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# Ductless Heat Pumps 2020 Long-Term Monitoring and Tracking Report

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### 1. Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) actively promoted Ductless Heat Pumps (DHPs) installations from 2008 to 2020 via its Northwest Ductless Heat Pump Project. In late 2020, NEEA transitioned from active market development to long-term monitoring and tracking (LTMT).

NEEA assesses the progress of market transformation in the residential Heating, Ventilation, and Air Conditioning (HVAC) market towards DHP adoption by tracking four Diffusion Indicators, which use data from multiple sources:

- **Diffusion Indicator 1**. The number of DHPs installed in single-family homes to displace/replace electric zonal heat or electric forced air furnaces is increasing.
- **Diffusion Indicator 2**. The installed cost for a single-head system remains constant or decreases.
- **Diffusion Indicator 3**. The share of regional HVAC companies/installers offering DHPs remains constant or is increasing.
- **Diffusion Indicator 4**. The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.

The current study determines the status of each of the four Diffusion Indicators during 2020. In addition to the residential HVAC market overall, NEEA is tracking residential single-head DHP installations across three specific target markets:

- TM1. Single-family homes with zonal heating (SF Zonal)
- TM2. Single-family homes with electric forced air furnace (SF eFAF)
- TM3. Manufactured homes with electric forced air furnace (MH eFAF)

The Johnson Consulting Group team was hired to evaluate progress on the four Diffusion Indicators by conducting an independent review of NEEA's data sources and market estimates and surveying HVAC contractors. We completed three surveys of HVAC contractors to determine DHP installation trends across NEEA's three target markets for DHPs, quantify overall installation costs, and determine the presence of HVAC contractors currently installing units throughout the Northwest. In addition, we completed a limited literature review which focused on HVAC sales trends in 2020 and the potential ramifications of the COVID-19 pandemic.

NEEA conducts LTMT studies for many years to monitor the market for signs of continued diffusion of the product or practice. This first year of DHP LTMT coincided with significant disruptions to the supply chain due to the COVID-19 pandemic, the full extent of which is not known and was outside the narrow scope of an LTMT study. Results from successive LTMT studies will be critical to shaping NEEA's understanding of market diffusion for DHPs.

### Key Takeaways

In 2020, we examined data regarding the market transformation of the DHP residential market from multiple perspectives. These analyses included reviewing NEEA's modeling of current market estimates, and collecting data directly from Heating, Air Conditioning and Ventilation (HVAC) contractors specializing in DHP installations in the Northwest. Unfortunately, none of these data sources indicated that the DHP market met the criteria for each Diffusion Indicator. These findings suggest that the DHP market did not expand into NEEA's three target market segments. However, additional data sources suggest that the overall residential DHP market is continuing to be transformed. These data sources suggest growth may have continued in the overall DHP market despite a turbulent year of supply chain and economic disruptions from the global COVID-19 pandemic.

Table E-1 summarizes our overall findings regarding the status of each Diffusion Indicator, based on our review and analysis of each data source.

Diffusion Indicator	Status in 2020		
1: The number of DHPs installed in single-family homes to displace/replace electric zonal heat or electric forced air furnaces is increasing.	<b>Mixed</b> Multiple data sources confirmed that DHP installations remained constant or <i>declined</i> for SF Zonal locations (TM 1) But data also suggest that DHP installations are growing in other sectors in the residential market, including: SF eFAF (TM 2) and MH eFAF (TM 3).		
2: The installed cost for a single- head system remains constant or decreases.	Did Not Meet Overall, average installed costs <i>increased</i> by 10% in 2020 compared to 2019. Equipment costs declined by 1%, while labor costs increased by 25% compared to 2019.		
3: The share of regional HVAC companies/installers offering DHPs remains constant or is increasing.	<b>Did Not Meet</b> The number of HVAC companies/installers installing DHPs in NEEA's region declined by 12 percentage points compared to 2019.		
4: The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.	Mixed The number of counties with DHP installers decreased by 13 percentage points across NEEA's region from 2019 to 2020. However, the DHP contractor survey confirmed that at least one contractor serves every county in NEEA's region.		

#### Table E-1: 2020 Status of DHP Diffusion Indicators

Our research and analysis provided additional insight regarding the status of each Diffusion Indicator, which is summarized next.

# • NEEA's current three target markets do not fully capture the overall changes occurring in the total residential DHP market.

- DHP contractors reported that installations in single-family new construction/addons accounted for 12% of their 2020 installations.
- More than one-half (57%) of contractors surveyed indicated that the percentage of customers asking for a DHP system had increased compared to the previous year. In comparison, one-third (35%) responded that the percentage of customer requests had "stayed the same."
- A recent study from Bonneville Power Administration (BPA) indicated a marked increase in online sales<sup>1</sup> of DHP installations, which may not be captured in distributor interviews or data tracking.<sup>2</sup>
- There has been an increase in "mix and match" configurations with outdoor DHP units combined with "new indoor configurations"<sup>3</sup> that may also mask the total number of residential DHP installations.
- Data from Heating, Air Conditioning, and Refrigeration Distributors International (HARDI)<sup>4</sup> suggested a trend towards larger DHP installations, which would affect the overall cost of these units and suggest that customers are expanding the capabilities of DHPs beyond zonal heating.
- The long-term effects of the COVID-19 pandemic on DHP residential sales are still unknown. The three surveys completed for this study indicated that the number of HVAC contractors who install DHP units declined markedly compared to 2019. Our literature review further supports this finding, as Washington State faced unprecedented levels of business closures compared to the rest of the United States<sup>5</sup>. However, the most recent sales data from AHRI and HARDI suggested HVAC sales remained strong throughout 2020.<sup>6</sup> These findings indicate that although some DHP contractors closed their businesses, there is still a demand for residential DHPs in the Northwest.

<sup>&</sup>lt;sup>1</sup> Bonneville Power Administration (BPA) Summer Learning Series HVAC Market Research, 1 of 3. June 2, 2021. Slide 14. <u>https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/060221</u>

<sup>&</sup>lt;u>BPA\_Summer\_Learning\_Series\_HVAC\_Market\_Research.pptx</u>, Slide 14. <<Accessed July 12, 2021>> <sup>2</sup> Ibid, Slide 12.

<sup>&</sup>lt;sup>3</sup> Ibid, Slide 11.

<sup>&</sup>lt;sup>4</sup> D+R International with HARDI, "2020 and Q1 2021 *Annual Unitary Market in Review*," June 15<sup>th</sup> and June 29th, 2021, Slides 16-17. (<u>HARDI Unitary Market Webinar Presentation</u>) <<Accessed July 1, 2021>>

<sup>&</sup>lt;sup>5</sup> <u>https://www.thecentersquare.com/washington/shutdowns-closed-27-of-washington-businesses-and-more-could-close-for-good/article\_b8929fd2-4326-11eb-9a6b-7b6364eecf00.html</u> <<Accessed June 28, 2021>>

<sup>&</sup>lt;sup>6</sup> <u>https://www.bpa.gov/EE/Utility/Momentum-</u> Savings/Documents/060221 BPA Summer Learning Series HVAC Market Research.pptx

#### **Recommendations**

The research findings led to the following recommendations:

- Given the market uncertainty associated with the COVID-19 pandemic and ongoing supply chain disruptions, NEEA should repeat the complete LTMT study, including all three of the contractor surveys conducted as part of this report, in 2022.
- NEEA should review its current tracking methods and assess if it wants to account for the changes in the DHP market in the Northwest. Specifically, NEEA should determine *if* it wants to expand its modeling to fully capture other market changes such as: new equipment configurations that are appearing due to "mix and match" systems, the increasing influence of online sales, and the trend towards larger DHP installations.
- NEEA should continue to work proactively with its utility partners to encourage a more robust completion of average DHP cost information into the Local Programs Survey. This survey provides valuable information about the current DHP programs and average installed program costs data which are critical to assess the progress of Diffusion Indicators 1 and 2.
- NEEA should work with trade associations, such as HARDI, to supplement or replace the installation data that will be no longer available from its former implementer. These data are used to assess progress related to Diffusion Indicators 1 and 2.
- NEEA should continue to refine and update its Sample Frame of HVAC contractors in the region. These data are used to monitor progress for Diffusion Indicator 4.

### 2. Introduction

Between 2008 and 2020, the Northwest Energy Efficiency Alliance (NEEA), through its utility partners, made substantial investments in promoting Ductless Heat Pump (DHP) installations. According to the program's final Market Progress Evaluation Report<sup>7</sup>, these market interventions paid off, with more than 100,000 DHP installations since 2008. NEEA formally began its DHP program in 2008 with a large-scale pilot project that supported roughly 5,000 DHP installations across the Northwest.

#### What is a Ductless Heat Pump?

This type of heating system, also known as a ductless minisplit, does not rely on ducts for transferring heat. DHPs provide heating and cooling.

The program's overall goal was to displace inefficient electric heating (such as baseboard heaters and inefficient electric forced-air furnaces) from single-family homes. By 2018, more than 101,000 DHPs had been installed in NEEA's target markets with more than 82,000 receiving a rebate from a NEEA partner utility company. The program trained over 1,200 HVAC installers, including 219 installers who earned Master Installer certification.

Previous NEEA research<sup>8</sup> identified the many benefits this heat pump technology offers customers including:

- Substantial energy and cost savings;
- Cooling capacity;
- Quiet operation;
- Potential to provide greater comfort compared to baseboard heating;
- Limited maintenance requirements;
- Easier to install compared to traditional ducted systems; and
- Zonal control of heating.

By 2018, most consumers in the Northwest were aware of DHPs as a residential heating and cooling option and demand for DHPs had continued to grow despite rising prices. Previous research and eight Market Progress Evaluation Reports (MPERs) suggested the DHP market in the Northwest had transformed sufficiently enough that NEEA could transition its DHP program into long-term monitoring and tracking (LTMT), and that the diffusion of DHPs will continue within the residential market without ongoing intervention from NEEA.

NEEA's LTMT studies gauge market transformation after the market intervention phase of NEEA market transformation programs have ended. They do this by assessing the status of Diffusion Indicators, each of which provides a different measurement of how a market is transforming towards adopting a new product or practice. NEEA determines diffusion is continuing only when the preponderance of evidence from the Diffusion Indicators suggests so. Diffusion Indicators are developed collaboratively by NEEA staff and external evaluators as part of a program's final market progress evaluation. A given program's final program evaluation report defines primary Diffusion Indicators to be assessed every year or every other year, as well as secondary Diffusion Indicators to assess if market transformation does not appear to be continuing by the third year of LTMT (or later, if market transformation begins to backslide). The

<sup>&</sup>lt;sup>7</sup> Cadmus, 2019. "*Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #8*, (MPER #8), Prepared for NEEA. November 19. p. 1. <u>https://neea.org/img/documents/Northwest-</u> <u>Ductless-Heat-Pump-Initiative-Market-Progress-Evaluation-8.pdf</u> <<Accessed July 1, 2021>>

<sup>&</sup>lt;sup>8</sup> Ibid, pp. A-10 - A-11.

final program evaluation report provides an LTMT evaluation plan mapping the data sources and relevant analyses to conduct for the primary and secondary Diffusion Indicators.

For DHPs, Market Progress Evaluation Report #8<sup>1</sup> (MPER #8) is the source of the LTMT evaluation plan and Diffusion Indicators. In addition to summing up the status of each Diffusion Indicator, LTMT studies provide data NEEA market analysts will use to update the alliance's models and estimates. The primary Diffusion Indicators for DHPs are:

- 1. **Diffusion Indicator 1**. The number of DHPs installed in single-family homes to displace/replace electric zonal heat or electric forced air furnaces is increasing.
- 2 **Diffusion Indicator 2.** The installed cost for a single-head system remains constant or decreases.
- 3 **Diffusion Indicator 3.** The share of regional HVAC companies/installers offering DHPs remains constant or is increasing.
- 4 **Diffusion Indicator 4**. The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.

NEEA expects that diffusion of the new product or practice will occur across narrowly defined target markets. In the case of DHPs, the target markets are:

- TM1. Single-family homes with zonal heating (SF Zonal);
- TM2. Single-family homes with electric forced air furnace (SF eFAF); and,
- TM3. Manufactured homes with electric forced air furnace (MH eFAF).

LTMT studies may also include data and analyses of additional markets to the extent that they provide useful context for understanding trends in the target markets.

NEEA conducts LTMT studies for many years to monitor the market for signs of continued diffusion of the product or practice. This first year of DHP LTMT coincided with major disruptions to the supply chain due to the COVID-19 pandemic, the full extent of which is not known and was outside the narrow scope of an LTMT study. Results from successive LTMT studies will be critical to shaping our understanding of market diffusion of DHPs.

The Johnson Consulting Group team completed several primary and secondary research activities designed to assess the overall progress of four Diffusion Indicators which NEEA established. This study's overall goal was to determine if diffusion of DHPs into the three market markets is continuing, or if it is stalling or backsliding. This is the first LTMT study of the DHP market, and its progress will be monitored by tracking the four Diffusion Indicators over time. Because the report draws from different data sources, each with unique sample sizes, strengths, and limitations, we present the evidence for each Diffusion Indicator by data source, followed by a summary of key takeaways that triangulates across the data sources.

### 3. Methodology

Our research methodology relied on the "preponderance of evidence" approach since no single data source can fully assess the progress for each Diffusion Indicator. Table 1 defines each Diffusion Indicator and identifies the data sources used to assess each factor. We describe each data source in detail following the table.

Diffusion Indicator	Data Sources	
<ol> <li>The number of DHPs installed in single-family homes to displace/replace electric zonal heat or electric forced air furnaces is increasing.</li> </ol>	<ol> <li>DHP Contractor Survey</li> <li>MPER #8 Installer Survey Data</li> <li>NEEA Local Programs Survey</li> </ol>	
2. The installed cost for a single-head system remains constant or decreases	<ol> <li>DHP Contractor Survey</li> <li>MPER #8 Installer Survey Data</li> <li>Local Programs Survey</li> </ol>	
3. The share of regional HVAC companies/installers offering DHPs remains constant or is increasing	<ol> <li>DHP Contractor Survey</li> <li>State HVAC Contractor Call-Down Survey</li> </ol>	
4. The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.	<ol> <li>DHP Contractor Survey</li> <li>County HVAC Contractor Call-Down Survey</li> </ol>	

#### Table 1: DHP Diffusion Indicators and Primary Data Sources

The main data sources for this study are:

- DHP Contractor Survey: We fielded a telephone survey from March to April 2021. The survey yielded a total of 228 completes, starting with an original overall sample size of 2,296 records. Where possible, we used the same survey questions as the MPER #8 Installer Survey (see below) to facilitate data comparisons across multiple years. However, this survey focused primarily on gathering data regarding non-incented DHP installations in NEEA's three target markets and did not provide any information regarding the number of incented DHP installations in 2020.
- 2. MPER #8 Installer Survey: MPER #8, published in 2019, included a survey with data gathered from 87 DHP installers based on installations completed in 2018. This survey collected information regarding DHP installation trends across target markets and heating zones but did not provide analysis regarding installation rates by state. This dataset also reported installation rates for both incented and non-incented installations by heating zone and target market. The present report includes data from MPER #8 to provide year-over-year comparisons.
- 3. NEEA Local Programs Survey: These data are collected from NEEA funders on the DHP units claimed through their incentive programs. This is primarily collected to ensure NEEA avoids double counting any savings when reporting to funders. This dataset also summarizes the local program units by climate zones by mapping the incented units to climate zones using customer counts by climate zone for each utility. The dataset included unit counts from 15 funders. Average installation costs were reported by six of the 15 funders.

- 4. State HVAC Contractor Call-Down Survey: The Johnson Consulting Group team completed an additional telephone survey (n=60) to identify the share of HVAC contractors who sell DHPs across NEEA's four-state region. We used the sampling frame from the DHP Contractor Survey, after eliminating all ineligible contractors. Our sample size of 600 records was randomly drawn and proportionate with each state's known population of residential HVAC contractors. We completed this survey in May 2020.
- 5. County HVAC Contractor Call-Down Survey: Through our previous survey efforts, we were able to confirm the physical presence of DHP contractors in 99 counties in NEEA's four-state territory. We conducted an internet search followed by a telephone survey to HVAC contractors in the remaining 63 counties. The call-down survey asked these contractors (n=187) if they install DHPs and in which counties.

The original LTMT evaluation plan included data from NEEA and Bonneville Power Administration's (BPA) jointly collected and analyzed HVAC Distributor Data to provide information about the residential HVAC market overall. NEEA was unable to obtain 2020 HVAC Distributor Data in time for inclusion in this report. As a substitute, the research team used available secondary data sources. Secondary sources included two technical analyses focusing on the DHP market from the Heating Air-conditioning and Refrigeration Distributors International (HARDI) and BPA's 2019 HVAC Distributor Data analyses. In addition, the team conducted a brief literature review summarizing the COVID-19 impacts on HVAC sales and business operations in the Northwest. Finally, NEEA market analysts provided their Current Estimates, which model market adoption using prior years' HVAC Distributor Data, Local Programs Survey data, and assumptions made from Market Progress Evaluation Reports, which are included as a supplemental appendix. Appendices A-J provide additional details regarding each data source and the analyses we used to monitor the progress of the DHP market, relative to the four Diffusion Indicators.

### 4. Diffusion Indicator 1 Findings

Diffusion Indicator 1: The number of DHPs installed in single-family homes to displace/replace electric zonal heat or electric forced air furnaces is increasing.

### 4.1 DHP Contractor Survey Findings

The DHP Contractor Survey provided insights regarding current installation practices for DHP installers operating in the four states serviced by NEEA's funders. As Figure 1 shows, the 228 DHP contractors survey represented all four states.<sup>9</sup>



#### Figure 1: Distribution of Surveyed DHP Contractors by State

Source: DHP Contractor Survey

To ensure a sufficient sample size from DHP contractors in Idaho and Montana, the DHP survey over-sampled contractors in Idaho and Montana. Table 2 compares the distribution of DHP contractors by state to the state's overall population.

|--|

US Census <sup>10</sup>	2020	% of Total in Region	% of DHP Represented in Survey (n=228)
Idaho	1,839,106	12%	21%
Montana	1,084,225	7%	21%
Oregon	4,237,256	28%	29%
Washington	7,796,941	52%	29%
Total	14,957,528	100%	100%

 <sup>&</sup>lt;sup>9</sup> Please refer to Appendix B for a full description of the proportional sampling strategy we used.
 We over-sampled contractors in Idaho and Montana to increase the overall confidence and precision for our survey responses.
 <sup>10</sup> U.S. 2020 Census Results

#### 4.1.1 Overall Findings

Each of the 228 surveyed contractors estimated the number of residential DHPs they had installed in the preceding 12 months. Contractors reported a total of 11,246 installations across the four states. Most installations were in Oregon (45%) and Washington (33%) (see Figure 2).



Figure 2: DHP Contractor-Reported Total Number of Residential DHP Installations by State

Notably, the DHP installations in Montana represented a larger percentage of reported installations (12%) compared to the actual population distribution (7%) of the state.<sup>11</sup>

#### 4.1.2 Incented vs. Non-Incented Installations

The DHP contractors also estimated the *total* number of residential DHP units installed both with and without a utility incentive.

As Figure 3 shows, the installation rates of incented vs. non-incented DHPs did not vary substantially within each state. Overall, non-incented installations accounted for 53% of these contractors' installations while 47% of the DHP installations received incentives.

Source: DHP Contractor Survey

QC1: the past 12 months, approximately how many residential DHPs did you install?

<sup>&</sup>lt;sup>11</sup> Note, MPER #8 did not report out total residential installations by state.

## Figure 3: DHP Contractor-Reported Incented and Non-Incented Residential DHP Installations by State



Source: DHP Contractor Survey

QC4. Of the number residential DHP installations you completed in the past 12 months; approximately how many **did NOT receive** a utility rebate?

#### 4.1.3 Target Markets

The DHP contractors also provided estimates of *non-incented* DHP installations by residential target market. For reference, NEEA defines the DHP target markets are as follows:

- **TM1**. Single-family homes with zonal heating (SF Zonal)
- TM2. Single-family homes with electric forced air furnace (SF eFAF)
- TM3. Manufactured homes with electric forced air furnace (MH eFAF)

Overall, the DHP contractors estimated that they installed a total 5,641 residential units without incentives. However, only 2,001 (35%) were installed in NEEA's three target markets. Another 695 units (12%) were installed in residential new construction, including new additions to existing homes. These data are summarized in Table 3.

Based on the DHP Contractor Survey, slightly less than one-quarter (21%) of the non-incented residential DHP units were installed in SF Zonal while the other target markets had installation rates of 11% for SF eFAF and 2% for MH eFAF units.

State	Non-Incented Total	NEEA's Target Markets			
		SF Zonal (QC5)	SF eFAF (QC5a2)	MH eFAF (QC5b2)	
ID	206	182	14	10	
MT	98	83	15	0	
OR	624	345	236	43	
WA	378	200	141	37	
Total	1,306	810	406	90	

#### Table 3: DHP Contractor-Estimated Non-Incented Residential DHP Installations by Target Market

Source: DHP Contractor Survey

QC5. Of the {NUMBER} residential DHP installations you completed in the past 12 months that did not receive a utility rebate, please tell me how many were installed in single-family retrofits excluding any new construction? QC5a1. About how many of those {NUMBER} replaced Electric resistance zonal heat such as baseboards, cadet-style, and ceiling cable?

QC5a2. About how many of those {NUMBER} replaced electric forced air furnaces? QC6. Of the {NUMBER} residential DHP installations please tell me how many were installed in garages, bonus rooms, or attics that added heating to previously unheated spaces that are not primary living areas?

QC5b. Of the {NUMBER} residential DHP installations you completed in the past 12 months that did not receive a utility rebate, please tell me how many were installed in manufactured housing

Table 4 compares the Year-Over-Year contractor estimates from 2018 and 2020. Non-incented installations in SF Zonal (TM 1) and MH eFAF (TM 3) declined (i.e., 6% and 2%, respectively), while they increased in SF eFAF (TM 2).

#### Table 4: Year-Over-Year Comparison of Non-Incented DHP Installations 2018-2020

2018		2020			
ТМ	MPER #8 Number Installed	% of Total DHP Installations	DHP Contractor Survey Number Installed	% of Total DHP Installations	Year-Over- Year % Point Change
TM1. SF Zonal	249	68%	810	62%	-6%
TM2. SF eFAF	83	23%	406	31%	8%
TM3. MH eFAF	33	9%	90	7%	-2%
Total	365	100%	1,306	100%	N/A

#### 4.1.4 Heating Zone (HZ)

The Johnson Consulting team aligned the responses regarding DHP residential installations to heating zone based on the contractor's primary location. Figure 4 illustrates the distribution of the total number of estimated DHP installations (N=11,246) by Heating Zone (HZ).



# Figure 4: DHP Contractor-Estimated Number of Total Residential DHP Installations by HZ

Source: DHP Contractor Survey

Table 5 compares the distribution of the actual population within NEEA's three HZs to the distribution of the installations reported by the DHP contractors in the 2021 survey. The DHP Contractor Survey slightly under-sampled HZ 1 (i.e., 72% compared to 76%) and over-sampled HZ 3 (i.e., 11% compared to 6%).

#### Table 5: Comparison of Population to DHP Contractor Survey Distribution by HZ

HZ	Total Population	% Total	% Distribution in Contractor Survey
1	20,225,006	76%	72%
2	4,330,666	17%	17%
3	1,511,727	6%	11%
Total	26,067,399	99%	100%

Source: NEEA Internal Analysis

Note: <100% because of rounding.

Table 6 compares the estimates of DHP installations across HZ by incentive status. As this table shows, 47% these installations received an incentive, according to the surveyed contractors.<sup>12</sup>

<sup>&</sup>lt;sup>12</sup> Note MPER #8 did not provide data about incented DHP installations by Heating Zone.

## Table 6: DHP Contractor-Estimated Incented vs. Non-Incented Residential DHP Installations by HZ

Heating Zone	Incented	Non-Incented	Total
1	3,851	4,271	8,122
2	910	1,027	1,937
3	548	639	1,187
Total	5,309	5,937	11,246

Source: DHP Contractor Survey

#### 4.1.5 Non-Incented DHP Installations

The DHP contractors also estimated the number of non-incented installations they completed during 2020 by target market. Unsurprisingly, the more populous HZs also had the highest number of installations. As Table 7 shows, HZ 1 accounted for most installations across all three target markets with the highest installation rates in SF Zonal. In contrast, HZ 3 had the fewest overall installations, with none for the MH eFAF target market.

## Table 7: DHP Contractor-Estimated Non-Incented Residential DHP Installations by HZ and Target Market

Target Market	HZ 1	HZ 2	HZ 3	Total
TM1. SF Zonal	519	193	98	810
TM2. SF eFAF	312	79	15	406
TM3. MH eFAF	66	24	0	90
Total	897	296	113	1,306

Source: DHP Contractor Survey

Table 8 provides another perspective, indicating that the largest concentration of DHPs are Oregon and Washington within HZ 1. HZ 3 accounts for the fewest installations overall in Idaho and Montana.

#### Table 8: Non-Incented Residential DHP Installations by HZ and State

State	HZ 1	HZ 2	HZ 3	Total
ID	105	227	179	511
MT	0	118	194	312
OR	1,555	34	0	1,589
WA	984	315	0	1,299
Total	2,664	694	373	3,711

Source: NEEA DHP Contractor Survey

Table 9 compares the total reported installation rates from DHP contractors at two specific points in time: 2018 and 2020. As this table shows, the installation rates of DHPs in HZ 2 (9%) and HZ 3 (4%) continued to increase while they declined in HZ 1 (13%)

	2018		2020		
HZ	MPER #8 Number Installed	% of Total	DHP Contractor Survey Number Installed	% of Total	Year-Over-Year % Point Change
1	1,667	85%	8,122	72%	-13%
2	154	8%	1,937	17%	9%
3	132	7%	1,187	11%	4%
Total	1,954	100%	11,246	100%	N/A

#### Table 9: Year-Over-Year Comparison of All DHP Installation Rates by HZ

Source: NEEA DHP Contractor Survey

#### 4.1.6 DHP Installations by Head Configuration

The DHP Contractors provided estimates of the total number of one-to-one or single-zone systems they installed in 2020. However, the contractors were not asked to differentiate between incented vs. non-incented single zone systems.

Table 10 summarizes these contractor estimates by state. As this table shows, the DHP contractors reported higher installation rates of "single head" units in Oregon (22%) and Washington (19%).

State	Number of "Single Head" Installations	% of Total DHP Installations
ID	572	5%
MT	739	7%
OR	2,515	22%
WA	2,111	19%
Total	5,937	52%

Source: DHP Contractor Survey

QC3: Of the number of residential DHP installations you installed in the past 12 months, approximately how many were one-to-one or "single zone" systems; that is, a unit with one outdoor compressor and one indoor unit?

Table 11 illustrates there has been an increase in the proportion of single-head installations in HZ 2 and HZ 3 relative to MPER #8.

	2018		202		
ΗZ	MPER #8 Number Installed	% Single Head Installed**	DHP Contractor Number Installed	% Single Head Installed	Year-Over-Year % Point Change
1	2,413	82%	4,271	72%	-10%
2	341	12%	1,027	17%	5%
3	181	6%	639	11%	5%
Total	2,935	100%	5,937	100%	N/A

#### Table 11: DHP Contractor-Estimated Number of Single Head Installations by HZ

Source: DHP Contractor Survey

\*\*Numbers of installations by HZ were calculated from the installations reported for each HZ in MPER #8.

### 4.1 Local Programs Survey Findings

Another data source providing an estimate of the numbers of installations across the region is the NEEA Local Programs Survey, which collected information from 15 utility funders that incent DHPs. These data are primarily collected to ensure NEEA avoids double-counting any savings when reporting to funders. <u>NEEA conducts the survey annually.</u>

Based on the information from the 15 utility program funders, NEEA estimated that utilities provided incentives for 8,624 DHP unit installations in 2020 (Table 12). This estimate is higher than the DHP installers' estimates by 3,207 units (22%).

Of these installations, 71% displaced zonal heating (TM1). The remaining units displaced electric forced air furnaces, specifically 19% in SF eFAF (TM2) and 11% in MH eFAF (TM3) (see Table 11).

Target Market DHP Installations	Incented	Non-Incented	Total	% of Total
TM1. SF Zonal	5,956	4,288	10,244	71%
TM2. SF eFAF	1,901	788	2,689	19%

753

1,520

11%

Table 12: Local Program Survey Estimates of Target Market DHP Installations in 2020

Source: Local Programs Survey Findings

TM3. MH eFAF

Table 13 summarizes the difference in DHP installation rates by targets from 2019 to 2020.

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#### Table 13: Year-Over -Year Comparisons of DHP Installations Rates by Target Market

Target Market	Local Programs Survey (2019)	Local Programs Survey (2020)	% Point Change
TM1. SF Zonal	7,380	10,244	28%
TM2. SF eFAF	1,083	2,689	60%
TM3. MH eFAF	1,316	1,520	13%
Total	9,779	14,453	N/A

Source: Local Programs Survey Findings

As Table 13 indicates, the proportion of DHP installations increased across all three target markets with the highest percentage of installations occurring in TM 2: SF eFAF (60%)

### 4.4 Key Findings for Diffusion Indicator 1

# Diffusion Indicator 1. The number of DHPs installed in single-family homes to displace/replace electric zonal heat or electric forced air furnaces is increasing.

- The results for Diffusion Indicator 1 are mixed. Contractor estimates of non-incented installations in SF Zonal (TM 1) and MH eFAF (TM 3) declined, while they increased in SF eFAF (TM 2). However, utility counts indicate increases in each target market.
- **Installations rates by HZ are also mixed.** There is evidence to suggest that installation rates are increasing in Heating Zone 2 and 3, but may be declining in Heating Zone 1.
- NEEA's current three target markets do not reflect the overall changes that are occurring in the total residential DHP market. For example, DHP contractors reported that installations in single-family new construction/add-ons, accounted for 12% of their 2020 installations.
- Other market factors, beyond incentives, are driving DHP residential installations. Installation rates of incented vs. non-incented DHPs did not vary substantially within each state. Overall, non-incented installations accounted for 53% of these contractors' installations while 47% of the DHP installations received incentives. However, these findings are only suggestive, and this is an area requiring further investigation.

### 5. Diffusion Indicator 2 Findings

# Diffusion Indicator #2: The installed cost for a single-head system remains constant or decreases.

To identify shifts in the installed costs for a single-head system, we compared costs from two separate sources: the costs reported in MPER 8, and the costs reported in the DHP Contractor Survey. We adjusted the MPER #8 costs from 2018 for inflation to 2020 costs, using Consumer Price Index data for the Western region to provide a nominal comparison of costs. Table 14 summarizes our cost comparison.

Source	Cost in 2020 Dollars	Change from MPER #8	% Change from MPER #8
MPER #8 - Equipment	\$ 2,641.69	N/A	N/A
MPER #8 - Labor	\$ 1,808.85	N/A	N/A
MPER #8 - Total	\$ 4,450.54	N/A	
2020 LTMT - Equipment	\$2,615.00	-\$26.69	-1.0%
2020 LTMT - Labor	\$2,260.00	\$451.15	24.9%
2020 LTMT - Total	\$4,875.00	\$424.46	10%

#### Table 14: Estimated Average DHP Costs for Single-Head Installations, 2018-2020

Source: DHP Contractor Survey

*MPER #8 Source:* 2018 average costs for Equipment (\$2,528) and Labor (\$1,731) have been adjusted for inflation to 2020, using the CPI, West Region, 2019 (2.69%) and 2020 (1.76%)

Furthermore, the Local Programs Survey dataset included the average overall installation cost as reported from six utility programs. The average cost, based on total of 4,459 DHP installations, was \$4,981.00. This new data source will be used in future LTMTs reporting the status of DHP installations.

### 5.1 Key Findings for Diffusion Indicator 2

Although equipment costs declined slightly, increased labor costs caused the overall average cost of single-head DHPs to increase 10%. Therefore, the DHP market did not meet the requirements for Diffusion Indicator 2.

### 6. Diffusion Indicator 3 Findings

# Diffusion Indicator #3: The share of regional HVAC companies/installers offering DHPs remains constant or is increasing.

To determine the status of this Diffusion Indicator, we conducted a call-down survey (State HVAC Contractor Call-Down Survey) of HVAC contractors located in NEEA's funders' service territories. The survey aimed to determine the percentage of HVAC contractors who install DHP units by state and the total percentage of DHP installers (weighted by state population). We first reviewed the results from the DHP Contractor Survey to identify potential counties in which DHP contractors were not serving. After excluding the results from the 228 contractors, we then reviewed the remaining original DHP Contractor Sampling Frame to identify respondents for this specific survey effort. After cleaning the data, we had 1,465 potential HVAC contractors whose current status was undetermined. This list became our recruiting list for the State HVAC Contractor Call-Down Survey. Full details are provided in Appendix D.

Table 15 summarizes our sampling frame and results from this call-down survey. First, we calculated the percentage of HVAC contractors surveyed, by state, who install DHP systems (Unweighted Percentage). We then weighted these percentages using the adjusted population estimates (column 1).

Adding the weighted averages together indicates that the percentage of the HVAC contractor population who install DHP systems overall in 2020 is 84%, a decrease of 12 percentage points from the 2019 estimate in MPER #8 of 96%.<sup>13</sup>

	Adjusted		State	HVAC Contracto	or Call-Down Survey	
State Population Estimate	Sample Frame	Achieved Sample Size	Number Who Install DHPs	Unweighted Percentage of DHP Installers	Weighted Percentage of DHP Installers	
ID	208	100	10	9	90%	13%
МТ	175	100	10	5	50%	6%
OR	408	200	20	19	95%	27%
WA	674	200	20	17	85%	39%
Total	1,465	600	60	50	NA	84%

#### Table 15: HVAC Contractors Who Install DHPs by State

Source: State HVAC Contractor Call-Down Survey

### 6.1 Key Findings for Diffusion Indicator 3

The proportion of HVAC contractors installing DHP units has declined since 2019 by 13 percentage points.

<sup>&</sup>lt;sup>13</sup>Cadmus, 2019. "*Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #8*" (MPER #8). Prepared for NEEA, November 14. pp. 22-23. (<u>https://neea.org/resources/northwest-ductless-heat-pump-initiative-market-progress-evaluation-8</u>)

### 7. Diffusion Indicator 4 Findings

# Diffusion Indicator #4: The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.

### 7.1 County HVAC Contractor Call-Down Survey

The Johnson Consulting Group team conducted a second call-down survey to determine the number of counties within NEEA's region with HVAC contractors who install DHPs physically located within that county. This County Call-Down survey included only counties for which neither the preceding DHP Contractor Survey nor the State HVAC Contractor Call-Down Survey identified a single DHP installer. This review identified 63 counties in which the presence of a DHP installer was unknown.

First, we conducted an internet search to identify all of the HVAC contractors with physical locations in these 63 counties. Our approach was to simply contact each contractor until we could affirmatively determine that they were located in the specific county and did install DHP units.

Based on data provided by NEEA, the alliance's region of 162 counties includes all of Idaho (44 counties), Oregon (36 counties), Washington (39 counties) and the western 43 counties of Montana. The results from our call-down survey determined that 39 counties across the four states *do not have* a confirmed DHP installation contractor physically located within that county. For 32 counties within this designation, we conducted the following steps:

- 1. Identified at least one HVAC contractor who confirmed they do not install DHPs;
- 2. Identified at least one HVAC contractor, left a voice message requesting a call back to confirm whether or not they install DHPs, and did not receive a call back; or
- 3. Identified at least one HVAC contractor and when calling, received a message that the number was out of service.

Finally, for seven counties, we were unable to identify a contractor using any of our sources.

Our county call-down analysis is summarized in Table 16 and Figure 5.

State	Number Counties with Confirmed DHP Installer	Number of Counties Without a DHP Installer	Number of Counties Status Unknown
ID	32	11	1
МТ	25	17	1
OR	33	0	3
WA	33	4	2
Total	123	32	7

#### Table 16: County HVAC Call-Down Survey Disposition

Source: County HVAC Sample Call-Down Survey

We confirmed conclusively that 32 counties do not have a DHP-installer physically located within the county in 2020. This represents a change from 2019, which determined there were a total of 15 counties that did not have a DHP contractor and 13 counties in which the status was unconfirmed.<sup>14</sup>

This finding suggests that the number of counties without a DHP installer has more than doubled from 15 to 32 in 2020. Overall, DHP installers are located in 123 NEEA counties (76%) compared to 134 counties (83%) in 2018. However, the number of "status unknown" counties has been reduced from 13 to seven in 2021.





As discussed more fully in Section 8 of this report, 5% of the businesses listed in the original contact list closed in 2020.

### 7.2 Key Findings for All Surveys

Finally, we tabulated results from all three surveys to arrive at the distribution of DHP installers who *serve* each county, rather than who are physically located in each county. Figure 6 shows the concentration of DHP installation services using a color code. Customers in red counties have access to at least five DHP installers who will install systems in their county, whereas customers in blue counties have access to only one DHP installer. Regardless of the distribution, the map illustrates that all customers within all of NEEA's region have access to at least one DHP installation contractor.

<sup>&</sup>lt;sup>14</sup> Cadmus, 2019. "*Northwest Ductless Heat Pump Initiative: Market Progress Evaluation #8*" (MPER #8). Prepared for NEEA, November 14. p. 20. (<u>https://neea.org/resources/northwest-ductless-heat-pump-initiative-market-progress-evaluation-8</u>)



Figure 6: DHP Installation Contractor Coverage

### 7.3 Key Findings for Diffusion Indicator 4

- The number of counties without a DHP installer has increased from 15 to 32 during the past year. This is an increase of 13 percentage points compared from 2019 to 2021. We reduced the number of "unconfirmed" counties from 13 to seven in 2020.
- All customers within NEEA's region have access to at least one DHP installation contractor.

### 8. Additional Findings

In addition to analyses specific to the four Diffusion Indicators, the research team completed a few additional analyses relevant to DHPs.

### 8.1 DHP Contractor Survey Findings

The 228 DHP contractors answered additional questions regarding their impressions of the overall DHP market in the Northwest. These questions provided further insight into market conditions and identified remaining barriers for residential single-head DHP units, specifically in displacement scenarios.

#### 8.1.1 Market Conditions

A total of 225 DHP installers estimated if the percentage of customers asking for DHPs had changed from the previous year. More than one-half (57%) indicated that the percentage of customers asking for a DHP system had increased compared to the previous year while one-third (35%) responded that the percentage of customer requests had "stayed the same." Just 7% of these DHP contractors indicated that the percentage of customers asking for DHP systems was "lower" compared to the previous year.

These findings were also consistent across all four states (Figure 7).





#### Source: DHP Contractor Survey

The DHP Contractor survey revealed a substantial number of DHP contractors were no longer in business in 2021. The analysis of our DHP contractor survey results indicated that of the original sample frame of 2,068 contractors, 5.03% or 104 establishments either had disconnected numbers or were no longer in business (See Table 17).

Table 17: DHP Contractor Survey-Reported Number of Contractors Out of Business
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Disposition	Total	% of Total Sample (n =2,068)
Disconnected	91	4.40%
Business Closed	13	<1%
Total	104	5.02%

Source: DHP Contractor Survey

#### 8.1.2 Market Barriers

The DHP contractors identified the significant barriers to DHP installations (Figure 8). The most common barrier was initial cost. Of note, 12% did not identify any barriers to DHP installations.

Figure 8:Top Five Barriers to DHP Installations Mentioned by DHP Contractors



These contractors also identified other barriers to DHP installations including houses were too big to accommodate DHP installations (11%) and the need for additional rebates or financing to reduce DHP installation costs (6%).

#### 8.1.3 Contractor Firmographics

All 228 contractors provided additional details about their businesses, which are summarized in the following tables. Most DHP contractors serve multiple markets as Table 18 shows. Contractors provided multiple responses in order to identify all of the markets they serve. Hence, the percentages will not add up to 100.

Table 18: Markets Ser	ved by DHP Contractor	rs Markets Served by	DHP Contractors

In what type of buildings do you install DHPs?	Number Mentioning	Percent Mentioning (n=228)
Residential Single-Family	224	98%
Multifamily Buildings	153	67%
Manufactured Housing	155	68%
Commercial Buildings	184	81%
Other	10	4%

Source: DHP Contractor Survey

The DHP Contractor Survey confirmed that a small number of contractors based primarily in Oregon and Washington also install DHP units in other locations. There was less overlap for contractors located in Idaho and Montana as Table 18 shows.

		Number of Contractors Serving Additional States*				
State	# of Respondents	ID	MT	OR	WA	Total Contractors Serving the State
ID	47		1	2	8	58
MT	47	5				52
OR	67		8		11	86
WA	67		4		15	99
Total	228	5	13	2	34	282

#### Table 18: Number of Contractors Who Serve Multiple States

\*Multiple response question

Source: DHP Contractor Survey

### 8.2 Literature Review of Market Conditions

The 2020 Program Year was unprecedented due to the worldwide pandemic caused by COVID-19. The pandemic created substantial market uncertainty as business operations were paused across the United States. There were also the ripple effects of disruptions in the supply-chain and distribution network for many products.

#### 8.2.1. COVID-19 Impacts

In order to better understand the impacts of COVID-19 on the DHP market in the Northwest, our team conducted a brief, focused literature review. Specifically, we analyzed news reports, economic data, and shipping reports from manufacturers and manufacturer associations.

The literature review revealed contradictory findings regarding COVID-19 impacts on the HVAC market. For example, D+R International collects and analyzes the data collected from the Heating Air-conditioning and Refrigeration Distributors International (HARDI).<sup>15</sup> These sales estimates, summarized in Figure 9, illustrated an increase in overall sales of ductless air source heat pumps nationally.

Of note, sales increased 11.1% in the Western Region, which includes ten western states from Washington to New Mexico, Alaska, and Hawaii. The HARDI data also illustrated an upward trend in non-cooling applications for ASHPs, declining from 9.8% cooling-only applications in 2019 to 8% in 2020. Long-term, the forecasts are for continued double digit growth in DHP installations, primarily because DHPs still comprise a relatively small part of the overall HVAC market.<sup>16</sup>

<sup>&</sup>lt;sup>15</sup> <u>https://hardinet.org/pages/join</u> <Accessed June 30, 2021>>

<sup>&</sup>lt;sup>16</sup> D+R International with HARDI, "2020 and Q1 2021 *Annual Unitary Market in Review*," June 15<sup>th</sup> and June 29th, 2021, Slides 16-17. (<u>HARDI Unitary Market Webinar Presentation</u>) <<Accessed July 1, 2021>>



Figure 9: Ductless ASHP Sales and Growth by Region 2019-2020

Source: HARDI Unitary Market Webinar Presentation, June 2021

The HARDI data analysis also identified a shift from single-head to multi-head units DHPs, as more customers install these systems to provide a "whole home" solution. Figure 10 illustrates this trend to larger DHP installations.<sup>17</sup> Although HARDI's data does not reveal the number of heads, the organization infers that units with larger cooling capacities (e.g., 30,000 or greater BTUs) are likely multi-head (see Figure 10).

<sup>&</sup>lt;sup>17</sup> Ibid, Slide 19. <Accessed June 30, 2021>>



Figure 10: Shifts in DHP Installation Rates by Capacity

Source: HARDI Unitary Market Webinar Presentation, June 2021

BPA confirmed these trends for the Northwest through in-depth interviews with HVAC distributors. The study identified two emerging trends in 2020:

- Changes in the DHP market are not readily detected due to changes in equipment configurations. More customers opt to "mix and match" outdoor DHP units with "new indoor configurations."<sup>18</sup>
- There has also been a notable shift to online sales of DHP systems in 2020, which may or may not directly involve HVAC distributors.<sup>19</sup>

The HVAC contractors also confirmed that BPA's current market estimates of 38,000 DHP installations appear "to be reasonable" to most of these respondents. <sup>20</sup>

Qualitatively, these findings suggest that the DHP market is continuing to evolve in the Northwest. NEEA's current tracking systems may not be capturing these market changes, and thus may not yet detect these changing market conditions.<sup>21</sup>

<sup>&</sup>lt;u>BPA\_Summer\_Learning\_Series\_HVAC\_Market\_Research.pptx</u>, <<Accessed July 12, 2021>> <sup>19</sup> Ibid, Slide 14.

<sup>&</sup>lt;sup>20</sup> Ibid, Slide 27.

<sup>&</sup>lt;sup>21</sup> Ibid, Slide 12

Other reports, including from the U.S. Bureau of Labor Statistics, reported that Washington State reported 27% of its businesses shut down, at least temporarily, in 2020. In addition, the Northwest region experienced high levels of unemployment due to business shutdowns during 2020 caused by mandated COVID-19 closures. This closure rate was higher than the national rate of 19% during the same time period of July to September 2020.<sup>22</sup>

#### 8.2.2 Key Findings from the Literature Review

The DHP market was affected by the COVID-19 pandemic. However, the long-term impacts from the pandemic are still unknown.

- Some contractors may have experienced increased sales during the pandemic.
- As both the U.S. Bureau of Labor Statistics and the DHP Contractor Survey confirmed, other businesses have permanently closed operations.

<sup>&</sup>lt;sup>22</sup> <u>https://www.thecentersquare.com/washington/shutdowns-closed-27-of-washington-</u> <u>businesses-and-more-could-close-for-good/article\_b8929fd2-4326-11eb-9a6b-7b6364eecf00.html</u> <<Accessed June 28, 2021>>

### 9. Discussion and Recommendations

The goal of the LTMT study is to provide a clear indication of the progress of the four Diffusion Indicators in NEEA's region overall and across its three target markets for DHPs. The mixed results suggest the status of the residential DHP market in 2020 may be more nuanced than what is reflected in the four specific Diffusion Indicators.

For example, DHP contractors indicated that overall sales of residential DHPs decreased compared to 2019, but utility reported increases over the same time period. Moreover, the DHP Contractor Survey, NEEA's Current Estimates, and the literature review identified several emerging trends that may not be fully reflected in NEEA's current tracking systems. In particular, there has been a surge of DHP sales online, which are not accounted for in the distributor data. Furthermore, the studies from BPA and HARDI suggest that the DHP market is evolving beyond single-head DHP unit installations. The new construction/add-on market was another strong area of activity in 2020, according to both the DHP contractors and NEEA's Current Estimates.

The COVID-19 pandemic further clouds these findings. While it is clear that HVAC businesses closed in 2020, there is no indication if this is a short-or long-term effect.

Overall, these findings lead to the following recommendations:

- Given the market uncertainty associated with the COVID-19 pandemic and ongoing supply chain disruptions, NEEA should repeat the complete LTMT study, including all three of the contractor surveys conducted as part of this report, in 2022.
- NEEA should review its current tracking methods and assess if it wants to account for the changes in the DHP market in the Northwest. Specifically, NEEA should determine *if* it wants to expand its modeling to fully capture other market changes such as: new equipment configurations that are appearing due to "mix and match" systems, the increasing influence of online sales, and the trend towards larger DHP installations.
- NEEA should continue to work proactively with its utility partners to encourage a more robust completion of average DHP cost information into the Local Programs Survey. This survey provides valuable information about the current DHP programs and average installed program costs data which are critical to assess the progress of Diffusion Indicators 1 and 2.
- NEEA should work with trade associations, such as HARDI, to supplement or replace the installation data that will be no longer available from its former implementer. These data are used to assess progress related to Diffusion Indicators 1 and 2.
- NEEA should continue to refine and update its Sample Frame of HVAC contractors in the region. These data are used to monitor progress for Diffusion Indicator 4.

### Appendix A: Overall Methodology

Table A-1 summarizes the research sources and analyses we conducted to assess the status of each Diffusion Indicator. As this table indicates, we relied on four primary data sources for our analysis. Details for each research activity are summarized in separate appendices.

Diffusion Indicator	Analyses	Sources
1. 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 annually and cumulatively, also disaggregated by target market, state, heating zone, and utility incentive/rebate status; single-head installations only.	DHP Contractor Survey NEEA Local Programs Survey MPER #8
2. The installed cost for a single-head system remains constant or decreases.	Average installed cost for a single-head DHP in the region, by state, and by heating zone.	DHP Contractor Survey MPER #8Local Programs Survey
3. The share of regional HVAC companies/ installers offering DHPs remains constant or is increasing.	Share of HVAC companies/installers selling DHPs in the region, by state, and by heating zone.	DHP Contractor Survey State HVAC Call-Down Survey
4. The number of counties in the region with HVAC companies that install DHPs remains constant or is increasing.	Number of counties with at least one HVAC company that installs DHPs. Maps of counties in the NEEA's region <i>with and without</i> at least one HVAC company that installs DHPs.	DHP Contractor Survey County HVAC Contractor Call-Down Survey

Table A-1:	Summary	and Sources	of DHP	Diffusion	Indicators
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Figure A-2 summarizes the analysis approach used to develop market estimates from the DHP Contractor Survey. This survey focused primarily on gathering data regarding non-incented DHP installations in the three target markets and in new construction.



#### Figure A-1: DHP Contractor Survey Data Flow Diagram

Source: DHP Contractor Survey

- The top bar shows the sum of DHP units installed in the region by surveyed DHP contractors (A).
- The second row shows the contactors' estimates of the number of incented (B) and non-incented units.
- The third row shows the number of installations reported in each target market by the DHP contactors. The number of units installed outside of the target market included estimates from new construction and other non-target market installations as reported by DHP contractors.

#### Survey Sample Frame and Survey Development

The process we used to develop the DHP Contractor Survey is summarized next.

Step 1. NEEA provided a list of all known HVAC contractors in the region for the research team to use to recruit participants to the DHP Contractor and call-down surveys. NEEA compiled the list by merging lists of participants in NEEA HVAC program training sessions (e.g., the Northwest Ductless Heat Pump Program's online installer orientation training) and a third-party contact list. The third-party list included contractors in the Northwest classified by the North American Industry Classification System (NAICS) as Plumbing, Heating, and Air-Conditioning contractors, which includes contractors who may not serve the residential HVAC market (i.e., plumbers as well as specialized work like Sheet Metal Work Contractors who are more likely to serve the commercial HVAC market).

Step 2. The research team reviewed and cleaned the list. The revised list resulted in 2,296 likely HVAC contractors. We used this sample frame to complete the DHP Contractor Survey. Our data research partner, Ward Research, completed 228 contractor interviews with verified DHP installers. Appendix B provides additional details.

Step 3. Next, to develop the sample frame for the State HVAC Contractor Call-Down Survey, we excluded the 228 respondents who completed the DHP Contractor Survey and an additional 603 records of firms that were no longer in business or did not install residential DHPs. This resulted in a remaining sample frame of 1,465 eligible HVAC contractors. Appendix D provides additional details on the State HVAC Contractor Survey.

Step 4. Finally, to complete the County HVAC Contractor Call-Down Survey, we first compared the physical location of the 228 DHP respondents to the total list of counties in NEEA's fourstate region. This analysis revealed that we could not affirmatively determine the presence of HVAC contractors in **63** counties. We then reviewed the locations of the remaining contractors from the proportionate sample call down survey, supplemented with internet research to identify potential DHP installers in each of the undetermined counties. The contact list we developed was based on identifying all HVAC contractors in a specific county, and then calling these businesses until we could determine if a DHP contractor was located within this county. Please refer to Appendix F for further details regarding the County HVAC Contractor Call-Down Survey.

These three surveys, coupled with the NEEA-provided research, form the basis for our analysis regarding the status of each Diffusion Indicator.

### Appendix B: DHP Contractor Survey

### Research Approach

Our research approach was to replicate, as closely as possible, the research methodologies used in MPER #8. The first research task was to field a telephone survey to Heating, Ventilation, and Air Conditioning (HVAC) contractors located throughout the Northwest. The research objectives for this survey were to track the progress of Diffusion Indicator 1 and Diffusion Indicator 2. The research survey also included additional questions designed to identify changes in DHP market conditions, remaining barriers to DHP installations, and the operating characteristics of firms that install residential DHP systems.

#### Sampling Plan

To develop a sampling approach, we combined the HVAC contractor list compiled by NEEA with additional research of potential firms completed by our research partner, Sodexo | Roth. Our initial list contained 5,972 potential contractors as our beginning population size. We scrubbed the list, eliminating duplicate entries, records with incomplete or missing telephone numbers, ineligible contractors, (including commercial contractors, general, mechanical and refrigerator contractors and plumbers) and out-of-state numbers, leaving a total of 2,068 viable contractor records for our sampling plan.

We then stratified the sample by state and drew a random sample for each state using the random number generator approach capability within MS Excel. This process ensured that we have a randomized stratified sample of the HVAC contractor population.

Table B-1 summarizes the proposed sample sizes we used for each state. We increased the sample weighting for Idaho and Montana, to more closely match the weights used in MPER #8. We oversampled Idaho and Montana while keeping the original sample sizes for Oregon and Washington. This approach results in a goal of 48 completed surveys each for Idaho and Montana. This approach also increases the Idaho and Montana samples' confidence and precision levels.

State	Proposed Weights	Proposed Sample Sizes	Confidence Interval and Precision	% Of Total
ID	15.89%	48	90/11.33%	21%
МТ	15.89%	48	90/10.9%	21%
OR	35.00%	68	90/10%	29%
WA	34.00%	68	90/10%	29%
Total	100.78%	232		100.00%

#### Table B-1: Proportion of HVAC Contractors by State

#### Survey Development

We modified and shortened the DHP Contractor survey used in MPER #8 to focus only on questions that directly relate to assessing the status of DI 1 and DI 2. We revised the DHP Contractor survey to include the critical questions regarding installation rates of single-head residential DHPs occurring in the three target markets.

We also added questions to confirm the locations of each DHP contractor (which partially addresses DI 4) and gathered information regarding the DHP contractors' market service area, installation costs (partially addresses DI 2), and barriers to DHP installations.

#### **Respondent Recruitment**

Our research partner, Ward Research, mailed out letters to each eligible contractor in our sampling frame, to increase the overall response rate. The NEEA project manager approved the contents of this letter before mailing it. One week after the data collection began, Ward Research sent out reminder postcards to these eligible contractors. Each respondent also received a \$50.00 e-gift card, which was distributed by Ward Research.

Ward Research began data collection in January 2021. However, the initial sample was exhausted before achieving all the required number of completes in each state. Therefore, we sent Ward Research the remaining sample, thus providing our research partner with the full census of 2,068 known HVAC contractors across the four-state region.

#### Survey Disposition

Table B-2 summarizes the disposition of the full census of HVAC contractors that Ward Research called. Ultimately, we were able to complete a total of 228 DHP contractor interviews, thus achieving nearly all our data collection goals. However, Ward Research ended up contacting all respondent numbers in the remaining sample of 2,068 records.

Call Disposition	Number	Percent
Completed	228	11.03%
Already completed survey - duplicate listing	20	0.97%
Bad number - computer tone	16	0.77%
Bad number - disconnected	91	4.40%
Bad number - wrong number	11	0.53%
Blocked call	12	0.58%
Business closed	13	0.63%
Duplicate phone number	84	4.06%
Duplicate record/remove	24	1.16%
Language problems	2	0.10%
Mid-interview terminates	4	0.19%
Not eligible - does not install any DHP	271	13.10%
Not eligible - does not install any residential DHP	12	0.58%
Not eligible - not HVAC	1	0.05%
Not reached - left voicemail message	65	3.14%
Not reached - need to leave phone number	43	2.08%
Not reached - need to send email	62	3.00%
Not reached - no answer/answering machine	647	31.29%
Not reached - phone busy	24	1.16%
Not reached - picked up & hung up	6	0.29%
Not reached - respondent not available	165	7.98%
Not reached - suspected answering service	8	0.39%
Not reached - uses answering service	11	0.53%
Over quota	4	0.19%
Refused - long term	18	0.87%
Refused - short term	360	17.41%
Robot/Automated greeting	3	0.15%
Schedule callback	91	4.40%
Total	2,068	100.00%

#### Table B-2: Detailed Sample Disposition from the DHP Contractor Survey

Source: DHP Contractor Survey

Table B-3 summarizes the Confidence and Precision levels for the DHP Contractor Survey.

Sample Frame	Original Sample Size	Completed Surveys	Confidence	Precision
Idaho	373	47	90%	11.23%
Montana	381	47	90%	11.25%
Oregon	611	67	90%	9.49%
Washington	931	67	90%	9.68%
Total	2,296	228	90%	5.17%

#### Table B-3: Confidence and Precision for the DHP Contractor Survey

Source: DHP Contractor Survey

### Appendix C: DHP Contractor Survey Instrument

The HVAC contractor survey is designed to measure the following research objectives listed in Table C-1 These include assessing three key Diffusion Indicators, which are listed as Research Objectives 3, 4, and 6 in Table C-1. The other research objectives confirm DHP's current operations (Research Objective 1), identify remaining barriers to DHP installations (Research Objective 5) and provide information about current DHP contractor operations (Research Objective 7).

#### Table C-1: Key Research Objectives

Research Objective	Question Number
1. Confirm HVAC DHP Eligibility	B1-B2
2. Home types where DHPs are installe	d C1
3. DHPs installed in single zones	C3
4. Number of DHPs incented in each m	arket C4, C5
5. Changes in the DHP Market	C2, C7
6. Types of heating measures DHPs are	e displacing C6a, C6b
7. Cost of DHP Systems	D1 -D2
8. Contractor "firmographic" information	E1, E3, E-4, E6

#### Last updated April 2, 2021

**Record the Following Variables from the Sampling Frame:** 

Contractor Name City State Zip Code NEEA "Oriented Contractor"

[1] ORIGINAL\_TELEPHONE
[2] Ward\_ID
[3] SAMPLE\_STATE
[4] SAMPLE\_STATE\_CODE
1> IDAHO
2> MONTANA
3> OREGON
4> WASHINGTON
5> UNKNOWN

#### A. Introduction

[5] [TELEPHONE] [ORIGINAL TELEPHONE] [PHONE2] [STATE] [CITY] [COMPANY]

#### [CONTACT] [TITLE]

Hello. I am \_\_\_\_\_\_ calling from Ward Research on behalf of the Northwest Energy Efficiency Alliance (NEEA- KNEE-AH). We are conducting a survey of HVAC contractors who install Ductless Heat Pumps or DHPs. Are you the best person to talk about your company's experience with DHPs? If Yes, Continue; If No: Who would be the right person? Is that person available?

If needed, reintroduce yourself and begin:

Hello. I am \_\_\_\_\_\_ calling from Ward Research on behalf of the Northwest Energy Efficiency Alliance (NEEA- KNEE-AH). We are conducting a survey of HVAC contractors who install Ductless Heat Pumps or DHPs. Are you the best person to talk about your company's experience with DHPs?

I'd like to ask you a few questions about your installation experiences with DHPs. To thank you for your participation, we will send you either a \$50 Amazon online e-gift card or make a \$50 payment to your PayPal account.

Is now a convenient time to speak? This is **not** a sales call. This survey will take about 10 minutes. \_\_\_\_\_\_Schedule Call Back

#### If redirected: Repeat Introduction.

1> YES CONTINUE 2> YES CONTINUE - DIFFERENT COMPANY NAME 6> SCHEDULE CALLBACK 7> GO TO DISPOSITION CODES

[6] [DIFFERENT\_COMPANY\_NAME] ENTER COMPANY NAME

[COMPANY] [UPDATE COMPANY NAME] [CONTACT] [TITLE]

[7] May I have your [7A] name and [7B] title? [ENTER NAME AND TITLE ON TWO LINES]

[8] CHECK NAME AND TITLE SCREEN

#### **B.** Screening Questions

[9] Thank you for taking the time to talk with me today. I'd like to start by asking about your company's experience with DHP installations.

QB1. Does your company install ductless heat pumps, also known as DHPs or mini-splits?

1. Yes

- 2. No [ASK QB1\_HVAC\_INSTALLER]
- 3. Don't know [ASK QB1\_HVAC\_INSTALLER]

[10][QB1\_HVAC\_INSTALLER] Is your company an HVAC installer?

- 1. Yes [THANK AND TERMINATE]
- 2. No [ASK QB1\_HVAC\_REPAIR]
- 9. Don't Know/Refused (DO NOT READ) [ASK QB1\_HVAC\_REPAIR]

[11][QB1\_HVAC\_REPAIR] Does your company repair and/or maintain HVAC equipment?

- 1. Yes [THANK AND TERMINATE]
- 2. No [THANK AND TERMINATE]

9. Don't Know/Refused (DO NOT READ) [THANK AND TERMINATE]

[13-A1-5] QB2. 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. [14] Other

[NOTE: THANK AND TERMINATE IF B2  $\neq$  1, 2, or 3; if 4, indicate contractor specializes in commercial in the recruiting spreadsheet]

#### C. Installations

Now, I'd like to ask you a few questions about the **numbe**r of DHPs you have installed in the past 12 months. Your best estimate is fine.

[16] QC1. In the past 12 months, approximately how many residential DHPs did you install? (*Read if necessary: This estimate should include installations in the residential, manufactured housing, and multifamily, applications)? Your best estimate is fine. Residential (all sectors)* \_\_\_\_\_\_Estimated # of DHPs Installed
 9999: Don't Know- THANK AND TERMINATE

[17] QC2. How does the percentage of customers specifically asking for DHPs compare to prior years? Is it?

- 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

9. Don't Know (DO NOT READ)

[18] QC3. Of the number of residential DHP installations you installed in the past 12 months, approximately how many were one-to-one or "single zone" systems; that is, a unit with one outdoor compressor and one indoor unit?
# of DHPs Installed DK = 9999 (DO NOT READ)

#### \_\_\_\_\_# of DHPs Installed DK = 9999 (DO NOT READ)

[19] CHECK QC3 IS NOT GREATER THAN QC1

 [20] QC4. Of the number residential DHP installations you completed in the past 12 months; approximately how many did NOT receive a utility rebate?
 # of DHPs Not Receiving a Rebate DK/REF=9999 (DO NOT READ)

#### [IF 0 OR DK/REF THEN SKIP TO QC7]

[21] CHECK QC4 IS NOT GREATER THAN QC1

[23] The next several questions are specifically about the residential DHP installations you completed in the past 12 months that **did NOT receive a utility** rebate. [INTERVIEWER NOTE: MANUFACTURER'S REBATE, TAX CREDIT, OR ANY OTHER INCENTIVE IS

- COUNTED AS LONG AS THEY DID NOT RECEIVE A UTILITY REBATE]
- [24] QC5. Of the [REPEAT NUMBER FROM QC4] residential DHP installations you completed in the past 12 months that did not receive a utility rebate, please tell me how many were installed in singlefamily retrofits excluding any new construction? Those are retrofits to replace/displace existing equipment in the primary living space only. I am going to ask you about other installations a little later. Your best estimate is fine.

QC5a. Single-family retrofits (excluding any new construction)

# of DHPs Installed DK/REF=999 (DO NOT READ) If Zero, Skip to <del>QC5b</del> QC6

#### [32] QC5a1. About how many of those (READ NUMBER OF DHPS FROM QC5a] replaced Electric resistance zonal heat such as baseboards, cadet-style, ceiling cable? Estimated # Electric Resistance Zonal Heat Systems Replaced

9999. Don't Know

[33] QC5a2. About how many of those (READ NUMBER OF DHPS FROM QC5a) replaced electric forced air furnaces?

\_\_\_\_\_Estimated Number of Forced Air Furnaces Replaced

#### 9999. Don't Know

[28] QC 6. Of the [REPEAT NUMBER FROM QC4) residential DHP installations please tell me how many were installed garages, bonus rooms, or attics that added heating to previously unheated spaces that are <u>not</u> primary living areas? Your best estimate is fine.

#### QC6a. Single-Family Additions # of DHPs Installed

[29] Check that QC6 is not greater than QC4 9999. Don't Know

[26] QC5b: Of the [REPEAT NUMBER FROM QC4] residential DHP installations you completed in the past 12 months that did not receive a utility rebate, please tell me how many were installed in manufactured housing? Those are retrofits to replace/displace existing equipment in the primary living space only. Your best estimate is fine.

Manufactured Housing:

#### \_\_\_\_\_# of DHPs Installed

9999. Don't Know

[27] Check that QC5\_2 is not greater than QC4

[36] QC5b1. About how many of those (**READ NUMBER OF DHPS FROM QC5b**) replaced Electric resistance zonal heat such as baseboards, cadet-style, ceiling cable?

#### Estimated # Electric Resistance Zonal Heat Systems Replaced

9999. Don't Know

[37] Q5b2: About how many of those (**READ NUMBER OF DHPS FROM QC5b**] replaced electric forced air furnaces?

\_\_\_\_\_Estimated Number of Forced Air Furnaces Replaced

9999. Don't Know

## [74-81][CHECK SCREEN FOR Q5 and Q6. SUM OF QC5a, QC5b, and QC6 LESS THAN QC4] ALL CONTINUE

[40] QC7. What do you see as the biggest barriers to DHP installations in your area? [PROBE FULLY.

- TYPE VERBATIM RESPONSES.] Open Ended\_\_\_\_
  - 1. Initial Cost
  - 2. Lack of Customer Awareness\Lack of knowledge
  - 3. Difficult to Install
  - 4. People Don't Like Something New
  - 5. Too cold\They are not as effective with our climate
  - 6. Too much regulation to deal with
  - 7. They need backup heat systems during cold weather
  - 8. People don't like the appearance\Aesthetics
  - 9. The need for more financial incentives\Rebates\Financing
  - 10. House is too big\Layout of the house\Multi-level
  - 11. Too much competition by people that don't know what they are doing\Online retailers
  - 12. Not enough qualified installers
  - 13. People already have a ducted system
  - 14. Need for an electrical upgrade
  - 15. Sometimes ducted is better
  - 88. Something Else (Other)\_\_\_\_\_
  - 99. Don't Know

#### **D. Installation Costs**

[41] D1. 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. DON'T KNOW/REFUSED=9999999 (DO NOT READ)

#### 1. \$ )\_\_\_\_\_ [RECORD DOLLAR AMOUNT ]

D2. For the **\$[INSERT RESPONSE FROM D1]** equipment and labor costs, about how much of that is just the cost of equipment and materials? Your best estimate is fine."

[42] a. Equipment and materials (for example, box/unit with single-head, as well as ancillary equipment such as the padmount, brackets, and lineset) \_\_\_\_\_\_ [RECORD NUMBER] DON'T KNOW/REFUSED=999999 (DO NOT READ)

#### E. Installer Background

Now, I'd just like to ask a few questions for classification purposes only.

- E1. What percentage of your HVAC installation work is for DK/REF = 999 (DO NOT READ)
  - 1. [51\_A1] Residential Customers \_\_\_\_\_%

2. [51\_A2] Commercial Customers \_\_\_\_\_%

[DP NOTE: THIS WON'T NECESSARILY SUM TO 100 FOR THE FIRST TWO DAYS]

[56\_A1-4] E3. What states do you serve? (*Mark all that Apply*)

- 2> Idaho 3> Montana 6> Oregon
- 9> Washington

E4. What counties do you serve? 97 > All of them (DO NOT READ) 99 > Don't know / Refused (DO NOT READ)

#### [58\_A1-10] [IF E3 EQ 2][E4\_IDAHO] What Idaho counties do you serve?

1> Ada County	16> Cassia County	31> Lewis County
2> Adams County	17> Clark County	32> Lincoln County
3> Bannock County	18> Clearwater County	33> Madison County
4> Bear Lake County	19> Custer County	34> Minidoka County
5> Benewah County	20> Elmore County	35> Nez Perce County
6> Bingham County	21> Franklin County	36> Oneida County
7> Blaine County	22> Fremont County	37> Owyhee County
8> Boise County	23> Gem County	38> Payette County
9> Bonner County	24> Gooding County	39> Power County
10> Bonneville County	25> Idaho County	40> Shoshone County
11> Boundary County	26> Jefferson County	41> Teton County
12> Butte County	27> Jerome County	42> Twin Falls County
13> Camas County	28> Kootenai County	43> Valley County
14> Canyon County	29> Latah County	44> Washington County
15> Caribou County	30> Lemhi County	

#### [59\_A1-10] [IF E3 EQ 3][E4\_MONTANA] What Montana counties do you serve?

- 1> Beaverhead County 2> Big Horn County 3> Blaine County 4> Broadwater County 5> Carbon County 6> Carter County 7> Cascade County 8> Chouteau County 9> Custer County 10> Daniels County 11> Dawson County 12> Deer Lodge County 13> Fallon County 14> Fergus County 15> Flathead County 16> Gallatin County 17> Garfield County 18> Glacier County 19> Golden Valley County
- 20> Granite County 21> Hill County 22> Jefferson County 23> Judith Basin County 24> Lake County 25> Lewis and Clark County 26> Liberty County 27> Lincoln County 28> McCone County 29> Madison County 30> Meagher County 31> Mineral County 32> Missoula County 33> Musselshell County 34> Park County 35> Petroleum County 36> Phillips County 37> Pondera County 38> Powder River County
- 39> Powell County 40> Prairie County 41> Ravalli Countv 42> Richland County 43> Roosevelt County 44> Rosebud County 45> Sanders County 46> Sheridan County 47> Silver Bow County 48> Stillwater County 49> Sweet Grass County 50> Teton County 51> Toole County 52> Treasure County 53> Valley County 54> Wheatland County 55> Wibaux County 56> Yellowstone County

#### [62\_A1-10] [IF E3 EQ 6][E4\_OREGON] What Oregon counties do you serve?

- 1> Baker County
   2> Benton County
   3> Clackamas County
   4> Clatsop County
   5> Columbia County
   6> Coos County
   7> Crook County
   8> Curry County
   9> Deschutes County
   10> Douglas County
   11> Gilliam County
   12> Grant County
- 13> Harney County
  14> Hood River County
  15> Jackson County
  16> Jefferson County
  17> Josephine County
  18> Klamath County
  19> Lake County
  20> Lane County
  20> Lane County
  21> Lincoln County
  22> Linn County
  23> Malheur County
  24> Marion County
- 25> Morrow County
  26> Multnomah County
  27> Polk County
  28> Sherman County
  29> Tillamook County
  30> Umatilla County
  31> Union County
  31> Union County
  32> Wallowa County
  33> Wasco County
  34> Washington County
  35> Wheeler County
  36> Yamhill County

#### [65\_A1-10] [IF E3 EQ 9][E4\_WASHINGTON] What Washington counties do you serve?

- Adams County
   Asotin County
   Benton County
   Benton County
   Chelan County
   Clallam County
   Clark County
   Columbia County
   Cowlitz County
   Douglas County
   Ferry County
   Franklin County
   Garfield County
   Grant County
- 14> Grays Harbor County
  15> Island County
  16> Jefferson County
  17> King County
  18> Kitsap County
  19> Kittitas County
  20> Klickitat County
  20> Klickitat County
  21> Lewis County
  22> Lincoln County
  23> Mason County
  24> Okanogan County
  25> Pacific County
  26> Pend Oreille County
- you serve? 27> Pierce County 28> San Juan County 29> Skagit County 30> Skamania County 31> Snohomish County 32> Spokane County 33> Stevens County 34> Thurston County 35> Wahkiakum County 35> Wahkiakum County 36> Walla Walla County 37> Whatcom County 38> Whitman County 39> Yakima County 40> Washington (state)

- [68] E6. Thank you for your time today. To thank you for participating in our survey today, we will email you a link to a \$50.00 Amazon online e-gift card or deposit a \$50 payment to your PayPal account.
- QE6a. Which gift card would you prefer?
  - 1. Amazon (CONTINUE TO Q6b)
  - 2. Pay Pal (SKIP TO Q6c)
  - 3. REFUSED INCENTIVE (DO NOT READ) (SKIP TO THANK YOU)

[69] QE6b. Please confirm your email address we should send this Amazon e-gift card to. \_\_\_\_\_\_confirm email address

**[IF THEY ASK, THEY SHOULD RECEIVE THE E-GIFT CARD OR PAYMENT WITHIN 7-10 DAYS.]** [71] Thank you very much for your time today!

### Appendix D: State HVAC Contractor Call-Down Survey

### Research Approach

To assess the status of Diffusion Indicator 3, the Johnson Consulting Group team conducted a call-down survey of DHP contractors in the Northwest.

#### Table D-1: State HVAC Contractor Call-Down Survey Research Objective

Research Activity	Research Objective
State HVAC Contractor Call-Down Survey	Determine the proportion of HVAC installers by state that install DHPs

#### Sampling Plan

The initial DHP Contractor Survey included only contractors who reported installing DHPs, and thus this survey could not be used to estimate the proportion of DHP installers in the region. Johnson Consulting Group reviewed the disposition of the original sample of 2,296 contractors in the initial DHP contractor study. Eliminating participants who had completed the survey (N=228) left a remaining sample of 2,068 records. Johnson Consulting Group eliminated another 603 records (see Table D-2). Overall, we excluded a total of 29% of the records.

#### Table D-2: Sample Selection for the State HVAC Contractor Call-Down Survey

Total Remaining Sample	2,068	100%
Numbers Excluded	# of Records	% of Original Sample
Duplicate listings	128	6.18%
Bad Numbers/Business Closed	146	4.93%
Not Eligible	284	13.73%
Need to leave phone number	43	2.08%
Language Problems	2	0.0010%
Total Records Excluded	603	29.15%
Remaining Records for Proportionate Sample	1,465	

Source: DHP Contractor Survey

Table D-2 identified a total of 1,465 HVAC contractors whose status regarding DHP installations was still unknown. These specific contractors had not completed the DHP Contractor Survey. Johnson Consulting Group used this list of 1,465 as the sampling frame to draw a second, random and representative.

We developed a stratified random sample designed to provide an overall Confidence/Precision Level  $\pm$  90/10%. The sample sizes for each state were selected to match the proportions used in the DHP Contractor Survey. Overall, the total number of completed surveys, N=60, would provide a Confidence/Precision Level  $\pm$  90%/10.14%. Table D-3 illustrates this sample distribution by state quota.

State	Population	Sample Size	Number of Completes
ID	208	100	10
MT	175	100	10
OR	408	200	20
WA	674	200	20
Total	1,465	600	60

#### Table D-3: State HVAC Contractor Call-Down Survey Sample

Source: State HVAC Contractor Call-Down Survey Sample

#### Survey Disposition

Table D-4 summarizes the disposition of our calls for this survey.

State	ID	МТ	OR	WA	Total	% of Total Population	% of Total Sample
Population	208	175	408	674	1,465	100%	
Sample	100	100	200	200	600	40.96%	100.00%
Number of Calls	26	49	37	53	165	11.26%	27.50%
Completed	10	10	20	20	60	4.10%	10.00%
Confirmed DHP Installers	9	5	19	17	50	3.41%	8.33%
Confirmed Do Not Install DHPs	1	5	1	3	10	0.68%	1.67%
Hang Ups	5	2	0	0	7	0.48%	1.17%
Refused	3	4	0	1	8	0.55%	1.33%
No Answer	7	31	15	30	83	5.67%	13.83%
Number Out of Service	1	2	2	2	7	0.48%	1.17%

#### Table D-4: State HVAC Contractor Call-Down Survey Totals by State

Source: State HVAC Contractor Call-Down Survey Sample

#### Table D-5: Confidence & Precision for the Proportionate Call Down Survey

Population	Number of Completed Surveys	Confidence	Precision
208	10		
175	10	N	٨
408	20	0 NA	
674	20		
1,465	60	90%	10.40%
	Population 208 175 408 674 1,465	Population         Number of Completed Surveys           208         10           175         10           408         20           674         20           1,465         60	Population         Number of Completed Surveys         Confidence           208         10

Source: Proportionate Call Down Survey

### Appendix E: State HVAC Contractor Call-Down Survey Instrument

We asked the respondents the following questions.

QC1. Does your company install ductless heat pumps, also known as DHPs or mini-splits?

- 1. Yes
- 2. No [THANK AND TERMINATE]
- 3. Don't know [THANK AND TERMINATE]

QC2. Do you install in Residential, Commercial or both?

- 1. Residential
- 2. Commercial
- 3. Both
- 4. Don't Know/Refused [THANK AND TERMINATE]

QC3. Can you verify that your firm installs new and repairs existing HVAC equipment?

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

Thank you for your time today.

### Appendix F: County HVAC Contractor Call-Down Survey

#### Research Approach

To further assess the status of Diffusion Indicator 3 and Diffusion Indicator 4, the Johnson Consulting Group team conducted a call-down survey of DHP contractors in NEEA's region for those counties where we had not yet identified if a DHP installer was situated.

#### Table F-1: County Contractor Call Down Survey Research Objective

Research Activity	Research Objective
County DHP Contractor Call-Down Survey	Determine if a DHP installer is operating in each county that overlaps with a NEEA funder service territory.

#### Sampling Plan

First, we reviewed the DHP Contractor Survey and State HVAC Contractor Call-Down Survey to identify where each DHP respondent was physically located. With these data, we identified 63 counties where we could not confirm if a DHP installer was located within the county.

#### Table F-2: Number of Counties – Unknown Status of DHP Installer

State	Number of "Missing" Counties
ID	19
MT	25
OR	7
WA	12
Total	63

For this survey, we used the initial contractor list from the contractor survey to identify potential DHP installers within any of the missing counties. We also conducted an internet search to try and identify HVAC contractors in these missing counties. Our County HVAC Call-Down Survey simply asked each respondent if they installed DHP systems.

For each missing county, we called contractors located within that county until we received a confirmation that they installed DHP systems or until we exhausted our list. For these 63 missing counties, we were able to identify DHP installers within 24 counties. For the remaining 39 counties, we identified 32 counties where no DHP installer exists and seven counties where we could not to locate any contractors to confirm whether they install DHP systems.

### Appendix G: County HVAC Call-Down Survey Instrument

#### **Record the Following Variables from the Sampling Frame:**

RECORD: Contractor Name City State Zip Code

QD1. Does your company install ductless heat pumps, also known as DHPs or mini-splits?

Yes
 No [THANK AND TERMINATE]
 Don't know [THANK AND TERMINATE]

QD2. In what counties do you provide DHP installation services?

Reference the look up table to identify all adjacent counties. Confirm the availability of DHP installations in each county served by the HVAC contractor.

Thank you for answering my questions today.

### Appendix H: NEEA Current Estimates

**NEEA Current Estimates:** NEEA's current model estimates by target market, drawing on multiple data sources. NEEA's regional market estimates are calculated by combining the local programs survey data with an estimate of total non-incented units installed in the target markets. To arrive at the non-incented unit estimate, NEEA completed the following steps.

- 1. Used HVAC distributor data to estimate the number of DHP units (reflected in this sample) <sup>23</sup>
- 2. Extrapolated<sup>24</sup> this estimate to the full market to estimate the total number of DHP installs in the region
- 3. Removed the utility incented units from the total
- Distributed the remaining units to the target markets based on assumptions gathered from the eight Market Progress Evaluation Reports (MPERs) for the DHP Program<sup>25</sup>.

Figure H-1 (adapted from a similar figure in the 6<sup>th</sup> DHP Market Progress Evaluation Report) illustrates the NEEA estimation process. This figure illustrates the process that NEEA used to estimate installation rates of residential DHPs across multiple market sectors as part of its Current Estimates modeling.

<sup>&</sup>lt;sup>23</sup> This dataset is not yet available for 2020. NEEA's 2020 estimate is based on actual local program survey data for 2020 and a conservative estimate of the non-incented units using historical trends.

<sup>&</sup>lt;sup>24</sup> This methodology was reviewed by Ecotope in 2020 as part of an ACE Model Review study. It uses historical data to develop an understanding of the market coverage represented by our current HVAC Distributor dataset and extrapolates from that to the whole market.

<sup>&</sup>lt;sup>25</sup> This method and the data sources were described in detail in MPER 6 and has since been reviewed by Ecotope in 2020 as part of an ACE Model Review study.



#### Figure H-1: NEEA Current Estimates Data Flow Diagram

- The top bar shows all DHP units installed in the region, (A), is an unknown number. NEEA estimates this number to be 10%-30% more than are currently tracked through its distributor sales data collection.
- NEEA tracks units in the region via distributor data—the second bar separates the heating-and-cooling units (B) from the cooling-only units (C). Cooling-only units are not included in NEEA's target market.
- The third bar shows NEEA Local Programs survey data, including target market incented units **(D)**.
- The third bar also includes the target market non-incented units (striped) and heatingand-cooling units outside the target market. Combined, these are estimated to be the target market incented units (D) that are subtracted from the distributor data heatingand-cooling units (B).
- The last bar presents the DHP units in their most granular form. Target market incented units (D) and target market non-incented units (striped) are further categorized into specific target markets. For (D), the number of incented units in each target market comes directly from NEEA's Local Programs Survey. NEEA disaggregated the non-incented units (striped) target market by applying its estimates of the proportions of non-incented DHP installations in each target market.

### Appendix I: Findings from NEEA Current Estimates

NEEA estimated the overall percentage of incented single-head DHP installations by each target market. NEEA's estimates bring together several data sources: the Local Programs Survey, HVAC distributor data, and findings from Market Progress Evaluation Reports. Compared to 2020, the percentage of single-head installations has declined (Table I-1). This finding is consistent with HARDI's recent sales estimates that indicate an upward trend for multi-head rather than single-head installations.<sup>26</sup> See Section 8 for further details.

Table I- 1: NEEA's Current Estimates of the Pe	ercentage of Incented,
Single-Head Installations by Target Market	ts in 2019 and 2020

Target Market	2019^ % Single Head	2020* % Single Head
TM1. Single-Family Zonal	61%	52%
TM2. Single-Family eFAF	60%	82%
TM3. Manufactured Homes eFAF	83%	80%
Total	62%	59%

\*Source: NEEA Current Estimates

^Source: DHP Market Progress Evaluation Report 8, p. 16

#### 9.3.1 DHP Installations by Target Market and Heating Zone

Table I-2 summarizes the number of DHP installations installed by target market in 2020. As this table shows, overall HZ 1 accounts for the majority of all installations (86%) with most units displacing single- family zonal (TM 1) units (67%).

HZ	SF Zonal	SF eFAF	MH eFAF	Total
1	4,981	1,773	676	7,429
2	754	114	80	948
3	221	14	12	247
Total	5,956	1,901	767	8,624

#### Table I- 2: NEEA's Current Estimates of Incented Unit Counts by Target Market and HZ

Source: NEEA Current Estimates

#### 9.3.2 DHP Installations by Home Type by Replaced Equipment Type

Table I-3 and Table I-4 summarize the non-incented DHPs by replaced equipment type. Table I-3 provides the totals and Table I-4 indicates the overall percentage for each equipment type. Consistent with the previous estimates, single-family zonal equipment accounts for the highest rate (9%) of non-incented installations in 2020, while DHP installations in new add-on space accounted for 8% of non-incented DHP installations in 2020.

<sup>&</sup>lt;sup>26</sup> D+R International with HARDI, "2020 and Q1 2021 Annual Unitary Market in Review," June 15<sup>th</sup> and June 29th, 2021, Slides 16-17. (<u>HARDI Unitary Market Webinar Presentation</u>) <<Accessed July 1, 2021>>

Total Non-Incented Installations	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
<b>Residential Total</b>	3,542	4,618	4,437	8,154	9,868	11,432	14,034	14,209	23,911	24,982
Single Family - in new add-on space										
Displaced electric zonal	527	688	661	719	870	1,834	2,252	2,280	1,841	1,923
Single Family - In primary liv	ing spa	се								
Displaced electric zonal	858	1,118	1,075	1,503	1,818	1,142	1,402	1,420	2,263	2,364
Displaced electric furnace	168	219	211	293	355	292	358	362	754	788
Manufactured Homes - In pri	imary liv	ving spa	ace							
Displaced electric zonal	32	42	40	36	43	70	85	86	296	309
Displaced electric furnace	38	49	47	195	237	464	570	577	721	753
Total	1,623	2,116	2,034	2,746	3,323	3,802	4,667	4,725	5,875	6,137

# Table I- 3: NEEA's Current Estimates of Non-Incented DHP Installations by Replaced Equipment Type

Source: NEEA Current Estimates

NEEA's estimates indicate that the non-incented portion of the DHP market experienced modest growth in 2020, compared to 2019. Specifically, installations in new additions and TM 2 and TM 3 increased 4% in 2019, while the increase was less than 1% for TM 1.

Table I-4 illustrates the overall percentage of installations across these sub-markets, which indicates that installations rates are identical to 2019.

Installation Application	2011 N=3,542	2012 N=4,618	2013 N=4,437	2014 N=8,154	2015 N=9,868	2016 N=11,432	2017 N=14,034	2018 N=14,209	2019 N=23,911	2020 N=24,982
Residential Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Single Family	y - In nev	v add-on sj	pace							
Displaced electric zonal	15%	15%	15%	9%	9%	16%	16%	16%	8%	8%
Single Family	y - In prin	nary living	space							
Displaced electric zonal	24%	24%	24%	18%	18%	10%	10%	10%	9%	9%
Displaced electric furnace	5%	5%	5%	4%	4%	3%	3%	3%	3%	3%
Manufacture	d Homes	- In prima	ry living sp	bace						
Displaced electric zonal	1%	1%	1%	0%	0%	1%	1%	1%	1%	1%
Displaced electric furnace	1%	1%	1%	2%	2%	4%	4%	4%	3%	3%

# Table I- 4: NEEA's Current Estimates of Non-Incented DHP Applications by Replaced Equipment Type

Source: NEEA Current Estimates

#### 9.3.3 Historical Installation Trends

NEEA has tracked regional DHP installations since 2008. From 2011 to 2018, the total target market DHP installations increased each year (Figure I-1). Between 2019 and 2020, the number of total target market DHPs installed declined by 6%. This signals a decline of nearly 1,000 units (n=906) in 2020. Although the total number of installations have declined, the number of non-incented installations has continued to grow year-over-year since 2011. Cumulatively, the total number of target market installations is 86,983 units.

Of note, NEEA's models estimated that there were 14,453 DHP installations in 2020, a market estimate that is comparable to market projections in other DHP studies, as described in Section 8.



# Figure I- 1: NEEA's Current Estimates-Total Target Market Incented and Non-Incented Installations by Year (2011–2020)

Source: NEEA Current Estimates

**Installations by State and Year**: Figure I-2 summarizes DHP installation trends by state and year since data collection began in 2008. Overall, the number of DHP incented installations has declined by 12% in 2020, compared to 2019. However, incented DHP installations actually increased by 20% in Montana, rising from 130 to 156 incented units.



Figure I- 2: NEEA's Current Estimates- Incented Installations by State and Year

Source: NEEA Current Estimates

Table I-5 summarizes the Year-Over-Year estimates based on NEEA's current estimates. According to NEEA's estimates, the non-incented DHP installations grew by 4% across all target markets.

Target Market	2019 Installations	2020 Installations	Year-Over-Year Growth
TM1. Single-Family Zonal	4,104	4,288	4%
TM2. Single-Family eFAF	754	788	5%
TM3. Manufactured Homes eFAF	721	753	4%
Total	5,579	5,829	4%

Source: NEEA Current Estimates

Table I-6 shows a decline in incented DHP installations for TM 1: SF-Zonal of 19.30% and 41.72% for TM 3: MH eFAF. However, installations in TM 2: SF eFAF increased 75.53%.

#### Table I- 6: NEEA's Current Estimates- Year-Over-Year Target Market Unit

Target Market	2019	2020	Year-Over-Year Change	
TM 1: Single-Family Zonal	7,380	5,956	-19.30%	
TM 2: Single-Family eFAF	1,083	1,901	75.53%	
TM 3: MH eFAF	1,316	767	-41.72%	
Total	9,779	8,624	-11.81%	

Source: NEEA Current Estimates

**Market Size and Saturation:** The following table and figure illustrate NEEA's estimates of market saturation relative to its planning models. NEEA estimates that there have been 134,958 DHP units installed since 2008.

Target Market	Market Size	Target Market Saturation by 2039	Cumulative Units 2008-2020	Market Saturation 2008-2020
TM1. Single-Family Zonal	505,066	65%	111,696	22%
TM2. Single-Family eFAF	222,981	20%	13,713	6%
TM3. Manufactured Homes eFAF	280,858	14%	9,549	3%
Total	1,008,905	100%	134,958	31%

Table I- 7: NEEA's Current Estimates- Target Market DHP Saturation-2020

Sources: NEEA Current Estimates MPER #8 Report, p. 16.

NEEA forecasts annual market saturation for each target market from 2008 to 2020 to project the path each target market will need to take to achieve maximum market saturation by 2039. Figures I-3, I-4 and I-5 compare the market saturation rates to NEEA's forecasts. As of 2020, TM1 has a market saturation of 21.7% while TM 2 and TM 3 had saturation rates of 6.2% and 3.4%, respectively.



Figure I- 3: NEEA's Current Estimates- Forecast and Actual Market Saturations

Source: NEEA Current Estimates



Figure I- 4: NEEA's Current Estimates- Forecast and Actual Market Saturations

Source: NEEA Current Estimates

Figure I- 5: NEEA's Current Estimates- Forecast and Actual Market Saturations by Target Market 3: Manufactured Housing eFAF (2008–2020)



Source: NEEA Current Estimates

### Appendix J: Literature Review

To better understand the impacts of COVID-19 on the DHP market in the Northwest, our team conducted a brief, focused literature review. Specifically, we analyzed three documents: a news report, economic data, and a shipping report from manufacturers and manufacturer associations (e.g., HARDI).

Specifically, the sources we reviewed for the literature review were:

- Bonneville Power Administration (BPA) Summer Learning Series HVAC Market Research, 1 of 3. June 2, 2021, Slide 11. <u>https://www.bpa.gov/EE/Utility/Momentum-Savings/Documents/060221\_BPA\_Summer\_Learning\_Series\_HVAC\_Market\_Research.pptx</u> <<Accessed July 12, 2021>>
- D+R International with HARDI, "2020 and Q1 2021 Annual Unitary Market in Review," June 15<sup>th</sup> and June 29th, 2021, Slides 16-17, 19. <u>HARDI Unitary Market Webinar Presentation</u>
   <Accessed July 1, 2021>>
- Gruver, T. 2020, "Shutdowns closed 27% of Washington businesses-and more could close for good," The Center Square, Dec. 21. <u>https://www.thecentersquare.com/washington/shutdowns-closed-27-of-washingtonbusinesses-and-more-could-close-for-good/article\_b8929fd2-4326-11eb-9a6b-7b6364eecf00.html <<Accessed June 28, 2021>>
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