

# Ductless Heat Pump Applications in Factory-built Housing

## Gaps and barriers addressed:

- Retrofitting homes with existing electric forced-air furnace systems
- Designing hybrid zonal heating systems for new homes

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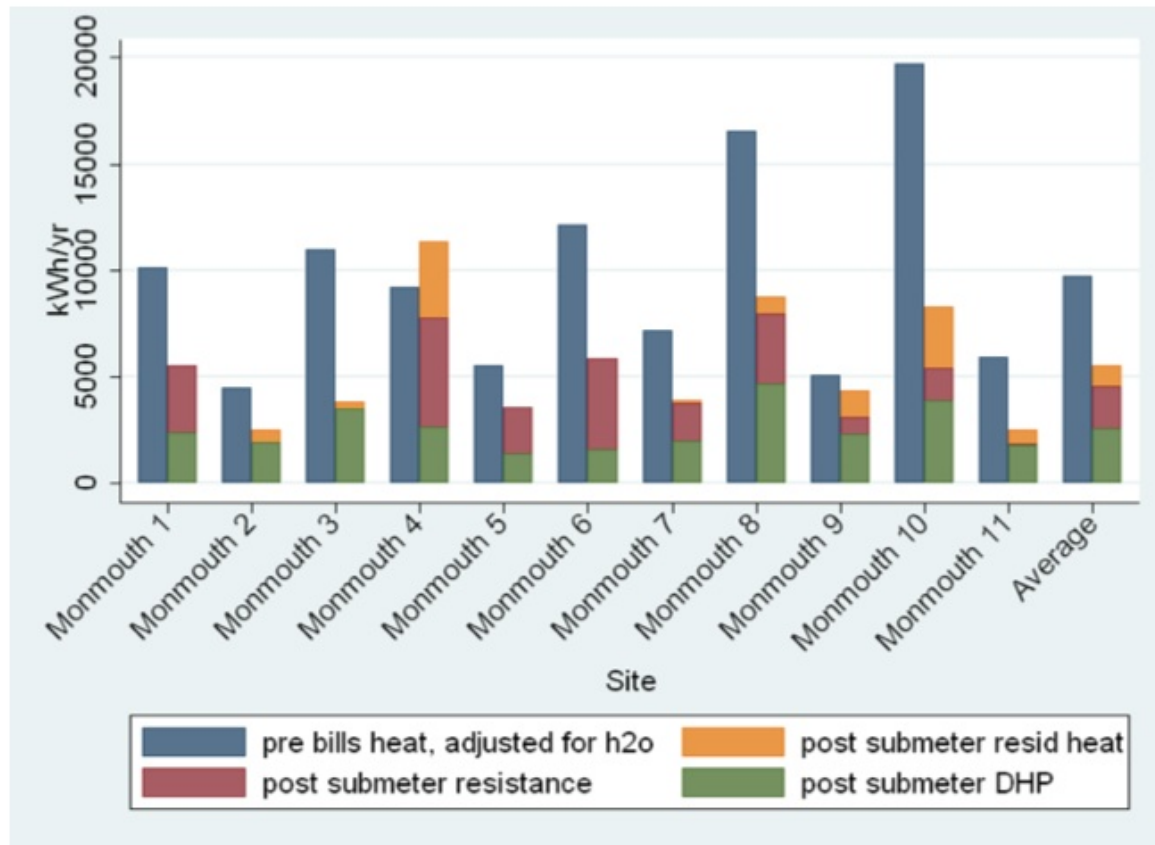
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# Ductless Heat Pump Retrofits in Manufactured Homes

- Gaps and Barriers:
  - DHP interaction with existing ducted electric forced-air furnace system is unknown
    - Pacific Northwest utilities are monitoring a handful of mfd. homes to determine if savings differ from other housing types—no attempt to influence furnace interactions
    - Building America Partnership for Improving Residential Construction (BA-PIRC) team effort to monitor sites where measures are implemented with the aim of optimizing forced air system interactions

# Ductless Heat Pump Retrofits in Manufactured Homes

Figure 2: Space Heat Energy Consumption Deltas for 11 Monmouth Sites



# Ductless Heat Pump Retrofits in Manufactured Homes

- BA-PIRC Research Test Plan
  - Recruit and perform audits on five test homes that have electric forced-air furnaces
    - Determine Design heating load of each home
  - De-energize heat strips in furnace beyond what is needed to supplement DHP to meet design heating load
    - Reduce furnace blower speed and/or replace with efficient blower to maintain air temperature and reduce duct system operating pressure
  - Test thermostat and/or other control strategies for ability to maintain secondary zone temps
  - Develop best practice guidelines for use by utility programs and other stakeholders

# Hybrid DHP Zonal Electric Heating System Design

- Gaps and barriers
  - System's ability to maintain year-round even temperatures throughout home is unproven
  - Factory installation is complex and may present transport issues
  - Industry and homebuyers are accustomed to central forced-air systems
  - Pricing of the DHP hybrid zonal system is unknown

# Hybrid DHP Zonal Electric Heating System Design

Work to date:

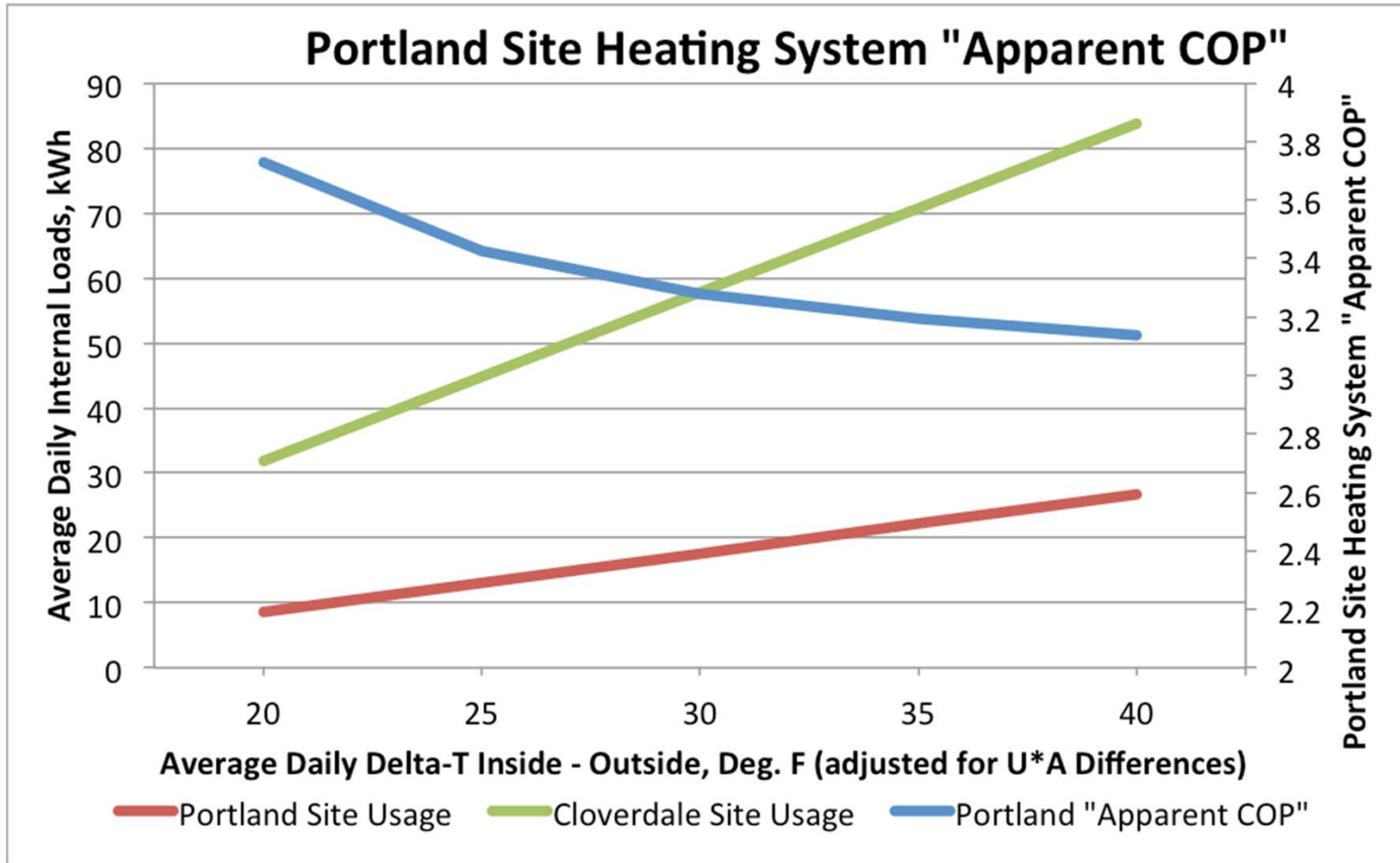
- NW Energy Efficient Manufactured Home program (NEEM) has factory-prototyped three DHP hybrid zonal homes
  - Homes received DAPIA approvals
  - Homes traveled to their destinations without problems

# Hybrid DHP Zonal Electric Heating System Design

Work to date, cont.:

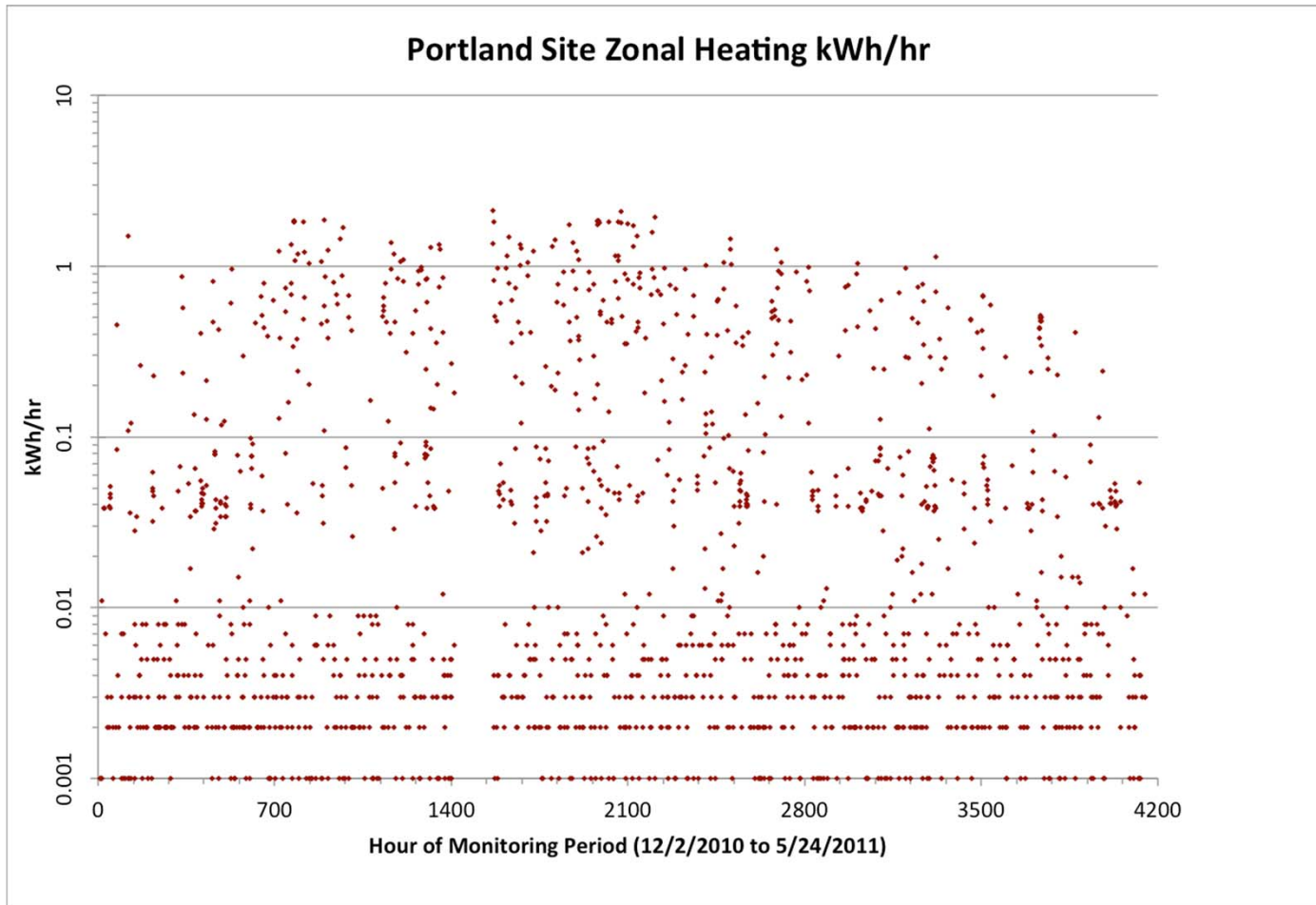
- NW Energy Works has worked with PNNL on a Building America research project to monitor a DHP hybrid zonal mfd. home vs. a similar conventional electric zonal home over a heating season
  - DHP maintained more even temperatures than conventional zonal home (much more even than typical forced-air mfd. homes)
  - Significant reduction in heating energy use

# Hybrid DHP Zonal Electric Heating System Design—Research to Date





# Hybrid DHP Zonal Electric Heating System Design—Research to Date



# Hybrid DHP Zonal Electric Heating System Design

## Next Steps:

- BA-PIRC work bringing technical support to BPA and NEEA utility initiatives
  - Assist home manufacturers with DHP hybrid system designs to facilitate bringing the option to market
  - Continue monitoring of prototype homes:
    - Collect summer cooling data
    - Optimize system performance through “extend-a-zone” techniques