The Humpty Dumpty of Heating
Piecing Together an Understanding
of Ductless Mini-Split Heat Pump
Usage in the Northeast

Danielle Vitoff, Navigant

2015 IEPEC Conference — Long Beach, California

Co-Authors:
Matt Nelson, Eversource Energy
Justin Spencer, Navigant
Terese Decker, Navigant
Ken Seiden, Navigant
Andy Machado, Cadmus
Online Survey Methodology

- Population frame = 3,289 participants
- Invitation to sample of 1,628 participants
- 26% receive bounce-backs
- 36% response rate ($10 incentive)
Online Survey Results: How Participants use their DMSHP

- 74% of respondents use their DMSHP only for heating.
- 25% of respondents use their DMSHP only for cooling.
- 1% of respondents use their DMSHP for both heating and cooling.

Percent

All Respondents

Responses

Only for cooling

Only for heating

Both heating and cooling
Online Survey Results:
Space Conditioning before the DMSHP Installation

Responses:
- 58% It was heated only
- 31% It was cooled only
- 7% It was heated and cooled
- 2% It was not heated or cooled
- 2% It is a new space
On-Site Survey Methodology

- 307 willing to participate in data logging
- 135 sites chosen to ensure adequate representation
- Detailed on-site survey completed at all 135 sites
Purchased the DMSHP for the Cooling Amenity Only

Stated Purchase Intent
On-Site Survey

Cooling (31%)

Alternative Action, Cooling
On-Site Survey

- Left space unconditioned (6%)
- Left other system installed (12%)
- Bought non-qualifying DMSHP (1%)
- Installed alternative (10%)
- Did not answer (3%)

Proposed Baselines
Navigant Analysis

Cooling

DMSAC

Existing

Heating
Purchased the DMSHP for the Cooling Amenity Only

**Stated Purchase Intent**

*On-Site Survey*

- Cooling (31%)

**Alternative Action, Cooling**

*On-Site Survey*

- Left space unconditioned (6%)
- Left other system installed (12%)
- Bought non-qualifying DMSHP (1%)
- Installed alternative (10%)
- Did not answer (3%)

**Proposed Baselines**

*Navigant Analysis*

- DMSAC
- Existing

**Cooling**

**Heating**
Purchased the DMSHP for the Heating Amenity Only

Stated Purchase Intent
On-Site Survey

Heating (4%)

- Left space unconditioned (2%)
- Left other system installed (1%)
- Installed alternative (1%)

Alternative Action, Heating
On-Site Survey

Proposed Baselines
Navigant Analysis

- Cooling
  - Existing
- Heating
  - DMSHP
  - Existing
  - Stated Alternative
Purchased the DMSHP for the Heating Amenity Only

*Would have alternatively ‘left space unconditioned’*

<table>
<thead>
<tr>
<th>Stated Purchase Intent</th>
<th>Alternative Action, Heating</th>
<th>Proposed Baselines</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>On-Site Survey</em></td>
<td><em>On-Site Survey</em></td>
<td></td>
</tr>
<tr>
<td>Heating (4%)</td>
<td>Left space unconditioned (2%)</td>
<td>DMSHP</td>
</tr>
<tr>
<td></td>
<td>Left other system installed (1%)</td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td>Installed alternative (1%)</td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stated Alternative</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cooling DMSHP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heating DMSHP</td>
</tr>
</tbody>
</table>

*Navigant Analysis*
Purchased the DMSHP for the Heating Amenity Only
Would have alternatively ‘left other system installed’

Stated Purchase Intent
On-Site Survey

Alternative Action, Heating
On-Site Survey

Proposed Baselines
Navigant Analysis

Cooling

Heating

- Heating (4%)
  - Left space unconditioned (2%)
    - DMSHP
  - Left other system installed (1%)
    - Existing
  - Installed alternative (1%)
    - Existing

- Stated Alternative

Existing

- DMSHP
- Existing
- Stated Alternative
Purchased the DMSHP for the Heating Amenity Only

*Would have alternatively ‘installed alternative’ system*

**Stated Purchase Intent**
On-Site Survey

- Heating (4%)
  - Left space unconditioned (2%)
  - Left other system installed (1%)
  - Installed alternative (1%)

**Alternative Action, Heating**
On-Site Survey

- Left space unconditioned (2%)
- Left other system installed (1%)
- Installed alternative (1%)

**Proposed Baselines**

*Navigant Analysis*

- Cooling
  - DMSHP
- Heating
  - DMSHP
  - Existing
  - Existing
  - Stated Alternative
Purchased the DMSHP for the Both the Heating and Cooling Amenities

<table>
<thead>
<tr>
<th>Stated Purchase Intent</th>
<th>Alternative Action, Cooling</th>
<th>Alternative Action, Heating</th>
<th>Proposed Baselines</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Site Survey</td>
<td>On-Site Survey</td>
<td>On-Site Survey</td>
<td>Navigant Analysis</td>
</tr>
<tr>
<td>Both Cooling and Heating (65%)</td>
<td>Left space unconditioned (10%)</td>
<td>Left space unconditioned (2%)</td>
<td>Cooling DMSHP</td>
</tr>
<tr>
<td></td>
<td>Left other system installed (38%)</td>
<td>Left other system installed (37%)</td>
<td>Heating DMSHP</td>
</tr>
<tr>
<td></td>
<td>Installed alternative (3%)</td>
<td>Installed alternative (2%)</td>
<td>Existing Stated alternative</td>
</tr>
<tr>
<td></td>
<td>Bought non-qualifying DMSHP (4%)</td>
<td>DMSHP</td>
<td>DMSHP</td>
</tr>
<tr>
<td></td>
<td>Installed alternative (13%)</td>
<td>Installed alternative (4%)</td>
<td>Existing Stated alternative</td>
</tr>
</tbody>
</table>

- Cooling: DMSHP
- Heating: DMSHP
- Proposed Baselines: Navigant Analysis

- Cooling: DMSHP
- Heating: DMSHP

- Cooling: Existing (None)
- Heating: Stated alternative

- Cooling: Existing (None)
- Heating: Existing

- Cooling: Existing
- Heating: Stated alternative

- Cooling: Stated alternative
- Heating: Existing

- Cooling: Stated alternative
- Heating: Stated alternative
Purchased the DMSHP for the Both the Heating and Cooling Amenities
Purchased the DMSHP for the Both the Heating and Cooling Amenities

<table>
<thead>
<tr>
<th>Stated Purchase Intent</th>
<th>Alternative Action, Cooling</th>
<th>Alternative Action, Heating</th>
<th>Proposed Baselines Navigant Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Site Survey</td>
<td>On-Site Survey</td>
<td>On-Site Survey</td>
<td></td>
</tr>
<tr>
<td>Both Cooling and Heating (65%)</td>
<td>Left space unconditioned (10%)</td>
<td>Left space unconditioned (2%)</td>
<td>DMSHP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left other system installed (8%)</td>
<td>DMSHP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installed alternative (0%)</td>
<td>Existing (None)</td>
</tr>
<tr>
<td></td>
<td>Left other system installed (38%)</td>
<td>Left space unconditioned (0%)</td>
<td>DMSHP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left other system installed (37%)</td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installed alternative (2%)</td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td>Bought non-qualifying DMSHP (4%)</td>
<td></td>
<td>Stated alternative</td>
</tr>
<tr>
<td></td>
<td>Installed alternative (13%)</td>
<td>Left space unconditioned (0%)</td>
<td>Stated alternative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left other system installed (8%)</td>
<td>Stated alternative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installed alternative (4%)</td>
<td>Stated alternative</td>
</tr>
</tbody>
</table>
Purchased the DMSHP for the Both the Heating and Cooling Amenities

<table>
<thead>
<tr>
<th>Stated Purchase Intent</th>
<th>Alternative Action, Cooling</th>
<th>Alternative Action, Heating</th>
<th>Proposed Baselines</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-Site Survey</td>
<td>On-Site Survey</td>
<td>On-Site Survey</td>
<td>Navigant Analysis</td>
</tr>
<tr>
<td>Both Cooling and Heating (65%)</td>
<td>Left space unconditioned (10%)</td>
<td>Left space unconditioned (2%)</td>
<td>Cooling</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Left other system installed (8%)</td>
<td>DMSHP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Installed alternative (0%)</td>
<td>Existing (None)</td>
</tr>
<tr>
<td>Bought non-qualifying DMSHP (4%)</td>
<td>Left space unconditioned (0%)</td>
<td>DMSHP</td>
<td>Stated alternative</td>
</tr>
<tr>
<td></td>
<td>Left other system installed (37%)</td>
<td>Existing</td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td>Installed alternative (2%)</td>
<td>Existing</td>
<td>Stated alternative</td>
</tr>
<tr>
<td>Installed alternative (13%)</td>
<td>Left space unconditioned (0%)</td>
<td>Stated alternative</td>
<td>Existing (none)</td>
</tr>
<tr>
<td></td>
<td>Left other system installed (8%)</td>
<td>Stated alternative</td>
<td>Existing</td>
</tr>
<tr>
<td></td>
<td>Installed alternative (4%)</td>
<td>Stated alternative</td>
<td>Stated alternative</td>
</tr>
</tbody>
</table>
Purchased the DMSHP for the Both the Heating and Cooling Amenities

Stated Purchase Intent
On-Site Survey

Both Cooling and Heating (65%)

Alternative Action, Cooling
On-Site Survey

Left space unconditioned (10%)

- Left space unconditioned (2%)
  - DMSHP
- Left other system installed (8%)
  - DMSHP
- Installed alternative (0%)
  - Existing (None)
  - Stated alternative

Left other system installed (38%)

- Left space unconditioned (0%)
  - DMSHP
- Left other system installed (37%)
  - Existing
- Installed alternative (2%)
  - Existing
  - Stated alternative

Bought non-qualifying DMSHP (4%)

- Left space unconditioned (0%)
  - DMSHP
- Left other system installed (8%)
  - Stated alternative
- Installed alternative (4%)
  - Stated alternative

Installed alternative (13%)

- Left space unconditioned (0%)
  - Stated alternative
- Left other system installed (8%)
  - Stated alternative
- Installed alternative (4%)
  - Stated alternative

Proposed Baselines
Navigant Analysis

Cooling

- DMSHP
- Existing (None)
- Stated alternative

Heating

- DMSHP
- Existing
- Stated alternative

Alternative Action, Heating
On-Site Survey

- Stated alternative

Proposed Baselines
Navigant Analysis
## Baseline Recommendation

<table>
<thead>
<tr>
<th>Cooling Baseline Scenario Breakdown</th>
<th>Heating Baseline Scenario Breakdown</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Efficiency DMSHP</strong></td>
<td><strong>Standard Efficiency DMSHP</strong></td>
</tr>
<tr>
<td>16%</td>
<td>16%</td>
</tr>
<tr>
<td><strong>Standard Efficiency DMSAC</strong></td>
<td></td>
</tr>
<tr>
<td>31%</td>
<td></td>
</tr>
<tr>
<td><strong>Existing Technology</strong></td>
<td><strong>Existing Technology</strong></td>
</tr>
<tr>
<td>35%</td>
<td>77%</td>
</tr>
<tr>
<td>Existing Room AC</td>
<td>Existing Gas</td>
</tr>
<tr>
<td>25%</td>
<td>24%</td>
</tr>
<tr>
<td>Existing Central AC</td>
<td>Existing Oil</td>
</tr>
<tr>
<td>8%</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td>Existing Electric Resistance</td>
</tr>
<tr>
<td></td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>Existing Wood, Pellet or Fireplace</td>
</tr>
<tr>
<td></td>
<td>%</td>
</tr>
<tr>
<td><strong>Stated Alternative Technology</strong></td>
<td><strong>Stated Alternative Technology</strong></td>
</tr>
<tr>
<td>13%</td>
<td>7%</td>
</tr>
<tr>
<td>New Room AC</td>
<td>New Gas</td>
</tr>
<tr>
<td>9%</td>
<td>2%</td>
</tr>
<tr>
<td>New Central AC</td>
<td>New Electric Resistance</td>
</tr>
<tr>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Extend Existing System (unstated)</td>
<td>Extend Existing System (unstated)</td>
</tr>
<tr>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Unconditioned</strong></td>
<td><strong>Unconditioned</strong></td>
</tr>
<tr>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>Total</strong></td>
</tr>
<tr>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>