Better Buildings®
U.S. DEPARTMENT OF ENERGY

Better Buildings Residential Network Peer Exchange Call Series

Heat Pumps – With Unprecedented Incentives, Where Are We Now?

September 14, 2023

U.S. DEPARTMENT OF ENERGY

Agenda and Ground Rules

- Moderator
  - **Jonathan Cohen,** Better Buildings Residential Network, DOE Residential Buildings Integration Program (RBI)
- Agenda Review and Ground Rules
- Residential Network Overview and Upcoming Call Schedule
- Opening Poll
- Featured Speakers
  - **Jamie Kono,** Pacific Northwest National Laboratory (PNNL)
  - **David Lis,** Northeast Energy Efficiency Partnerships (NEEP)
  - **Justin Margolies,** Slipstream
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Join the Network

Member Benefits:

- Recognition in media, social media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- *9/28: Combining Incentives from the Inflation Reduction Act, Tax Credits and Other Sources*
- *10/12: Deep Retrofits – How Deep Can You Go with the Inflation Reduction Act?*

Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call

Jamie Kono

Pacific Northwest National Laboratory (PNNL)

Preparing the Workforce for Heat Pumps

Jamie Kono, PE, Pacific Northwest National Laboratory

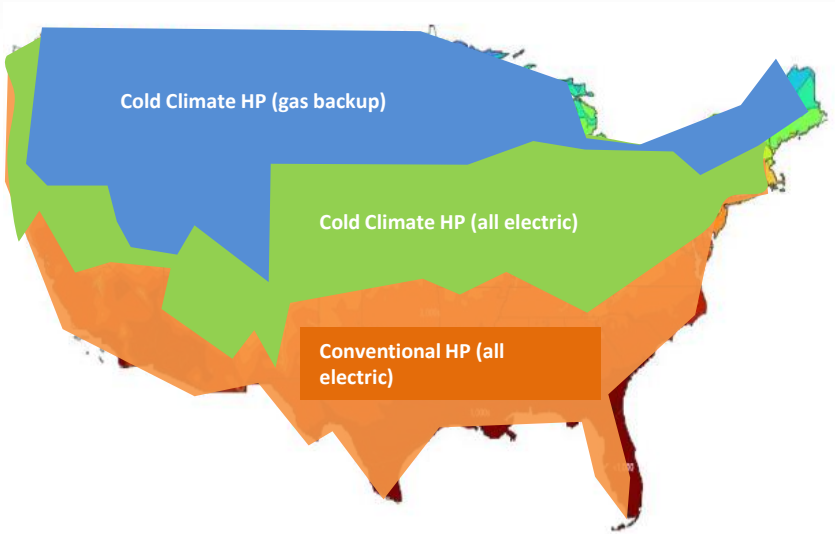
Heat Pumps are the Future

Heat pumps and HPWHs are viable for an overwhelming number of applications.

Significant developments in heat pump technology requires new training for existing technicians.

Increase in heat pump use requires more workers in the skilled trades.

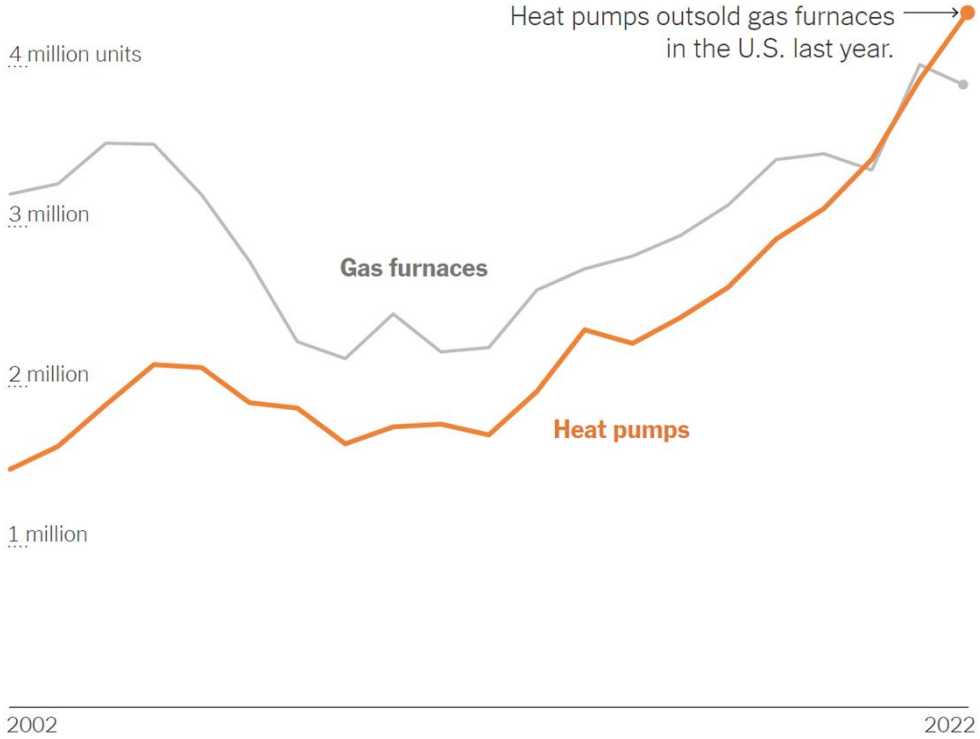
Life Cycle Cost Effective Single-Family Heat Pump Installations
Source: ACEEE 2022 https://www.aceee.org/research-report/b2205



Cold climate heat pumps work well at low temperatures (5°F or lower).

Heat Pumps are the Future

- Heat pump sales in the U.S. grew 10% in 2022, 15% in 2021
- Federal incentives and a general push toward decarbonization will continue to grow the demand for heat pumps



Source: Rewiring America, using data from Air-Conditioning, Heating, and Refrigeration Institute • Note: Data shows units shipped to customers in the United States. There may be a lag between shipments and sales, but shipments are generally an approximation of sales.

What's new? – Cold Climate Performance

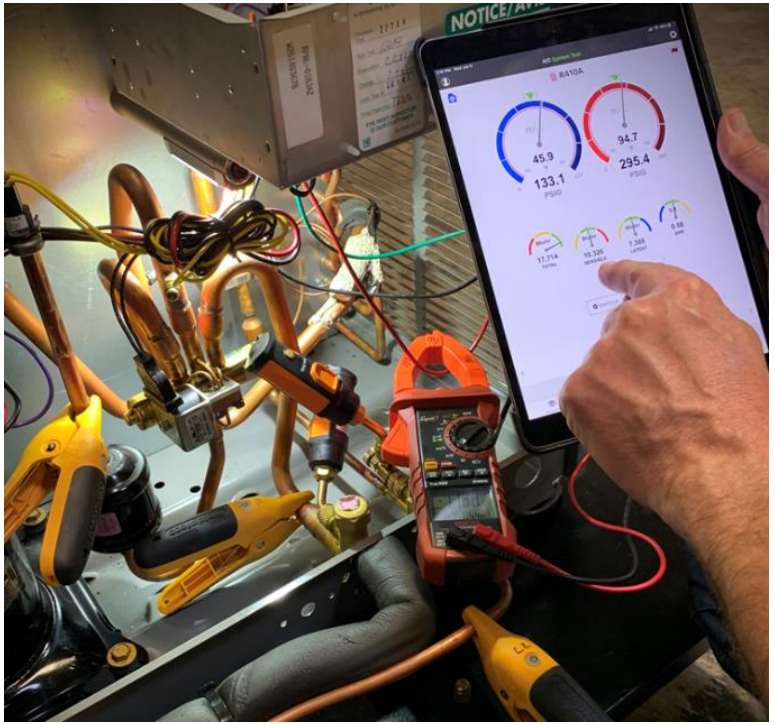
- Conventional (single speed) heat pump lose capacity dramatically in cold weather
- Variable speed heat pumps operate well at 5F or lower

What's new? – Whole Home Considerations

- Heat pumps installation should consider air and duct sealing, window and insulation improvements
- Reduced heating loads can reduce initial system size & cost, and lower utility bills

What's new? – Smart Diagnostic Tools

- Residential systems suffer from improper installation or commissioning
- One or more energy-wasting HVAC faults in 70–90% of homes[1]
- Estimated 9% national residential HVAC energy waste due to installation faults in CAC/ASHP[2]
- Smart diagnostic tools help streamline commissioning and quality assurance processes



1. DOE EERE, 2019. Residential HVAC Installation Practices: A Review of Research Findings
2. Winkler et al. 2020. Impact of installation faults in air conditioners and heat pumps in single-family homes on U.S. energy usage. Applied Energy, Volume 278

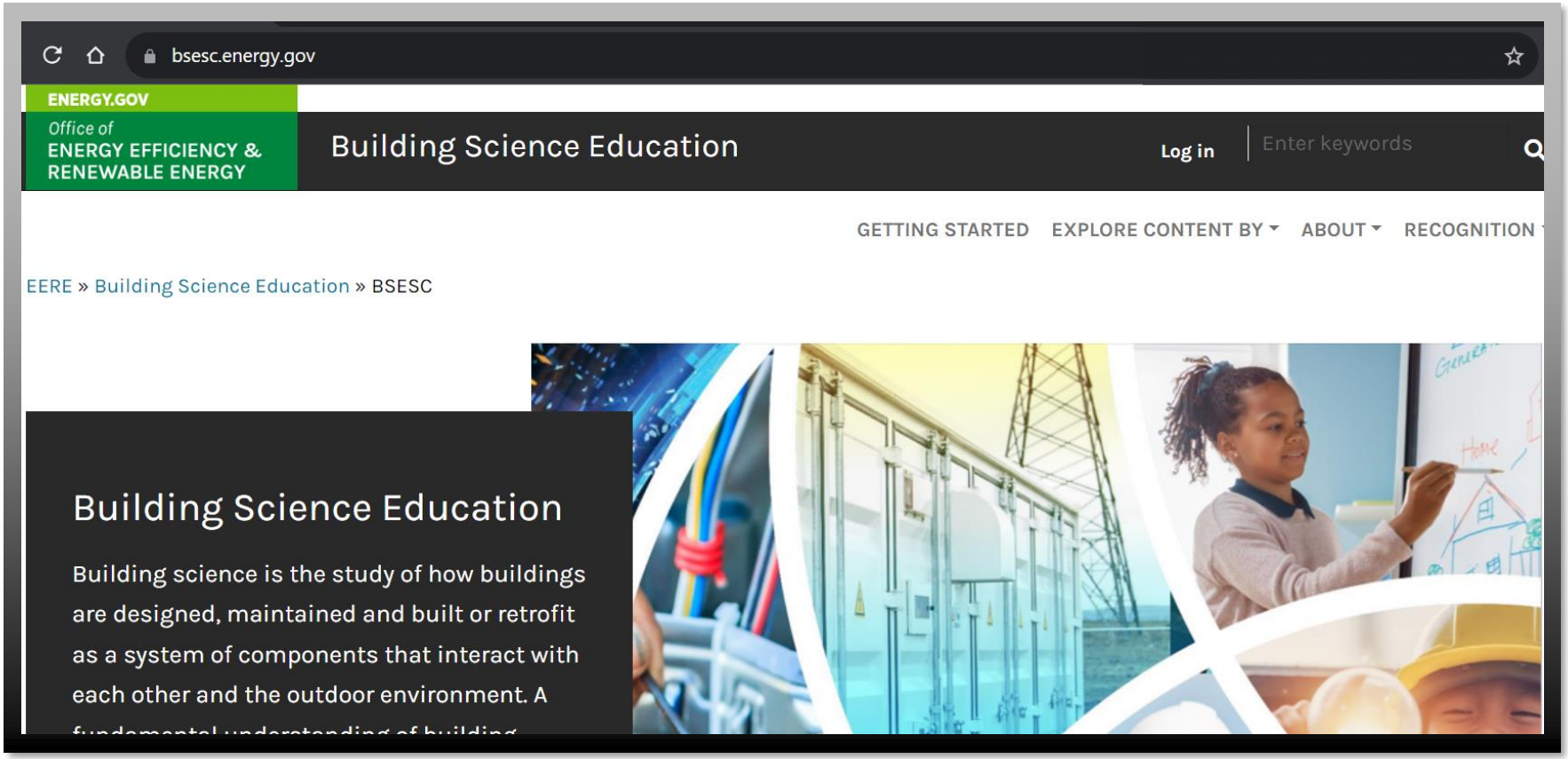
What's new? Heat Pump Water Heaters

- Heat pump water heaters heat water at 3-5 times the efficiency of traditional electric or gas water heaters (even tankless gas water heaters)
- These systems have different installation requirements

New Tech Requires New Training

- Upskill existing HVAC and plumbing contractors
- Update training pathways
- Recruit more people into heat pump and heat pump water heater fields

Building Science Education: bsesc.energy.gov



DOE Recognition for Training & Certifications

bsesc.energy.gov/submit-recognition

- Boost visibility of programs that meet DOE curriculum requirements
- Connect qualified training programs with federal incentives
- Drive greater attendance of programs that upskill workers for effective heat pump and HPWH deployment
- Encouraged by guidance for Contractor Training Grants program

Heat Pump Installation	Heat Pump Comfort Advising	Heat Pump Water Heater Installation	Energy Audit

Free Instructor Resources – Space Heating

bsesc.energy.gov/training-modules

- Lecture notes
- Problem sets
- Slide decks
- Other resources

Electrifying Residential Heating Systems with Heat Pumps:

- Intro to Heat Pumps
- Smart Diagnostic Tools
- Smart and Dual-Fuel Thermostats
- Electrical Panel Assessment
- Business Development
- Cold Climate Heat Pump Sizing

HVAC - Cold Climate Heat Pump Sizing

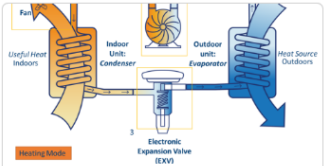
Sizing and selection practices for air source heat pumps specified to operate efficiently in cold...

HVAC - Electrical Panel Assessment

Description of Electrical panels and and its components. How electrical panels can be read and...

HVAC - Smart Diagnostic Tools

Training module for the assessment of smart diagnostics tool usage in HVAC installation...



HVAC - Introduction to Heat Pumps

Introduction to heat pump systems, including heat pump basics, sizing and design, and customer and...

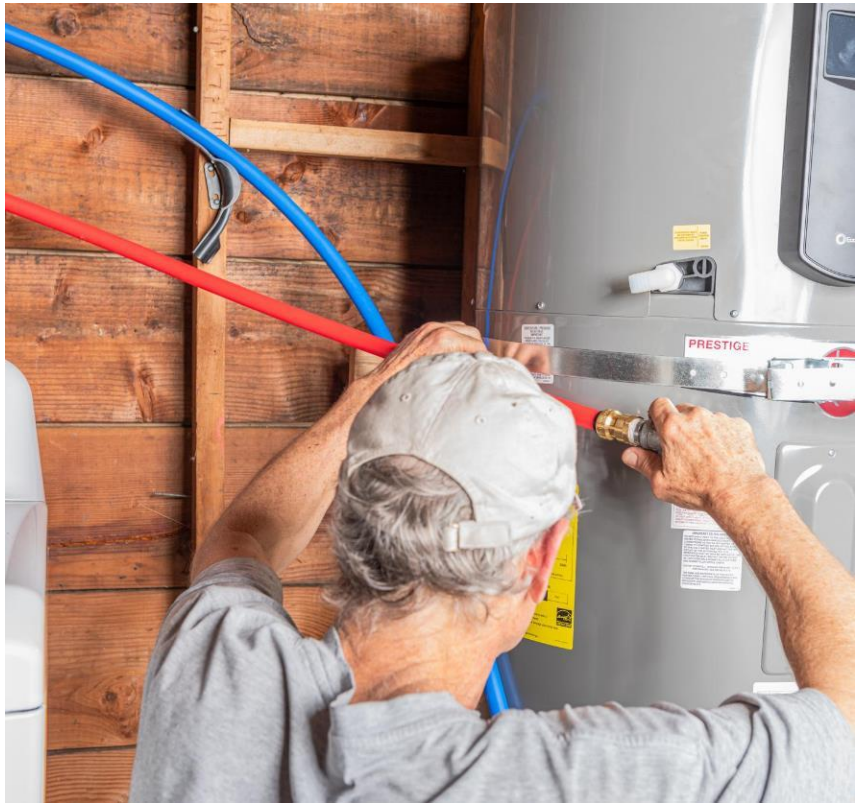
Free Instructor Resources – Water Heating

bsesc.energy.gov/training-modules

- Lecture notes
- Problem sets
- Slide decks
- Other resources

Electrifying Domestic Water Heating with Heat Pump Water Heaters (HPWHs):

- Introduction to HPWHs
- Decision Guidance for HWPHs
- Installation of HPWHs
- Load Shifting
- HPWH Business Development



Textbook Updates

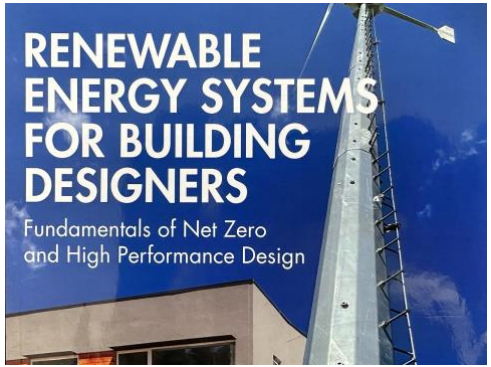
NCCER (National Center for Construction Education and Research)

- HVACR textbooks (under revision now) include significant updates on next gen heat pumps
- Solar PV e-courses updated, including integrated design and sales with heat pumps

NCCER
National Center for Construction Education and Research

Taylor & Francis

- Recently released chapter on heat pumps publicly available at no cost
- Accessible to architects and other building professionals



HVAC Certifications Updated

North American Technical Excellence (NATE)

- Heat Pump Service Specialty & Heat Pump Installation Specialty (Learn more)

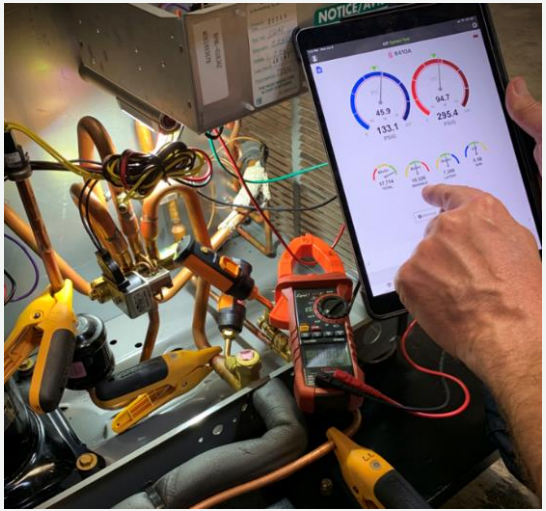
HVAC Excellence

- Heat Pump Service & Heat Pump Installer (Learn more)

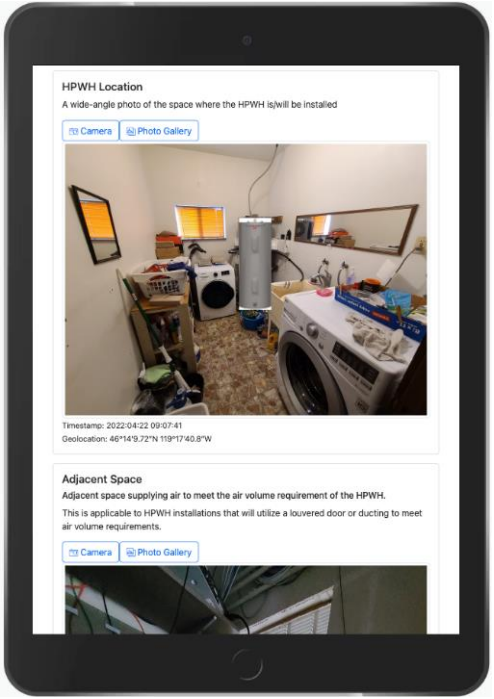
Quality Assurance for Home Energy Rebates

STEP CAMPAIGN

Use this QR code to visit the STEP Campaign website



PNNL Quality Install Tool



https://quality-install-tool.pnnl.gov/

Thank you!

Jamie Kono, PE, Pacific Northwest National Laboratory

bsesc@pnnl.gov

Instructor Resources

Recognition

STEP (Smart Tools) Campaign

David Lis

Northeast Energy Efficiency Partnership (NEEP)

Heat Pumps – With Unprecedented Incentives, Where Are We Now?

Northeast/Mid-Atlantic Perspective

Dave Lis, Director of Technology Market Transformation
Northeast Energy Efficiency Partnerships

Northeast Energy Efficiency Partnerships

Mission

We seek to accelerate regional collaboration to promote advanced energy efficiency and related solutions in homes, buildings, industry, and communities.

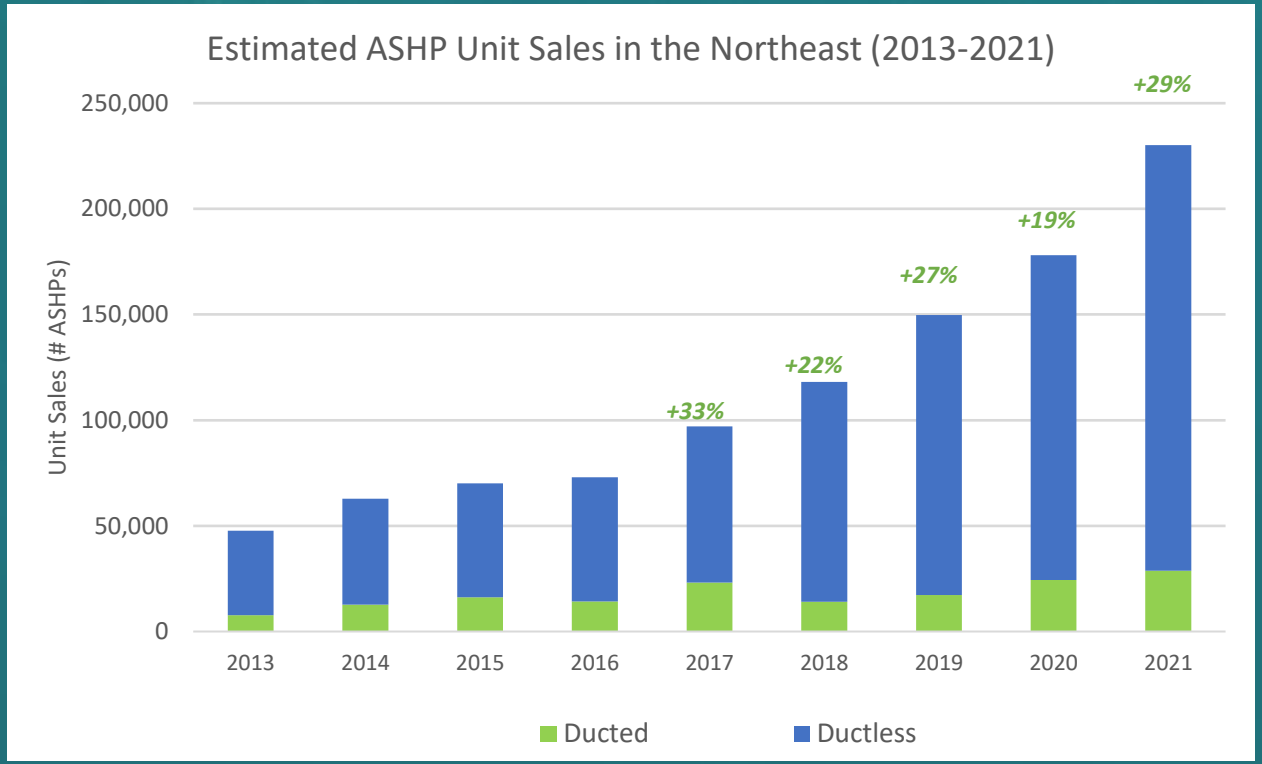
Approach

Drive market transformation regionally by fostering collaboration and innovation, developing tools, and disseminating knowledge

Robust incentives nothing new to region

- What residential heat pump tech is being incentivized?
  - ASHP
    - Air to Air Systems (majority)
    - Air to Water Systems (Mono-Bloc & Split Systems)
  - GSHP
    - Water to Air Systems
    - Water to Water Systems
  - Heat Pump Water Heaters
- Highest Incentives
  - Massachusetts
  - New York (Utility Programs)
- Target of Incentive
  - Customer
  - Contractor (New York)

Market Momentum Building



Sales in context

- Furnaces (235k)
- Boilers (160k)
- Central AC (220k)

NYSERDA data. Provided by D+R International.

Growth driven by "partial displacement" solutions

- Regional programs responding by adding enhanced incentives for integrated controls and whole home heat pumps
- Inflection point in the market?

Influx of IRA tax credits and rebates

Market Acceleration or Market Confusion?

Upfront costs aren't the only barrier

Consumer Education & Awareness

Increase consumer education and awareness

Installer/Builder Awareness

Increase installer/builder awareness of, and confidence in, ASHP through expanded training and education

Upfront Cost Reduction

Reduce upfront costs of installed systems through robust and aligned promotional programs and the support of alternative business models

Mobilize Policymakers

Mobilize state and local policymakers to expand support for ASHPs

Advanced Control Technologies

Promote advanced control technologies to allow automated coordination among multiple heating systems

Improved Performance Metrics

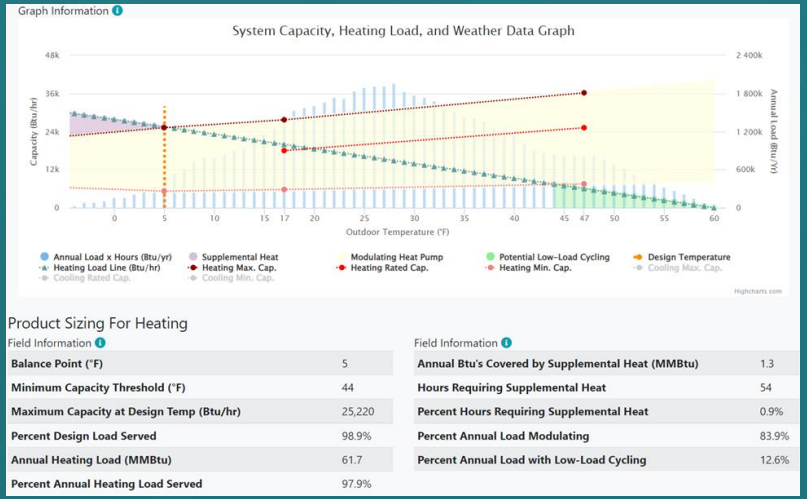
Enable the promotion of climate-appropriate ASHPs through Improved Performance Metrics

Real-World Performance Data

Develop more accurate tools to predict energy, cost, and GHG savings associated with ASHP installation through collection and analysis of Real-World Performance Data

Regional Priorities

- Market- Shift to "whole-home" solutions
- Equity- Program delivery to underserved communities
- Contractor- Shifting perspectives/practices
- Contractor- Growing Workforce



Product Sizing For Heating

Field Information		Field Information	
Balance Point (°F)	5	**Annual Btu's Covered by Supplemental Heat (MMBtu)**	1.3
Minimum Capacity Threshold (°F)	44	**Hours Requiring Supplemental Heat**	54
Maximum Capacity at Design Temp (Btu/hr)	25,220	**Percent Hours Requiring Supplemental Heat**	0.9%
Percent Design Load Served	98.9%	**Percent Annual Load Modulating**	83.9%
Annual Heating Load (MMBtu)	61.7	**Percent Annual Load with Low-Load Cycling**	12.6%
Percent Annual Heating Load Served	97.9%		

Upcoming Workshop

- 1.5 day in-person experience October 24 & 25
- Day Zero: Working Group Meeting, Opening Reception and Dinner Clubs
- Day One topics including contractor insights, designing and implementing heat pump programs for underserved customers, and new heat pump categories

THANK YOU!

Dave Lis
djlis@neep.org

Jeff Luoma JLuoma@neep.org
Deepti Dutt DDutt@neep.org
Tara McElhinney TMcElhinney@neep.org

500 Unicorn Park Drive, Woburn, MA 01801
P: 781.860.9177 X127
www.neep.org

Justin Margolies

Slipstream

Heat Pumps - With Unprecedented Incentives, Where Are We Now?

DOE BetterBuildings Residential Network Peer Exchange Call

Justin Margolies | Slipstream

September 14th, 2023

slipstream

Climate + Clean Energy Solutions for everyone.

The knowledge, people, and resources to solve our biggest energy challenges.

Where we've been?

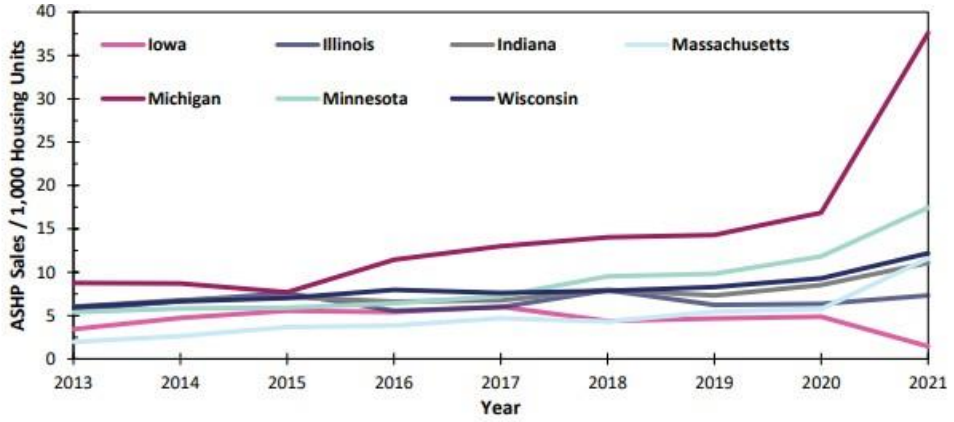


Figure 3. Changes in housing normalized ASHP sales by state from 2013 to 2021 (Data obtained from Unity Market Report (2022) prepared by HARDI under data license by HARDI. Reuse is prohibited without permission. All rights reserved.)

CANARY MEDIA

HOME OF THE FUTURE

This is part of our special series "Home of the Future." Read more.

Chart: Americans bought more heat pumps than gas furnaces last year

Even before Inflation Reduction Act incentives kicked in, Americans bought more heat pumps than ever before last year — well over 4 million.

10 February 2023

Source: 2022 Michigan Heat Pump Collaborative Market Characterization (Delivered by Slipstream on behalf of Michigan Heat Pump Collaborative)

Today, residential ASHP market is in period of intense change

Technology

- Ongoing product development and technology advancements
- Innovations in software, tools, and controls

People

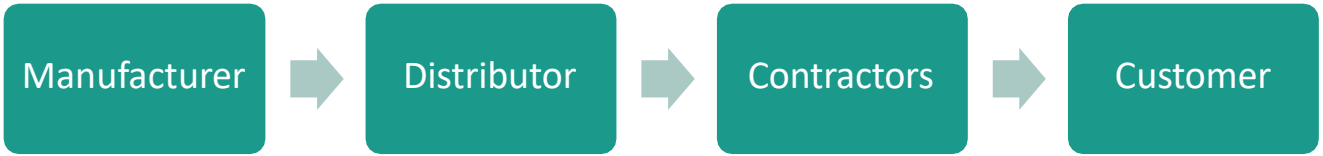
- Changing labor force; need for more tradespeople
- Homeowner and contractor education needed
- Energy Efficiency actors ramping up demands on heat pump technologies

Regulations and policy

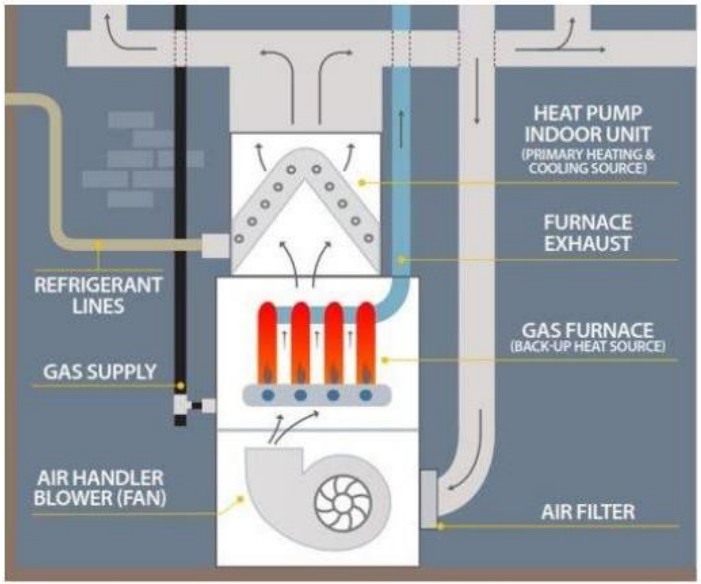
- Changing efficiency metrics and minimum efficiencies
- Refrigerant global warming potential draw downs
- Electrification attention and dollars (federal, state, local)

Supply chain

- Constraints and inflation increase wait time and cost
- Distributor stocking liability
- Supply chain recovering from Covid-19 restrictions



Dual Fuel Heat Pump Market and Opportunity



Type of Dual Fuel Heat Pump	Model examples	Relative Cost	Cold-climate potential performance
Single or two-speed	Available from all manufacturers	Low	No
Modern inverter-system	Top-tier from all manufacturers	Moderate to High	Yes
Standalone add-on inverter system (outdoor unit + indoor coil)	Bosch IDS Gree Flexx Mitsubishi Intelli-heat Samsung Hylex	Moderate	Yes
Multizone Inverter system	Daikin VRV LIFE Carrier/Bryant Crossover Mitsubishi Intelli-heat	Moderate to High	Yes

76% of Midwestern homes use natural gas or propane and **83%** use a furnace as their main heating equipment

Third-party stakeholders can help fill contractor education gaps

- Focus most on equipment specifier
- Trusted third parties can provide value in elevating value propositions and supporting sales
- Market need and demand for ideas exchanges
- Cost of operation calculators can support contractors and their customers

HVAC Contractors' Role Diversity:

- Owners
- Sales (i.e., comfort advisors)
- Service technicians
- Installing technicians

Third-party stakeholders can help empower customers

- What type of heat pump is right for me?
- How much will I save?
- How do I find an installer?
- How do I use and maintain my heat pump?

Source: NEEP ASHP Buying Guide

Committed, qualified, and supportive contractors are still not the norm

ASHP
air source heat pump collaborative

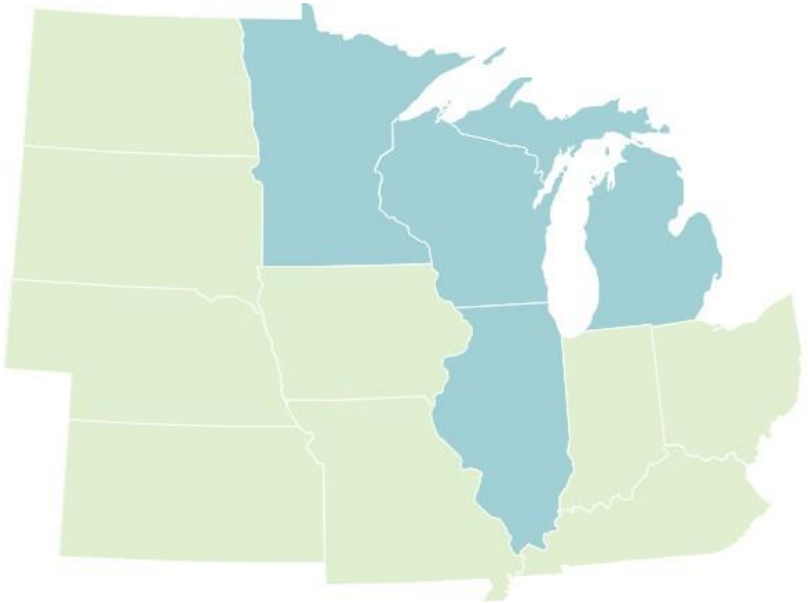
MI HEAT PUMP COLLABORATIVE GRADUATE

Source: https://slipstreaminc.org/research/dual-fuel-air-source-heat-pump-pilot

- Designated Contractor Network
- Generate leads thru marketing and consumer awareness
- Drive leads to network
- Offer benefits only available to network members

MIDWEST ASHP COLLABORATIVE

Goal: *By 2030, ASHP technology is the first choice for contractors and homeowners replacing heating systems or air conditioners, optimized to provide heating and cooling.*



- Live webpage with webinars, whitepapers, and resources
- Planning for growing scale and impact 2023-2024

Center for Energy and Environment · slipstream · MEEA Midwest Energy Efficiency Alliance · ELEVATE

How do we responsibly and quickly scale adoption of air source heat pumps?

We're in the early stages of market transformation.
Unprecedented incentives create a unique opportunity.

- Low hanging fruit applications
- Resident and contractor **expectation setting** and install and use **practices**
- Fostering equitable market transformation
- Role of dual fuel

Heat Pump Water Heaters in Cold Climates

Energy Factor

Scenario	Heat Pump Mode	Hybrid Mode	Weighted Average
Field-Derived	2.56	1.60	2.17
MFR Rating	----------3.45 ----------		

Source: Installed Performance of Heat Pump Water Heaters in a Cold Climate (2022) (Slipstream)

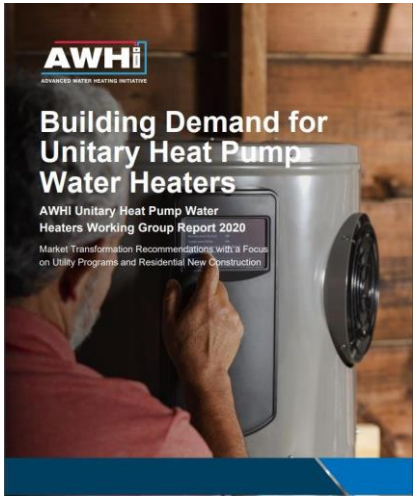
Consumer demand

- Lack of customer awareness and most commonly emergency replacement
- Power of consumer marketing

Installation and use

- Heavier, larger, air supply requirements
- Not major issue today but as consumer demand grows, stocking challenges may emerge
- May be self-installed or professionally installed.
- Customer education on use/maintenance

Heat Pump Water Heater Market Transformation



Source: Advanced Water Heating Initiative

Pathway 1: Install HPWHs in all newly-constructed homes

Pathway 2: Replace existing electric resistance water heaters with HPWHs (240V)

Pathway 3: Replace existing gas and propane water heaters with HPWH (240V or 120V)

A few emerging residential heat pump applications

120V heat pump water heaters

Air-water heat pumps

Micro (window) heat pumps

District/Community geothermal

Heat pump related trends to monitor

- Connected heat pumps
  - Fault detection and diagnosis
  - Demand responsive
- Electrification service providers
- Refrigerant scarcity and cost

Source: Department of Energy

Thank you!

Justin Margolies
Slipstream
jmargolies@slipstreaminc.org
608.729.6803

Smart Tools for Efficient HVAC Performance (STEP) Campaign

Pacific Northwest NATIONAL LABORATORY

STEP CAMPAIGN

Scan this QR code to visit our website

Contact: christian.valoria@pnnl.gov

The STEP Campaign aims to increase adoption of smart diagnostic tools to streamline HVAC system performance testing and troubleshooting, reducing energy-wasting faults and improving occupant comfort.

To join the STEP Campaign, visit: bit.ly/3DFmEaE

HVAC Contractors and Technicians

- Reduce callbacks, improve consistency and quality, streamline processes
- Find out where to get training on smart diagnostic tools
- Be recognized for successful adoption of smart diagnostic tools!

Utilities and Program Implementers

- Streamline quality installation and quality maintenance programs
- Improve engagement with your contractors
- Be recognized for programs that utilize smart diagnostic tools!

HVAC Training Organizations

- Offer qualified training on System Performance with smart diagnostic tools
- Promote your training events
- Be recognized for providing training!

Weatherization Organizations

- Ensure your ASHP/CAC installations are operating at optimized efficiency
- Develop pilot with PNNL team
- Be recognized!

ORGANIZING PARTNERS

ACCA · BUILDING PERFORMANCE ASSOCIATION · CEE Working Together, Advancing Efficiency · HVAC Excellence · NATE · neea · U.S. DEPARTMENT OF ENERGY

Explore the Residential Program Guide

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.
- Health + Home Performance Infographic – spark homeowner conversations.

https://rpsc.energy.gov

Health + Home Performance Infographic

DOE's Health + Home Performance Infographic reveals the link between efficiency and health – something everyone cares about. Efficiency programs and contractors can use the question-and-answer format to discover a homeowner's needs.

The infographic is ideal for the "kitchen table" conversations where people decide what to do – and who they want to do it. It also has links for homeowners to find a qualified contractor if they do not already have one.

Download this infographic from DOE's Better Buildings Residential Network.

Looking for photos to help tell your energy efficiency story? Visit our image libraries: https://www.energy.gov/eere/better-buildings-residential-network/articles/image-libraries

Thank You!

Follow us to plug into the latest Better Buildings news and updates!

Better Buildings Twitter with #BBResNet

Better Buildings LinkedIn

Office of Energy Efficiency and Renewable Energy Facebook

Please send any follow-up questions or future call topic ideas to:
bbresidentialnetwork@ee.doe.gov