# Midwest Air Source Heat Pump Collaborative

## Pre-conference Workshop

Monday, January 29th from 1:00 PM – 5:00 PM
Reception to Follow from 5:00 PM – 7:30 PM

**Welcome! Please find a seat at a table with the topic you are most interested in discussing later this afternoon.**

**Thank you to our Heat Pump Happy Hour sponsors!**

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# MIDWEST ASHP COLLABORATIVE

## PROJECT PARTNERS

Center for Energy and Environment

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# Housekeeping

- 5-minute break from 2:00 PM - 2:05 PM
- 15-minute break from 3:35 PM – 3:50 PM
- You are welcome to use the restrooms anytime by exiting towards the back of the room.
- Q&A opportunities will be available as time permits. If time constraints arise, we encourage you to connect with the speakers during the pre-conference, happy hour, and MES conference!
- Conference registration on Floor 7, opens at 10:00 AM tomorrow
- Welcome & opening remarks tomorrow at 1:00 PM, exhibit hall opens at 12:00 PM

**Conference App:**

Whova

DOWNLOAD APP

Wi Fi™

**Network: MES2024**
**Password: SurePay**

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# Agenda

| Topic | Speaker(s) | Minutes | Time |
|---|---|---|---|
| Welcome | Molly Graham | 5 | 1:00 PM – 1:05 PM |
| Overview of Collaborative and ASHPs in the Midwest | Molly Garcia | 10 | 1:05 PM – 1:15 PM |
| Heat Pumps and the U.S. DOE | Jay Wrobel | 15 | 1:15 PM – 1:30 PM |
| Regional Roundup | Julia Wells<br>Justin Margolies<br>Jacqueline Freidel<br>Mark Milby | 30 | 1:30 PM – 2:00 PM |
| **5-minute break** | | | **2:00 PM - 2:05 PM** |



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# Agenda (con’t)

| Topic | Speaker(s) | Minutes | Time |
|---|---|---|---|
| Manufacturer Panel | Kevin DeMaster<br>Charles Elliott<br>James Momperousse<br>Jon Blaufuss | 90 | 2:05 PM – 3:35 PM |
| **15-minute break** | | | **3:35 PM– 3:50 PM** |
| Breakout sessions | | 60 | 3:50 PM – 4:50 PM |
| Close and Next Steps | Molly Garcia | 10 | 4:50 PM – 5:00 PM |
| **Happy Hour: Theory** | | | **5:00 PM - 7:30 PM** |

# Happy Hour

- Happy Hour immediately following the workshop from 5:00 PM – 7:30 PM
- Location: Theory (9 W. Hubbard St, Chicago)
- Please register for the Happy Hour before arriving. First-come, first-served.

## Thank you to our Happy Hour sponsors!

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# Overview of Midwest ASHP Collaborative and ASHPs in the Midwest

Molly Garcia, Center for Energy and Environment

# Project Team – Organization Leads


**Molly Garcia**

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**Joe Ricchiuto**

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**Abby Francisco**

abby.francisco@elevatenp.org




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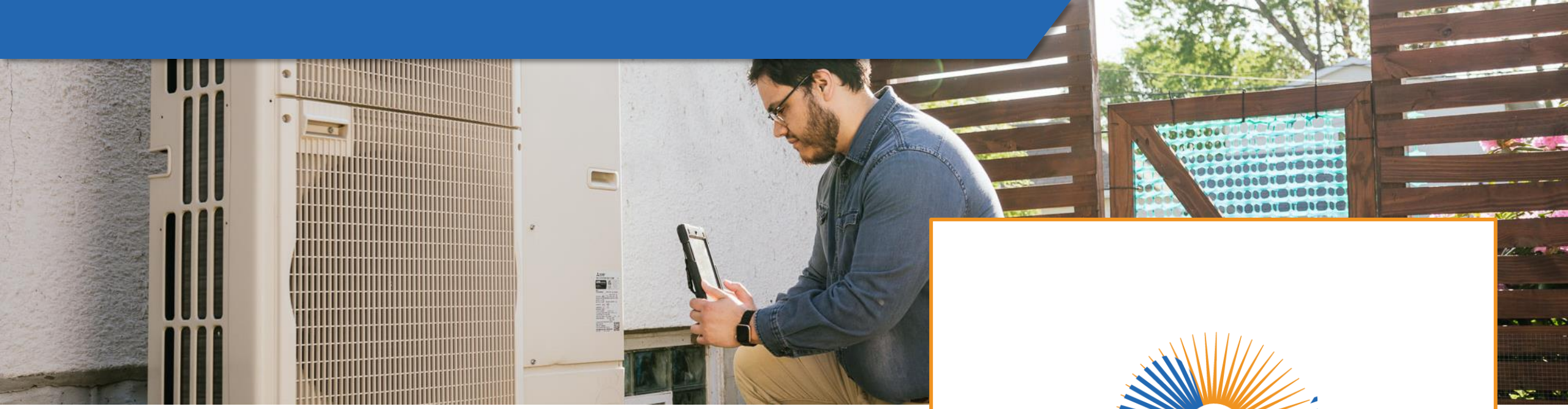

***By 2030, ASHP technology is the first choice for contractors and homeowners replacing heating systems or air conditioners, optimized to provide heating and cooling.***

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# In focus

**Residential heat pumps**

- **Minisplit heat pumps**
- **Centrally ducted heat pumps**
- **Dual-fuel heat pumps**
- Air-to-water heat pumps
- Ground source heat pumps
- Gas-fired heat pumps

Commercial heat pumps

- VRF heat pumps
- RTU heat pumps

Industrial heat pumps

# ASHP Market Context

## Technology

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

## Regulations and policy

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

## People

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

## Supply Chain

- Costs and stock availability in some areas remain an issue that may increase wait times
- Distributor stocking liability
- Growing US-based manufacturing capacity

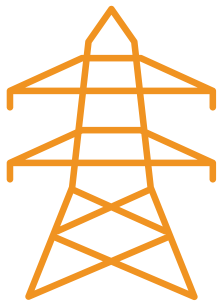
# Market Partners

Manufacturers and distributors

Local Governments

Trade schools and technical colleges

State Energy Offices and Regulators



Utilities

Community-based organizations

Dealers/contractors



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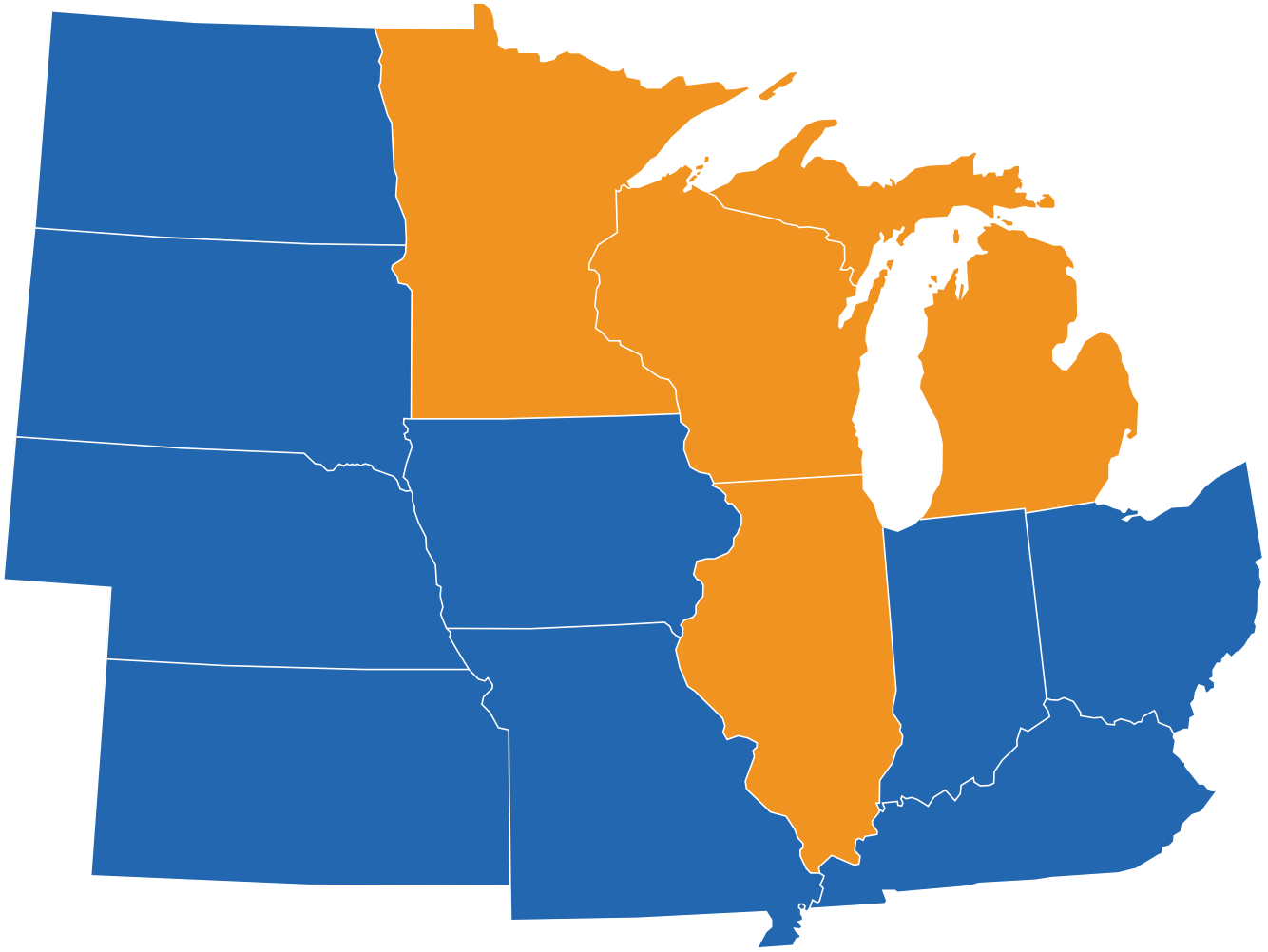
# Refining Objectives

Cross pollinate program best practices throughout the region to advance ASHP technologies and adoption

**2024 Focus**

- Refine best practices and leverage proven concepts and strategies across Align states
- Apply concepts and strategies to strategically selected Activate states, via relationship building and partnerships with local market partners
- Collaborate to raise ASHP technology understanding and ASHP adoption considerations across the region



Align State

Activate State



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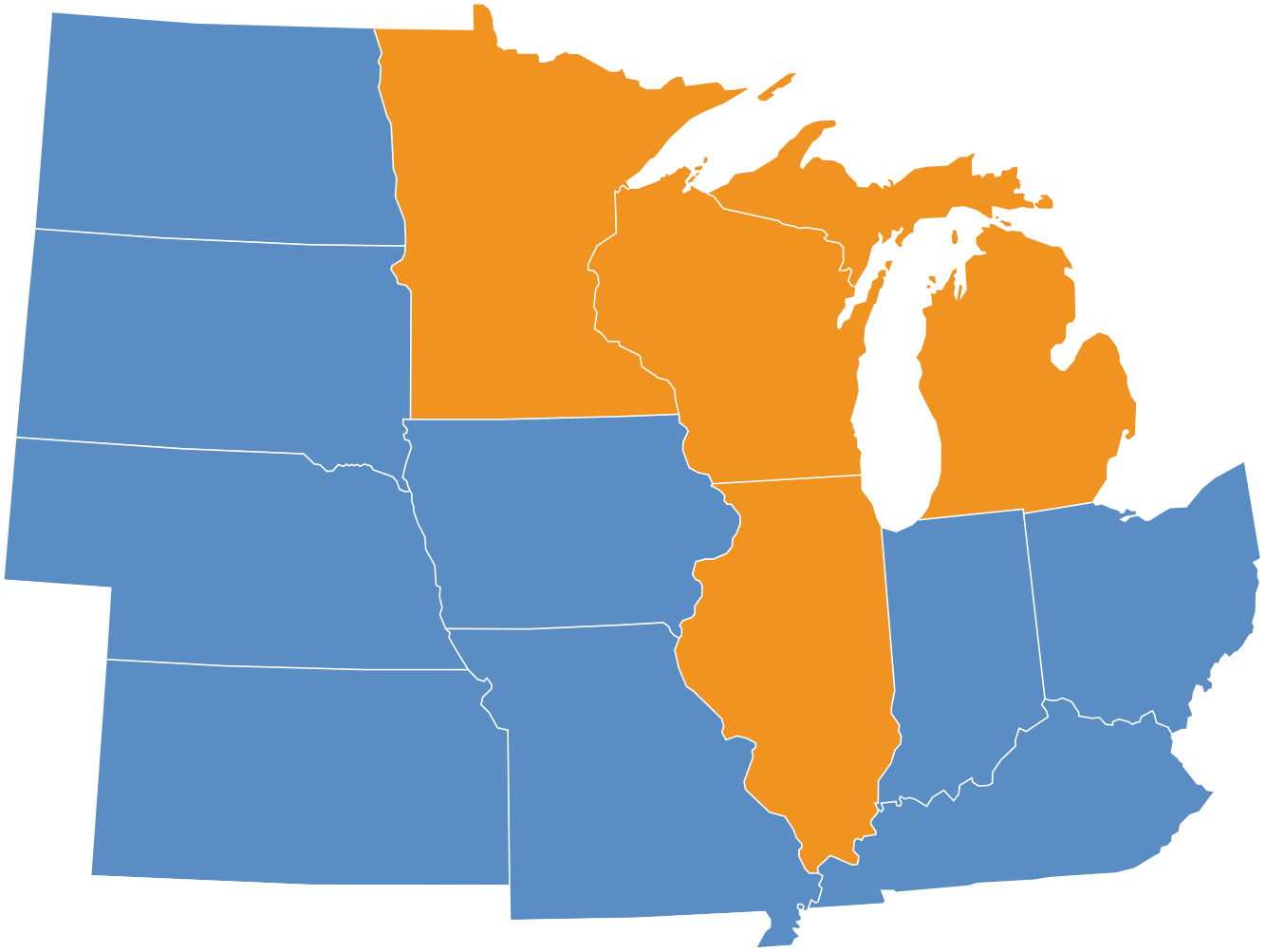

Align State

Activate State



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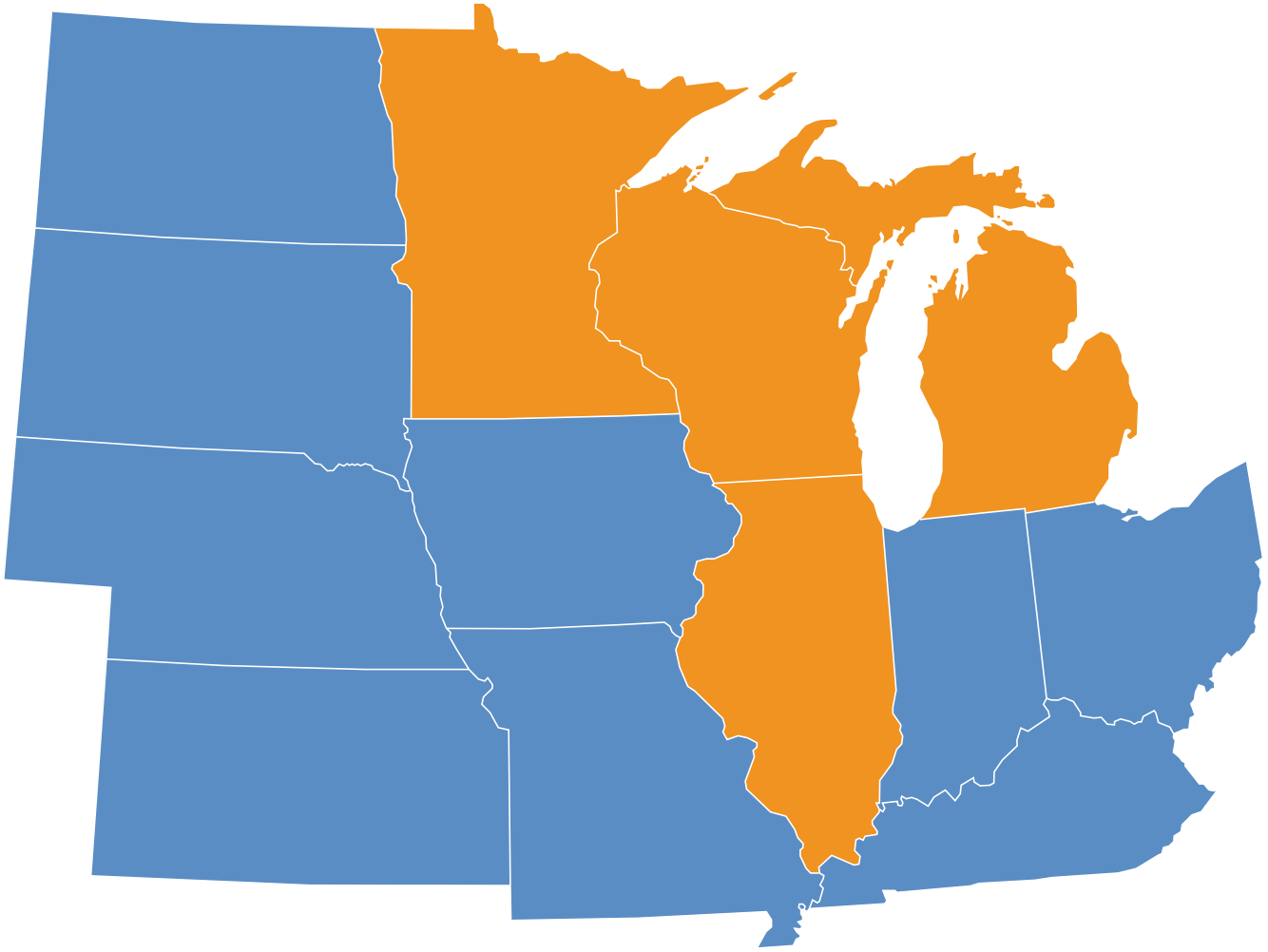

Align State

Activate State



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# 2024 Approach and Activities

- Tracking impact
- Utility intelligence gathering
- Website revamp and buildout
- Resource development, including local government toolkit and presentation materials
- Dual fuel roadmapping to 2050 for the region
- Contractor training summits
- Foster equitable collaboration cycles in workforce development
- Specified rates assistance

# Thank You

The Midwest ASHP Collaborative website
info@mwashpcollab.org

# Heat Pumps and the U.S. Department of Energy

Jay Wrobel, Department of Energy

# Heat Pumps and the U.S. DOE

# Home Energy Rebates

**Home Energy Rebates**

SEC. 50121 & 50122

**Amount:** $8,800,000,000

**Through:** September 30, 2031

**Recipient:** State Energy Offices & Indian Tribes

**Goal: Develop, implement, and subsidize residential energy efficiency and electrification projects in US households.**

States & Indian Tribes may use funds to:

- ✓ Provide rebates to households, contractors, and others
- ✓ Determine eligibility of households for rebates based on income
- ✓ Work with trusted contractors & retailers to streamline rebate processing for households
- ✓ Verify quality installation and document home upgrades
- ✓ Help households bundle funds & financing to further reduce upfront costs

**These Funds Are Not Yet Available.**

# Home Energy Rebates Cont.

## Rebates may apply to the installation of –

- ✓ Electric ***heat pump*** clothes dryer
- ✓ Electric ***heat pump*** for space heating and cooling
- ✓ Electric ***heat pump*** water heaters
- ✓ ***Electric panel & wiring upgrades***
- ✓ Electric stove, cooktop, range, or oven
- ✓ Air sealing
- ✓ Duct sealing
- ✓ Insulation
- ✓ Materials to improve ventilation
- ✓ & Potentially other energy-saving technologies

Where applicable, technologies must be certified under EPA's ENERGY STAR program.

## In the following types of buildings –

- ✓ Single-family homes
- ✓ Multi-family residential buildings
- ✓ Newly constructed homes
- ✓ Rental properties

More funds are available for households below 150% Area Median Income (AMI) and below 80% AMI.

# Tax Credits: 25C, 25D, 45L

| Equipment Type | Credit Amount (25C, 25D) |
|---|---|
| ***Heating, Cooling, and Water Heating*** | |
| ***heat pump*** | 30% of cost, up to $2,000 |
| ***heat pump*** water heaters | |
| Biomass stoves | |
| Geothermal ***heat pump*** | 30% of cost |
| Solar (water heating) | |
| Efficient air conditioners* | 30% of cost, up to $600 |
| Efficient heating equipment* | |
| Efficient water heating equipment* | |
| ***Other Energy Efficiency Upgrades*** | |
| ***Electric panel or circuit upgrades*** for new electric equipment* | 30% of cost, up to $600 |
| Windows, including skylights* | |
| Insulation materials* | 30% of cost |
| Exterior doors* | 30% of cost, up to $500 ($250 each) |
| Home energy audits* | 30% of cost, up to $150 |

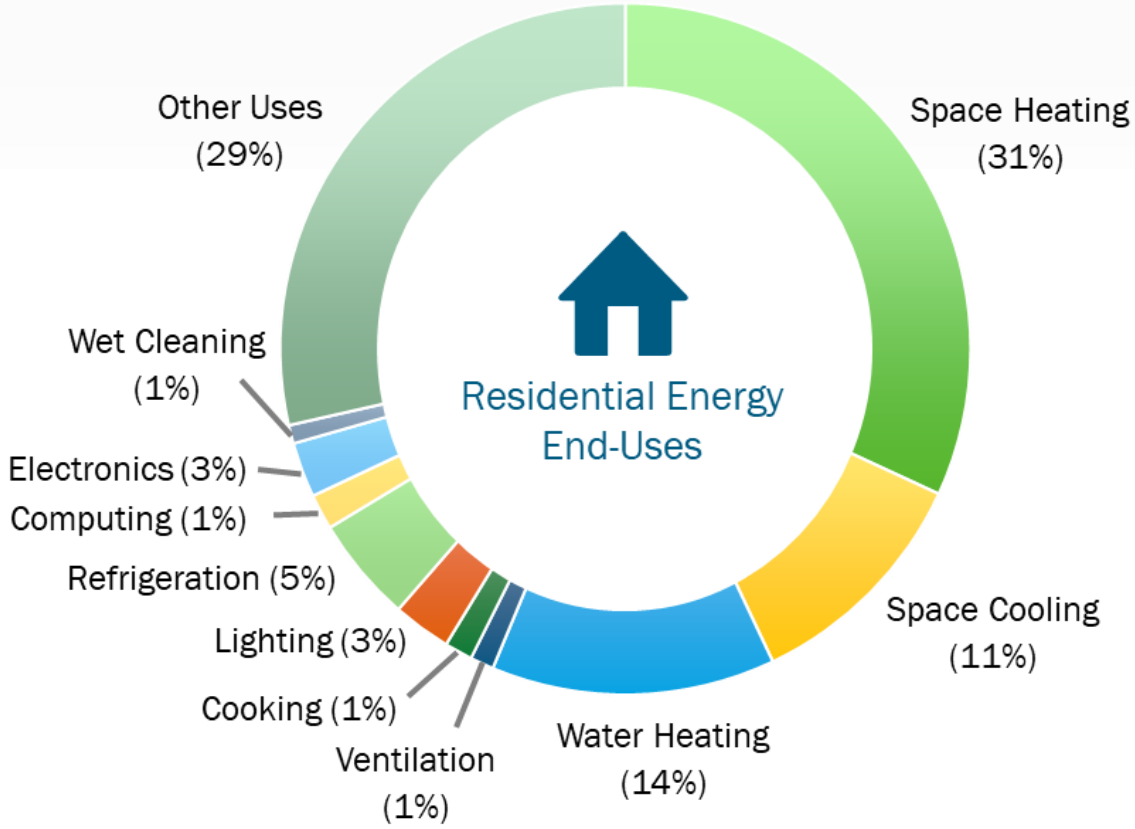
*Subject to a cap of $1200/year

| Building Type | ENERGY STAR Tier | Zero Energy Ready Tier |
|---|---|---|
| Single Family<br>Manufactured | $2,500 | $5,000 |
| Multifamily (per dwelling) | $500 | $1,000 |
| Multifamily (per dwelling, prevailing wages) | $2,500 | $5,000 |

# DOE Goals for Market Transformation

- We want folks to be comfortable in their homes
- We want to help energy burdened households
- We want to improve resilience
- We want homeowners to naturally choose HPs
- We want contractors to have HPs on their trucks
- We want to bring *everyone* along in this transition

# HVAC & Water Heating




## HVAC + Water Heating is

# 57%

## of residential energy use

Source: U.S. Energy Information Administration AEO 2022

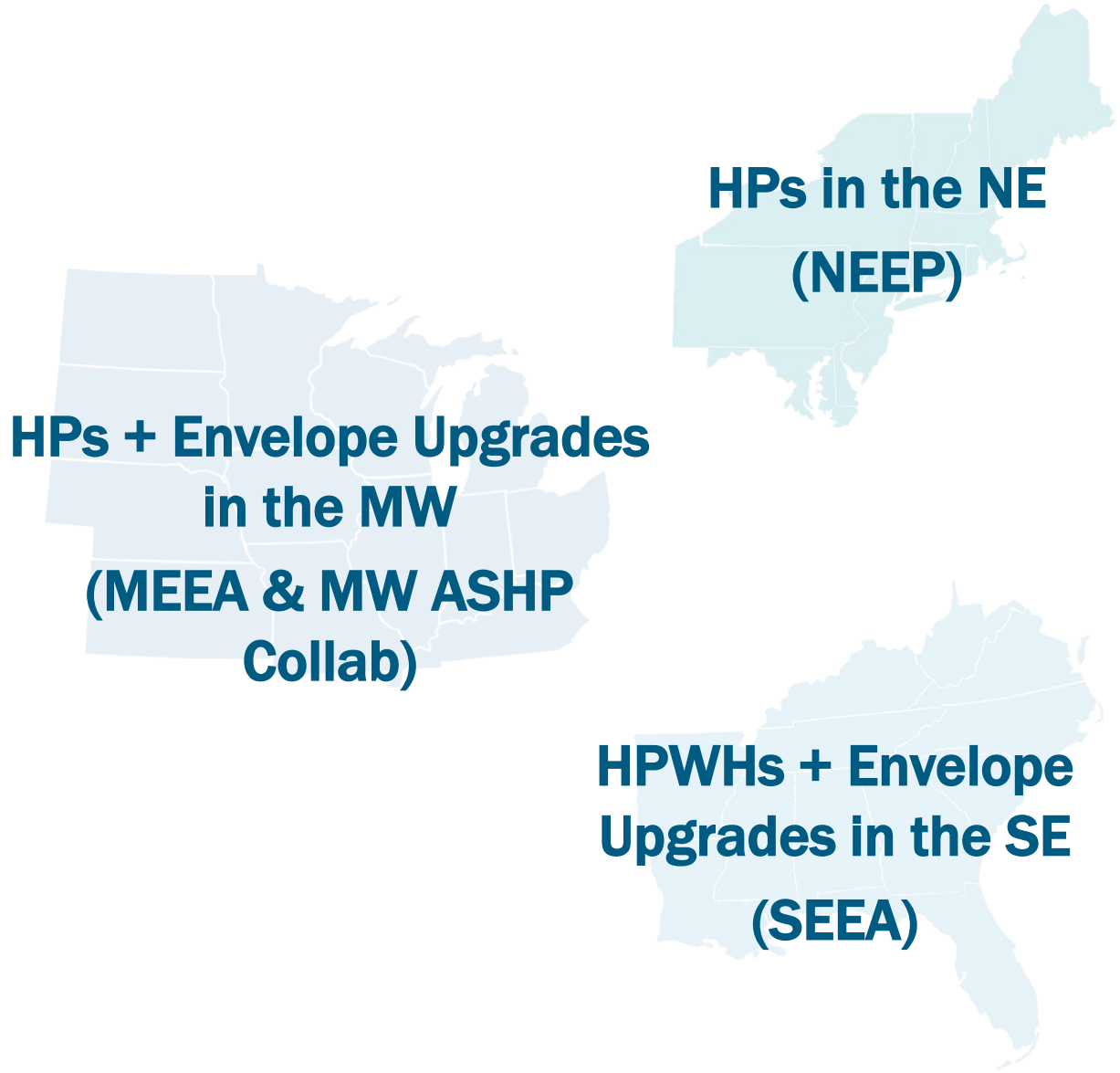
# Decarbonizing HVAC + Water Heating

- DOE's goals promote a transition away from in-home combustion
- Electrifying HVAC + water heating systems are a very high priority

## Heat Pumps!

Source: U.S. DOE – Energy Saver

# Kick-off: Regionally-Focused HP/HPWH Projects




## Goals

- ✓ Get market intelligence from utility, state and community programs
- ✓ Catalog the incentives and claimable savings
- ✓ Get program feedback
- ✓ Hear contractor feedback on uptake and barriers
- ✓ Create regional best practices, barriers and ability to advance new programs

# DOE's CCHP Challenge

Kickoff Workshop *(June 2021)* → Workshops / Discussions with Manufacturers *(Summer 2021)* → Commitments & Public Announcement *(Nov. 2021 – Jan. 2022)* → Product Prototype *(2021-2022)* → Lab Testing *(2022-2023)* → Field Testing *(Winter '22-'23 & '23-'24)* → Deployment Programs/ Commercial-ization *(2024)*

**We are here**

BOSCH Invented for life

Johnson Controls

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TRANE TECHNOLOGIES

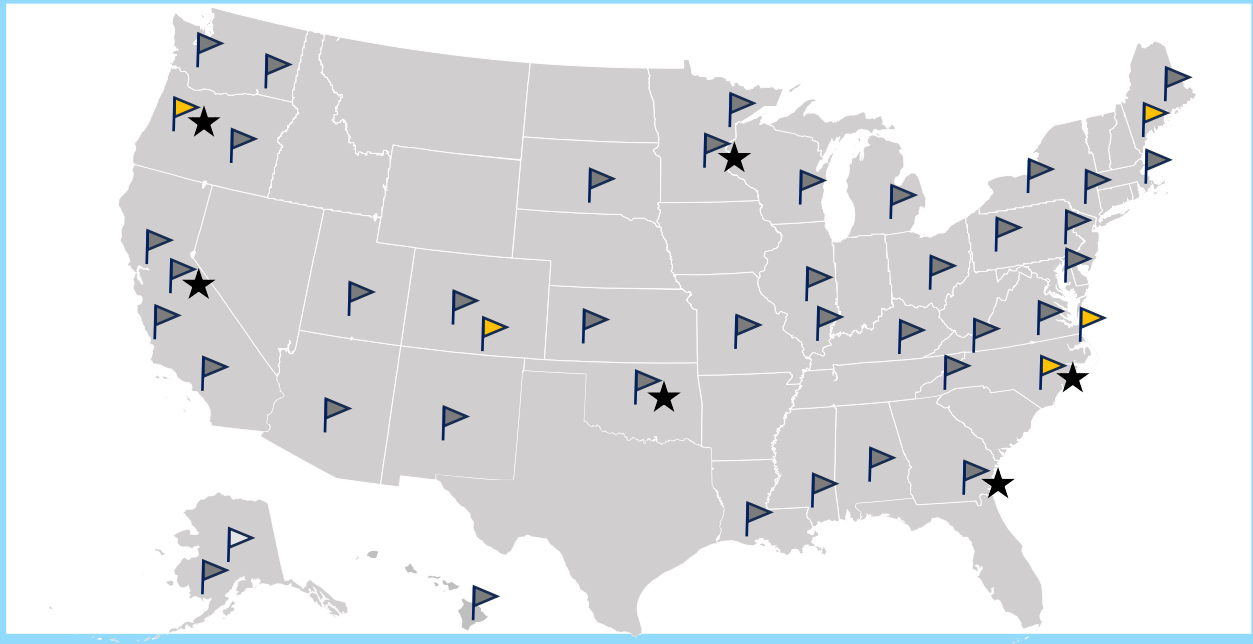
Rheem

## Main Specifications

- COP > 2.1–2.4 at 5 °F
- HSPF2 > 8.5 at 5 °F
- 100% capacity at 5 °F
- Minimum turndown ratio >30% at 47 °F
- Low GWP-refrigerant
- Grid-interactive capabilities

# The Buildings Upgrade Prize (Buildings UP)

**Launched in January 2023, Buildings UP is designed to rapidly scale energy efficiency and efficient electrification building upgrades in communities nationwide**



## Phase 1: Concept

- 45 Phase 1 winning teams selected to continue to Phase 2: Plan
- $22M+ in Prizes to Teams + Technical Assistance

Buildings UP is a capacity-building prize to support teams with solutions that:

- **Accelerate building upgrades** for efficiency and on-site emissions reductions beyond current best practices in the applicant's identified area of focus
- **Demonstrate scalability and replicability** across building type(s), climate zone(s), and/or, community type(s)
- **Advance holistic and lasting energy efficiency and efficient electrification** initiative development
- **Benefit underserved communities** by ensuring that benefits accrue to equity-eligible buildings*, their occupants, and surrounding communities.

*Equity-eligible buildings include buildings in disadvantaged communities; low- and moderate-income (LMI) households; and underserved commercial, nonprofit, and public buildings.

# The Energy Affordability Challenge

ENERGY earthshots
U.S. DEPARTMENT OF ENERGY

Our imperative is to deliver equitable solutions to households with the highest energy burdens.

### High energy burdens
**1 in 4** households face high energy burdens (>6% of income spent on energy).

### Energy affordability challenges
**1 in 5** households were unable to pay an energy bill in full in 2022.

### Adverse pollution & health impacts
Black children are nearly **twice as likely** to have asthma compared to the national average.

50% lower upfront cost

20% lower energy bills

Within a decade

# Three Technology Areas Unlock Cost Savings and Energy Performance

## Integrated designs will deliver whole-home solutions

### Building Envelope*

Improved livability and comfort make for more resilient homes

- Advanced leakage detection
- Low-impact retrofit techniques
- Panelized exterior insulation

### Efficient Electrification*

Smaller, compact equipment and streamlined systems enable affordable and adaptable installations

- Lower-voltage equipment
- Plug-and-play HP designs
- Integrated ventilation packages

### Smart Controls*

Flexible energy loads transform homes into energy resources

- Grid-interactive technologies
- Smart electric panels
- Shared circuit control between loads

*Listed technologies are examples of what could be achieved in each area and are not representative of every solution possibility

# Contact Us!

- Jay Wrobel <jay.wrobel@ee.doe.gov>
- Alexander Rees <alexander.rees@ee.doe.gov>
- Kyle Biega <kyle.biega@ee.doe.gov>
- Blake Lajiness <Blake.Lajiness@ee.doe.gov>
- Mandy Mahoney, Director <mandy.mahoney@ee.doe.gov>

# Regional Roundup

Julia Wells, Minnesota ASHP Collaborative

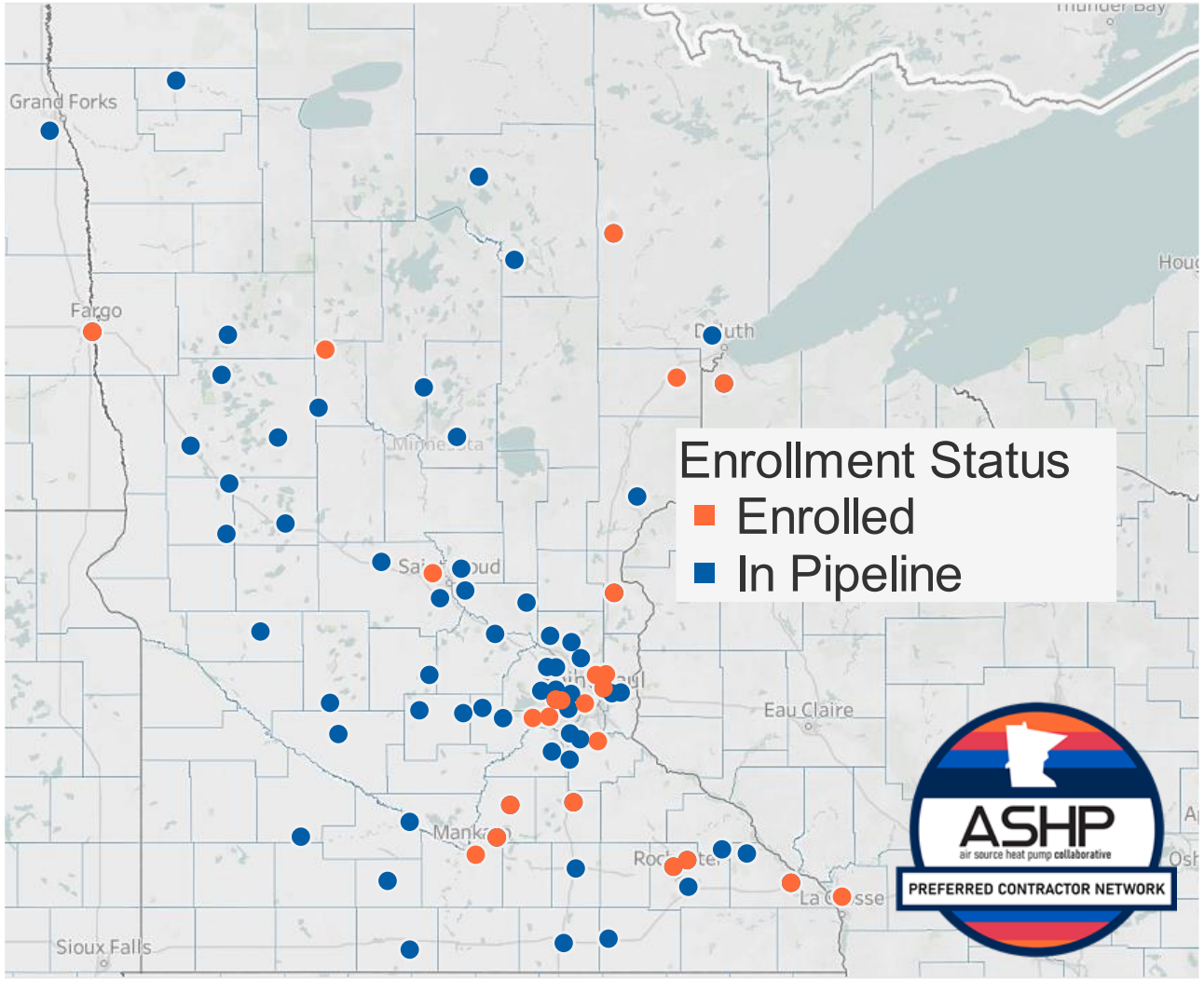
# MN ASHP Collaborative Overview

- Launched in 2019
- Investor-owned, cooperative, and municipal utilities contribute funding
- Mission to make air source heat pumps the first choice for consumers when cooling and heating their homes
- Supportive of dual fuel approaches


Minnesota's Efficient Technology Accelerator is a partnership funded by the state's investor-owned utilities (IOUs), administered by the Minnesota Department of Commerce, Division of Energy Resources (DER), and implemented by Center for Energy and Environment (CEE).

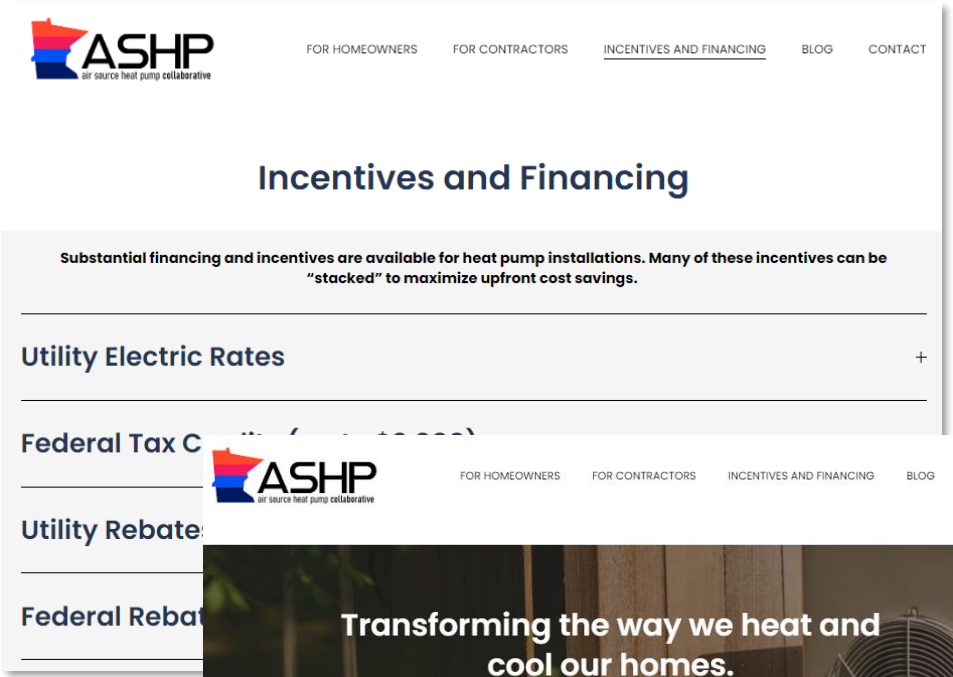
# Successes and learnings from 2023

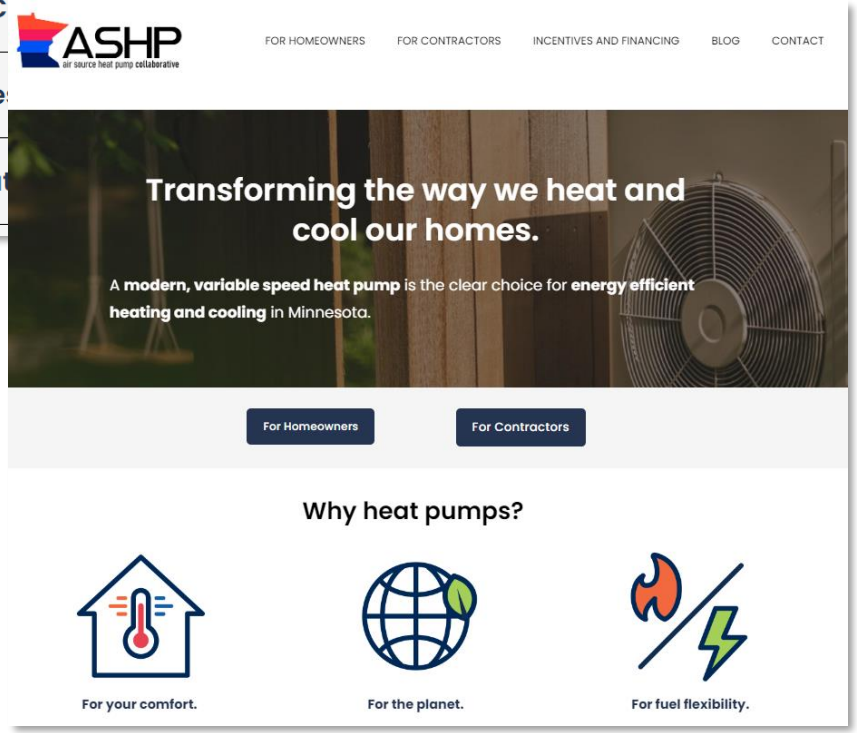
- Statewide contractor trainings
- Preferred Contractor Network



# Successes and learnings from 2023

- Convening MN utilities to align rebates
- Building distributor relationships
- Improving web resources




AIR SOURCE HEAT PUMP

ASHP
air source heat pump collaborative

## Specification Summary

This table summarizes the main heat pump specifications for ducted and ductless systems. The federal minimum standard for heat pumps is also included for comparison.

For more details, please see the links in the table below.

| System type (ducted/ductless) | Specification | HSPF2 | SEER2 | EER2 | COP @ 5°F | Capacity maintenance: 5°F / 47°F | Capacity maintenance: 17°F / 47°F |
|---|---|---|---|---|---|---|---|
| Both | 2023 Federal Minimum Standard (North) | 7.5 | 14.3 | | | | |
| Both | ENERGY STAR v6.1 | 7.8 | 15.2 | 11.7 | | | |
| Ducted | NEEP v4.0 | 7.7 | 14.3 | | 1.75 | | |
| Ducted | Consortium for Energy Efficiency Tier 1, North (qualifies for 25C tax credit) | 8.1 | 15.2 | 10.0 | 1.75 | 70% or | 58% |

# Focus areas for 2024

- Refine customer value proposition
- Become a strategic partner and convener
- Develop and grow distributor and manufacturer relationships
- Expand and enhance the Preferred Contractor Network
- Rates and demand response

ASHP
air source heat pump collaborative

# Regional Roundup

Justin Margolies, Michigan Heat Pump Collaborative

# Michigan Heat Pump Collaborative

MI

HEAT PUMP COLLABORATIVE

# Michigan Heat Pump Collaborative Overview

- Launched in 2022
- Aims to remove barriers to increase adoption of residential heat pumps in Michigan.
  - Air-air, air-water, ground-source, heat pump water heaters
- Holistic education, outreach, and training forum to bring heat pump education opportunities and resources to contractors supporting Michigan residents.

Consumers Energy Count on Us®

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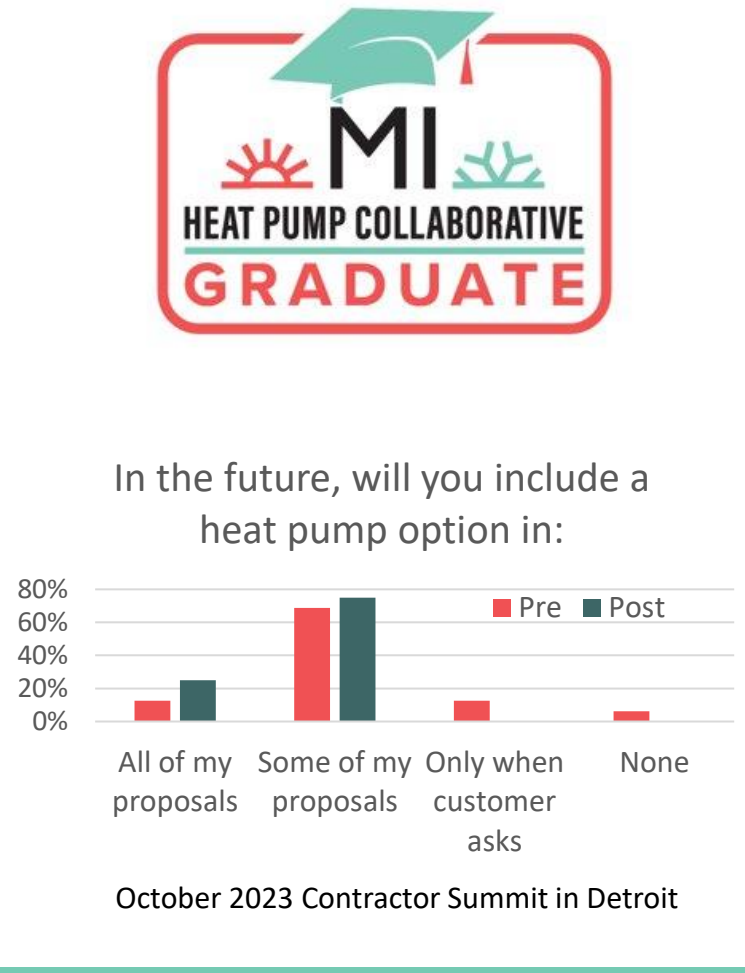
MI HEAT PUMP COLLABORATIVE

# 2023 Milestones

- Launched ASHP training in response to market needs
- Launched Graduate contractor designation
- Stakeholder engagement



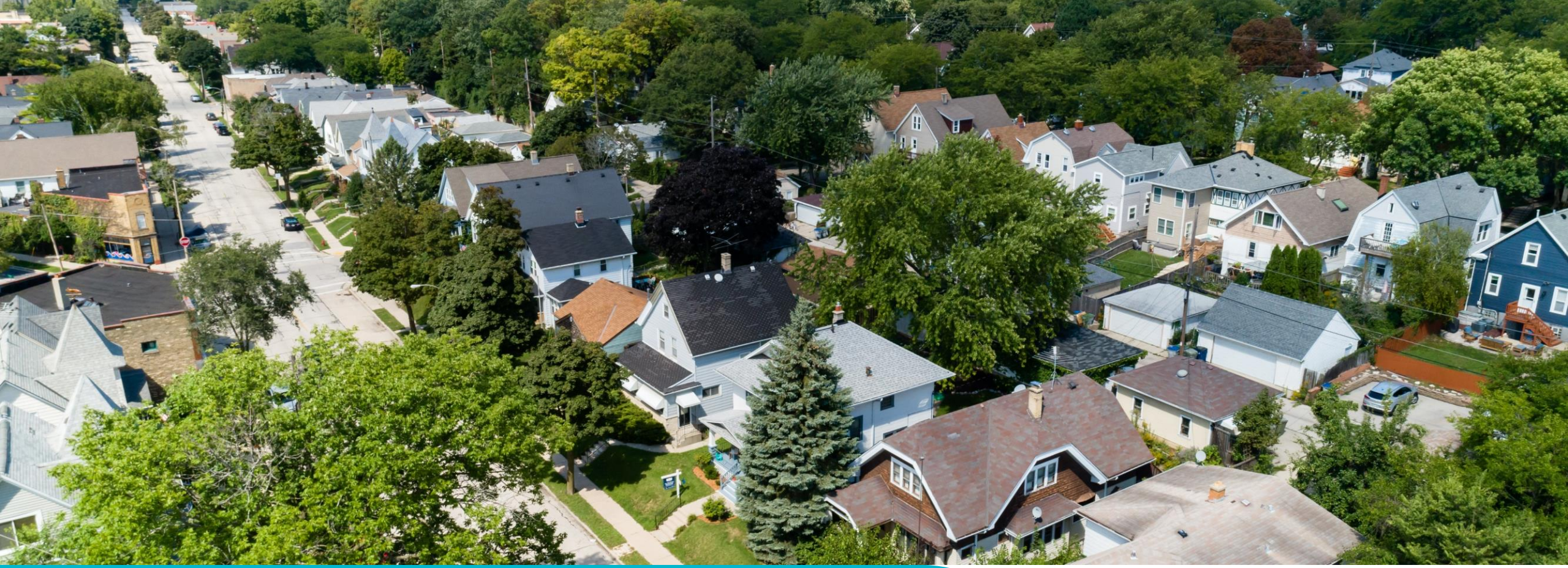

October 2023 Contractor Summit in Detroit


# 2024 Priorities

- Scale contractor trainings
  - 6 webinars
  - 4 summits (working with MW ASHP Collaborative)
  - Direct-to-contractors and in partnership with manufacturers and distributors
- Refine Graduate designation and grow network
- Provide contractor resources
- Friends of the Collaborative

# Regional Roundup

Jacqueline Freidel, Focus on Energy



# HEAT PUMPS

Jacqueline Freidel, Consultant

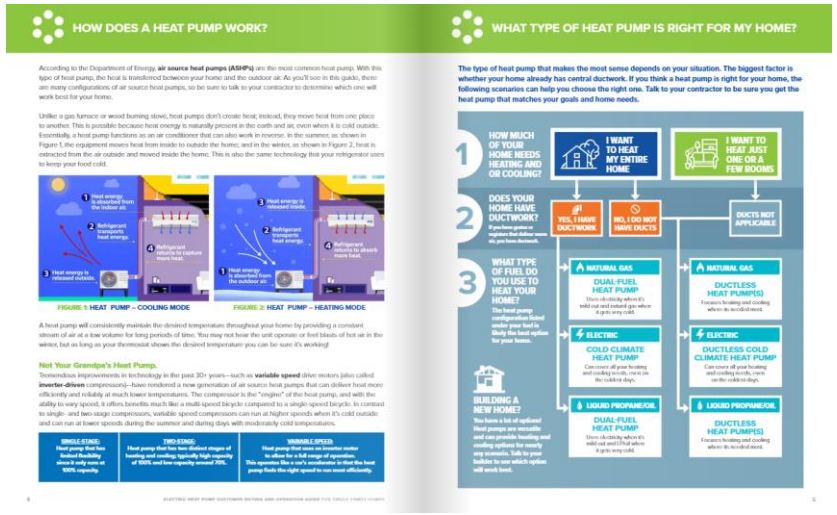
January 29, 2024

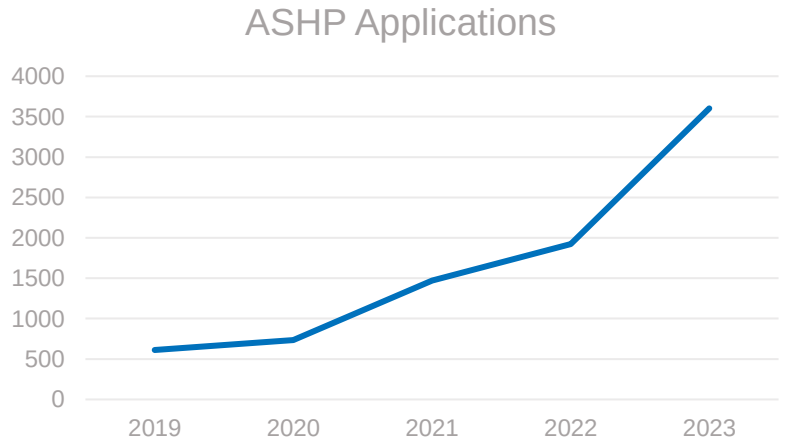
focus on energy®

Partnering with Wisconsin utilities

# 2023 MILESTONES

- Developed the Electric Heat Pump Customer Buying and Operation Guide.
- 3,600 ASHP incentive applications in 2023.
  - Nearly 100% increase since 2022.
  - 600% increase since 2019.
- Notable trends.
  - Nearly all ASHP installs were cold climate ASHPs.
  - More natural gas customers installing ASHPs than anticipated.



# 2024 PRIORITIES

focus on energy®
Partnering with Wisconsin utilities

- Roll-out of the Instant Discount program.
- Address negative energy savings challenges.
- Make the Inflation Reduction Act and Focus rebates/incentives easy for customers to navigate and contractors to sell.
- Conduct Research Projects/ Implement Pilots.
  - Air-to-Water Heat Pump Field Study.
  - Focus Emerging Technology Accelerator.


# Regional Roundup

Mark Milby, ComEd

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Midwest Air Source Heat Pump Collaborative
January 29, 2024

# ComEd ASHP Trends

Mark Milby
Manager of R&D
ComEd Customer Solutions

# Home Heating & Cooling – Incentives & Training


## Coming Soon

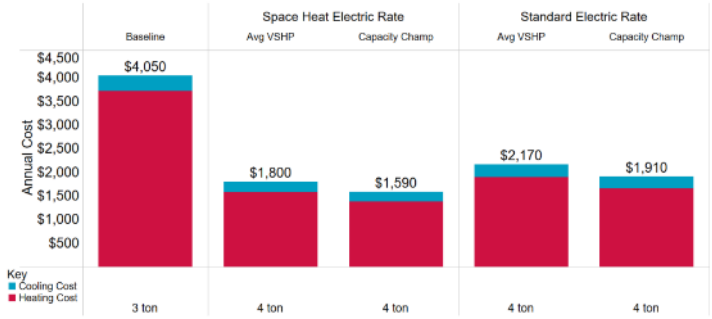
- Designing ASHPs with Sizing and Selection in Mind | January 25, 2024 | Webinar | Register
- Heat Pump Control Strategies and Best Practices | February 8, 2024 | Webinar | Register
- Replacing ACs with ASHPs | February 15, 2024 | Webinar | Register

ComEd Energy Efficiency Program

**AIR-SOURCE HEAT PUMP BEST PRACTICES INSTALLATION GUIDE**

**SCENARIO 1 – HOME BUILT IN THE 1950S**

The home considered here is one built in the 1950s, which means it costs the homeowner more to heat and cool. For this homeowner, installing an ASHP could save $1,800 or more per year, depending on the system size and type.

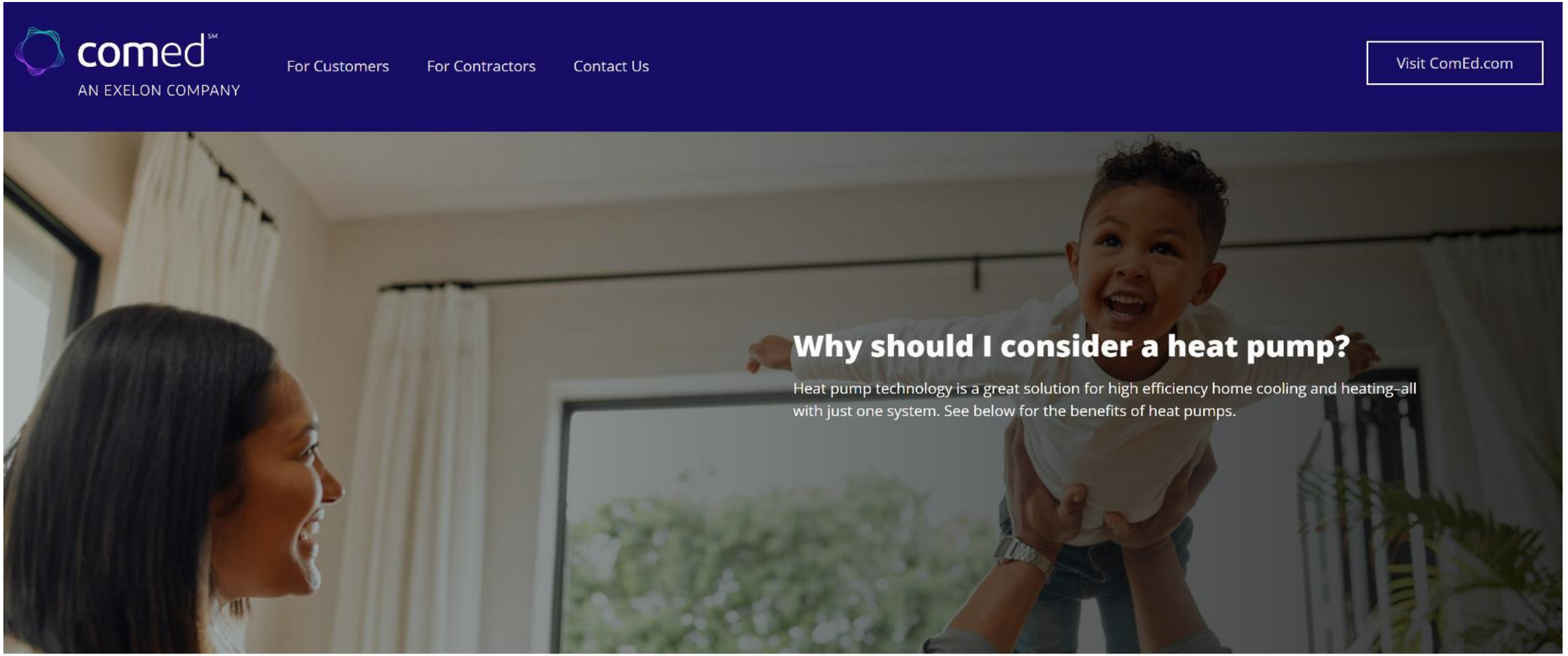


# All-Electric New Construction & Multifamily Energy Savings

# Whole Home Electric

# ComEd Go Electric

goelectric.comed.com



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# Thank you

**Mark Milby**
mark.milby@comed.com

**Pauravi Shah**
pauravi.shah@comed.com

View all innovation projects, submit ideas and subscribe for updates at **innovate.comed.com**

# Please enjoy a break

2:00 PM – 2:05 PM

MIDWEST ENERGY SOLUTIONS CONFERENCE

PRESENTED BY MEEA MIDWEST ENERGY EFFICIENCY ALLIANCE

# ASHP Manufacturer Perspectives

Kevin DeMaster, Mitsubishi
Charles Elliott, LG
James Momperousse, Carrier
Jon Blaufuss, Daikin
Facilitated by: Emily McPherson, CEE

# About our Panel

**Kevin DeMaster**
Sr. Mgr, Utilities & Electrification
**Mitsubishi Electric Trane**

**James Momperousse**
Utility Rebate Program Manager
**Carrier Corporation**

**Jon Blaufuss**
Manager – Energy Efficiency and Electrification Programs
**Daikin**

**Charles Elliott**
Sr. Account Manager
**LG Electronics North America**

MIDWEST ASHP COLLABORATIVE

# Agenda

| Topic | Est. time |
|---|---|
| **Spotlight on variable speed technology and EER2 specification**<br>Panel Q&A<br>Audience Q&A | 45 |
| **Panel discussion on themes:**<br>Simple effective program design<br>Contractor readiness<br>Cold climate performance<br>A2L refrigerant change | 30 |
| **Audience Q&A** | 15 |

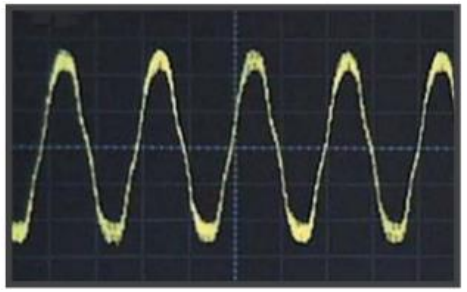
# Inverter-Driven Heat Pumps and the Barrier of EER2 Requirements

MEEA MES Pre-Conference Heat Pump Workshop
January 29, 2024

MIDWEST ASHP
COLLABORATIVE

# Variable Speed Heat Pumps

- **Single-stage:** Operates in one setting, cost effective with low to average efficiency ratings
- **Two-stage:** Operates in two settings allowing for better efficiency ratings
- **Variable capacity:** High end modulating functionality, allowing for excellent efficiency ratings across a spectrum of conditions



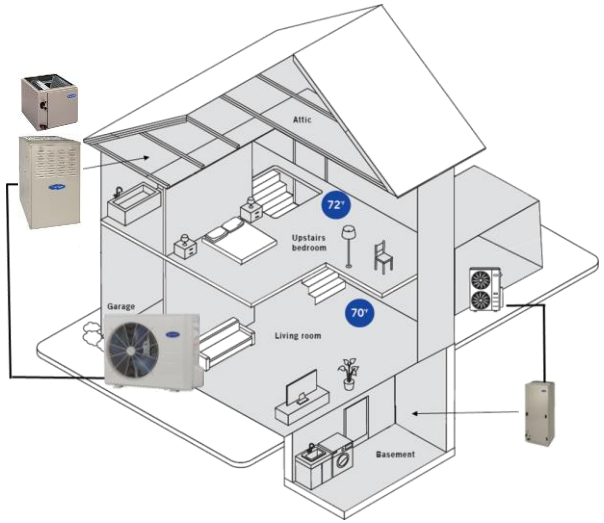
MIDWEST ASHP COLLABORATIVE

# Residential Products

## *Unitary*

## *Ductless*

## *Crossover/Hybrid*

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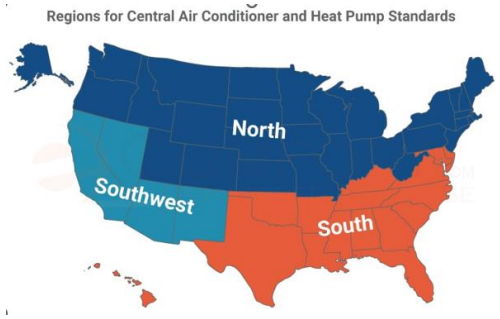
# What is EER/EER2

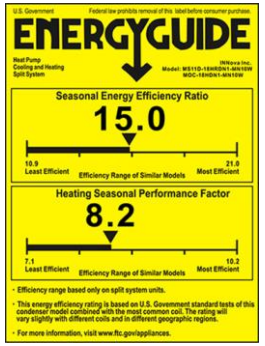
The Energy Efficiency Ratio (EER) measures the amount of ***cooling*** output a system delivers to the amount of electrical energy it consumes.

The official EER ratings of heat pumps and ACs are determined with the units running at full capacity at AHRI standard test conditions (95°F outdoor temperature).

**EER = Cooling Output (BTU/hour) / Power Input (watts)**

# Department of Energy DOE Minimum Specifications




DOE Energy Efficiency Standards (Effective 2023)

| System Type | North Region | | South Region | | Southwest Region | | |
|---|---|---|---|---|---|---|---|
| | SEER2 | HSPF2 | SEER2 | HSPF2 | SEER2 | HSPF2 | EER2 |
| Split System A/Cs with a Certified Cooling Capacity <45,000 Btu/h | 13.4 | NA | 14.3 | NA | 14.3 | NA | 11.7/9.8* |
| Split-System A/Cs with a Certified Cooling Capacity ≥45,000 Btu/h | 13.4 | NA | 13.8 | NA | 13.8 | NA | 11.2/9.8* |
| Split-System Heat Pumps | 14.3 | 7.5 | 14.3 | 7.5 | 14.3 | 7.5 | NA |
| Package Air Conditioners | 13.4 | NA | 13.4 | NA | 13.4 | NA | 10.6 |
| Package Heat Pumps | 13.4 | 6.7 | 13.4 | 6.7 | 13.4 | 6.7 | NA |

*The lower EER requirement is for equipment at or above 16.0 SEER using the M test method (or 15.2 SEER2 using the M1)

ENERGY STAR

## Energy Star 6.1
## Residential Cold Climate Specification

| Product Type | SEER2 | HSPF2 |
|---|---|---|
| HP Split Systems (Non-Ducted) | ≥ 15.2 | ≥ 8.5 |
| HP Split Systems (Ducted) | ≥ 15.2 | ≥ 8.1 |

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# Why EER2 and Inverter Compressors don’t Mesh

**Dynamic Operating Conditions**:

Inverter compressor heat pumps dynamically adjust their speed to meet the heating or cooling demands. EER2 is typically measured at specific operating conditions, and the dynamic nature of inverter compressors may lead to variations in efficiency under different load and ambient temperature conditions. EER2 may not fully capture the system's performance in real-world, dynamic scenarios.

**Seasonal Performance Variability:**

EER2 provides a snapshot of efficiency at specific conditions, and it may not account for seasonal variations. In regions with significant temperature fluctuations, a metric like Seasonal Energy Efficiency Ratio (SEER2) could offer a more comprehensive assessment, considering the system's performance over an entire cooling season.

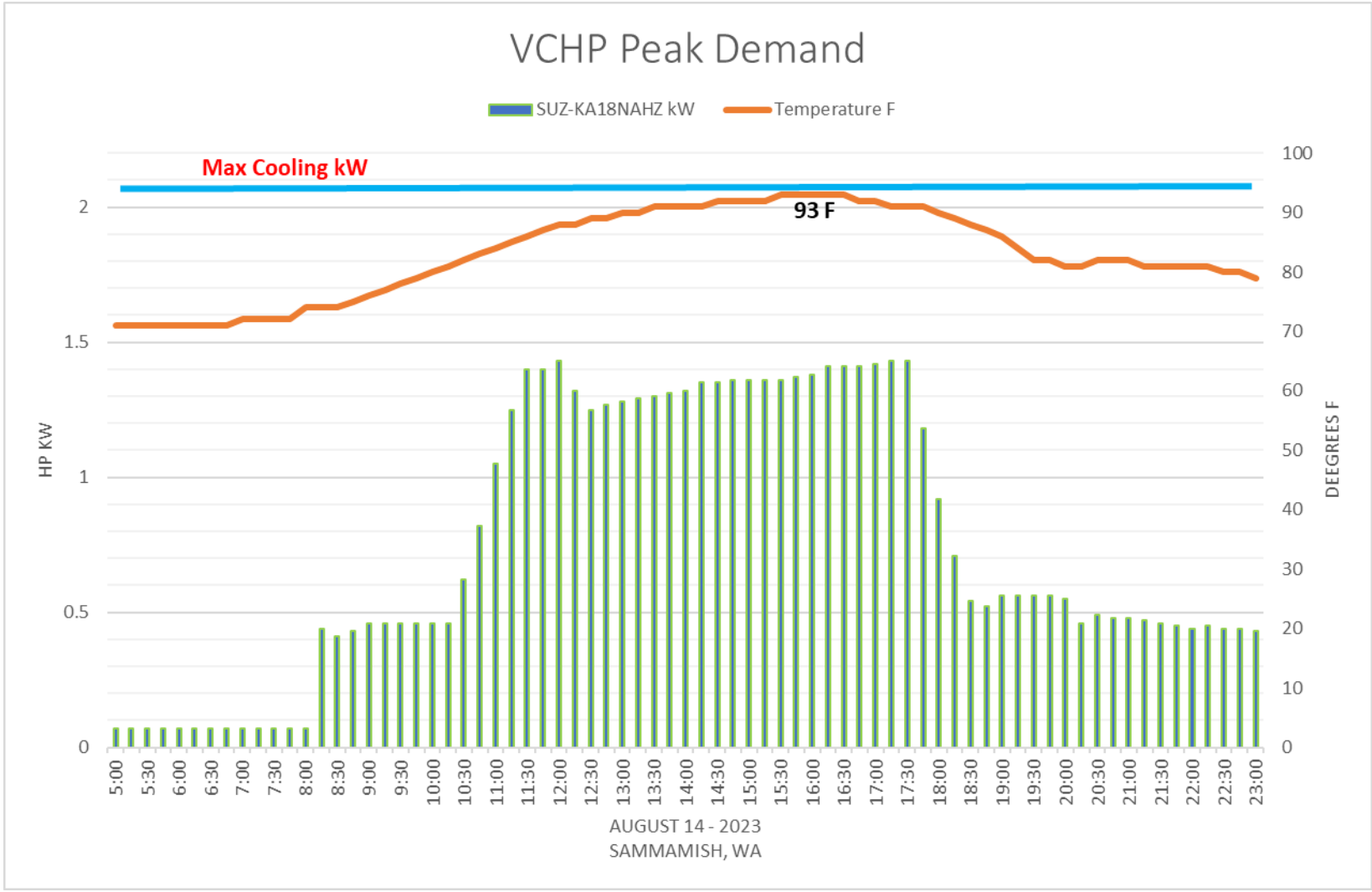
**Potential for Overestimation at Part Load:**

Inverter compressors excel at part-load conditions, adjusting their speed to match the required heating or cooling capacity. EER2 values may not accurately reflect the efficiency gains achieved during part-load operation, potentially leading to an underestimation of the system's overall efficiency.

# 2023 Summer Peak – VCHP Performance - Seattle

**SUZ-KA18NAHZ / SVZ-KP18**
Summer Peak
93°F @ 4pm, Aug 14, 2023
T-stat set at 73°F

- 1.43 kW peak @ 12 & 5:15 & 5:30
- 2.1 kW Max Cooling Rating

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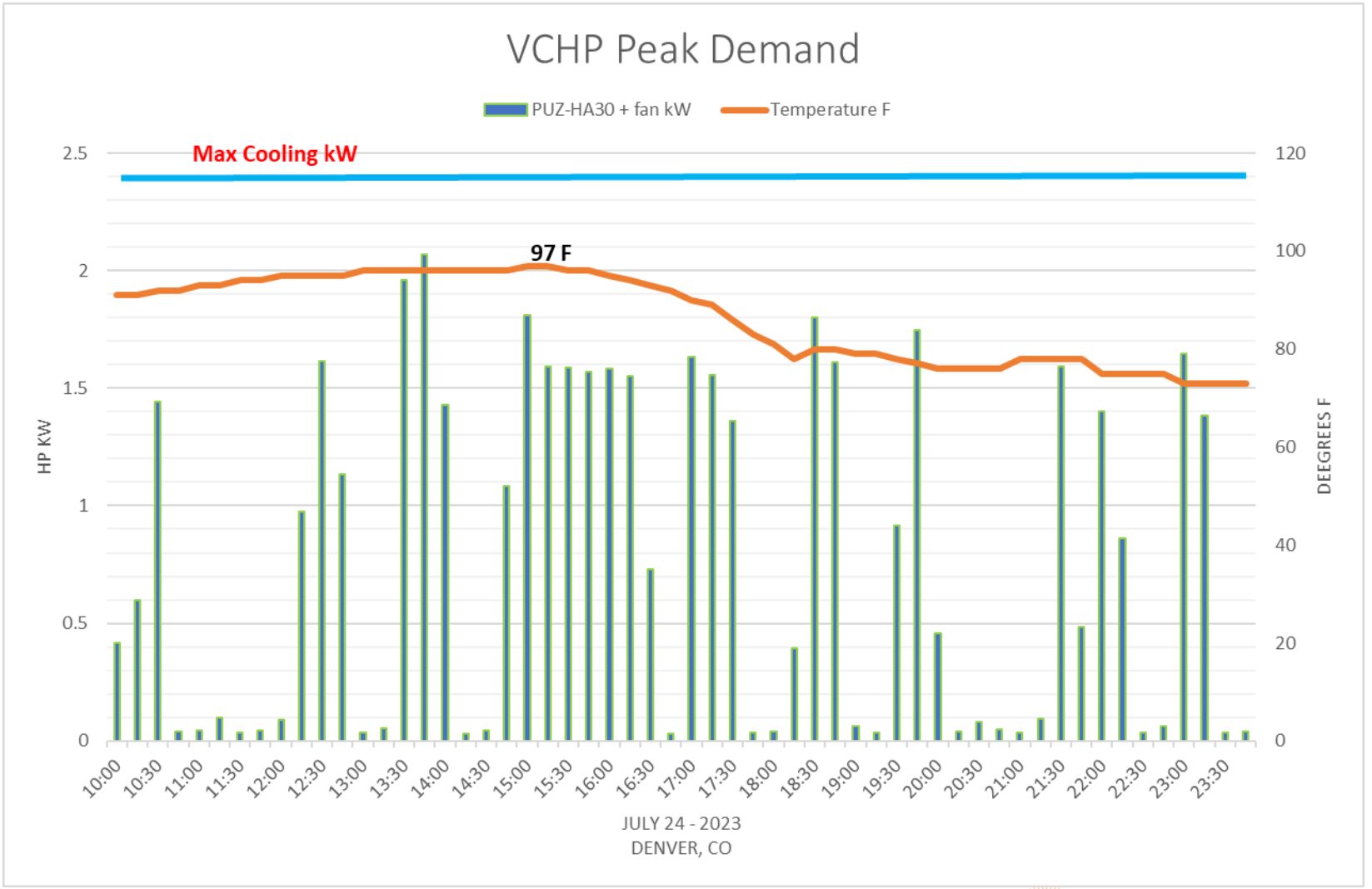
# 2023 Summer Peak – VCHP Performance - Denver

**PAA-A30AA1 & PUZ-HA30NKA**
Summer Peak
97°F @ 3pm, July 24, 2023
T-stat set at 73°F

- 2.07 kW peak @ 1:45
- 2.4 kW Max Cooling Rating

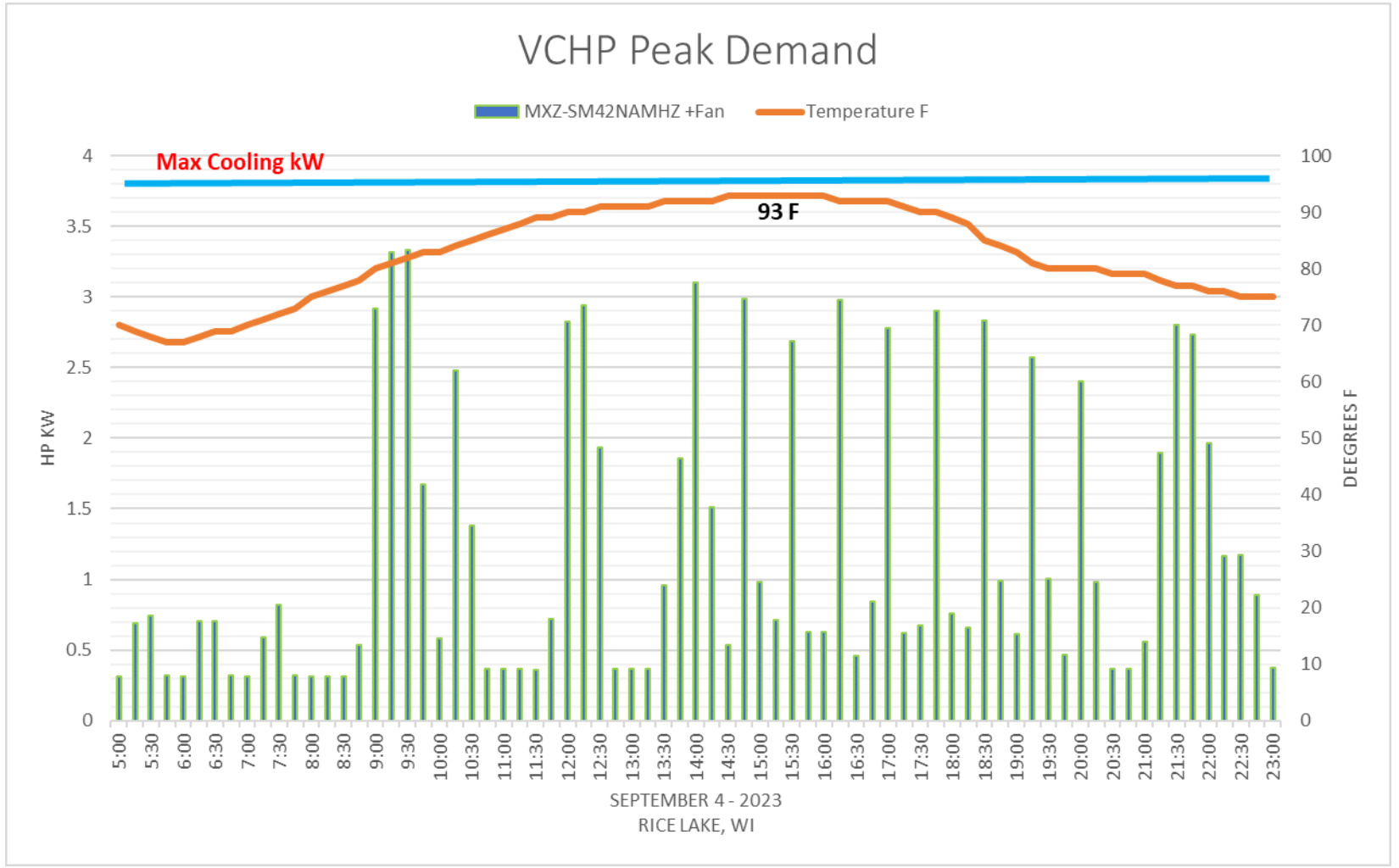



MIDWEST ASHP COLLABORATIVE

# 2023 Summer Peak – VCHP Performance – Rice Lake, WI

**PAA-A36CA1 & MXZ-SM42NAMHZ** Summer Peak
93°F @ 2:30-3:45 PM, Sept 4, 2023
T-stat set at 75°F

- 3.33 kW peak @ 9:30 AM
- 3.82 kW Max Cooling Rating

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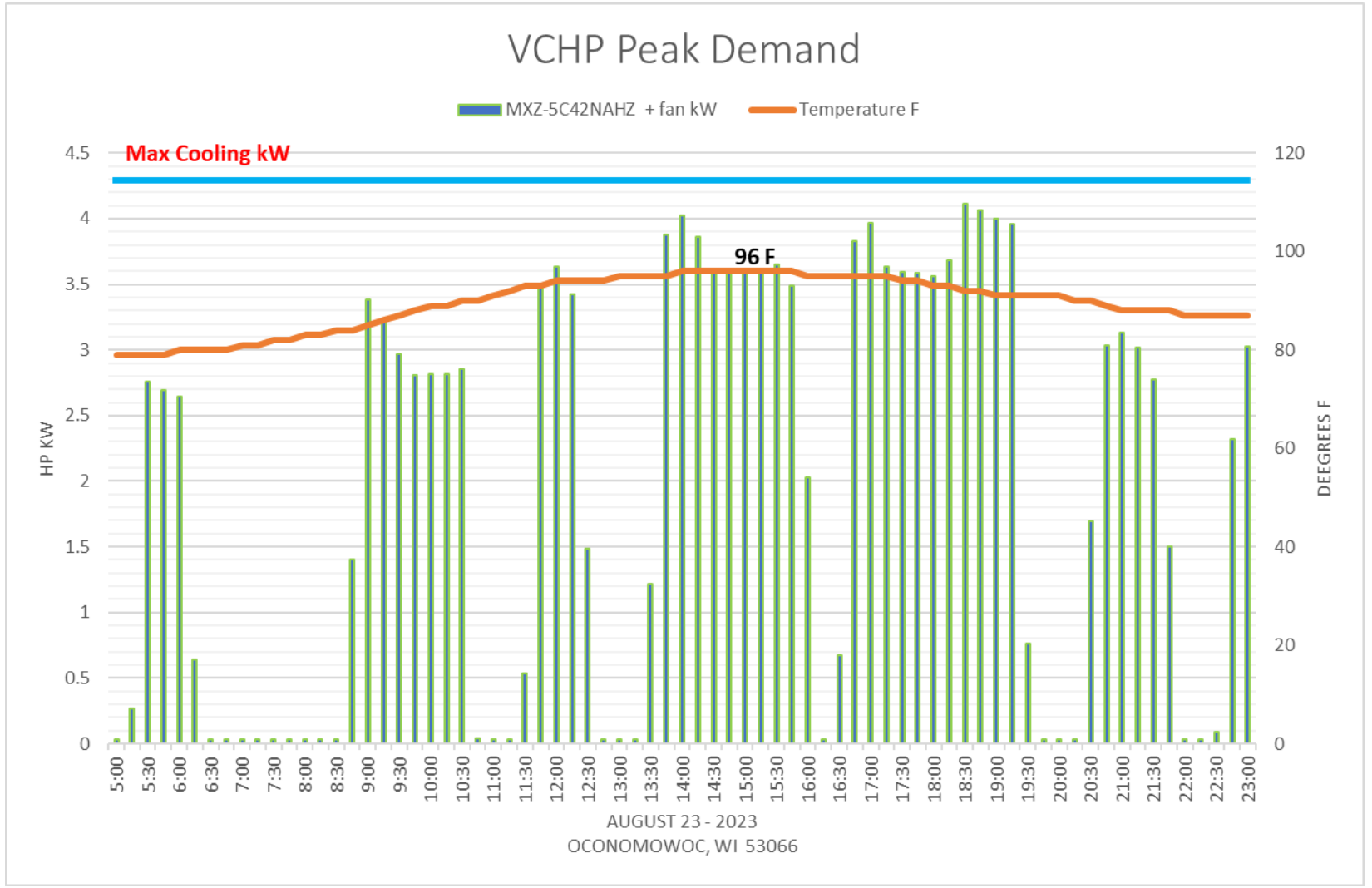
# 2023 Summer Peak – VCHP Performance – Oconomowoc, WI

**PAA-A42CA1 & MXZ-5C42NAMHZ2** Summer Peak
96°F @ 2:00-3:15 PM, Aug 23, 2023
T-stat set at 75°F

- 4.14 kW peak @ 6:30 PM
- 4.33 kW Max Cooling Rating

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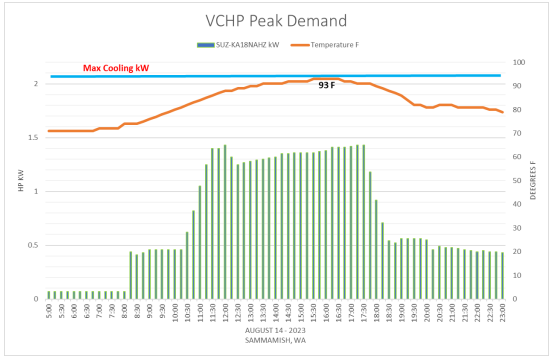
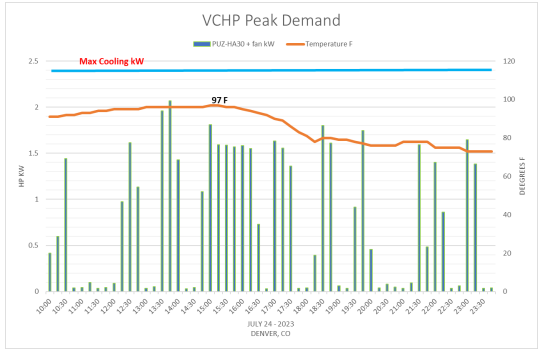
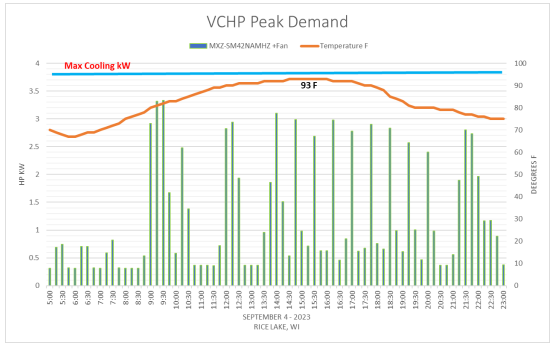
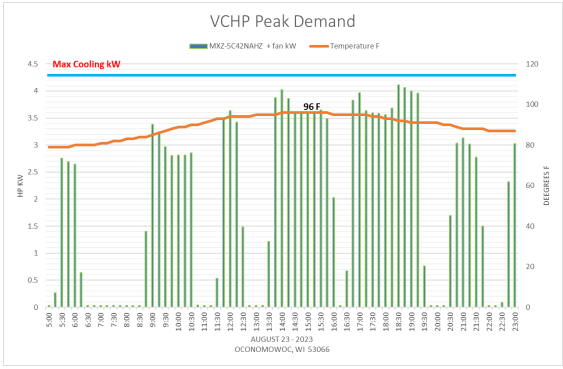
# 2023 Summer Peak – VCHP Performance – Summary




| Region | Seattle | Denver | Rice Lake | Oconomowoc |
|---|---|---|---|---|
| Summer Peak Temp F | 93 | 97 | 93 | 96 |
| HP MAX kW Rated | 2.10 | 2.40 | 3.82 | 4.33 |
| HP Peak kW | 1.43 | 2.07 | 3.33 | 4.14 |
| Delta kW | .67 | .33 | .49 | .19 |
| % Difference Max | 32 | 14 | 13 | 4 |

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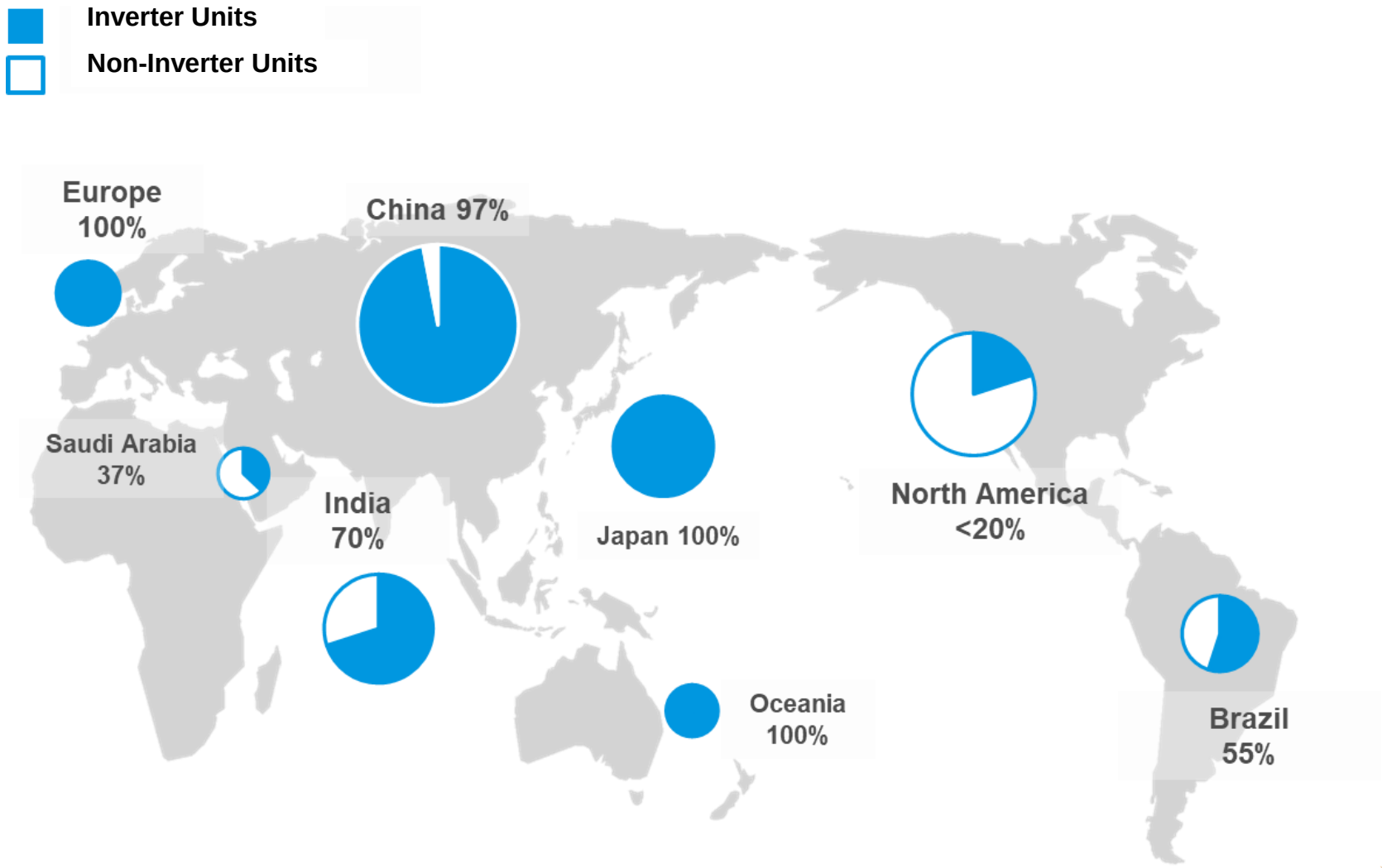
# Comparing Global Inverter Adoption with North America




Source: BSRIA World Air Conditioning Overview 2023 (North America percentage is an internal Daikin estimate)

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# EER Requirements in Incentive Programs Discourage Inverter-Driven Heat Pump Adoption

What EER “IS”:

- A test for fixed-capacity, earlier generation ACs and HPs
- Measures operating efficiency at hot (95°F) outdoor temperatures under the only operating state fixed capacity systems are capable of: 100% compressor speed
- Utilized by utilities to measure the relative difference in demand between fixed capacity systems, allowing for calculation of peak demand savings.

What EER “ISN’T”:

- Not designed for modern, inverter ACs and HPs which consistently run at less than full capacity
- Not representative of how modern inverter HPs and ACs operate in the field on hot (95°F) days
- Not helpful for utilities trying to manage peak demand while increasing modern HP adoption

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# Overview of Daikin's Research

- In 2023, Daikin initiated research to test industry claims that EER isn't an accurate representation of variable capacity HP and AC operation in the field.

- Hypothesis: As a fleet, variable capacity HPs and ACs operate at "part-load" during peak conditions, namely 95° F and higher.

- Additional research questions:
  - What is the average operational capacity during peak conditions?
  - What is the average part-load efficiency (energy savings)?
  - How does the average operational capacity differ by region?
  - What contributes to any variability seen in the data?

# Daikin's Research Methodology for EER and Variable Capacity HPs/ACs

- Large data set (+7,000 sites)
- Individual HVAC systems reporting via cloud connectivity
- Equipment type is central system, variable capacity HPs and ACs
- Methodology:
  - Sites are organized by ZIP code
  - Weather data is gathered for each for ZIP and associated with each site
  - Study days are exclusively those where outdoor temperatures reach 95°F or above
  - Dependent variables are outdoor temperature and compressor operating speed

- Research is ongoing.
- The data set continues to grow as more systems are installed and connected to Daikin's cloud servers.

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# Results

1. Large groups (or fleets) of variable capacity HPs and ACs consistently operate at significantly less than 100% capacity during EER conditions
   - Even at much higher outdoor ambient conditions (e.g. 105˚F), these fleets operate at considerably less than 100% capacity
2. Additional energy and demand savings (from part-load efficiency) appear to be available for programs
3. Results vary by region, but less than we initially assumed
4. Several end-user behaviors were identified as contributing greatly to variability within the results

Interested in learning more? Daikin is willing to review regional and/or statewide data sets with utilities.

We are conducting these reviews upon request.

If you are interested, please contact Jon Blaufuss (Jon.Blaufuss@daikincomfort.com).

# Takeaways

- Modern, inverter-driven heat pumps will be key to achieving space heating electrification goals
- EER requirements for inverter-driven heat pumps in utility and government incentive programs jeopardize those goals by disincentivizing this class of equipment and eliminating the savings opportunities presented by them.
- What should program designers do?
  - Remove EER for inverter-driven, variable capacity heat pumps; EER is still an appropriate metric for fixed capacity one and two-stage equipment.
  - Support removal of EER requirements from Energy Star and CEE specifications for inverter-driven heat pumps
  - Focus on SEER2, HSPF2, and performance at 5°F!

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# Discussion

# Up Next…..

- 15-minute break
- Discussion break-out groups
- Feel free to move to the table topic of your interest

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# Break Out Topics

| |
|---|
| Contractor support |
| Equity focused deployment |
| Workforce development |
| Incentive alignment |
| Program design metrics |
| Customer awareness and engagement |
| Innovative rate options |
| Success in other regions |
| Path to 2050 decarbonization and the role of dual fuel |

# Please enjoy a break

3:35 PM – 3:50 PM

# Break Out Topics

| |
|---|
| Contractor support |
| Equity focused deployment |
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| Path to 2050 decarbonization and the role of dual fuel |

# Breakout Sessions

Facilitated by Molly Garcia, CEE

3:50 PM – 4:50 PM

# Breakout Sessions Instructions

Dedicated topic breakouts will involve a 60-minute guided discussion to identify actions and facilitate connections via problem statements and questions for groups to consider.

**Please:**

- **Contribute your perspective**. Whether you're an expert or not, we want to hear from you.
- **Be respectful**. Take turns speaking and give others an opportunity to speak.
- **Stay engaged**. Contribute to the discussion and avoid distractions. Save other discussions and topics for another time.

# Breakout Session Agenda

| **Introductions** | **10 mins** |
|---|---|
| • Topic and the activity<br>• Fellow participants | |
| **Self-Reflection** | **5 mins** |
| • Opportunity for self-reflection on the topic at hand | |
| **Discussion** | **25 mins** |
| • Guided discussion and problem solving | |
| **Check-out Question** | **15 mins** |
| • Recap of key themes | |
| **Encourage Information Sharing** | **0 mins** |
| • Reminders to share contact information for further engagement | |

# Close and Next Steps

Molly Garcia

# Close and Next Steps

- Slides and short summaries of the breakout group topic discussions will be distributed
- Check in on the Collaborative website for resources and regional ASHP news
- Questions, comments, or general feedback is always welcome, so please get in touch

# Happy Hour!

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**Location: Theory (9 W. Hubbard St, Chicago)**
**Time: 5:00 PM – 7:30 PM**

- Please register for the Happy Hour before arriving. First-come, first-served.
- Proof of pre-conference or conference registration is required for entry (pre-conference name badge or email confirmation)
- Safety Reminder: Always remain vigilant and ensure you have a companion when traveling in unfamiliar areas.

## Thank you to our Happy Hour sponsors!

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# Please visit our website for project updates

## Midwest ASHP Collaborative Website

https://www.mwalliance.org/midwest-ashp-collaborative

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# Additional Resource Links

DOE/PNNL STEP Campaign:
https://www.energy.gov/eere/buildings/smart-tools-efficient-hvac-performance-campaign

DOE/PNNL Building Science Education Center:
https://bsesc.energy.gov/

https://www.miheatpumps.com/
https://www.mnashp.org/

https://www.mncee.org/
https://www.mncee.org/air-source-heat-pumps
https://www.mncee.org/career-training

https://www.etamn.org/residential-air-source-heat-pumps

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