ET Summit 2024

Presented by

Heat Pump Water Heater Installation Guidance

Lessons from the Amazing Shrinking Room Study

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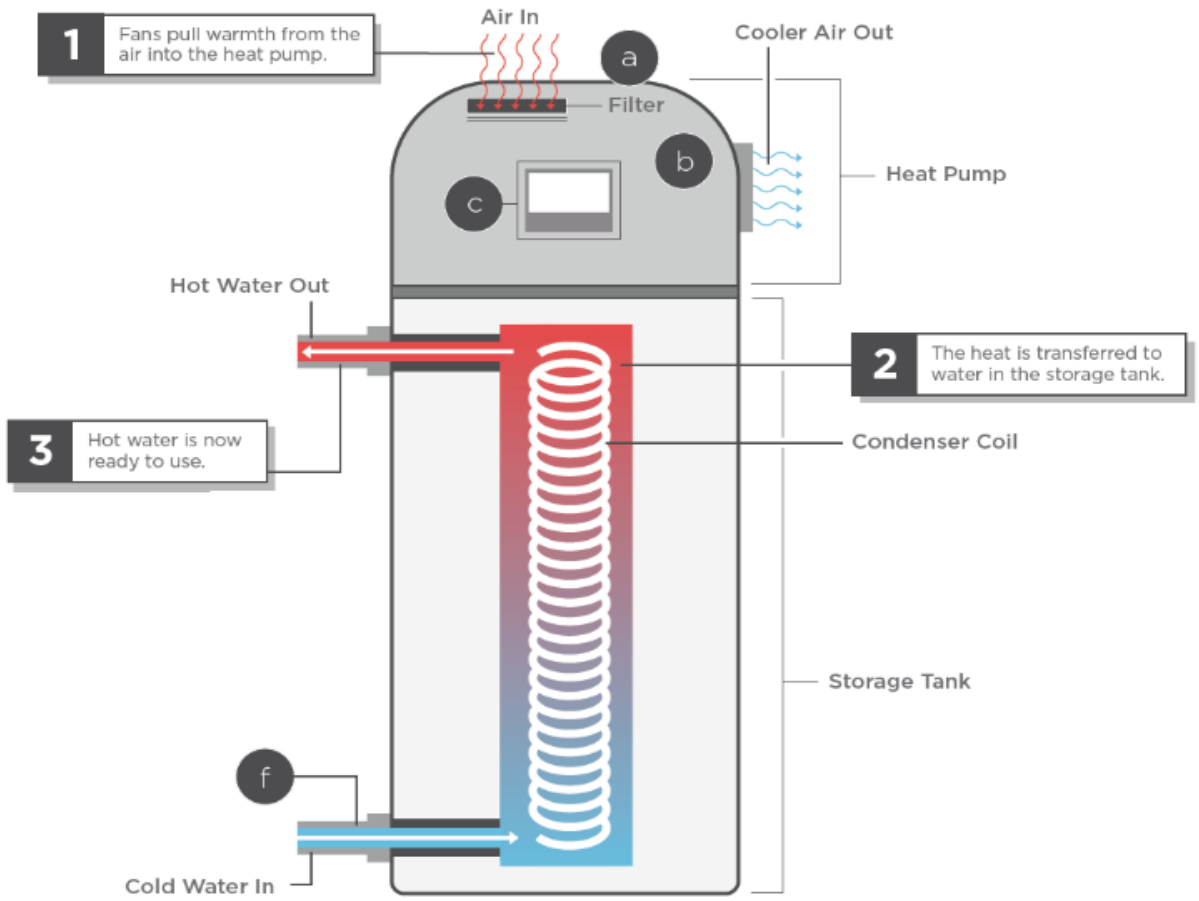
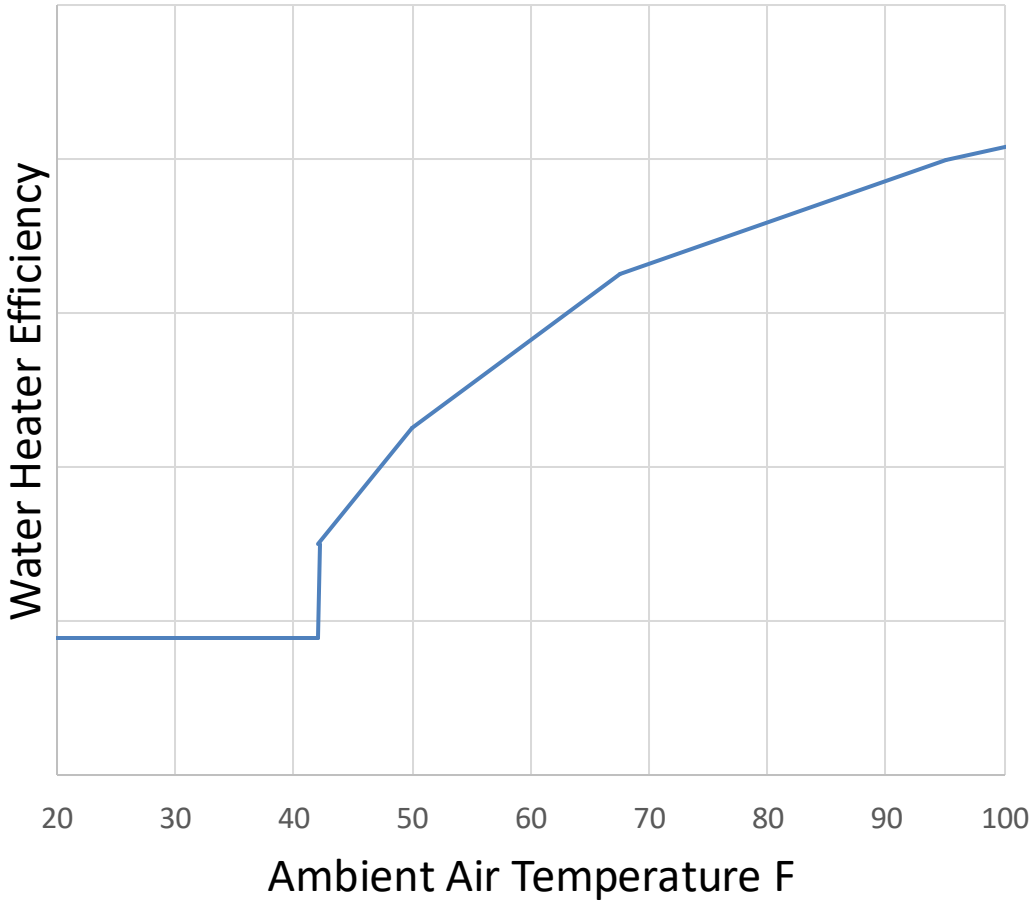
NEEA

Thermal Transfer



- HPWHs draw heat from the surrounding air and transfer it to the water
- The resulting exhaust air is cooler

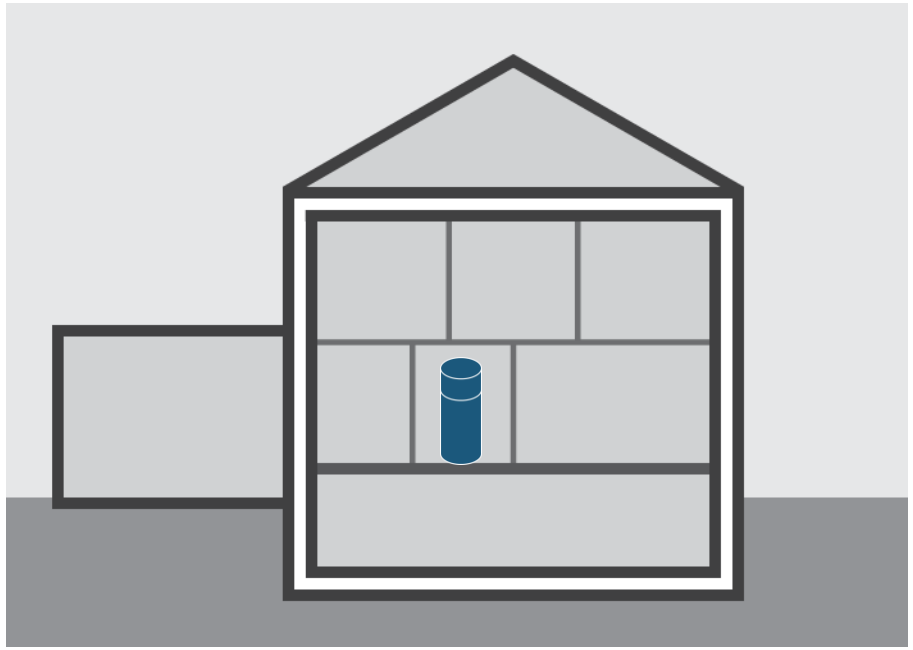
Temperature-Efficiency



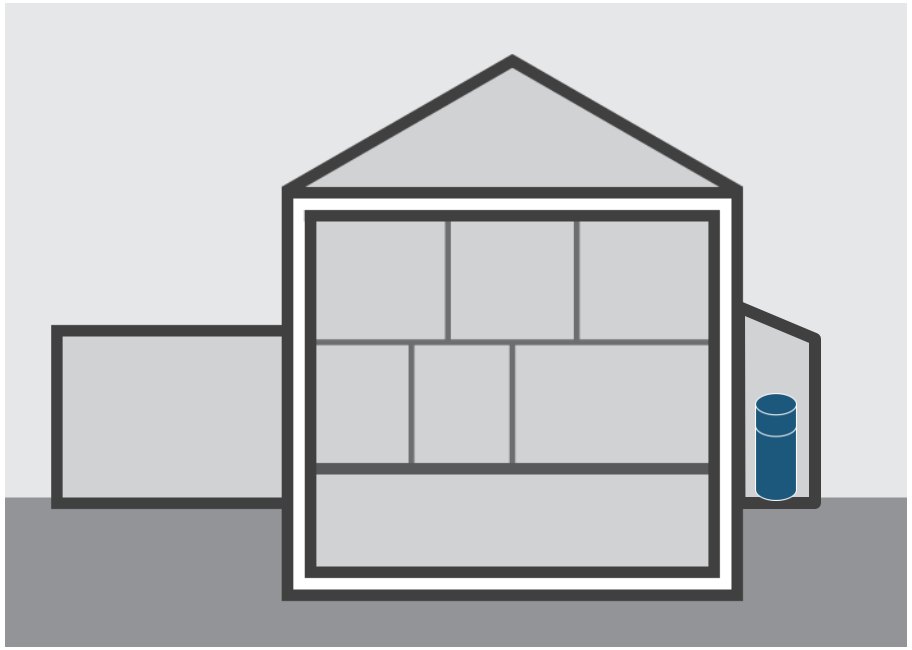
- As ambient air temperatures decrease a HPWH's efficiency and output capacity are diminished
- It becomes more likely to require electric resistance heating to make up the difference

Installation Locations

Interior



Exterior



Amazing Shrinking Room Study

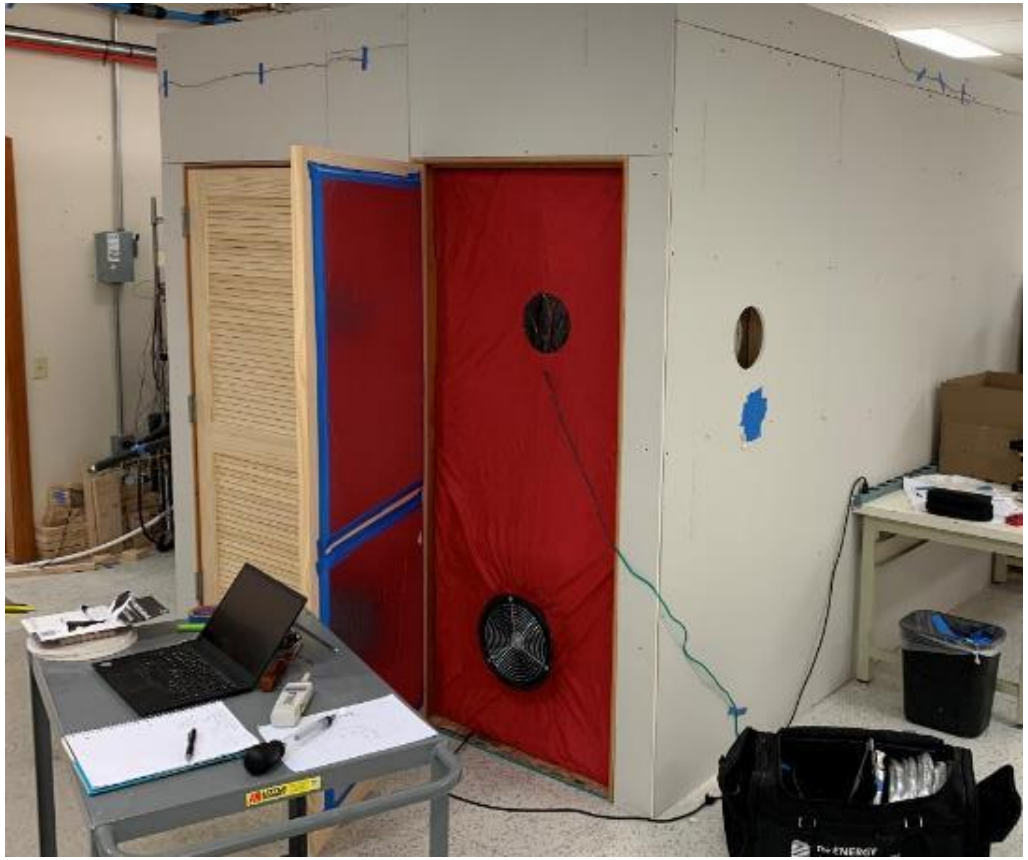
The Problem

- HPWHs can run less efficiently when installed...
- In a small space
- With insufficient ventilation
- Where they are subject to outdoor air temperatures

The Study Questions

- How small is too small?
- How to effectively improve ventilation?
- Can the challenge of outdoor air sources be overcome?

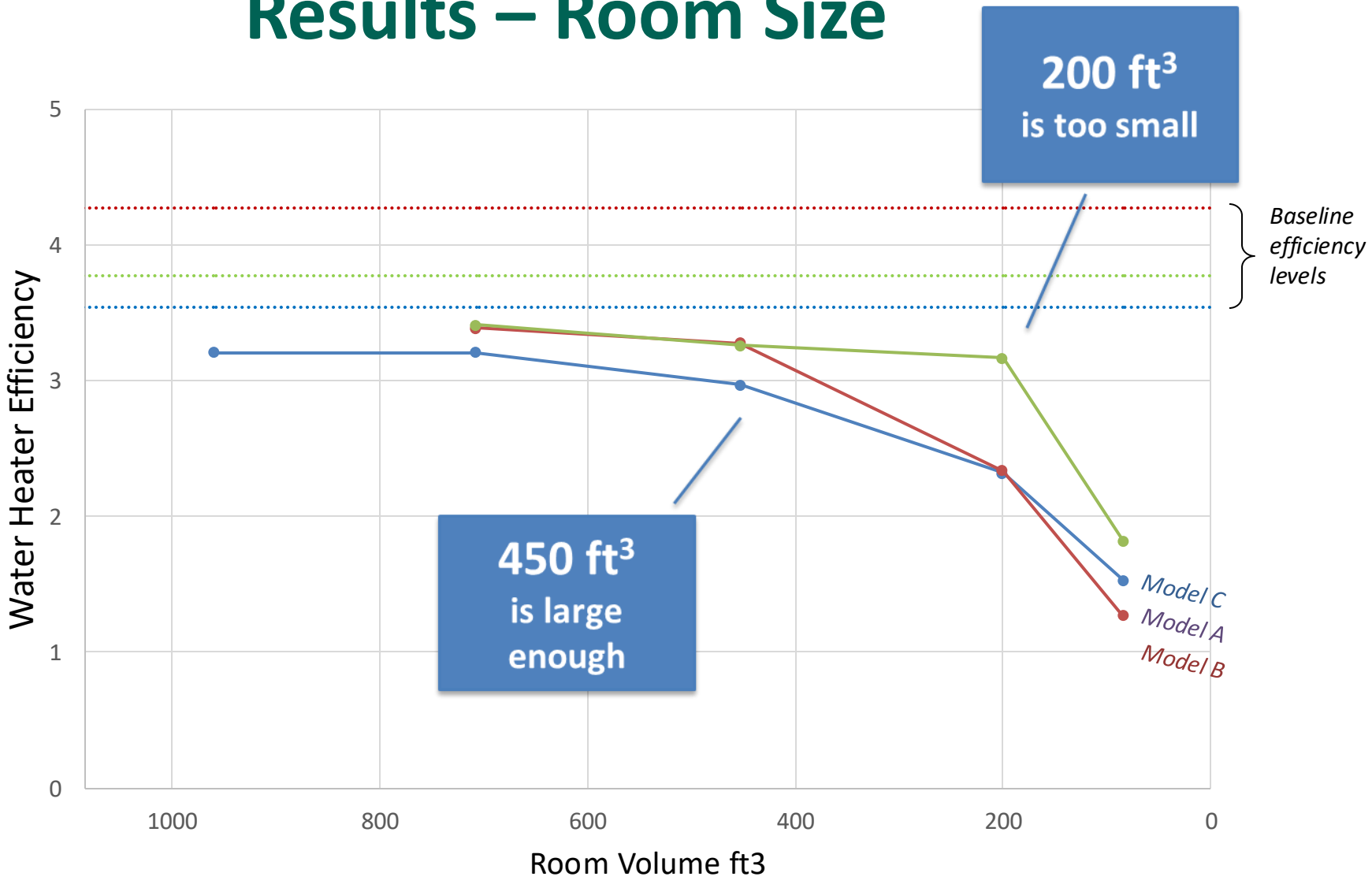
The Amazing Shrinking Room



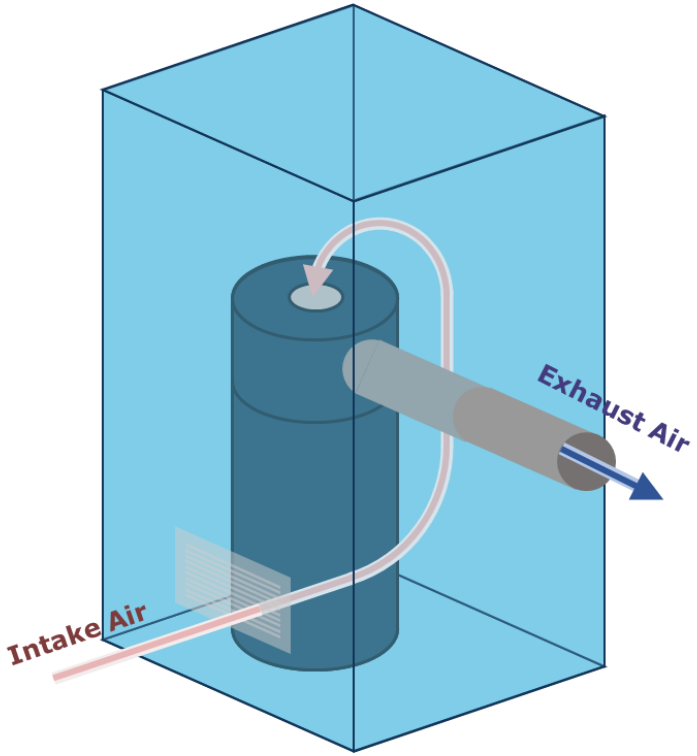
- Built to resemble typical single-family residential construction
- Adjustable room volume allows comparison of HPWH efficiency in different room sizes
- Tested three water heater models at five room sizes


FOAMULAR NGX
250
R-10

Results – Room Size



How to Improve Ventilation in a Small Space?
Active Ventilation: Forced Air



- Use HPWH's evaporator fan to expel exhaust from room
- Provide pathway for make-up air to enter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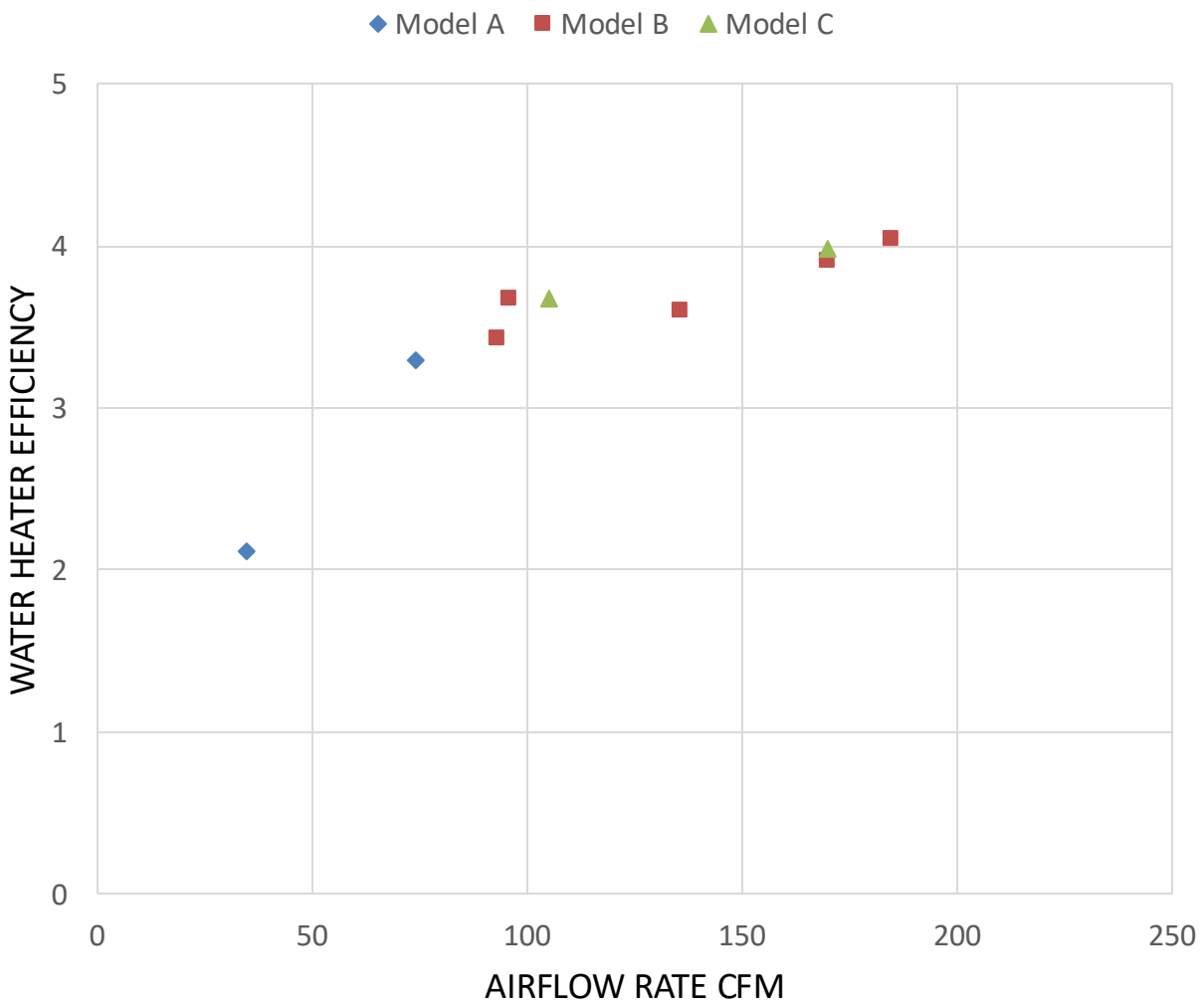
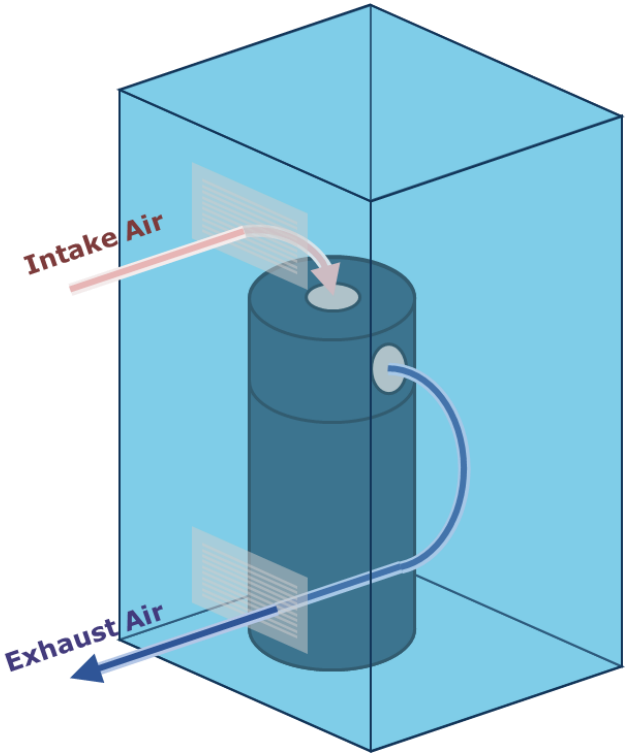
TECH
TECH

Results – Forced Ventilation



- Primary factor for effectiveness is airflow rate
- Flowrate dependent on:
  - Fan strength
  - Static pressure of exhaust path

How to Improve Ventilation in a Small Space?
Passive Ventilation



- Cooler exhaust air settles downward due to higher density
- Given a pathway, it will flow out of the lower portion of the room
- This will draw in warmer make-up air through an opening higher up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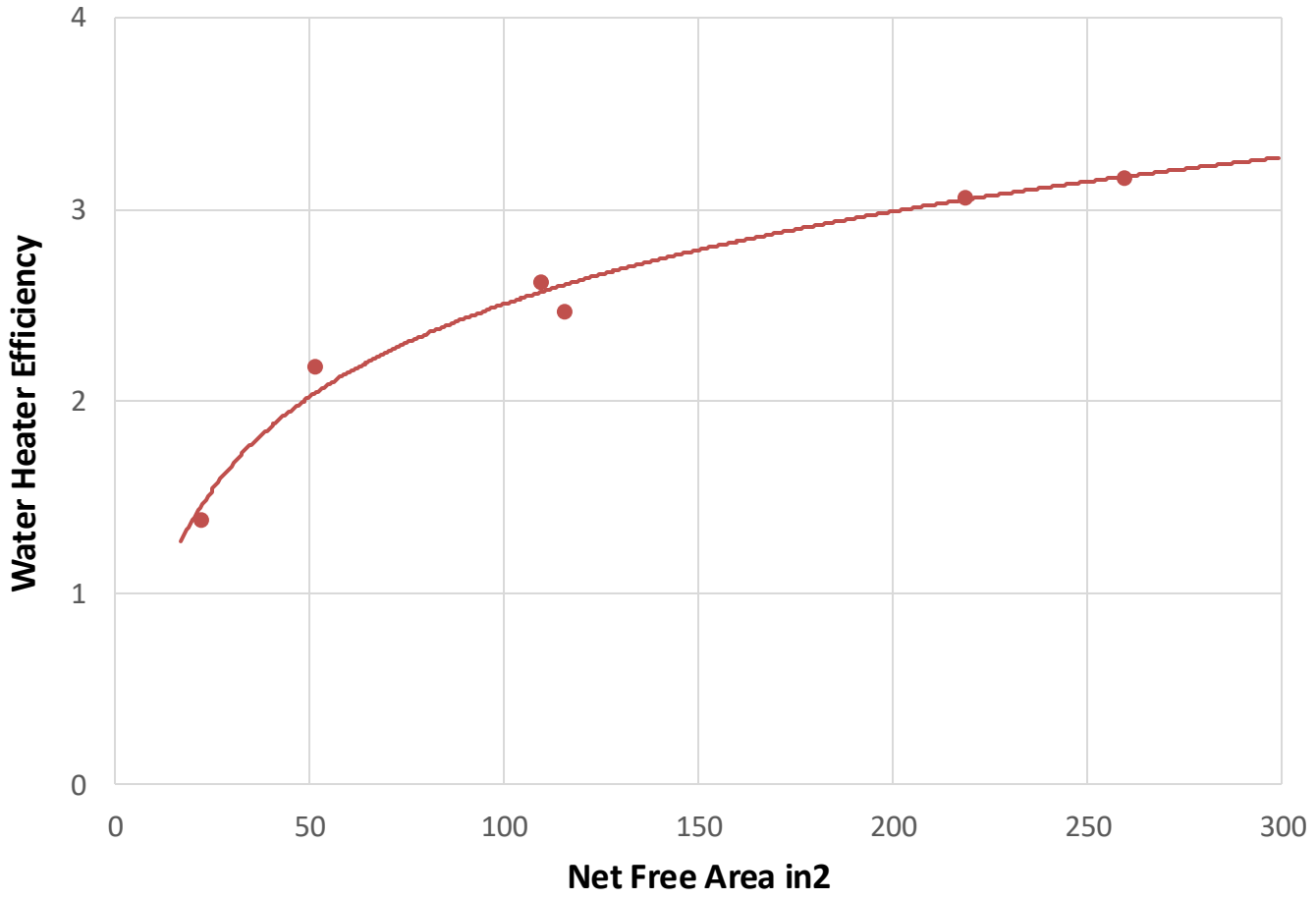
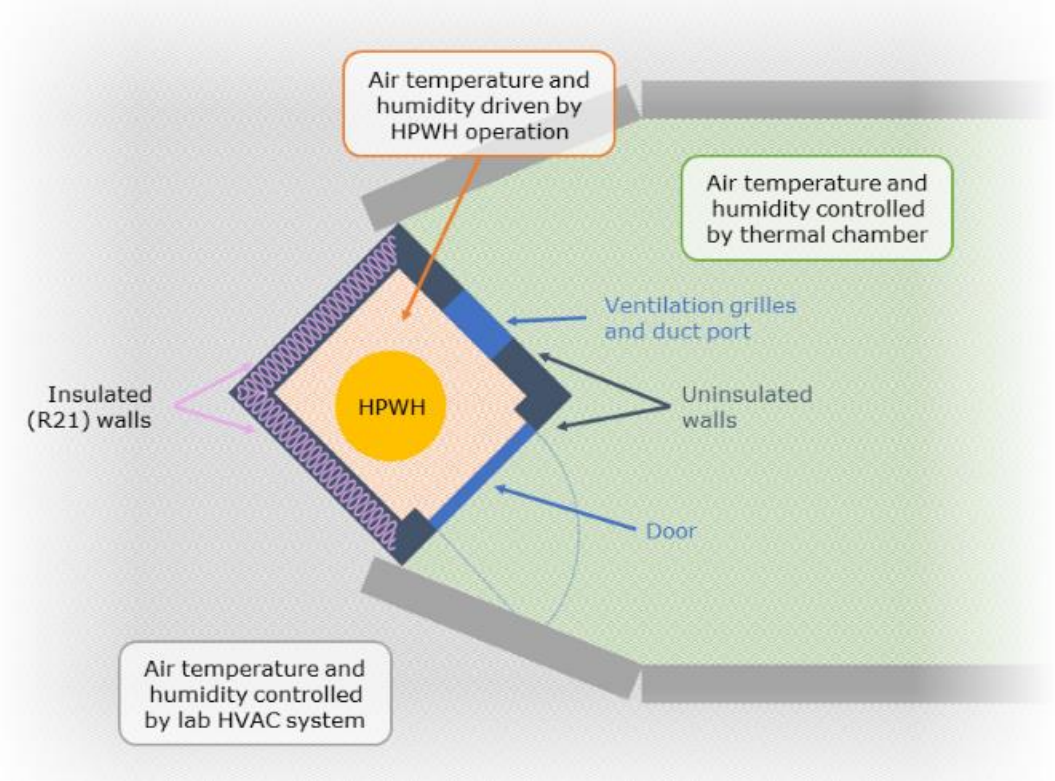
Results – Passive Ventilation



Successful interventions have:

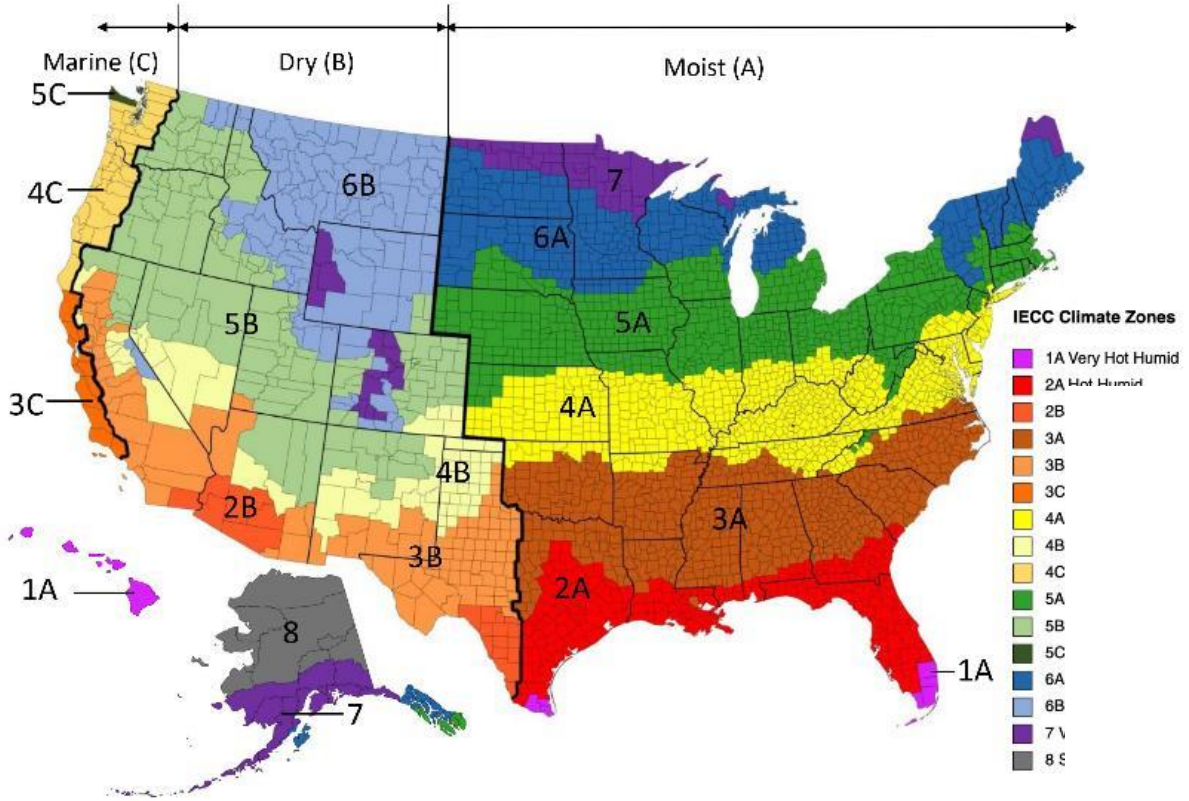
- Openings both high and low
- A total net free area over 200 in^2

Overcoming Challenges of Outside Air Exterior Closet



- Simulates a closet outside the thermal barrier, sharing two insulated walls with structure and two uninsulated walls with exterior
- Able to control air temp on “exterior” side to simulate different weather conditions

Results – Exterior Closet



IECC Climate Zone Map

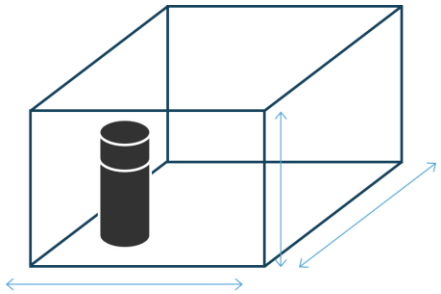
- Outdoor air temperature has significant effect on efficiency
- At lower temperatures, forced-air ventilation is more effective than passive
- Suitability of exterior installations highly dependent on climate:
  - Zones 1 & 2: Acceptable
  - Zone 3: Possible
  - Zones 4+: Not recommended

New Construction

Replacement

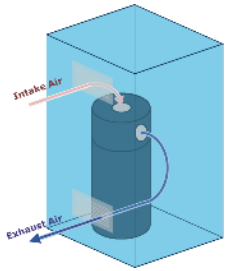
Single-Family

Install in interior space of 700 ft³ or more

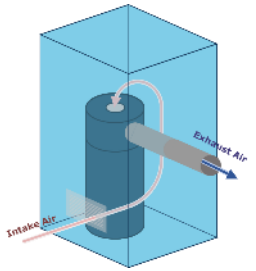


If current installation space less than 450 ft³, add ventilation

passive for **interior** locations

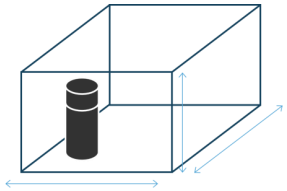


active for **exterior** locations



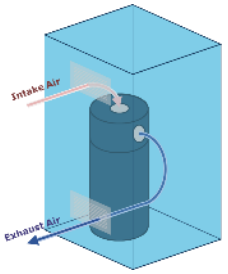
Multi-Family

Install in interior space of 450 ft³ or more if practical



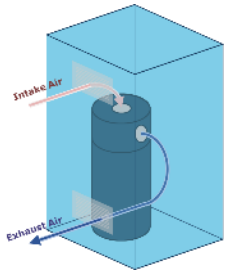
or

Install in small interior space with passive ventilation

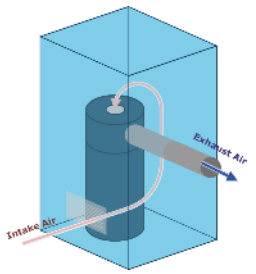


If current installation space less than 450 ft³, add ventilation

passive for **interior** locations



active for **exterior** locations



Heat Pump Water Heaters in Small Spaces Lab Testing:
"The Amazing Shrinking Room"
https://neea.org/resources/heat-pump-water-heaters-in-small-spaces-lab-testing-the-amazing-shrinking-room
NEEA 2022

Laboratory Testing of Heat Pump Water Heater Performance: Impact of Airflow and Space Configurations
https://etcc-ca.com/reports/code-readiness-laboratory-testing-heat-pump-water-heater-performance-impact-airflow-and
PG&E 2023

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