BONNEVILLE POWER ADMINISTRATION

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.

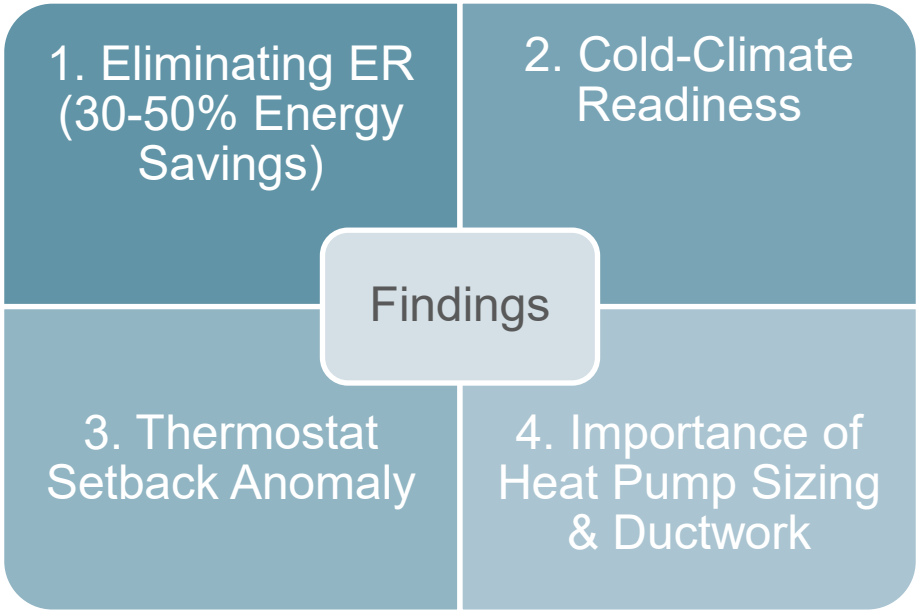
Methodology

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

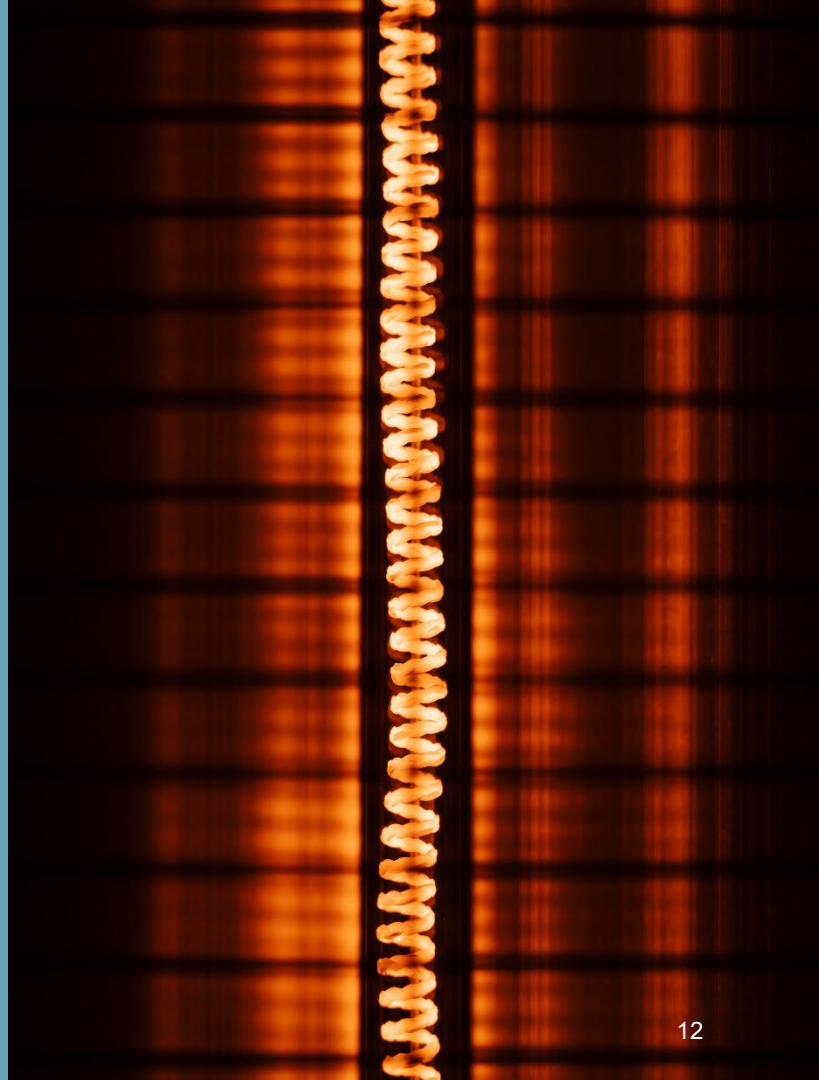


Finding 1:

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

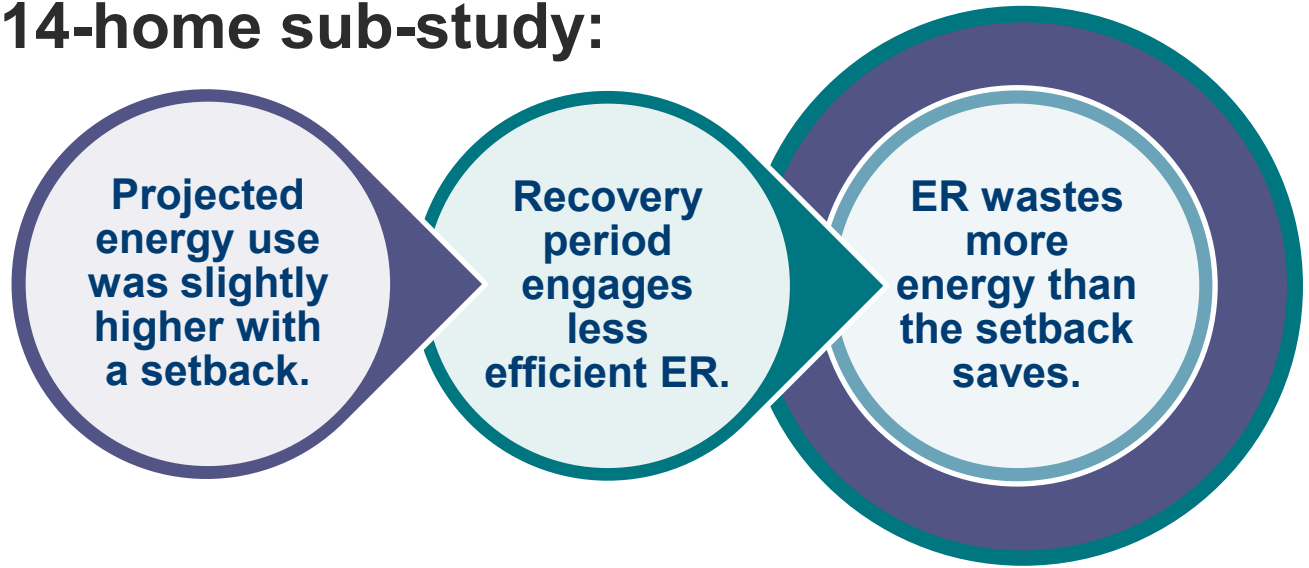
The Counter-Intuitive Cost of Setbacks

- 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

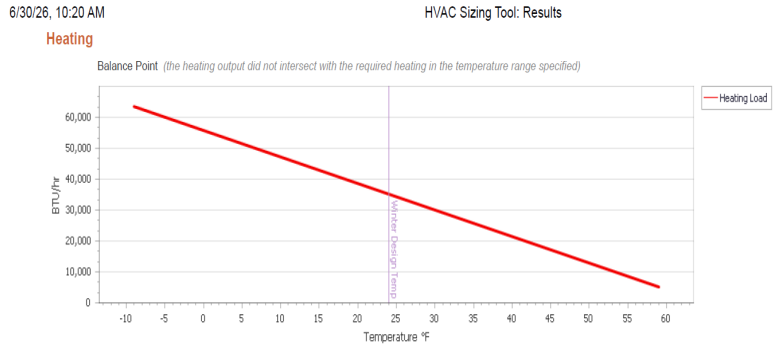
Focus on Manual J load calculations and verify airflow.

Homeowners

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

What You Need to Save kWh

MEASURE	INCENTIVE
1. System is good enough:	$1,800
2. Sized right:	$ 500
3. Ducts work:	$ 500



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

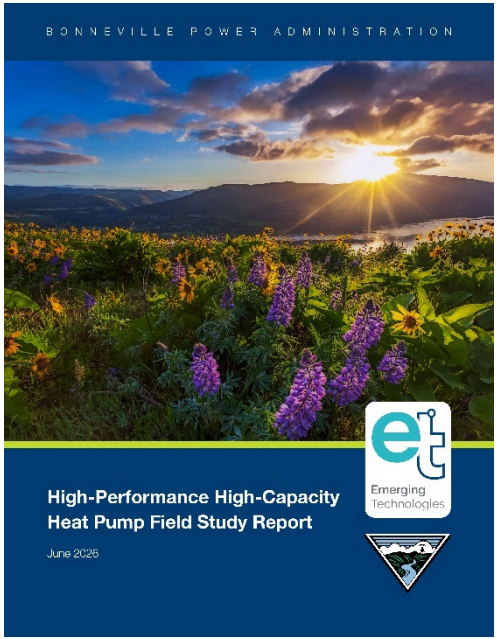
Future Work

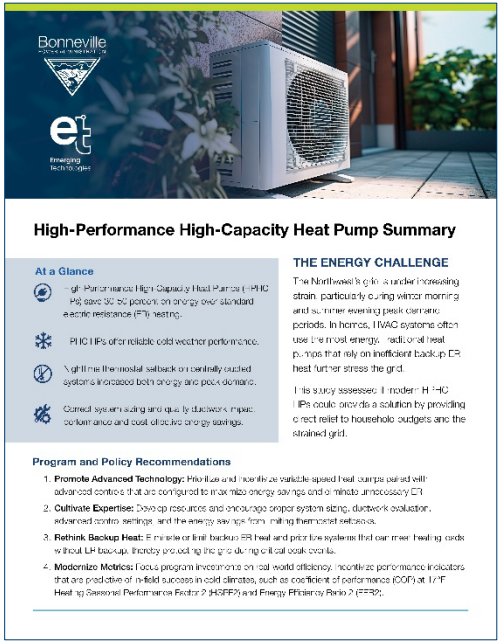
Where do we go from here?

- 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





Acknowledgements

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Thank you!

Questions?

Contact Info:

Tony Koch | jakoch@bpa.gov

Emerging Technologies

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