Cold Climate Heat Pumps and EE Programming

October 6, 2015
Northeast “Site” Energy Use

- Space heating dominates residential site energy consumption

6153 Heating Degree Days - 299 Cooling Degree Days

*EIA’s 2009 Residential Energy Consumption Survey*
Air source heat pump performance varies with outdoor air temperature
# Low Temperature Performance

<table>
<thead>
<tr>
<th>Outdoor Temp</th>
<th>Btu Load</th>
<th>Btu Rated</th>
<th>kW Rated</th>
<th>COP Rated</th>
<th>Btu Max</th>
<th>kW Max</th>
<th>COP Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>55</td>
<td>0</td>
<td>25,274</td>
<td>1.65</td>
<td>4.49</td>
<td>36,314</td>
<td>3.51</td>
<td>3.03</td>
</tr>
<tr>
<td>45</td>
<td>6,000</td>
<td>22,272</td>
<td>1.58</td>
<td>4.13</td>
<td>33,283</td>
<td>3.43</td>
<td>2.85</td>
</tr>
<tr>
<td>35</td>
<td>12,000</td>
<td>15,984</td>
<td>1.45</td>
<td>3.23</td>
<td>30,252</td>
<td>3.35</td>
<td>2.65</td>
</tr>
<tr>
<td>25</td>
<td>18,000</td>
<td>14,472</td>
<td>1.28</td>
<td>3.31</td>
<td>27,221</td>
<td>3.26</td>
<td>2.44</td>
</tr>
<tr>
<td>15</td>
<td>24,000</td>
<td>12,960</td>
<td>1.10</td>
<td>3.45</td>
<td>24,190</td>
<td>3.18</td>
<td>2.23</td>
</tr>
<tr>
<td>5</td>
<td>30,000</td>
<td>10,157</td>
<td>0.89</td>
<td>3.34</td>
<td>21,159</td>
<td>3.10</td>
<td>2.00</td>
</tr>
<tr>
<td>0</td>
<td>33,000</td>
<td>8,761</td>
<td>0.77</td>
<td>3.33</td>
<td>19,643</td>
<td>3.06</td>
<td>1.88</td>
</tr>
<tr>
<td>-5</td>
<td>36,000</td>
<td>7,260</td>
<td>0.64</td>
<td>3.32</td>
<td>18,128</td>
<td>3.02</td>
<td>1.76</td>
</tr>
<tr>
<td>-10</td>
<td>39,000</td>
<td>5,759</td>
<td>0.52</td>
<td>3.24</td>
<td>16,612</td>
<td>2.98</td>
<td>1.63</td>
</tr>
<tr>
<td>-15</td>
<td>42,000</td>
<td>4,257</td>
<td>0.40</td>
<td>3.12</td>
<td>15,097</td>
<td>2.94</td>
<td>1.50</td>
</tr>
</tbody>
</table>

Air source heat pump performance varies with load.
Cost Comparison per Delivered MMBtu

Cost effectiveness varies with fuel price
Cost Comparison per Delivered MMBtu

Electric rates increased ($0.17 to $0.21 per kWh)
Oil prices decreased ($4.10 to $3.15 per gallon)
Fit for EE programming

- **Verifiable savings = EE programming**
  - Savings from defined baseline
  - “Cost effective” per regulatory requirements
  - Influence market

- **Reduced variability = better fit for EE**
  - Focus on features that improve performance
  - Improve design guidelines for heating dominated climate
    - Primary heating (smaller market opportunity)
    - Supplemental heating (larger market opportunity)
Appendix
2014 Fuel Costs

Electric $0.17 kWh
Natural Gas $1.60 therm
Oil $4.10 gallon
Propane $3.00 gallon
Pellet $250.00 per ton