 final	Significant Progress	NEEA has developed a testing and rating procedure designed for variable-speed inverter driven heat pump technology. In 2018 and 2019, it is being used to test and rate the first systems.

MPI Number	Outcome	MPI Description	Metrics	Progress Assessment	Rationale/Progress Made
VI	**Market Competition Improves**	An increasing share of regional HVAC companies/ installers are offering DHP.	Number of HVAC companies/ installers in the region Number of regional HVAC companies/installers that sell DHPs	Significant Progress	During the pilot, 312 contractors (out of 602 oriented contractor companies) installed qualified DHPs and became active participants.** In 2019, 1,223 unique companies were on NEEA's oriented installer list. Additionally, Cadmus determined that 96% of HVAC installation companies in the Northwest install DHPs.
		An oriented installer is present within 50 miles of any point in the region.	Oriented installer company addresses	Some Progress	NEEA determined that a more effective proxy for installer availability would be to assess the distribution of DHP installers across counties in the region. In MPER 8, Cadmus found that of 162 counties in the region served by NEEA funders, 103 had at least one oriented installer company present.
		More consumers (or purchase intenders) are able to approximate the installed cost of a single-head DHP.	Percentage of consumers who know approximate installed cost of a DHP	N/A	NEEA does not currently have data available to assess this metric. However, NEEA has made additional resources available to promote price transparency through the Buyer's Guide.
VII	**Availability Improves**	The net number of distributors that stock/sell DHPs is increasing.	Number of distributors that sell DHPs	Significant Progress	Historically, DHP manufacturers' perception that the U.S. represents a limited market for sales of residential DHPs had resulted in a lack of manufacturer marketing activity and limited availability of DHPs through distributors. • In 2019, NEEA identified 27 distributors who carry DHPs. • As of 2017, NEEA maintained relationships with nine distributors that sell and actively promote DHPs.
		An increasing share of regional HVAC companies/ installers are offering DHPs.	Number of HVAC companies/ installers in the region	Significant Progress	MPER 1 estimated that in 2010 approximately 80% of HVAC installation companies in the Northwest had installed DHPs.*** In this MPER, Cadmus found that in 2019, 96% of HVAC companies in the region install DHPs.
		A DHP is available (either from a distributor, retailer, or installer) within 50 miles of any point in the region.	Company addresses of distribution outlets where DHPs are sold	Significant Progress	NEEA determined that a more effective proxy for installer availability would be to assess the distribution of DHP installers across counties in the region. In MPER 8, Cadmus found that of the 162 counties served by NEEA's funders, 134 had at least one DHP installer present. Cadmus did not identify any counties that had an HVAC installation business and no DHP installers (in the remaining counties, results were either inconclusive or the county did not have an HVAC installation business present).

MPI Number	Outcome	MPI Description	Metrics	Progress Assessment	Rationale/Progress Made
VIII	**Increased Consumer Demand**	The percentage of the general population aware of DHPs (aided and/or unaided) is increasing.	Percentage of consumers aware of DHPs	Significant Progress	Although awareness has leveled off in recent years,**** prior to the initiative launch in 2010, national awareness of DHPs was estimated at 5%. In 2018, DHP awareness among the general population in the Northwest was estimated at 57%.
		The number of DHPs installed in single-family homes to replace electric zonal heat or electric forced air furnaces is increasing.	Number of DHPs sold	Significant Progress	• Since the launch of the pilot in 2008, 101,395 DHPs have been installed in the region in NEEA's target markets, achieving 17% market saturation in single-family homes with electric heating, 5% in single-family homes with electric forced air furnace heating, and 2% in manufactured homes with electric forced air furnaces. • Two of NEEA's three target markets met or exceeded 2018 forecasted saturation, and are on track to achieve target maximum saturation by 2039. • Total DHP installations have increased each year since 2008, and DHP sales have seen year-over-year growth in target markets.
IX	**Utility Program Qualified Products List (QPL) Uses New Test Procedure**	Utility program QPL uses new test procedure.	Test procedure	Limited Progress	Currently, no QPL exists. NEEA is currently completing testing of 25 products, but NEEA does not consider this a sufficient number of products to justify a utility QPL.
X	**DHPs Are Affordable**	The average price for a single-head system remains constant or decreases compared to multi-head systems.	Average price of single-head DHP from distributor channel Average price of multi-head system per indoor head Average installed price of single-head DHP	Limited Progress	Despite exploring and implementing a variety of strategies aimed at cost containment, DHP cost has not decreased in recent years and may continue to be a barrier for both accelerated consumer adoption and utility cost-effectiveness.
		Consumers have more financing options.	Share of consumers purchasing DHPs with financing Number of different financing tools consumers use to purchase DHPs	N/A	NEEA does not currently have data available to assess this metric. In 2016, NEEA researched financing opportunities for DHPs; however, NEEA determined that although financing could make DHPs more accessible for some consumers by lowering upfront costs, the fees associated with financing often increase the overall total cost to the consumer. This would further decrease utility cost effectiveness. In addition, NEEA's funders have recommended that NEEA should not take on a role in advancing financing.
XI	**Federal or State and Voluntary Efficiency Standards Increase for ASHPs**	Progress is made toward a change to an existing federal, state, or voluntary standard (or toward development of a new standard), which drives higher average savings compared to pre-standard conditions.	Federal, state, and voluntary standards	Some Progress	NEEA participates in an advisory group established by ACEEE and members of AHRI to develop a proposal for the anticipated 2021 federal rule making process that would improve the federal test procedure. The Department of Energy's new standard for air-source heat pumps goes into effect in 2023. NEEA is exploring an alternative way to evaluate system performance after system installation.

*ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.* Prepared for NEEA. July 28, 2016.
https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-5.pdf
** 2008-2009 implementation report
*** Research Into Action. *Northwest Ductless Heat Pump Initiative 2010 Market Progress Evaluation Report #1.* October 27, 2011.
https://neea.org/img/uploads/NorthwestDuctlessHeatPump15116CF434BC7.pdf
**** Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7*. Prepared for NEEA. September 20, 2018.
https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

3.6. Diffusion Indicators and LTMT Evaluation Plan

As part of this evaluation, Cadmus identified distinct diffusion indicators for LTMT. NEEA's initiative life cycle process requires that an evaluation plan be developed in order to consider a transition into LTMT. The evaluation plan is a key component in NEEA and its partners' consideration of whether an initiative is ready to transition, and the quality and viability of the evaluation plan is one of the factors that informs the decision to transition. A rigorous and logical evaluation plan in advance of transition ensures that the data needed to track an indicator are available, can be obtained cost effectively, and that the relationships needed to assess progress on indicators are in place.

Diffusion indicators are metrics (qualitative and quantitative) that can be tracked over time to assess ongoing progress in market adoption. When the results of NEEA's tracking studies show positive trends for a diffusion indicator, that is one signal that market transformation may be continuing. Although a positive trend for a single diffusion indicator does not necessarily indicate continued market transformation, taken together with results from the tracking of other diffusion indicators, NEEA can assess whether market transformation is occurring. With input from NEEA staff and stakeholders, Cadmus identified and adapted a subset of indicators from the current market progress indicators (MPIs) identified in the logic model and tracked in prior MPERs.

3.6.1. Diffusion Indicators and LTMT Evaluation Plan

Table 13 and Table 14 list the proposed diffusion indicators and their associated metrics and data sources, along with a ranking (low, medium, high) of the importance of the diffusion indicator to track ongoing product diffusion and a ranking of the difficulty to gather data and track the indicator. The following sections provide an in-depth discussion of each diffusion indicator and the proposed evaluation plan.

Table 13. Proposed Primary Diffusion Indicators

Associated Logic Model Outcome(s)	Diffusion Indicator	Metric	Data Source	Expected Analysis Outcomes	Importance	Assessment Difficulty
			PRIMARY INDICATORS			
Consumer Demand	**DI1. The number of DHPs installed in single-family homes to displace/ replace electric zonal heat or electric forced air furnaces is increasing.**	Number of DHPs sold	• Distributor sales data • Utility survey • Installer survey	Number of DHPs installed annually and cumulatively over time by target market, state, and incented vs. non-incented; proportion of single vs. multi-head installations	High	High
DHP Affordability	**DI2. The installed cost for a single-head system remains constant or decreases.**	Installed cost for a single-head DHP	DHP cost data from partner utilities or rebate tracking data from CLEAResult	Averaged installed cost for a single-head DHP	High	Medium
Availability and Market Competition	**DI3a.The share of regional HVAC companies/installers offering DHPs remains constant or is increasing.**	Share of HVAC companies/ installers selling DHPs in region	Online and/ or telephone survey of general population HVAC contractors	Share of DHP installers as proportion of HVAC companies in region by state	High/ Medium	Low
Availability and Market Competition	**DI3b. The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.**	Number and geographic distribution of counties in region with at least one HVAC company that installs DHPs	Telephone survey of general population HVAC contractors	Number of counties in region, identifying those with at least one HVAC company that installs DHPs; map of counties in the region identifying those that do/do not have an HVAC company that installs DHPs	High/ Medium	Low

Table 14. Proposed Secondary Diffusion Indicators

Associated Logic Model Outcome(s)	Diffusion Indicator	Metric	Data Source	Expected Analysis Outcomes	Importance	Assessment Difficulty
SECONDARY INDICATORS FOR CONSIDERATION						
Consumer Demand	**SDI1. Consumer awareness of DHPs is increasing.**	Percentage of target market consumers aware of DHPs	Target market general population survey	Percentage of consumers aware of DHPs by target market, and state and/or east vs. west of the Cascades	Medium	Low
Quality Installation	**SDI2. Customer satisfaction remains high.**	DHP purchaser satisfaction	Survey of DHP purchasers	Percentage of consumers rating high satisfaction with DHP by state and/or east vs. west of the Cascades	Medium	Low
Availability and Market Competition	**SDI3. Number of distributors offering DHPs remains constant or is increasing.**	Number of DHP distributors in region	Census of Northwest HVAC distributors	Number of distributors in region by state and/or east vs. west of the Cascades	Medium	Low

3.6.2. Primary Indicators

Cadmus identified two high-importance diffusion indicators to assess consumer demand and DHP affordability as well as two high-medium importance indicators to assess availability and market competition.

DI1. Consumer Demand: The number of DHPs installed in single-family homes to displace/ replace electric zonal heat or electric forced air furnaces is increasing.

Tracking the sales and installation of DHPs installed in the region is one of the most critical inputs for assessing ongoing DHP product diffusion. A leveling off or decrease in annual DHP sales growth would signal that diffusion may be faltering and could justify a need for additional investment from NEEA in the DHP market or investigation into other indicators.

Data Collection and Analysis Activities

Cadmus proposes that NEEA focus on three main data collection activities—distributor sales-data collection, a utility survey, and a DHP installer survey—to track and provide context for regional DHP sales, described further as follows:

- **Distributor sales data collection.** Throughout the initiative, NEEA has gathered comprehensive DHP sales data from regional distributors to track the total number of DHPs installed in the region. In 2018, in partnership with BPA, NEEA implemented a more comprehensive approach to collect regional sales data for all HVAC equipment. There were many challenges with this data collection effort in 2018 and 2019, and the data NEEA received was not complete and did not include data from a sufficient number of distributors to reliably extrapolate to the full market. However, NEEA anticipated these challenges knowing these were the initial years of a more time-intensive data request from its distributor contacts. Cadmus recommends continuing to work with distributors to gather sales data as a significant focus for the DHP initiative in LTMT to ensure a robust and comparable dataset for tracking DHP sales.
- **Utility survey.** NEEA fields an annual utility survey to record incented units installed in NEEA's three target markets. Cadmus recommends continuing to gather these data in LTMT to track incented DHP installations. For a subset of utilities, the survey also provides information about head configuration, which can be used to track the proportion of incented single-head versus multi-head installations.
- **DHP installer survey.** NEEA typically conducts an installer survey every two years to provide its planning team with context surrounding non-incented DHP installations. Cadmus recommends that NEEA continue fielding the biannual survey. Specifically, this survey should assess the heating types that DHP installations are displacing and the home types in which they are installed to inform NEEA's calculations of savings and the share of non-incented installations in NEEA's three target markets.

If the effort to collect distributor sales data is insufficient, NEEA will need to develop alternative strategies for estimating regional DHP sales. In 2018 and 2019, NEEA estimated total installations using the 2016 ratio of incented-to-total installations to the 2017 and 2018 incented installations reported by utilities. Cadmus does not recommend solely relying on this same assumption to estimate DHP sales in

LTMT because the percentage of incented DHP sales is likely to shift as the market matures. However, there may be opportunities to triangulate with other primary and secondary data sources to determine the proportion of incented DHP sales. For example, the MPER 6 installer survey found that 27% of DHPs reported were installed without a utility rebate,[29] which aligns with NEEA's 2016 estimate that 75% of DHP installations were incented.

Table 15 lists these research activities, a brief description of methodology and expected outcomes, party responsible for data collection, and evaluation frequency.

Table 15. Research Activities to Assess Annual DHP Sales

Research Activity	Methodology	Expected Outcomes	Responsible for Data Collection	Timeline
Distributor Sales Data Collection	HVAC sales data collection from regional distributors, including DHPs	Total annual DHP sales in Northwest	NEEA	Annual
Utility Survey	Survey of NEEA's partner utilities	Total incented DHP sales by target market and state; proportion of single vs. multi-head installations (subset of utilities)	NEEA	Annual
Survey of DHP Installers	**Mode:** Online or telephone survey **Sample frame**: Northwest DHP project installer list and/or general population of heating and cooling contractors in Northwest purchased through third-party sample provider	Non-incented DHP installations by replaced equipment type	LTMT Evaluation Contractor	Biannual

These three data collection activities will inform an annual market update that summarizes DHP installations and market saturation and can be reported in DHP initiative LTMT evaluation reports. As with prior MPERs, Table 16 identifies the data attributes that should be included in the market update.

[29] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #6.* Prepared for NEEA. January 17, 2018. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-6.pdf

Table 16. Market Update Data Attributes

	Annual Installs (Market Size)	Market Saturation	Installs 2008–Present (Market Size Over Time)
State	✓		✓
Inside versus Outside Target Market*	✓		✓
By Target Market	✓	✓	
Incented vs. Non-Incented (all sales)	✓		✓
Incented vs. Non-Incented (within target market)	✓		✓
* Target markets include single-family homes heated by an electric forced air furnace and zonal heat and manufactured homes.			

Cadmus also recommends that NEEA continue tracking the proportion of single-head versus multi-head incented installations by target market from the subset of utilities that share this information (In this MPER, NEEA received head configuration information from a subset of utilities whose incented installations represented about 58% of all incented DHP installations).

DI2. DHP Affordability: The average installed cost for a single-head system remains constant or decreases

Price may continue to be a barrier to accelerated consumer adoption and the cost-effectiveness of utility DHP programs. If DHP price (i.e., installed cost to the consumer) increases, consumers may be less willing to purchase. And because rising price can impact cost-effectiveness, utilities may discontinue or scale back their support for DHPs, further stalling customer uptake. Given the potential for increasing price to impact diffusion, DHP cost, in tandem with DHP sales, will remain an important indicator to assess through LTMT.

Data Collection and Analysis Activities

Cadmus understands that NEEA plans to request installed DHP cost data from partner utilities or to purchase rebate tracking data from third-party implementers managing utility data.[30] NEEA also has a large database of installed DHP costs from rebate tracking that covers several years through 2017. Cadmus recommends that NEEA or its LTMT evaluation contractor analyze these annual DHP cost data to determine average and median installed costs and equipment costs for single-head and multi-head systems, each year and over time, to document cost trends.

Because NEEA will also likely continue fielding a biannual installer survey, Cadmus also recommends that NEEA consider gathering average DHP cost data from installers.

Table 17 presents the cost analysis methodology and expected outcomes, the party responsible for data collection, and evaluation frequency.

[30] At the time of this memo, CLEAResult was the third-party implementer that managed (currently and historically) these data for several regional utilities.

Table 17. Research Activities to Assess DHP Cost

Research Activity	Methodology	Expected Outcomes	Responsible for Data Collection	Timeline
DHP Cost Analysis	**Data source:** NEEA-administered utility survey and/or data purchase of third-party rebate tracking data	DHP costs (such as average and median installed costs to consumer and equipment costs) in 2018 and over time	NEEA and/or LTMT Evaluation Contractor	Annual
Survey of DHP Installers (same survey conducted to assess DI1)	**Mode:** Online or telephone survey **Sample Frame**: Northwest DHP project installer list and/or general population of heating and cooling contractors in the Northwest purchased through third-party sample provider	Average installed DHP cost to consumer	LTMT Evaluation Contractor	Biannual

DI3. Availability and Market Competition: The number and share of regional HVAC companies/installers offering DHPs remains constant or is increasing

Product availability was one of the first and most critical DHP market barriers NEEA sought to address when launching the initiative in 2008. A limited number of manufacturers were producing and distributing products for the U.S. market, HVAC installers had low awareness and capability to install DHPs, and once they did become aware installers were concerned about how the growth of ductless systems would impact the economics of their business.

Over the past decade, initiative activities have included a strong focus on installer recruitment and training to increase DHP market availability and promote greater growth in the market diffusion. NEEA has sought to increase the availability (both the number and geographic distribution) of trained DHP installers throughout the Northwest region to ensure that residents in all locations have access to qualified installers.

To assess ongoing progress in ensuring an adequate DHP installation workforce, enhancing market competition, and improving DHP availability, Cadmus recommends that NEEA track the following diffusion indicators:

- **DI3a.**The share of regional HVAC companies/installers offering DHPs remains constant or is increasing.
- **DI3b.** The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.

In stakeholder interviews with utilities, Cadmus found that utilities generally agreed that the DHP market would continue to transform west of the Cascades, but they expressed concerns that more work may be needed to continue progress and prevent backsliding outside of the I-5 corridor. A few utilities specifically said that an insufficient DHP installer workforce east of the Cascades was a significant barrier

to market transformation in their service territories. Two utilities also noted that cold climate heat pump technology was not available or promoted widely early in the initiative when NEEA was most actively working with the supply chain; therefore, DHP options suitable for colder climates east of the Cascades were not sufficiently available in their service territory. Cadmus recommends that NEEA assess DI3a regarding the share of DHP installers at the state level in addition to the region overall.

Data Collection and Analysis Activities

Cadmus proposes general population installer call-down surveys to address these two diffusion indicators to assess ongoing DHP availability and market competition:

- **Share of regional HVAC companies offering DHPs:** NEEA has historically used its oriented installer list—with more than 1,000 DHP installation companies—as a proxy for the number of companies in the region that sell DHPs.[31] However, when the initiative transitions to LTMT—and is no longer actively engaging with the DHP installer population and updating the list—this list may become less representative of the installer population over time. Prior to this MPER, the initiative lacked information about what proportion of total DHP installers in the region are represented in this list. For this MPER, Cadmus quantified the proportion of DHP installers (including oriented and non-oriented installers) in the region. Cadmus recommends that NEEA continue to field call-down surveys from the general population of HVAC installers in LTMT to assess any changes to the proportion of contractors in the region who install DHPs.
- **The number of counties in the region with HVAC companies**: To assess the geographic distribution and availability of DHP installers across the region, Cadmus suggests that NEEA continue to conduct call-down surveys in LTMT to assess any changes in the number of counties in the region (in NEEA's funders' service territories) that have an HVAC company that installs DHPs. NEEA can use its oriented installer list to identify all counties represented on that list where a DHP installer is present. For counties with no oriented installers (installers who have participated in NEEA's training),[32] Cadmus suggests calling HVAC companies (identified in a third-party list as plumbing, heating, and air-conditioning contractors) in each county to determine where at least one DHP installer is present.

[31] NEEA uses the term "oriented" for installers who have completed NEEA's training.

[32] In 2018, Cadmus determined that 49 counties in NEEA's territory had a total of 353 plumbing, heating, and air-conditioning contractors. However, none are oriented installers served by NEEA funders.

Table 18. Research Activities to Assess Availability and Market Competition

Research Activity	Methodology	Expected Outcomes	Responsible for Data Collection	Timeline
DI3a. The number and share of regional HVAC companies/installers offering DHPs remains constant or is increasing.				
General Population HVAC Installer Call-Down Survey	**Mode:** Telephone survey **Sample Frame**: General population of heating and cooling contractors in Northwest purchased through third-party sample provider	Number and proportion of HVAC installers selling DHPs in region by state	LTMT Evaluation Contractor	Annual or Biannual
DI3b. The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.				
General Population HVAC Installer Call-Down Survey	**Mode:** Telephone survey **Sample Frame**: General population of heating and cooling contractors in Northwest (NAICS code: 238220) purchased through third-party sample provider	Number of counties in region with at least one HVAC company that installs DHPs; map of counties in region identifying those that do/do not have an HVAC company that installs DHPs	LTMT Evaluation Contractor	Annual or Biannual

3.6.3. Secondary Indicators for Consideration

In addition to the diffusion indicators of high and high-medium importance, Cadmus also identified three secondary indicators—consumer demand, quality installation, and availability and market competition—that NEEA may consider tracking in LTMT. Cadmus considers these less critical indicators of market diffusion; nevertheless, they may provide more context on market conditions, particularly if NEEA identifies potential threats to market diffusion through assessing the primary indicators.

SDI1. Consumer Demand: Consumer awareness is increasing

MPER 7 found that DHP awareness has remained consistent over the last three years—more than half of the consumers in the target market have seen or heard of a DHP and approximately one-third of this population are aware of DHPs by name alone.[33] NEEA may consider continuing to track consumer awareness via a target market general population online survey moving forward because a decrease in consumer awareness could be a precursor to stalled market growth. As a departure from the consumer awareness surveys since MPER 4, NEEA may consider including DHP purchasers (in the target markets) in

[33] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7*. Prepared for NEEA. September 20, 2018. https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

the sample (instead of just target market consumers) to more accurately account for any increases in awareness over time as consumers become aware of and then purchase a DHP.[34]

SDI2. Quality Installation: DHP purchaser satisfaction remains high

MPER 5 was the most recent MPER that assessed DHP purchaser satisfaction. In prior assessments of the initiative, customers have shown extremely high satisfaction with DHP technology.[35] As a result, purchase satisfaction is not an immediate concern for the initiative. However, to assess installation quality, NEEA may consider fielding a satisfaction survey with DHP purchasers in the future, particularly if DHP sales growth slows or decreases.

SDI3. Availability and Market Competition: Number of distributors offering DHPs remains constant or is increasing

If NEEA identifies a sizeable downward trend in the proportion of HVAC installers offering DHPs over time (assessed through DI3), this could indicate low DHP availability and support further upstream in the supply chain. If NEEA identifies a shrinking installer market, Cadmus recommends a telephone survey of all HVAC distributors in the Northwest to assess the number who are offering DHPs and to determine if DHP availability from distributors is decreasing.

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[34] Including DHP purchasers in the target markets (i.e., purchasers who replaced or displaced their electric forced air furnace or zonal heat with a DHP) would allow for the inclusion of target market consumers who become aware of and then purchase a DHP. Note that if the survey is limited to DHP target market non-purchasers, at the same time as DHP installations are increasing, the survey results may underrepresent awareness.

[35] ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.* Prepared for NEEA. July 28, 2016. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-5.pdf

Appendix A. Detailed History of the DHP Initiative

Initiative Activities and Interventions

Over the past decade, the initiative has fostered demand and created a market for ductless heat pumps (DHPs) in the Northwest by encouraging and providing resources to utilities to create DHP programs, influencing manufacturers and distributors to expand distribution to the Northwest, educating and training installers on how and why to sell DHPs and installation best practices, and supporting supply chain actors with consumer-focused marketing.

Utility Engagement and Support

Northwest Utility Engagement and Support

Utility buy-in was critical to the success of the DHP initiative. NEEA supported utility participation in the initiative through the following activities:

- **Encourage utilities to offer DHP incentives and confirm utility buy-in.** NEEA focused on engaging utilities in the region to actively participate by sharing information, offering DHP incentives, and encouraging installers in the utilities' networks to attend training. Early in the initiative, NEEA also processed DHP rebates on behalf of the utilities.
- **Establish communication channels with utilities (utility outreach and workgroup).** NEEA convened a utility workgroup and produced utility bulletins, newsletters, and webinars. Through the workgroup, utilities have continued to share their program activities, strategies and lessons learned, information on their installer networks, and any key market developments.
- **Facilitate strategic utility and supply chain actor partnerships.** The initiative facilitated opportunities for utilities to engage with supply chain actors through webinars in which manufacturers and distributors told utilities about their products and fostered discussion.
- **Provide utility marketing support.** NEEA provides a wide array of marketing materials and research to utilities and in turn utilities can pick and choose what is most useful to them and their customers. The following are examples of marketing support NEEA has provided:
  - **Customizable marketing materials and templates.** The initiative produces a variety of marketing materials aimed at consumers that utilities can easily co-brand or adapt with their own branding and distribute.
  - **Goingductless.com website**. Utilities can point consumers to a website, hosted by NEEA, that explains DHPs, offers technical resources, and lists trained installers. On the websites partner resource section, utilities can download marketing templates and images for use in their own marketing.
  - **Target audience segmentation.** The initiative helped utilities identify the characteristics of potential DHP customers and provide examples of messaging and value propositions.

Marketing Support beyond the Northwest

Utilities outside of NEEA's territory also took advantage of the initiative's marketing resources to increase customer awareness and contractor knowledge. For example, in 2011, NEEA provided Connecticut Light & Power, BC Hydro, and LiveSmartBC, an efficiency initiative of the British Columbia government, with resources to bolster DHP programs. These resources included content for contractors (e.g., Contractor Orientation Webinar and Installation Best Practices Webinar and Guides) and content for homeowners (e.g., Frequently Asked Questions and Homeowner Guide).[36]

Supply Chain Engagement and Support

Supply Chain Marketing and Promotional Support

Early in the initiative, NEEA focused on building relationships with supply chain actors and persuading them to engage with ductless technology. NEEA has engaged in marketing and promotional support of supply chain actors through the following activities:

- **Investment in promotions.** Early on, NEEA used lead-development campaigns to build awareness of DHPs in the Northwest. These initial campaigns brought together manufacturers, distributors, contractors and utilities to co-promote a DHP sale. After the success of small-scale DHP promotions, NEEA began coordinating regional market-driven promotions with manufacturers and distributors. The initiative provided both labor support and direct funding to market the promotions. Recently, NEEA found that installers and distributors are busy selling ductless systems and no longer need the same level of interaction from NEEA.[37]
- **Marketing support, trade pitches, and media outreach.** NEEA has provided copywriting, design, coordination, and distribution of supply chain marketing materials as well as trade pitches and media outreach to trade publications. Some manufacturers and distributors have worked closely with NEEA to develop marketing resources while others have used only imagery or information produced by NEEA.[38] Over the course of the initiative, NEEA has been able to influence supply

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[36] Northwest Energy Efficiency Alliance. *2011 Annual Report NW Ductless Heat Pump Project.*

[37] Northwest Energy Efficiency Alliance. *2017 Annual Report.* March 2018. Prepared by CLEAResult.

[38] ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.* Prepared for NEEA. July 28, 2016. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-5.pdf

chain marketing activities. For example, manufacturers began emphasizing heating capabilities (as opposed to cooling) of DHPs to appeal to northern climates.[39,40]

- **Attendance at live events and presentations**. To foster regional support for ductless systems, the initiative provided marketing support for distributors that involved coordinating display units for internal training and home shows. NEEA has also encouraged contractor participation in the initiative at distributor-hosted contractor trainings and events.

Strengthen Supply Chain

NEEA has sought to increase the availability of DHPs in the Northwest by strengthening the supply chain through identifying and building upon strategic market partnerships with manufacturers and distributors through numerous activities including these:

- **Facilitate market collaboration.** Early in the initiative, NEEA hosted two workshops to increase market collaboration of manufacturers, distributors, contractors, energy efficiency organizations, and utilities. In 2009, more than 230 people attended the first workshop.[41] These partnerships endure today as NEEA continues to identify market barriers to growth in the Northwest and work with supply chain actors to mitigate these barriers.
- **Training to distributors.** The initiative has engaged new distributors by conducting training on opportunities for DHP sales and how to work with utility programs.
- **Collaboration with distributors and manufacturers to train regional installers.** NEEA increased awareness of displacement theory (that is, displacing heating load rather than replacing a customer's entire heating system) by lending information and materials to distributor and manufacturer trainings.

Develop Regional Installer Network

Over the past decade, initiative activities first focused on convincing installers of the market opportunity presented by DHPs. Activities then focused on installer training to ensure that homeowners in all locations have access to qualified installers. NEEA sought to develop and strengthen a regional installer network through the following activities:

- **Gain installer buy-in.** NEEA's early installer outreach focused on presenting the market opportunity of DHPs because an initial barrier was that HVAC installers lacked motivation to install something less expensive and profitable than a ducted system.

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[39] Evergreen Economics. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #3.* Prepared for NEEA. April 24, 2014. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-3.pdf

[40] Research Into Action. *Northwest Ductless Heat Pump Pilot Project MPER #2.* Prepared for NEEA. March 28, 2010. https://neea.org/img/uploads/northwest-ductless-heat-pump-pilot-project-market-progress-evaluation-report-2.pdf

[41] Northwest Energy Efficiency Alliance. *Final Implementation Report Ductless Heat Pump Project 2008-2009*.

- **Installer pitch and messaging support.** Installers were taught how to sell DHPs and how to identify appropriate target homes. In addition, the initiative produced consumer-facing marketing materials for installers to use when introducing DHP technology to their customers. In 2010, NEEA delivered 104,000 sales sheets to installers designed to assist sales efforts.[42]
- **Ensure regional coverage of trained installers.** To jumpstart markets, NEEA identified areas such as the Tri-Cities, Spokane, and Idaho that had less DHP activity than the rest of the region and offered training that installers in these areas could easily access.
- **Displacement theory education, best practices training, and contractor sales training.** NEEA designed the Master Installer Program to increase installers' knowledge and promotion of DHPs to displace zonal electric heat equipment.
- **Promote high-quality installers to consumers.** NEEA showcased and rewarded installers who completed training and employed best practices in many installations through "installer of the year" awards, priority listings on goingductless.com, and access to marketing collateral and an image library. NEEA maintains its oriented installer list to ensure promoted installers continue to be actively engaged with the initiative.

Retail Channel Development

Through retail channel development activities, NEEA worked toward increasing the awareness of DHPs, generating demand, and providing additional purchase options for customers, with the goal of reducing costs and increasing access to equipment:

- **Retail partnership.** The initiative was instrumental in creating a Northwest retail channel for customers. NEEA partnered with a major manufacturer to display DHPs in The Home Depot retail stores in the Northwest so potential customers could learn about the technology. The initiative assisted with the development and deployment of in-store signage to alert customers of utility rebate information. NEEA collaborated with the manufacturer and the retailer to prepare a new television advertising campaign, improve customer in-store education, and train staff on closing sales.
- **DHP marketing material provided to manufactured home retailers.** NEEA provided manufactured home retailers with consumer-facing DHP advertising materials that retailers said were essential to getting information about DHPs to the public.
- **Do-it-yourself (DIY) channel and contractor-assisted installations.** Throughout the initiative, NEEA has explored the pathways through which customers can acquire and install a DHP, including the possibility for customers to purchase a DHP and then either install it themselves (DIY channel) or partially install it themselves (contractor-assisted installations). To support development of these channels, NEEA has conducted market research with utilities and the supply chain, tested off-the-shelf DHPs, tested and documented the DIY installation process, and offered utility support and quality control for contractor assisted-rebated installations.

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[42] Northwest Energy Efficiency Alliance. *Annual Report Northwest Ductless Heat Pump Project.* 2010.

Downstream Marketing and Consumer Resources

Early in the initiative, NEEA dedicated substantial resources toward direct-to-consumer marketing, with the goal of increasing consumer awareness and demand. At pilot launch, 5% of consumers were aware of DHP technology.[43] As the initiative has matured, NEEA has shifted its marketing activities to supporting utilities and the supply chain (as described in the Supply Chain Marketing and Promotional Support section above).

NEEA's downstream marketing efforts and consumer-facing resource and tool development has focused on the following:

- **Customer awareness campaigns and marketing.** Early in the initiative, NEEA deployed a number of marketing campaigns and activities including television and radio public service announcements (PSAs) and advertisements (some co-funded by manufacturers) in markets with low DHP uptake, online marketing that included online banner ads (for example, on weather websites on particularly hot or cold days) to attract a younger market, and social media campaigns.
- **Develop, host, and maintain the goingductless.com website.** NEEA launched the website with the goal of fostering a better understanding of DHPs and their benefits and ultimately greater sales. The website presents a wide variety of resources for consumers (e.g., information on DHPs, why to install them, and a list of qualified installers), utilities (e.g., market data, customer segmentation data, image library, marketing templates), and supply chain actors (e.g., marketing resources, utility rebate forms, installation best practices).
- **Consumer confidence and purchase decision support tools.** In 2019, NEEA launched its "Buyer's Guide" on the goingductless.com website. To support price transparency, consumer confidence in DHP technology, and purchasing decisions, the guide offers several tools such as a pricing factor checklist, questions to ask an installer, and a bid and analysis guide.
- **Operational resources for consumers to maximize energy savings.** NEEA has also developed resources to educate homeowners and help them optimize DHP efficiency. These resources include NEEA's homeowner's guide, which provides heating and cooling operation and maintenance recommendations.

[43] National Association of Home Builders Research Center. *Ductless Heat Pump Market Research and Analysis*. June 2008.

DHP Market and Technical Research

NEEA generates, commissions and disseminates DHP market and technical research to track market progress, promote best practices, and answer questions unique to the Northwest through the following types of market and technical research:

- **Sales data tracking, analysis, and trends.** NEEA produces Northwest market data for use by utilities and supply chain actors. The initiative acts as a conduit of information and data from utilities and installers to manufacturers and distributors and vice versa.
- **DHP technology recommended practices and use cases**. NEEA develops guides for recommended practices such as for cold climate DHPs, use cases for specific technology such as variable speed heat pumps, and guidance on how to select the correct DHP technology for various applications such as ducted mini-split.[44]
- **Technical resource development and research**. NEEA commissions a number of technical reports to better understand the context of the Northwest market and answer questions unique to the Northwest:
  - **Lab and field-testing of DHPs to improve the technology for Northwest.** One example is field-testing energy savings generated by DHPs across a range of temperature conditions and comparing these savings to manufacturer ratings. Another is performing lab and field-tests in Northwest homes of DHP prototypes to give manufacturers feedback on how to improve the DHP product prior to final design and full-scale manufacturing.[45,46]
  - **Research to support increasing the energy-savings potential of DHPs.** NEEA initiated and organized an effort conducted by the Pacific Northwest National Lab (PNNL), with financial contributions from BPA, Silicon Valley Power, America Public Power Association, and NEEA, to determine how controls and homeowner operation could be used to maximize the energy savings of a DHP system when operated in concert with pre-existing electric resistance heating systems.
  - **Technical and market assessments used to track and forecast the likely total displacement of electric resistance heating by DHPs under different market adoption scenarios.** An example is the Residential Inverter-Driven Heat Pump Technical and Market Assessment,[47] which quantified maximum technical potential for displacing electric resistance heating in

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[44] CLEAResult. *2017 Annual Report.* Prepared for NEEA. March 2018.

[45] Ecotope Inc*. Final Summary Report for the Ductless Heat Pump Impact and Process Evaluation*. Prepared for NEEA. February 19, 2014.

[46] Energy 350. *Combination Ductless Heat Pump and Heat Pump Water Heater Lab and Field Tests.* Prepared for NEEA. August 26, 2015.

[47] Navigant Consulting, Inc*. Residential Inverter-Driven Heat Pump Technical and Market Assessment.* Prepared for NEEA. June 2, 2015. https://neea.org/img/uploads/residential-inverter-driven-heat-pump-technical-and-market-assessment.pdf

relevant Northwest market segments, identified current market barriers, and forecast likely total displacement of electric resistance heating by standard and specialized DHPs over the next 20 years.

- **Cost containment research to find areas to decrease costs.** Examples of NEEA's cost containment research include these:
  - The Residential Inverter-Driven Heat Pump International Market Characterization Report, which NEEA commissioned to assess how international DHP market experience can be applied in the NW and to assess market cost drivers.[48]
  - An assessment of regional cost and invoice data to assess variables that drive costs and determine potential intervention points.
  - DIY system investigation that included a review of all DIY products, installation of several products in a field trial, and evaluation of the technical risks of DIY products for reliability, performance, and safety.
  - Research designed around cost reduction conducted through market progress evaluation reports (MPERs).[49, 50]

Quality Assurance

To influence regional installation quality and uniformity, NEEA conducted installation quality control, provided utilities with support through on-site inspections, and communicated its findings with the supply chain. Over the past decade, NEEA conducted these quality assurance activities:

- **On-site inspections.** NEEA performed a significant number of on-site inspections (e.g., in 2010, the initiative inspected 4% of the initiative's installations or 189 installations).[51] The project refined NEEA's on-site inspection trigger system annually to ensure the best use of resources by targeting new installers while lowering the number of inspections required for proven, high

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48 Navigant Consulting, Inc. *Residential Inverter-Driven Heat Pump International Market Characterization Report.* Prepared for NEEA. June 2, 2015. https://neea.org/img/uploads/residential-inverter-driven-heat-pump-international-market-characterization.pdf

49 Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #6.* Prepared for NEEA. January 17, 2018. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-6.pdf

50 Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7*. Prepared for NEEA. September 20, 2018. https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

51 Northwest Energy Efficiency Alliance. *Annual Report Northwest Ductless Heat Pump Project.* 2010.

performing installers.[52,53,54] Findings from these inspections influenced technical updates to initiative marketing materials and installer training.

- **Foster and promote quality installations.** By identifying and addressing common installation issues, NEEA promoted best practices among contractors and ensured the high quality of project installations. Supply chain actors also benefited from NEEA's inspection findings. Feedback directly from NEEA's on-site inspections helped manufacturers identify inaccurate installation guidance and laid the groundwork for successful installations of cold-climate technology.[55] In addition, NEEA worked with distributors to ensure the region had adequate supplies of tools needed for quality installations. [56]
- **Quality assurance (QA) inspection support.** NEEA supported utility-driven QA efforts by developing and delivering utility QA webinars to help unify regional efforts and provide utilities with resources to refine, improve, and increase their QA activities. NEEA also shared inspection and recordkeeping templates with utilities to facilitate their inspections.

Codes and Standards

Over the course of the initiative, NEEA's Codes and Standards program has helped utilities as well as DHP supply chain actors by making beneficial changes to existing codes and informing all parties of upcoming changes to regulations through the following activities:

- **Identify and change inefficient state and local codes**. NEEA contributed to changing codes to make the installation of DHPs in the Northwest as efficient as possible.
  - **Internal disconnect switch requirements.** Washington and Oregon codes required installation of internal disconnect switches, which contributed to installation cost and created an aesthetic barrier for homeowners. NEEA collaborated with utilities, trade associations, and supply chain actors to draft a document stipulating that internal disconnect switches should no longer be required. This change was approved by the State of Oregon in 2009.[57] In 2010, Washington State Labor and Industries subsequently released an interpretation that followed the initiative's request.[58]
  - **Programmable thermostats.** NEEA identified an installation barrier in a Washington State code interpretation requiring programmable thermostats for DHP installations. The initiative

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52 Northwest Energy Efficiency Alliance. *Final Implementation Report Ductless Heat Pump Project 2008-2009*.

53 Northwest Energy Efficiency Alliance. *Annual Report Northwest Ductless Heat Pump Project.* 2010.

54 Northwest Energy Efficiency Alliance. *2011 Annual Report Northwest Ductless Heat Pump Project.*

55 Northwest Energy Efficiency Alliance. *Annual Report Northwest Ductless Heat Pump Project.* 2010.

56 Ibid.

57 Northwest Energy Efficiency Alliance. *Final Implementation Report Ductless Heat Pump Project 2008-2009*.

58 Northwest Energy Efficiency Alliance. *Annual Report Northwest Ductless Heat Pump Project.* 2010.

overcame this barrier by providing testimony that led to the Washington State Building Code Council alleviating this requirement.

- **Disseminate code and regulation changes.** Ahead of impactful code and regulation changes, such as the U.S. Environmental Protection Agency's January 1, 2018, changes to refrigeration regulations, NEEA informed utility partners, changed distributor presentations, and revised the installer orientation and best practices webinar to ensure that installers accurately implemented changes.
- **Influence ENERGY STAR® rating systems.** NEEA influenced product category approach by advising that the rating system used to illustrate ductless system efficiency was not an appropriate fit for ductless technology.[59]

Drivers of DHP Adoption

Many factors have contributed to DHP adoption in the Northwest, including compelling product features unique to DHPs, market forces and conditions, and regional activities and interventions implemented by utilities, NEEA, and the supply chain.

DHP Product Features

Their unique product features make DHPs well suited for achieving energy savings and high customer satisfaction and have contributed to the increased adoption of DHPs in the Northwest market. In assessments of the initiative, customers have shown extremely high satisfaction with DHP technology.[60] A former NEEA initiative staff member said, "something we saw really early was how much customers love this technology… [customers] found me at NEEA to tell me how much they loved their DHP." Word of mouth has been well documented in prior MPERs as the main driver of customer awareness of

[59] Northwest Energy Efficiency Alliance. *2011 Annual Report Northwest Ductless Heat Pump Project.*

[60] ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.* Prepared for NEEA. July 28, 2016. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-5.pdf

DHPs.[61,62,63,64,65] Some stakeholders have identified word of mouth as a particularly effective accelerator of market adoption. In MPER 2, a utility representative said the rapid expansion of DHP installations through word-of-mouth advertising was "like someone throwing gasoline on a dry field."[66]

Previous MPERs and research with DHP program stakeholders, consumers, and the supply chain have highlighted these product features as significant drivers of adoption:

- Substantial energy and cost savings
- Cooling capability
- Quiet operation
- Potential to provide greater comfort (e.g., more even heating) than baseboard heating
- Limited maintenance requirements
- Less complex/costly installation than ducted central heating systems
- Ability to displace existing heating system

Zonal control of heating and cooling

Of these DHP product features, prior research has found the ability to reduce monthly heating costs (by some estimates up to 50%) and cooling capability are the most compelling product attributes to

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61 Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7*. Prepared for NEEA. September 20, 2018. https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

62 Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #6.* Prepared for NEEA. January 17, 2018. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-6.pdf

63 ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.* Prepared for NEEA. July 28, 2016. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-5.pdf

64 ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #4.* Prepared for NEEA. July 23, 2015. https://neea.org/img/uploads/ductless-heat-pump-market-continues-to-increase-dhp-mper-4.pdf

65 Evergreen Economics. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #3.* Prepared for NEEA. April 24, 2014. Page i. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-3.pdf

66 Research Into Action. *Northwest Ductless Heat Pump Pilot Project MPER #2.* Prepared for NEEA. March 28, 2010. https://neea.org/img/uploads/northwest-ductless-heat-pump-pilot-project-market-progress-evaluation-report-2.pdf

consumers.[67] In MPER 7, two installers who were interviewed said DHPs sell themselves because of bill savings and energy efficiency. Cooling is increasingly a driver of customer interest in DHPs, as the region overall has seen an increase in residential homes with cooling.[68]

Market Conditions/Forces

Market conditions and forces have also contributed considerably to DHP adoption. For this MPER, interviewees elaborated on the following:

- Steadily increasing electricity rates that have caused customers to look for more efficient heating options to save on bills
- An aging population in need of a more effective heating and cooling option to improve home comfort
- Increasing urban density driving a need for small space heating and cooling solution
- Increasing demand for air-conditioning due to hotter summers and customers closing windows during summer forest fire season in an effort to reduce smoke intake

Although some interviewees identified the economic recession of 2007–2009 as a reason for market stagnation, they noted that economic recovery has resulted in a renovation and construction rebound, which has supported an increase in installations of both ducted and ductless systems.

NEEA staff, manufacturers, and one distributor noted that the recession had contributed to the current shortage of skilled labor to support DHP installations, exacerbated by an aging HVAC workforce with fewer new installers joining the trade, which two NEEA staff noted may have exerted upward pressure on installations costs. Some DHP installers who left the trade during the economic recession did not rejoin the HVAC installer workforce following the recession.

Utility DHP Programs

Utility buy-in was critical to early and continuing success of the initiative. NEEA staff who were interviewed for this MPER explained that ongoing utility involvement, support for DHPs, and deployment of DHP programs has been critical to accelerating adoption of DHPs in the region. Utility programs offer customers incentives to help reduce the initial cost of a DHP, track DHP installations, engage contractors in their DHP programs, cultivate their own DHP trade ally networks, ensure quality installations, and provide ongoing training and support. Several manufacturer and distributor interviewees agreed that utility incentives have served an essential role in driving customer demand. As

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[67] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #6.* Prepared for NEEA. January 17, 2018. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-6.pdf

[68] Cadmus. *Residential Regional Building Stock Assessment.* Prepared for NEEA. https://neea.org/img/uploads/Single-Family-Web-Version.pdf

of 2018, 108 utilities in the Northwest offered DHP rebates. Since 2008, 82,702 DHPs installed in the region have received a utility rebate.

Most and Least Impactful NEEA Interventions

Most Impactful NEEA Interventions

NEEA and utility interviewees identified several NEEA interventions and activities that were critical for accelerating DHP adoption in the Northwest, including the following.

Building consumer awareness. Several NEEA staff, manufacturers, distributors, and utility representatives noted the importance, particularly early in the initiative, of NEEA's direct-to-consumer marketing activities to help build consumer awareness of DHP technology. One manufacturer characterized NEEA's early customer messaging as the "catalyst" that sparked the market. Manufacturers and distributors interviewed mentioned that NEEA's messaging carries weight with both utilities and customers given NEEA is a trusted, third-party source. Most utilities interviewed said they benefited from NEEA's centralized marketing efforts to introduce the public to the new technology and increase market adoption throughout the region. Utilities said important aspects of NEEA's marketing activities included devoting staff to creating radio, print, and web marketing tools and maintaining the initiative's website, goingductless.com. Three utilities, two of which are small and rural, said that being provided with marketing material they could co-brand or rebrand, along with the ability to direct consumers to resources on the goingductless.com website, has been invaluable because they do not have the staff resources to create or maintain these marketing products themselves.

NEEA said its early work in building awareness helped prove the business case to manufacturers and distributors for greater investment in the Northwest DHP market. Supply chain actors have also acknowledged that raising consumer awareness improved their sales—for example, in MPER 3, when asked about the impact of NEEA's initiative on their sales, a manufacturer and a retailer said NEEA was essential in informing the public about DHPs and that they could attribute their recent sales increases to NEEA's work in the market.

Influencing the supply chain. Both NEEA and the utilities acknowledged that NEEA is uniquely suited to influencing manufacturers and distributors in developing the technology and bringing new products to the Northwest market. Utilities said they value the initiative's ability to prod supply chain actors, and as one interview noted, "we need [NEEA] to gracefully push the supply chain toward solutions."

Past MPERs have documented the substantial impact NEEA has had on manufacturers and distributors in the following areas:

- **Expanding distribution throughout the Northwest.** Given historical demand for DHPs was low in the Northwest prior to the initiative, NEEA focused efforts on encouraging manufacturers and distributors to expand their distribution throughout the Northwest. For example, NEEA's shared market research to help demonstrate the business case and customer preference to supply chain actors. One interviewee said that NEEA's information sharing with supply chain actors was invaluable because it helped them stock the right equipment in the right areas. According to one

manufacturer interviewed early in the initiative, Oregon and Washington ranked eighth and ninth, respectively, in 2010 national data in total DHP units sold, compared with rankings of nineteenth and twentieth in 2008.[69]

- **Expanded awareness and perspective of potential DHP applications.** In MPER 1, manufacturers reported that "the initiative had expanded their perspective and awareness of potential DHP applications and value, including displacement applications for DHPs."[70] When the initiative began, the leading manufacturers of DHPs sold in the U.S. perceived them as a solution for problem zones, bonus rooms, or add-ons rather than whole-house heating and cooling systems, and manufacturers did not promote DHPs as an energy efficiency measure or as an alternative to zonal electric heat.[71]
- **Supply chain adoption of NEEA's messaging.** MPER 2 and MPER 3 noted that suppliers had adopted the initiative's messaging (emphasizing multiple benefits such as energy efficiency, ease of installation, and bill savings) in their marketing strategies as well as had begun to market regional rebates.[72,73] This adoption continued and by MPER 5 supply chain actors were still using imagery or information produced by NEEA in their marketing efforts.[74]

Developing regional installer network. Utilities, manufacturers, distributors, and NEEA acknowledged the importance and value of NEEA's development of a regional installer network. NEEA's early outreach focused on securing contractor buy-in by promoting the market opportunity of DHPs in the Northwest. NEEA interviewees noted that the early quality assurance programs were also important for making installers comfortable and confident with DHP technology.

According to some utility interviewees, NEEA's role as an educator and resource for installers in the region grew when the initiative designed the Master Installer Program. A few utilities noted that this distinction and the training course was a driving force in the professionalization of DHP installation in

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69 Research Into Action. *Northwest Ductless Heat Pump Pilot Project MPER #2*. Prepared for NEEA. March 28, 2010. https://neea.org/img/uploads/northwest-ductless-heat-pump-pilot-project-market-progress-evaluation-report-2.pdf

70 Research Into Action. *Northwest Ductless Heat Pump Initiative 2010 Market Progress Evaluation Report #1.* October 27, 2011. https://neea.org/img/uploads/NorthwestDuctlessHeatPump15116CF434BC7.pdf

71 Research Into Action. *Northwest Ductless Heat Pump Pilot Project MPER #2*. Prepared for NEEA. March 28, 2010. https://neea.org/img/uploads/northwest-ductless-heat-pump-pilot-project-market-progress-evaluation-report-2.pdf

72 Ibid.

73 Evergreen Economics. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #3.* Prepared for NEEA. April 24, 2014. Page i. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-3.pdf

74 ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.* Prepared for NEEA. July 28, 2016. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-5.pdf

the region. Although utilities and NEEA acknowledged the importance and value of NEEA's development of the regional installer network, one utility and a few NEEA staff members who were interviewed said NEEA's importance may be diminishing, as utilities are cultivating their own DHP trade ally networks.

Facilitating market collaboration. Throughout the initiative, NEEA has served an important role in facilitating market collaboration among utilities, manufacturers, distributors, and installers. For example, NEEA interviewees noted, and prior MPERs have documented, that the workshops NEEA hosted and facilitated early in the initiative history—bringing together these diverse market actors—helped educate the supply chain on the market opportunity for DHPs in the Northwest and build partnerships that continue to the present. Utility interviewees also noted that it has been useful to have NEEA facilitate conversations among utilities to share insights and lessons learned from their DHP programs and for NEEA to facilitate conversations with contractors. Manufacturer and distributor interviewees agreed that NEEA has been incredibly valuable in facilitating their collaboration with utilities.

Providing research and sharing information. Interviewees mentioned NEEA's important role as a leader of DHP research in the region and as a conduit for sharing information among all supply chain actors and utilities. Utility interviewees said NEEA has done a good job of informing utilities about the benefits of DHPs to the region and that this has had a snowball effect. As one said, "if you can get the utilities fired up on it then you've got a good portion of the battle done."

DHP Cost Containment Interventions and Ongoing Challenges

A critical challenge and ongoing focus of the initiative has been the affordability of DHPs for target market consumers. NEEA has explored and implemented a variety of strategies aimed at cost containment. NEEA has had some success in partnering with manufacturers and distributors, for example, on limited time promotions to reduce product cost, which the supply chain now regularly offers without program support and sometimes directly in partnership with utilities. Despite these efforts, however, overall installed DHP cost to the consumer has not decreased in recent years. NEEA and the utilities have identified the cost of a DHP as a potential barrier to accelerated consumer adoption and, for some utilities, to cost-effectiveness.[75,76]

This section describes NEEA's interventions and activities that have been aimed at reducing cost, the outcome of these activities, and the ongoing challenges in addressing the cost barrier.

Lower-cost installation pathways. A key element of NEEA's market transformation logic since the initiative's inception has been to expand the pathways through which customers can acquire and install

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[75] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #6.* Prepared for NEEA. January 17, 2018. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-6.pdf

[76] Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #7*. Prepared for NEEA. September 20, 2018. https://neea.org/img/documents/DHP_MPER_7_Report_FINAL_CC.pdf

a DHP. NEEA conducted market activities in 2016 and 2017 to determine the viability of supporting two options targeting homeowners and shared these results with the region.

- **DIY installation channel development.** NEEA explored opportunities for a DIY installation channel, where customers purchase and install a DHP themselves. NEEA conducted market research with the supply chain and utilities. Ultimately, NEEA's funders expressed concern about the efficacy of DIY installations, and supply chain partners expressed concerns about lack of warranty and equipment performance and reliability. NEEA also evaluated and tested off-the-shelf DHPs and conducted and documented the DIY installation process but determined that the tested DIY models were not ready for reliable, easy self-installation with dependable savings.
- **Contractor-assisted installation (CAI) channel development.** NEEA explored opportunities for developing a CAI channel by conducting market activities to determine its viability, researching the market with supply chain and utilities, conducting a limited number of quality control post-installation visits, observing a CAI class, and offering utility support and quality control for CAI-rebated installations. As with the DIY option, the CAI channel has received low support from the supply chain. According to NEEA, this approach has received mixed support among utilities. NEEA has identified a few utilities that are currently accepting CAI installations for rebates; however, given that some utilities directed NEEA not to present this option or support it through consumer-facing messaging, NEEA is not actively pursuing this option any further.

Retail sales channel development. Although NEEA was successful in partnering with a key manufacturer to offer DHPs in The Home Depot retail stores in the Northwest and has supported manufacturer partnerships with other retail chains, NEEA believes the retail channel has not yet proved it can lower DHP cost. According to NEEA, consumers typically see the product in retail stores but are then directed back through the supply chain to a partner installer. Furthermore, NEEA has noted that manufacturers have guarded their relationships with retail chains and have not been willing to accept NEEA's offer for greater support or access to their contacts.

Support for direct-to-dealer distribution model. In 2017 and 2018, seeking to further drive down the cost of DHPs, NEEA explored opportunities to introduce competition for the single-head system market. NEEA worked with a manufacturer of lower-cost DHPs on a direct-to-installer distribution and sales model (aiming to reduce cost by removing the distributor and associated distributor overhead). NEEA encountered challenges identifying willing participant contractors but ultimately chose to halt the pilot project because of concerns that the manufacturer had not set aside sufficient resources to support the contractors directly. This concept was still viewed favorably but placed on hold until a suitable manufacturer could be identified to pilot this potentially market-disruptive approach to cost reduction.

Focus on single-head displacement approach. The initiative has remained focused on a single-head or one-to-one displacement over the past 10 years because these smaller, more targeted systems are less costly than multi-head systems, produce the desired energy savings impact and, from the standpoint of utilities, are more likely to be a cost-effective measure than a larger multi-head system. Even so, as DHPs have been introduced in the Northwest, multi-head systems have increased partly because of customer preference for a multi-zone heating and cooling solution and partly because supply chain

actors prefer the more lucrative opportunities of installing multi-zone DHPs in a home. In 2016 and 2017, installers and suppliers reported that most of their sales were one-to-one configurations; however, they also expected the portion of multi-head installations to increase in upcoming years.[77,78] In addition, utility rebate data show that the share of multi-head installations is increasing.[79]

Unique partnerships to support and promote lower-cost and single-head installations. In 2018 and 2019, NEEA explored two options for new partnerships to support and promote single-head and lower-cost DHP installations.

- **Community-based organization (CBO).** NEEA explored opportunities to partner with CBOs that serve clients who may benefit from DHPs to increase customer awareness, drive leads, and reduce cost through bulk purchasing and aggregating installations.
- **Nontraditional installers.** NEEA explored the viability of recruiting installers in other trades (e.g., electricians, solar installers) who may be more likely to have customers with zonal heat and/or may be more receptive to focus on single-head installations in addition to their primary business model. Research with nontraditional installers found that recruiting and training adjacent trades to expand services to offer DHP installation was not likely to be a highly effective way for the DHP initiative to engage more contractors and accelerate market adoption.

Ultimately, NEEA's funders did not recommend actively pursuing either of these partnerships. Instead, NEEA has shared findings from this effort and developed guidance for utilities that may be interested in cultivating CBO partnerships or recruiting new trade partners.

Consumer targeting support. NEEA has encouraged the region to focus marketing on reaching target-market homes that are right for single-head systems and educate these consumers on the benefit of displacement. NEEA created marketing materials, developed a targeted address list of areas with concentration of homes most likely to be appropriate for a single-head DHP installation, and proposed a consumer awareness campaign through direct mail and digital media, and it shared these with utilities to use in their own marketing. However, there is no evidence currently available to indicate whether utilities are using these resources to target homeowners.

Consumer financing. In 2016, NEEA researched financing opportunities for DHPs; however, NEEA determined that although financing could make DHPs more accessible for some consumers, the fees

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77 ILLUME Advising, LLC. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #5.* Prepared for NEEA. July 28, 2016. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-5.pdf

78 Cadmus. *Northwest Ductless Heat Pump Initiative: Market Progress Evaluation Report #6.* Prepared for NEEA. January 17, 2018. https://neea.org/img/uploads/northwest-ductless-heat-pump-initiative-market-progress-evaluation-report-6.pdf

79 CLEAResult. *2016 Annual Report*. Prepared for NEEA. March 2017.

associated with financing often increase the overall total cost to the consumer. In addition, NEEA's funders have recommended that NEEA should not take on a role in advancing financing.

Consumer confidence and purchase decision support tools. In 2019, NEEA launched its "Buyer's Guide" on the goingductless.com website. To support price transparency, consumer confidence in DHP technology, and purchasing decisions, the guide offers several tools such as a pricing factor checklist, questions to ask an installer, and a bid and analysis guide. Because these tools have been deployed only recently, NEEA does not yet have a measure of the impact of these resources.

Appendix B. Installer Research Findings and Methodology

The primary objectives by installer research task are outlined in Table B-1.

Table B-1. Installer Research Activities and Associated Research Objectives

Research Activity	Research Objective
Installer Call Down Surveys	Determine whether at least one DHP installer is operating in each county that overlaps with a NEEA funder service territory
	Determine the proportion of HVAC installers by state that install DHPs (oriented and non-oriented).
Installer Online Survey	Explore installer promotion of DHPs
	Document DHP equipment and installation costs
	Assess the heating types that DHP installations are displacing and in what home types DHP installations are occurring

Installer Call Down Survey

This section provides an overview of the installer call down survey methodology and results.

Methodology

To assess ongoing progress in enhancing market competition and improving DHP availability, Cadmus surveyed HVAC installers to assess the following:

- Distribution of DHP Installers by determining if a DHP installer is operating in each county
- Proportion of HVAC installers who install DHPs by state

Distribution of DHP Installers

To assess the geographic distribution and availability of DHP installers, Cadmus and NEEA sought to understand if any counties had no DHP installers. Cadmus reviewed the locations of NEEA's oriented installers (installers who have participated in NEEA's training) and determined that, of the 162 counties in the Northwest that are served by NEEA funders, 59 counties do not have any oriented installer companies. Therefore, Cadmus called businesses (identified in a third-party list as plumbing, heating, and air-conditioning contractors[80]) in 50 of the 59 counties (nine counties had no plumbing, heating, and air-conditioning companies listed) to determine if at least one DHP installer was present in each county. Specifically Cadmus conducted the following activities:

- Contacted businesses in each of the 50 counties to determine whether they install residential HVAC equipment and/or install DHPs.

[80] Cadmus identified the population of potential businesses as plumbing, heating, and air-conditioning contractors (identified by the NAICS code 238220 in a third-party provided list). Not all businesses in this population sell residential HVAC equipment. Additionally, Cadmus acknowledges that not all HVAC installation companies are represented by this NAICS code, and there may be additional companies that sell DHPs that were not included in this analysis.

- Considered calls complete in each county by either identifying one DHP installer or, after contacting all companies in the population in a given county, not identifying any DHP installers.

Proportion of DHP Installers

NEEA also sought to assess what proportion of HVAC installers in the region install DHPs. To estimate this proportion, Cadmus surveyed businesses identified in the same list provided by a third party as plumbing, heating, and air-conditioning contractors . Cadmus randomly selected contractors from the population for the sample frame. As with the approach to assess DHP installer distribution, Cadmus called businesses on the list to determine if they install residential HVAC equipment and if they install DHPs in residential applications.

Table B-2 identifies the estimated installer population size, target sample size to achieve 90/10 confidence and precision, and number of completed surveys.

Table B-2. HVAC Installer Estimated Population Size and Achieved Sample Size by State

State	Population*	Sample Frame	Total Companies Contacted	Ineligible **	Percentage Ineligible	Adjusted Population Size***	Target Sample Size (90/10)	Achieved Sample Size (90/10)
ID	915	350	161	93	58%	529	68	68
MT	592	300	144	73	51%	302	68	71
OR	1696	350	149	81	54%	922	68	68
WA	2473	350	193	123	64%	1576	68	70
Total	**5,676**	**1,350**	**647**	**370**	57%	**3,329**	**272**	**277**

***** Population of businesses identified as plumbing, heating, and air-conditioning contractors. Not all businesses in this population sell residential HVAC equipment.

** Ineligible identified as number of businesses contacted that indicated they do not sell residential HVAC equipment.

*******Population size adjusted to reflect the proportion of businesses contacted in each state deemed ineligible.

Installer Online Survey

Cadmus conducted an online survey with 87 DHP installers. This survey gathered insights to assess DHP sales and installations, explore installer promotion of DHPs, and document DHP equipment and installation costs. To provide NEEA's planning team with inputs necessary to estimate the share of energy savings from non-incented DHP installations in NEEA's target markets, the survey also assessed the heating and home types that DHP installation are displacing and/or replacing.

This section provides an overview of the installer online survey methodology and results.

Methodology

Cadmus conducted an online survey with DHP installers. Cadmus fielded the survey in June and July 2019 and completed surveys with a total of 87 installers, distributed across three heating zones in the four states in NEEA's region (Table B-3).

Table B-3. Survey Completes by Heating Zone

State	Heating Zone			
	1	2	3*	Total
ID	5	2	5	12
MT	0	2	10	12
OR	22	6	1	29
WA	32	2	0	34
Total	**59**	**12**	**16**	**87**

***** Higher sample size in HZ 3 due to oversample, described in detail in Heating Zone 3 Oversample section below.

Sampling Approach

Cadmus fielded the online installer survey using three sources (Table B-4) :

- NEEA's NW DHP Project Oriented Installer List
- Idaho Power's DHP Participating Contractor List
- Infogroup, via a purchased list of businesses identified as plumbing, heating, and air-conditioning contractors

Table B-4. Sample Design

Sample Source	Unique Companies	Total Contacts	Ineligible*	Missing Contact Information**	Duplicate Contact***	Sample Frame
NEEA NW DHP Project Oriented Installers List	1,223	1,707	4	58	496	1,149 302****
Idaho Power DHP Participating Contractors	79	79	0	0	39	40
InfoGroup	1,313	1,472	818	0	154	500
Total	**2,584**	**3,258**	**822**	**58**	**689**	**1,689**

* Contact from an ineligible state or business

** Contact missing email or company name

***Duplicate within the same list or overlapping with another list

**** These contacts are excluded from sample frame total as they are an additional contact from one of the 1,149 companies

Cadmus launched the online survey in three waves, each time checking we were not sending duplicate online survey invitations to contacts on the other two contact lists:

- **NEEA NW DHP Project Oriented Installer List.** After contacting the initial group of 1,149 eligible installers, we contacted a second contact (n=302) from NEEA's NW DHPP Oriented Installer List if no one from the company had responded to initial survey invite and two follow-up reminder emails.

- **Idaho Power's DHP Participating Contactors.** Approximately half of the companies on Idaho Power's DHP Participating Contactors list, overlapped with NEEA's oriented installers, and were therefore removed from the sample frame. Cadmus emailed the survey to the 40 remaining contacts on that list that had not already received the survey.

- **InfoGroup.** Finally, we contacted 500 installers from a list purchased from Infogroup. From the Infogroup list, Cadmus removed 818 contacts from businesses deemed ineligible businesses—that is companies that Cadmus identified as plumbers, manufacturers, distributors, and utilities--and a further 154 contacts that were either duplicates within the list or overlapped with installers on the other two contact lists.

The vast majority—87%—of installers who completed the survey were from NEEA's oriented installer list. Table 18 shows the distribution of survey completes by sample source and state. Table 19 shows the distribution by sample source and heating zone.

Table 19. Survey Completes by Sample Source And State

Sample Source	State				Total
	ID	MT	OR	WA	
NEEA NW DHP Project Oriented Installers List	10	10	25	31	76
Idaho Power DHP Participating Contractors	2	0	1	0	3
InfoGroup	0	2	3	3	8
Total	**12**	**12**	**29**	**34**	87

Table 20. Survey Completes by Sample Source And Heating Zone

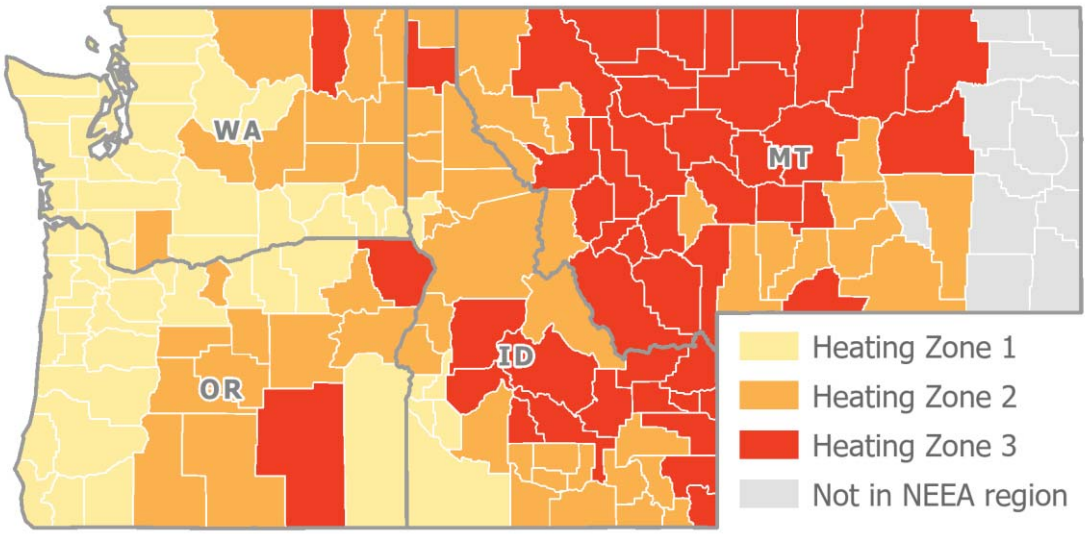
Sample Source	Heating Zone			Total
	1	2	3	
NEEA NW DHP Project Oriented Installers List	53	9	14	76
Idaho Power DHP Participating Contractors	1	2	0	3
InfoGroup	5	1	2	8
Total	**59**	**12**	**16**	87

Heating Zone 3 Oversample

For MPER 8, NEEA was particularly interested in gathering data to develop a better understanding of DHP installations and displaced heating types in HZ 3. Given the smaller population of contractors in HZ 3, and therefore small sample size target, Cadmus conducted an oversample to provide robust results within this heating zone. We conducted additional outreach via telephone to encourage installers with company addresses in HZ 3 to complete the online survey. In order to account for oversampling, we applied sampling weights to the results.

Figure 10 shows the heating zone assignments by county across the Northwest. HZ 3 is mostly concentrated in Idaho, Montana, and limited areas of eastern Oregon and Washington.

Figure 10. Northwest Regional States Heating Climate Zone Assignments by County



Source: NEEA, 2019

Sample Weights

Cadmus implemented sample weights in the analysis of survey results due to oversampling installers in HZ 3 to account for the difference in the distribution of installers between the sample and population by heating zone (e.g., 9% of the population of installers is in HZ 3, but 18% of Cadmus' sample is in HZ 3). Results in previous years were not weighted since there was no oversampling performed by heating zone or other sampling variables.

We calculated the sample weight as the sample frame size divided by the sample size which shows how many installers are represented by each sampled installer by heating zone. For example, each sampled installer in HZ 3 represents 9.13 installers in HZ 3. Table B-5 shows the counts and distributions of the population and sample of installers by heating zone, as well as the final heating zone sample weights.

Table B-5. Sample Weights by Strata

Heating Zone	Sample Frame Size	Population Percent	Achieved Sample Size	Sample Percent	Sample Weight*
HZ 1	1,219	72%	59	68%	20.66
HZ 2	324	19%	12	14%	27.00
HZ 3	181	9%	16	18%	9.13
Total	**1,689**	**100%**	**87**	**100%**	

*Sample weights are applied when calculating results across heating zones. If results are reported at the heating zone level, sample weights do not need to be applied.

**The sample frame from the InfoGroup data source is used in the calculation of sample weights since the true population of installers is unknown and the sample frame was used to sample installers for this survey.

Appendix C. Interview Guides

Current and Former NEEA Staff Interview Guide

Researchable Questions	Question Number
Document key milestones, events, and activities in the initiative	B1-B3
Assess key barriers to market adoption and how these have evolved over time	D1-D2
Document lessons learned from the Initiative, including most and least successful interventions and activities/conditions (within or outside NEEA) most impactful to the initiative results	C1-C3
Document current status of MPIs and progress over time	E1-E4
Explore potential risks of NEEA transition to LTMT, including impacts of failed diffusion on the market and regional savings	F1-F2

A. Introduction/Background

A1. To start, could you please tell me a little bit about your involvement with the DHP Initiative?

1. When did you first start working on/with the DHP Initiative?
2. How long were you/have you been involved with the DHP Initiative?
3. What is/was your role with the DHP initiative? How has your involvement with the initiative changed over time?

B. Initiative History and Key Milestones

Next, I have some questions for you about the history of the DHP initiative. While we've been a reviewing prior MPERs, other NEEA DHP studies, and current and prior logic models to provide a foundation for understanding the initiative history, interviews with initiative stakeholders are critical to providing a holistic understanding of the initiative's history and evolution.

B1. *[If knowledgeable about early initiative]* Thinking back to the early stages of the initiative—around or prior to the Initiative launch in 2008—what was the state of the DHP market at that time?

1. How did NEEA first get involved in DHPs? What was the impetus for launching the DHP initiative?
2. What were the most significant early barriers to DHP adoption?

B2. How did NEEA's initiative's thinking on the market or approach to DHPs evolve over time? *[Probe for specifics regarding the below topics and others as identified]*

1. Appropriate application(s) of the technology
2. Target markets *(Probe: When did the initiative broaden its definition of target markets to include displacement of eFAF? What was the impetus for this change?)*
3. Quality installation practices

4. Target audience(s) for engagement and support: Utilities, supply chain (manufacturers, distributors, retail channel, installers), consumers
5. Marketing
6. Market barriers

(1) Have there been major shifts in thinking or initiative direction since pilot launch? *If yes, what were they and why?*

B3. What stands out to you as key milestones and events in the DHP initiative's history?

C. Lessons Learned

C1. What activities or market conditions have been most impactful for driving adoption of DHP technology in the Northwest? *[Probe for activities or conditions from within and outside of NEEA]*

1. What product features have been most impactful in driving adoption of DHP technology?

C2. Thinking about the DHP initiative since 2008, where do you think NEEA has had the most impact on the adoption of DHPs in the NW? *Why do you say that? , consumer awareness, installer engagement and training, persuading distributors to stock DHPs, persuading manufacturers to invest in the northwest]*

1. What NEEA interventions and activities have been most successful? Least successful?

C3. What opportunities remain for increasing sales and installations of DHP equipment in the region?

D. Market Barriers

D1. What do you currently see as the primary barriers to increased sales of DHPs in the NW? [Probe for: lack of customer awareness, cost/limited financing options, limited product availability, unclear supply chain value proposition, lack of installer training opportunities/knowledge, inadequate test procedures]

D2. What opportunities remain for increasing sales and installations of DHP equipment in the region?

E. Market Progress Indicators (NEEA DHP Initiative Team Only)

As you may recall, as part of last year's MPER, the DHP Initiative team qualitatively assessed the extent to which the DHP initiative had achieved its market progress indicators (i.e. the outcomes that the initiative tracks to assess how the market for DHPs is progressing) and how important achievement of these outcomes is for NEEA to make a successful transition out of the market.

The results of the team exercise indicated that:

- The market has made significant progress in achieving outcomes related to the strength of the supply chain. The market for DHPs is strong, or improving, in the areas of supply chain adoption and product availability.
- The team identified several outcomes where the market has shown progress, but where more work may be needed to ensure NEEA's successful exit from the market. For example, more work may be needed in:
    - Increasing installer competence (where competence is measured by the share of installers that have received quality training and the quality of the installations installers deliver),
    - Supply chain marketing investment
    - Maintaining competition in the DHP market
    - DHP affordability for target market consumers

The DHP Initiative team also fielded a similar survey with utility workgroup members. Results were similar, with the exception that work group members generally indicated that level of supply chain marketing investment was sufficient.

E1. To what extent do you agree or disagree with these assessments? *[Probe, as needed: why do you say that?]*
    1. What are supply chain marketing and promotion activities and level of investment? How has this changed over time?
    2. How has DHP product availability & competition changed over time?

E2. What interventions or activities is the Initiative doing/planning in 2019 prior to LTMT transition? *Why?*
    1. Are there other areas that need continued intervention? *If yes, what are they?*

Next, I'd like to walk through the MPI table with you. As part of this MPER, we're assessing current progress towards MPIs and progress over time. Some of these MPIs have been prioritized for additional primary or secondary research as part of this MPER. For others, we're planning to be document from existing sources or a qualitative review.

[NOTE TO REVIEWER: Cadmus will review and facilitate a discussion on the DHP Initiative MPI table and data sources with DHP Initiative Team. We will circulate copies of the MPI table as part of this discussion]

E3. Based on our review of the MPI table, there are a few areas where we're anticipating that the DHP initiative team will provide a qualitative assessment or share with us data from the sources identified in the table. These include data on the following metrics:
    - IIb2. The number of quality installs
    - IIIa1. The number of utility DHP programs that offer incentives
    - IIIa2. The average and median amount of utility incentives
    - IIIa4. The number of utilities with a DHP focused website.
    - IV. The number of manufacturer and distributor promotions in the region.

1. Can you confirm the data sources for each of these metrics as identified in the MPI table (e.g. the metrics regarding incented installations reference an annual utility survey in the MPI table) and the best way for Cadmus to get this information from NEEA?
    a. What historical data, outside of past MPERs, do you have for assessing these metrics over time?

E4. Please provide a brief summary of outputs, activities, and progress related to these MPIs:
1. MPI IV: Variable capacity test procedure becomes available
2. MPI IX: Utility Program QPL uses New Test Procedure
3. MPI XI: Federal or State and Voluntary efficiency standards increase for ASHPs

F. Risk Assessment

F1. Without NEEA's active engagement in market development, do you think that the market for DHPs in the NW will continue to grow at the same rate, more slowly, or more quickly? *Why or why not?*
1. What might stall market growth moving forward?

F2. What risks do you think there are of NEEA exiting the market? *[Probe for risks to the market overall and specifically to supply chain actors (manufacturers/distributors), utilities, and consumers]*
1. What risks are there to utility cost-effectiveness?
2. If DHPs are not cost effective, what impact do you think this would have on a) utility programs and b) market diffusion?

F3. What market indicators could signal that diffusion is faltering?

G. Closing

G1. Are there any other thoughts would you like to share regarding NEEA's DHP initiative or the regional DHP market?

This completes our interview. We appreciate your participation and thank you for your time.

Utility Staff Interview Guide

Research Objective	Question Number
Assess key barriers to market adoption and how these have evolved over time	D1; E1-D2
Document lessons learned from the Initiative, including most and least successful interventions and activities/conditions (within or outside NEEA) most impactful to the initiative results	B1-B3
Document utility partner's perspective on DHP Initiative progress towards MPIs	E1-D2
Explore potential risks of NEEA transition to LTMT, including impacts of failed diffusion on the market and regional savings	E1-E2
Document utility partner's expectations for the future of their own DHP program and incentives	F1-F3

A. Introduction/Background

To start, to provide some context for our discussion, I'd like to hear about your role at your organization and your involvement with the Northwest Ductless Heat Pump Project.

A1. Please tell me a little bit about your role at your organization.

A2. What involvement have you had with the Northwest Ductless Heat Pump Project?

1. When did your utility/organization start working with the NW DHP project?
2. How long have you been working with the NW DHP project?
3. At a high level, could you tell me about the DHP program your utility/organization offers? *[Probe for details on rebate amount, eligibility requirements, installer and trade ally engagement, consumer marketing or utility sponsored promotions]*
4. How has your utility/organization's involvement with the project changed over time? How has your involvement with the project changed over time?

B. Lessons Learned

My next questions are about your perspective on the impact of the Northwest Ductless Heat Pump Project on your utility as well as its impact on the general DHP market.

B1. What DHP tools or support has the NW DHP Project provided for your utility? *[Probe for marketing support, assistance with promotions or contractor training, training resources support/development, meetings or updates on market opportunities]*

1. What tools or support that stand out as having been particularly helpful?
2. What tools or support, if any, were not particularly helpful or could have been more helpful? *[probe for specifics] [Follow up if needed, were the tools or support unhelpful for the utility or for the market transformation?]*

B2. What activities or market conditions in the NW region have been most impactful driving adoption of DHP technology in the Northwest? *[Probe for activities or conditions from within and outside of NEEA]*

B3. Thinking about the NW DHP Project since 2008, where do you think NEEA has had the most impact on the adoption of DHPs in the NW? *Why do you say that? [Probe if needed: retail engagement (aimed at increasing DHP access and affordability), consumer awareness, installer engagement and training, persuading distributors to stock DHPs, persuading manufacturers to invest in the northwest]*

1. What NEEA interventions and activities have been most successful? Least successful?

C. Market Barriers

C1. What do you currently see as the primary barriers to increased sales of DHPs in the NW? *[Probe for: lack of customer awareness, cost/limited financing options, limited product availability, unclear supply chain value proposition, lack of installer training opportunities/knowledge, unpredictable performance and savings]*

1. How have the barriers to sales and installation of DHPs evolved over time (i.e. since the NW DHP Project launched 2008)?

C2. What opportunities remain for increasing sales and installations of DHP equipment in the region?

D. Market Progress

Next, I'd like to ask you a few questions about your perspective on how the DHP market has evolved/progressed over time.

As you may be aware, in October of 2018, NEEA fielded a brief survey of DHP workgroup members regarding their perspective on the extent to which the DHP initiative had achieved its market progress indicators (i.e. the outcomes that the initiative tracks to assess how the market for DHPs is progressing) and how important achievement of these outcomes is for NEEA to make a successful transition out of the market.

The NW DHP Project currently tracks several MPIs, including:

- Strong supply chain adoption

- Number of competent installers increases and new DHP focused business
- Utility programs supports DHPs
- Strong supply chain and retailer marketing presence
- Market competition improves
- DHP availability improves
- Increased consumer demand
- DHPs are affordable

Eleven utilities responded to NEEA's survey and indicated that:

- DHPs are widely available in the NW, have strong supply chain adoption, and the market is competitive
- Ensuring quality installations, increasing consumer demand, and helping to lower the cost of DHP are areas that need may need continued intervention.
    - There was consensus among respondents that a high rate of quality installations is important for a successful transition
    - Opinions as to whether single-head DHPs are affordable to target market consumers, varied, but most indicated that DHP affordability is a very important condition

D1. To what extent do you agree or disagree with these assessments?

1. To what extent do you agree or disagree that DHPs are widely available in the NW, have strong supply chain adoption, and the market is competitive? *Why do you say that?*
    a. What activities or market forces have been most impactful in driving these outcomes?
2. To what extent do you agree or disagree that the following areas may need continued intervention: *[Probe for each: Why do you say that?]*
    a. Ensuring quality installation
    b. Increasing consumer demand, and
    c. Helping to lower the cost of DHPs are areas that may need continued intervention?
        i. What work still needs to be done to ensure quality installation? To increase consumer demand? To lower costs of DHPs?

D2. Are there other areas that need continued market intervention? *If yes, what are they?*

E. Risk Assessment

As I mentioned earlier, NEEA is evaluating readiness to transition out of the DHP market.

E1. Without support of the NW DHP Project, do you think that the market for DHPs in the NW will continue to grow at the same rate, more slowly, or more quickly? *Why?*

1. What might stall market growth moving forward?

E2. What risks do you think there are of NEEA exiting the market? *[Probe for risks to the market overall and specifically to supply chain actors (manufacturers/distributors), utilities, and consumers]*
   1. What might indicate/signal that the DHP market is slowing down?

F. Future of Program Offerings and Incentives

F1. Do you expect your 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.] Why do you think this is likely to happen?*

F2. Are DHPs currently a high priority measure for your utility/organization? *Why do you say that? [Probe for high energy savings, customer preference and satisfaction, high use rate for rebates, beneficial installer relationships?]*
   1. What is your organization's long-term vision for DHPs? Will DHPs be a high priority measure in the next few years?

F3. Do you have an expected time frame for when your utility/organization will no longer offer DHP incentives?

G. Closing

G1. Are there any other thoughts would you like to share regarding the NW DHP Project or the regional DHP market?

This completes our interview. Your responses are very important to NEEA. We appreciate your participation and thank you for your time.

Supply Chain Interview Guide

Research Objective	Question Number
Document supply chain marketing, promotional activities and level of investment	B1-B5
Assess key barriers to market adoption and how these have evolved over time	C1-C3
Gauge distributor and manufacturer's perspective on impact of the NW DHP Project on the supply chain	D1-D3
Document lessons learned from the Initiative, including most and least successful interventions and activities/conditions (within or outside NEEA) most impactful to the initiative results	E1-B3
Understand supply chain perspective on potential risks to the market of NEEA transition to LTMT	E1-E2

A. Introduction/Background

To start, to provide some context for our discussion, I'd like to hear about your role at your company and your involvement with the NW DHP Project.

A1. Please tell me a little bit about your role at your company.

A2. What involvement have you had with the NW DHP Project?

1. When did your utility/organization start working with the NW DHP project?
2. How long have you been working with the project?
3. How has your company's involvement with the project changed over time? How has your involvement with the project changed over time?

B. DHP Marketing and Promotion

Next, I'd like to ask you a few questions about your company's sales and promotion of DHPs.

B1. 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?*

B2. How do you typically promote and merchandise DHP equipment? *[Probe for specific promotional events]*
   1. How, if at all, has this changed over the last two years? Five years? Ten years? *Why?*

B3. Have your DHP promotion efforts increased, decreased, or stayed the same over the last two years? *[Probe: How much would you estimate those efforts have increased/decreased (a rough estimate is fine)*
   1. What are your reasons for increasing/decreasing promotional efforts?

B4. How much effort does your company put into marketing DHP equipment in comparison to the other equipment it sells?
   1. How has this changed over the last two years? five years? Ten years?

B5. Do you anticipate any changes to how DHP equipment is marketed in the future? *Why do you say that?*
   1. Do you anticipate your company's investment in DHP marketing and promotion will increase, decrease, or stay in the same over the next two years? Five years? Ten years? *Why do you say that?*

C. Market Barriers

Now, I'd like to discuss opportunities and barriers to increased sales and installation of DHP equipment in the NW.

C1. What are the primary barriers to increased sales of DHPs in the NW? *[Probe for the following barriers: lack of customer awareness, cost/limited financing options, limited product availability, unclear supply chain value proposition, lack of installer training opportunities/knowledge, inadequate test procedures]*
   1. *[If not mentioned]* How much of a barrier would you say DHP costs to the consumer are to increasing DHP sales? *Why?*
      a. What opportunities, if any, do you see for reducing DHP cost to the consumer? What about opportunities to help reduce the costs associated with DHP installation?
      b. Regarding moderate income earners, do you feel like DHP cost is or isn't a barrier? Why do you say that?

C2. How have the barriers to sales of DHPs evolved over time (i.e. since the NW DHP Project launched in 2008)?
   1. What activities or market forces were most impactful in mitigating these barriers?

C3. How have the barriers to installation of DHPs evolved over time (i.e. since the NW DHP Project launched in 2008)?
   1. What activities or market forces were most impactful in mitigating these barriers?

C4. What opportunities remain for increasing sales and installations of DHP equipment?

D. DHP Market Progress

Next I have some questions about how the DHP market and supply chain has evolved over time.

D1. How has the availability of DHPs (to the consumer) in the NW region changed over the past 10 years?

1. How has the availability of trained DHP installers changed over the past 10 years?
2. What factors have been most impactful in increasing DHP availability to the consumer? In increasing availability of trained DHP installers?
3. What impact would you say NEEA has had on DHP availability in the region? *[Probe, if needed: why do you say that? To what actions or activities, specifically, do you attribute that impact?] [Probe: what about on the availability of installers?]*

D2. Is there a part of the NW region that still lacks DHP installers or suppliers?

1. Is there anything you think NEEA can or should do to help to increase availability?

D3. Have you seen a change in the quality of installations in the region over the past 10 years?

D4. How has competition for DHP sales among distributors and/or manufacturers in the NW changed over the past 10 years?

1. Would you say competition has increased? What factors have driven/are driving increasing competition?
2. What impact would you say NEEA has had on competition among DHP suppliers in the region? *[Probe, if appropriate/needed: why do you say that? To what actions or activities, specifically, do you attribute that impact?]*
3. What have been the impacts of increased competition on the supply chain? *On the market? On consumers?*

D5. How has the "appropriate application" for a DHP historically been defined? How has this changed since 2008?

E. Project Activities and Lessons Learned

My next questions are about your perspective on the impact of the NW DHP Project on your company well as its impact on the general DHP market.

E1. What DHP tools or support has the NW DHP Project provided for your company? *[Probe for marketing support, assistance with promotions or contractor training, training resources support/development, meetings or updates on market opportunities]*

1. What tools or support stand out as being particularly helpful?
2. What tools or support, if any, were not particularly helpful or could have been more helpful? *[Probe for specifics]*

E2. What activities or market conditions in the NW region have been most impactful driving adoption of DHP technology in the Northwest? *[Probe for activities or conditions from within and outside of NEEA]*

1. What product features have been most impactful in driving adoption of DHP technology?

E3. Thinking about the NW DHP Project since 2008, where do you think NEEA has had the most impact on the adoption of DHPs in the NW? *Why do you say that? [Probe if needed: retail engagement (aimed at increasing DHP access and affordability), consumer awareness, installer engagement and training, persuading distributors to stock DHPs, persuading manufacturers to invest in the northwest]*

1. What NEEA interventions and activities have been most successful? Least successful?

F. Risk Assessment

F1. Moving forward do you think that the market for DHPs in the NW will continue to grow at the same rate, more slowly, or more quickly *Why?*

1. What might stall market growth moving forward?

F2. What risks do you think there are of NEEA exiting the market? *[Probe for risks to the market overall and specifically to supply chain actors (manufacturers/distributors), utilities, and consumers]*

1. What might indicate/signal that the DHP market is slowing down?

G. Closing

G1. Are there any other thoughts would you like to share regarding the NW DHP Project or the regional DHP market?

This completes our interview. Your responses are very important to NEEA. We appreciate your participation and thank you for your time.

Appendix D. Installer Survey Instrument

Researchable Questions	Question Number
Document current sales in different market segments	C1-C6
Explore installer sales and promotion process for DHPs	D1-D5
Assess DHP equipment and installation costs	E1-E3
Gather firmographic information	F1-F5

AA. Introduction

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?

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. Installations

C1. In the past 12 months, approximately how many residential and commercial DHPs did you install (this includes installations in the residential, multifamily, and commercial applications)? Your best estimate is fine.

Sector	Description	Number of 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]

C2. Of the [INSERT NUMBER FROM C1a] residential DHP installations you performed in the past 12 months, 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]

C3. *Of the [INSERT NUMBER FROM C1a] residential DHP installations you performed in the past 12 months, approximately how many were **cold climate DHPs**?

Cold climate DHPs are designed to operate efficiently at colder temperatures. Units suitable for colder climates typically meet the following criteria:

- Include a variable capacity compressor
- Have a minimum capacity of 80% at 5 degrees Fahrenheit
- Are rated HSPF ≥ 10.0
- Have a coefficient of performance (or COP) greater than or equal to 1.75 at 5 degrees Fahrenheit at maximum capacity

1. [RECORD NUMBER]

C4. Of the [INSERT NUMBER FROM C1a] residential DHP installations you performed in the past 12 months, 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 the past 12 months **that did NOT receive a utility rebate.** We define residential as single family, multifamily, or manufactured homes.

C5. Of the [INSERT NUMBER FROM C1a] residential DHP installations you performed in the past 12 months 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]
Single-Family	b. Single-Family Additions	Newly heated areas of single-family home – like new additions, garages or bonus room with no space conditioning	[RECORD NUMBER]
	c. Single-Family Retrofit	Retrofit to replace/displace existing equipment in primary living space	[RECORD NUMBER]
Multifamily	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]
Other			[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]

C6. You indicated that you installed [INSERT NUMBER FROM C5] 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 C5.c]**	**[INSERT NUMBER FROM C5.d]**	**[INSERT NUMEBR FROM C5.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. Wood or pellet heat	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]
e. Other (e.g. oil, kerosene))	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]	[RECORD PERCENTAGE]

D. *DHP Promotion and Sales*

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

D1. How often do you recommend DHPs to customers with electric heat?

Always (5)	Often (4)	Sometimes (3)	Rarely (2)	Never (1)

D2. *[ASK IF D1=2 OR 1] What are the main reasons you [D1 RESPONSE] recommend DHPs to customers with electric heat?

1. [OPEN RESPONSE]

D3. In the last two years, what, if anything, have you changed with respect to how you promote and merchandise DHPs?

1. [OPEN RESPONSE]

D4. In the past 12 months, 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]

[Ask if D4>0]

D5. How does this percentage of customers specifically asking for DHPs compare to prior years?
1. A higher percentage specifically requested a DHP in the past 12 months compared to prior years
2. A lower percentage specifically requested a DHP in the past 12 months
3. Approximately the same percentage specifically requested a DHP in the past 12 months compared to prior years

E. Installation Cost

E1. 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]

E2. For the $[INSERT RESPONSE FROM E1] equipment and labor costs, what is the typical cost break down for the following components?

Cost Components	Average Cost ($)
a. Equipment and materials (i.e. box/unit with single-head, as well as ancillary equipment such as the padmount, brackets, and lineset)	[RECORD NUMBER]
b. Labor and equipment associated with electrical work	[RECORD NUMBER]
c. Labor associated with installation	[RECORD NUMBER]
d. Labor associated with permitting/paperwork	[RECORD NUMBER]
e. Labor associated with inspection	[RECORD NUMBER]
f. Other	[RECORD NUMBER]

E3. [ASK IF E2.f>0] You indicated that $[INSERT NUMBER FROM E2.f] was associated with other costs. What is included in those other costs?
1. [OPEN RESPONSE]

F. *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.

F1. 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]

F2. 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]

[SKIP IF F2=16]

F3. Are you planning to add any other DHP brands in the next 12 months?

1. Yes
2. No

[IF F3 = 1]

F4. 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]

F5. How many locations does your company have in the Northwest?

1. [RECORD NUMBER]

F6. 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]

[END OF SURVEY MESSAGE]

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