# Cold Climate Room Heat Pump Field Study

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## ABSTRACT

This study presents results of a field study on cold climate room heat pumps. The heat pumps studied represent a new class of room heat pumps that can be quickly installed in a sash window in less than an hour as they do not require an EPA 608 certification or permits. The units have substantial heating capacity at 5°F and offer the potential of substantial displacement of existing heating at a lower cost than conventional mini split ductless heat pumps. This study gathered field data on customer experience and operational data to understand if customers use them differently than either conventional room air conditions or ductless mini split heat pumps. A basic billing analysis is also performed for each customer to more directly quantify savings over legacy systems.

The study deployed 13 Midea Packaged Window Heat Pumps and 13 Gradient All-Weather room heat pumps across three climate zones in multiple residential types. All units except one were do it yourself installations. Delivered air temperature and runtime data collected from May 2025 through March 2026 was analyzed along with four quarterly customer interviews and then paired with participant activities to explore if additional education enhanced the overall participant satisfaction or energy savings.

## Introduction

Traditionally, residential heating equipment consists of permanent appliances installed by professionals that require dedicated electrical circuits or plumbing for fuel, permanent installation techniques that may require specially trained workers such as electricians, HVAC technicians, and plumbers.

Over the past two decades, the HVAC market has seen the emergence of mini-split heat pumps. These ductless solutions have largely emerged as supplemental heating solutions capable of providing lower operational cost than oil, electric resistance. Ductless mini split systems have become especially prominent in the Northwest, where Mini splits now consist of 25% of HVAC system sales. Like their traditional solutions, however these solutions are permanently installed, and are almost always installed by licensed individuals as they require certification from the United States Environmental Protection Agency for refrigerant handling and the support of a licensed electrician.

The realm of customer and easy DIY heating systems has largely been small electric resistance space heaters and window air conditioners. These are easily purchased and relatively inexpensive, however they use considerable electric for space heating. Reverse cycle room air conditions have been available, but their lack of active defrost cycle prevented them from operating below about 40 degrees Fahrenheit making them poor space heating solutions for all but very temperate climates.

Recently new products have entered the US market that can be accurately called room heat pumps (RHP)". These devices provide both heating and cooling through the usage of a heat pump with reversing valve and can be non-permanently installed in a standard sash window. The device can be powered via a standard 120-volt indoor electrical receptacle and typically draw between 5 and 12 amps, making them suitable in a shared 15A circuit providing the other loads on that circuit are small. What distinguishes them from reverse cycle room air conditioners is that they have a programmed active defrost cycle with an onboard condensate management system, allowing them to be installed in nearly any space with appropriate clearances. These devices do not require any permanent installation techniques like wall penetrations or permanent electrical connections.

The emergence of cold climate room heat pumps can be largely attributed to State of New York, New York State Energy Research and Development Agency, and NYCHA joint request for proposals for a new heat pump device aimed at public housing residents (Dubey, 2021). This effort was designed for multipronged benefits- the ability to remove antiquated heating equipment including fossil-based steam heat, the reduction of larger window air conditioners, which were inefficient and blocked much available light, and more comfort and control for users, who previously had very little ability to control the temperature in their homes. NYCHA, and NYSERDA wanted to procure 30,000 of these devices for their housing spaces. The RFP spurred the entrance of both cold climate room heat pumps by both Midea and Gradient (New York City Housing Authority, 2022). Investment by the city and NYCHA has continued into 2026, with an additional $38.4 million commitment for these heat pumps through the Clean Heat for All under the new administration (City of New York Office of the Mayor, 2026).

Table 2. Room Heat Pump Types and Performance Tiers

| EPA Type | CEE Tier | Est. Cost | Defrost | Min Temp | Notes |
|---|---|---|---|---|---|
| 1 | N/A | $400-$800 | Passive | Above 40°F | Same as reverse cycle Room AC |
| 2 | 1 | $600-$1200 | Active | 40°F-17°F | Not suitable for freezing climates |
| 3 | 2 | $800-$1200 | Active | 17°F- 5°F | Good candidate for moderate heating climates |
| 4 | Advanced | $2,500 + | Active | Below 5°F | Cold Climate Capable- same as DHP |

These new Type 2, 3 and 4 room heat pumps offer six unique value propositions that could be transformative to some until now largely missed market segments. First, their do-it-yourself potential makes them one of the very few HVAC solutions are both energy efficient and sold through retail channels. Second, they offer a highly competitive price point compared to other heat pump solutions, especially if the application was already intending to purchase a room air conditioner, making the incremental cost for the room heat pump potentially as low as only $300. Third, they are ideally suited to displace zonal electric heating systems (cadet type or baseboard) with a heat pump that uses roughly a third as much electricity per unit of heat delivered. Fourth, they provide utilities with low- and moderate-income programs an energy efficiency measure that is largely plug and play. Fifth, they are well suited for apartment and temporary applications that are otherwise very expensive and time consuming to introduce heat pump technology too. Sixth, in markets with limited heat pump experienced or refrigerant qualified contractors, these systems can provide a way for people to access heat pumps quickly, safely, and affordably.

Room heat pumps come with several market challenges. The most obvious is the lack of commercial availability and low levels of market awareness of these products. The physical constraints of the product are also challenging. They take up space in a window and most are only functional in vertical, sash-style windows. Saddlebag-style units, such as the Midea and Gradient products, also require additional space in front of the window both indoors and out, which further limits deployment opportunities.

One of the aspects under investigation in this study is customer perception and reaction to these room heat pumps. They are much like room air conditioners, but require a different use pattern to get the best heating experience. Specifically, if a customer continues to use their existing heating system in the same occupied space, the amount of heating provided by the room heat pump will be significantly compromised.

Positively, market availability is increasing, and early experiences have been strongly favorable. In 2024 the US Environmental Protection Agency established a test procedure (developed by the US DOE) for testing room heat pumps. This enabled the EPA to set a specification for these systems to qualify for the ENERGY STAR ® certification and for the Consortium for Energy Efficiency to define a bi-national program specification for required levels of performance (EnergyStar 2024). Regional energy policy actors are beginning to develop supportive programs for these products such as California Market Transformation Agency, Northwest Energy Efficiency Alliance, Vermont Energy Investment Corporation, and more. Furthermore, NYCHA's Clean Heat for All Challenge, the progenitor of the cold climate products leading the segment, announced a further $38.4 million investment in window heat pumps in February 2026, indicating government-recognized success in both the operational and manufacturing/supply chain aspects of these products.

Market adoption of this technology in the Northwest is likely to be driven by consumers who are seeking air conditioning being added incrementally to a space already served by an existing heating system. Where utilities and other programs can help most is in validation that room heat pumps are better options than classic "window shakers". In the Northwest, the demand for cooling has sharply increased over the last 5 years, from 38% of rental tenants in 2017 to just under half of all tenants in 2022 (Northwest Energy Efficiency Alliance, 2025). Rental properties built prior to about 2005 have virtually no built-in space cooling in the Northwest. This and similar studies are intended to provide energy efficiency organizations with information that can help leverage the thirst for supplemental cooling to use room heat pumps instead, which will have follow-on effects during heating season.

## Research Objectives

The goal of this research is to provide utilities, retailers, and other market partners with a better understanding of any unique challenges that could affect program design. The general research objectives were:

- Understand user experience, customer settings, run times, installation challenges, and other potential impacts which may affect performance or customer satisfaction.
- Develop energy savings estimates for different climate types and housing types.

- Develop program recommendations that can be used by utilities and other community-based organizations with an interest in using room heat pumps in their programs to save energy, improve comfort or air quality, serve disadvantaged populations, and/or other needs.

Parallel to this project are other projects involving lab testing and development of performance maps of the capacity and Coefficient of Performance of room heat pumps as a function of the type of heat pump and the outdoor temperature. While the heat pumps studied in this report are all Type 4 cold climate varieties with cut-in/cut-out operating ambient temperatures below 5°F (and stated by both manufacturers to be -13°F), the authors believe the operational learnings from the field study can be applied to Type 3 moderate climate systems which have cut-in/cut-out operating ambient temperatures between 5-17° F.

## Research Methodology

The field study consisted of five elements: site identification, procurement and deployment, customer interviews (qualitative), data logging (quantitative) and overall synthesis and reporting. The room heat pumps chosen for this study were the Midea PWHP and the Gradient All Weather systems. The study resulted in 26 systems being installed across the Northwest states, with four rounds of interviews and operational data collected from both the cooling season of 2025 and the winter heating season of 2026.

## Equipment

Both are type 4 cold climate capable units with exceptional performance range. They are designed for quick, semi-permanent installation into existing residential buildings that may replace or supplement existing electric resistance heating systems or window air conditioners. A key design constraint of these systems is that they are large and require sash type windows with window openings at least 25 inches wide and with space in front of and behind the window sill. Figures 1 and 2 are images of the Gradient system's inside and outside window sizing criteria, which is very similar to the Midea unit (Gradient, 2024).

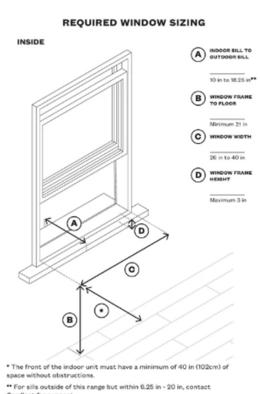


*Figure 1. Gradient Comfort interior window sizing requirements.*

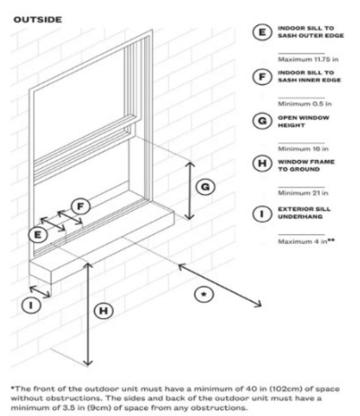


*Figure 2. Gradient Comfort exterior window sizing requirements*

While both are largely identical in terms of installation requirements, dimensions, and capacity. There were some moderate differences in performance, design, and condensate management systems. Both products offered handheld remote control or Wi-Fi capable models, however this study only included Wi-Fi models which were able to be remotely scheduled via proprietary phone apps. The Midea product made great efforts to provide consumers with energy consumption and performance reporting via their phone app.

The rated system performance of these systems are similar with HEER values above 9.0 and CEER values above 16.0 and exceed the CEE advanced tier specification. Reported capacity and efficiency values are shown in Table 1.

Table 1. Manufacturer-Reported Capacities and Efficiency Values

| | | Gradient | | Midea | |
|---|---|---|---|---|---|
| | Outdoor Temperature | Capacity (BTU/hr) | Efficiency | Capacity (BTU/hr) | Efficiency |
| Cooling Mode | 95° F | 9300 | 3.98 COP | 9010 | 3.46 COP |
| Heating Mode | 47°F | 9000 | 4.04 COP | 9000 | 4.0 COP |
| | 17°F | 9000 | 2.37 COP | 9000 | 2.42 COP |
| | 5°F | 7200 | 2.06 COP | 9000 | 2.0 COP |
| | -7°F | 5400 | 1.80 COP | | |
| | -13° F | | | 5050 | 1.41 COP |

**Site Selection and Recruiting:**

NEEA and Bonneville Power Administration provided funding for this project with the intention of defining regional energy efficiency measure(s) for room heat pumps. A core assumption is that occupant behavior and experience would largely be consistent across the region, but a diversity of sites was needed to capture different use cases and across the different climatic regions of the Northwest.

Informing usage patterns in the Northwest, utilities across Washington, Oregon, Idaho, and Western Montana were solicited for participation. Positive responses were received from many NEEA and BPA partners including Puget Sound Energy, Seattle City Light, Snohomish PUD, Portland General Electric, Energy Trust of Oregon, Idaho Power, Chelan PUD, Okanogan PUD, Clark PUD, Tacoma Power, Glacier Electric, Ravelli Electric, and Flathead Electric Cooperative. Utilities were requested to locate customers that met the basic qualifications for participation including heating and window type, size considerations, and, where possible, income qualified.

The final list of participating utilities well-represented the various ASHRAE Heating Zones that are served by NEEA and BPA- 4, 5, and 6. Not all utilities were able to provide potential participants.

Table 2. Sites by Climate Zone and Electric Utility.

| IECC Climate Zone | 4 | 5 | 6 |
|---|---|---|---|
| Utilities in Study | Seattle City Light, Puget Sound Energy, Clark PUD, Energy Trust of Oregon | Okanogan PUD | Flathead Electric Cooperative Ravelli Electric Cooperative |
| Total Sites | 16 | 3 | 7 |

Each participant was recruited through their respective electric utility to find the best matches in terms of home type, existing heating source, income qualification, and previous involvement in energy efficiency project or programs. While many participants have worked with utilities on energy efficiency projects previously, this screening method ensured that we had an appropriately sized sample in a reasonable amount of time. Over 90% of participants reported a pre-existing zonal electric resistance system in their residence such as a cadet wall heater or baseboard heater, and all but one retained their original heating system for supplemental heat.

Of the 26 sites involved in this study, 21 were single-family homes of various vintages, sizes, occupancy levels, and original heating sources. 5 were considered multifamily homes, with 4 homes possessing a party wall (i.e. a townhome or duplex) and one residence being a condominium in a historic apartment building. Two of the multifamily homes were opposite sides of a duplex, which were assigned separate models of heat pump for something approximating an A/B test.

**Qualitative Data Gathering**

Qualitative data is critical to understanding the user experience, especially with new technologies. Great care was taken in developing a series of interviews for each participant and their willingness to participate in interviews. Once accepted into the study, they were interviewed prior to receiving their unit, in the weeks following delivery and installation, at roughly the halfway point of the study, and at the conclusion of the study period. Each interview consisted of between 20 and 25 questions that were consistent between participants and were conducted virtually. The variety of responses to the questions allowed for the best understanding of how a user would interact with and think about their window heat pump. Questions were designed to assess both the facts of using and controlling equipment as well as opinions around usability, comfort, and general functionality.

Additional quantitative data was gathered as a response to novel occurrences in the field, generally after failures that prompted communication or service with the manufacturer. This gave us a brief window into the service networks that may support these products as the market matures, as well as how the company handled any issues noted by customers.

**Quantitative Data Gathering**

There are two study-derived datasets that are critical to the research questions posed as well as several external datasets leveraged for analysis. Study authors were hoping to understand the energy consumption of each unit as well as whether the unit was operating in heating or cooling mode.

As packaged window heat pumps are one of the few HVAC appliances with a standard 110V power outlet, they were an excellent candidate for tracking electricity consumption via an inline plug load logger. The Onset HOBO Plug Load Logger was selected for its ease of use, as study staff would not be attaching the logger to the equipment; that was the responsibility of the participant. Participants were instructed to attach the Plug Load Logger to the window heat pump ONLY (i.e. no extension cords or strips) and were instructed to leave it in place for 6 months at a time. Loggers were sent to participants and returned to the authors via a standard package delivery service.

Beyond the power consumption, it was desirable for study partners to learn about the type of space conditioning in use during the study period. Was it cooling the space? Was it providing heat? The least intrusive and most accurate method was determined to be through small temperature loggers placed on or inside of the air supply ducts of the window heat pump. Due to their convenient size, long battery life, sufficient data storage capabilities, and similar technological requirements as the plug load loggers, the Onset HOBO UX100-001 and UX100-011 were selected for participant uses. These loggers were set up to record only temperature at 5-minute intervals, though the -011 models could also track relative humidity. Like the plug load loggers, these temperature loggers were distributed to study participants to place in the prescribed location after the heat pumps were delivered and installed.

The data collection devices in this study are substantively similar to data collection performed by NEEA and Christopher Dymond in a 2023 study on previous iterations of room heat pumps (Dymond, 2023).

Both the plug load logger and temperature loggers were recalled by the research team at roughly the halfway point of the study to refresh batteries and download data. At the first data download, it was determined that several temperature loggers were not functioning as intended, resulting in the loss of data. The offending loggers were reset and replaced prior to sending back to participants. One plug load logger was indicating usage well beyond reasonable levels, so the logger was replaced for the second logging cycle over the winter.

The second logging cycle was also impacted by failed logging equipment. Several temperature loggers and one power logger did not contain any usable data upon return. Two sites failed to return their logging equipment as well.

In addition to the two study-supplied loggers and the 5-minute plug load and temperature interval data obtained for the majority of the study, external datasets were sought by researchers. Each site was approximated to the closest National Oceanic and Atmospheric Administration weather station in the Global Historic Climate Network often the nearest public airport, and hourly weather data including temperature and relative humidity was added to the analysis. Every site in this study was within 10 miles of a NOAA weather station. This data was used to infer the presumed efficiency of the heat pump based on manufacturers' and third-party testing. Researchers also worked with each participant's servicing utility to gather billing data for the duration of the study, as well as the 12 months of data preceding the study. This allowed for a whole-home energy analysis when combined with the logger data, and total savings provided by the heat pump could be quantified to each participant.

## Results

Results were divided into two main categories: qualitative and quantitative. Qualitative information was largely gathered through direct interviews with participants at four key points in the study and largely revolved around the user experience and comfort. Quantitative data included in this study includes plug load and temperature logger data collected from installed units, NOAA weather data, and monthly utility billing data for the study period as well as the preceding 12 months of usage.

Qualitatively, these products were very well received with a few minor exceptions. Installation and setup were largely considered easy, and most users had an operational unit the day they began installation. Nearly everyone remarked positively about the look and feel of the equipment and easy-to-use digital controls.

Quantitatively, these products generally appear to save significant amounts of energy during the heating season, but savings may be offset by increased summertime usage for those homes that added cooling. The products delivered appropriate return air temperatures for the space conditioning need. While not every home saved energy every month, every home did observe some levels of savings, and savings were observed year-over-year fleetwide.

**Qualitative Results**

Researchers had several research questions that were best addressed through qualitative data collection in direct user interviews. How easy was this product to install as a consumer? How well did it meet your expectations of being comfortable in your own home? Were there any aspects of operation that we should investigate further?

**Installation and Setup**

A key question in the Window Heat Pump User Experience Study revolved around the feasibility of a user acquiring and installing the window heat pump on their own, without professional installation. As a fully packaged HVAC appliance with a full refrigerant charge and simple electrical connection, devices such as a window heat pump are a good fit for self-installation at face value.

The devices ship with a kit for self-installation, including foam insulation blocks and tape as well as a metal mounting bracket. Both products include detailed installation instructions, and Gradient produced a video of the installation process that many users found extremely helpful to that process. Generally, the installation process can be completed without the removal of the existing heating equipment, but one location did remove baseboard heaters prior to installing their product.

Aspects of the mounting bracket design did not work for all windows and homes. Some required mild modifications during installation.

6 participants noted that the pressure fit bracket needed additional bracing due to a much thinner wall thickness or windowsill than the product was originally designed for. Three others noted having to fashion some additional hardware for external bracket feet sitting against their home- one with a historic home and clapboard siding and two with log walls. It is presumed that the original application of these products- New York City public housing projects built between the 1930's and 1960's- influenced design decisions that may not be appropriate for all home types or vintages.

Each participant was able to successfully install and start up their product, usually with the assistance of one other person to facilitate lifting the 120-pound-plus device into position. No participant required direct assistance from study staff or manufacturers, though some did report that some inconsistencies in the instruction manual did slow them down. Several users likened the process to the installation of a major appliance like a dishwasher- largely an easy process with bulky equipment, but much easier with some basic technical skills.

**Comfort**

Comfort is perhaps the most critical aspect of the user experience. Even with great dollar savings and other financial benefits for using a product, many users would stop if the activity caused discomfort. When it comes to heating and cooling choices, particularly when there may be other options available, a comfortable experience leads to more predictable equipment use due to the user not constantly changing settings or reverting to their previous heating system in the quest for comfort.

Nearly every user remarked positively about their perceived comfort for the duration of the study, whether in terms of indoor air temperature, noise levels, look and feel of the equipment, digital features, or reliability. Of the 26 sites, 25 communicated feeling more comfortable in their living space in the winter, and all 26 responded positively about cooling season. The major outlier in the winter was due to a less-than-ideal installation in a back bedroom, which was not able to provide heating to other parts of the home. A common positive remark was regarding the perceived humidity- a majority of participants noted that their homes no longer felt "dry" in the winter, and one noted that their throat was no longer dry on winter mornings. This is likely due to the lower output temperature of the heat pump versus electric resistance or fossil-fired heating systems.

Several also noted positive reactions to aspects of these products that were not directly investigated through this study, including dehumidification abilities. No user left the study with uneasy feelings about the product, and most have shared their experiences with this product among their friend groups, usually as encouragement to get their own. No user plans to remove or modify their heat pump following this study.

**Temperature Settings**

Indoor air temperature was found to be largely predictable and comfortable during all seasons of the study across most indoor spaces. For rooms directly served by the window heat pump, there were zero complaints of the equipment failing to maintain warm or cool areas. Most users noted the gentle heating and cooling of the heat pump as opposed to their existing, mostly electric resistance heating. This was the most mixed reaction of the study, with many expressing some level of apprehension over the gentle heat in the deep winter. Most users were able to "set and forget" their window heat pump, leaving the thermostat set at the same temperature all day and night. Four users noted utilizing a mild nighttime setback for comfort reasons, with a slow morning ramp up to the daytime indoor temperature. Indoor temperatures only varied from the "comfortable" rating when the window heat pump was asked to condition more space than designed for (roughly 750 $ft^2$) or when significant obstructions such as walls, long hallways, or other zonally-limiting features are in a home.

**Perceived Noise Levels**

Noise levels were also largely comfortable for all users. In fact, the majority of users were pleasantly surprised by the "whisper-quiet" functionality of both products at low settings. One user who was more experienced with window air conditioners noted that he generally forgot about the heat pump it was operating so quietly. Even at the highest operational settings, indoor noise levels were low enough to have a quiet conversation in close proximity to the register. Outdoor noise levels were generally not found to be obtrusive- even when directly asked, most participants could not recall an event where outdoor noise was an issue, even in tightly packed urban residences.

One area where noise was a moderate concern for many was when the active condensate management system was operational. Both the Gradient and Midea products feature active condensate pumps, which collect and exhaust liquid condensate through a pressurized atomizer. The sound of the pump spooling up was slightly alarming at first, but the majority of participants got used to the noises. It was observed by many in the study that the condensate system was more active during cooling, where it would fire several times per day.

Later in the study, several participants, particularly those testing Midea products, reported significant noise from the condensate system pumps. This was determined to be a combination of two factors- general filter maintenance needs not being met and a condensate filter design that prematurely clogged, starving the condensate pump of water even when the condensate tray was full. It was found that a new filter design with a different medium nearly eliminated these noise events, and that increasing filter maintenance to a monthly cycle would reduce clogging versus the manual's recommended 6-month cleaning cycle. Gradient products did not experience the same issues in the field, though their manual indicates a shorter, 3-month maintenance cycle for condensate filters.

Indoor and outdoor noise levels were not directly measured as a component of this study, but outside of incidental issues, the devices were broadly thought of as "quiet" by end users.

**Aesthetics and Physical Properties**

Users were very pleased with the physical attributes of the devices. Both designs had sleek, modern aesthetics that multiple participants described as "futuristic." Additionally, the saddlebag profile of the devices was a novel approach to most users. For those that replaced an existing window air conditioner with one of these products, they remarked on the additional light available as well as the new interior flat space available on top of the unit. Participants did remark that the size of the unit complicated selecting the appropriate location, and the interior air handler did impede into limited spaces. Weight was also a concern of more than half of the participants regardless of manufacturer. With equipment weighing at least 120 lbs., moving it inside was a multiple-person job, and one user in particular was worried about the weight of the equipment on the fiberglass window frame he intended to install it in.

**Digital Features**

Digital features developed by both manufacturers were also attractive to participants that utilized them. While not necessary for operation, both units were able to utilize scheduling and remote controls when activated via a native app. Midea's product included additional features such as energy consumption and trends for enhanced consumer-level analysis. When connected to the internet, Midea and Gradient engineers were able to view different sensor metrics remotely to diagnose and assist in troubleshooting issues. Several users noted that with the maintenance needs of this equipment and the potential for complex faults, it would be extremely helpful to the end user to receive fault alerts, maintenance reminders, and other operational helpful hints. Users of both products noted that faults and error codes were only viewable on the machine itself and the app would not inform you if your unit was malfunctioning.

**Perceived Reliability and Performance**

Users also by and large found the products extremely reliable. Of the 26 units tested in this study, 20 required no user intervention for the duration of the study period outside of basic, seasonal maintenance of user-accessible filters, which was performed by each participant. Otherwise, they operated for at least 12 months (as of 6/10/26) with zero faults or noted degradation in service. Failures and faults will be further discussed in the next section, but those units that did experience a failure were either fixed or completely replaced with expediency. Equipment uptime across the study period was more than 99%, and users found they could depend on this new technology to perform as expected in all weather conditions.

Users also had a positive outlook on the perceived cost of ownership. Prior to study data being available for analysis, participants were asked at each interview how they felt the equipment impacted their bills. While most said they had not investigated, several users coming from electric resistance systems felt their bills were lower, and they were more likely to keep their residence at a comfortable temperature than if they continued to utilize their cadet and baseboard heaters. Cost of ownership will be further discussed and quantified in the Findings section.

When asked for a general level of satisfaction, every user found they were 'satisfied" to "extremely satisfied" with the product and their experiences to date. No user found themselves unsatisfied with their product, and no user is planning on removing their heat pump following the conclusion of the study period.

**Equipment Faults, Failures, and Service**

Over the course of the study, there were several equipment failures that required consultation and occasional direct qualified service or, in one case, a complete replacement of the entire unit. Each participant that had experienced a failure was returned to service, generally within 10 days of notifying the manufacturer of an issue. Failure types were different depending on the manufacturer, with a few consistent trendlines.

**Midea**

Of the 13 Midea PWHP's in the study, two had failures requiring service by a trained professional, one had a delivery issue requiring new brackets, and two more required new condensate filters that were under development by Midea engineers. Midea is an established manufacturer of many home appliances and already has a network of qualified service providers in the Northwest, and the company had several members of the R&D team available for consultation as needed.

Midea PWHP's also appeared to have a somewhat consistent issue with the condensate management system. In the Midea design, condensate from the air handler was collected in a small trough on the inside of the unit. Float switches in this trough would indicate approximate levels to the system, and when an appropriate volume of water collected, the condensate pump would be activated to pull the water out of the trough and push it through the atomizer to mist the water outside. To prevent clogging, a series of flat and barrel filters were utilized, which are intended to be cleaned by the end user semi-regularly. As noted previously, increased filter maintenance was a functional stopgap, with upgraded filters from the manufacturer ultimately solving the problem. Only three of the 13 Midea products were confirmed to have received new filters by the conclusion of the study period.

Aside from the above-noted delivery issues, the only faults experienced in the field were due to issues with this system. The two PWHP's that required trained service both had the main condensate pump fail due to water starvation. These were quickly replaced on site and in situ by trained staff, and both participants were returned to normal operation the day of service.

The two other troubled units seemed to be telling the story of an early condensate system failure as well. While not showing any noted failure codes, each unit would make noises like the water pumps were spinning up and the outdoor atomizer would eject small, inconsistent volumes of water. Even when filters were cleaned and in some cases replaced, this issue was somewhat persistent. Midea is still working with study participants to find the best solution to this failure mode, but has provided filters with a different medium as a stopgap measure. (this will have an answer by the final draft). As of March 2026, one participant that received the new filters reported an elimination of condensate noise.

**Gradient**

Gradient All Weather heat pumps did not experience the same condensate issues as the Ideas, and as a whole their failure rate was less than half that of the other product. Of the 13 units in this study, two experienced faults requiring a trained service technician. The first failure was due to a faulty indoor air temperature sensor, which locked out the thermostat and prevented the unit from operating. The second failure was ostensibly due to a faulty clip, but further operations demonstrated the need for a wholesale replacement of the unit. Gradient shipped to the customer. In both cases, Gradient had to send a representative from their home office in San Francisco as there was no local service option for this product. The company indicates an eventual desire to stand up a service and repair network in the Northwest, but does not have the market penetration to make that venture practical at the moment.

All repairs required for this study were performed under warranty at no cost to the participant or study authors.

## Quantitative Results

**Operating hours**

A key intention of this study was to determine operating hours by Mode, Season, temperature bin, and ASHRAE Heating Zone. Parallel laboratory testing was conducted to determine actual efficiency in line with known testing standards. By applying lab data to the operating hours, general field efficiencies and consumption can be determined with a reasonable level of confidence. Operating hours were determined with plug load data and are rounded to the nearest 5 minutes.

**Mode used by participants**

Both types of equipment have similar operating modes- heat only, cool only, and automatic. Both products also have an “eco” mode, which reduces pump speed and outputs. Researchers were interested if users were setting these devices up seasonally or just letting them run continuously without much interaction. Additionally, a previous version of this study with an out of production, less capable version of this product had frequent mode switching to maintain temperatures (Dymond, 2022). Researchers were curious if that bug had been engineered out of the next generation of products.

A further delineation of mode types was possible after reviewing initial plug load data returns. The most variable statistic in the plug load data was the wattage- overall, other metrics such as voltage and power factor were somewhat consistent over the course of the study. When examining wattage across the fleet and between models, some clear trends became apparent that could be clearly defined for the rest of the analysis: Wattage readings could be grouped into several large tranches that broadly represent a type of operation including standby, fan only, reduced capacity, moderate capacity, and full capacity. The names and definitions of the usage modes are below alongside % of total hours in each mode. Other binning methods for wattage were considered, including 100W bins, 10W bins, and others, but those methodologies introduced significant extra statistical noise that could be reduced by simplifying the binning method.

Table 3. Usage Modes and % of Total Time in Each Mode.

| Usage Mode | Recorded Wattage Range | % Cooling Hours | % Heating Hours | % of Total Fleet Hours |
|---|---|---|---|---|
| Off | 0 Watts | 8.18% | 0.63% | 4.83% |
| Standby | >0 Watts – 15W | 53.79% | 27.28% | 42.02% |
| Fan Only | >15 Watts- 45W | 4.33% | 5.08% | 4.66% |
| Eco Mode/ Reduced Capacity | >45 Watts- 500W | 27.86% | 53.66% | 39.31% |
| Medium power | >500W – 900W | 5.20% | 10.06% | 7.35% |
| High Power | >900W-1400W | 0.44% | 2.71% | 1.45% |
| Max Power | >1400W | 0.01% | 0.19% | 0.09% |

According to interviews, most participants recalled setting their product to cooling settings during the summer and heating mode during the winter. Very few (2/26) relied on the "auto" setting for temperature maintenance. When looking at delivered air temperatures, a proxy for the heat pump mode, it was observed that during the cooling season, 98% of output temperatures were below 60F when power was being consumed by the heat pump.  At no point was any temperature noted that would have proxied to heat. In the wintertime, there are several times that maximum power consumption does not translate to a maximum return temperature- this was often observed to be a result of a defrost mode that is hard coded into the heat pump. Figure 3 demonstrates the consumption curve and return air temperature of a Midea in Seattle on January 25, 2026, the coldest day of the study. There are several defrost periods over the course of the day, including the 06:00, 08:00, and 18:00 hours. Note the maximum draw (light blue) occurs as the lower return air temperatures (Dark Blue) are logged.


*Figure 3. Power Consumption (Light Blue) and Return Air Temperature (Dark Blue) for a Midea PWHP in Seattle, WA, Jan 25, 2026*

## Fraction of home conditioned

Room heat pumps are zonal products by default. They are installed in a single window and their output is only from the unit themselves- there's no ducting or refrigerant lines to move air to other parts of the residence. In this study, none of the participating sites were small enough for just one unit based on sizing guidance provided by the manufacturers. The majority of sites placed the heat pump in the largest common area (living room, kitchen, etc.) and would rely on their incumbent heating system or supplementary heat sources to heat the extremities.

Many homes were able to condition nearly ¾ of all floor space with a room heat pump, especially when the home is one floor. Multistory homes noted roughly half of the home conditioned by the room heat pump, with the incumbent heat making up the difference. Most single floor residences in the study were able to move enough air via fan to provide some level of space conditioning to the extreme back rooms, though two did note needing an electric heat dish in the wintertime in the furthest rooms from the heat pump. It should be noted that conditioned space percentages were rough estimates by the participant and may vary due to subjectivity.

**Interaction with other heating and cooling sources**

As zonal products with limited reach, users often had to rely on their old space conditioning systems to make up for where the room heat pump was unable. Participants were advised to set their existing systems significantly lower than the heat pump to allow for the heat pump to provide most heating energy. Similarly, when providing cooling, the heat pump should be set significantly lower than the incumbent systems. It was critical that participants were careful not to set the heat pump opposite of what the house was providing (i.e. cooling from the heat pump and heating from the furnace). Generally, the heat pumps appeared to take a large load off the incumbent heating systems, as many participants were reporting lower monthly bills, which were somewhat proven in the billing analysis. Several homes did have increased consumption, and some homes had increased bills with lower consumption as a result of rate increases over the course of the study.

**Billing Analysis**

A utility billing analysis was conducted for participants as data was available. Each participant was requested to provide a total of 26 months of billing history including up to a year of billing prior to the start of the study and every bill for the study period. As of June 2026, only 11 complete billing histories were provided for analysis. Efforts are underway to access the remaining bills.

Of the 11 sites with complete billing histories, 8 showed reduced kWh consumption and 5 of those showed reduced year-over-year bills. The largest savor was a multifamily apartment where a single Gradient heat pump replaced older, 1970's vintage electric resistance baseboards. These participants saw a nearly 3,000 kWh reduction, year over year, which was a total utility bill savings of over $450.00, even with the addition of cooling where there was none before. Another site, this one a townhouse, observed similar kWh and dollar savings, with over $420 saved year over year.

Not every home was a saver in the user experience study. There were two homes, one in Western WA and one in Montana, that observed some moderate energy savings between 300 and 400 kWh/year but did not see reduced bills due to rising energy tariffs, and in fact still spent nearly $130 more year over year despite saving energy. They may have avoided some cost increases with the window heat pump, however.

There were two other single-family homes, one in Montana, one in Western WA, that showed significant energy increases that may not even be entirely heat pump related. One home had a 700kWh increase over the year, and another was an extreme outlier with nearly 1900 more kWh recorded between April 2025 and 2026 than between the same months in 2024 and 25. Other factors, including changing occupancy, impacted the extreme outlier, and increased consumption was more than was recorded by plug load loggers at the site. Table 4 contains the billing analysis for sites to date. Both products have comparable results from the billing analysis, with some positive results and some negative results.

| Site | kWh Savings | Total Dollar Savings |
|---|---|---|
| 10D | (692) | ($74.08) |
| 10F | (88) | ($56.73) |
| 10H | 315.3 | ($66.51) |
| 10I | 1935.04 | $325.45 |
| 10K | 2072.92 | ($182.06) |
| 10L | 2899.12 | $453.81 |
| 10M | 1383.34 | $247.99 |
| 11I | (1837.19) | ($528.44) |
| 11G | 393 | ($133.58) |
| 11J | 1342.71 | $135.47 |
| 11M | 2716.84 | 422.38 |

## Conclusions and Next Steps

**Key Findings**

Cold climate-capable room heat pumps appear to be a feasible and effective way to provide advanced space conditioning to a variety of residential spaces with a low impact on the resident and facility. Their quick installation without permanent attachments makes them attractive for homeowners and renters alike, and their efficiencies are equal to or better than many equivalent mini split heat pumps that require professional installation. Study participants were overwhelmingly satisfied with both Midea and Gradient products. While there were some minor product issues during the course of the study, both models seemed to operate consistently and any failures seemed incidental. Any issues were promptly resolved through the manufacturer.

Even as a primary method of heating and cooling, these products very rarely draw their maximum rated power. Analysis points toward the maximum power draw only being called for less than 2 percent of the time, and often as a momentary draw during a defrost cycle. Most active heating and cooling appears to occur in the Eco/Reduced capacity mode that draws less than 500W, with Medium and High modes making up a tenth and fiftieth of the total heating mode time respectively. There appears to be minimal risk of electrical issues from the draw of these devices, as even the momentary maximum amperage was less than 13 amps across all sites.

The capacities of both zonal products at 9,000+ BTU/hr may be a bit much for small rooms, but not enough for many large, open-floorplan areas. Occupants wanting to utilize these products may want to consider multiple units for medium-to-large residences and may want to explore other options with lower capacities for bedrooms and other smaller spaces that may be closed off.

Data gathered from this user experience study will be combined with laboratory data collected on these products by NEEA, Calm, and others to assist in developing a utility incentive structure for cold climate room heat pumps in the Pacific Northwest.

**Program Recommendations**

As an easily installed, efficient heating and cooling device, these products may be selected for inclusion in utility energy efficiency programs or housing aide programs, as they are currently with NYCHA and several other regional programs in a pilot capacity. To better guarantee energy savings while maintaining occupant comfort, a few program recommendations came from data collected in this study.

Window type and size is very important to a successful installation. While these products fit a wide variety of sash windows, the 26.5” minimum width does limit a large subset of potential users, especially in older homes. Additionally, the required clearances above the floor both inside and our further limit installation options. This product is not appropriate for users with horizontal sliding or casement windows, which would require full window replacements to be compatible with these products. Great care should be taken during window measurements to ensure that the narrowest point in the window is accurately measured to reduce installation issues.

Occupants will likely have access to two fundamentally different heat sources after installing this equipment. The pre-existing heat source is expected to be much less efficient than the window heat pump, so users should reduce loads on the older system though a significant setback of that thermostat- at least 5 to 7 degrees below the setting of the window unit. Similarly, pre-existing cooling should be set 5 to 7 degrees higher than the window unit during cooling season, but there will likely not be many cases where a window heat pump is displacing cooling equipment in the Pacific Northwest.

Users of this equipment should take care to seasonally change modes instead of relying on the auto setting- i.e. set the window heat pump to “heat” during heating season and “cool” during cooling season. This will prevent mode switching and reduce energy consumption.

Critically, while these devices are able to be installed by most end-users, mass deployments should leverage a white glove installation service similar to dishwasher and refrigerator delivery and installation services offered by many big-box retailers. In original NYCHA installations, the units were installed by day-to-day maintenance staff, and not certified HVAC technicians or electricians. This will ensure the equipment is properly set up, safely attached, and insulation is properly placed, leading to better energy savings for the end user and more consistent savings outcomes for the programs supporting these products.

As the market further develops, similar products aimed at more moderate climates will be coming on the market. Manufacturers such as General Electric already have a 10°F capable room heat pump nearing market readiness at a fraction of the price of these units. More analysis, lab testing, and user testing of these products across the varied Pacific Northwest climate zones will be necessary to understand potential savings and develop incentive schemes to motivate adoption.

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