MINNESOTA HEAT PUMPS

A Cold-Climate Test Bed

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cce
Center for Energy and Environment
Center for Energy and Environment

40 years of energy efficiency services

- Research and Engineering
- Program Development
- Program Delivery
- Financing
MN Policy

• Conservation Improvement Program (CIP)
  • Energy efficiency required of utilities since early 1980’s
  • 1.5% of retail sales savings requirement since 2010
  • Investor-owned electric utility achievements in 2018 were 2.3% (Xcel Energy), 2.6% (Minnesota Power) and 4.2% (Otter Tail Power)

• Fuel switching is not currently allowed in CIP by agency guideline

• MN is exploring legislative and regulatory options to include beneficial electrification in CIP
CEE’s ccASHP field research

Study Overview: 2015 – 2018

• 8 ccASHP in a variety of MN residences
  • 6 ducted whole house system
  • 2 ductless mini-split systems
• Climate zones 6 & 7
• Monitor installed field performance of ASHP & backup
• Develop performance curves
CEE’s ccASHP field research

- Significant savings for replacing propane and electric resistance

<table>
<thead>
<tr>
<th>PERCENTAGE REDUCTIONS FOR CCASHPS</th>
<th>Site Energy</th>
<th>Source Energy</th>
<th>Homeowner Cost</th>
<th>Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual fuel ASHP vs Prop. Furn.</td>
<td>40%</td>
<td>10%</td>
<td>30%</td>
<td>5%</td>
</tr>
<tr>
<td>All elect. ducted &amp; ductless vs elect. resistance</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
</tr>
</tbody>
</table>

- Systems delivered heat at as low as -20 °
  - Technology continues to improve
- Savings can be difficult to achieve – sizing, design, etc.
Minnesota Statewide Potential Study

All Sectors

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>60%</td>
</tr>
<tr>
<td>Other</td>
<td>1%</td>
</tr>
<tr>
<td>Plug Loads</td>
<td>5%</td>
</tr>
<tr>
<td>Cooling</td>
<td>6%</td>
</tr>
<tr>
<td>Lighting</td>
<td>6%</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>10%</td>
</tr>
<tr>
<td>System Efficiency</td>
<td>11%</td>
</tr>
<tr>
<td>Water Heating</td>
<td>13%</td>
</tr>
<tr>
<td>Appliances</td>
<td>13%</td>
</tr>
<tr>
<td>Space Heating</td>
<td>35%</td>
</tr>
</tbody>
</table>

Residential

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<tr>
<td>Space Heating</td>
<td>1%</td>
</tr>
<tr>
<td>Plug Loads</td>
<td>1%</td>
</tr>
<tr>
<td>Cooking</td>
<td>2%</td>
</tr>
<tr>
<td>Cooling</td>
<td>2%</td>
</tr>
<tr>
<td>Process Heating</td>
<td>2%</td>
</tr>
<tr>
<td>Other</td>
<td>8%</td>
</tr>
<tr>
<td>Ventilation</td>
<td>9%</td>
</tr>
<tr>
<td>Motors</td>
<td>13%</td>
</tr>
<tr>
<td>System Efficiency</td>
<td>17%</td>
</tr>
<tr>
<td>Refrigeration</td>
<td>20%</td>
</tr>
</tbody>
</table>

Commercial & Industrial

<table>
<thead>
<tr>
<th>Sector</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting</td>
<td>25%</td>
</tr>
<tr>
<td>Other</td>
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<tr>
<td>Ventilation</td>
<td>9%</td>
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Minnesota Statewide Potential Study

Measures within residential space heating end use

- Insulation & Air Sealing: 65%
- Tier 1-3 Thermostat: 18%
- Air Source Heat Pump: 17%

Proportion of households using electricity as primary heating source:
- 0.00 – 0.15
- 0.16 – 0.26
- 0.27 – 0.5

Map showing distribution across Minnesota.
Delivered Fuels

- 16% of MN homes are heated with delivered fuels
- Together this equals approx. 547,000 homes

Minnesota Market - ASHPs

Status – immature market

• Historically centered around AC
  • Typically lower HSPF - rarely used for heating
• Cold-climate market is beginning to grow

Barriers

• Limited contractor knowledge or awareness
  • System options, sizing, and change-over temp
  • Inflated price
• Lack of consumer awareness
  • Don’t understand heating potential
  • Difficulty with controls
ASHP Rebate Programs

Rebate amounts vary widely throughout state
$200 - $2,000

Utility rebate requirements also vary
From 14+ SEER to
18+ SEER, HSPF > 10, and an inverter driven

Need guidance on product specification and quality installations
Breadth of Upcoming Research

- Looking to incorporate a variety of systems
  - Single-family and Multi-family
  - Ducted and Ductless
  - Single head and multi-head
- Validating protocols and verifying performance of optimized ccASHPs and controls
  - Completing over 20 installations in MN
- Developing design, installation and operational protocols for contractors
  - Focus on reducing barriers
Market Engagement

- Contractor education
  - System and install options
  - Setting change-over temperature
  - Presenting value proposition

- Quality installation program
  - Product specifications
  - Quality installation guidelines and requirements
  - Field verification
Opportunities for Collaboration

• Joint cold climate product specifications
  • Incorporation of new test methods
  • Uniform cold climate definitions, terminology and requirements
  • Setting stretch goals and targets for new performance and controls

• Coordinating our efforts
  • Sharing case studies, marketing materials and messages, and training materials
  • Utilities, manufacturers, contractors, and homeowners need to see results and momentum from around the country
THANK you!

Questions?
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