Heat Pumps = Less Fire, but it's not that simple

A guide on where to start and what to consider
Agenda

- Intro to ASHPs
- Applications: Full Speed Ahead!
- Applications: Pilot stage, ready to launch
- Applications: Still more to come
- What is needed for HP adoption
Heat Pump technology is key to building electrification

• Heat pumps are familiar technologies
  • Air conditioning
  • Refrigeration

• Strong gains in cold climate performance with variable speed HPs

• Innovation and rapid technology development
  • Disruptive technologies
  • Increasing scale
  • Policy support
Comparing system types using COP

Coefficient of Performance – For every unit of energy utilized, how many units of heat are produced?

Approximate Coefficient of Performance

- Electric Resistance Heat: 1
- Natural Gas furnace: 0.8
- High Efficiency Natural Gas furnace: 0.95
- Natural Gas Boiler: 0.8
- High Efficiency Natural Gas Boiler: 0.92
- Centrally ducted ASHP: 2.5
- Cold Climate Centrally ducted ASHP: 3
- Cold Climate Minisplit: 3.5
2013
• Inverter driven technology comes to market
• NEEP ccASHP spec.

2015
• CARD single family ccASHP field study

2017
• Xcel Energy all-electric ASHP projects

2019
• MN Potential Study
• CARD single family ccASHP optimization study
• CARD multifamily ccASHP study

2020
• ComEd ASHP research study
• NEEA ASHP modeling tool

2021
• Heat pumps for AC – multiple projects
• CARD air to water heat pump study
ASHP COP

COP vs. Outdoor Air Temperature

- COP at max
- COP at min
ccASHP Research Findings

01 Perform well in cold climates
   • Delivering heat as at temps as low as -25°F

02 Deliver increased capacity and COP

03 Meet manufacturer specifications

But they must be installed correctly
Keys to Performance - Installation Considerations

Control and Operation

Integration with backup

Sizing
Types of ASHPs - Gift and a Curse

- Residential Heat Pumps
  - Minisplit heat pumps
  - Multi-split heat pumps
  - Centrally ducted heat pumps
  - Dual-fuel heat pumps
  - Air-to-water heat pumps
  - Ground source heat pumps

- Commercial Heat Pumps
  - VRF heat pumps
  - Ground source heat pumps
  - PTAC heat pumps
  - RTU heat pumps

- Other heat pumps
  - High temperature heat pumps
  - Heat pump water heaters
  - Automotive heat pumps
Where do we start?

- SOURCE ENERGY SAVINGS
- EMISSION SAVINGS – EARTH OR WIND?
- CUSTOMER SAVINGS
Applications: Full Speed Ahead!

- Electric Heat Displacement
- Propane Heat or Delivered Fuel Replacement
## CEE’s field research results

### Percentage Reductions for ccASHPs

<table>
<thead>
<tr>
<th></th>
<th>Site energy</th>
<th>Source energy</th>
<th>Homeowner cost</th>
<th>Emissions</th>
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</thead>
<tbody>
<tr>
<td><strong>Dual-fuel ASHP</strong> vs. propane furnace</td>
<td>40%</td>
<td>10%</td>
<td>30%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>All-electric ducted &amp; ductless HP</strong> vs. electric resistance</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
<td>55%</td>
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</tbody>
</table>
Electric Displacement via Ductless
Electric replacement via Ductless

55% homeowner cost savings

- Head location is important
  - Size for space
- Controls – integration with heating sources is key
- Ductless will operate whenever system is capable
- Lots of design and install flexibility
Ducted Whole House Propane Heat Replacement
Dual Fuel ccVSHP systems

30% homeowner cost savings

- Installation is very comparable to traditional furnace/AC
- Size HP for heating not cooling
- Simple, integrated controls
- Hard switch to backup heat
Applications: Pilot stage, ready to launch

- Beneficial Electrification
- AC Replacement
- All electric
- Multifamily (zoned ER)
Beneficial Electrification

The fuel switching dream
Electrify everything!

The Reality
Often increases customer costs
Starts with building envelope
Consider peak impacts

Gas cost: $0.80/therm
Electric: $0.11/kWh
Starting Point – Dual-fuel / AC Replacement

• Never install an AC again!
  • Stop incentivizing ACs
• Tiered HP rebates
  • Entry level – 15+ SEER and 8.5+ HSPF
  • Variable speed - 17+ SEER and 9.5+ HSPF
• New A-coil units
  • Compatible with existing furnace
• Eliminates peak concerns
• Current research
  • Paper coming soon
AC Replacement – customer costs

- Gas cost: $0.80/therm
- Electric: $0.11/kWh
When to go all-electric

Low load homes
- Weatherized, new construction

Onsite renewables

All-electric rates – 8 cents / kWh
- Competitive with $0.80/therm gas
Multifamily Applications – target electric heat

- Lower load living space
- Cost considerations
  - Should we install a head in every room?
- Integration with backup is key
- Split incentive
  - Who pays and who saves?
- Current research
  - 20 units
  - Monitor performance and savings
  - Install and controls
Applications: Still more to come

- Air to water heat pumps
- HP RTUs
- Through wall PTHPs
Ever increasing applications of HPs

RTUs

PTHPs

AtWHP-
CEE Research
Overcoming HP Market Barriers

- Contractor availability
- Product availability
- Up-front product cost
- Familiarity of modern HP technology
MN ASHP Collaborative Contractor Resources

- Free training modules
- Best practices guide
- Manufacturer promotions
- In person training
- Preferred Contractor Network
MN ASHP Collaborative Homeowner Resources

- Case studies across MN
- Buying guides
- Product finders
- Financing information
- FAQs
- Blog (recently launched)
- Contractor lookup through Preferred Contractor Network (coming soon)
Thank You!

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