

# Wisconsin Air Source Heat Pump Market Transformation Planning Playbook (2022-2030)



# Climate + Clean Energy Solutions for everyone.

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





# Center for Energy and Environment





# ELEVATE

**Elevate seeks to create a world in which everyone has clean and affordable heat, power, and water in their homes and communities — no matter who they are or where they live**



# Acknowledgement and Disclaimer



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# Office of Energy Innovation

## Vision

Our vision is that Wisconsin homes, businesses, and vehicles are powered with clean, efficient, reliable energy that creates jobs and grows our economy in an equitable manner where all can share in the benefits.

## Mission

Developing Wisconsin's energy landscape to be secure, environmentally responsible, and growing the state's economy for all.

## Programs

- ✓ Focus on Energy: Incentives, Technical Assistance, Training, Trade Ally Support
- ✓ State Energy Office: Grants, Technical Assistance, Energy Statistics & Data, Energy Security

# EIGP 2021 Program Objectives

- ▶ **Support innovative energy technologies** that have the potential to serve as a model or better inform decision-makers on emerging trends in the energy sector.
- ▶ **Help to provide equitable access** to the benefits of clean energy, efficiency, and preparedness by reaching broad applicant types.
- ▶ **Support Carbon Reduction** with projects supporting Governor's goal of 100% carbon-free electricity by 2050.

# EIGP 2021 Program Funding

- ▶ **Total Funding Available- \$10 million**

- ▶ Activity 1: Renewable Energy and Energy Storage - \$4.6 million

- ▶ Activity 2: Energy Efficiency and Demand Response - \$4.6 million

- ▶ **Activity 3: Comprehensive Energy Planning - \$714,000**





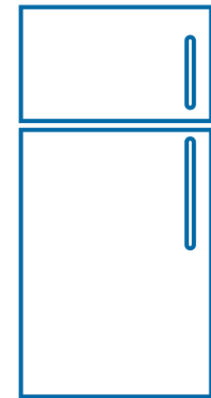
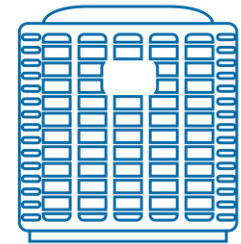
# Introduction

# Playbook Outline

- Introduction
- Wisconsin residential building landscape
- Evaluating ASHP opportunities
  - Screening criteria for high priority applications
  - Economics and emissions of top ASHP opportunities
- Wisconsin ASHP market transformation roadmap
- Wisconsin ASHP market transformation recommended actions
  - State and regulatory
  - Focus on Energy
  - Utilities
  - Communities (Local governments, tribes, and communities)
- Next steps

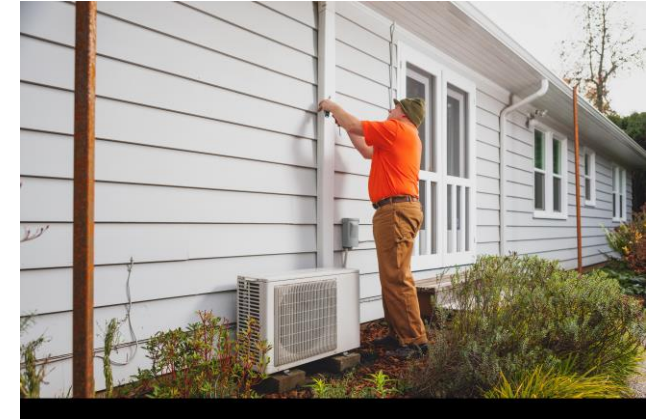


# What is a heat pump



# In focus for WI ASHP market transformation planning

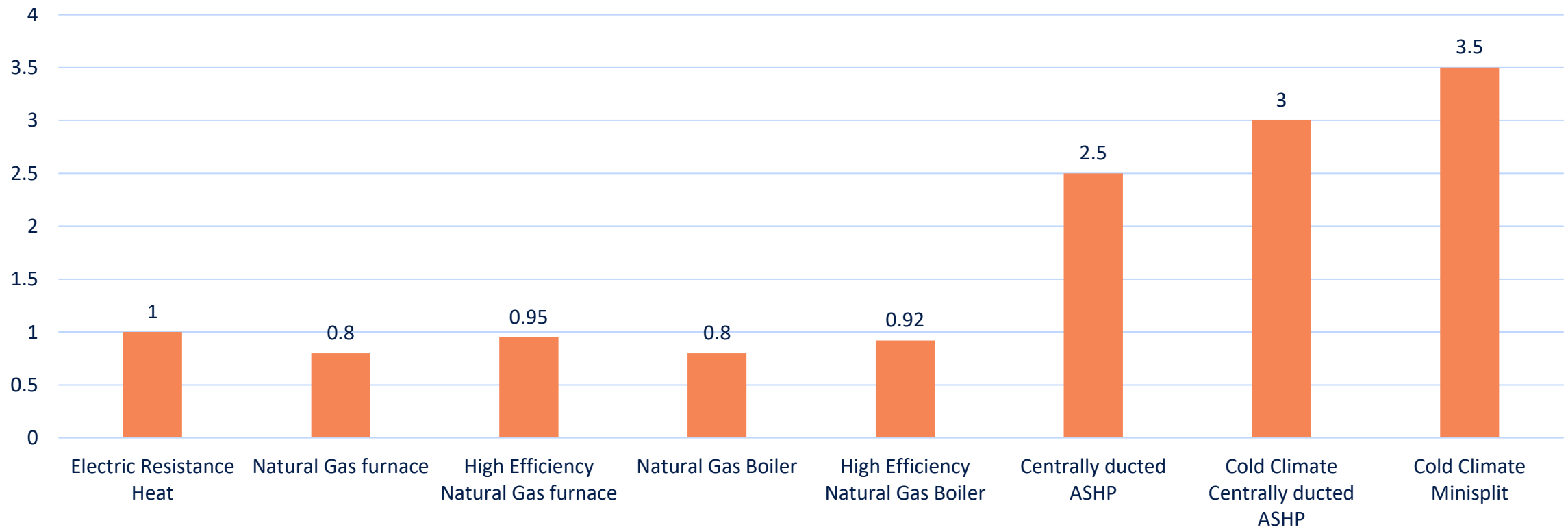
- **Residential heat pumps**
  - Minisplit heat pumps
  - Centrally ducted heat pumps
  - Dual-fuel heat pumps
  - Air-to-water heat pumps
  - Ground source heat pumps
  - Gas fired heat pumps
- Commercial heat pumps
  - VRF heat pumps
  - RTU heat pumps
- Industrial heat pumps



# Why ASHPs?

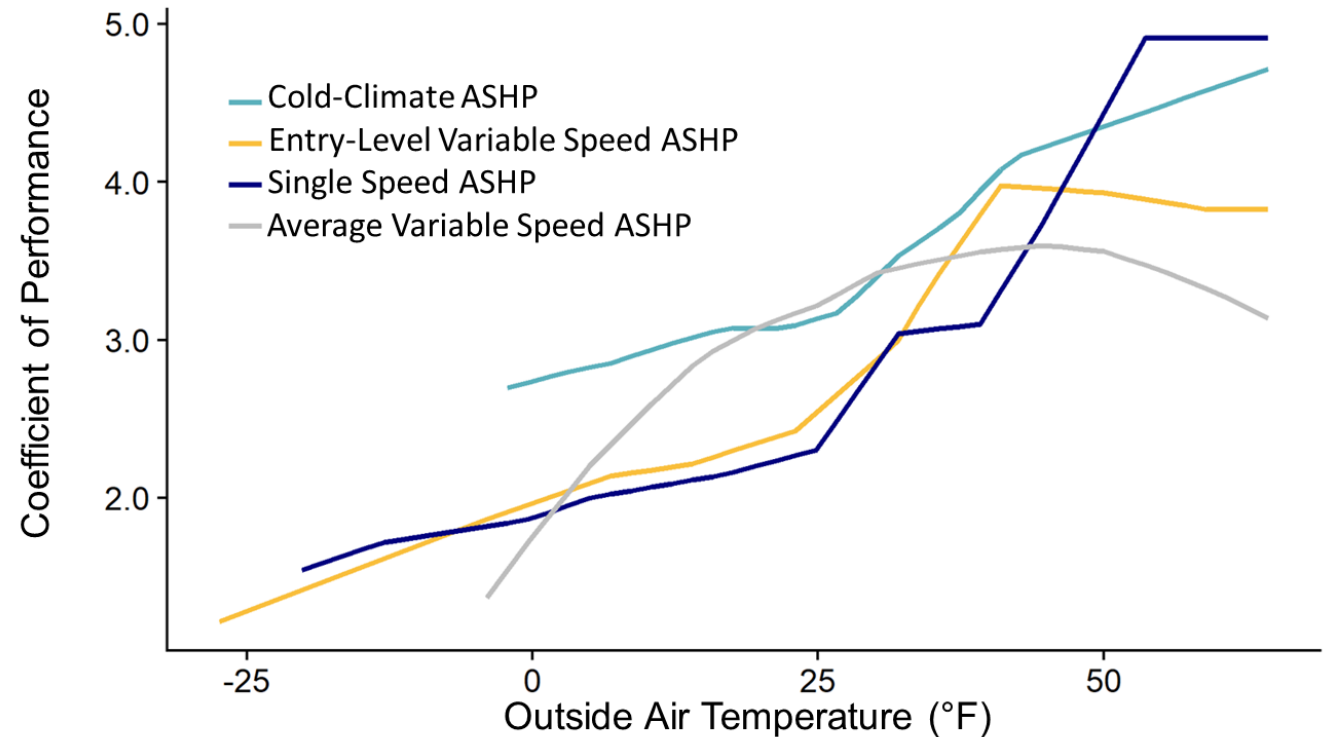
Immense fuel efficiency and carbon reduction

Approximate Coefficient of Performance (COP)



## ASHPs in cold and very cold climates

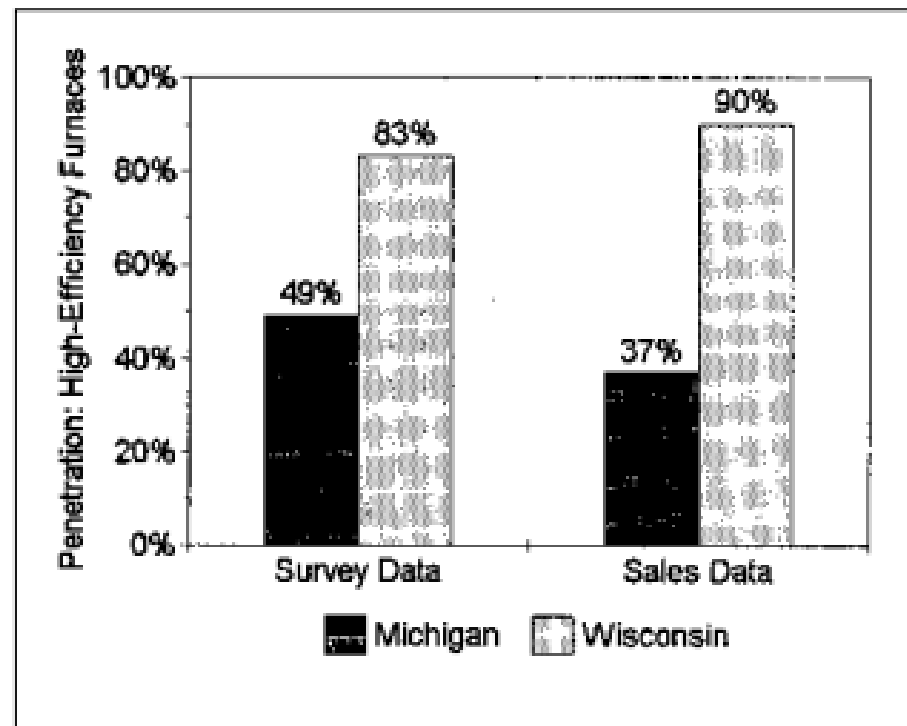
- ccASHPs offer promise for large site energy savings and emissions reductions
- Many models do work at these very cold design temperatures
- But they still have significant capacity limitations compared to space heating needs



# Wisconsin has led residential HVAC market transformation before

## A Tale of Two States: A Case Study Analysis of the Effects of Market Transformation

Martin Kushler, Michigan Public Service Commission  
Jeff Schlegel, Schlegel & Associates  
Ralph Prah, Public Service Commission of Wisconsin



1994 estimates of penetration of high-efficiency furnaces purchased.  
Source: [ACEEE Summer Proceedings](#) (1996)

# Today, residential ASHP market is in period of intense change

## Technology

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

## Regulations and policy

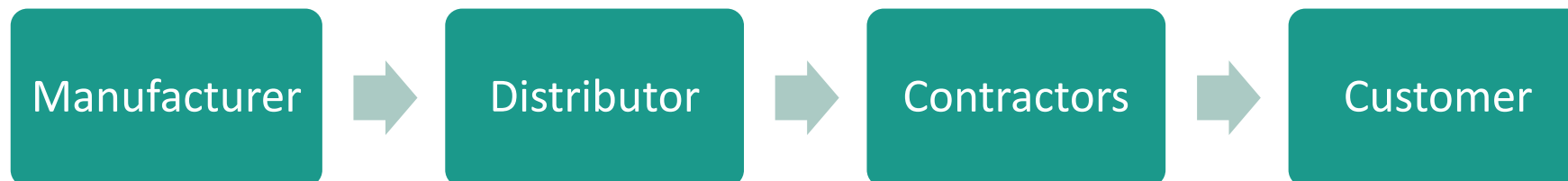
- Changing efficiency metrics and minimum efficiencies
- Refrigerant global warming potential draw downs
- Electrification attention and dollars (federal, state, local)

## 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

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



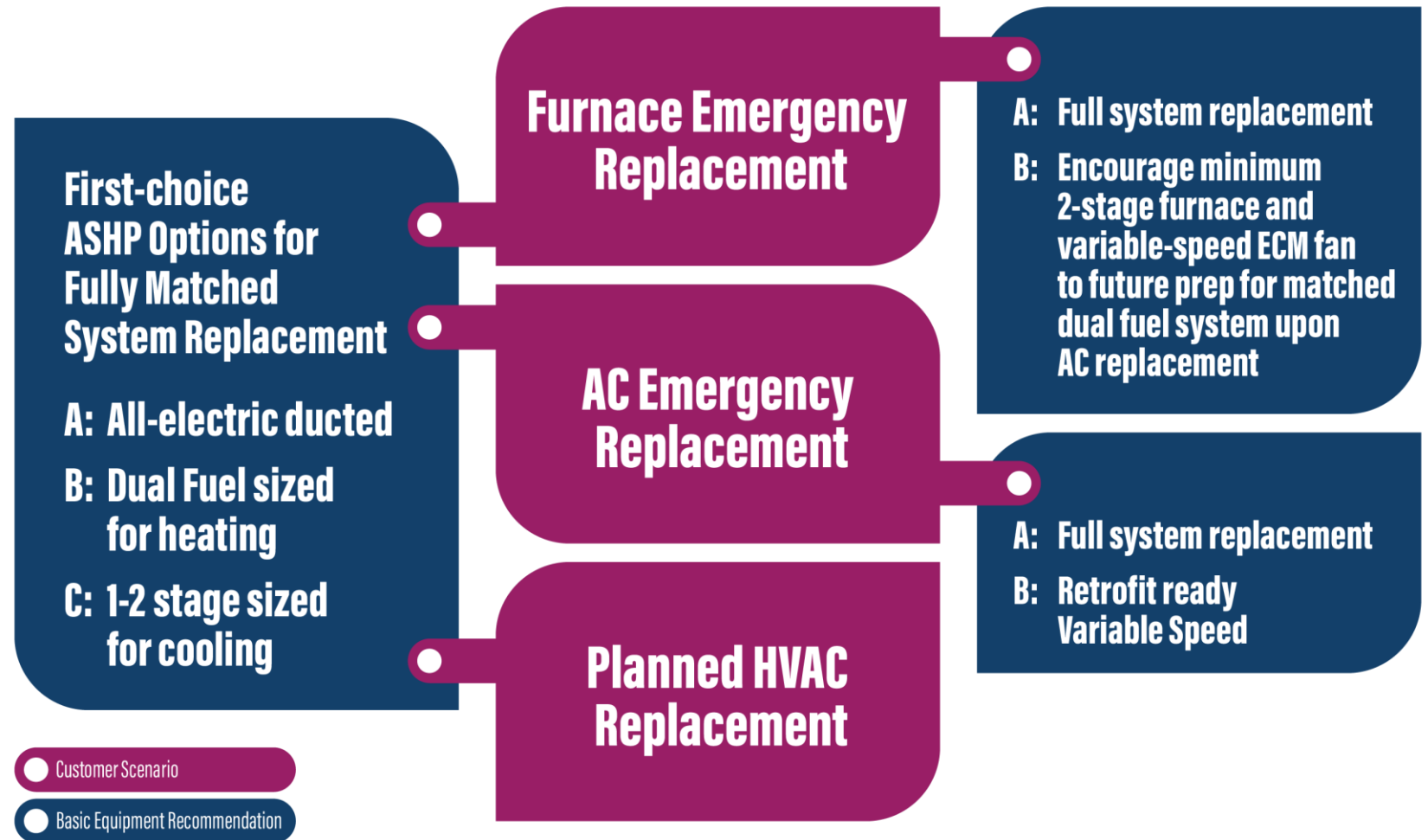


# How to incorporate a heat pump into sales process for single-family homes with forced air furnaces?

“Good” “better”

“best” depends on:

- Existing fuel type
- Customer goals
  - Economics
  - Environment
  - Comfort



# Wisconsin Heat Pump Coalition

- Informal coalition that includes following primary stakeholders:
  - Manufacturers
  - Distributors
  - State actors (including Focus on Energy staff)
  - Local actors
- Started in 2021 and meets approximately every couple months
- **Working Goal:** Facilitate collaboration among market actors, share best practices, and coordinate action to build momentum for heat pumps in Wisconsin.

## Free Heat Pump Workshop

May 3, 2023 Lussier Family Heritage Center

The residential HVAC market is changing fast.

In 2022, for the first time, US households bought more electric heat pumps than gas furnaces. The transition away from natural gas is happening locally too as heat pumps become an increasingly large portion of HVAC sales in Dane County.

### Is your HVAC company ready to profit from this transition?

HVAC manufacturers and distributors are coming together to host a heat pump workshop with HVAC contractors across South Central Wisconsin.

This free workshop will outline changes happening and identify the resources you need to succeed through this transition.

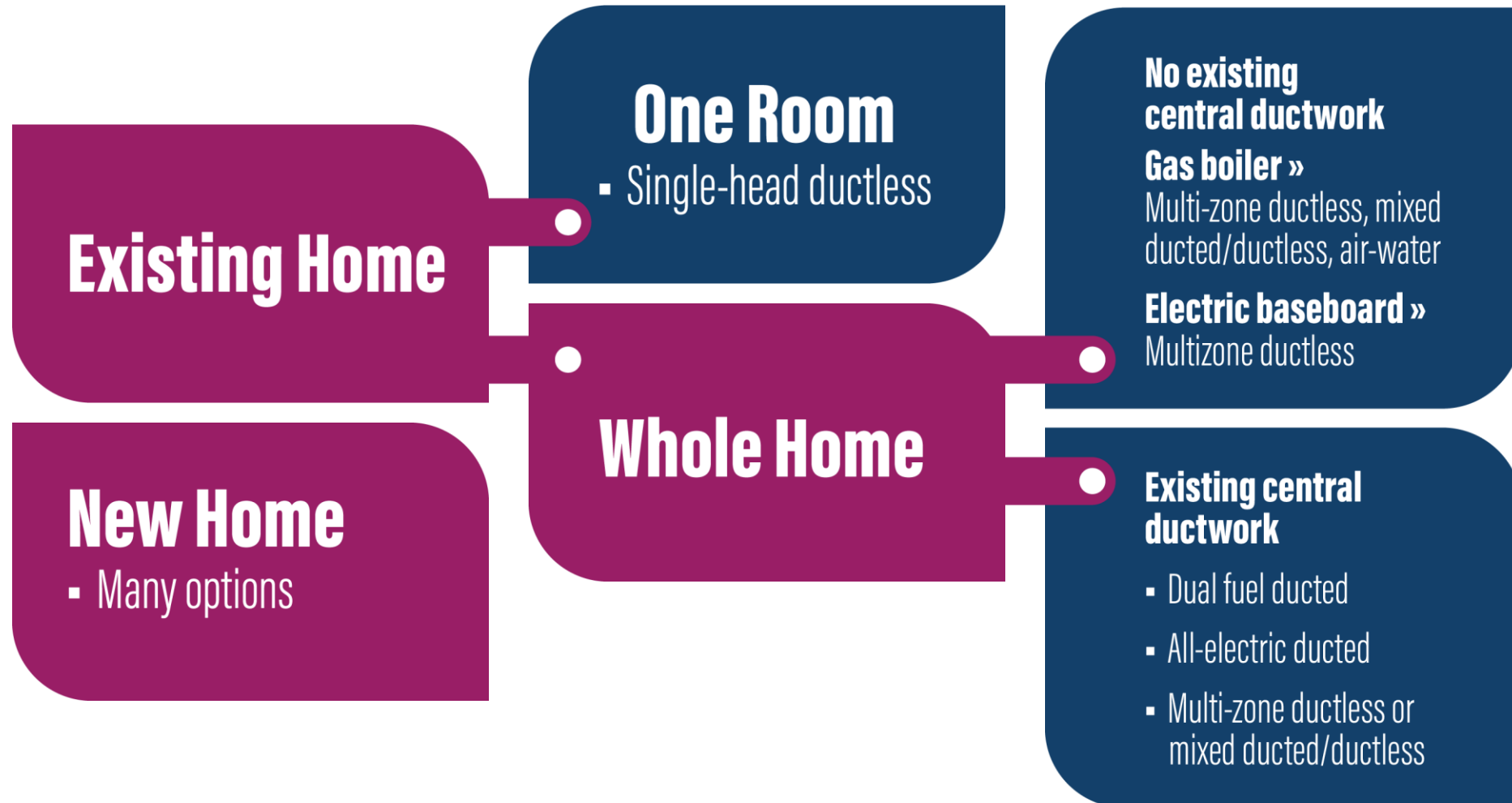
Join us for a free workshop May 3 from 8 am - 1 pm at the Lussier Family Heritage Center in Madison, Wisconsin.

Space is limited so **register now** at <http://bit.ly/3ZF0KVE> for this free event. Lunch will be provided.



Example of WI Heat Pump Coalition collaboration to drive contractor ASHP interest and knowledge in Dane County

# Single-family: What type of heat pump is right for me?



## Primary playbook audiences



Utilities



State and regulatory  
offices



Focus on Energy



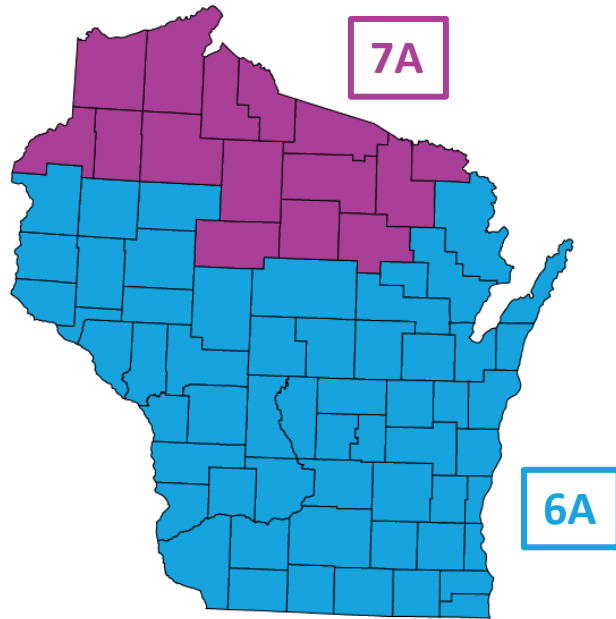
Local governments,  
tribes, and communities



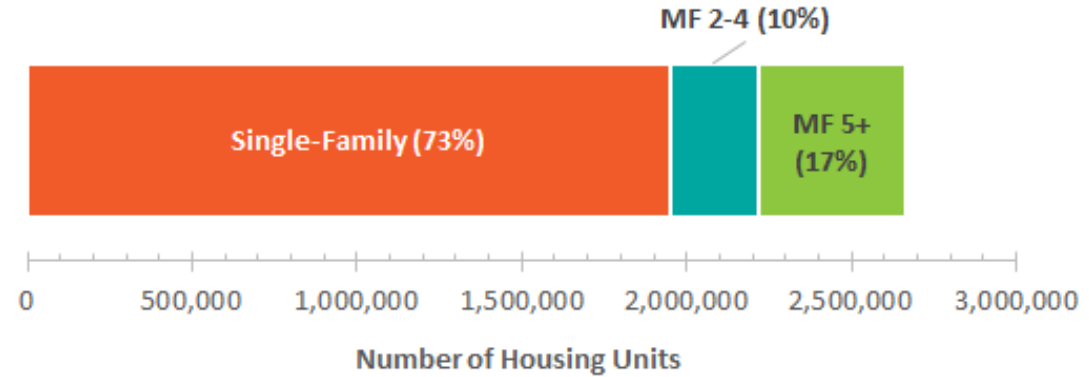
# Wisconsin's residential building landscape

# Wisconsin market size overview

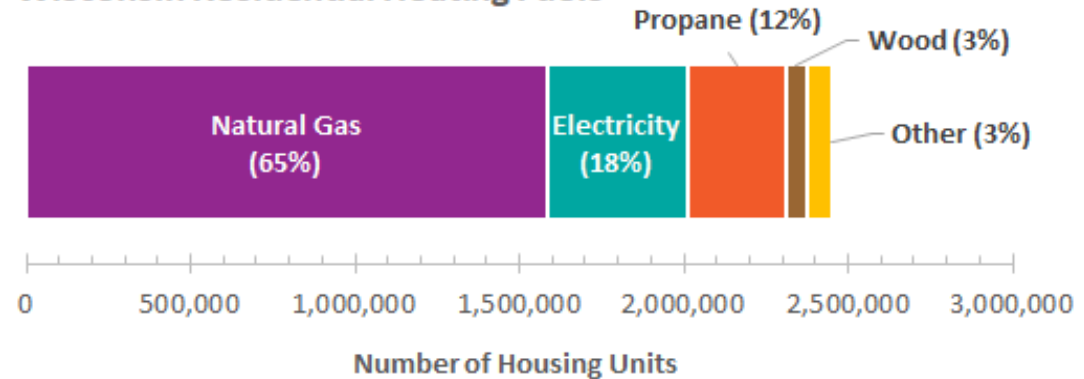
IECC Climate Zones - WI



Wisconsin Residential Units

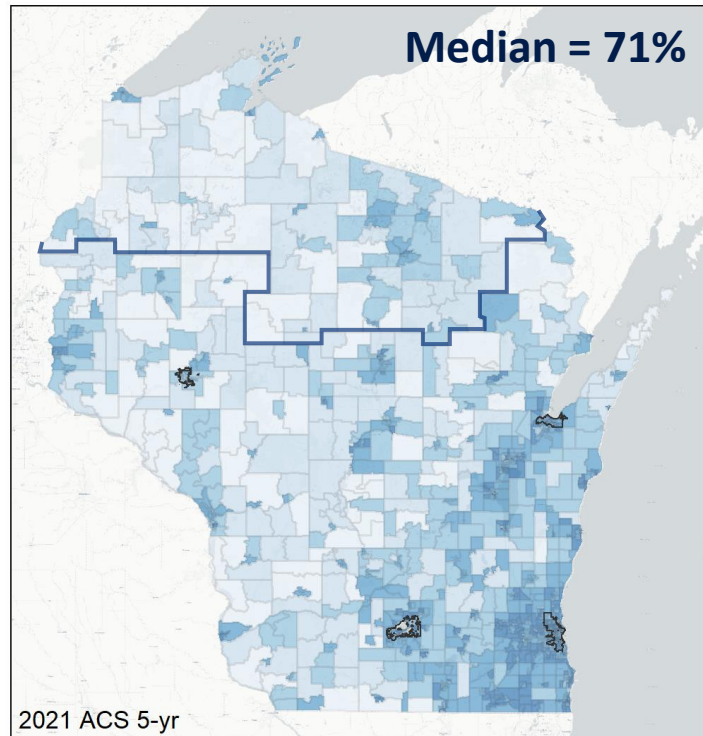


Wisconsin Residential Heating Fuels

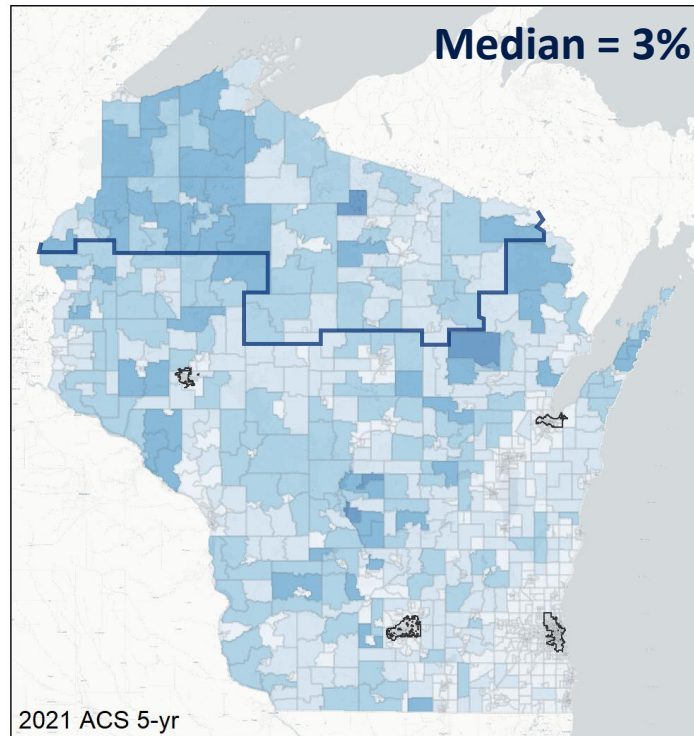


# Wisconsin market size – percent heat fuel by census tract

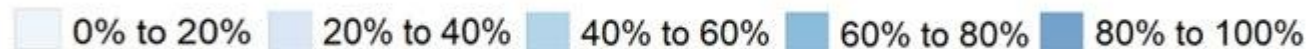
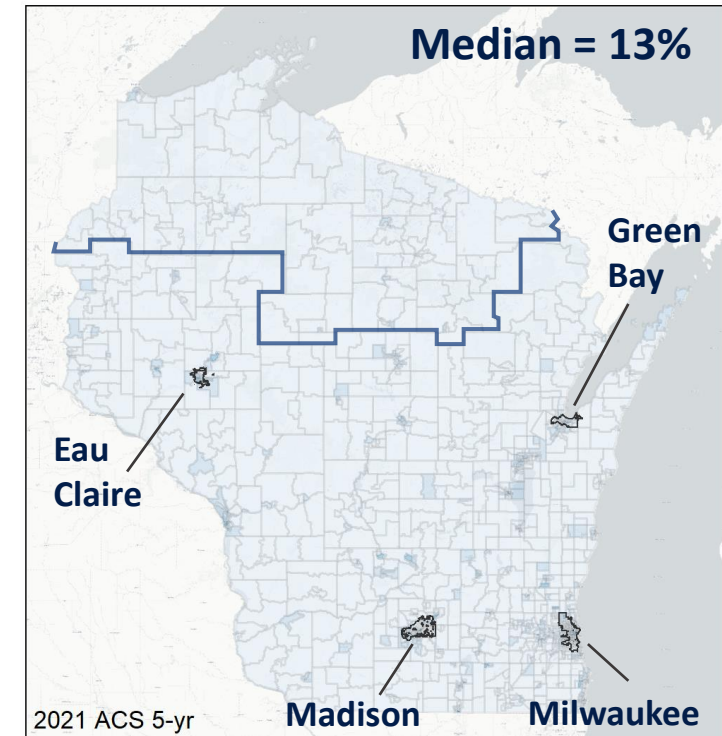
## Natural gas



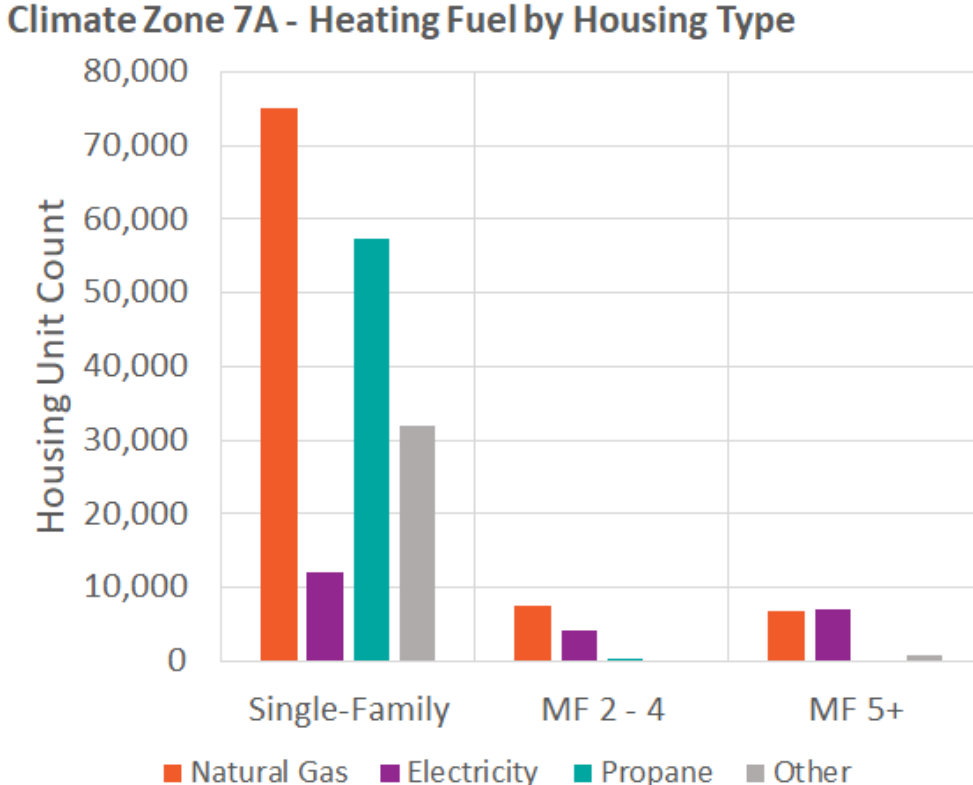
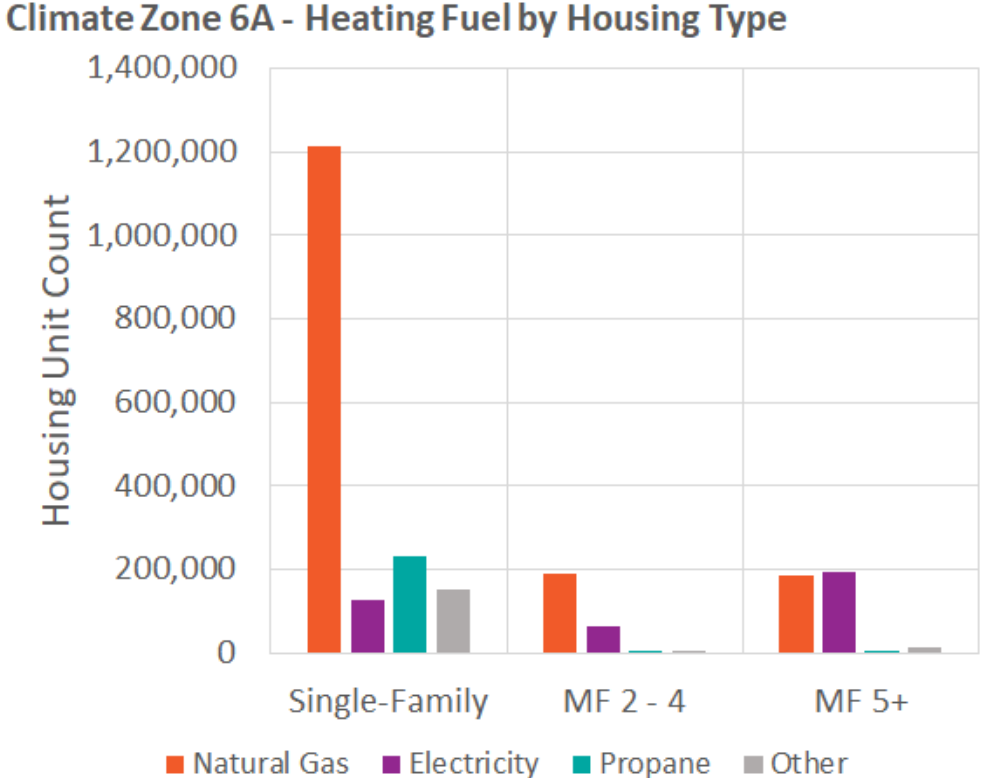
## Propane



## Electric



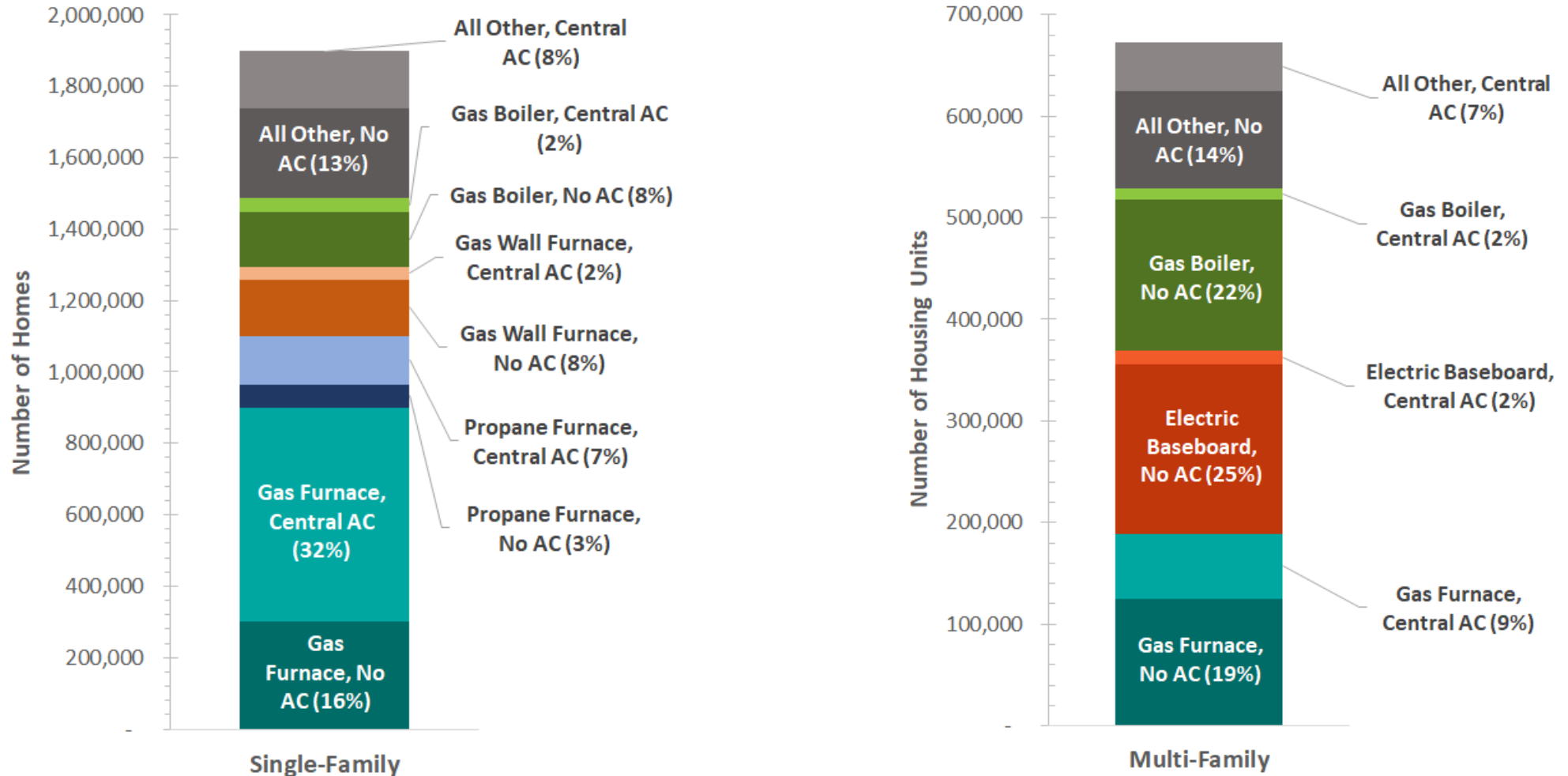
# Wisconsin market size – heating fuel and housing type



Source: ResStock, 2018



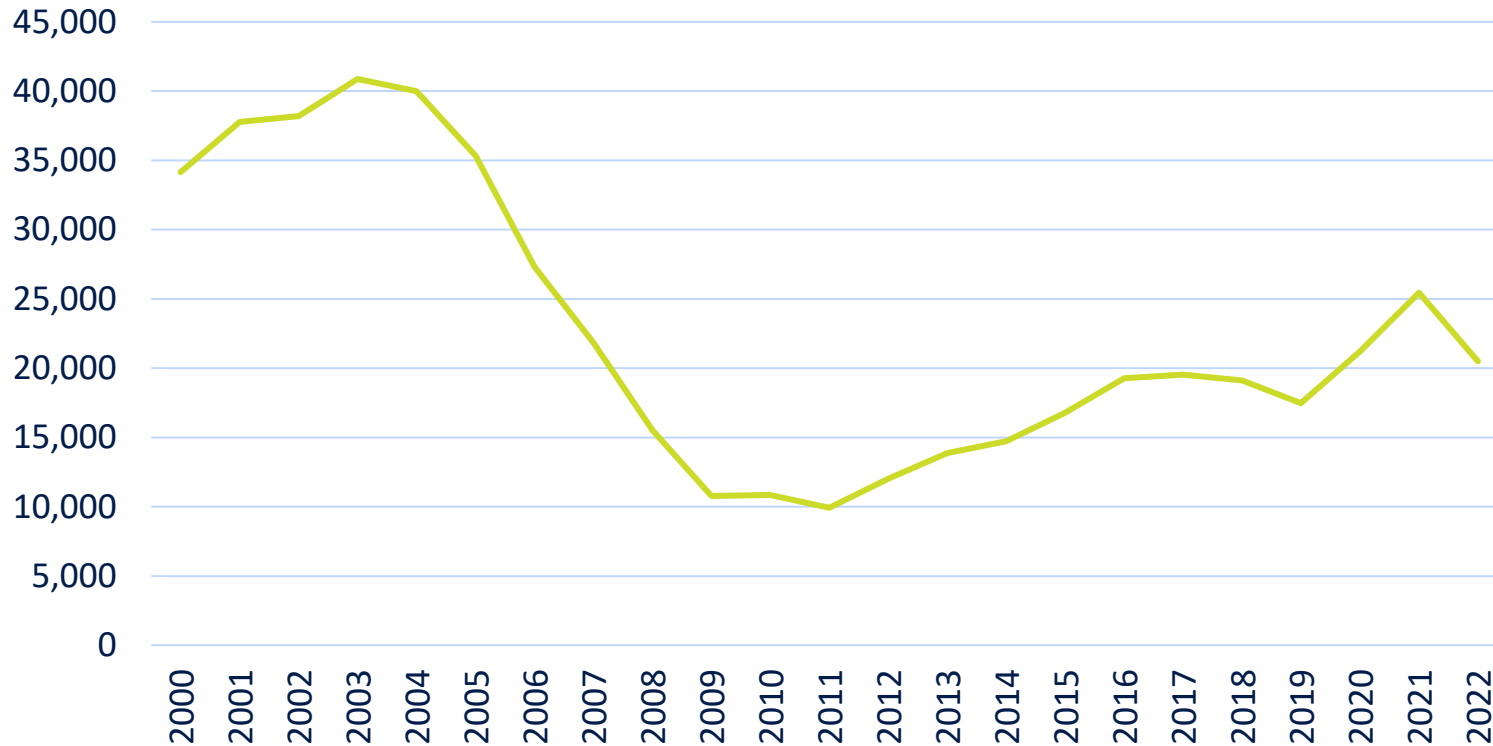
# Wisconsin market size – heating and cooling systems



Source: ResStock, 2018

# Wisconsin's residential new construction market

Total Wisconsin newly constructed SF and MF units  
(2000-2022)



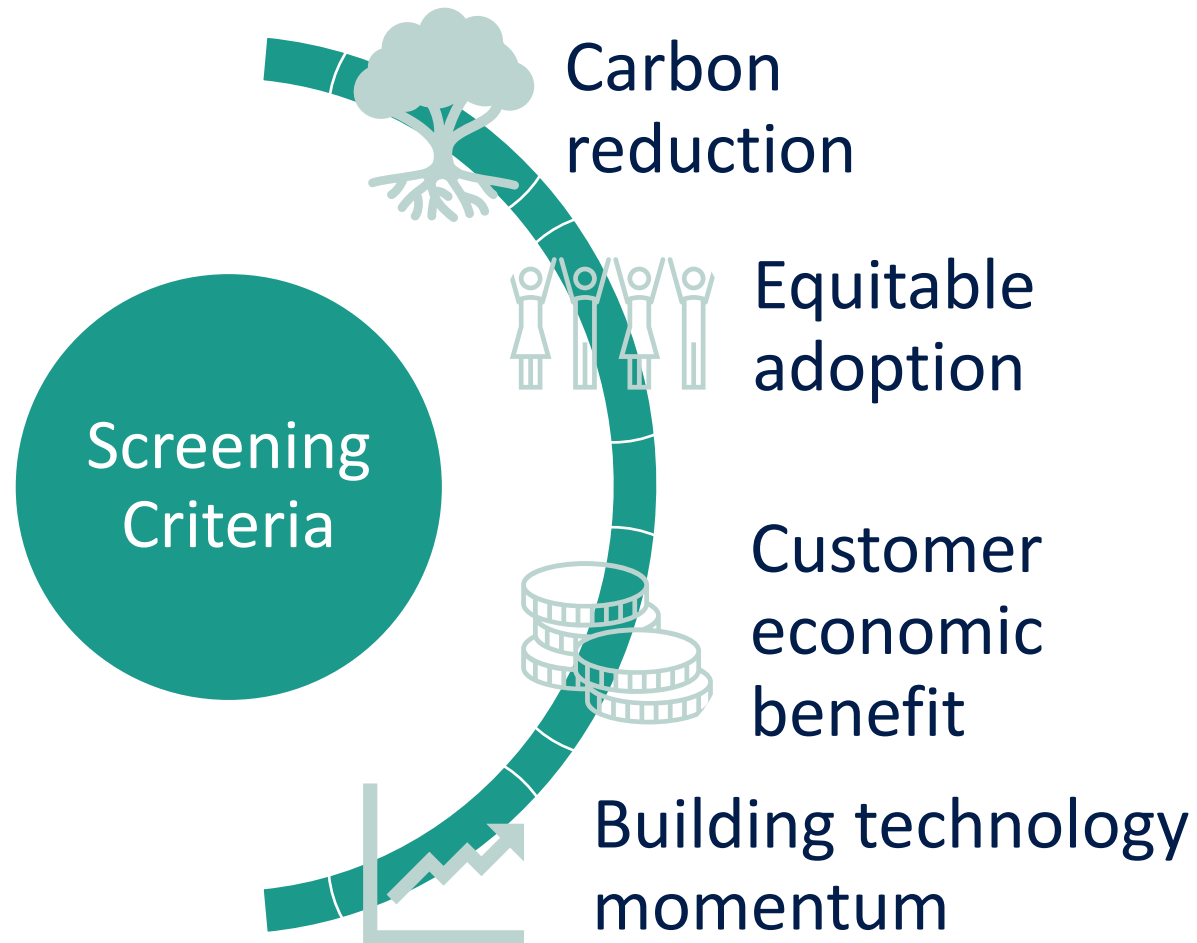
Wisconsin residential  
new construction (2022)

Unit Building Type	Number
1 unit	11,699
2 unit	1,296
3 and 4 unit	132
5+ unit	7,387
Total	20,514

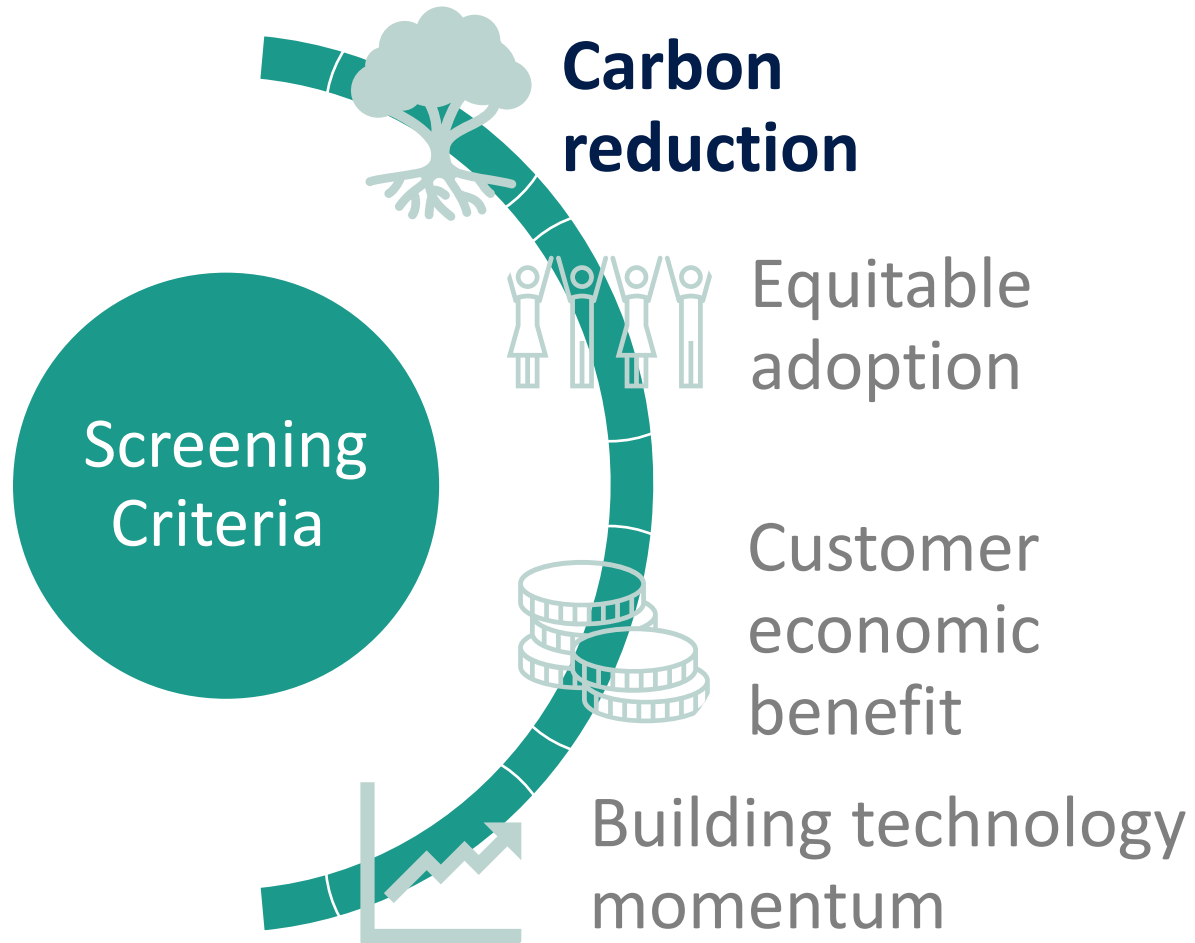


# Evaluating ASHP opportunities

# Evaluating top immediate ASHP market opportunities



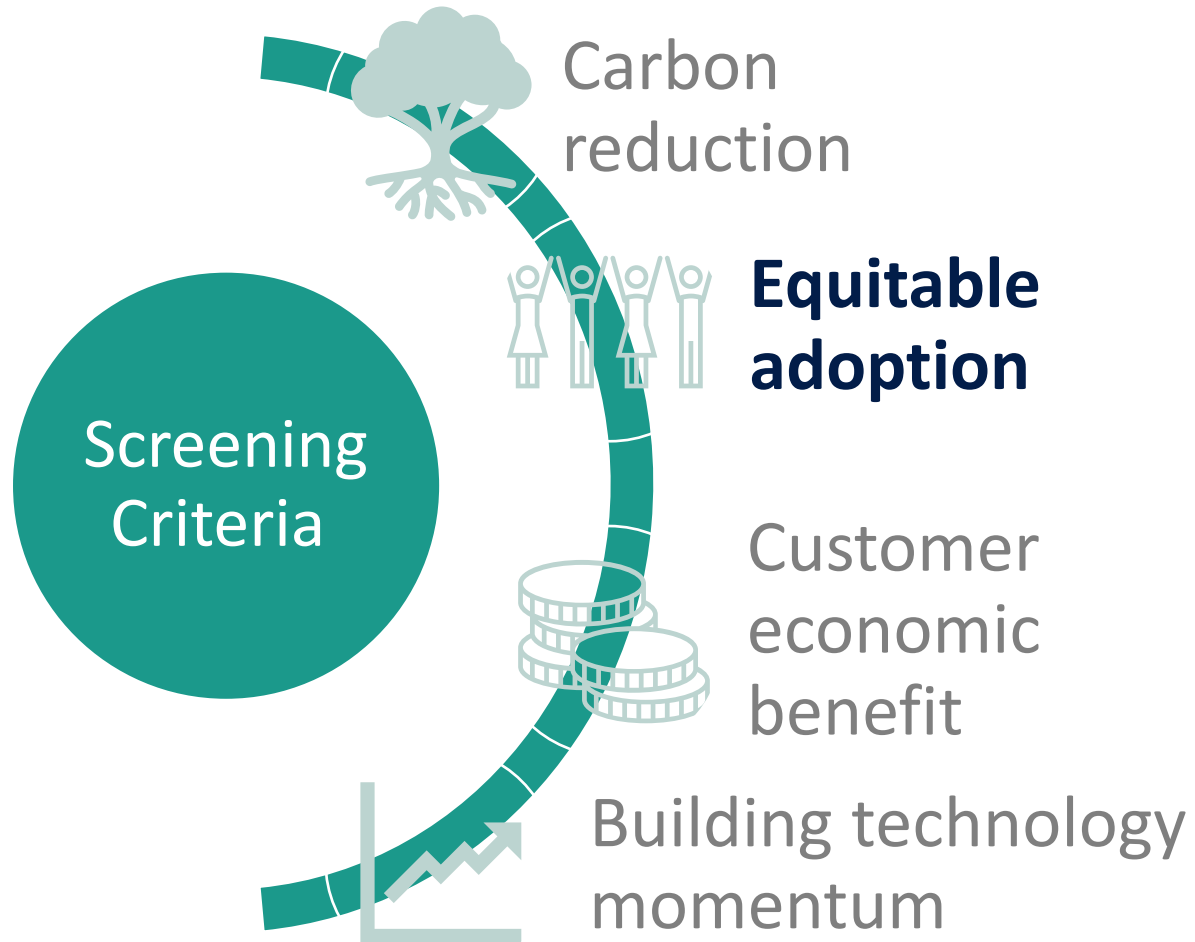
# Evaluating top immediate ASHP market opportunities



## Criteria

- Large market size
- Large carbon savings potential per home

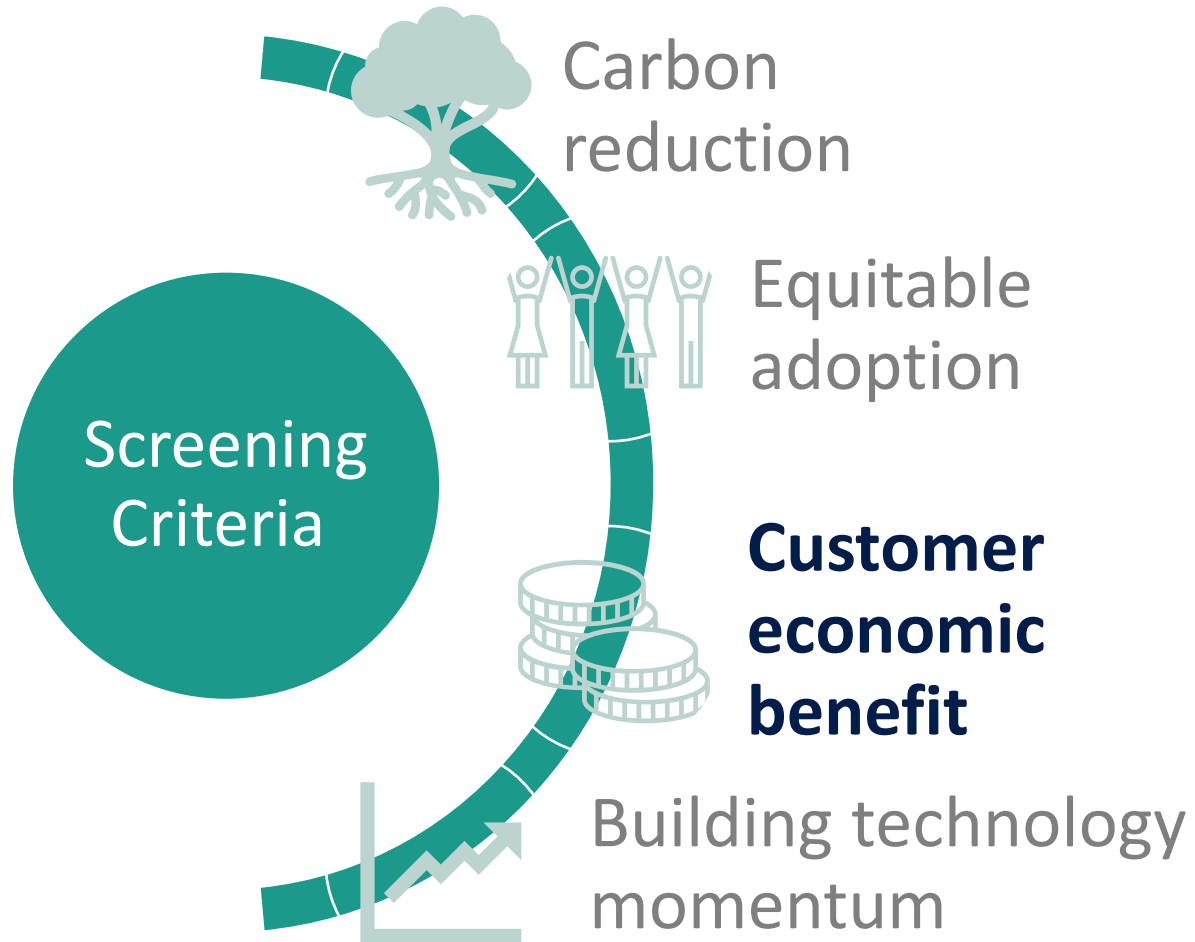
# Evaluating top immediate ASHP market opportunities



## Criteria

- Impacts people with high energy burdens
- Focuses on renters
- Focuses on Tribal Nations

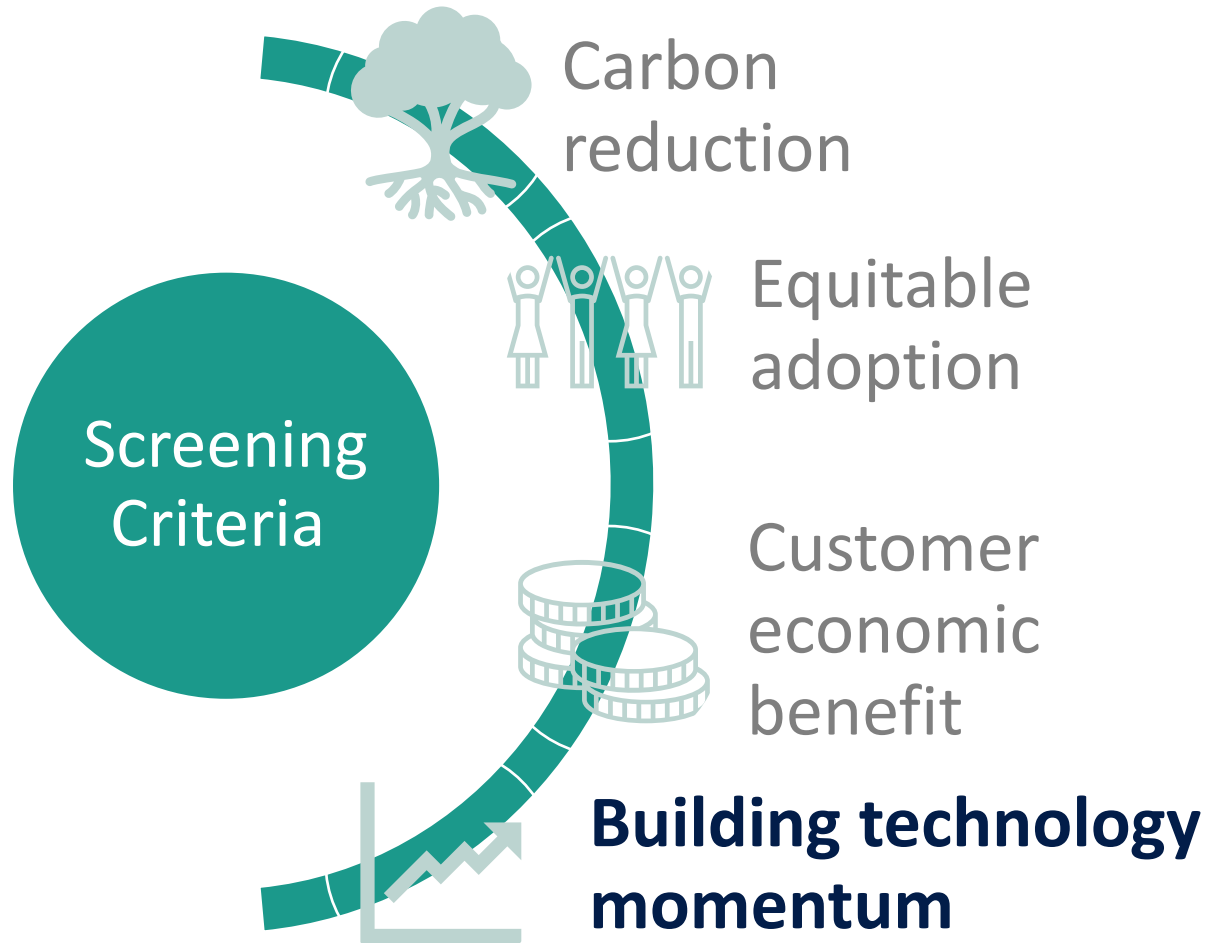
# Evaluating top immediate ASHP market opportunities



## Criteria

- Reduction or no change in utility bills
- Lower upfront cost
- Available incentives/rebates

# Evaluating top immediate ASHP market opportunities



## Criteria

- Clarity of pathway for product, program, market readiness for opportunity
- Strong business case and value proposition to supply chain actors
- Macro trends favor the opportunity
- Non-energy benefits to the customer



# Top 5 immediate ASHP opportunities in Wisconsin

Opportunity	Carbon reduction	Equitable adoption	Customer economic benefit	Building technology momentum
Single-family AC replacement/dual fuel for natural gas	High	Low	Low	High
Single-family propane displacement	High	Moderate	High	High
Single-family all-electric new construction	Low	Low	Moderate	High
Multi-family electric resistance heat	Moderate	High	Moderate	High
Multi-family all-electric new construction	Low	High	Low	High

# Additional ASHP opportunities in Wisconsin

- Single family
  - Electric baseboard and window AC
  - Electric furnace and central AC
  - Natural gas boiler and window AC
  - Single-family wood heat and window AC
- Multi-family
  - Gas boiler and window AC
  - Gas furnace and central AC





# **Economics and emissions analysis of top 5 opportunities**

## Single-family dual fuel natural gas displacement (AC replacement)

*A resident with a natural gas furnace adds a ducted heat pump to partially offset heating load instead of adding or replacing an AC*

## Single-family dual fuel propane displacement (AC replacement)

*A resident with a propane furnace adds a ducted heat pump to partially offset heating load instead of adding or replacing an AC*

## Single-family all-electric new construction

*A new single-family home is constructed with two ductless minisplits and electric baseboard backup instead of a traditional ducted furnace and AC*

## Multi-family all-electric new construction

*A new standard 8-unit multi-family building is constructed with ductless minisplits instead of a traditional central boiler and unit AC*

## Multi-family electric resistance heat

*All residents of a standard 8-unit multi-family building with baseboard heating add a ductless heat pump to partially offset heating load instead of adding or replacing unit ACs*

# Process for upfront cost comparisons

- Calculated first cost of installation for each opportunity
  - Applied standard contractor markups
- Compared to an appropriate baseline cost
  - Aimed for most common baseline and most appropriate ASHP replacement

## Markup method 1

- Time and materials
- 40% mark up of material for SF
- 25% mark up of material for MF
- Labor calculated at 5X avg Pay to employee

## Markup method 2

- 4 times multiplier applied to the equipment only for the minimum price
- 15% markup applied to the multiplier for the max price
- Leaves 15% to negotiate with the consumer

# Offsetting upfront costs - tax credits and rebates

## Available tax credits

**HOMES:** Can claim 30% of heat pump retrofit cost up to \$2000

- Through December 31, 2032

**EEHC:** Tax Credits for New Construction but not directly tied to heat pump

## Available rebates

### Focus on Energy rebates

- Retrofits: \$300-\$500 propane; \$1000-\$1300 natural gas

### HEEHRA

- Up to \$8000 (income-based) for qualifying ASHP
- Implementation by SEOs is pending, expected in 2024

Contractor/manufacturer rebates



# Process for operating, lifetime payback and emissions comparisons

## Modeled system operation to assess:

- Energy use (kWh/therms/gal. propane)
- Operational costs
- Carbon emissions – two scenarios

## Lifetime payback:

- Assumed 18-year equipment lifetime and 4% discount rate



## Case by case is important!

### We looked at the median situation

- Chose most common configurations for baseline and ASHP
- Two markup strategies and two emissions profiles, but not a multidimensional profile otherwise

### Wide range of real-life situations

- Marginal benefit (e.g. natural gas dual fuel) for our median scenario means many homes would benefit greatly
- Results sensitive to fuel prices, specifics on panels, wiring, and natural gas hookups, and building characteristics



# Opportunities summary of economic and emissions impacts

Opportunity	Carbon reduction	Upfront cost difference	Operating cost difference	Lifetime payback without rebates?	Lifetime payback with rebates?	Market size
Single-family dual fuel natural gas displacement (AC replacement)	High	Higher	Similar	No	Yes	Very large
Single-family dual fuel propane displacement (AC replacement)	High	Higher	Much lower	Yes	Yes	Moderate
Single-family all-electric new construction	Low	Much lower	Much higher	Yes	Yes	Moderate
Multi-family electric resistance heat	Moderate	Much higher	Lower	No	Yes	Moderate
Multi-family all-electric new construction	Low	Higher	Similar	No	Maybe	Small

## Cost Information - Single family dual fuel retrofit with existing natural gas furnace

Opportunity	Estimated Upfront cost	Upfront cost difference (incremental cost)	Operating cost difference (yearly)	Rebates Available	NPV payback with rebates (years)
2sASHP with furnace	\$12,000	\$1,600	\$65	Focus on Energy: \$1000, \$50-\$150 for efficient furnace	10
2sASHP swap out	\$8,750	\$350	\$65	Focus on Energy: \$1000	< 1
ccASHP with furnace	\$27,750	\$16,750	\$30	Focus on Energy: \$1300, \$50-\$150 for efficient furnace HOMES: \$2000 HEEHRA: \$0-\$8000	Never

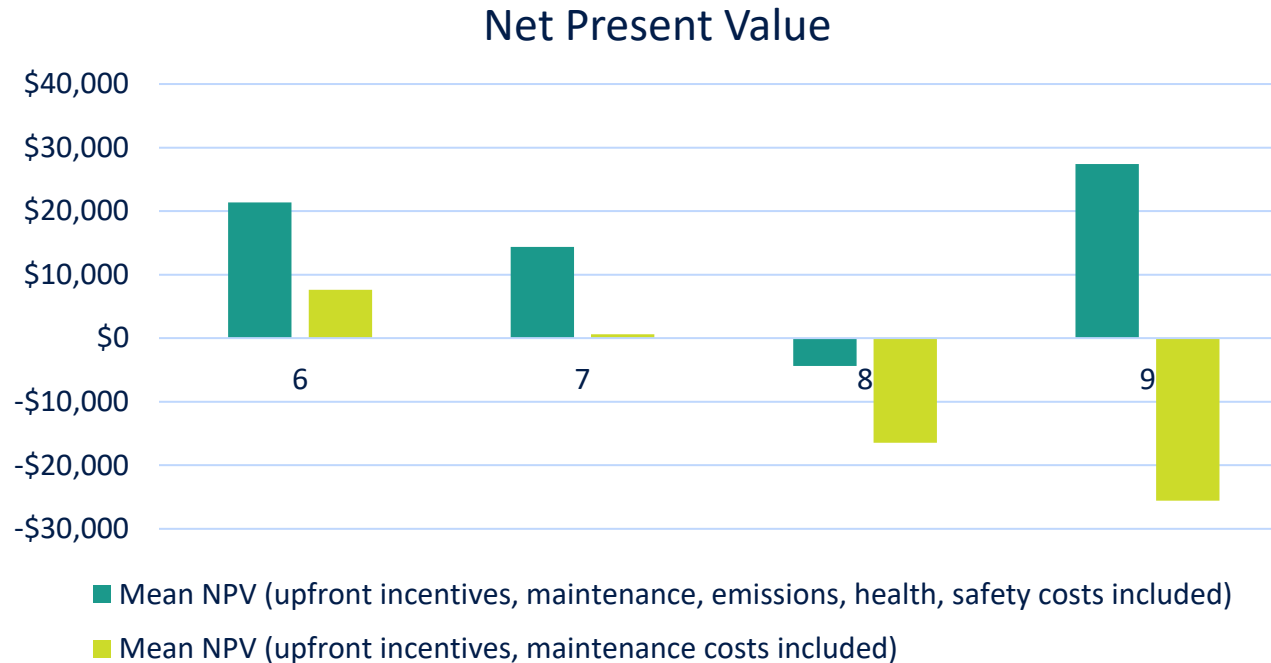
## Cost Information - Single family dual fuel retrofit with existing propane furnace

Opportunity	Estimated Upfront cost	Upfront cost difference (incremental cost)	Operating cost difference (yearly)	Rebates Available	NPV payback with rebates (years)
vsASHP swap out	\$20,000	\$9,500	\$1,200	Focus on Energy: \$400	7
vsASHP with furnace	\$16,000	\$7,500	\$1,200	Focus on Energy: \$400, \$50-\$150 for efficient furnace	9
ccASHP with furnace	\$27,750	\$16,750	\$1,100	Focus on Energy: \$500, \$50-\$150 for efficient furnace HOMES: \$2000 HEEHRA: \$0-\$8000	13

## Other opportunities

Opportunity	Estimated upfront cost	Upfront cost difference (incremental cost)	Operating cost difference (yearly)	Rebates Available	NPV payback with rebates (years)
<b>SF All Electric New Construction</b>	\$14,500	-\$13,377	-\$325	<b>EEHC:</b> \$2500 for ENERGY STAR qualified, \$5000 for Zero Energy Ready	Yes
<b>MF All Electric New Construction</b>	\$8,500	\$4,500	-\$90	<b>EEHC:</b> \$500 for ENERGY STAR	-
<b>MF DHP Retrofit for Electric Baseboard</b>	\$10,000	\$9,250	\$500	<b>Focus on Energy:</b> \$1300 <b>HOMES:</b> \$2000 <b>HEEHRA:</b> \$0-\$8000	< 2

# Cost benefit analysis for additional single-family heat pump opportunities



Opportunity	Baseline	Heat Pump	Annual bill savings
6	Electric baseboard and window AC	Ductless ASHP	\$2,500
7	Electric furnace and central AC	Ducted ASHP	\$2500
8	Natural Gas boiler and window AC	Ductless ASHP	-\$67
9	Wood heat and window AC	Ductless ASHP	\$20

[Air Source Heat Pumps for Residential Space Heating in Wisconsin: A Cost–Benefit Analysis \(UW Madison Analysis\)](#)

# Wood heat opportunity

- Majority of benefits accounted are from health and safety (\$3,700 annually)
  - Reduced inhaled PM2.5 and CO
  - Residential fire safety hazard
  - Splitting and hauling wood
- American Lung Association offers vouchers in Northern WI for ENERGY STAR heat pump
  - Approved applicants: \$2,500
  - Income-qualified: \$4,450



Source: <https://www.lung.org/getmedia/412cee7f-b7ee-475e-a8f7-33a9b6eb0144/ala-northern-wisconsin-wood-burning-appliance-changeout-program-instructions-and-application-5-27-21-final-fillable-form.pdf>



## Economics takeaways

### Strong opportunities for propane and (most) all-electric

- Target existing propane and electric heat for retrofit to drop customer heating costs substantially
- Single-family all-electric new construction can save money overall compared to furnace and AC combos



### Evaluate natural gas and multi-family new construction case by case

- Upfront costs dominate minimal fuel savings for median case
- Large market for natural gas retrofit shouldn't be ignored



# Emissions takeaways

## All scenarios reduce carbon emissions

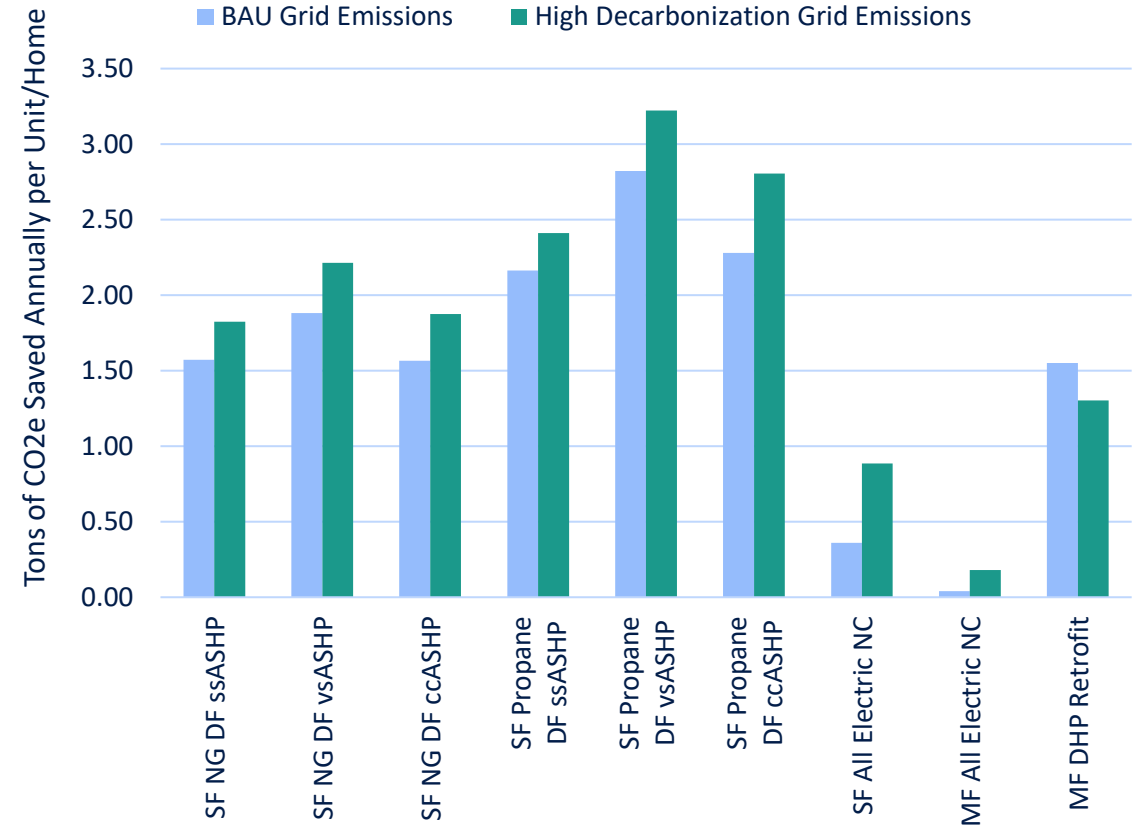
- Partial displacement of propane or natural gas creates the largest emissions reductions
  - Reductions increase as the grid decarbonizes
- Displacing existing electric baseboard heat also greatly reduces carbon emissions
- New construction slightly reduces carbon emissions



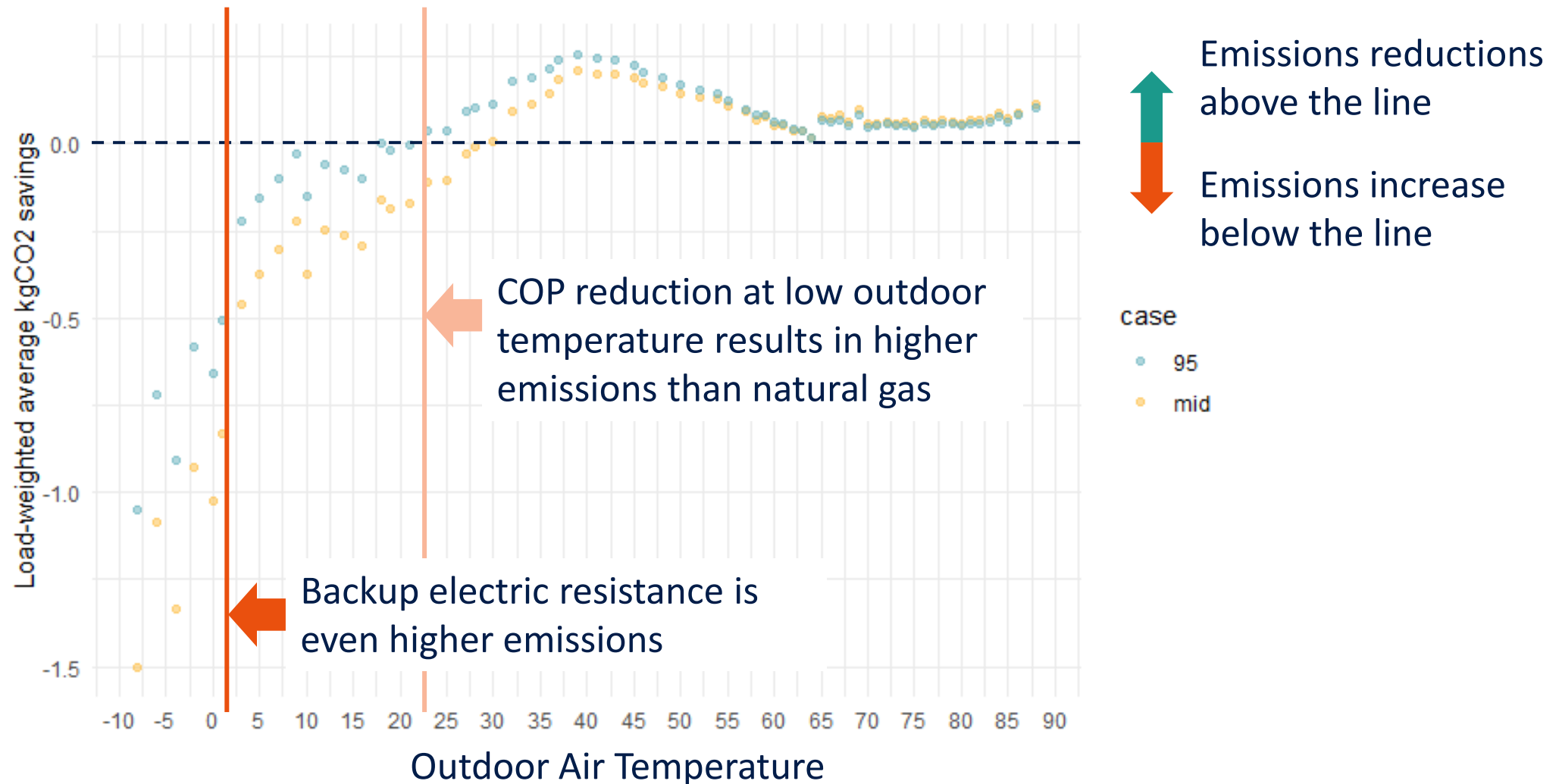


# All installations reduce carbon emissions in Wisconsin

- Investigated emissions under two scenarios for electricity supply
  - The grid's current track for decarbonization (mid)
  - High decarbonization track by 2050 (95%)
- Every type of heat pump installation reduced overall carbon emissions in both scenarios
- Dual Fuel retrofits reduce emissions substantially more across the heat pump lifetime
  - Natural gas heat produces less emissions than inefficient electric backup in this timeframe
- As we convert more supply to renewables (i.e. for future installs), all values will increase



# Why such small all-electric new construction emissions reductions?





# WI ASHP market transformation roadmap

# ASHP market transformation roadmap from 2023-2030



# ASHP market transformation roadmap

## Destination

*Air source heat pumps are the first choice for customers and contractors for heating and cooling by 2030.*

Destination

Impacts

Actions

Opportunities

Barriers

# ASHP market transformation roadmap

## Impacts (between now and 2030)

- Customers and contractors are increasingly aware of ASHPs and their value propositions
- Number of contractors installing ASHPs increases over time
- Customer demand for heat pumps increases over time
- Customers can easily engage qualified installers and solicit competitive bids
- Economic value proposition improves over time



# ASHP market transformation roadmap

## Barriers

- Undefined or weak value proposition for customers, landlords, contractors, distributors, and manufacturers
- High first cost - product and installation
- High operating costs in comparison to alternate fuels
- Lack of installer technical proficiency and knowledge of installation best practices and maintenance
- Contractor labor shortage to meet current and future demand
- Lack of contractor customer awareness, experience, and trust



# ASHP market transformation roadmap

## Opportunities

- Increasing motivation to add cooling to homes
- Increasing motivation to reduce carbon emissions (customers, manufacturers, utilities, media, federal, state and municipal actors)
- State and Federal initiatives and incentives
- Fuel flexibility enables cost saving and resiliency opportunities for customers and utilities







# WI ASHP market transformation recommended actions

Destination

Impacts

Actions

Opportunities

Barriers

# State and regulatory recommended actions

## Amplify utilities and Focus on Energy

- Ensure Focus on Energy administration of HEEHR and HOMES programs is complementary to current Focus on Energy program and incorporates Quality Installation (QI) components
- Motivate utilities and regulators to design and adopt rates that increase value proposition for heat pumps (e.g. lower electric rate for all-electric and dual fuel ASHP applications)
- Support metering strategies to increase heat pump adoption in multi-family properties and reduce energy burden for residents
- Building off Quad IV Focus on Energy determinations, support research to determine value of demand response for ASHPs

Destination

Impacts

Actions

Opportunities

Barriers

# State and regulatory recommended actions

## Supporting market growth

- Lead and help facilitate workforce development initiatives that grow pool of installers and technicians and empower contractors to install ASHPs.
- Create structure for market transformation programs (includes tracking progress)
- Weatherization should be considered alongside ASHP contractor training and workforce development
- Integrate ASHP training focus in workforce and education plans of state agencies and state-funded higher education institutions.

Destination

Impacts

Actions

Opportunities

Barriers

# Focus on Energy program recommended actions

- Play leading role in customer education and guidance
- Support contractor education and how to connect with customers
- Address nuanced multi-family and low-income applications
- Synergize with state administration of Inflation Reduction Act rebate programs
- Play supportive role and partner with others on workforce development



# Utility recommended actions

## Seize early opportunities

- Target easy economic wins (propane, SF NC, electric baseboard MF) at scale to deliver value and evolve the market
- Facilitate stacking of federal/state incentives to maximize economic benefits to customer

## Prepare for shifting electric demand

- Develop pilot projects on demand response and innovative rate design



# Utility recommended actions

## Drive workforce evolution

- Use program incentives and education initiatives to drive growth of ASHP contractor network early

## Actively engage

- Develop internal competency to effectively respond to customers and facilitate electrification programs
- Engage with regional and national working groups to gather additional insights



# Community and local government recommended actions

## Act as a facilitator and convener

- *Contractor engagement:* Partner with utilities/distributors/etc to host events and grow local heat pump contractor community
- *Consumer engagement:* Launch or support consumer awareness campaigns and disseminate utility resources on heat pumps - especially customers with propane and electric baseboard heat!

## Lead demonstration projects

- Create local, relevant heat pump case studies in public buildings to document lessons learned, verified savings, and successes

## Advocacy

- Advocate on behalf of consumers to utilities, regulators, and Focus about consumer needs for electrification

Destination

Impacts

Actions

Opportunities

Barriers

# Tribal nation recommended actions

## Support planning efforts

- Complete portfolio planning on Tribally owned buildings to align with Federal and State funding, ensure whole building upgrades, understand costs and associated energy savings

## Act as a facilitator and convener

- *Contractor engagement:* Partner with utilities/distributors/etc to host events and grow local heat pump contractor community
- *Tribal member engagement:* Launch or support consumer awareness campaigns and disseminate utility resources on heat pumps - especially customers with propane and electric baseboard heat!

## Lead demonstration projects

- Create local, relevant heat pump case studies in Tribal owned buildings to document lessons learned, verified savings, and successes

## Advocacy

- Advocate on behalf of consumers to utilities, regulators, and Focus about consumer needs for electrification

Destination

Impacts

Actions

Opportunities

Barriers



# Cross-cutting actions

## Consumer awareness

- **State** – Consumer awareness materials and support through the IRA rebate roll out. Leverage clear and consistent messaging.
- **Focus on Energy** - Main touchpoint and source of dissemination for consumer awareness building: customer support, awareness campaigns, and resources.
- **Utilities** - Back up and reinforcement on messaging deployed through Focus on energy. Provide customer support and can be a connector to resources.
- **Communities** – Community-based initiatives can be a great platform to increase customer engagement and awareness of the technology. Leverage Focus on Energy messaging for consistency.

Destination

Impacts

Actions

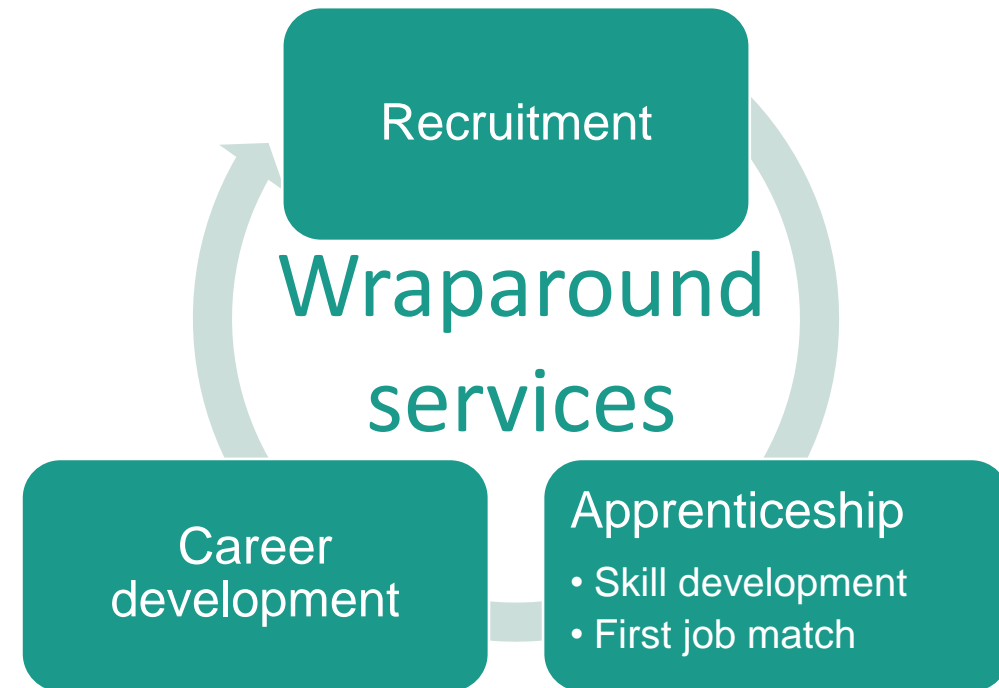
Opportunities

Barriers

# Cross-cutting actions

## Developing the new workforce

- **State** - Play leading role. Convene and guide where the following stakeholders can support.
- **Focus on Energy** - Not directly in purview but can be supportive and connect dots, particularly through a heat pump contractor designation.
- **Utilities** – Sponsor scholarships and education for EE jobs.
- **Communities** - Utilize existing infrastructure to provide wraparound services and connect dots between recruiting, trade schools, and employers.



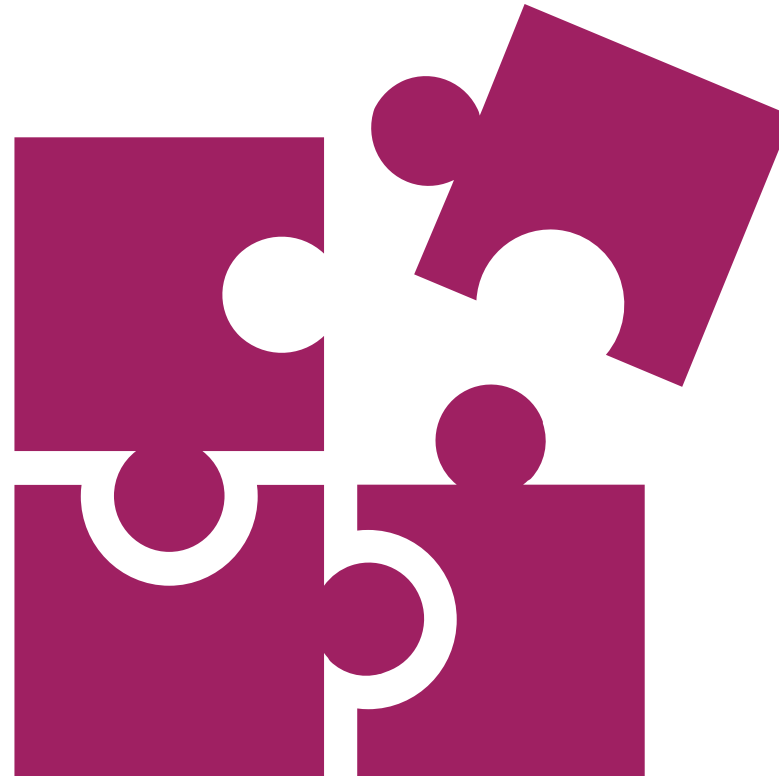
# Cross-Cutting opportunity for contractor development and building market momentum





## Next steps

# Take action steps – collaboration is key



# Maintain and advance the Wisconsin Heat Pump Coalition

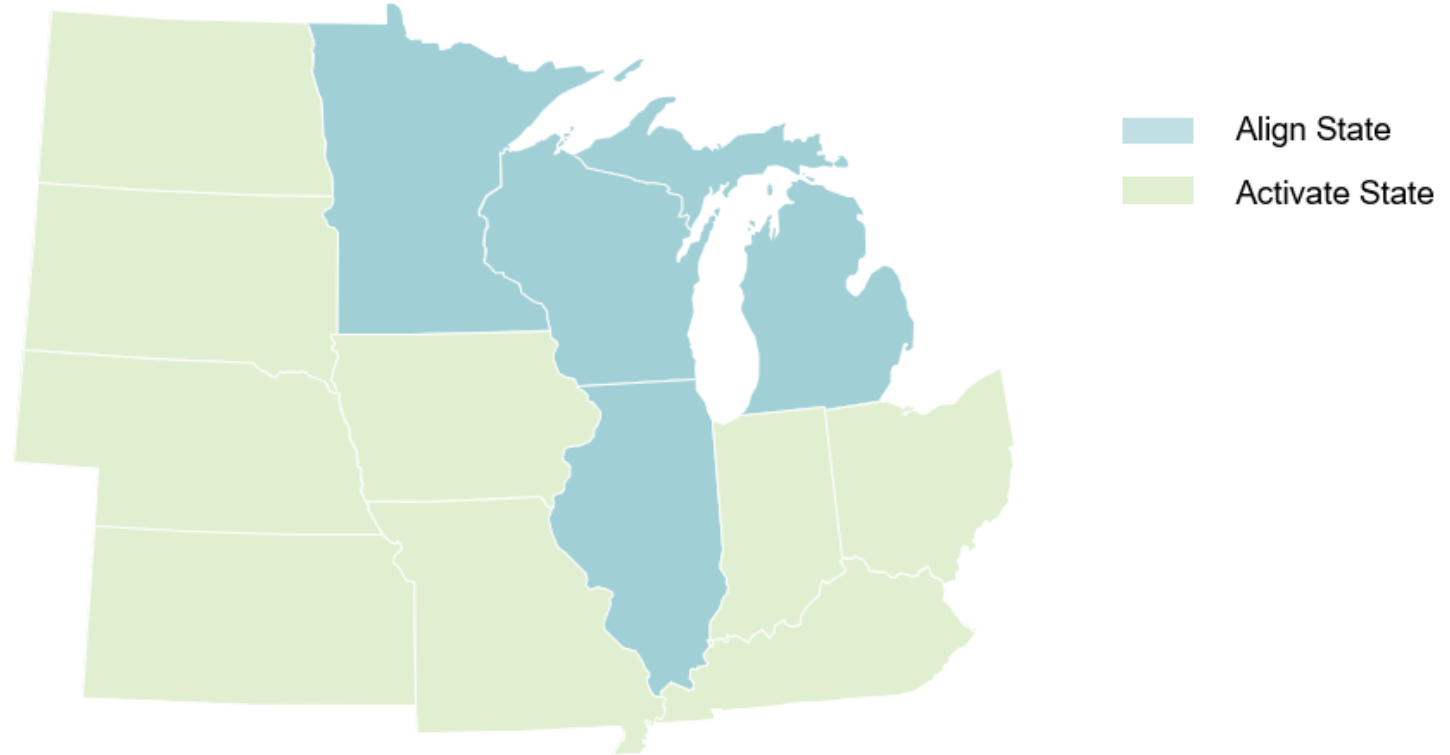
- Engagement
- Alignment
- Knowledge sharing



# Midwest ASHP Collaborative Overview

## 2022-2023 Objectives:

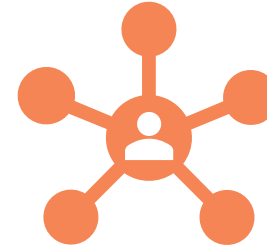
- Cross pollinating program best practices
- Rate design for heat pumps
- Equitable workforce development
- Regional market transformation strategy



# Plug into Midwest ASHP Collaborative



An interactive website with resources for major stakeholders in the industry will launch later this year



Keep an eye on communications from the Collaborative to leverage these regional resources for the state. Sign up for newsletter [here](#).





**Thank you!**