

High-Performance High-Capacity Heat Pump (HPHC HP) Field Study:

Key Findings and Recommendations

**A Comprehensive Review of the 2022-2025
Pacific Northwest Field Study**

July 2026



Emerging
Technologies



Project Sector and Scope: **Residential Single Family Home** **Space Conditioning** **(Residential HVAC)**

Presenters:

Tony Koch

Mechanical Engineer
Utility Distribution Sector
and Metering Technical Lead

Jamie Anthony

Mechanical Engineer
Residential and Commercial
Sector Technical Lead



Agenda

- The Regional Challenge
- Introduction to HPHC HPs
- Study Goals & Scope
- Methodology
- Key Findings
 1. Energy Savings
 2. Cold-Climate Ready
 3. Setback Anomaly
 4. Sizing and Ductwork
- Program & Policy Recommendations
- Future Work



The Northwest's Energy Challenge

The Homeowner's Challenge is the Region's Challenge

- **High HVAC consumption.**
- **Issues with backup Electric Resistance (ER).**
 - Homeowner costs
 - Electric grid impact
 - Diminished regional savings
- **Can HPHC HPs solve both problems?**



Introduction to HPHC HPs

What is HPHC HP?



What is high performance?



What is high capacity?



What were we looking for in this project?

- Capacity Ratio (5°F / 47°F) > 70%
- Min Capacity COP (@47°F) > 4
- Heating Seasonal Performance Factor (HSPF2) > 8.5
- Coefficient of Performance (COP) @ 5°F > 1.75

Study Goals & Scope

- **Primary Goals:**
 - Quantify energy savings.
 - Assess peak demand reduction.
 - Verify manufacturer performance claims (as publicly printed on the Northeast Energy Efficiency Partnership (NEEP) list).
 - Identify factors influencing real-world performance.

Goals & Scope – Timeline: 2022-2025

Study Participants:



Utilities

Central Electric
Glacier Electric
Inland Power
Snohomish PUD
Tacoma Power
Yakama Power
Okanogan PUD
City of Plummer



Tribes

Blackfeet
Yakama
Colville
Coeur d' Alene



Manufacturers



Unique Systems



Homes Across Three PNW Climate Zones

NEEP Heat Pump Product List

NEEP database was used to select project specs.

- Air Source Heat Pump (ASHP) NEEP list.
- <https://ashp.neep.org/#!/>
- Provides more product performance details vs. Air-conditioning, Heating, and Refrigeration Institute (AHRI) document.
- Performance values entered by manufacturers.



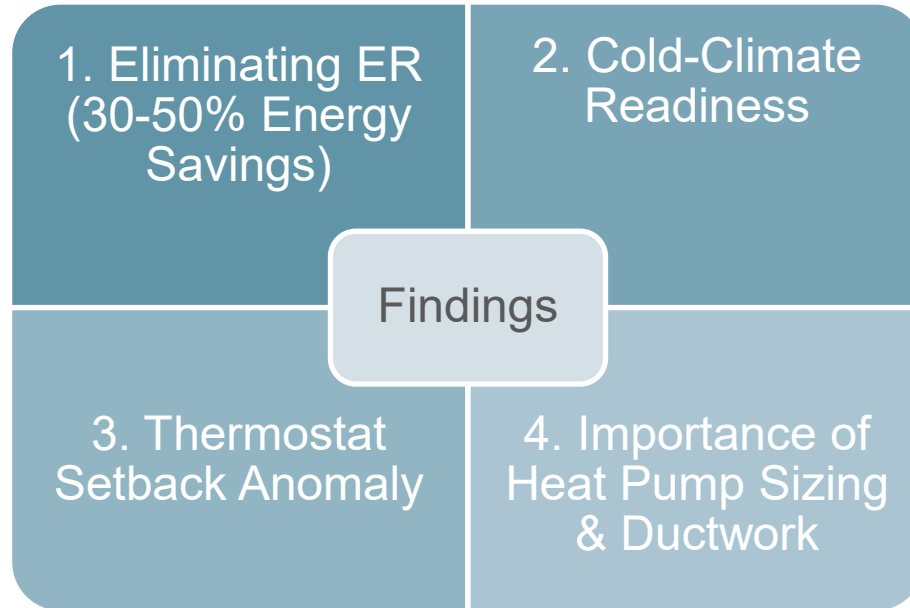
Methodology

How We Conducted the Study:

- Heat pumps qualified via NEEP database.
- Tested actual home performance.
- Collected one-minute average intervals.
- Studied 57 single family homes.
- Compared logger data to utility energy billing.
- Qualified participants w/ significant heating load.

Executive Summary of Findings

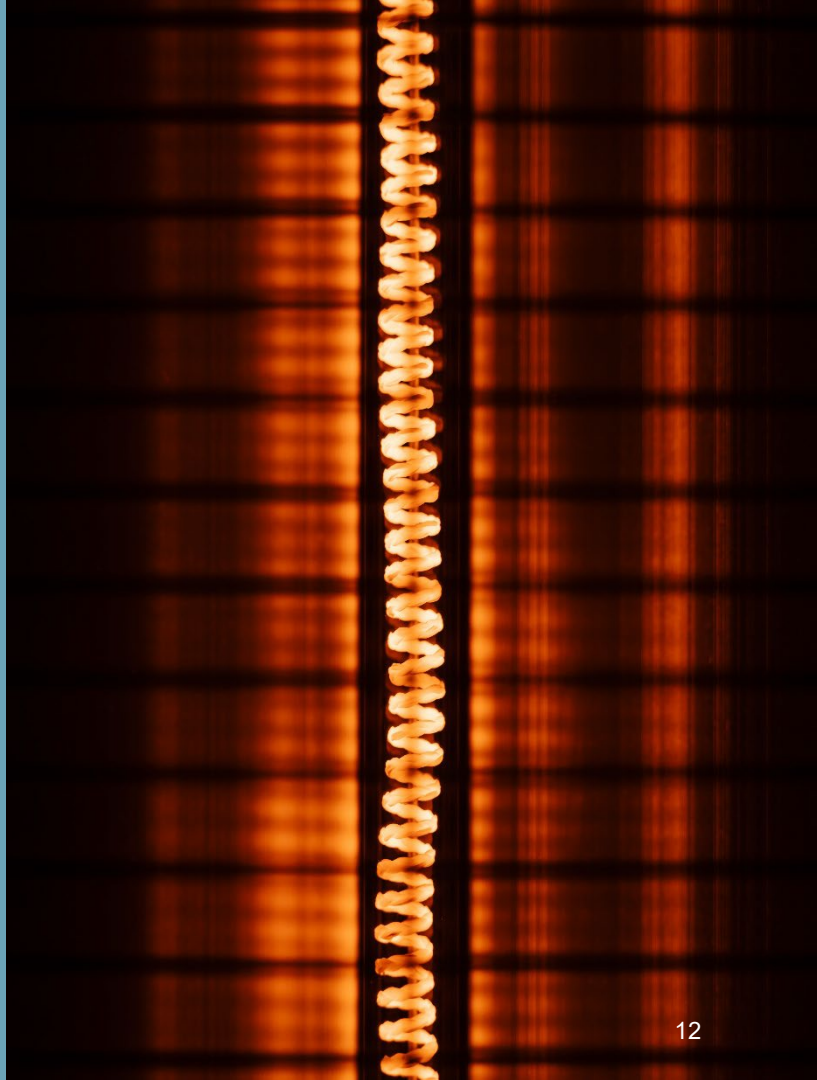
Key Findings at-a-Glance



Finding 1:
**The Key to Energy Savings is
Eliminating Electric Resistance**

The End of Electric Resistance?

- With proper sizing, HPHCs can largely eliminate the need for backup ER heat, especially in the maritime Northwest.
- In the Puget Sound region (Heating Zone 1 (HZ1)), systems sized to a 20°F balance point met design heating loads.



Finding 2:
**Cold Climate Ready:
Can We Trust The Ratings?**

Manufacturer Ratings (HSPF2) Are Not Everything

- Wide variation exists between rated HSPF2 and field-measured efficiency.
- "Relying on HSPF2 alone is not enough." Metrics like COP at 17°F are more predictive.



Finding 3: The Thermostat Setback Anomaly

The Counter-Intuitive Cost of Setbacks

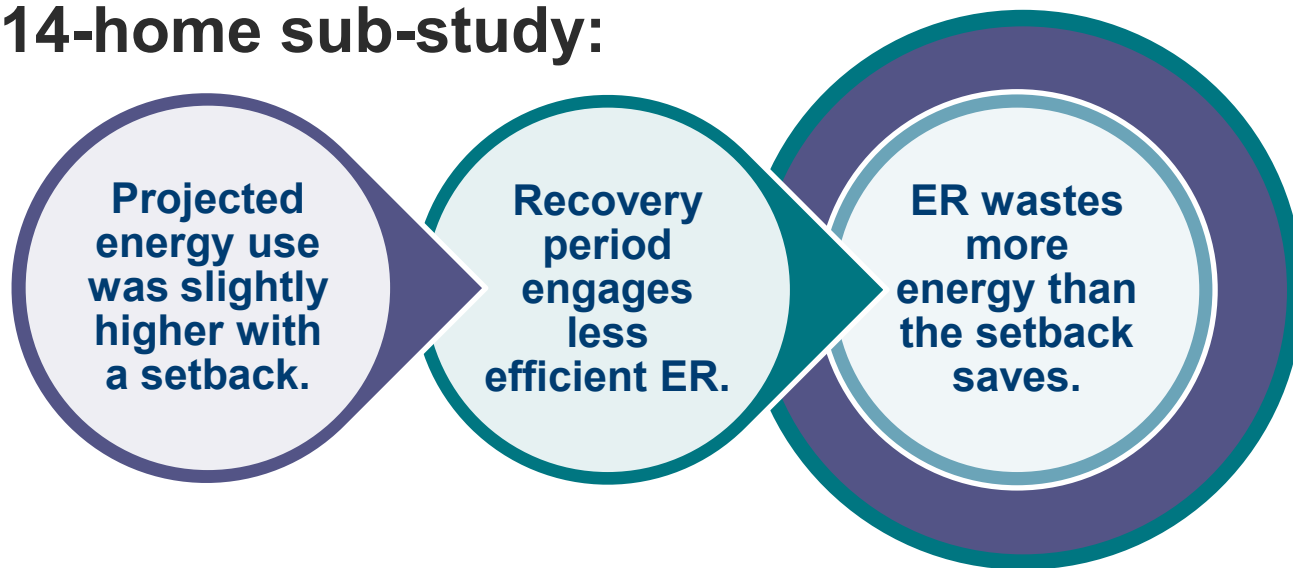
- Thermostat setbacks with heat pumps often increase energy use and exacerbate morning peak demand.



Data Spotlight: The Setback Energy Penalty

The Setback Penalty in Action

– In14-home sub-study:



Finding 4: The Importance of Heat Pump Sizing and Ductwork

Proper Installation is Non-Negotiable

Adequate duct sizing and accurate load calculations are essential:

- Use NEEA's HVAC Sizing Tool (HVACST) or similar.



Program and Policy Recommendations

1. Promote advanced technology
2. Cultivate expertise
3. Rethink backup heat
4. Modernize metrics



Recommendations for Contractors and Homeowners

Education for Regional Energy Savings



Contractors

Focus on Manual J load calculations and verify airflow.



Homeowners

Avoid aggressive setbacks; understand that longer run times are needed to achieve efficient heating.

What You Need to Save kWh



MEASURE

1. System is good enough:
2. Sized right:
3. Ducts work:

INCENTIVE

\$1,800
\$ 500
\$ 500

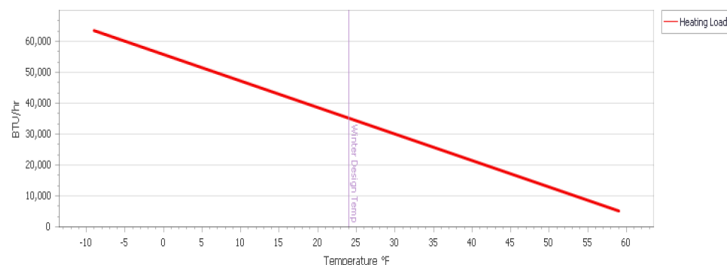


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HVAC Sizing Tool: Results

Heating

Balance Point (the heating output did not intersect with the required heating in the temperature range specified)



Summary

State	Specifications Summary
Box Spec	• Energy Star Cold Climate Version 6.1 • HSPF2 8.1 • COP 1.75 at 5°F • 70% capacity maintenance • Controls verification procedure
Sizing	• 100% of load at 20°F or 99.6% design temp: Full Air Conditioning Contractors of America (ACCA) Manual J report
Ducts	• Measure and document external static pressure at Full Cubic Feet per Minute (CFM)

WSU HPHC HP team: John Bush and Ben Larson

Future Work

Where do we go from here?

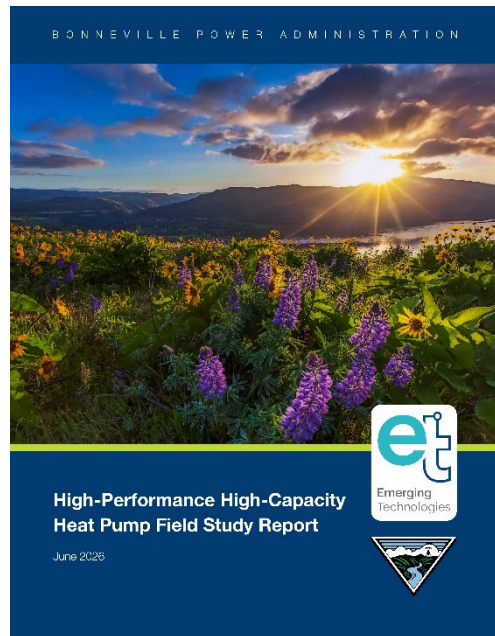
- Key Areas

- BPA helping with Regional Technical Forum (RTF)-deemed measure.
- Developing BPA-qualified (BPAQ) measure.
- Sharing data.
- Sizing tools / installation guides.
- Participation in RTF Pacific Northwest centrally-ducted research gaps.

A New Era for Home Heating



Report Posted on BPA Webpage



High-Performance High-Capacity Heat Pump Summary

At a Glance

- High-Performance High-Capacity Heat Pumps (HPHCs) save 30-50 percent on energy over standard electric resistance (ER) heating.
- HPHCs offer reliable cold weather performance.
- Nighttime thermal setback on centrally ducted systems increased both energy and peak demand.
- Control system tuning and quality ductwork improved performance and cost of ductwork savings.

THE ENERGY CHALLENGE

The Northwest is going to experience increasing strain, particularly during winter morning and summer evening peak demand periods. In homes, HVAC systems often use the most energy – residential heat pumps that rely on inefficient backup ER heat further stress the grid.

In this study, assessed, 11 modern HPHCs could provide a solution by providing direct relief to household budgets and the strained grid.

Program and Policy Recommendations

- Promote Advanced Technology:** Prioritize and incentivize variable speed heat pumps paired with advanced controls that are configured to maximize energy savings and minimize unnecessary ER.
- Cultivate Expertise:** Develop resources and encourage proper system sizing, ductwork evaluation, advanced control settings, and the energy savings from making thermostat setbacks.
- Rethink Backup Heat:** Encourage full backup ER heat and prior low systems that can meet heating loads without HP backup, thereby providing the grid with no fossil fuel load growth.
- Modernize Metrics:** Focus program incentives on real-world efficiency incentives performance indicators that are predictive of in-field success in cold climates, such as coefficient of performance (COP) at 1°F Heating Seasonal Performance Factor (HSPF) and Energy Efficiency Ratio (EER).



Acknowledgements

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Thank you!

Questions?

Contact Info:

Tony Koch | jakoch@bpa.gov



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