Gas Backup as a Demand Response Resource? Exploring Potential Savings and Demand Response Benefits of a Residential Dual-fuel HVAC System in the Pacific Northwest

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ABSTRACT

This paper presents preliminary findings from a Northwest Energy Efficiency Alliance (NEEA) pilot that analyzes the efficiency and demand response (DR) performance of a novel residential dual-fuel system currently installed in 13 homes in Washington. The system consists of a ducted, single-zone air source heat pump paired with a hydronic air handler. The hydronic air handler is served by a tankless gas water heater that can meet the full home heating load while also serving domestic hot water demands. Using control technology developed by iFLOW, the systems can run gas and electric heat in series (unlike a conventional ducted heat pump with gas furnace backup which can typically only run one system at a time) or independently as the controller optimizes operation based on the home's loads and utility DR needs.

The pilot seeks to understand both the overall efficiency of these systems and their ability to be used in DR programs. DR capability is being tested under a variety of conditions by sending a signal to the equipment directly to reduce load. This paper presents the findings across several areas:

- Installation lessons learned and operational findings
- DR performance
- Overall energy performance and savings potential
- User experience and comfort impacts

Introduction

Over the past decade, ducted heat pumps have had a steadily growing market in the Northwest (BPA 2023), reaching an estimated 180,000 units per year sold in the region in 2024 (BPA 2024). Many of these heat pump systems are being installed with electric resistance backup that is often utilized more than would be anticipated based on climate conditions (Douglass and Rushton 2024). This rate of heat pump growth and associated electric resistance use could increase critical peak load on the grid significantly if not managed appropriately (Winer 2026). This is in an overall context of load growth in the Northwest: current predictions indicate that demand will exceed available resources by 2030 due to transportation and building electrification (Winkel 2023).

Dual-fuel residential space heating provides several potential benefits to meet these increasing demands on the grid. These include the ability to switch between fuels to optimize cost and emissions as well as providing grid flexibility during peak demand periods, curtailing some of the anticipated heat pump load growth. To explore this potential further, the Northwest Energy Efficiency Alliance (NEEA) initiated a field study in 2024 to study a novel dual-fuel technology pairing that consists of a tankless gas water heater, hydronic air handler, and ducted, single-zone air source heat pump ("the system"). As described in more detail below, the system uses technology developed by iFLOW[1] to deliver space heating and cooling as well as domestic hot water to a single-family home. The system can operate in multiple modes and curtail heat pump usage in response to demand response (DR) signals. This paper gives an overall description of the field study parameters and summarizes its preliminary findings.

System Description

System Overview

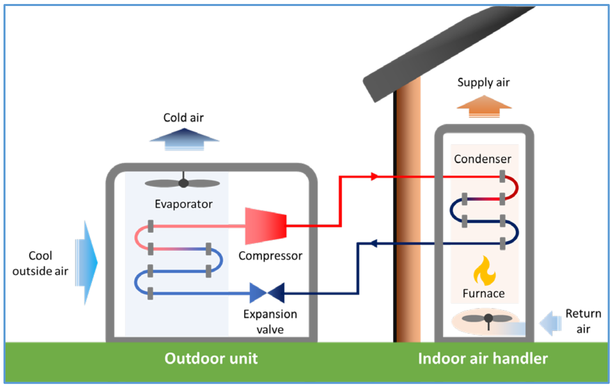
The system tested consists of a natural gas tankless water heater (TWH) combined with an electric air source heat pump (ASHP) and hydronic air handler serving a ducted single-zone system. The system provides domestic hot water via the TWH, space cooling via the ASHP, and is unique in its ability to provide space heating in one of three modes[2]:

- **Heat pump mode (electric only):** the unit operates like a standard heat pump, using the heat pump to supply heat and fan from the hydronic air handler to supply air.
- **Water heater mode (gas only):** the unit provides heat using only the hydronic air handler supplied by the tankless gas water heater.
- **Simultaneous mode (dual-fuel):** Both the heat pump coil and hydronic coil are used to supply heat simultaneously, relying on both gas and electricity.

Simultaneous mode differs from standard dual-fuel systems which typically can only operate the heat pump or gas furnace at a given time, since the furnace is upstream of the heat pump coil, as shown in left side of Figure 1.[3] Conversely, the system studied has the heat pump upstream of the gas hydronic coil as shown in the right side of Figure 1. This allows the system to run the ASHP and hydronic coil simultaneously, with the TWH ramping in output[4] to supplement the ASHP as its capacity declines with decreasing outdoor air temperature.

NEEA opted to install minimum efficiency, single speed ASHP models to better understand the capability of the system to improve efficiency and reduce costs compared to a standard ASHP model. NEEA also wanted to better understand simultaneous mode operation, which would not have been needed with a variable speed or cold climate ASHP in the study's mild climate zone. The full list of specified equipment is included in Table 1.

[1] https://www.iflowhvac.com/
[2] In this paper, we use the term "mode" to refer to the way the system is operating at any given time. The system also has "settings" of similar names described later in the paper. These settings control what mode the system is in at a given time based on outdoor air temperature.
[3] While precautions can be taken to mitigate this risk, this configuration is common industry practice to prevent rusting on the furnace heat exchanger during cooling.
[4] The TWH model used has a maximum turndown ratio of 15:1.



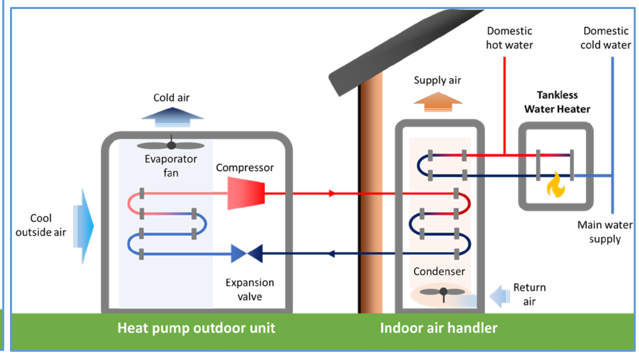


Figure 1. Schematics of typical ducted dual-fuel configuration (left) and dual-fuel combination systems tested ("the system," right).

Table 1: Specific equipment selected.

Equipment Component	Specific Model Selected
Air Handler	iFLOW hydronic air handler (iFLH-18000W)5
Air Source Heat Pump	Trane XR14 single speed heat pump
Tankless Water Heater	Navien tankless water heater (NPE-240S2)

System Control Settings

A key component of the system is the iFLOW controller which can integrate any ASHP and TWH with a hydronic air handler. This controller also enabled the use of the iFLOW control dashboard which allowed system settings to be controlled remotely, including triggering DR events either through direct control (i.e. manually switching the mode through the dashboard) or through a DR event scheduler. While this controller was imbedded in the iFLOW hydronic air handler units studied, it is also available as a standalone unit that theoretically could be used with any combination of systems. This capability made it particularly attractive to NEEA for its future scaling potential. Not to be confused with the operating modes of similar names, the system had the ability to be controlled to one of three settings through the dashboard:

- **Hybrid setting**: the unit operates in heat pump mode (electric only) down to a specified outdoor air switchover temperature and then switches to water heater mode (gas only).
- **Hydronic setting:** the unit operates in water heater mode (gas only) regardless of outdoor air temperature.
- **Simultaneous setting**: the unit operates in simultaneous mode (dual-fuel) down to a specified outdoor air switchover temperature and then switches to water heater mode (gas only).

Notably, at the outset of the study the simultaneous setting was understood to operate differently than just described. As originally understood, the simultaneous setting should have operated the unit in heat pump mode down to the switchover temperature and in simultaneous mode below this temperature. The manufacturer has since developed this control capability, but this is not how the simultaneous setting functioned for the duration of this study, severely

[5] https://www.iFLOWhvac.com/iflh-18000w/

limiting the application of simultaneous mode for supplementing heat capacity at low outdoor temperatures.

Field Study Implementation

Site Selection

Site selection began in September 2024 from a pool of utility employee candidates[6] with homes located in and near Vancouver, WA. The intent of the study was to be a proof of concept for energy savings and DR potential as well as to identify barriers to scaling for utility programs that might want to use the technology. It was not the intent of the study to develop a representative sample; results found are directional, rather than broadly indicative of average energy savings throughout the region. Ultimately 13 sites were selected. Key criteria for the selected sites included:

- Single-family homeowners with no plans to move within the year
- Existing gas connection (minimum ¾" to support TWH)
- Existing central ducted air-conditioner or heat pump
- Water heater and furnace/heat pump co-located within 10' of each other
- Ductwork capable of supporting a heat pump
- No galvanized pipes (due to potential clogging issues with TWH)
- Physical space for iFLOW unit

Sites were selected first by sending out a survey to gather a list of interested participants, followed by phone screening calls, and site visits for all potential sites. During the site visits, information was collected to calculate loads and overall feasibility was assessed. In the end, all sites selected had existing ducted AC-furnace combinations with existing gas storage water heaters. These AC-furnaces and water heaters were all located in garages with distribution ductwork through the crawlspace and attic. All but one of the systems were downflow units.

Equipment Sizing

Once sites were selected, loads were calculated using the BetterBuilt NW HVAC Sizing Tool for all sites.[7] Heat pumps were generally sized to meet the calculated cooling load, while also attempting to ensure units were sized small enough to trigger the need for gas heat in the relatively mild Vancouver, WA climate.[8] This was a delicate balancing act for each site to avoid inadvertently undersizing cooling compared to the existing system,[9] while also ensuring that gas heating operation would be triggered on the coldest winter days. This was of particular interest to NEEA to study operation in the simultaneous setting (as understood at the study outset).

[6] Utility employee candidates were chosen to manage the risks of the project, but do not reflect a random sample and may not fully reflect the average usage patterns or opinions of the general population.
[7] https://hvac.betterbuiltnw.com/Account/Login.aspx?ReturnUrl=%2f
[8] 2025 ASHRAE 99% Heating DB of 27.6 degrees F and 1% cooling dry bulb of 88.1 degrees F.
[9] Especially because the Vancouver area regularly has heat waves that vastly exceed the 1% design cooling temperature.

The design switchover temperature (i.e. the outdoor temperature at which supplemental heat would be required) was calculated for each site by overlaying the design heat load with the heat pump capacity curves. Table 2 summarizes design heating and cooling loads for each site, along with selected equipment size and calculated design switchover temperature.

Table 2: Design loads, installed ASHP size, and design switchover temperature.

Site	Design Heating Load (BTU/h)	Design Cooling Load (BTU/h)	Installed System Size (tons)	Design Switchover Temperature (F)
1	39,700	23,800	2.0	40
2	52,600	38,100	3.5	36
3	37,200	26,700	2.5	36
4	42,800	34,200	3.5	32
5	42,700	33,700	3.0	36
6	40,900	31,300	3.0	35
7	35,800	26,900	3.0	32
8	35,100	32,100	3.0	32
9	33,700	30,900	3.0	31
10	37,100	27,100	2.5	37
13[10]	46,900	35,900	3.5	34
14	34,500	25,000	2.5	35
15	36,500	24,800	2.5	36

Once the final sites and equipment sizes were selected, project installation began. Originally, the hope had been for all units to be installed in time for winter 2025 data collection, but due to delays in receiving equipment and contractor scheduling availability the first system wasn't installed until December 2024, with the final system installed by May 2025. Figure 3 provides an example of what the final installed system looks like.

[10] Originally the study had planned for 15 sites, but two sites were ultimately removed from the study.

Figure 3. Final installed system at Site 1 (left) and Site 7 (right).

Metering Configuration

To obtain the data necessary to answer the research questions, metering equipment was deployed to collect 1-minute interval data. While initially the plan had been to obtain the vast majority of points via the iFLOW system dashboard, integrating with that system proved time consuming and challenging. Therefore, supplementary metering equipment, summarized in Table 3, was deployed in November 2025 to ensure data integrity and access.

Table 3: Metered Data Points

ID	Data point	Unit	Meter Type	Accuracy/ Range	Purpose
1	Outdoor air temp	F	EKM - 1-Wire Temperature Sensor DS18B20	+/- 0.5°C from -10°C to +85°C	Calculate space heating output from combined hybrid system, gas TWH, and/or heat pump.
2	Return air temp	F			
3	Mixed air temp	F			
4	Air temp after heat pump coil	F			
5	Supply air temp	F			
8	Blower fan electricity use	W	Split-Core CT, 200A 0.6" ESCT-015-200UL 1 CT for single-phase 120v 2-wire power	+/- 0.1% for 0-200A	Calculate heat output (using air temperatures and calibrated air flow rate).[11]

[11] We did a one-time measurement at each site to develop a relationship between the blower door fan power (W) and supply air volume (CFM) using the Energy Conservatory Digital TrueFlow Solution. A one-time measurement of blower power draw will also allow approximating power draw at different fan capacity (%).

9	Space heating water flow rate	GPM	3/4" Stainless Steel Pulse Output Hot Water Meter - HOT-SPWM-075-CF	5% from Q_min (1.8 c.f./h) to Q_transient (7 c.f./h); 2% from Q_transient to Q_max (176.5 c.f./h)	Calculate tankless water output energy going to hydronic coil.
10	Hydronic coil, entering H20 temp	F	EKM - 1-Wire Temperature Sensor DS18B20	+/- 0.5°C from -10°C to +85°C	Calculate energy from water heater transferred to air through hydronic coil.
11	Hydronic coil, leaving H20 temp	F			
12	Water heater, entering H20 temp	F			
13	Water heater, leaving H20 temp	F			
15	Heat pump electricity consumption	Amp	Split-Core CT, 200A 0.6" ESCT-015-200UL 2 CTs for split-phase 240v 3-wire power	+/- 0.1% for 0-200A	Calculate heat pump energy use and efficiency
16	TWH natural gas consumption	ft^3	EKM 3/4" Pulse Output Gas Meter (EKM-PGM-075)	$Q_{min} \le Q < 0.1 Q_{max}$ ± 3% $0.1 Q_{max} \le Q \le Q_{max}$ ± 1.5%	Calculate Navien TWH energy use and efficiency

Data Gaps and Adjustments

Issues with sensors and site connectivity caused some sites to have an incomplete set of data points. Table 4 documents key data gaps and any adjustments made to resolve the data gap. Because of data gaps and instances of low data quality, it was not possible to determine field test efficiency for all sites. Of the thirteen sites metered in the study, it was possible to calculate a field efficiency for seven sites: 1, 3, 4, 8, 10, 13, and 15. Of these, sites 1, 4, 8, and 15 had their airflow scaled based on waterside heating output which was calculated based on circulator flow and hydronic entering and exiting temperatures.

Table 4: Metered Data Points

Data Gap or Low Quality Data Point	Negative Impact of Data Gap	Adjustment (if possible)
Supply air temperature data for sites 7 and 14	Unable to determine space heating output	None. Supply air is essential to calculating space heating output.
Mixed air temperature for site 6	Unable to determine space heating output	None. Considered using return air temperature in place of mixed air temperature, but that would have underestimated efficiency.

Circulator flow for sites 1, 7, 13	Unable to determine hydronic status or circulator power	Developed a formula to determine circulator status (on or off) based on other data points from the hydronic system: hydronic entering temperature, gas consumption, and blower fan. Assumed a constant flowrate of 50% from circulator tests.
Blower fan tests for sites 4 and 5	Not able to determine supply airflow.	Used site-specific power from sites 4 and 5, but applied average airflow equations based on three most similar sites: 10, 13, and 14.
Site-specific OAT was significantly impacted by garage temps	Unable to determine results by outdoor air temperature (OAT) bin	Used average outside air temperature for Portland for all sites when calculating results by OAT. This also simplified analysis because temperature always aligned with date.
Observed that switchover temperature settings periodically reset in the dashboard	Analysis by switchover temp are using the wrong reference temperature for unknown periods of time.	None. The impact of switchover temperature on performance is still assessed in the results section using the intended switchover temperature, which was still true for the majority of the test period. It is expected that this data gap did not change the findings on switchover temperature.
Observed that operating mode settings periodically reset in the dashboard	Operating mode setting is unknown for periods of the study	Developed an operating mode designation based on metered data instead of recorded settings. This was needed anyway because even if a unit is set to run in the hybrid setting, it will change to water heater mode if the outside air temperature is below the switchover temperature.

Test Plan and Demand Response Testing

To test the performance of the system in each of the three modes and ensure cold weather data was captured in each of the modes,[12] the sites were split into two study groups of equal size with similar distributions of home size, year constructed, and ASHP size. A weekly test plan was developed that specified what settings the homes in each of the study groups would be set to during that week (hybrid, hydronic, or simultaneous). Using iFLOW's remote control dashboard, the setting was set at the start of each week for each site and documented in a spreadsheet.

For DR testing, there were two types of events: cold weather and scheduler. Cold weather events happened ad hoc based on actual cold weather events. Scheduler events attempted to use an integrated scheduler function in the iFLOW dashboard that switches the system to water heater mode during designated peak demand times.

Installation and Commissioning Challenges

Installation Process

[12] A challenge of running a field study in the Portland metro area is the lack of cold weather days. Some seasons only have one cold snap where temperatures drop into the low 30s or 20s. In order to ensure data was collected data in all of the modes whenever this cold snap hit, the control group and setting switching protocol was developed.

As described above, installation occurred during a 5-month window, with the first installation occurring in late December 2024 and the final installation completed in May 2025. The extended length of the installation process was largely due to contractor and homeowner scheduling as well as challenges encountered in the first several installations. The installations were completed by two different contractors, with one smaller contractor completing four of the installations and the other larger contractor completing the remaining nine installations. The iFLOW technology lead was also deeply involved in the installation process, coming out both in person and virtually to help set up systems and troubleshoot. Key learnings from the installation process included:

- **Subcontractor requirements.** Installation in Washington required licensed subcontractors for any work involving electrical or plumbing systems, including minor tasks such as low-voltage wiring. This introduced coordination challenges and delays, as HVAC contractors were often dependent on subcontractor availability to complete critical installation steps. To manage these constraints, installation sequencing was adapted, including allowing short periods without heat to streamline scheduling.
- **Importance of contractor training with a novel configuration.** A virtual training was conducted with both contractors and the equipment vendor in advance of the first installation. However, despite this it still took substantial troubleshooting to get the first couple of installations operational and the installation process running smoothly. The largest example of this was on the first installation: all of the installation instructions provided by the manufacturer were for upflow units as these are most common in Canada (where the manufacturer is based). However, all but one of the sites selected have downflow units. This led the contractor to install the first unit in reverse order, with the hydronic coil upstream of the heat pump coil (which prevents the ability to operate in simultaneous mode). This unit had to be reinstalled adding an additional day of installation time.
- **Need for extra and replacement parts.** Some installation kits provided with the system were incomplete or didn't perform as expected. Some sites also required additional parts (such as isolation valves and service connections) to meet site-specific constraints. These issues increased installation time and cost. Contractors improved efficiency over time by pre-stocking necessary components.
- **Equipment selection.** For this study, NEEA chose a novel pairing of single speed ASHPs with the iFLOW system in order to observe operation in all three modes in the study's mild climate. iFLOW brands and markets a cold climate ASHP that they typically sell with their hydronic air handler. Using the single speed unit worked well in most cases but also led to challenges in some systems in matching the air flow provided by the air handler to the heating/cooling output of the ASHP. In general, this could be solved by modulating the air handler airflow, although in some cases this resulted in more fan noise than the previous system. In one extreme case – the only 4-ton unit studied – the fan speed was not able to be adequately matched to the single ASHP output which led to significant performance issues with that system and ultimately a burned-out compressor. This issue was resolved by downsizing to a 3.5-ton unit.

Operation

All thirteen units have been in operation since May 2025 or earlier. On the whole, the units have been operating as intended and providing heating, cooling, and domestic hot water to the sites. However, there have been a variety of operational issues across the sites throughout the study period. Examples of these operational issues include:

- **Season switch.** With both the switch from heating to cooling in spring 2025 and from cooling to heating in fall 2025, several systems initially did not switch modes. This was typically resolved by changing settings or doing a reset through the software remotely. Notably, no issues occurred with the switch to cooling mode in late spring 2026.
- **Power outages.** During the summer, several units were unable to come back online after power outages. Other sites had issues after outages where the systems would power back up but deliver conditioned air opposite to the intended mode (e.g. heating instead of cooling or vice versa). Both issues were typically remedied through power cycling.
- **Condensate leakage.** Several units had issues with leaking condensate water over the summer that required troubleshooting to correct. Ultimately, settings were adjusted to avoid the over production of condensate.
- **WiFi connectivity.** The iFLOW controller relies on the homeowners' WiFi to allow remote connectivity and control of the unit. While the unit will continue to operate in response to the thermostat without being connected, no settings can be adjusted remotely. Over the course of the study several homeowners replaced their modems, changed WiFi passwords, or otherwise experienced connection issues, which led to periods of disconnection for several units over the course of the study.
- **Control dashboard:** The control dashboard was an incredible resource to the study team as it allowed remote control of the installed units. However, it also presented several challenges, including disconnection due to WiFi or other issues, seemingly random resetting of parameters, and a lack of function of the DR event scheduler. The team was able to work around these issues by carefully tracking what settings the system was set to, the timing of manual DR events, and creating analysis logic to determine what mode a unit was operating in at a given time.

Results

User Experience

Online participant surveys were conducted following installation (June 2025), after the cooling season (September 2025), and after a full heating season (May 2026). Surveys asked the participants about their satisfaction with the system, comfort, and any issues they had experienced, using the same question format each time. Additional feedback was also collected through informal discussions with participants throughout the study period. Completion of the surveys was a required component of participation and surveys were not anonymous.

Overall, participants' satisfaction with the system was high across the study period.[13] Respondents consistently cited improved energy efficiency, lower utility costs, reliable heating and cooling performance, and the availability of continuous hot water as key benefits. Most participants reported that overall comfort was the same as or better than with their previous

[13] Across all three surveys, when asked on how satisfied they were with their systems, one participant selected neutral on the first survey and somewhat dissatisfied on the final survey. All other responses were somewhat or very satisfied. The survey options were: very satisfied, somewhat satisfied, neutral, somewhat dissatisfied, very dissatisfied.

systems. Things participants liked about the systems include lower costs, energy efficiency, and improved AC performance.

Despite strong overall satisfaction, several recurring concerns emerged. The most common included lower perceived supply air temperatures during heat pump mode (a typical concern with heat pump systems), slower recovery following thermostat setbacks, and longer wait times for hot water delivery associated with the tankless system. Participants also reported increased fan or airflow noise in some cases, as well as isolated operational issues such as condensate leakage, seasonal mode-switching challenges, and system resets following power outages, as discussed above.

Efficiency by Mode

Field efficiency was calculated for the seven sites with sufficient data quality to determine efficiency. Average heating efficiency varied significantly by operating mode, reflecting the fundamentally different energy inputs and system configurations in each mode. Table 4 shows the average efficiency by mode and the highest and lowest average efficiencies seen across all sites by mode.

Table 4: Field efficiencies by operating mode

Mode	Average efficiency	Efficiency range
Heat Pump	304%	264-400%
Simultaneous	143%	108-160%
Water Heater	79%	72-87%

These results demonstrate that heat pump mode provides the highest efficiency, with performance consistent with expectations for single-speed air-source heat pumps operating in mild winter conditions. Efficiency increased strongly with outdoor air temperature, rising by roughly 130 percentage points between 35°F and 60°F.

Simultaneous (dual-fuel) operation improved efficiency relative to water heater mode but did not outperform heat pump operation. This reflects the combined fuel inputs of the two systems; simultaneous mode functions primarily as a capacity and comfort enhancement rather than an efficiency-maximizing mode.

Water heater (gas-only) operation provided consistent heating but with lower-than-expected field efficiency for condensing equipment, likely reflecting cycling losses and short-duration operation in field conditions.

Supply Air Temperature

Supply air temperature varied meaningfully by mode, with simultaneous operation providing the highest temperatures (typically >100°F), followed by water heater mode, and then heat pump mode. This temperature differential is a key finding, since one of the biggest concerns with the system was low supply air temperatures.

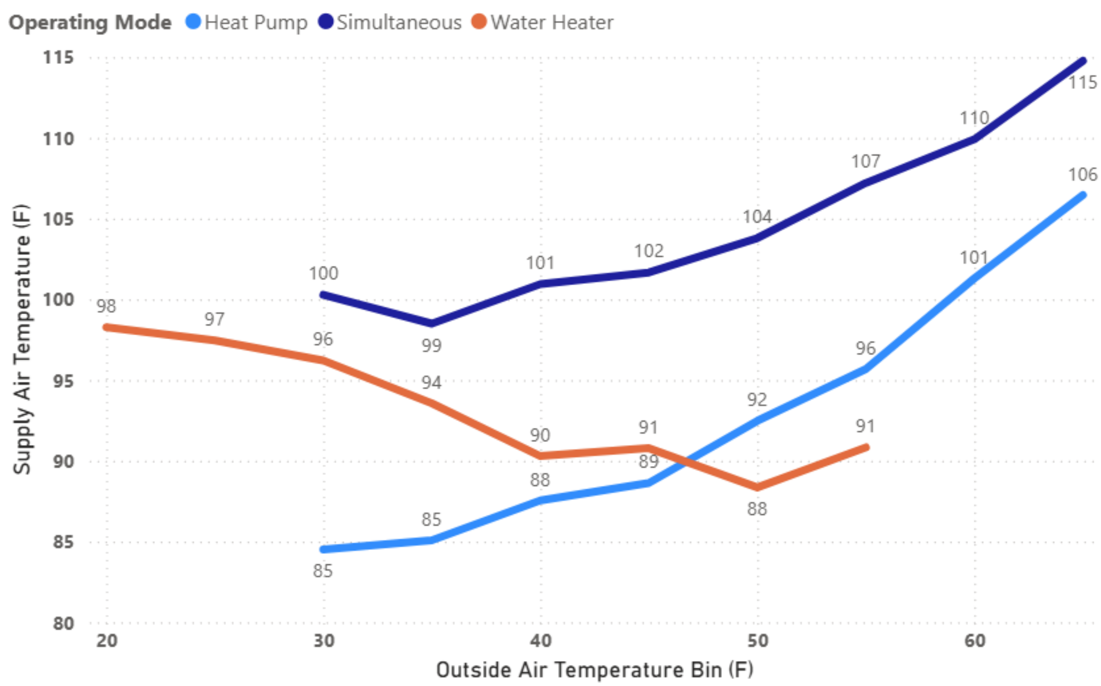


Figure 2: Average supply air temperature by outside air temperature and operating mode

Overall Energy Use, Costs, and Emissions During Study Period

A whole-home utility bill analysis was conducted using a weather-normalized baseline derived from pre-installation monthly utility meter data (January 2023–December 2024) compared to utility meter data from the study period (June 2025–March 2026).

Results indicate substantial reductions in natural gas consumption, with savings ranging from 38% to 72% across sites, as shown in Table 5. As expected, electricity consumption generally increased due to heat pump operation, although the magnitude of change varied widely across homes due to differences in occupancy and usage patterns.

Despite increased electricity use, overall outcomes were favorable:

- All sites achieved emissions reductions, averaging approximately 1.85 metric tons CO_2e per site.
- All but one site achieved net utility cost savings, with average savings of approximately $328 per site over the study period.[14]

Table 5: Overall Energy, Cost, and Emissions Savings June 2025 through March 2026

Site	Electricity Savings (kWh)	Electricity Savings as % of Total Baseline	Gas Savings (Therms)	Gas Savings as % of Total Baseline	Cost Savings	Emissions Savings (MT CO2eq)
1	(144)	-2%	321	61%	$409	1.69
2	(3,425)	-82%	551	72%	$424	2.75
3	1,222	13%	329	56%	$540	1.80

[14] Notably, the site with increased costs had a substantial increase in occupancy during the study period.

4	(4,189)	-85%	371	71%	$119	1.76
5	(3,712)	-105%	435	61%	$246	2.12
6	(1,018)	-13%	264	52%	$258	1.35
7	(1,529)	-11%	275	49%	$227	1.38
8	(993)	-14%	212	38%	$192	1.07
9	(7,087)	-70%	354	63%	$(157)	1.52
10	2,075	17%	535	64%	$885	2.94
13	(2,168)	-17%	444	61%	$393	2.24
14	(1,419)	-13%	181	47%	$114	0.89
15	(389)	-3%	489	65%	$609	2.57
Average	(1,752)	-30%	366	58%	$328	1.85

These results demonstrate that the dual-fuel system can simultaneously reduce fossil fuel consumption and emissions while maintaining or improving customer economics under current utility rate structures. Variability in electricity impacts highlights the importance of household behavior and site-specific conditions in determining realized savings.

Demand Response Performance

The initial test plan included three types of demand response events: cold weather, scheduler, and shoulder season. These event types aligned with temperature conditions that represent the various types of demand response events needed by Clark PUD. However, several barriers were encountered in following this test plan:

- The winter of 2026 was particularly mild, leading to very few hours below 30F, when a cold weather event would have been triggered.
- Settings in the iFlow dashboard were not persistent. That is to say that at times, operating setting or switchover temperature would be changed without apparent user intervention.
- The dashboard went down for periods over the study period, cutting off unit control.
- The dashboard relied on a consistent WiFi connection to the sites, which not all sites had, leading to intermittent access.
- The demand response scheduler did not function as intended. Sometimes demand response events worked in response to the scheduler and sometimes they did not, without apparent reason.

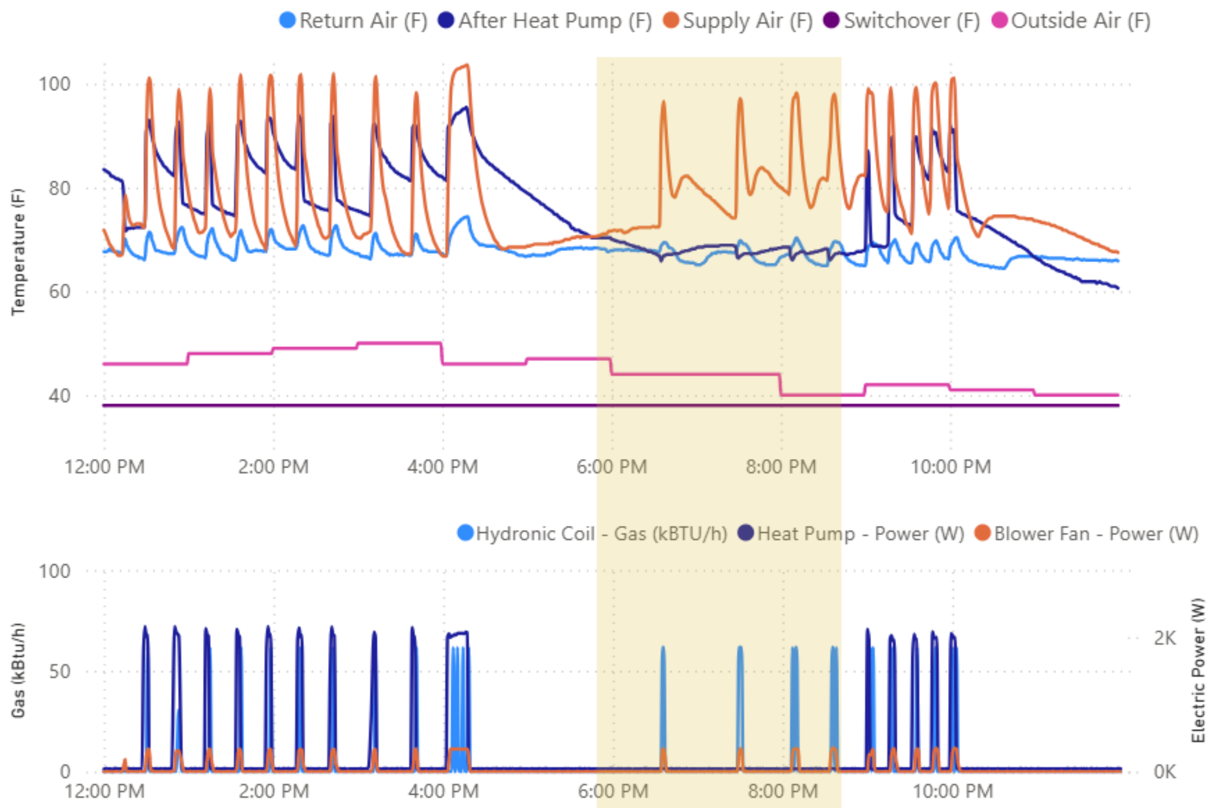


Figure 6. Graph of demand response event on 4/15/26 at Site 3, showing unit switching from simultaneous mode to water heater mode in response to demand response call. The demand response event window was from 5:45-8:45PM (shaded yellow).

Despite the issues with the dashboard, the study team was able to observe demand response capabilities (i.e. switching modes via remote control) in the direct control demand response events conducted. As shown in Figure 6, units did change modes from simultaneous or heat pump mode to water heater mode when the setting was changed in the dashboard. One nuance to the control system logic was that this transition only occurred at the end of the given thermostat call. This means that even if the demand response event was called, the mode switch would not happen until that current call for heating ended, which in some cases was as long as 45-minutes later. While this is currently limiting, there is a second control method ("Smart Mode") that enables the user to switch the heating source immediately – within a matter of seconds – and the research team did observe the system being able to switch immediately from heat pump or simultaneous to water heater mode using Smart Mode when controlled by the manufacturer. Therefore, we conclude that the system is capable of being used for DR but needs control system upgrades to be utilized in utility pilot programs.

Given the more limited DR functionality in the dashboard, rather than calculating the DR savings from individual events, savings were calculated based on the average power usage by mode by temperature bin to understand the potential power (kW) reduction and gas usage increase (kBtu/h), as indicated in Table 6.

Table 6: Calculated demand response savings

Outside air bin (°F)	Peak power reduction (kW)		
	HP → WH	Simultaneous → WH	HP → Simultaneous
35	1.7	2.5	-0.76
40	1.8	2.4	-0.62
45	1.8	2.2	-0.48
50	2	2	-0.01

Outside air bin (°F)	Average Power Reduction (kW)		
	HP → WH	Simultaneous → WH	HP → Simultaneous
35	1.2	0.72	0.45
40	0.77	0.50	0.27
45	0.46	0.30	0.16
50	0.26	0.17	0.09

Outside air bin (°F)	Gas Increase (kBtu/h)		
	HP → WH	Simultaneous → WH	HP → Simultaneous
35	15	8.6	6.6
40	11.2	7.0	4.2
45	7.2	4.5	2.7
50	4.4	2.9	1.6

Conclusion

This field study demonstrates that the system can operate successfully in Northwest homes, providing energy, cost, and emissions reductions and grid flexibility, while maintaining high levels of occupant comfort. Across the 13 pilot sites, participants generally reported satisfaction with system performance and comfort, even as they adjusted to characteristics typical of heat pump systems such as lower supply air temperatures. Measured supply air temperatures confirm these perceptions, with heat pump operation producing temperatures in the mid-80s to low-100s °F range depending on outdoor conditions, while simultaneous operation consistently exceeded 100°F. While installation and operational challenges were encountered—particularly related to contractor training, system configuration, and control software—the core technology functioned as intended.

Measured efficiency and energy outcomes reinforce the value proposition of the system across each operating mode. Heat pump operation delivered the highest average efficiency (301%), increasing significantly with outdoor air temperature, while simultaneous mode improved output capacity and comfort but operated at lower efficiency (average 143%) due to combined fuel inputs. Gas-only operation showed the lowest field efficiency (79%), though it provided consistent backup heating and DR functionality. At the whole-home level, these operational characteristics translated into substantial gas savings (38–72% across sites), universal emissions reductions averaging 1.85 metric tons CO_2e per home, and average utility cost savings of $328 per site despite increased electricity consumption. These findings suggest that the system can meaningfully reduce fossil fuel use and emissions while maintaining favorable customer economics, though outcomes are sensitive to occupant behavior and site-specific conditions.

From a grid perspective, the study confirms that dual-fuel systems of this type can provide measurable DR capability, while also highlighting important implementation considerations. Mode-switching tests demonstrated that systems can reduce electric demand by approximately 1.7–2.5 kW during peak conditions when switching from heat pump or simultaneous operation to gas-only mode, with larger impacts at lower temperatures. However, limitations in the control platform, including delayed response tied to thermostat cycles and unreliable scheduler functionality—constrained the ability to fully automate these responses. Despite these constraints, observed performance indicates strong potential for dual-fuel systems to serve as flexible grid resources, particularly in mitigating winter peak load growth associated with electrification.[15] Realizing this potential at scale will require improved control integration, more robust commissioning practices, and clearer installation guidance, but the core results of this pilot suggest a viable pathway for aligning customer benefits with grid needs.

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AI Disclosure template

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Extent: Drafted conclusion from bullet points provided by author.
Human review: The authors reviewed and verified all content, calculations, and citations.

[15] Furthermore, this type of dual fuel system eliminates the need for back up electric resistance heat, permanently reducing that potential load on the grid.