2016 NORTHEAST/MID-ATLANTIC AIR-SOURCE HEAT PUMP WORKSHOP

FACILITATED BY

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NORTHEAST ENERGY EFFICIENCY PARTNERSHIPS

July 21-22, 2016
Thank you to our Workshop Sponsors!
WORKSHOP DAY 2 - ASHP SIZING & INSTALL/ROUND-ROBIN

• 7:30am - Breakfast
• 8:30am - Welcome Back
• 8:40 - 10:10 ASHP Size/Select/Install Session
• 10:10-10:30 AM Break
• 10:30-12:30 - Manufacturer “Round Robin”
Sizing/Selecting/Installing ASHPs in cold climates

PURPOSE OF TODAY’S SESSION

• NEEP is working with DOE to develop ASHP installer sizing/selection and installation guidance resources. This session is meant to gather stakeholder input on the guidance resources content and format.
Session Agenda

- Current installer sizing/selection/installation practices; Share findings from installer assessment (20 min)
- Discuss Application-based sizing/selection guidance (“decision tree” approach) (30 min)
- Discuss/Prioritize cold climate install best practices (20)
- Best vehicles to disseminate resources (10 min, time allowing)
- Next steps
Contractor Practices Assessment Report Sections

• Current Contractor practices for Information collection prior to heat pump selection
• Current Contractor practices for sizing/selecting ASHPs in cold climates
• Current Contractor practices for installing ASHPs in cold climates
• Summary of existing Guidance resources related to Sizing/Selecting/Installing ASHPs in cold climates
<table>
<thead>
<tr>
<th>Typical information of interest to installers</th>
<th>Common methods of gathering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intended use of ASHP</td>
<td>Heating/Cooling/Both</td>
</tr>
<tr>
<td>Extent of coverage</td>
<td>Whole house solution/Zoned solution</td>
</tr>
<tr>
<td>Size of desired conditioned space(s)</td>
<td>Sq footage (by zones)</td>
</tr>
<tr>
<td>Existing Heating system(s)</td>
<td>Furnace/Boiler/Heat Pump/other</td>
</tr>
<tr>
<td>Existing Cooling System(s)</td>
<td>Central AC/Window AC/No cooling</td>
</tr>
<tr>
<td>Existing HVAC distribution system(s)</td>
<td>Air ducts/No air ducts</td>
</tr>
<tr>
<td>Heating Load (@ heating design temp)</td>
<td>Btu</td>
</tr>
<tr>
<td>Cooling Load (@ cooling design temp)</td>
<td>Btu</td>
</tr>
<tr>
<td>Cooling loads (Latent and Sensible)</td>
<td>Btu</td>
</tr>
<tr>
<td>Design Temperatures (Winter and Summer)</td>
<td>°F</td>
</tr>
<tr>
<td>Availability of energy sources</td>
<td>Electricity/natural gas?</td>
</tr>
<tr>
<td>Energy prices</td>
<td>$/kWh, $/gallon of oil, $/therm of propane, $/therm of gas, $/cord of wood</td>
</tr>
</tbody>
</table>
## Equipment Information

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating Season Performance Factor (HSPF)</td>
<td>Energy Guide Label, <a href="https://ahri.org">AHRI</a>, Design and Technical Manuals</td>
</tr>
<tr>
<td>ENERGY STAR Certification</td>
<td>Energy Guide Label</td>
</tr>
<tr>
<td>Cooling Capacity (Across range of temperatures)</td>
<td>Cooling Capacity Tables in Design and Technical Manuals</td>
</tr>
<tr>
<td>Heating Capacity (Across range of temperatures)</td>
<td>Heating Capacity Tables in Design and Technical Manuals</td>
</tr>
<tr>
<td>Heating Capacity (“Rated” at 47 F)</td>
<td><a href="https://ahri.org">AHRI</a>, Design and Technical Manuals</td>
</tr>
<tr>
<td>Heating Capacity (“Rated” at 17 F)</td>
<td><a href="https://ahri.org">AHRI</a>, Design and Technical Manuals</td>
</tr>
<tr>
<td>Heating Capacity (@ 5F)</td>
<td>Heating Capacity tables (in some instances) <a href="https://www.neep.org">NEEP’s Cold Climate ASHP Specification Tables</a></td>
</tr>
<tr>
<td>Cooling Capacity (@ 95 F)</td>
<td><a href="https://ahri.org">AHRI</a>, Design and Technical Manuals, “nameplate” value</td>
</tr>
<tr>
<td>Partial load efficiencies (COP)</td>
<td>Design and Technical Manuals (in some instances) <a href="https://www.neep.org">NEEP’s Cold Climate ASHP Specification Tables</a></td>
</tr>
</tbody>
</table>
Observations related to information collection

- Many interviewees highlighted the importance of understanding the homeowner/building owner’s intended use of the heat pump.
- Formal load calculations very rare.
- Most common load being developed is cooling load. Heating loads usually only calculated in applications where the heat pump is being relied on to deliver full heating load, which is rare.
- Determination of shell efficiency very rare, many installers overestimate building leakage.
- Installers utilize only a portion of potential information, both on the home/building side as well as the equipment side, to inform system sizing/selection.
## Sizing Methods

<table>
<thead>
<tr>
<th>Sizing method</th>
<th>Basic Process</th>
<th>Information utilized</th>
<th>Existing Tools/Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cooling Load Sizing</strong></td>
<td>Match cooling load of applicable zone to cooling capacity of ASHP</td>
<td>Calculated/Estimated Cooling load, Cooling capacity of ASHP (Nameplate capacity)</td>
<td>Manual S, rules of thumb</td>
</tr>
<tr>
<td><strong>Heating Load Sizing</strong></td>
<td>Match heating load of applicable zone to heating capacity of ASHP</td>
<td>Calculated/Estimated Heating Load, Heating capacity of ASHP at design temperature</td>
<td>Manual S, rules of thumb</td>
</tr>
<tr>
<td><strong>“Balance point” Sizing</strong></td>
<td>Finding intersection of capacity graph (heating capacity table) to load line</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>“Economic balance point” Sizing</strong></td>
<td>temperature at which the supplemental heat is less expensive than the heat supplied by the heat pump</td>
<td></td>
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</tr>
</tbody>
</table>
Observations related to Sizing/Selecting

• Challenge- Designing a system that is appropriate for extreme heating and extreme cooling conditions

• No clear guidance on when it is most appropriate to size for heating/cooling/both.

• Variable-capacity equipment helps offset this difference. Careful equipment selection and/or the use of existing central heating equipment to offset peak heating loads can also help optimize the balance between heating and cooling needs.
Observations related to Sizing/Selecting

• Large majority of ASHP systems installed in “cold-climates” are ductless. Ducted systems typically installed in new construction or in applications with existing air distribution (ducts).
• Use of heating design temperature and system low temp capacity/performance is very uncommon
• Oversizing- “Oversizing” for cooling is still the norm. Multiple sources also support ‘oversizing’ of heat pumps as being beneficial due to the advantages of inverter technologies and multi-stage compressors. Some think it eliminates worry of being oversized especially in displacement scenario
Observations related to Sizing/Selecting

• In scenario where ASHP will serve as primary heating, strategies to size/select /control “back up” heating system are needed
• Industry not receiving consistent messages related to when it make sense to invest in “cold climate” system. When is it wise to size for worst case scenario?
• Aux heat options- fireplace insert, portable, electric strip or existing system
• ACCA resources need to be simplified/streamlined to be used by contractor industry
• Installer main desire should be to provide comfort efficiently. However, quick sale is bigger driver. Customers not yet aware/willing to pay for time it takes to use sophisticated methods to properly size systems.
Observations related to Selection

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Applications-based Guidance

• New construction / gut remodel
  – Low-energy new homes/deep retrofits
  – Conventional construction

• Existing home
  – Partial offset of conventional high-cost heating
    • New cooling and/or offset of window or other room cooling
    • Multi-zone approach
    • Single-zone “high-value” approach
  – Full heating system replacement
    • With existing ductwork
    • Without existing ductwork

• Isolated zones
  – Solution for isolated comfort problem(s) in existing home
  – Provide conditioning for addition or basement remodel
New construction/gut remodel

• Low-energy new homes/deep retrofits
  – Typically 1 - 3 zones mini split (ductless or mini-duct)
  – Plan to supply 100% of heating load with ASHP at design conditions

• Conventional construction
  – Typically needs more zones in mini split
  – Or, central ducted system(s) depending on size of house and load

• Both cases: easier to justify time for load calculation
Existing home - Partial offset of heating

• Existing, conventional high-cost heating (resistance, LP or oil)
  – Single-zone “high-value” approach
    • Targeted towards most-occupied, most open area of home
    • Provide the most heat/savings for lowest investment
    • Plan for staged multi-zone later when central equipment fails
  – Multi-zone approach
    • Targeted when house is spread out; needs multiple cooling zones; higher savings but bigger initial investment.

• Both cases:
  – customer control/integration of existing central heating is key
  – Detailed load calculations not critical - better places to spend attention
Existing home - Full heating system replacement

- With existing ductwork
  - Typically central ASHP replacing existing system
- Without existing ductwork
  - Multi-zone and/or multiple single mini-split
  - Possibly including new mini-duct system in attic or basement

- In both cases
  - Sizing system for full heating and cooling load
  - Make sure existing / new ductwork is tight/well insulated

• If existing ductwork is lousy / inaccessible, consider scrapping for multi-zone ductless
ISOLATED ZONES

• Solution for isolated comfort problem(s) in existing home
• Provide conditioning for addition or basement remodel

• Both cases:
  – Typically single-zone mini split, possibly mini-duct
  – Detailed load calcs not critical especially if the application includes some spillover “offset” of existing heat
NEXT STEPS

• NEEP to draft guidance resources over the next few months, circulate with interested stakeholders
• Finalize/Disseminate by December
Join us to our next events

- **Sept 20**: Residential Lighting Workshop
- **Sept 21**: Home Energy Management Systems Workshop
- **Sept 22**: EM&V 2.0 Workshop
- **Oct 21**: Rhode Island High Performance Schools Summit
- **Nov 9**: New Hampshire High Performance Schools Summit
THANK YOU!

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