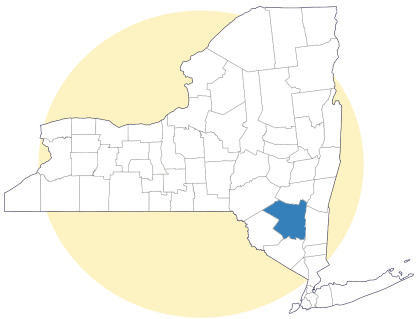
Who's Afraid of a Polar Vortex?

Case Study

NYSERDA
New York State Energy Research and Development Authority



This 59-year-old home in the Hudson Valley had heat pumps installed in July of 2024. The homeowners made the switch when replacing a broken boiler to reduce their carbon footprint, save money, and improve their home's comfort during both the heating and cooling seasons.





Project Overview

Location:
Port Ewen, NY

House Size:
2,448 square feet

Year Built:
1967

Number of Stories:
2

Previous Heating Fuel:
Natural Gas

Heat Pump Installed:
July 23, 2024

Design Temperature:
5°F

Design Heating Load:
63,378 Btu/h
(25.5 Btu/SF)

Heat Pump Capacity at Design Temperature:
72,230 Btu/h

Project Cost:
$36,400
($29,677 after incentives)

Study Objective

Due to the increasing prevalence of **cold-climate heat pumps** in homes across New York State, NYSERDA commissioned a study of some homes with these systems installed. This study examined how well heat pumps maintained indoor temperatures during **real-world extreme cold conditions,** and what the homeowners who had these systems installed had to say about their experiences.

Over the course of the heating season, this study measured temperatures inside single-family homes that heat entirely with whole-home air source heat pumps, without any fossil fuel heating sources, to investigate the systems' performance during cold spells when outdoor temperatures were **at or below design temperatures.** This case study details the results from one of those homes that participated in the study.

Heat Pump System Details

Equipment Manufacturers:
Mitsubishi

Models:
SUZ-KA12NAHZ
MUZ-FS09NAH (x3)
MUZ-FS15NAH
MUZ-FS12NAH

Number of Outdoor Units:
6

Number of Indoor Units:
6

Distribution Method:
Mix of Ducted and Non-Ducted

Installing Contractor:
Hot Water Solutions







System Design

PREVIOUS SYSTEM CHALLENGES:

This house previously had a three-zone natural gas boiler that was decomissioned during the heat pump installation.

- The boiler zone that served the upstairs bedrooms **did not provide adequate heat,** and the homeowners regularly used plug-in space heaters in those rooms.

HEAT PUMP DESIGN & CONTRACTOR SOLUTIONS:

- The house is heated by six one-to-one air source heat pumps
- First floor is heated by three mini-splits
- Second floor is heated by two mini-splits and a compact ducted unit

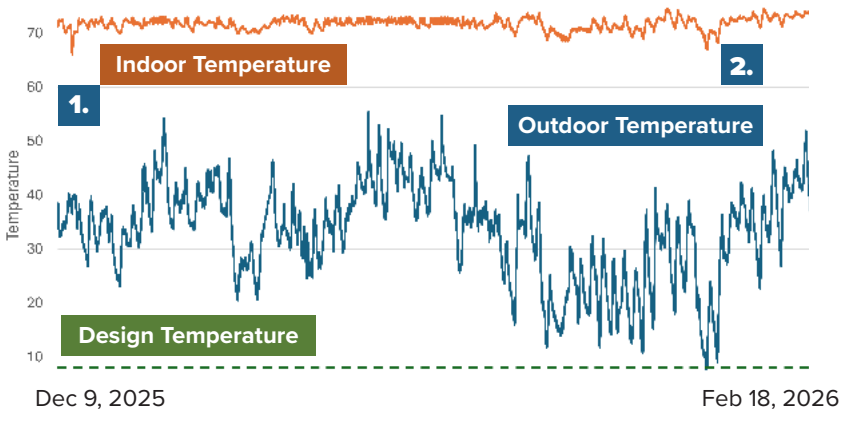
Having independent compressors for each zone is especially well-adapted to how the participants use their home. They book the lower floor as a short-term rental, so it has significantly different heating and cooling needs from the upper floor of the house, where they live. Having these distinct zones on separate compressors reduces short cycling if the rental is vacant. If a multi-split system was used across zones with very different heating needs, the outdoor unit may not be able to turn down enough when some of the indoor unit are turned off. This setup also prevents rental occupants from creating settings that impact the performance of the heat pump in other areas of the home.

The compact ducted unit solved comfort issues and overcame the challenge of conditioning rooms that, individually, have loads too low for a ductless head.

Temperature Maintenance

Over the course of the 2025 – 2026 heating season, the heat pumps kept the indoor temperature an average of 72°F. There were two temperature dips over the course of the winter:

1. The first corresponds with a power outage in early December, where the indoor temperature fell to 66°F. When the power was restored a few hours later, the heat pump quickly returned the house to the set point.
2. The second occurred between February 8 – 9, the coldest nights of the year, when indoor temperatures fell to 67°F. Because this dip happened overnight and the temperature rebounded to 69°F by late morning, the participants did not report an impact on comfort.



Heat Pump Specifications

HSPF2 (Region 5):
7.5 (SUZ-KA12NAHZ)
7.6 (MUZ-FS09NAH)
7.7 (MUZ-FS15NAH)
8.1 (MUZ-FS12NAH)

SEER2:
19.3 (SUZ-KA12NAHZ)
29.8 (MUZ-FS09NAH)
22.3 (MUZ-FS15NAH)
26.3 (MUZ-FS12NAH)

Capacity at 5°F (Btu/h):
15,000 (SUZ-KA12NAHZ)
11,590 (MUZ-FS09NAH)
19,360 (MUZ-FS15NAH)
14,690 (MUZ-FS12NAH)

Capacity Maintenance at 5°F:
100% (SUZ-KA12NAHZ)
120% (MUZ-FS09NAH)
121% (MUZ-FS15NAH)
119% (MUZ-FS12NAH)

Lowest Rated Outdoor Temperature:
-13°F (SUZ-KA12NAHZ)
-13°F (MUZ-FS09NAH)
-13°F (MUZ-FS15NAH)
-13°F (MUZ-FS12NAH)

Maximum Power Draw (kW):
2.12 (SUZ-KA12NAHZ)
1.74 (MUZ-FS09NAH)
3.36 (MUZ-FS15NAH)
1.99 (MUZ-FS12NAH)

Energy Use and Costs

Because this household has solar panels and a battery backup, it was not possible to determine the electricity use from their bills alone.

After the heat pumps were installed in July 2024, this participant's solar production covered the electricity that the household used, so they only had to pay approximate $20 per month to remain connected to the grid. This level of performance continued all the way through the winter of 2024 – 2025 despite lower solar output and higher heating needs during that time. In fact, they were not charged for electricity use for the first 18 months that they had the heat pumps.

Due to colder, snowier weather during the 2025 – 2026 heating season, the household ran out of solar credits before the end of that winter. At this point, the participant described their electric bills as a "normal winter time bill before the heat pumps," compared to their former situation, which would have had a gas bill on top of the "normal" electric bills.

Customer Experiences

This homeowner listed several reasons for wanting to get heat pumps. Here is how the new system measured up in their own words:

IMPROVE HOME COMFORT WITH BETTER HEATING

"On the old system, there was no way to make yourself more comfortable [in the bedrooms] unless I ran a space heater down there a good portion of the winter to supplement the system. Since the heat pumps have been put in, no need."

IMPROVE HOME COMFORT WITH BETTER COOLING

"[Referring to their previous central AC system] the central air failed during a heat wave, and it was pretty brutal in the house. So, to have immediate relief and comfort in the house was just spectacular."

SAVE MONEY

"I can say that my Central Hudson bills [...] they're more affordable on the heat pumps, meaning, the year before."

REDUCE CARBON FOOTPRINT

"So I'm a big environmental supporter, and I'm happy to do anything that's green and better for the environment."

Cold Snap Events

Cold Snap 1

Dec. 8 – 9, 2025

Poughkeepsie Airport

Lowest Reported Temperature **4°F**

"I think that they're a great experience so far, and [I am] going into the second winter season. I feel good about the decision, and I'm glad I made it."

Cold Snap 2

Jan. 27 – Feb. 9, 2026

Lowest Reported Temperature **-9°F**

"It met our expectations in every way. And I think in a way too, because it was quiet, it didn't struggle to work. It's kind of out of sight, out of mind. And it was there, it worked."

Survey Results

Despite the 2025 – 2026 heating season being much colder and snowier than the one before, they continued to be highly satisifed with their heat pumps and enthusiastically recommend them to others.

When asked if there was anything they wanted to share about their heat pumps, the homeowners responded:

"We love them. It was absolutely the right thing to do. And this winter just confirmed yet again that it was the **right choice** and will continue to be the right choice. We're not going back."

5 out of 5

Overall Comfort, Noise, and Utility Bill Ratings



Callbacks, Power Outages, and Issues

This participant did not have any contractor callbacks during the 2025 – 2026 heating season.

They had one power outage during the study period in December 2025 that lasted approximately 4.5 hours and caused the battery backup to turn on automatically. The battery powered the house for about 2 hours but, due to heavy use of the electric dryer, was depleted faster than expected. During the remaining 2.5 hours without electricity, the indoor temperature drifted to 66°F. The participant noted that even if the utility had not been able to restore power so quickly, their solar panels would have been able to recharge the battery backup the following morning.

Key Takeaways and Lessons Learned

- The heat pumps generally kept the house between 70°F and 72°F. The few times that the indoor temperature dipped below 70°F were overnight **on the coldest nights of the year** when the outdoor temperatures were well below design conditions. Because the occupants were asleep and the indoor temperatures recovered quickly in the morning, they did not experience any impact to their comfort.
- The legacy heating system left one zone of the house so cold that the homeowner regularly used a plug-in space heater to supplement it. **The contractor solved this issue without oversizing or over-zoning** the house by installing a compact ducted unit for those rooms.
- Thanks to their solar panels, the homeowners were able to run their heat pumps for a year and a half without buying electricity from the grid. These panels led to a **savings on operating costs over their gas boiler**.
- Having a battery backup let this household run their heat pumps for several hours into a power outage, while also running other major electrical loads in the house. Even when the backup ran out, the house remained a safe temperature until power was restored.